THE COMPLETE BOOK OF ROSES

P.K. Roy

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Prof. Supriya Kumar Bhattacharjee is an eminent scientist in the field of Horticulture, retired as Project Coordinator, All India Coordinated Research Project on Floriculture, Indian Council of Agricultural Research, Indian Agricultural Research Institute, New Delhi. He has 38 years research, teaching, management, developmental and administrative experience in private organizations; Indian Botanic Gardens, Botanical Survey of India; State Agricultural Universities and ICAR Institutes. He was Head of the Division of Medicinal and Aromatic Crops, Indian Institute of Horticultural Research, Bangalore. He has also served as Professor of Horticulture and Professor-in-Charge, North Bengal Campus, Bidhan Chandra Krishi Viswavidyalaya, Coochbehar, West Bengal which was later converted into a full-fledged Agricultural University, presently named as Uttar Banga Krishi Viswavidyalaya.

He has conducted extensive and pioneering research work on standardization of agro-techniques in ornamental crops, plant propagation and post-harvest technology of cut flowers. He is the pioneer in the research work on the post-harvest technology of rose cut flowers and agro-technology, and has completed several outstanding research projects successfully. While serving in private organizations, he has laid out, and maintained several rose gardens in various climatic zones and introduced large number of varieties. He has served as National Leader of ornamental crop research and development in India, prepared research programmes on various ornamental crops for different agro-climatic conditions of the country and monitored the research work of different agricultural universities and the national institutes at 20 different centres.

Prof. Bhattacharjee has visited several foreign countries like England, Germany, France, Italy, Belgium, The Netherlands, Thailand, Malaysia and Singapore. He has published about 400 research papers and popular scientific articles in the journals of national and international repute. He is the author of 15 books titled (a) Advanced Commercial Floriculture (b) Orchids of India (c) Garden Plants (d) Advances in Horticulture-Ornamental Plants (in 2 volumes) (e) Cacti-Botany, Culture and Uses (f) Handbook of Medicinal Plants (g) Handbook of Aromatic Plants (h) Medicinal Herbs and Flowers (i) Advances in Ornamental Horticulture (in 6 volumes), (j) Postharvest Technology of Flowers and Ornamental Plants (k) Landscape Gardening and Design with Plants (l) Orchids-Botany, Breeding, Cultivation, Uses and Post-harvest Management (m) Vanilla-The World's Most Flavourful Spice Orchid of Commerce and (n) Handbook of Edible Fruits. He has also written 15 bulletins on Ornamental Crops and prepared many reports.

Prof. Bhattacharjee was the Vice-President of the Indian Society of Ornamental Horticulture and served as a member in the selection committees of CSIR, ASRB and Agricultural Universities. He was one of the editors of a journal entitled *Annals of Agricultural Research*. He is a member of several scientific societies of India and abroad; referee of scientific projects of different organizations; referee of foreign and Indian journals. He has a long teaching experience at post-graduate level in the Universities and has guided 6 M.Sc. and 8 Ph.D. students in floriculture as Chairman.

Dr. B.K. Banerji is associated with the National Botanical Research Institute, Lucknow for the last 34 years and closely associated with floriculture Section since 16 years. He obtained Ph.D. (Botany) in 1990 from Kanpur University. He has conducted extensive research work on mutation breeding of vegetatively propagated ornamental crops and successfully induced many new and novel mutants in foliage/flower colour and form which has already been released and well documented. He has also carried out extensive work on essential oil bearing and medicinal plants.

He has developed three gamma ray induced mutants of multi bracted bougainvillea viz. 'Los Banos Variegata', 'Mahara Variegata' and 'Pallavi' from Floriculture Section, NBRI, Lucknow and got them registered.

He has published more than 130 research papers and popular scientific articles in journals. He has attended many symposium and presented large numbers of paper. He has written one bulletin in chrysanthemum and 10 chapters in Book. He is recognized Ph.D. guide of Gujarat Agriculture University, Ahmedabad and Tamil Nadu Agriculture University, Coimbatore. Dr. Banerji is head, Floriculture Section and presently working on eight projects.

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Prof. Supriya Kumar Bhattacharjee, Ph.D.
Formerly
Scientist S-3 and Head
Division of Medicinal and Aromatic Crops
Indian Institute of Horticultural Research, Bangalore
Professor of Horticulture and Professor-in-Charge
Bidhan Chandra Krishi Viswavidyalaya
N.B. Campus, Coochbehar, W. Bengal
Principal Scientist, ICAR, New Delhi
Principal Scientist, IARI, New Delhi
Project Coordinator
All India Coordinated Research Project on Floriculture
Indian Council of Agricultural Research, New Delhi

Dr. B. K. Banerji, Ph.D.
Deputy Director and Head
Floriculture Section
National Botanical Research Institute
Lucknow

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PREFACE

The rose is a subject of absorbing interest with unending source of pleasure. This flower has always been favourite year after year and generation after generation. This has drawn distinctive personalities, people of all sphere of different countries of the world under many prominent associations and renouned societies to work together and discuss on the common cause of love in one's heart. There are many beautiful species in roses and some of them are of exceptional garden value. These species and their progeny have the advantage of hybridizing more easily. There are wild roses, natural roses, albas, sweet briers, scotch roses, gallicas, mosses, centifolias, Damasks, fairy roses, Portlands, Bourbons, Noisettes, hybrid Rugosas, hybrid musks, hybrid polyanthas, hybrid perpetuals, teas, hybrid teas, floribundas, miniature, climbers, ramblers etc. Men have not been slow to take advantage of their beauty in diversity which resulted ever increasing source of enjoyment and interest. The roses are grown in many countries of the world, admired by all and are used in many ways. They are the symbols of love and used to express scentiments and emotions. Rose has been the symbol of dignity, love and affection, and also accepted as "The Queen of Flowers". Different groups of roses are used in many countries to express their feelings in different ways, even different colours of roses can take on special meaning.

There are rose with intoxicating delicious scents, the fragrance is unparalleled and is of several types. The modern roses, a hybrid mixed but steriotyped strain are except fragrance. Quantity or even the quality of fragrance is never the major criterion to the breeder while selecting seedlings. There is no doubt that rose gardens will achieve another unique dimention with fragrance. The fragrance usually comes from the rose flowers, but also from other parts of the plant like leaves, pedicels or from flower stalks. Rose species like *Rosa alba, R. canina, R. centifolia, R. gallica, R. gigantean, R. glutinosa, R. filipes, R. helenae, R. longicuspis, R. moschata, R. nutliflora, R. wichuraiana* etc. are source of the rose fragrance. Many types of roses in their ancestry are still producing in the moderns scents pure and impure and mixed beyond measure without any selection having been carried out. The

"James Alexander Gamble Fragrance Medel" is awarded to the outstanding new, very fragrant roses by the "All American Rose Selection" of the American Rose Society, USA. Intense fragrance of a parent rose pass on in subsequent generation. Percentage of seedling with intense fragrance varies from cultivar to cultivar and it is the responsibility of the rose breeder to assess them in proper time to maintain the intense fragrance through rigorous selections, generation after generation. It has been observed that mostly dark red, orange red and pink varieties of rose are fragrant. It has also been noticed that there is close contest between mauve, lavender and red so far fragrance is concerned. The varieties of rose like "Angel Face", "Blue Moon", "Crimson Glory", "Chrysler Imperial", "Confidence", "Double Delight", "Fragrant Cloud", "Granada", 'Inge Hortsman", "Papa Meilland," "Prima Ballerina", "Sunsprite", "Sutter's Gold", "Sterling Silver", "Tiffany", "Wendy Cussion" are still very popular among growers as fragrant rose.

As we walk around rose gardens, rose shows, rose collections we are delighted in the form, colour and fragrance of the bloom of innumerable varieties. The rose breeders have taken advantage of these qualities, sufficiently appreciated different traits with sincere efforts. They have spent years for raising new varieties which now grace our garden. For every new rose which is brought into commerce thousands of seedlings have failed the test and been destroyed. It was the such an immense labour, well thought devotion and endurance of the breeder gave birth to new roses of commerce. We owe to the leading hybridist like Alec Cocker, Andries Verschuren, Alex and Pat Dickson, C.W. Gregory, Douglas Gandy, E. B. Le Grice, Eugene Boerner and William Warriners, Georges Delbard and Andre' Chabert, Herbert Robinson, Herbert C. Swim, Jean Gaujard, J.L. Harkness, Louis Lens, Mathas Tantan, Neils Poulsen, Pedro Dot, Ralph S. Moore, Reimer Kordes, Sam Mc Gredy, Sean Mc Cann, Svend, The Meilland Family, W.J.W. Sanday, Wilhelm Kordes and several others with immense debt for their excellent work in making our rose gardens healther, colourful and fragrant since many years. There is no space here to record their triumps and awards.

Many professional and amateur rose growers are engaged in the production of new cultivars. The annual influx of novelties is quite bewildering and also, a large portion of them seem to disappear with no trace after few years. Marketing of new roses must be drastically curtailed and only really sound and worthwhile cultivars are to be introduced. The new cultivars must be viable commercially and be distinct from existing varieties. It must appeal to the general rose buying public and also to the rose specialists. The keen rose growers, nurserymen, commercial growers, specialised collectors and breeder must make all out effort to collect only the award winning cultivars of the international rose societies.

Rose is a widely accepted product in the market, and there is not much need for preselling advertisement to explain the public. There is steady rise in the production of flowers, as well as in demand and consumption. The marketing of rose require a thorough knowledge because it walks a tightrope with its relatively delicate quantity variation, which cause larger swings in market price. Relatively small increases in supply tend to create low prices. Price of the rose depends on the cost of planting material, polyhouse erection and maintenance, cultivation cost, fuel, labour, air freight, marketing etc. Moreover,

there are complaints on the quality of roses. These complaints could, however, be eliminated if all the rose cut flowers are handled properly from the time they are cut until the customers receive them. Since the rose market is highly competitive and very particular about the quality and regularity on the quantity of supply; we have to work harder to expand the markets, work better and more efficiently to cut down the expenses of labour, fuel, water and chemicals. We must go for better selection of varieties, cultivate selected propagation material and, hence produce a better quality flower. To built a stronger rose industry and to create a better and rosier world to live in, the rose growers all over the world must unite with emphasis on research and improving quality.

Roses are the largest traded flowers in the world. International trade of rose is highly competitive and the exporters of rose cut flowers must be able to supply products of consistant quality and on regular basis. Import of rose cut flowers in European Union during 2005 is 919 million Euro and by volumes it is about 170 thousand tonnes. According to CBI Market International Database 2006, sale of cut rose flowers at the Netherlands auction during 2005 was 725 million Euro and the supply in quantities of Aalsmer auction is 1930 million stems. In the European Union developing country's supply share of rose cut flowers in 2005 were Kenya 20%, Ecuador 6%, Uganda 2% and Zimbabve 2%. Share of imports from developing countries indicate that there is huge demand and growing market in the international flower trade. Import of rose cut flower in Japan during 2005 was highest from India and the share was 46.25%; rest of the rose imports in Japan was from Korea (23.75%), the Netherlands (4.75%), Kenya (5%) and other countries (20.25%).

As per statistics total area under flower and ornamental plant in India is 1,06,477 ha. India's exports of floricultural products during the period 2006-2007 was Rs. 649.89 crores. The rose cut flower production in India in the same year was 3,290 million numbers. Maharashtra, Karnataka, Andhra Pradesh and Haryana has emerged as primary rose cut flower producing centres. Major destination of Indian cut flowers are Japan, the Netherlands, Germany, United Kingdom, UAE and Hong Kong. India ranked 23rd amongst world exporters of floriculture products in 2004, and its share in the world export are negligible and around 0.38%. It was estimated that in 2004 almost 51% (US $ 6.27 billion) of world floriculture exports came from the Netherlands; and with an 8% annual growth, world exports from the Netherlands is expected to reach US $ 16 to 18 billion by 2010. There is huge demand and growing market of floricultural products in the international flower trade. Realising the prospects and demand in this sector, floriculture industry in India is targeting an annual US $ 1 billion export of Floricultural products by 2010. Corporate houses are encouraged to set up units with global scale and size, in order to meet the quantity, consistency and quality demand of the international buyers.

It is not that rose growing is only a big business, it can create pleasant environment, promote mental and physical health and develop healthy communities. Our effort should also be to save the rare and declining species of roses. Socio-economic changes in our life style over the years have reduced our time and space for rose garden. People are demanding more from public gardens and outdoor landscape. Rose growers are interested to learn how to make rose gardens effectively with limited space, careful planning,

functional and easy to maintain garden. Since the gardens in new housing estates are considerably smaller, there is good reason to grow more compact types of roses, and people are particularly interested in Hybrid Tea roses of more compact habit. Rose growing induce a feeling of pride in the community. Practical techniques are in demand to reduce or eliminate time consuming maintenance task.

In view of the above and considering the various aspects of roses, the present book is organised in such a way that it will be useful to everyone interested in the subject-whether the reader be a veteran rosarian or a hobbyist. An integrated and comprehensive account on roses with up-to-date knowledge has been provided in this publication in 26 extensive chapters. The first chapter is an introductory one primarily based on scope and importance. The second chapter traces the brief history of early days with roses. The third chapter elaborately deals with the classification where detail account of *Rosa* species and their varieties are also available. The next four chapters deal with breeding, biotechnology, conventional methods of propagation and tissue culture highlighting the present development in these interesting areas. The chapters 8 and 9 enumerates important aspects on soil and climate; garden design, planting and management. The basic cultural requirements are considered in 10 to 16 chapters with indepth discussion based on the results of research work carried out on pruning, nutrition, irrigation, mulching, weed control, pot culture and green house cultivation. Chapters 17 and 18 are exclusively on growth regulating chemicals, and post-harvest technology in details where elaborate reviews of scientific investigations are presented.

Chapter 19 give an exclusive insight on the allied products. Chapter 20 is entirely devoted to insect pests and diseases based on experimental evidences. Chapter 21 discusses the intellectual property rights and patenting of new rose varieties. A brief account of the rose breeders of the world is given in Chapter 22. While an exclusive selected list of exotic varieties is presented in Chapter 23. The Chapters 24 and 25 provided information on the rose breeders of India, and the varieties evolved in India. Lastly the books on roses are enlisted.

It is our pleasure to acknowledge the help which we received from very many publications for completing the work. We are thankful to Mr. Akshay Jain and Vipin Jain of Aavishkar Publishers, Distributors for taking keen interest in making the publication as good as possible. It can be humbly claimed that such exclusive and elaborate information on various aspects of roses in a single publication is the first of its kind. We sincerely hope this book on "The Complete Book of Roses" will be useful to the scientists, teachers, researchers, students, planners, rosarians, amateurs, commercial rose growers and exporters.

S.K. Bhattacharjee

B.K. Banerji

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List of Colour Plates

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1

INTRODUCTION

Rose has ever been the world's most favourite and unchallenged queen of flowers. From thousands of years now there is probably no flower is a better symbol of love, adoration, innocence and better virtues than the rose. It is the adaptability of the plant, which makes its appeal so wide and popular. Roses grow and flourish in the widest range of conditions of soil, climate and treatments. From the time immemorial, poets have sung its praise and the love of it can be traced to the most ancient documents in the literature of Aryan race. Rose growing calls forth so many varied and unexpected qualities from the growers- the skill of the craftsman, the creative vision of the artist, the persistence of the lover, the trained eye of constant observation. To grow rose is not hard, but to grow the best roses demands and repays all the care and skill we lavish upon them.

The origin of the rose is quite prehistoric: geologists tell us of the evidence of its existence more than fifty million years ago. The rose is older than Man himself, and its original home can only be surmised. Species of wild roses have been found in all the northern countries from Greenland to Mexico; from northern Russia and Siberia, where are found members of *Rosa spinosissima* group, of interest to modern gardeners; in the oasis of Sahara from India and to Persia; from Japan, Korea and China, where are the home of so many valuable roses, to Burma from where comes *R. gigantea,* one of the species important in the pedigree of modern roses (Park, 1969). No native wild rose has ever been found in Southern hemisphere, although the introduced roses grow and flower very well in some of these countries. About 300 species of rose have been listed by Dr.George H.M.Lawrence of Cornell University (as published in Modern Roses IV). Botanists are by no means unanimous about the total number of species and there are possibly 150 true species of roses (Gibson, 1984).

There are famous rose gardens in different parts of the world. In the United States of America, the Park of Roses, Columbus, Ohio; Harshey Rose Garden; Pennsylvania; Rose garden of Portland in Oregon; the Tyler Municipal Rose Garden, Tyler, Texas are most outstanding. Queen Mary's Rose Garden, Regent's Park, London; the Royal National Rose Society's Garden at St. Albans, Hertfordshire and the Belfast rose Garden in Northern Ireland are most beautiful and educative gardens in England. In France, the Rose Garden at Begatelle, Paris; La Roseraie De L' Hay Les Roses in Paris and Parc De La Tete D' Or garden in Lyons are very attractive. In Germany, Zweibrucken Rosarium and Rosarium of the German Rose Society are well known. Apart from this Parque De La Grange in Geneva, Switzerland; Parque Del Oste in

Madrid, Spain and West Broek Park, Hauge, the Netherlands are worth mentioning. Some of the important rose gardens of India are Zakir Hussain Rose Garden, Chandigarh; Rastrapati Bhavan Garden, Indian Agricultural Research Institute Garden, National Rose Society Garden; International Airport Authority Rose Garden, New Delhi; Lal Baugh Botanic Garden, Bangalore; Sims Park, Conoor; Mughal Garden, Pinjore which have very good collection of rose cultivars (Mukhopadhyay, 1990).

Owing to their diversified growth habit, exquite shape, variation in size and form, attractive colours, delightful fragrance and innumerable varieties; roses have gained wide acceptability. It is a suitable item for garden decoration and landscaping. They can fulfill the requirements of trees, shrubs, climbers, hedges and edges in the landscape planning and garden design. Roses are also grown as pot plants and there are types, which can even suit for planting in the rock gardens or hanging baskets. Apart from their use in the garden, rose cultivation is done in different parts of the world for production of cut flowers and loose flowers. A sizable portion of loose flowers is utilized in India in religious and ceremonial functions, for making garlands and button-holes.

Roses are cultivated in almost all countries in the world. Some of the important countries where roses are grown in large commercial scale as cut flowers are the Netherlands, the United States of America, the United Kingdom, Germany, France, Italy, Japan, Switzerland, Kenya, Zimbabwe, Israel, Ecuador, Columbia, India, Malawi, Nigeria, Switzerland, Uganda and Tanzania. Roses are recognized as both traditional and modern flowers in India. The major rose growing states are Rajasthan, Maharastra, Karnataka, Tamil Nadu, Andhra Pradesh and West Bengal. But roses with long stems as modern flowers are produced predominantly in Maharastra, Karnataka, Tamil Nadu, West Bengal, Haryana, Uttar Pradesh, Delhi and Chandigarh. Commercial cultivation of rose is confined to Pune, Nasik, Sangli, Ratanagiri, Mumbai, Ahmedabad, Jalgoan and Nagpur in Maharastra; Haldighati, Girwa, Jaipur, Udaipur, Khamnour and Pushkar in Rajasthan; Bangalore, Kolar and Mysore in Karnataka; Lucknow, Allahabad, Varanasi, Kannauj, Aligarh, Meerut, Etah, Gazipur and Balia districts of Uttar Pradesh; Delhi; Ambala, Kurukhetra, Gurgaun and Faridabad in Haryana; Hosur., Coimbatore and other parts of Tamil Nadu; Midnapur, 24 Parganas, Howrah, Kalimpong and Darjeeling in West Bengal; Chandigarh; Ludhiana, Ropar, Jallandhar, Patiala and Amritsar in Punjab; Ahmedabad, Vadodara, Anand, Surat, Navsari and Valsad in Gujrat; Guwahati and Jorhat in Assam; Hyderabad and other areas in Andhra Pradesh (Bhattacharjee and De, 2003).

Rose cut flowers are imported in the world market in huge quantities. Germany is by far the largest market for rose cut flowers in the world. After Germany the second largest market is in the United States of America, followed by the Netherlands, France, The United Kingdom and Switzerland. The Netherlands is the largest supplier of roses to Europe. Other supplying countries of rose cut flowers are Kenya, Zimbabwe, Israel, Ecuador and Columbia. Because of the development of the new rose industries in India, Malawi, Nigeria, Swaziland, Uganda and Tanzania, these countries are also exporting roses to the European Union. International market of rose cut flowers accounting for 19 per cent of the global trade.

In view of the growing demand for its flower in the cut flower trade in international market, cultivation of cut rose in India under polyhouse conditions for export purposes has been given priority status. Nearly, 134 export oriented cut flower producing projects have been approved to be established with indigenous as well as imported polyhouse technology and exotic varieties of planting material imported for cultivation and sale in the export markets. Sudha (2001) has worked out the establishment cost for setting up a hectare of polyhouse grown rose for export purposes in Karnataka state of India, which is Rs. 225 lakhs. The cost of polyhouse and accessories alone account for 30.67 per cent, while the cost of importing planting material forms 21.33 per cent. The average cost of maintenance per annum worked out to Rs 67.21 lakh per hectare of polyhouse grown rose. The yield of over 15.15 lakh cut rose stem, with at least 60 per cent export fetch a net realization of over Rs 27 lakh. According to her, polyhouse cultivation of cut rose is nearly 150 times more expensive compared to open cultivated rose. In Maharastra, India, the cost of annual maintenance of hi-tech rose would be around Rs.46.25 lakh/ha (Tilekar and Nimbadkar, 1999) compared to only Rs. 95,000 to Rs. 1,32,900/ha in case of open cultivated rose.

Apart from above uses of roses, extraction of essential oils from rose petals is another commercial aspect of rose cultivation. Scented rose like *Rosa alba, R. bourboniana, R. centifolia, R. damascena, R. gallica* and *R. moschata* are used for this purpose. Bulgaria is a major producer and exporter of Otto of roses and the rose perfumery. Other important countries are France, Turkey, Morocco, Italy, Greece, Iran and United States. In India primarily four states are involved in the rose petals for the preparation of commercial products. Preparation of *Gulkand* and rose water is a home industry in Jammu and Kashmir states. There are three units in Amritsar (Punjab) producing *Gulkand*. In the cities of Udaipur, Nathdwara and Ajmer in Rajasthan, fifteen units are making rose Otto, syrup, rose water and gulkand. Considerable quantities of rose products are also produced in Aligarh, Kannauj, Etah and Ghazipur District of Uttar Pradesh (Kolavalli *et. al.*, 1991). Large-scale cultivation of *R. damascena* has also been taken up in Himachal Pradesh for its commercial use. In India, a large proportion of roses produced are converted into rose water. Rose oil is one of the main constituents of the some of the costliest and refined perfumes and cosmetics. Certain amount of rose oil is also used in snuff and chewing tobacco, alcoholic drinks etc. Rose water is extensively used in flavouring foods and confectionary (Husain, 1986).

The rose is an extensively researched crop, this plant has attracted attention of plant breeders, floricultural scientists and plant physiologists the world over. Innumerable rose cultivars have been developed by eminent rose breeders, which are used for different purposes. The Research work conducted on rose breeding was reviewed by Kaicker (1995) and Datta (2006). In India, rose breeding work has lead to the development of about 600 rose cultivars. The varieties of rose evolved by Dr. B.P. Pal, an eminent rose breeder from India, have been documented and described by Singh and Dadlani (1996). Rose germplasm in India, mutation breeding, micro propagation, value addition and biotechnology in rose improvement have been enumerated by Singh *et. al.*, (2003). Passport data of rose germplasm existing in various Institutions of India under different agroclimatic conditions has also been documented by Bhattacharjee *et. al.*, (2002). Greenhouse technology for cultivation of roses in India has been standardized (Chandra

and Gupta, 2006; Jadhav *et. al.*, 2006, Patil and Patil, 2006). Agro-techniques for growing roses in open field has been worked out (Bhattacharjee, 1995, Bhattacharjee, 2006). Various aspects of post-harvest biology and handling of cut roses have been investigated, and technology for retaining the quality of cut flowers for a longer duration has been developed (Bhattacharjee, 2003; Bhattacharjee and De, 2005). Important species and varieties of essential oil yielding roses as well as qualitative and quantitative traits of rose oil have been documented (Gupta, 1995; Bhattacharjee, 2000).

The gardening is a pride of rich and poor both. There is a wrong impression that rose can be grown only by experts. These plants can however, be cultivated easily with little efforts by the amateur. People need some satisfying occupation other than their daily work. The nonworking hours can be spent in the pursuit of one or more hobbies. Rose growing is a good hobby, which is considered most pleasurable and satisfying leisure activity. Rose growers are becoming a powerful force in our society. There is a need to conserve natural resources of rose species, and also to maintain germplasm of the ever-increasing cultivars. The large rose garden and parks bring happiness to those who came to seek it amidst varied beauty and thus impart a three-pronged service; scientific, educational and social. Rose growing requires sustained interest and involvement, which is an evidence of individual achievement. Growing of rose can be used as treatment modalities in horticultural therapy. Working with roses in the garden imparts a feeling of peace and tranquility, reduces stress and offers a sense of self-esteemed and mastery of the environment. Rose gardening should assume importance in the school curriculum and this may act as an agent for improving social, psychological and physical development of children. For highly urbanized society, school gardens are but one of the many other fields of education for enhancing the quality of life. To attract tourists; modern cities, streets, plazas, residential blocks, archaeological monuments, historic sites, public places, recreational areas and theme parks, can be tastefully landscaped by involving different types of roses; which in turn increase the value of the property and enhance the quality of environment.

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2

HISTORY

There is no flower in the world which enjoys such a romantic history, adoration and remarkable written record as does the rose. It has been growing in this earth for many million years before man himself appeared (Fairbrothers, 1965; Gault and Synge, 1971). The fossil of rose-leaves have been recorded from chalk strata of seventy million years past, during the Miocene Age (Park, 1962). According to palaeobotanists, about 50 million years ago a few remnants of leaves, short pieces of stem and thorns which were found are in probably roses but a flower has never been found. So far 25 fossilized rose have been found in the places like Alaska, California, Colorado, Oregon, Japan, Austria, Czechoslovakia, Germany, Bulgaria and France. The information on early history of rose in many rose books is very often not correct. Reliable and acceptable information is, however, available from the general archaeological and historical literature and research work of C.C. Hurst (1955) and A. Wylie (1955). Our knowledge concerning the antique world is derived from historical inscriptions on stones, wall paintings, religious text, classical writers, coins and finds in antique tombs (Krussmann, 1977).

China with its ancient culture is known as the mother of gardens, where probably for the first time man planted a rose in the garden. During the time of legendary ruler Chin-Nun (2737-2697 BC), it is presumed by the historians that the Chinese garden culture started. Confucius (551-479 BC), the Chinese philosopher, mentioned in his writings about the extensive plantings of roses in the imperial gardens of Peking. He has reported some 600 books of the rose in the library of Chinese Emperor, and also indicated that Chinese knew about the rose oil which was being produced in Imperial gardens. During the Han dynasty (206 BC to AD 8) the number of ornamental gardens and parks is said to have been so great, that there was alarming reduction of agricultural production on the remaining areas, so that the Chinese government was obliged to reduce the number and dissolve many large gardens and parks in order to ensure the public food supply. In one old Chinese book of Ming Dynasty (1621 AD) written by Wang Xiang Jin entitled *An Anthology of Fragrance*, many rose varieties were described, and there were mention of roses with red, pink and white shades of colour, many were double and scented, but no yellow coloured roses. It was probably never be known for certain when the Tea Rose and the China Rose originated, but undoubtedly this took place within the last 2000 years in China by selection or by crossing especially beautiful varieties, which then came to Europe at the beginning of 19th century, having been cultivated in Chinese gardens for some hundreds of year (Krussmann, 1977; Airun, 1999). Garden in China, however, has a long antiquity and indeed, Chinese drawings on cloth, paper or furniture show a traditional passion for flowers and gardens.

Persian are said to have known the art of producing rose water and rose attar: Rose was the symbol of the executive power of the Persian government, and King Kyros, is said to have introduced this symbol in 538 BC. We get the idea of the Persian Gardens of the 12th centenary from Nizami's poem on the love tale of the Layla and Majnu written in 1188 AD where mention was made about red tulips, yellow roses, narcissus and pomegranates. In ancient Persian tradition the rose was linked with nightingale or bulbul. A legend narrates that each time a rose was plucked, the bird use to cry out in protest. The Avesta, the holy script of the Persian mentions the rose as a sacred religious symbol. In ancient Persia, rose was a symbol of secrecy.

The hanging garden of Babylon was planted with colourful and attractive roses in the 6th century BC., and the *Rosa* species like *R. centifolia, R. damascena, R. gallica* and *R. moschata* were popularly known in Babylon then. There are evidences in the archaeological literature that in the ancient Assyria and Mesopotamia the roses were grown. In the 17th century BC Nineveh was founded, the capital of Assyria; it was reported that the cornices and door cases of the palaces in town, were chiseled rosettes of stone. During the reign of Nebuchadnezzar II (605-562 BC), the Chaldean dynasty reached its greatest extend. His palace court column were depicted with broad ribbon of white "roses" with yellow centre, on a blue ground, and blue diamonds edged with yellow (Krussmann, 1977). The oldest paintings of roses were found in the palace of Knossos the famous palaces of king Minos built in the period 2000-1700 BC of ancient Crete. Roses were painted on the walls of palaces. A fresco of the time depicting possibly the *Rosa gallica* represents the flower erroneously with 6 petals, instead of 5 (Mukhopadhyay, 1990).

There was no trace of any kind of evidence for garden art in ancient Greece until well past its cultural Zenith. We have heard something about "oil with rose scent" about the time of 1200 BC which was discovered in the Palace of Nestor at Pylos, Peloponnese. The famous Greek poetess, Sappho who lived on the island of Lesbos in the 8th century celebrated the rose in her songs for the first time as the "Queen of Flowers". Pindar, the poet and musician of Athens (520-447 BC) described the roses in details. Herodotus the father of the historians (490-420 BC) described the famous rose of 60 petals with strongest scent of all roses known at that time, which was available with king Midas of Phrygia. The wonderful rose garden of king Midas was most probably planted with *Rosa alba, Rosa centifolia* and *Rosa gallica.* Herodotus also described the method of cultivation, propagation and transplantation of roses. Theophrastus (372-287 BC), the father of botany and an important historian was borne in the island of Lesbos, among whose work was an "An Enquiry into Plants." He wrote about roses with hundred petals and also many other roses. Theophrastus also mentioned that number of petals varies in roses (5, 12, 20 and 100), differ in colour, beauty and sweetness of smell. It may be that he was referred *Rosa canina, R. centifolia, Rosa gallica.* After Theophrastus we find the references of rose with 100 petals in the writing of Pliny. Greek gardens were above all, utilitarian initially, but the idea of garden for enjoyment only comes after Persian conquest under Alexander (330 BC). It was at this time that Epicurus (341-271 BC), according to Pliny, had a landscape garden within the walls of the city of Athens. Epicurus was very particular about procuring of fresh rose flowers at any time and he was possessing very attractive rose

gardens of his time. It was said that Island of Rhodes in the 4th century BC was very rich in roses, and during that time coins depicted in the picture of open rose flower were released. Greece women used to maintain the gardens at home. It was believed that scent of flowers would make the home healthy place in which to live. The Greek author Plutarch (46-120 AD), who was a writer about the history of art, stated that the scent of roses can be intensified if the garlic is planted near roses. According to Noisette, the Greeks knew how to increase the beauty of their plants by a more enlightened type of gardening.

The wealth of pyramid murals and inscription of Egypt throw a flood light on the ancient Egyptian gardens. According to a writing found on an Egyptians tomb, gardening had survived in Egypt as far back as 3000 BC. In ancient Egypt, the rose was sacred to the Goddess Isis. When an ancient tomb of the Egyptian Pharroh Tutankhamen was open, several gold and jeweled boxes were found filled with dried roses, still giving off a delicious fragrance after 3000 years. According to German writer, Woenig (1897), who studied intensively the plants of ancient Egypt, asserts that there were no roses in Egypt before 631 BC. At the time of Ptolemys in the 4th century BC most probably rose appeared which were planted only in the valley of river Nile. The cultivation of roses possibly started in the Egypt around the time of Alexander the Great, Prince of Macedonia (356-323 BC) come to Egypt in 332 BC. Roses were extremely popular in Egypt then. In Egypt during the era of Cleopatra VII (69-30 BC), roses were cultivated on a large scale around the delta of Nile, and the flowers were sent to market in Egypt and Rome.

Theophrastus, who died in 287 BC, stated that roses flower in Egypt two month earlier than Greece. According to Pliny, Egyptian made artificial rose flowers prepared from thin chips of wood, paper and cloth, scented with rose oil and used to export the same to Greece and Rome. From one Archeological excavation near Haura or Haware, a district of Fayyoum, in 1888, a wreath of roses was found in a tomb from the time of the birth of Christ; these roses were later identified as *Rosa sancta,* a near relative of *Rosa gallica,* with bluish pink single flowers. These roses were a necessity in daily life of ancient Egypt for religions and ceremonial functions, decoration and personal use.

The best of the earlier gardens were those of the Romans in which we find combined the best ideas of the Egyptians, Persians and Greeks. They were the most ardent lover of roses, and extravagant with it to the point of vulgarity. The rose was brought from Greece by Greek settlers quite early on, to Rome, as well as to North Africa, Sicily and Spain, all places where Greek colonies have been founded. Roses were still a luxury during the early years of the first Roman emperor, Augustus (64 BC to AD 14), but soon they become a necessity. Seneca, the famous Roman philosopher and teacher of Nero, (3BC-AD56), who committed suicide by order of Nero described a method of forcing roses with warm water and cultivation in forcing house. Pliny (AD 23-79) mentioned Albion, the "The Island of the White roses", and he said that it obtained the name from the white roses. The cruel and lavish Roman emperor, Nero (AD 37-68) who for a single famous banquet spent no less than 4 million sesterces (which is equivalent to £ 80,000 in gold) for the supply of roses. According to Suetonius, the emperor Nero once purchased roses worth £ 4,500 for a banquet and £ 20,000 worth for a fete. The later emperor of Rome followed Nero in the same way to produce at his banquet and orgies, a heavy "rain" of roses for the roof down to his guests, and sometimes in such masses, that some of them would be stifled under the weight of petals.

For supply of such immense quantity of flowers, extensive nurseries were necessary, and the majority of those were situated at Paestum. The place, Paestum is situated about 40 km south of Naples, on the gulf of Salerno, and was founded by Greeks about 600 BC as "Poseidonia". In 270 BC the city became Roman. Paestum was a flourishing center of the rose trade. We find the references of Paestum roses in the writings of Virgil and Pliny (Krussmann, 1977).

The first Earl of Lancaster brought the red rose from the France to England in the 13th century, as his emblem. One of the most brutal wars in England was known as "War of the Roses" (1455-1486 AD). The house of Lancaster feuded with the house of York. The red rose of Lancaster (*R. gallica*) and the white rose of York (*R. alba*) soon became the symbols of this war, that ended in 1486, when Princes Elizabeth of York married Henry Tudor, a Lancastrian (Airun, 1999). There are numerous passages in Shakespeare allude to the quarrel between the houses of Lancaster and York, and of the taking of the red and white roses as the emblem of the respective houses. The rose was the emblem of Tudor dynasty.

In 1759 British soldiers wearing roses on their caps won a great battle against the French at Minden. Since then it has become a regimental custom to decorate the caps with Minden roses on 1st August. In England Queen Alexandra's Rose Day was first celebrated on 26th June 1912 when £ 20,000 were collected for the poor (Mukhopadhyay, 1990). Empress Josephine, wife of Napoleon I, purchased Malmaison, a Chateau on 65 acres, 40 miles outside Paris, in the year 1777 for Planting roses. The garden consisting more than 20 species of roses, 8 Albas, 27 Centifolias, 9 Damasks and 167 Gallicas.The Empress used to spend hours together in the garden, caring her rose bushes. Finally the empress appointed Pierre Joseph Redonte, the most acclaimed botanical artist to immortalize her roses in paintings with a text by Thorb. Redonte, and published 117 coloured drawings of Josephine's collection in "Les Roses". The collection at La Malmaison of over 250 varieties was the first of its kind and ranked one of the great milestones in the history of roses. It was a touching and charming compliment when the Grand Duke of Russia, while visiting the Empress Josephine's rose garden saw an unnamed rose there and asked for a plant for the Imperial Garden at St. Petersburg, requesting that it be named "Souvenir de la Malmaison". This was in the memory of the Empress who died in 1814. The garden at Malmaison, which now lay in ruins, has been restored, and made into a public museum. Some rose varieties collected during her lifetime still grow in this unique museum (Airun, 1999).

The country of Syria took its name from the word "Suri", which means "land of roses". Damask rose used to bloom profusely around the area of Syria bordering with Lebanon that it gave its name to the town of Damascus. It is said that rose was the first flower from which perfume was made and it was an Arabian Doctor, Avicenna, who discovered the art of extracting the perfume of roses by distillation (Genders, 1965).

Many kings and queens of England used rose emblem. Edward III was first to have incorporated a rose emblem in an English coin in the year 1344. The rose is also shown on the two-shilling piece of Queen Elizabeth II. Henry IV (1399-1413) used the red rose (*Rosa gallica*) for his emblem while Edward IV (1461-83) had for his badge the "white rose-en-soleil". It was Edward IV who, after Yorkist victory at Mortima Cross in 1461, surrounded his white rose of York with the sun's rays, the sign thus becoming known

as the rayed rose (Genders, 1965). The rose became England's National flower in the 15th century during the war of roses. A coin of Edward IV minted in 1465, had a rose design on one side. Many British regiment use the rose an emblem. Many of the states of the USA adopted the rose as their symbol. The state of Georgia has the white "cherokee rose", Iowa a "wild rose" and North Dakota a "prairie rose" (Mukhopadhyay, 1990).

Dr Nicolas Monardes, who lived and died in Seville in 1577, has written the first monograph on the rose. Miss Mary Lawrance wrote the first book on rose entitled "A Collection of Rose from Nature" in 1799. Sir Hugh Platt has described in great details in his *Delights for Ladies* published in 1597, many ways of using rose blooms in the home (Genders, 1965).

Gardening has been popular in India since ancient times. It is also the place of origin of many plants of floricultural importance. India is a home of large number of *Rosa* species, many are endemic to the Himalayas. Several species and hybrids grow wild in the Himalayas and in the plains of India. In the ancient Sanskrit literature, "Charak Samhita" there are verse containing the seven names of rose, and these are *Satapatri, Saumygandha, Sivapriya, Gandhyadya, Susita, Suritta* and *Sumana* (Airum, 1999). Roses have been cultivated in India from ancient times, as roses are referred to in old Sanskrit works as *Taruni pushpa, Atimanjula* and *Semantika* (Bhattacharjee, 1959).

Babur, the Mughal Emperor had introduced damask and musk roses in his garden at Agra in 1526. He was very fond of roses, and named several of his daughters after the rose. Father Catron, in his *Historie de Moghol* stated that Mogul Empress, Noor Jehan, wife of Babur's descendant Jahangir has discovered the "*Attar* of Roses". In India roses are extensively used as for many religious and social occasions as cut flower and loose flowers, making garlands, indoor decoration and various other decorations, floral arrangements, button holes, corsages, worship. Rose petals are showered over newly wed brides and grooms and are also used in *rangoli*. The flowers are used for preparation of rose water, rose oil, rose petal conserve, *gulkand, pankhuri* and pot-pourri.

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3

CLASSIFICATION

Rose belongs to the family of *Rosaceae* and the genus *Rosa* consists of more than one hundred different species. There is controversy regarding the number of *Rosa* species in existence. According to Rehder (1947), the American Taxonomists, the genus *Rosa* contains about 120 species. During the 19th century several thousand rosa species are named and described, to produce a crazy situation of near anarchy. Later, common sense prevailed and many so-called species were lumped together to produce a world total of 100 to 150 distinct species. In recent years, however the splitters have again been on the ascendancy and the number of species being distinguished is on the increase. It may be that some of the new species can be justified by increasing knowledge arising from detailed field work (Allen, 1973). Not all taxonomists have shown equally critical judgement as to what constitute a species.

Rosa

Sub genus

I. Hulthemia	II. Eurosa	III. Platyrhodon	IV. Hesperrhodos
(Simplicifoliae)	Sec. I Pimpinellifoliae	Species	Species
H. perscia	II. Gallicanae	*R. roxburghii*	*R. stellata*
H. hardii	III. Caninae	*R. roxburghii normalis*	*R. stellata mirifica*
	IV. Carolinae	*R. roxburghii plena*	*R. minutifolia*
	V. Cinnamomeae	*R. praelucens*	
	VI. Synstylae		
	VII. Indicae		
	VIII. Banksianae		
	IX. Laevigatae		
	X. Bracteata		

The genus *Rosa* presents certain peculiar difficulties, which are not encountered in most other groups of plants. The classification of the rose must be useful to the rose breeders as well as amateur and professional rose growers. The system of classification, which is more natural and reflects the course of evolution, will be more justified. The genus is divided into four subgenera, namely *Hulthemia, Eurosa, Platyrhodon* and *Hesperrhodon.* The subgenus *Eurosa* is further divided into 10 sections. This classification of roses was based largely on presumed genetical and botanical affinities.

ROSA SUBGENUS I : *HULTHEMIA* (SIMPLICIFOLIAE)

Hulthemia is included in the *Rosa* subgenus but this subgenus has been reclassified by botanists and is no longer part of the genus *Rosa.* It grows and behaves like rose except for foliage, which consists of simple individual leaves without stipules. The resemblance is so much so that to discriminate against it and omit it on grounds of race would be quite wrong. There are two species of *Hulthemia* viz. *Hulthemia perscia* and *Hulthemia hardii.*

Hulthemia perscia : This species of rose is also known as *R. persica* and *R. berberifolia.* Variety is reported from Central Asia in 1789. It is difficult to grow but worth some perseverance. Leaves are slender and stipules are absent. Blooms are small, single and bright clear yellow with a browny-crimson splodge in the center. Flowers are borne at end of twiggy, clowny, angular shoots with hooked thorns that are arranged in pairs below the leaves. Blooms are spasmodicall for a fairly long season.

R. x Hulthemia hardii : It is also known as *R. X hardii* and evolved as a hybrid of *H. persica X 'R. clinophylla.* It is a medium growing rose, very unusual with small, single, buttercup-size flower. Blooms are deep, golden yellow with a striking, bright, reddish-brown eye in its center. Plant growth is twiggy but dense with spiteful thorns and numerous pinnate leaves. Stipules are absent from the leaves (Hardy, France, C. 1830).

ROSA SUBGENUS II : *EUROSA*

The hips are prickly, although they may not be glandular-bristly. The leaves are five or more foliate.

Section I : Pimpinellifoliae

Plant growth is mostly upright, varying from 90cm to 360cm and plant spread is 100cm to 400cm. Stems are prickly with many thorns. Foliage are small in some cases, 7 to 9 leaflets are there, while in others 9 to 11 leaflets are recorded. The maximum range of leaflets (13-17) has been recorded in *R. serica.* Flowers mostly produced singly on short stems. A sepal always persists on ripe hips. In this section pimpinellifoliae following species viz. *R. X cantabrigiensis, R. dunwichensis, R. ecae, R. foetida (R. lutea), R. foetida bicolour, R. foetida persiana, R. X hemisphaerica, R. hibernica, R. hugonis, R. X involuta (R. gracilis, R. rubella, R. wilsonii, R. koreana, R. pimpinellifolia (R. spinosissima), R. primula, R. X pteragonis, R. X reversa, R. X sabinni, R. seica, R. xanthina* and garden groups Austrian Briar and Burnet and Scotch roses have been discussed.

R. ecae : This species of rose has been reported from Afghanistan in the year 1880. It is a small very prickly shrub with reddish brown twigs with small, fern-like leaves. It produces numerous buttercup size single flowers of deep, rich yellow with pronounced stamens. The plant needs extra special care when it can be spectacular. Various forms and hybrids of *R. ecae* have been explained below :

Golden Chersonese : Evolved as a hybrid of *'R. ecae'* X 'Canary Bird'. It is a fine shrub with single, rich golden-yellow flowers produced profusely early in the season. Plant growth is upright with dark brownish wood and thorns. Foliage is fern like, individually small but abundant (E.F. Allen, U.K., 1963).

Helen Knight : Evolved as a hybrid of *'R. ecae'* X *'R. pimpinellifolia altaica.* It is a useful hybrid with large, slightly cupped, single, deep yellow flowers produced in late spring amid fern like foliage. Plant growth is vigorous. This shrub has darkish stems and thorns (F.P. Knight, U.K., 1966).

***R. foetida* :** It is reported from Asia in 16th century or earlier and known as *R. lutea* and Austrian Briar. Blooms are large, single and produced in early June. Flower colour is rich golden yellow with prominent stamens. Plant growth is erect and it has blackish thorn. Wood is chestnut brown. Foliage is bright green and firm in texture. It is an important rose, being largely responsible for, with its cousin *R. foetida persiana* for the yellow colour in our modern roses. A flower has unpleasant smell.

***R. foetida bicolour* :** It is reported from Asia in 16th century or earlier and know as *R. lutea punicea* and 'Australian Copper'. It is originated as a bud sport from *R. foetida'*, which occurred at sometimes in the distant past. In this form the flowers are rich copper-orange, dazzling when at their best. The blooms occasionally revert to the original yellow and sometimes both colours appear on the plant simultaneously.

***R. foetida persiana* :** Plant is reported from southwest Asia in the year 1837. It is also known as 'Persian Yellow'. Blooms are double, globular and rich yellow in colour. It has all the attributes and faults of both previous species except that its less vigorous growth. Forms and hybrids of *R. foetida* have been explained below :

Lawrence Johnston : It is reported from France in the year 1923. It is also known as 'Hidcote Yellow'. It is evolved as a hybrid of 'Mme Eugene Verdier' *X 'R. foetida persiana'*. It is an early flowering, climber with clusters of semi double, yellow flowers with prominent stamens. Flowers are fragrant. Plant growth is very vigorous with abundant, lush light green foliage.

Le Reve : It is reported by Peter-Ducher from France in the year 1920. It is evolved as a hybrid of 'Mme Eugene verdier *'X R. foetida persiana.* It is similar to Lawrence Johnston, in fact from the same cross. It is slightly less vigorous and shade less bright in colour. Blooms are very fragrant. It is an excellent variety.

Star of Persia : Pemberton reported it from U.K., in the year 1919. Evolved as a hybrid of *R. foeitida* X 'Trier'. It is an interesting hybrid from Pemberton proving that he explored other avenues of breeding while working on his hybrids Murbs. Plant growth is tall, vigorous and bushy. It is a small climber. Blooms are semi double and bright yellow in colour. Display of deep golden yellow stamens are very clear in full bloom stage.

***R. X hemisphaerica* :** It is reported from Southwest Asia in the year 1625. Variety is known as 'The Sulphur Rose'. Blooms are globular, fully double, luminous and rich sulphur in colour. Foliage is greyish-green. In damp weather bud seldom open properly. Flowers are most attractive. Prefers a warm, sheltered position to thrive. Blooms are scented.

***R. hugonis* :** It is reported from China in the year 1899. It is popularly known as Golden Rose in China. The bush grows upright with large quantities of medium sized, primrose yellow flowers. Stems are bronzy- brown in colour and thorns are densely arranged. Leaves are plentiful, fern like in appearance and to touch. Leaves turn bronzy-orange in autumn. Plant bears small, dark red fruits in late summer.

R. X cantabrigiensis : It is reported from Cambridge Botanic Gardens U.K., in the year 1931. This rose is also known as *R. pteragonis cantabrigiensis* and evolves as a hybrid of *'R. hugonis'* X *'R. sericea'*. Plant growth is less upright than *R. hugonis*. Flowers are large and slightly paler. Shoot is graceful, arching and of a fawny- brown colour with numerous thorns. Foliage is fern-like but not as colourful in autumn as its parents. Forms and important hybrids are explained below :

Earldomensis : Evolved as a hybrid of *R. hugonis X R. sericea*. It is a spreading shrub, with flat reddish thorns, which are translucent when young. Foliage is very attractive and fern like. Blooms are single and rich yellow in colour. It is difficult to propagate (Page, U.K., 1934).

Headleyensis : Evolved as a hybrid of *R. hugonis* X unknown possibly *R. pimpinellifolia altica*. It is a handsome shrub and more compact than *R. hugonis*. Foliage is good, clear green and produced in profusion from thorny, brownish stem. Bloom colour is soft primrose yellow. Flowers have good perfume (Warburg, U.K.,).

R. x involuta : It is also known as *R. gracilis, R. rubella* and *R wilsonii*. It is thought to be natural hybrid between *R. pimpinellifolia* and *R. villosa* but pollen parent could be another species of its habitat region such as *R. tomentosa* or *R. spherardii*. Plant is free suckering and has flowers of small to medium size. Bloom colour is white. Foliage is grey-green. Older stem is fawnish brown. Hips are oval to round, slightly bristly (North Europe, 1820).

R. Koreana : It is reported from Korea in the year 1917. A shrubby, fairly dense, bristly plant with greyish wood. Blooms are single, white to bluish pink, followed by small, pendulous oval orange hips. Foliage is dark green and made up of 7 to 11 leaflets. (Korea, 1917).

R. pimpinellifolia **(Burnet Roses) :** It is reported from Europe in pre-1600. This rose is also known as *R. spinosissima*, Burnet rose and Scotch Briar. Flowers are single, charming and creamy white, sometimes with subtle hints of pink, borne freely early in the season. Blooms have pronounced stamens. Leaves are small and fern like. Stems are very densely, long needle like prickles. Fruits are globular almost black in colour. Suckers freely when it is grown on its own roots. Grows well in sandy soil and can be grown easily in all types of soils. Species have given rise to many and varied hybrids over the years (Europe, Pre-1600).

R. pimpinellifolia altaica : It is reported from Asia in 1818 and also known as *R. pimpinellifolia spinosissima*. Plant has numerous spiny thorns and soft-textured, well serrated, greyish-light green foliage. Blooms are single, large, beautiful white with pronounced golden-yellow stamens. This is very useful healthy shrub possesses maroon-purple hips in the autumn.

R. pimpinellifolia hispida : This variety of rose has been reported from North East Asia and Siberia in 1781. It is an upright growing shrub with slightly larger foliage than *R. pimpinellifolia altaica*. Flowers are large and soft yellow to white with prominent stamens. Shoots are darkish green to brown with numerous spicy thorns (N.E. Asia, Siberia C., 1781).

R. pimpinellifolia lutea : It is reported from Asia but date is unknown. Blooms are single and deep yellow in colour. Plant growth is upright and bushy. It is similar to *R. pimpinellifolia altaica* in growth habit but less vigorous and with small flowers.

BURNET ROSES

Many double forms of *R. pimpinellifolia* have existed over the years since the first were introduced around 1800. The Royal Rose Society has a good and varied, representative collections of these are well worth seeing. Some of the most important double forms of Burnet rose are double white, double pink, and double marbled pink. All form of these roses has globular flowers, which are produced in profusion of tidy, well-foliated, thorny plants. Most of the member produces globular, dark, almost black hips in the late summer and all make useful, tidy, rounded shrub or attractive thick hedge.

Double Yellow Form : Several exist with the yellow in their make up obviously derived from *R. foetida.* The most important are *R. x harisonii* or Harison's Yellow (Yellow Rose of Texas) - very double (USA, 1846).

William's Double Yellow' : It is also called as old yellow scotch. They are coarser in growth than other colour. This is more compact in growth, pleasingly scented and of very ancient origin (U.K., 1828).

Other forms and hybrid of *R. pimpinellifolia* are Andrewsii, Dunwid Rose, Falkland, Fruhlingsanfang, Fruhlingsgold, Fruhlingsmorgen, Fruhlingsschnee, Fruhlingstag, Fruhlingszauber, Glory of Edzell, Golden Wing, Karl Foster, Maigold, Mary Queen of Scots, Mrs. Colville Ormiston Roy, Single Cherry, Stanwell Perpetual, and William III. Majority of them are reported from Germany, few of them are reported from USA, China, South Europe, U.K., Holland and Himalayas.

R. primula : This rose species is known as Incense Rose. It is reported from central Asia and China in 1910. It is a beautiful species with strong, upright, dark brown thorny stem supporting arching laterals. Foliage is glossy fern like and has a strong aroma of incense. Blooms appears early in the season, are single and soft buttercup-yellow with prominent stamens. Flowers are strongly scented. It is an interesting and most useful shrub which sometimes set small reddish fruits.

R. petragonis : Evolved as a hybrid of *R. hugonis* x *R. sericea* and reported from Germany in 1938. It is a medium tall shrub with broad dark red prickles similar to those of *R. sericea* but with primrose yellow, five petalled flowers.

R. x reversa : Evolved as a hybrid of *R. pendulina* X *R. pimpinellifolia.* Blooms are variable from pink to white mostly pink. Flowers are of medium sized oval to round, pendulous. Hips are deep red in colour. Plant growth is slightly angular with purple shoots, often quite bristly (South Europe, 1820).

R. sabinii : Reported from North Europe in the year 1850. It is very similar to *R. xinvoluta.* It is different in having longer flower stamens. Hips are large. Stem colour is light brown. It is evolved probably a cross between *R. pimpinellifolia* and *R. mollis.*

R. sericea : Reported from Himalayas and west China in the year 1822. It is also known as *R. omeiensis.* It is vigorous shrub with fern-like foliage and stout branches around

with large, hooked thorns and numerous small spines. In young stage thorns are translucent red. Blooms are white with pronounced pale yellow stamens. Unlike any other species of the genus, these are comprised of four petals only. Hips are bright red almost oval but slightly pear-shaped.

R. xanthia : Reported from China in the year 1906. It is an angular shrub with dark stems and thorns and dark green fern like foliage. Blooms are small, loosely and raggedly semi-double, scarlet, rich yellow, produced early in the season.

R. sericea chrysocarpa : It is reported from Himalayas but actual date of introduction is not known. It is same in all the morphological characters in all respect to *R. sericea* except that its fruits are bright yellow.

Some of the important forms and hybrids of *R. sericea* are *R. sericea pteracantha, R. omeiensis pteracantha, R. sericea pteracantha atrosanguinea,* Red wing, Heather Muir and Hidcote Gold. Most of these forms are reported from U.K.

R. xanthina : It is reported from China in the year 1906. It is an angular shrub with dark stem and thorns and dark green fern-like leaf. Flowers are small, loosely and raggedly semi-double, scented, rich yellow. Produced early in the season.

Forms and hybrids of *R. xanthina*

Canary Bird : It is also known as *R. xanthina spontanea* and reported from China in the year 1908. Plant is tall, angular with dark wood and thorns. The shrub has dark green, fern like foliage. Plant produces lateral of a graceful, pendulous habit on which the flowers are borne, making it a useful standard rose in good soils. Blooms are single, rich creamy yellow with prominent stamens. Flowers are well scented. Blooms sometimes appear intermittently in the autumn.

Section II : Gallicanae

In this section there are five leaflets per leaf. In fifteen and sixteen century man began to interfere with the progeny of the rose to more effect. The Dutch in particular, did pioneer work, especially in selecting improved strains of *R. x centifolia* and its hybrids. Chromosomal studies carried out by plant cytologists in the recent year on *R. x centifolia* prove beyond doubts that it is a complex hybrid and not, as previously thought, a true species. Apparently the centifolias are made up of genes from *R. gallica, R. phoenicia, R. moschata, R. canina* and *R. x damascena.* Late Dr. Hurst opined that they were one of the youngest group, developed in Holland some 300 years ago, contradicting the belief, based on references to hundred-petalled roses as early as 300 BC, that they were among oldest (Dr. C. V. Hurst's work is collected and documented in Graham Staart Thomas's book "The old Shrub Roses"). It is said that Dutch introduced over 200 varieties of centifolias between 1580 and 1710; a tremendous qualities in roses, suggesting a very fertile parent stock. One wonders how much of the work done by the Dutch was wholly original. There are no records to determine the origins of *R. x centifolia,* which is likely to remain yet another fascinating horticultural mystery. In this section various groups like Moss, Damask, Portland, Cabbage, *Macrantha* and *Richardi* Roses are discussed.

MOSS ROSES

R. x centifolia muscosa **(Moss Rose) :** The moss rose apparently evolved as a sport from a centifolias prior to the mid 18th century. There is no record as to exactly when the first mossy mutation occurred. It is identical in all respects except for the moss, which is really closely packed reddish- brown bristles, brighter in young shoots and covering both stem and calyx. In early 19th century a free single-flowered form appeared in their ranks, enabling a few hybridists to cross them with hybrids from other groups in an attempt to prolong their flowering period, but this was discontinued. Probably they have been with us for longer than 280 or so years. In Victorian nurseryman's catalogue between 30 and 40 varieties were commonly listed. Many of these varieties are without the novelty of mossy clothes. As per the record of River's, Wood and Hooker's catalogues listed some thirty between them and Paul listed thirty-two Moss roses in the rose garden (10th Eds, 1903). Many of these probably come about by seedlings raised haphazardly and in large numbers, yielding a small proportion of moss bearing offspring, which, in turn, were selected for this propensity- rather than for the high quality for their flowers. Now a days many growers and rose lover still appreciate the moss rose. These hardy shrub roses are closely allied to the Provence or Cabbage Roses, but differ in having the stems, branches and petioles, densely covered with bristle; the backs and edges of the sepals are covered with resin scented mossy glands. All moss roses are sports of *R. centifolia muscosa* or hybrid derived from these sports. The deeply fragrant flowers, 8 cm across, are double or semi double and borne singly or in groups of two or three in June and July in European climate. The shrubs ranges in size from dwarf varieties to tall pillar roses. The mossy glands are less prominent in the hybrids. They are not very popular today. The fallowing is still available today. Forms and hybrids of *R.* × *centifolia muscosa* are discussed below :

Alfred de Dalmas : This form is also known as 'Mousscline' and its parentage is unknown. Blooms are semi double. Flowers are creamy-pink in colours. Blooms have fragrance. Plant growth is tidy and manageable. Its moss is green, tinted pink, turning to russet on its older shoots. It is an ideal outdoor pot plant (Portemer, France 1855).

Blanche Moreau : Evolved as a hybrid of "Contesse de Murinais" x "Quatre Saisons Blanc". The bristly purple almost black moss is present on this rose. Flowers are beautiful, fully and double. Blooms are pure white and scented (Moreau-Robert, France, 1880).

Capitaine Basroger : Parentage is unknown. This rose produces a sparse second flush of flowers in late summer. Blooms are large, double, deep crimson and scented. Blooms emerge from tight, globular buds, sprinkled rather than concerned with moss. Plant growth is vigorous, better with support (Moreau-Robert, France, 1890).

Captain John Ingram : Parentage is unknown. This rose is one of the most charming of the moss roses deserving more attention. Well endowed with reddish moss on stems receptable and calyx. Blooms are fully double. Colour of the flower varies with weather from dark crimson to purple. Blooms are very strongly scented (Laffay, France 1856).

Chapeau de Napoleon : It is also known as Cristata and Cristed Moss. It a result of chance discovery. Blooms are fully double, highly scented. Flowers are cabbage like silvery deep pink in colour. Fascinating moss formation on calyx enhances blooms. It is a useful shrub of medium size, well dressed with foliage (Vebert, France 1926).

Common Moss : Parentage is unknown. It is also known as old Pink Moss and Communis. These pink mosses were very common in the 19th century. It is better than *R. centifolia muscosa* in several respects. It is softer in colour, regular in shape and tidier in growth habit. Common moss flower have exceptionally strong perfume (France Pre-1700).

Dresden Doll : Parentage is unknown. This is a charming miniature moss rose. Presumably it has centifolias genes some where in its make up. It is quite exquisite, with heavily mossed buds and stems and lush green foliage. Buds are small pointed open to fully double, cupped. Flowers are scented. Bloom colour is pink. It is ideal for pots or even in window box (R.S. Moore, USA, 1975).

Duchesse de Verneuil : Parentage is unknown. It is one of the more refined moss roses. Plant height is medium tall with well-foliated light green leaves and dense darker green moss. Flowers are flattish and composed of many folded petals, these reflex to expose pale pink beneath and brighter pink above. Foliage, moss and flowers combine to pleasing effect (Portemer, France 1856).

Eugenie Guinoisseau : Parentage is unknown. Flowers are scented and its colour is mixture of shades between violet-grey and purple. Its shape is cupped. Foliage is smooth glossy and moss is dark green. It is better grown with support (Guinoisseau, France 1864).

General Kleber : Parentage is unknown. It is an excellent variety both for beauty of flower and garden value. Flowers are very bright, almost silvery pink, quite large with patternless petals. Look like small crumpled, pink tissues. Leaves are large, lush bright green in colour. Stem is thick and covered in bright lime green moss extending to the tip of sepals. Plant has very few thorns (Laffay, France, 1856).

Gloire des Mousseux : Parentage is unknown. Flowers are double, scented and their colour is clear soft pink. This rose probably has the largest flower of all the mosses. Petals are reflexing. Blooms produced freely on a substantial plant with light green leaves and moss (Laffay, France, 1852).

Golden Moss : Evolved as a hybrid of 'Freu Karl Druschki' x ("Souvenir de Clandius Pernet" X "Blanche Moreau"). This relatively recent moss is only yellow in its group. Flower colour is pale yellow. Blooms are cupped and fragrant (Pedro Dot, Spain, 1930).

Henri Martin : Parentage is unknown. It is also known as red moss. A bloom appears in clusters. Flowers are bright crimson in colour and are of medium sized. Blooms are scented. Stems are mossed (Laffay, France, 1863).

Hunslett Moss : It is one of the earliest English moss roses discovered by Humphrey Brooke and introduced by Peter Beales. Blooms are large, full and heavily mossed. Flower colour is deep pink. Blooms have strong perfume. Foliage is dark green and produced on a upright plant (U.K., 1884).

James Veitch : Parentage is unknown. It is most interesting, short growing Moss rose. Bloom colour is royal purple with stale-grey highlights. This is another moss rose, which could be placed among the Portland Damasks (Verdier, France, 1865).

Little Gem : Parentage is unknown. This tidy useful little rose is very free flowering and colourful. Flower appears in cluster, evenly spaced and pompon like, bright crimson.

Stems are amply clothed in moss, are provided with many small, closely packed, rich green leaves (W. Paul, U.K., 1880).

Maréchal Davoust : Parentage is unknown. Flower colour is unusual and it had many reflexing petals. Bloom colour is a mixture of purple grays and pinks. The flower sometimes reveals a little green eye in the centre. Buds are fairly tidy with very dark moss and grey-green foliage (Robert, France, 1853).

Mme de la Roche Lambert : Parentage is unknown. Blooms are globular which open flattish with many deep purple petals, which hold their colour even in hot sunshine. Blooms are scented. Moss is deep purple and leaves are dark green. It is a medium shrub which sometimes repeat its flowers well into the autumn (Robert, France, 1851).

Nuits de Young : Parentage is unknown. It is also known as old black. This shrub is compact and erect with small, dark green leaves. Blooms are double. Flower colour is very dark, velvety maroon-purple emphasized by golden stamen. This is one of the best moss roses for general effect specially when dark colour is needed (Laffay, France, 1850).

Pelisson : Parentage is unknown. It is also known as Monsieur Pelisson. Flowers are double opening to red, which changes with age to purple. Shrub growth is vigorous and upright. Leaves are coarse dark green and deeply veined. Stems have stumpy thorns and darkish green moss (Vibert, France, 1848).

Salet : Parentage is unknown. This rose is useful for smaller garden. Flower is clear rose pink, deeper in autumn, double and somewhat muddled when fully open. Not very mossy but the leaves are bright green especially when young (Lacharme, France, 1854).

Striped Moss : Its origin, date and parentage are unknown. It is most shapely rose. Flowers are small with various shades of pink with random red marking. Its small, upright stature makes it an ideal pot plant.

White Bath : It is also known as Clifton Moss and White Moss. It is said to be bud sport of common moss and white moss. Flowers are large fully double and pure white. Blooms are heavily scented. Foliage, stems and buds are well mossed. Plant growth is medium vigorous (Salter, U.K., 1817).

William Lobb : Parentage is unknown. It is also called as Duchesse d' Istrie and Old Velvet Moss. Plant growth is very vigorous, after producing long stem, each with large clusters of flowers, so heavy as to bend to the ground. Well mossed with ample large leaves. Flowers large, semi double and scented, a mixture of purple, grey, magenta and pink. Petals are slightly paler on the reverse side (Laffay, France, 1855).

Zoe : Parentage is unknown. It is a free flowering moss rose with medium size flower. Bloom colour is bright pink. Flowers have many narrow, fluted petals. Blooms are scented. Plants are well endowed with brownish red moss. Foliage colour is mild-green (Vibert, France 1830).

DAMASK ROSE

R. x damascena **(Damask Rose)** : There are three species of *Rosa damascena* viz. *R. x damascena bifera, R. x damascena trigintipetala* and *R. x damascena versicolour.* The plant height and spread is up to 180cm. A shrub bearing grey-green foliage and double flowers,

often with an incurved centre or green eye, blooms are 7. 5cm wide and have fragrance. Buds are pink and changes to almost white in full blooming stage. "Semperflorence" (four seasons) is a sport that flower again in autumn. Trigintipetala, with red-pink flowers is cultivated for rose oil (Attar) in south Eastern Europe. Versicolour (York and Lancaster) has untidy, semi double blooms; these are pink, white or bicolour.

Important forms of *R. damascena* are discussed below :

Autumn Damask : Evolved as a hybrid of *'R. gallica'* X *'R. moschata'*. This damask rose has a close affinity to the Gallicas. It is also known as *R. x damascena bifera* and Quatre saison. It is reported from Middle East and extremely ancient. Blooms are lovely double with large sometimes rather crumpled petals. Flower colour is clear silky pink. Blooms are highly scented. Shrubs have greyish and downy foliage. It tolerates pruning better than most others in this group. It is ideal and good for making pot-pouri.

Belle Amour : Its origin, date and parentage is unknown. Miss Nancy Lindley discovers this rose in 1950. Petals are crinkled, salmon pink in colour and framed by two layers around rich yellow stamens. It is possibly related to the Albas but its foliage and growth, respectively greenly grey and thorny, places it here among the Damasks.

Blush Damask : Its origin, date and parentage are unknown. Plant growth is vigorous. The shrub is very floriferous. Flowers are double, medium and rich pink, paling to soft pink at the edges. Needs de-heading, as the decayed flowers are very reluctant to fall.

Botzaris : Origin and parentage is unknown. Flowers are flattish, fully double and creamy-white, often quartered when fully open. This has the affinity with the Albas. It has quality perfume. Stem wood is thorny, covered with rich light-green foliage.

Celsiana : Its origin and parentage is unknown. It is an attractive shrub in full bloom. Flowers are highly scented. Flowers are borne in nodding clusters. Blooms are semi double, displaying yellow anthers. Flowers are clear pink in colour, which fades with aging into pinkish-white in hot sun (Pre-1750).

Coralie : Its origin and parentage is unknown. It is a thorny shrub of medium stature with smallish greyish-green foliage. Blooms are soft pink, open flat, rather more than semi double, petals inclined to fold backward when fully open. Even looks attractive when faded to blush-white in hot sun (C. 1860).

Glorie de Guilan : Nancy Lindlay introduced it in 1950. Its origin is Middle East. Blooms are double and flat when open, are often beautifully quartered. Flowers are clear pink in colour and richly fragrant. Foliage is light green. Densely populated with small thorns. Variety is probably of some antiquity.

Ispahan : It is known as 'Rose d' Isfahan' or 'Rose of Ispahan' and its parentage is unknown. Flowering season is quite long in comparison to other members of this category. Blooms are semi double, light pink and hold both their shape and colour well. Blooms are very fragrant. It has attractive foliage and its stems are not over thorny (Middle East, Pre- 1832).

Kazanlik : Its parentage is unknown. Reported from Middle East. This variety is very ancient. It is also known as Trigintipetala. It is a vigorous rose, originating in the

rose fields of Bulgaria as one of the varieties used in manufacture of Attar of Roses. It is ideal for making pot-pourri. Petals are soft textured, warm pink and very fragrant. Blooms are double and foliage is dark green. It makes a good shrub. Growth is vigorous and better with support.

La Villede Bruxelles : Its parentage is unknown. Blooms are large, full, pure pink with quartered and in curving centre. Blooms are highly scented. Plant growth is strong, vigorous and upright. Shrub is good for specimen planting (Vibert, France 1849).

Leda : It is probably reported early in 19th century, however, its origin and parentage is unknown. Blooms are double, blush-pink to white with interesting crimson markings on the margins of each petals. Flowers are scented. Blooms are tidy and compact for damask. Foliage colour is downy grey-green. Its pink form also exists which is known as 'Pink Leda'.

Marie Louise : Its parentage and origin is unknown. Flower colour is glowing pink. Blooms are double, full and flat when fully open. Blooms are well perfumed. Shrub is compact and bushing with good foliage. Plant is fairly free of vicious thorns (C. 1813).

Mme Hardy : Its parentage is unknown. It is an elegant and sumptuous rose. Flower colour is pure white, fully double and quite large, considering the number it produces. Centre petals are folded inwards, exposing a rich green eye. Flowers are strongly scented. Plant growth is strong and vigorous. Foliage is bright, almost lime-green especially when young (M. Hardy in Luxembourg Gardens, 1832).

Omar Khayyam : Its parentage and origin is unknown. Propagated from a plant growing on an Edward Fitzgerald's grave in Suffolk. Planted there in 1893 from seed gathered from plants on Omar Khayyam's tomb at Nishapur. Blooms are of medium size, double scented and its colour is light pink. Shrub is shortish, foliage grey-green and downy.

Quatre Saisons Blanc Mousseux : Evolved as a bud sport of 'Quatre Saisons'. This variety is well evolved, with brownish-green moss on both stems and buds. All the morphological characters are same as parent except the white flowers. Buds are densely covered in moss. It is a perpetual flowering type.

Rose d' Hivers : Its parentage and origin is unknown. It is an old little rose placed here as sibling. It is rather un-Damask like, with small, grey foliage and twiggy, yellowish green shoots. Its flowers are small, though quite shapely. Petal colour is pale towards the margin from clear pink to white.

St Nicholas : It is possibly a chance seedling of an unknown Damask x *R. gallica.* It is an old rose but attractive. It is a short growing with downy grey leaves and vicious thorns. Blooms are almost single, pink with rich golden anther. Hips are attractive. (James, U.K., 1950).

York and Lancaster : Its parentage and origin is unknown. It is also known as *R. x damascena versicolour.* Flowers have inconsistent blush-pink and white flowers. Sometimes mottled, or with two colours on different flowers on the same head, semi double and scented. Foliage is grey, thorns are numerous (Pre-1551).

PORTLAND ROSES

During the early 19th century in Italy a natural crossing took place between Slater's Crimson China rose and a Plant obtained belived to be a cross between autumn floweming Damask with red Gallica roses. These crossess produced plants of brilliant red blooms and noticed by Duchess of Portland. It was taken to England by her and named the Portland rose in her honour. These roses are small flowered, modern standards, possessed a unique perfume and vivid colouring.

Portland Roses are included in Damask group by Peter Beales (1985). He has grown most of the Portland roses for numbers of years and found them more and more of an enigma. He opined that whatever their place amongst the roses, the Portland's is ideal for the smaller garden. Forms and hybrids of Portland roses has been discussed below :

Arthur de Sansal : Parentage is unknown. It is short growing rose, well foliated and very free flowering. Flowers are very double rosette form, dark crimson-purple. Blooms are scented (Cartier, France, 1855).

Blanc de Vibert : Parentage is unknown. Flowers are double with strong scent. Flower colour is white with a touch of pale lemon in the base. Bush growth is upright, well covered, clothed with Gallica-like foliage. It is very useful but quite rare these days (Vibert, France, 1847).

Comte de Chambord : Evolved as hybrid of 'Baronne Prevost' x 'Portland Rose'. It is an outstanding member of this group with plentiful, large, grey-green foliage, which sometimes hides the buds. Flowers are large for such a small plant. Blooms are rich warm pink, exuding a strong, heady perfume (Moreau- Robert, France, 1863).

Dalambre : Parentage is unknown. Blooms are fully double, deep reddish pink flower, freely borne on a compact plant. Leaves are dark green and healthy (Moreaue-Robert, France, 1863).

Jacques Cartier : Parentage is unknown. It is very much like 'Comte de Chambord' especially in growth habit. Blooms are less cupped and flatter in appearance, in bud and fully open stage. Petals are short which give attractive, ragged look. The colour is deep pink fading towards the edges, to soft pink. It is blessed with good perfume. Leaves are strong, leathery and dark (Moreaue-Robert, France, 1863).

Marbree : Parentage is unknown. It is an interesting variety. It is slightly taller than most of its group, with ample dark green foliage. Blooms are double, open to flat deep pinkish purple with paler mottling. Flowers are slightly fragrant (Robert et Moreau, France, 1858).

Mme Knorr : Parentage is unknown. It is a similar in morphology to 'Jacques Cartier' and'Comte de Chambord with slightly fewer leaves. Blooms are semi d ouble and their colour is pink. Flowers have good strong fragrance (Verdier, France, 1855).

Pergolese : Parentage is unknown. It is a very good rose. Blooms are small to medium sized, fully double and scented. Bloom colour is rich purple-crimson, some times paling to soft lilac-mauve, produced in small spaced clusters on a plant which is well endowed with darkish green foliage. Flowering repeats in most seasons if pruned regularly. It shows considerable Gallica influence (Moreau, France, 1860).

Portland Rose : It is also known as *R. portlandica, R. paestana* and 'Duchess of Portland'. Parentage is obscure. It is said to be evolved as hybrid of 'Quatre Saisons' X 'Slater's Crimson China'. It is a very useful rose, of ancient origin, important as a progenitor of its race. Flowers are single to semi double, borne freely on a short well-foliated plant, cerise-red with pronounced golden stamens. Blooms are scented. It is useful for group planting (early 19th century).

Rose de Rescht : Its origin and parentage is obscure. Miss Nancy Lindley discovered this variety. Date is unknown. This is fascinating little rose. Foliage is *gallica* like. The only difference from Damask is being a short flower stalk. Blooms are highly scented. Flowers are rich, fuchsia red in colour with strong purple tints, changing with age to magenta pink. Blooms are tightly formed rosette shaped, almost pompon and produced in small, upright clusters amid lots of foliage, well worth a place in any garden, very remontant especially when young. Needs hard pruning to remain so when over five years old.

Rose du Roi : Evolved as a hybrid of Portland Rose *R. gallica officinalis.* It is an important rose. Sometimes classified a hybrid Perpetual. Blooms are double, red mottled purple, loosely formed when open. Flowers are highly scented. Variety is short growing but slightly straggly. Foliage is small, rather pointed and dark-green (Lelieur, France 1815).

Rose du Roi a' Fleur Pourpré : This variety of rose is also known as 'Roi des Pourpre's and 'Mogador'. It is said to be a sport of 'Rose du Roi', an interesting rose. The red-violet purple flowers are similar to those of 'Rose du Roi' and freely produced throughout the season. Plant short, bushy and slightly straggly.

CABBAGE ROSE

R. centifolia (Cabbage Roses) : It is also known as Provence Rose. It is reported from Europe in pre-1600. The fully double flowers of *R. x centifolia* prohibit this rose from self-perpetuation from seed. *R. x centifolia* is usually listed as a species; it is probably a quite complex hybrid with a genealogy comprising *R. canina, R. gallica, R. moschata* and others. A rose similar to the present form was cultivated before 1600. A rather lax, medium - sized, shrub have thick, coarse, grey-green leaves and abundant thorn. Blooms are double, cupped or cabbage shape when open. Flower colour is deep pink. Blooms have strong, heady perfume. *R. x centifolia alba* and *R. x centifolia muscosa* has already been explained in white Provence and Moss rose section. Forms and hybrids of *R. x centifolia* is discussed below :

Blanchefleur : Parentage is unknown. Flowers are flat, double and sweetly scented. Petals are white with occasional pink tint. Variety is slightly tidier than other centifolia but the weight of flowers sometimes gives the plant a lax, open gait when they are in bloom. Foliage colour is greyish-green. It is soft to touch (Vibert, France, 1835).

Bullata : This variety was cultivated in the 16th century. Its origin and parentage is unknown. It has very large size leaf and fewer thorns distinguish this rose from others in the group. Leaves are unique being loosely crinkly both in appearance and touch. Flowers are almost identical to these of *R. centifolia* as is its growth habit, except that the density of foliage.

Duchesse de Rohan : Its origin and parentage is unknown. It is a fine rose. Flowers are many petalled and fade slightly with age from rich, warm pink to lavender, exuding a characteristically handy, *centifolia* perfume. It could be an early Hybrid Perpetual.

Fatin Latour : Its origin, date and parentage are unknown. Flowers are soft. Delicate pink and their form put it into this group. Foliage is smoother and dark green and more rounded than it's typical. Shoots are less thorny Flowers have perfume rather more *alba*-like than *centifolia.*

Juno : Its origin and parentage is unknown. It is an arching shrub. Blooms are double and globular. Flower colour is pale blush-pink. Blooms are produced profusely and are highly scented.

La Noblesse : Parentage is unknown. It is exceptionally tidy for a member of this group and flowering rather late in summer in European condition. Flowers are highly scented. Blooms are well-formed, fully double, open flat and are soft silver-pink.

Ombree Parfait : Parentage is unknown. It is one of the most unusually coloured centifolias. Blooms are produced abundantly. Flowers are not very large and have many petals of varying shades from pink to purple, giving them a mottled effect. Flowers are scented. Leaves are small and rich green. It is closely related to Gallicas, and shorter growing shrub (Vibert, France, 1823).

Petite de Hollande : Parentage is unknown. It is also known as 'Pompon des Dames' and 'Petite Junon de Hollande'. It is compact, small and an attractive shrub. Flowers are many, small, double and 4cm across. These are cupped until fully open and clear pink with deeper centre. Blooms are scented (Holland, 1800).

Petite Lisette : Parentage is unknown. Blooms are small and pompon type, 2.5 cm across. Flower colour is deep rose pink, produced in considerable numbers in large, evenly spaced heads. Foliage is small, deeply serrated, greyish-green and pointed. It makes a useful shrub for front of borders (Vibert, France, 1817).

Petite Orleanaise : Its origin and parentage is unknown. This *centifolia* rose is small, pompon like but taller than the other small flowered varieties. Plant has ample foliage, which makes it ideal for growing in large tubs.

Pompon de Bourgogue : Its origin and parentage is unknown. This *centifolia* rose is also known as Parvifolia and *R. burgundica.* It is a superb little rose. Flowers are pompon like and their colour is rosy claret to purple flecked with pink. Plant growth is erect with foliage packed closely along clustered thin stiff stems. This ideal miniature rose is suitable for terrace or patio (Pre-1664).

Reine des Centfeuilles : It is reported from Belgium in 1824. Its parentage is unknown. Blooms are large, double, scented and reflexed when fully open. Flower colour is clear pink. Plant growth is medium to tall with ample foliage (Belgium, 1824).

Robert le Diable : It is reported from France. Its parentage and date of origin is unknown. It is very useful and interesting small shrub rose, slightly procumbent and well endowed with foliage. Flower colour is very difficult to describe, but on the crimson side tinged with lilac and grey highlights and dark-purple shadings. A small green eye is often exposes in the centre of each bloom.

Rose de Meaux : Its parentage is unknown. It is a short, erect, well-foliated bush with massed, small, double, pink-flowers. Blooms are not quite pompons but more like small dianthus with slightly frilly petals. Flowers are scented. It is a superb shorter growing rose. This variety is much rewarding once established in soil (Sweets, U.K., Pre-1789).

Rose de Meaux White : Its origin is unknown. All the morphological characteristics are just like "Rose de Meaux" but flower colour is white. Probably evolved as a bud sport.

Rose des Peintres : It is also known as 'Major','Centiferille des Peintres' and *'R. x centifolia.* Its origin and parentage is unknown. It is slightly more refined form of *R. centifolia.* Blooms are large opening fully double.

Spong : Parentage is unknown. The name is unusual for an unusual rose. Plant stature is medium and like "Rose de Meaux" with larger flowers and taller growth. Blooms are scented. Flowering is early and its needs heading after flowering, especially in wet weather. Foliage is greenish-grey (Spong, France, 1805).

The Bishop : Its origin date and parentage is unknown. Blooms are full and rosette shaped. Flower colour is a mixture of unusual magenta, cerise and purple. Blooms are fragrant. Flowering is rather earlier than most of this group. Plant growth is upright. It is an excellent rose.

Toru de Malakoff : This variety of rose is known as 'Black Jack' and its parentage is unknown. It is a unique rose with magenta flowers flushed deep purple and fading to lilac grey. Each bloom is large, double but loosely formed. It is a lanky, lax plant, which benefits from support.

Village Maid : It is also known as 'Belle des Jardins', 'La Rubance' and *R. x centifolia variegata.* This vigorous thorny rose have strong shoot. Plant growth is rather more upright and it is taller than most centifolias. Flower colour is soft off white with streaked and striped of pink. It blooms in late June and very floriferous. Blooms are very scented (Vibert, France, 1845).

White Provence : This variety of rose is also known as "Unique Blanche', 'Vierg de Clery' and *R. x centifolia alba.* It was discovered in U.K., in 1775. In good weather blooms are quite the most beautiful of all the white roses. Flower colour is white silk.

R. macrantha

***R. macrantha* :** It is probably of Gallica origin. It is a vigorous spreading shrub bearing many attractive single flowers. Bloom colour is clear pink, fading to white, with prominent stamens and a good fragrance. Plant has plentiful darker veined foliage. Hips are globular and produced in autumn. Forms and hybrids of *R. marcantha* are discussed below :

Chianti : Evolved as a hybrid of *R. macrantha* X 'Vanity'. Blooms are semi double. Flower colour is rich purple maroon. In fully open flower pronounced golden anthers are visible. Flowers are produced in clusters on well-foliated plants. Leaf colour is dark green. Blooms are scented.

Daisy Hill : Evolved as a hybrid of *R. macrantha.* Its date of origin is not known.

Blooms are large slightly more than single. Flower colour is rich pink. Blooms are well perfumed. Plant growth is vigorous, rather wider than high in habit. Foliage is abundant and dark green in colour. Hips are globular and red in colour.

Harry Maasz : Evolved as a hybrid of 'Barcelona' X 'Daisy Hill'. Plant growth is very vigorous. This little known spreading rose has dark greeny-grey foliage. Blooms are single large and cherry red in colour, paling to pink towards centre, each with a prominent arrangement of stamens. Blooms are scented (Kordes, Germany, 1939).

Raubritter : It is also known as 'Macrantha Raubritter'. Evolved as a hybrid of 'Daisy Hill' X 'Solarium'. It is a trailing shrub of great charm. Excellent for use in banks and similar features. Bloom appears in trusses of clear silvery-pink, semi double blooms of cupped, Bourbon form. Flowers borne all along rather thorny branches amid dark, greyish-green, matt foliage (Kordes, Germany, 1967).

Scintillation : Evolved as a hybrid of *R. macrantha* X *'Vanity'*. A cluster of blush-pink, semi-double flowers appears on a sprawl, useful-sized plant. Foliage is grey-green in colour and produced in plenty (Austin, U.K., 1967).

R. richardii

***R. richardii* (The holy Rose)** : This variety of rose is also known as *R. richardii* and *R. sancta.* Its origin is not fully known. It is probably a Gallica hybrid of considerable antiquity. A low growing, slightly sprawly plant with dark green, matt-finished leaves. Blooms are single, beautifully formed and soft rose pink in colour (Abyssinia, 1897).

Section III : *Caninae*

The *Caninae* is a source of rootstocks, but the breeding of these is a highly specialized job. The indeterminate number of species in *Caninae,* added to the fact that many are susceptible to one or more of the three chief leaf diseases. The Dog Roses of this section are virtually confined to the old World (Allen, 1973).

Plant growth is upright and arching. Thorns usually hooked and numerous, foliage medium sized, mostly greyish-green and has 7 to 9 leaflets. A bloom appears in small clusters. Hips are oval to round. Outer sepals divided. Sepals have no consistence pattern. Some of the important species included in caninae group are *R. agrostis; R. X alba; R. biebersteinii; R. britzensis; R. canina; R. collina; R. corymbisera; R. dumales; R. eglanteria; R. gluca; R. inodora; R. jundzilli; R. micrantha; R. mollis; R. orientalis; R. pulverulenta; R. serafinii; R. sherardii; R. sicula; R. stylosa; R. tomentosa; R. villosa; R. villosa duplex* and *R. waitziana* and garden groups which includes viz. Albas, Dog roses and Sweet Briars.

R. x alba

R. x alba : It is reported from Europe pre- 16th century. It is also known as 'White Rose of York'. This lovely rose is closely related to Dog Rose and in many ways similar, both in shape of flower and growth habit. Single flowers are pure white and sweetly scented. Foliage are matty grey and smooth, stem is light green with an average population of stout thorns. Albas as a garden group are very healthy and comprise some of the most beautiful roses from the past. Flowers are mostly of pastel shades and without exception,

are superbly scented. Their foliage, fruit and stems are rather similar to, if more refined than *R. canina* which supports the belief that this group of roses have a common ancestry with this species and the other parent could be either *R. x damascena* or *R. gallica.* All the members of this group grown today are blessed with a strong constitution. The general names for *R. alba* 'Maxima' afford historical insights, for they include 'Bonnie Prince Charlie's Rose', 'Jacobite Rose', 'Cheshire Rose' and 'White Rose of York" indicating an auspicious rose. The true 'White Rose of York', however, was probably the specific and single form of R. x *alba* or even a white rose from of the common *R. canina.* Forms and hybrids of *R. x alba* are described below:

Amelia : Its parentage is unknown, this form of *alba* is less vigorous with possibly some damask influence. Blooms are large, semi double and their colour is pink. Flower size is 8 cm across with prominent golden stamens. Flowers have superb scent. Foliage is grey-green (Vibert, France, 1823).

Blanche de Belgique : It is also known as 'Blanche Superbe'. Its parentage is unknown. Flowers are pure white and their shape and size is good. Blooms have superb perfume. Foliage is grey-green in colour and they are healthy. Plant growth is vigorous, bushy and upright (Vibert, France, 1817).

Celestial : Its origin date and parentage is unknown. It is also known as 'Celeste'. It is very ancient. Flowers are beautiful, semi double, soft pink combining well with lavender grey foliage. It is healthy, robust and charming rose with superb expensive perfume.

Chloris : Its origin date and parentage is unknown. It is also known as 'Rosee du Martin'. It is very ancient. It has the darkest green leaves of all, and comparatively thornless. Flowers are double with incurving petals curling into tight central button. Flower colour is soft satiny- pink. Blooms are scented.

Felicite Parmentier : Its origin date and parentage is unknown. Shrub is tidy and bearing abundance of flat, reflexing flowers similar in colour to pink coconut-ice. Its good healthy, dark greyish-green foliage are attractive.

Jeanne d' Arc : Its parentage is unknown. It is very useful shrub. It has the dark green leaves. Flowers are creamish white in colour, fading to white in hot sun.

Konigin Von Danemark : Its origin date and parentage is unknown. Individual flowers of this rose are slightly smaller than most other Albas and its colour is deeper pink. Shoots are typically thorny and the, foliage although greyish-green is more coarse. Blooms are superbly scented. This rose is still an excellent ambassador for the Albas as a whole.

Maiden's Blush Great : Its parentage is unknown. It is also known as 'Cuisse de Nymphe', 'Incarnata', 'La Virginale' and 'Seduisante'. These names are very popular in France but in England it is known as 'Maiden's Blush'. It has all the last Albas attitudes. Flower colour is blushing pink and it has refined perfume. Plant is covered with blue-grey leaves.

Maiden's Blush Small : Its parentage is unknown. It is evolved as a bud sport of 'Maiden's Blush Great'. It is similar to its sister but slightly smaller, both in stature and size of flower (Kew Gardens, U.K., 1797).

Maxima : Evolved as a hybrid of *R. canina* X *R. gallica.* It is also known as Jacobite Rose, Bonnie Prince, Charlie's Rose, White Rose of York, Great Double White and Cheshire Rose. Blooms are pure white, sometimes creamy white, very double flower appear in upright clusters. Foliage is healthy and grey-green in colour. Fruits are oval shape (Europe, 15th century or earlier).

Mme Legras de St Germain : Its parentage and origin is unknown. It is reported earlier in 19th century. It is relatively thornless rose. Flowers are of medium sized, very double, and creamish white colour. Blooms are produced in large clusters. Flowers are highly scented, standing up well in inclement weather. Foliage is grey-green, soft and downy to touch. It is equally good as a shrub and climber. It will attain atleast double its equal height if support is provided.

Mme Plantier : Its parentage is unknown. It is best classified as *Alba.* Evolved as a cross of *alba/moschata.* It is capable of climbing. It is good as a lax shrub or pillar rose. Blooms are flattish and made up of many convoluted petals. Flower colour is pale cream, changing to pure white with age. Blooms appear in very large clusters on long, sometimes on arching stems. Foliage and stems are light greyish-green with few thorns (Plantier, 1835).

Pompon Blanc Parfait : Its parentage and origin is unknown. It is an upright growing variety. Foliage is small with short leaf stalk. Blooms are scented. Flowers are pure white produced freely in small clusters.

Princess de Lamballe : Its parentage, origin and date are unknown. It has small white semi double flowers and grows upto 90cm. It is also known as *R. alba suavelens* and *R. alba nivea.*

Semi-plena : It has been reported from Europe on 16th century or earlier. Blooms are semi double, sweetly scented and pure white in colour. Leaves are greyish-green. It is underrated form of *R. x alba.* It can be used as an informal hedge or lax shrub in the wilder garden.

R. biebersteinni :It is also known as *R. horrida.* Reported from West Asia in 1796. It is a curious, almost gooseberry like bush with small, white flowers followed by globular red hips.

R. britzensis : It is reported from Middle East 1901. It is a tallest upright shrub with bluish green thornless branches and greyish-green leaves. Blooms are large, upto 7. 5cm across. Flower colour is blush-white. Blooms are scented. Hips biggish, oval and dark red with sparse bristles.

R. canina

It is commonly known as Dog Rose. This species is ancient in Europe, occasionally found naturalized in other temperate areas such as North America. It forms somewhat awkward shrub but its individual flowers are quite beautiful. Bloom colour is pale or blush pink. Flowers have sweet scent. Its distinctive feature is the abundance of orange-red hips, which are produced in autumn. These are rich in vitamin C and used in rose hip syrup. They also make a good wine. The common Dog Rose was the most widely used under stock for the production of modern roses. *R. canina inermis* is a fairly thornless

form now sometimes used as such. Forms and hybrids of *R. canina* is described below:

Abbots wood : It is also known as Canina Abbots Wood. This form is evolved from R. *canina X* unknown garden variety. It is a chance hybrid with scented flowers. Blooms are double pink in colour. It is very useful for the places where dense shrub is required for specific purpose (Hilling, U.K., 1954).

R. andersonii : Evolved as a chance hybrid of *'R. canina' X 'R. arvensis'* (possibly) or *R. gallica.* Flowers are large and deep pink in colour. Plant has fewer thorns with tidier growth habit. Hips are similar to those of its parent (Hiller, U.K., 1912).

R. x collina : Evolved as a hybrid of *'R. corimbifera' x 'R. gallica'*. It is medium growing shrub with sparse, reddish thorns and pale, greyish-green leaves. Flower colour is mid to pale pink. Hips are oval and bright red (Central Europe, 1779).

R. corymbifera : Form is related to *R. canina* as plant size and foliage morphology resembles with it. Blooms are slightly larger in size, creamy white with hints of blush pink. Hips are good and their colour is orange, very similar to *R. canina* (East Europe and Asia, 1838).

R. dumales : It is a medium shrub related, and similar to *R. canina,* found mostly in mountainous areas in Southern Europe. Flowers are large 7cm across and clear rose pink in colour. Blooms are scented. Hips are large, oval to round in shape and red in colour (East Europe and Middle East, 1872).

R. eglanteria (Eglantine Rose)

This species of rose is reported from Europe and also known as *R. rubiginosa,* Sweet Briar and Eglantine Rose. Its date of origin is unknown. It is quite similar to *R. canina,* distinguished by its perfumed foliage and higher density of prickles. Blooms are small, single and blush pink in colour. Fruits freely and hips stay on the bush well into winter. To encourage young growth it is advisable to clip the plant each year as tips of growth exude the strongest scent. It is native of Europe and probably been appreciated for its perfumed leaves since civilization began. As per records of available literature many of the varieties are listed in the 19th century catalogues, but most of these seem to have disappeared now. Forms and hybrids of *R. eglanteria* are mostly reported from Penzance (UK) and Germany viz. Amy Robsart, Anne of Geierstein, Catharine Seyton, Edith Bellenden, Flora McIvor, Goldbusch, Greenmantle, Hebe's Lip, Herbstfeuer, Janet's Pride, Julia Mannering, La Belle Distinguee, Lady Penzance, Lord Penzance, Lucy Ashton, Magnifica, Manning's Blush, Mechtilde von Neuerburg, Meg Merrilees and Rose Bradwardine. In most of the forms and hybrids of *R. eglanteria* parentage is unknown. Some of the forms with known parentages are described below :

Hebe's Lip : This forms is also known as Rubrotincta and Reine Blanche. W. Paul in U.K., introduced it in 1912. Its origin is probably very old. It is evolved as a hybrid of *R. damascena X R. eglanteria.* It has scented foliage. Flowers are almost single, white tinged with red at the petal edges. Stem is thorny with coarse foliage. Its growth habit is open.

Lady Penzance : Evolved as a hybrid of *R. eglanteria* X *R. foetida* bicolour. It is a dense vigorous shrub reported from Penzance, U.K., in 1894. It has strongest -scented foliage. Blooms are single, copper salmon and pink with pronounced yellow stamens followed by bright red hips.

Lord Penzance : This vigorous growing shrub is reported from Penzance, U.K., in 1890. Evolved as a hybrid of *R. eglanteria* X Harrison's Yellow. Foliage is sweetly scented. Flowers are single and their colour is buff-yellow tinged with pink. Hips are bright red in colour.

Magnifica : Hesse reports this form from Germany in 1916. Evolved as a seedling of 'Luck Ashton. It is a splendid shrub rose which should be more widely grown. Blooms are semi double. Flower colour is purplish red and its size and quality is good. Leaves are slightly scented. Foliage colour is dark green and it is dense. It makes a very good hedge.

Meg Merrilees : This shrub is reported from Penzance, U.K., in 1894. It is an extremely vigorous and prickly shrub rose. It has bright crimson semi-double flowers followed by an abundance of good red hips. It is one of the best of its group, with scented flower and foliage.

R. glauca

It is also known as *R. rubrifolia* and reported from Europe in 1830. It is very useful ornamental shrub with glaucous purple stems and foliage. A bloom appears in clusters. Flowers are beautiful and soft mauve in colour. Hips are oval reddish-purple. The species is very useful for flower-arranging, one or two plants will give an almost unending supply of foliage for this purpose. For many years it is erroneous known as *R. rubrifolia* but the name of *R. glauca* has now been accepted as more accurate. Forms and hybrids of *R. glauca* are described below :

Carmentta : It is reported from Central Experimental Farm Canada in the year 1923. Evolved as a hybrid of *R. glauca* X *R. rugosa*. Plant growth is vigorous. Foliage and stems are glaucous-purple with numerous small thorns. Blooms are slightly larger than that of *R. glauca*.

R. inodora : It is reported from South Europe in 1905. It is also known as *R. graveolens* and *R. obtusifolia*. It is a coarse, vigorous, thorny shrub with scented (Sweet Briar) foliage. It is ideal for naturalizing or growing in to hedgerows, almost a less refined form of *R. eglanteria*. Blooms are single. Flower colour is soft pink to blush-white. Hips are beautiful, oval and bright red in colour.

R. jundzillii : It is reported from Eastern Europe in 1870 and also known as *R. marginata*. It is a handsome rose. Blooms are single, quite large, bright pink, produced freely on a medium-sized, moderately prickly plant bearing ample darkish green, serrated leaves. Hips are smooth, oval and bright red in colour.

R. macrantha : It is reported from Europe in 1900. It is similar to *R. eglanteria* but slightly less vigorous in growth. Flowers are small. Foliage is slightly scented.

R. mollis : It is reported from Europe in 1818. The small shrub has greyish to red

stems and grey, downy foliage. Blooms are mid-pink, borne mostly in small clusters of three or four fragrant blooms in mid-summer. Plant is bristly, occasionally smooth. Hips are globular.

R. oriantalis : It is reported from Europe and Middle East in 1905. Plant is short growing. Shrub has slender hairy branches. Leaves are made upto five, seldom seven small, oval leaflets, which are bright, green. Blooms are papery and soft pink in colour. Hips are small, narrow, oblong and bright red in colour.

R. perverulenta : It is introduced in 1821 from Mediterranean region. It is a short growing prickly plant. Blooms are small pinkish white. Hips are small and globular. Foliage has smells of pine.

R. serafinii : It is reported from Eastern Mediterranean region in 1914. Blooms are small, single and pink; borne on a short growing, thorny, rather sprawly plant. Fruits are rounded and bright orange in colour. Foliage is scented and glossy.

R. sherardii : It is reported from North Central Europe 1933. It is also known as *R. omissa.* Plant growth is medium. Shrub produces angular sometimes zigzag branches and blush-green foliage. Flowers are deep pink and borne in small clusters followed by smallish, almost urn-shaped hips.

R. siecula : It is reported from South Europe and North Africa in 1894. It is short, free suckering shrub similar to *R. serafini* with reddish wood when young. Foliage is greyish-green and slightly scented like their flowers. Blooms are soft pink in colour. Hip shape is round to oval.

R. stylosa : It is reported from Europe in 1838. Plant is an arching shrub with small, narrow, oval mid green leaves. Blooms appear in small clusters. Blooms are of medium size 5cm across. Flower colour is blush-pink white followed by smooth, oval red hips.

R. tomentosa : It is an ancient European species. Shrub is tall and similar in many respects to *R. canina.* Blooms are of medium size and clear soft pink in colour with many yellow stamens. Blooms are scented. Foliage is matty grey-green in colour. Leaves are softer in both appearance and touch to that of the 'Dog Rose'. Fruits are bright red and oval. It is found growing wild in many parts of Mainland Europe and the British Isles.

R. villosa : It is reported from Europe and Asia in 1761 and also known as *R. pomifera* and 'Apple Rose'. It is a medium sized shrub with greyish, downy leaves, which are said to be fragrant. Blooms are single, scented and clear pink in colour. Fruits are large, orange, apple shaped and well covered with bristles.

R. villosa duplex : It is also known as *R. pomifera duplex* and Wolly Dodd's Rose. It is the first garden form discovered in the garden of the Rev. Wolly-Dodd, Cheshire, in 1900. Parentage is unknown. It is similar in most respects to *R. villosa* but slightly shorter in growth. Blooms are semi double and clear pink in colour. Repeats flowers intermittently when growing in good situations suggesting hybrid origin.

R. x waitziana : It is reported from Europe in 1874. Evolved as a hybrid of *R. canina* X *R. gallica.* It is a medium to tall shrub with stem and armature similar to those of *R. canina.* Blooms are of medium size. Flower colour is deep pink.

Section IV : *Carolinae*

Plant growth is shortest and upright. Thorns short, usually borne in pairs, hooked. Leaves composed of 7 to 9 leaflets. Flowers appear mostly singly on short stalks. Hips are mostly roundish. Sepals drop when ripe. *Carolinae* section has fallowing species viz. *R. carolina, R. carolina alba, R. carolina plena, R. foliolosa, R. x kochiana, R. x marie-graebnerae, R. nitida, R. palustris and R. virginiana.* Description of these species are given below.

R. carolina : It is reported from North America in 1826. It is a useful, free suckering rose. Shrub growth is thin, relatively thornless shoots and its latent branches are completely thornless. Leaves are ample and glossy. Blooms are clear, soft pink in colour and borne solitary. Hips are roundish and red in colour.

R. carolina alba : It is reported from USA garden in 1867. It is also known as *R. virginia alba.* Blooms are single and white. It is similar in most respect to *R. carolina.* Slight differences in foliage suggest the influence of genes from other species or variety.

R. foliolosa : It is reported from North America in 1880. Blooms are bright pink, solitary, slightly ragged flowers amid strange, narrow, elongated foliage. Produces free suckers when on its own roots. Thorns are absent in stem. Plant is short growing and tolerant to wettest soil. Hips are small, widely spherical and bright red.

R. x kochiana : It is reported from North America in 1869. Evolved probably as a hybrid of *R. paulstris* X *R. pimpinellifolia.* It is a little shrub with bright lime-green foliage. A leaf remains healthy and changes to a rich, russet red in autumn. Shoots have few strong thorns on stiff, thin angular stem. Blooms are solitary and deep rose pink, reminiscent of those of the shrub *Cistus crispus.*

R. carolina plena : It is also known as 'The Double Pennsylvanian Rose'. It is reported from USA in 1790. Lynes rediscovered it in 1955. Blooms are double, small charming and clear pink in colour paling to almost white at the edges. Leaves are smooth and dark green in colour. It is a short growing, free suckering plant when on its own root.

R. x marie-graebnerae : It is reported by H. Dabel in 1900 from Germany. Evolved as a hybrid of *R. paulstris* X *R. virginiana.* It is a most useful striking little shrub. Flowers are bright rose pink and are produced at first in profusion and then intermittently throughout the summer. Shoots are sparsely thorned with almost shiny foliage. Fruits are small, round and good autumn colour.

R. nitida : It is reported from North America in 1807. It is a free suckering, short shrub with thin prickly stem. Leaves are dainty, fern like turning to rich crimson in autumn. Flowers are small, single, numerous and deep pink rose in colour. It is a useful shrub. Hips are small, oval and slightly bristly.

R. palustris : It is also known as 'The Swamp Rose'. It is reported from North America in 1726. Plant is vigorous with abundant, mid to dark-green foliage. The stem is reddish and has an upright habit. Blooms are single and deep pink in colour produced intermittently over a long season. Hips are oval. Plant can tolerate wet boggy conditions.

R. virginiana : It is reported from North America in 1807. It is a very useful shrub, does particularly well in light sandy condition. Leaves are light green and glossy and

looks very colourful in autumn. Plant growth is bushy and upright. Flowers are single, rich clear pink with yellow stamens. Blooms have good scent. Blooms appear later than in some species, followed by orange, plump, round hips remaining on the plant well into winters.

R. virginiana plena : It is also known as 'Rose d' Amour', 'St. Mark's Rose'. Parentage and origin is unknown. It is taller than *R. viginiana* but plant has many characteristics in common with this species. Blooms are beautiful, quite small, high centred and fully double with petals scrolled as they open, pastel pink deepening towards the centre of each bloom.

Section V : Cinnamomeae (Cassiorhodon)

The largest section of *Eurosa* subgenus is Cinnamomeae comprises of 50 or more diploid, tetraploid, hexaploid and octoploid species from throughout the northern hemisphere. The greatest variation is shown in Asia, with the centre of diversity in China. The section provides the greatest untapped source of fresh genetic material for use by rose hybridists of the future (Allen, 1973).

Plant growth is mostly shrubby and upright. Plant height ranges from 100cm to 400cm. Thorn appears in pair and they are often large. Leaves comprises of 5 to 9 leaflets and in extreme cases it goes upto 11 leaflets. A bloom appears in groups. Flower colour varies from red to pink except in *R. wardii* and *R. rugosa*. Hips are usually a special feature, large and variously shaped. Sepals held erect when ripe. This section has many species and Boursault roses, their descriptions are as follows :

R. acicularis : This species have been reported from N.E. Asia, N. America and N. Europe in 1805. Flower colour is rich pink. Blooms are solitary, occasionally 2 or 3, and 4cm in diameter. Hips are smooth, pear-shaped and their colour is bright red. Foliage colour is mid-green to grey on a lax plant with thin shoots. Plant has an abundant amount of variably sized bristles and few real thorns.

R. acicularis nipponensis : This species have been reported from Japan in 1894. Blooms are solitary, 4 to 5cm across and deep pink, almost red in colour. Hips are pear-shaped. Foliage is greenish-grey in colour. Flower stalks and hips are bristly, with few real thorns.

R. amblyotis : This species have been reported from N. E. Asia in 1917. This medium size shrub has an upright growth. The shrub is similar to *R. majalis* to which it is obviously related. Flower colour is red. Hips are pear shaped and red in colour.

R. arkansana : It is a short growing dense shrub with a fairly long flowering season in mid summer. Foliage is heavily veined and has glossy surface. Flower size is 5cm. Flower colour is bright red with yellow stamens, usually appears in clusters. Hips are small, roundish and red in colour.

R. banksiopsis : This species have been reported from China in 1907. It is a medium size shrub with small, rose-red flowers, followed by flask-shaped hips.

R. beggeriana : This species have been reported from Central Asia in 1869. It has

a long flowering season. Early blooms are small and white. Hips are small, round and orange. Stems are covered with lightish coloured hooked thorns. Foliage is greyish-green in colour.

R. bella : This species have been reported from China in 1910. It is an upright growing rather prickly shrub with many of the characteristic of *R. moyesi*. Blooms are single. Flower colour is bright pink. Blooms are of medium size. Fruits are flask shaped and orange in colour.

R. blanda : This species have been reported from North America in 1773. It is known as Smooth Rose, Meadow Rose, Hudron Bay Rose, and Lavender Rose. It is similar to *R. canina* except for fewer thorns and deeper pink flowers. It is less vigorous in growth. Hips are more pear shaped than oval.

R. californica : This species have been reported from North West America in 1878. It is uncommon in U.K., Plant attains height upto 250cm with corymbs of single pink flowers which are 4cm across.

R. californica plena : This species have been reported in 1894. It is an excellent garden shrub with lilac-pink flowers, shaped rather like the individual blooms of a semi double hollyhock. The shrub is healthy, upright in habit and amply foliated with greyish-green leaves. The wood is dark and has few thorns.

R. candida : This species have been reported from China in 1907. It is very similar to *R. setipoda*. It forms a dense shrub with thick, well-armed branches. Flowers are produced in large clusters. Blooms are pink, followed by flagon - shaped, bristly hips.

R. coriifolia froebelii : This species have been reported from Europe in 1890. It is also known as *R. dumetorum laxa*. It is a dense shrubby rose with grey-green wood and foliage. Plants are moderately thorny. Blooms are white. Hips are plump but oval. It is widely used as an under stock.

R. coryana : It is reported from Cambridge Botanic Gardens, U.K., in 1926. Evolved as a hybrid of *R. macrophylla* X *R. roxburghii*. It is a medium sizes shrub with leaning towards *R. roxburghii* in appearance. Flowers are large, single and deep pink in colour.

R. corymbulosa : It is reported from China in 1908. Plant is of medium growth, rather lax, almost thornless thin-stemmed shrub. Leaves are small with slightly hairy underside. Leaf colour changes from green to deep purple in autumn. Flowers are single, deep, and pinkish-red, with a white eye. Hips are of medium sized rounded and their colour is red.

R. davidii : It is reported from China in 1908. It is a useful late flowering species. Flower colour is soft pink. Sometimes borne in clusters along the length of each stem, sometimes singly. Plant growth is upright and vigorous. Leaves are heavily veined and light green in colour. Hips are flagon-shaped and orange red in colour.

R. davurica : It is reported from North China and Asia in 1910. Shrubs have average thrones with small leaves. Flowers are of medium sized and their colour is pink. Hips are small and oval.

R. farreri persetosa : It is reported from China in 1910. It is also known as 'Three Penny Prit Rose'. It is a charming; sparily shrub with fine fern like leaves which changes

into purple and crimson in the autumn. Hips are produced in profusion and their colour is bright orange red. Flowers are small and their colour is lilac-pink. Shoots are biscuit brown in colour densely covered in minute but fairly harmless thorns, giving an almost mossed effect.

R. fedtschenkoana : This species have been reported from South East Europe and Central Asia in 1880. It is a most useful shrub with single white, papery flowers, produced at first in profusion then intermittently throughout summer. Leaves are light grey green and feathery. Hips are sparsely bristled and oval to pear-shaped.

R. forrestiana : It is reported from West China in 1918. Flower colour is pinkish crimson with creamy-buff anther produced in small clusters, followed by bottle shaped red hips. Leaves are produced in ample and purplish-green in colour. Plant growth is arching and dense.

R. gymnocarpa : It is reported from North America 1893. It is a graceful shrub with moderately thorny, wiry shoots and numerous small roundish leaves. Flowers are small, single and pale pink. Hips are small, smooth, pear shaped and red in colour.

R. hemsleyana : It is reported from China in 1904. It is a vigorous shrub similar to *R. setipoda.* Flower colour is medium pink and they are borne in clusters. Hips are bottle shaped bristly, and orange red in colour.

R. kamtchatica : It is reported from USSR in 1770. It is also known as *R. ventenatiana.* It is evolved as a hybrid of *R. rugosa* X *R. amblyotis* (possibly). Blooms are smallish, single, pink touching cerise. Blooms are slightly scented. Foliage is mid-green. Stems are well armed but less so than *R. rugosa.* Hips are small to medium, round and bright red in colour.

R. x Kordesii : Kordes reported this species from Germany in 1950. It is a seedling of 'Max Graf'. Herr Kordes used this species extensively in the breeding of some very important hybrids. Its offspring's are disease resistant. Forms and hybrids of *R. x Kordesii* are explained below.

Dortmund : It is reported by Kordes from Germany in 1955. It is evolved as a hybrid of seedling x *R. bordesii.* Blooms are large, single, crimson with a pale, almost white, central eye. Blooms are produced in large clusters. Plant growth is vigorous. Plant is thorny with dark green foliage.

Hamburger Phoenix : It is reported by Kordes from Germany in 1954. It is evolved as a hybrid of *R. Kordesii* x seedling. A bloom appears in large clusters. Flowers are semi-double, rich crimson and borne on a spreading, vigorous shrub. It is a short climber with dark green foliage.

Leverkusen : It is reported by Kordes from Germany in 1954. It is evolved as a hybrid of *R. Kordesii* x 'Golden Glow'. Blooms are semi double. Flower colour is lemon yellow. It looks very attractive in full bloom stage due to presence of ragged edges. Flowers are sweetly scented. Foliage is glossy, light green with deeply serrated margin and looks very attractive.

Parkdirecktor Riggers : It is reported by Kordes from Germany in 1957. It is evolved as a hybrid of *R. Kordesii* x 'Our Princess'. It is a very good climbing rose. Blooms appear

in large clusters of deep red to crimson. Flowers are single and firm textured. Plant growth is vigorous and upright. Leaves are healthy, dark green and glossy.

THE BOURSAULT ROSES

The Boursault Roses are few and it was assumed until recently that *R. lheritierana*, from which they descend, had occurred from a cross between *R. pendula* and *R. chinensis* as their smooth stems, dark wood and leaf shape point in this direction. It has been also confirmed by chromosomes count.

R. lheritierana : It is probably reported from Europe in 1820. Plant is made up of unarmed cane like stems. Plant is having variable colour from green to reddish brown. Leaves are dark green, rather black berry type, but smooth. Blooms are double, opening flat, deep pinkish red to blue-white. Hips are round and smooth.

R. pendulina plena : Morlet reported it from France in 1883. It is also known as 'Morletti' and *'R inermis morletti'*. It is slightly less vigorous in growth with other characters similar to Boursault Rose. Foliage is colourful in autumn. Bloom colour is deep pink-magenta, almost double, rather ragged when fully open. Blush Boursault and Mme Sancy de Parabere are also included in this Boursault Roses but their parentage is unknown. In both the cases flower colour is pink.

R. macrophylla : It is reported from Himalayas in 1818. It is a medium tall shrub. Flowers are bright, cerise-green. Wood is purplish and smooth. Fruits are large, orange and hangs conspicuously rather small, slim bristly pears. Some of the important forms and hybrids of *R. macrophylla* are 'Arthur Hiller', 'Auguste Roussel', 'Doncasterii' and 'Master Hugh'.

R. macrophylla rubricaulis : It is reported from Himalayas by Hillier. It is also known as 'Rubricaulis'. It is similar to the *R. macrophylla* species but wood darker and often covered in a greyish bloom. It is said to be less hardy.

R. majalis : It is also known as *R. cinnamomea* and 'Cinnamon Rose'. It is reported from north Europe in 17th century or earlier. Plant growth is upright. Plants have branches with slightly downy greyish-green foliage and mauvish-purple stems. Bloom colour is variable from pale pink to mid pink. Fruits are medium-sized and round.

R. Marretii : It is reported from Middle East in 1908. Shrub is upright growing with purple wood and medium sized, mid-green foliage. Flower colour is mid to pale pink usually in small clusters. Fruits are round, medium size and red in colour.

R. maximowicziana : It is reported from North East Asia in 1905. Plant produces single, white flowers in small spaced clusters, sometimes hidden among soft-textured, serrated foliage. Plant growth is bushy and attains 150cm of height and sparsely spiny stem and many lateral branches on which flowers are produced. It is a rogue hybrid. It is most similar to *R. fedtchenkoana.*

R. Malina : It is reported from North America in 1930. It is a short growing dense shrub with large, soft rose pink flowers. Foliage are greyish- green in colour.

R. x micrugosa : It is reported from Strasbourg Botanical Institute in 1905. Evolved as a hybrid of *R. roxburghii* x *R. rugosa*. It is a dense medium-sized shrub. Foliage is like

rugosa. Blooms are large, delicate, single and pale pink in colour followed by stubbled, round, orange hips.

R. micrugosa alba : Dr. Hurst reports it from U.K., Plant produces very beautiful flowers. Bloom colour is white. Shrub growth is more upright than its parent *R. micrugosa*.

R. mohavensis : It is reported from South America and 1930. It is a short growing, dense shrub with numerous slender stems and an average population of thorns. Leaves are small, mid-green. Flowers are small, mid-to-soft pink. Hips are round and red in colour.

R. moyesii : It is reported from West China and introduced in 1894. Flower colour is deep crimson and foliage is dark green. This combination makes this species very attractive. Fruits make this plant and its hybrid popular. Fruits are produced pendulously, orange red and flagon shaped with five-pointed crown at the bottom that is formed from the retained sepals of the spent flowers. Shrub growth is vigorous. Seeds and seedling are sterile.

***R. moyesii* 'Pink' form** : It is reported from China and its date of origin is unknown. It is similar to most respect to *R. moyesii* except colour of flower, which is, of course, pink. Several variable forms seem to have been distributed, presumably from seedling, of *R. moyesii* or its form, raised deliberately or by chance. Some of the important forms and hybrids are Eddie's Crimson, Eddie's Jewel, Eos, Fred Streeter, Geranium, High Downensis and Hillieri. These are mostly reported from various regions of the world viz. USA, UK and Canada.

R. fargesii : It is reported from U.K., by Veitch in 1913. It is very similar to stature to *R. moyesii* but slightly less vigorous. Blooms are pinker than red and foliage are smaller. Hips are of the same shape but are usually larger and perhaps fewer.

R. holodonta : It is reported from China in 1908. Blooms appear in small cluster on an upright growing well-armed plant. Flower colour is glowing pink. Hips are pendulous and flagon shaped. Its important forms and hybrids are 'Marguerite Hilling' (Nevada sport), 'Nevada', 'Sealing Wax' and 'Wintoniensis'.

R. multibracteata : It is reported from China in 1908. It is an elegant shrub. Stem is thick with numerous, spiky thorn, usually produced with fern like leaves, borne in pair. Blooms appear in bunches or small cluster often at the end of arching shoots. Flower colour is lilac pink.

Cerise Bouquet : It is an important hybrid of *R. multibracteata* reported from Germany by Kordes in 1958. Plant produces double flowers in profusion on long arching branches. Foliage are dense and their colour is greyish green.

R. murielae : It is reported from West China in 1904. It is a rare medium growing, widish, shrub with the stem of red-brown, mid-green to greyish foliage. Plant has white flowers in small corymbs. Hips are small flagon shaped and a bright orange red colour.

R. nutkana : It is reported from North America in 1876. It is a strong growing shrub. Foliage are greyish-green. Stems are strong, relatively thornless, nut-brown stems. Blooms are single clear lilac-pink with a touch of lilac, followed by smooth, rounded fruits untouched by birds well into winters. *R. nutkana* is an important species and many forms

and hybrids are evolved from it viz. 'Cantab' (*R. nutkana* X Red Letter Day), 'Schoener's Nutkana' (*R. nutkana* x Paul Neyron) are popularly grown. Flowers are Lilac pink and Pink in colour with five petals and reported from U.K., in 1939 by Hurst and USA by Schoener in 1930 respectively.

R. x paulii : It is reported in 1903 and also known as *R. rugosa repens alba* thought to be evolved as hybrid of *R. arvensis X R. rugosa.* Plant growth is prostate almost creeping shrub with, thick, thorny growth and coarse, leathery, dark green foliage. Blooms are single with five long, well-spaced, pure white petals.

R. x paulii rosea : It is reported in 1910 and its origin is unknown. It is possibly sport of *R. pauli.* Morphology of the plant is similar to *R. paulii* but with slightly darker wood and foliage. Flower colour is clear rose pink. Blooms are single, with petals more closely arranged than in the white form.

R. pendulina : It is also known as *R. alpina* and 'Alpine Rose'. It is reported from Europe in 1700. Plant growth is arching, reddish purple stems form a short, slightly spreading, almost thornless bush. Foliage is dark green and varies in shape from elongated to oval and in size from small to medium large. Blooms are single, deep pink and have pronounced yellow stamens. Hips are elongated, handsome and plum shape.

R. pisocarpa : It is reported from North America in 1882. It is a medium size shrub with a dense, slightly procumbent habit. Plant has plentiful smallish leaves and shoots, covered in spines. Blooms appear in small clusters. Flower is single and lilac pink in colour. Fruits are small, round sometimes slightly elongated and bright red in colour.

R. prattii : It is reported from China in 1908. It is an almost thornless, short to medium shrub with purple stems. Thorns that exist are yellow. Foliage colour is greyish-green. Bloom colour is pink. Flower appears in small corymbs, followed by small, oval whiskery fruits. It is a medium growing, widish, shrub with the stem of red.

R. pyrifera : It is reported from west USA in 1931. It is a short to medium, quite dense shrub. It is very similar to the better-known *R. woodsii* in many ways. Blooms are white usually appear in corymbs. Hips are small and deep red in colour. Fruits are pear shaped.

R. rugosa

R. rugosa :It is reported from Japan and parts of West Asia in 1796. A vigorous thorny shrub, freely sending of long canes. It hybridized with other roses and produced seedlings with minor variations has led to uncertainty as to which form is the true species. All the semi wild forms have lightish to mid green, sometimes wrinkled but always-rough textured foliage. Blooms are scented. Flowers are single and in most clones have prominent, soft yellow stamens, their colour ranging from clear deep pink to deep cerise red. The hips are globular, usually rich red, and variable in size according to clone.

R. rugosa alba : Its garden origin is not known. This species is reported in 1870. This is one of the best forms of *R. rugosa.* It is the most useful garden plant. Blooms are large, pure white and scented. Bush growth is vigorous. Leaves are fine, deeply veined, coarse textured and slightly glossy. Stems are thick, buff greyish and densely populated with small thorn of similar colouring. Fruits are large and tomato red in colour.

R. rugosa rubra :It is also known as *R. rugosa atropurpurea.* It is reported from Japan but its date is unknown. Flowers are large, deep crimson-purple with creamy yellow stamens.

R. rugosa typica : It is reported from Japan in 1976. Shrub is dense and rounded. Its morphology is nearest to the true, wild species. Flowers are single, scented, deep reddish-carmine, followed by bright red, globular hips. It is good for making hedge and frequently used by growers.

Forms and hybrids of *rugosa* are healthy and can grow anywhere and provides flowers throughout the season. They are becoming increasingly popular as subjects for massed planting in parks, as barriers for motorways and as trouble free screen for factories. Some important forms and hybrids of *R. rugosa* viz. Agnes, Belle Poitevine, Blanc Double de Coubert, Carmen, Conrad Ferdinand Meyer, Culverbrae, Delicata, Dr Eckener, Fimbriata, E. J. Grootendorst, Frau Dagmar Hartopp, Grootendorst Supreme, Hansa, Hunter, Lady Curzon, Martin Frobisher, Marry Manners, Max Graf, Mme Georges Bruant, Mrs Anthony Waterer, New Century, Nova Zembla, Nyveldt's White, Perfum de l'Hay, Pink Grootendorst, Robusta, Rose a'Parfum de l'Hay, Roseraie de l' Hay, Ruskin, Sarah Van Fleet, Scabrosa, Schneelicht, Schneezwerg, Souvenir de Philemon Cochet, Steela Polaris, Therse Bugnet, Vanguard, White Grootendorst, *R. sertata, R. setipoda, R. spaldingii, R. suffulta, R. sweginzowii macrocarpa, R. ultramontane, R. wardii, R. webbiana, R. willmottiae* and *R. woodsii fendleri.* Some of the most important hybrids of *R. rugosa* are described below :

Agnes : It is evolved, as a hybrid from *R. rugosa* x *R. foetida persana.* Plant growth is bushy. Plant is dense with dark green, rather crinkled foliage. Stem is thorny. Flowers are fully double and highly scented. Bloom colour is amber yellow fading to white (Saunders, Canada, 1922).

Culverbrae : It is evolved, as a hybrid from Scabrosa x *Francine.* Blooms are very full. Flowers are crimson purple appear on well-foliated bushy plant. Blooms are well scented. It is a useful variety due to its attractive flower size (Gobbee, U.K., 1973).

Hunter : It is evolved, as a hybrid from *R. rugosa rubra* x "Independence". Blooms are double and scented. Flower colour is bright crimson. Plant growth is bushy and its size is medium. Foliage is dark green in colour. It is a very useful rose (Mattock, U.K., 1961).

Martin Frobisher : It is a seedling of Schneezwerg. Flowers are shapely, double and soft pink in colour. Blooms are well scented. Foliage colour is dark green. Plant growth is upright and stem is very prickly (Department of Agriculture, Canada, 1968).

Mary Manners : It is evolved, as a bud sport of 'Sarah Van Fleet'. Flower colour is pure white. Blooms are semi double. Bush is thorny with ample, dark green leaves where blooms appear in profusion. Flowers are highly scented. It is a useful rose (Leicester Rose Company, U.K. C 1970).

Robusta : It is evolved, as a hybrid from *R. rugosa* x Seedling. Blooms are large, single and rich scarlet red in colour. Plant growth is robust, strong, dense and thorny. Foliage is dark green in colour. Blooms are scented. Plant makes a very good, impenetrable hedge (Kordes, Germany, 1979).

Scabrosa : Its parentage is unknown. Blooms are large, single, rich silvery-cerise with prominent anthers often accomplished by large, tomato shaped hips, are produced as abundantly as its flowers. Foliage are dark green, thick textured, heavily veined and almost glossy green. Shrub is dense and its growth is upright. Blooms are sweetly scented. It is very good for hedging (Harkness, U.K., 1960).

Vanguard : It is evolved, as a hybrid from *(R. wichuraiana* x *R. rugosa alba) x 'Elder ado'*. It is a vigorous shrub, rather atypically Rugosa, bearing semi double flowers of salmon burnished bronze. Blooms are very fragrant. Plant growth is upright. Plant has glossy brushed leaves (Stevens, USA, 1932).

Souvenir de Docteur Jamin : Evolved as a seedling of 'Charles I,efebvre'. This rose variety is superb and need care and perform better if kept away from scorching sun. Flowers are rich ruby red. Blooms are semi double. open to a cupped shaped and sometimes showing off their anthers. Stems are relatively thorn less with dark green foliage. Flowers are scented (Lacharme, France, 1865).

Spencer : This variety of rose is evolved as a bud sport of 'Merveille de Lyon'. Flowers are fully double, opening flat from globular buds. Flower colour is soft satin pink with paler, almost white reverse. Plant growth is vigorous with dark green foliage (W. Paul. U.K., 1892).

Surpassing Beauty : I his variety of rose is also known as ' Woolverstone Church Rose'. It is an old variety of climbing rose discovered growing at Woolverstone Church, Suffolk. Flower colour is deep red crimson. Blooms are very strongly fragrant. Plant growth is relaxed and vigorous. Date of origin of this variety is unknown. This variety reintroduced by Beales in 1980.

Ulrich Brunner Fils : This variety of rose is also known as 'Ulrich Brunner'. Parentage is confused but probably origin is as a bud sport of 'Paul Nevron'. Flowers are large, plump and initially high centred. Flower colour is rosy carmine lading to pinkish with age. Blooms are sweetly scented. Bush growth is upright with dark green foliage. Sterns have few thorns (Levet, France, 1882).

Vick's Caprice : Originated as a bud sport of"nrchiduchesse Elizabeth d' Autriche'. Blooms are large, double, cupped with high centred opelr ing loosely but attractively. Flower colour is combination of pale pink with lilac and white, flecked with striped deeper pink. Foliage is large, attractive with light green colour. Stems have few thorns (Vicks, USA, 1891).

Victor Verdier : Originated as a hybrid from cross between 'Jules Margottin' X 'Safrano'. Blooms arc large and fully double. Flower colour is pink, held on strong neck. Blooms have good perfume. Stern is strong and healthy with dark green foliage (Lacharme, France 1859).

Xavier Olibo : Originated as a bud sport of 'General Jacqueminol'. All the morphological characters are similar to its parent but its colour is a much darker red ((Lacharme, France, 1865).

Yolande d' Aragon : Parentage is unknown. Blooms are flat and double. Flower

colour is bright purplish to rich pink. Blooms are scented. Shrub is good and healthy. Stern is strong and upright with light green foliage (Vibert, France, 1843).

White Grootendorst : It is evolved as a bud sport from 'Pink Grootendorst'. All the morphological characters are similar to its originator except the white flowers and lighter green foliage (Eddy, USA, 1962).

R. sertata : It is reported from West China in 1904. It is a loose shrub with thinnish, arching, brownish branches with few thorns and greyish-green leaves. Blooms are deep pink. Flowers appear in small clusters followed by small, narrowly oval, dark red hips.

R. setipoda : It is reported from Central China in 1895. It is a medium sized, shrub with thick stems and well-spaced thorns. Plant has scented foliage noticeable only when crushed. Exquisite flowers, produced in large clusters clear pink, single and quite big, with yellow stamens. Flower stalks are strangely purple. Hips are pendulous, plump, flagon shaped, bristly, and deep red in colour.

R. spaldingii : It is reported from North America in 1915. It is a medium sized shrub with yellowish green stem and soft greyish-green foliage. Blooms are pink and slightly crinkled when fully open. It blooms shyly. Fruits are small, round and red in colour.

R. suffulta : It is reported from North America by Greene in 1880. A bloom appears in clusters. Flowers are single, pink and followed by small orange hips. Plant growth is short and dense with soft grey foliage and thin, spiny stems.

R. sweginzowii macrocarpa : It is reported from North West China. Stems are thick, smooth and light brown in colour. Stems are viciously armed with thorns belie the beauty of this rose. Flowers are numerous, single and bright pink in colour. Hips are large, shiny, plump, flagon-shaped and bright red in colour. Plant is well foliated and rather angular in growth.

R. ultramontane : It is reported from USA in 1888. It is a short to medium shrub with few or no thorns of Consequence. Blooms appear in small to medium size clusters of pink flowers in mid summer. Hips are small, smooth rounded and red in colour.

R. wardii : It is reported from Tibet in 1924. The plant is a medium growing, lax shrub which now appear to be extinct in its native form. *R. wardii culta* was raised at Wesley from seed, from the original forms, and introduced in this name. Blooms are single, white like those of *R. moyesii*, with distinct brownish stigmas and yellow stamens. Shoots are brownish, thorns sparse but sharp. Leaves are bright green.

R. webbiana : It is reported from Himalayas and East Asia in 1879. It is a good shrub with long arching almost trailing, pliable shoots densely packed with small greyish blue foliage and fairly harmless thorns. Blooms are numerous, small and soft pink flowers. A bloom has scent. Hips are small orange red and bottle shaped.

R. willmottiae : It is reported from West China in 1904. It is a superb shrub with arching stem of a darkish plum colour with grey blooms. Leaves are grey-green, fern like which makes a pleasing foil for the small, lilac pink flowers.

R. woodsii fendliers : It is reported from North America. The bush is dense, tall upto 2 m. Foliage is grey. Flowers are soft-pink coloured; hips are large and round, red in colour.

Section VI : *Synstylae*

The section contains an indeterminate number of predominantly white-flowered, diploid climbers and sprawlers. All its members share the easily recognizable "beak" to the hips, derived from the fused column of protruding styles (Allen, 1973).

Plant growth is vigorous and its habit is climbing. It attains height of 2cm to 10m. Thorns are variously sized, curved sometimes sparse in some species. Leaves have 5 to 7 leaflets and in extreme cases it goes upto 9. Blooms are mostly in corymbs or clusters. Styles fused together into a central column. Hips mostly small, oval or round. Sepals drop when hips ripe. In this section there are many species viz. *R. anemoneflora; R. arvensis; R. brunonii; R. x dupontii; R. filipies; R. gentiliana; R. helenae; R. henryi; R. longicuspis; R. luciae; R. moschata; R. moschata nastarana; R. mulliganii; R. multiflora; R. multiflora carnea; R. multiflora cathayensis; R. multiflora grevillii; R. multiflora watsoniana; R. multiflora wilsonii; R. phoenicia; R. polniana; R. sempervirens; R. setigera; R. sinowilsonii; R. soulieana* and *R. wichuraiana.* This section has garden groups, which includes Ayrshire; Hybrid Musk's; floribunda roses (clustered flowered roses); modern shrubs, modern climbers; Polyanthas and Ramblers are included. Descriptions of the species are given below.

R. anemoneflora : It is reported from Eastern China in 1844. It is a climbing rose. Garden form of it has small clusters of double white flowers. In wild forms flowers are single. Outer petals are large and many smaller one in the centre. Plant growth is vigorous with few or no thorns. During colder climate it needs molly coddling.

R. arvensis : Its date of origin is unknown. It is also known as The Field Rose. It is beautiful, pure white single rose with medium-sized flowers and showy olden anthers. 1t is ground-creeper or rambler with dark green stem and foliage and well-spaced thorns. It can be grown for hedgerows especially in southern England. There are many forms and a hybrid of *R. arvensis,* which includes Ayrshire, rose also known as *R. capreolata, R. arvensis ayrshirea* and seems now to be lost to cultivation. Some of the important forms of *R. arvensis* are Ayrshire Queen, Bennett's seedling (Thoresbyana), Dundee Rambler, Dusterlohe, Ruga *(R. ruga),* Splendens (The Myrrh-scented Rose) and Venusta Pendula.

R. brunonii : It is reported from Himalayas in 1823. It is also known as *R. moschata Nepalensis* plant is densely foliated. It is a vigorous climber. Leaves are large and light grey-green in colour. Plant growth is extremely vigorous with hooked thorns. The blooms are single, tissuey in texture. Flower colour is creamish white, which appears in clusters. A hybrid of *R. brunonii* includes La Mortola and *R. x dupontii.*

R. filipes : It is reported from China in 1908. Plant growth is vigorous and it attains height upto 9 meters. It looks like a tree. Flowers are single, white, with golden stamens. A bloom appears in large panicles. Flowers are scented. Foliage is lush light green. Hips are numerous and developed during autumn season. Some of the important hybrids and forms of *R. filipes* are 'Brenda Colvin', 'Kiftgate', and 'Treasure Trove'. It is a climbing rose. Garden form of it has small clusters of double white flowers.

R. gentiliana : It is reported from China in 1907. It is erroneously called as *R. polyantha grandiflora.* Blooms are single to semi-double. Flower colour is creamy white produced in dense, cascading clusters. Plant growth is exceptionally vigorous. It is a

climbing plant. Hips are small and orange in colour. Foliage is dense and light green in colour. Stems and foliage has same colour.

R. helenae : It is reported from China in 1907. It is a vigorous climbing rose well worth its popularity as a climber into small tree. Foliage is large, plentiful and grey-green. Blooms as used single, scented, creamy white and borne in dense corymbs. Hips are small, oval and red in colour.

R. henryi : It is reported from China in 1907. It is a vigorous shrub. It is a small climber with ample almost glossy foliage and large hooked thorns. Blooms are white, appears in dense corymbs. Hips are small, round and dark red.

R. longicuspis : It is reported from China in 1915. It is an evergreen vigorous growing rose with profuse, long, leathery, serrated, dark green foliage. Leaves are reddish pink when young. Blooms are white with pronounced yellow stamens. It is a very floriferous species with huge, cascading panicles of bunched, medium size, single bloom. The strong, wiry stems are excellent in assisting it to achieve great heights into tree. The flowers have little or no scent. Hips are small, oval and orange red in colour. The species grown and sold, as this variety in most modern day catalogues in actually *R. mulliganii.*

R. luciae : It is reported from East Asia in 1880. It is very similar to the better-known and more widely grown *R. wichuraiana.* Shrub is dense spreading with plentiful, almost glossy, dark green leaves. Blooms of medium size appears in cluster. Flower colour is white. Blooms are scented. It is now thought that this species was used to produce many of the hybrid Wichuraiana rambler's of late Victorian and Edwardian times.

R. moschata : It is reported from South Europe and Middle East. It is commonly known as The Musk Rose. Earlier this rose was thought to have become extinct. Available description from botanist and plants man were equally variable. Graham Thomas worked very hard for many years; at last, it seems, with success. It is an ancient variety probably introduced during the reign of Henry VIII. It is a medium to short growing climber with grey-green, slightly drooping foliage. Stems are greyish-green and sparsely populated with hooked thorns. Blooms produced in large spaced clusters. Flowers are cream until fully open and changes to white. Hips are small and oval. This species has a few direct descendants and many more a few generations removed, which are currently growing in our gardens. Genes from *R. moschata* certainly inhabit the chromosomes of many of our modern roses (Beals, 1985). Forms and hybrids of *R. moschata* those known to be available today and which are probably true to have are explained below :

R. moschata floribunda : Its origin and date is unknown. It is a very vigorous, spreading, dense and relatively thornless climber. Leaves are large, long, light green in colour. Large and tightly packed clusters of single, white flowers are produced rather earlier in the season than other Moschata hybrids. Each bloom has an attractive ring of yellow stamens and emits a pleasant musky scent. Hips are oval to round and their colour is orange. This variety is a pleasing, and under-used.

R. moschata grandiflora : Bernaix reported it from France in 1866. It is an extremely vigorous climbing rose with Moschata type foliage. Blooms appear in extremely large

clusters. A flower colour is white and has yellow stamens. Blooms are very fragrant. Hips are round and their colour is orange.

R. moschata nastarana : It is also known as Persian Musk Rose and reported from Asia Minor in 1897. It is possibly hybrid between *R. moschata* and *R. chinensis.* It is very similar in much respect to *R. moschata* but vigorous in growth and with more numerous, small leaves. Flowers although similar in form to those of the species, are slightly touched with pale pink, and can also be fractionally larger in some ideal situations. Some of the important forms of *R. moschata* are Narrow Water, Paul's Himalayan Musk, Paul's Perpetual White (Paul's Single White), Princess of Nassau and The Garland. Most of these forms have white flowers and some of them are very fragrant like 'The Garland'. These forms are reported mostly from U.K., in early 19th century.

R. mulliganii : Forrest reported it from South China in 1917. It is a medium vigorous species with broad, sharp, hooked thorns. It is very similar in much respect to *R. rubra.* Young shoots and foliage are purplish-green which turns greyish-green with age. Blooms are single and appear in small space clusters. Flowers are white and scented. Fruits are small, round, conspicuous and red in colour.

Rosa multiflora : It has played an important role in the development of modern rose. Peter Beal's 1985 opined that *R. multiflora* has had great influence in the development of modern Roses and he further explained that he could almost complete two books of approximately 450 pages with the descriptions of hybrids which have *R. multiflora* somewhere in their lineage. He has placed number of important groups under this heading since this is where they are best placed in the family true of roses. It is reported from East Asia in late 18th early and 19th century. Plant is very floriferous because of its relative short flowering season. Flowers are small, single and creamy white grow in large clusters on wood produced in the previous season. In full flush, they almost obscure the foliage, which are smooth and light green. Stems are smooth and fairly free from thorns. Fruit is small round to oval, smooth and red in colour.

R. multiflora carnea : It is reported from China in 1804. It is a fully double form of *R. multiflora* with stronger shoots and larger leaves. Blooms tend to be globular. Flowers are white faintly tinted pink.

R. multiflora cathayensis : It is reported from China in 1907. It is a pink form of *R. multiflora* with larger flower. Foliage is lighter colour.

R. multitlora grevillei : It is also known as *R. multiflora platyphylla* and 'Seven Sisters Rose'. It is reported from china in 1816. It is a vigorous climbing rose with large, dark green coarse foliage with still, dark green stem. Blooms are dark, quite large and borne in very large tresses. Flower colour varies from deep pink to soft pink with sometimes lilac and even deep red bloom all produced together in the same tune. Blooms are scented. In Victorian times, it was commonly called 'Seven Sisters' derived from the seven different colours to be seen in each tresses of flowers.

R. multiflora watsoniana : This unusual form of *R. multiflora* flora is probably an old garden hybrid. Stem is slim, trailing with small hooked thorns. Leaves are small, narrow and light green with wavy margin. Flowers are small and closely packed in large

panicle. Flower colour ranges from off white to pale pink. Hips are produced in small globular, red and in masses. This variety is more of novelty than a useful garden plant.

R. multiflora wilsonii : It is reported in 1915, but its origin is unknown. Plant is vigorous, moderately thorny and bears almost shiny foliage. A bloom appears in rounded tresses of medium sized. Flowers are produced very freely. Blooms are single and white. Hips are smooth, rounded, small and orange in colour.

Multiflora species hybrids are subdivided in their lineage into their garden groups each with a brief note of introduction as follows : Hybrid Musk, Multiflora Ramblers, Modern Shrubs, Polyanthas, Floribundas and Modern Climbers.

Hybrid Musk

These rose have very long flowering season and hence popularized among the most useful of shrubs. Growth habit is also good. Credits goes to Joseph Pemberton who worked on rose breeding and came up with a complete breakthrough-a distinct strain of long flowering 'Shrub Rose' with substantial flowers borne in clusters and in quantities equal to those of Polyanthas. By crossing *R. moschata* cv. 'Aglaia' and *R. multiflora* cv. 'Trier' with selected Tea's, Hybrid Teas and Hybrid Perpetuals he produced a unique strain, initially known as 'Pemberton Roses'. They are now called as Hybrid Musk. Descriptions of some of the important Hybrid Musk Roses are given below :

Autumn Delight : Parentage is unknown. Flowers are soft, buff-yellow in colour, shapely and developed from deeper colour buds. Blooms are semi double, produced in large tresses on an almost thornless, upright but bushy shrub with dark green, leathery foliage (Bentall, U.K., 1933).

Ballerina : Parentage is unknown. It is an outstanding rose with multi use. Ideal for growing in pots and beds. Spray is huge. Flowers are single and pink in colour with a white centre. Bush is decorated with these delightful blooms throughout the summer in European climate. Bush is upright in growth with plentiful midgreen foliage. Shrub is dense (Bentall, U.K., 1937).

Bishop Darlington : Evolved as a hybrid of 'Aviateur Bleriot' X 'Moon Light'. Flowers are large semi double and creamy white tan pink in colour with yellow base to each petal, and a strong scent. Bush growth is vigorous with mid to dark green foliage (Thomas, USA, 1926).

Buff Beauty : Parentage is unknown. One of the best of this group. Shrub growth is vigorous with spreading habit. Foliage is dark green in colour. Flowers are fully double, opening flat from light, cupped buds and produced in large tresses. Colour varies with the weather and soil type in which they are growing. Flower colour is buff yellow to almost apricot, at time paling to primrose. Flowers are strongly scented (Probably Pamberton, 1939).

Cornelia : Parentage is unknown. A plant has conspicuous bronzy foliage, which is produced on long, dark brownish shoots. The small fully double flowers are produced in large clusters. Flower colour is apricot pink flushed deep pink with paler highlights. Performance is particularly good in the autumn (Pemberton, U.K., 1925).

Danae : Evolved as a hybrid of 'Trier' X'Gloire de Chedane-Guinoisseau'. Blooms appear in clusters of semi double bright yellow colour changing to buff and than to cream with age. Plant growth is healthy, vigorous with dark green foliage. It is a most useful less known Hybrid Musk well worth growing (Pemberton, U.K., 1913).

Day Break : Evolved as a hybrid of 'Trier' X'Liberty'. It has flower rather less than double. Flower colour is paling to primrose, produced on strong stems in medium-sized, well-shaped clusters. Foliage is coppery especially when young. Seldom gets very tall and seldom outgrows. It can be grown and welcome in any gardens (Pemberton, U.K., 1918).

Eva : Evolved as a hybrid of 'Robin Hood' X 'J.C. Jhornton'. Flower appears in tresses of good size, almost single bright carmine to red colour, which pale towards the centre of white. This lesser known variety is well scented. Plant growth is fairly tall. Foliage is dark green (Kordes, Germany, 1938).

Felicia : Evolved as a hybrid of 'Trier' X 'Ophelia'. This rose is among the best of its group. The fully double flowers open rather muddled but even so remain quite a charming mixture of rich pink with salmon shadings. Blooms fade slightly with age, which is an added attraction due to presence of rich pink and pale colour. Leaves are dark green, crisp, slight crinkled at the edges. The bush retains its shape well, making it ideal for specimen planting (Pemberton, U.K., 1928).

Francesca : Evolved as a hybrid of 'Danae'. X 'Sun burst'. Blooms appear in large spray. Flowers are semi double and apricot yellow in colour. A stem is dark and has glossy dark green leaves. It is very useful due to its strong yellow flower colour. It is rare among shrub rose (Pemberton, U.K., 1922).

Kathleen : Evolved as a hybrid of 'Daphne' X 'Perle des Jeannes'. It is a very vigorous rose. Foliage is dark green. Stem colour is greyish green. Flowers are almost single and medium sized. Flower colour is clear pink with deeper shadings (Pemberton, U.K., 1922).

Lavender Lassie : Parentage is unknown. A flower appears on long tresses of beautiful, double and lavender pink colour, opening flat and continued throughout the summer in European conditions. Bush is healthy with dark green foliage. It is an ideal rose, which can fulfill a variety of roles in the modern rose gardens (Kordes, Germany, 1960).

Moonlight : Evolved as a hybrid of "Trier' X'Sulphurea'. Plant growth is vi orous and healthy. Stem is long and covered by leaves. Blooms appear in clusters. Flowers are single and creamy white in colour with pronounced stamens. Blooms are scented (Pemberton, U.K., 1920).

Nur Mahal : Evolved as a hybrid of 'Chateau de Clos Vougeot' X Hybrid Musk Seedling. Flowers appear in large clusters. Blooms are semi double, bright crimson in colour and are well perfumed. It is an interesting rose with its healthy dark foliage (Pemberton, U.K., 1923).

Pax : Evolved as a hybrid of 'Trier' X 'Sun Burst'. Flowers are very large, semi double, creamy white to pure white and have golden stamens. Blooms are produced in large, well-

spaced clusters, which, in turn, are on long, arching stems. Foliage is crisp and dark green in colour. It is a superb rose (Pemberton, U.K., 1918).

Penelope : Evolved as a hybrid of 'Ophelia' X 'Trier'. It is very favourite among the Hybrid Musks. This beautiful rose has large, semi double flowers which, when open, show off to advantage the slightly frilled petal edges. Petals are creamy pink with deeper shadings, especially on frilled edges. Blooms are scented. Foliage is dark green with plum-red shadings likewise the stems (Pemberton, U.K., 1924).

Pink Prosperity : Parentage is unknown. Plants have large tresses of small, clear pink, fully double blooms with deeper shadings. Bush growth is upright which is covered with dark green foliage. Blooms are scented (Belltall, U.K., 1931).

Prosperity : Evolved as a hybrid of 'Marie Jeanne 'X' Perle les Jadines'. Flower is large, double and creamy white. Blooms are produced in large even clusters on strong arching shoots with dark green foliage. Arching effect, caused largely by bending from the weight of blooms, rather than any tendency to sprawl, which adds additional beauty to this cultivar. It is well worth growing (Pemberton, U.K., 1919).

Robin Hood : Evolved as a hybrid seedling X 'Miss Edith Cavell'. A flower of medium size appears in large clusters. Blooms are single, bright scarlet aging to crimson. Foliage is good dark green. Plant growth is tidy and bushy (Pemberton, U.K., 1927).

Sadler's Well's : Evolved as a hybrid of 'Penelope' X`Rose Gaujard'. It is a newest member of this group. It is a fine flowering shrub. Blooms are semi double and slightly scented, produced in large well-spaced clusters on a vigorous but tidy bush. Background colour of the petals are silvery-pink with each petals laced with cherry red, especially at the edges. When cut sprays, last very well in water. Foliage is dark green, glossy and plentiful (Beales, U.K., 1983).

Thisbe : It is evolved as a bud sport of 'Daphne'. Flower colour is Sulphur-Straw. Blooms are semi double, rosettes and borne in large clusters on a bushy, upright shrub. Leaves are glossy and mid green in colour (Pemberton, U.K., 1919).

Vanity : Evolved as a hybrid of 'Chateau de Clos Vougeot' X a Trier seedling. A single flower of considerable size appears in large sprays of rose pink colour. Blooms are fragrant and produced freely. Plant growth is bushy. Shrub growth is angular. Flower density and brightness is good (Pemberton, U.K., 1920).

Wilhelm : It is a hybrid of 'Robin Hood X' J. C. Thornton'. This variety is also known as 'Sky Rocket'. Single flower appear on clusters on stout and strong stem. Flower colour is crimson. It is very useful rose since good red varieties are scare among the Hybrid Musks. Leaves are dark green and healthy. Hips are beautiful and give a good display if not dead-headed (Kordes, Germany, 1944).

Will Scarlet : It is originated as a bud sport of 'Wilhelm'. It is almost identical to 'Wilhelm' except being the brighter red colour of the blooms (Hilling, U.K., 1947).

Multiflora Ramblers

Apple Blossom : Evolved as a hybrid of 'Dawson' x *'R. multiflora'*. Flower colour

is pink with crinkled petals. Blooms appear in huge tresses. Foliage colour is rich green with copper overtones. Wood is similar in colour to its foliage with few or no thorns (Burbank, USA, 1932).

Aglaia : Evolved as a hybrid of *'R. multiflora* 'X *'Reve d or'* and also known as 'Yellow Rambler'. Blooms are small, semi double and pale primrose yellow in colour. Plant growth is upright. Stem is almost thornless. Foliage is rich light green with bronzy tints, especially in young stage. It is very important as one of the rose used initially Pemberton in breeding his race of Hybrid Musks (Schmitt France France, 1896).

Blue Magenta : Its origin and parentage is unknown. The variety is one of the daintiest of flowers. Flower colour is rich deep purple with yellow stamens. Flowers are sweetly scented. Foliage is dark green in colour and plant is thornless.

Blush Rambler : Evolved, as a hybrid of 'Crimson Rambler X 'The Garland'. Plant growth is vigorous. It is almost thornless rose. It was very popular as a cottage rambler in Edwardian days. Blooms are fragrant and their colour is blushing pink. Flowers are borne in cascading clusters. Foliage is plentiful and light green in colour (B.R. Cant, U.K., 1903).

Bobbie James : Parentage is unknown. It is a vigorous climber capable of climbing into trees and hedges. It is considered as one of the best ramblers. Flowers are white, cupped shaped and quite large. Blooms are highly scented and displayed in large, drooping clusters. The leaves are rich green brown and polished. Stems are strong and well equipped with sharp, hooked thorns (Sunningdale Nurseries, U.K., 1961).

Crimson Rambler : Parentage is unknown. It is also known as 'Turner's Crimson', and 'Engineer's Rose'. It is more important as stud rose in the development of ramblers than as garden plants. Blooms are semi double; flowers are crimson in colour and produced in clusters. Leaves are light green. It is disease porne variety and this is the main reason for its disappearance from modern gardens (Japan, 1893).

Dela Grifferaie : Parentage is unknown. Plantgrowth is vigorous. It is extensively used as an understock and found in old gardens. Tresses of spaced, fully double flowers are magenta in colour fading to dingy white. Blooms are well scented and not of great garden value (Vibert, France 1845).

Francis E. Lester : Evolved, as a hybrid of 'Kathleen' x Unnamed seedling . Bloom appears in very large tresses. Flowers are well spaced, good shaped and are of medium sized. Flowers are single, white with splashes of pink on the edges of each petal. It has strong perfume. The shrub growth is vigorous but not overpowering with lush, copperytinted, glossy foliage. Hips are small and red in colour (Lester Rose Gardens, USA, 1946).

Ghislaine de Feligonde : Evolved as a hybrid of 'Goldfinch' x Unknown. It is a small climber. If proper space is given it grows as a large shrub. Blooms are fully double and orange yellow in colour, which appear in very large clusters. Foliage is large, healthy and glossy. The variety is almost thornless (Turbat, France, 1916).

Goldfinch : Evolved, as a hybrid of 'Helene' x Unknown'. Plant growth is less vigorous but very useful when a small ramblers or climber is required. Flowers are small

and cupped. Bloom colour is a mixture of golden yellow and primrose with pronounced golden brown anthers. Blooms look still charming even when fading to cream in hot sun. Stem is almost thornless, greyish-brown in colour and has glossy foliage (W. Paul U.K., 1907).

Hiawatha : Evolved, as a hybrid of *'Crimson Rambler'* and 'Paul's Carmine Pillar'. Blooms are single, deep pink to crimson colour with paler shade almost white centre. Blooms are borne in clusters on a vigorous, free growing plant with light green leaves. is best placed here because of its *multiflora* influence (Walsh, USA, 1904).

Leuchtstern : Evolved, as a hybrid of 'Daniel Lacombe' X'Crimson Rambler'. Blooms appear in clusters of medium size. Flower is single, deep pink centre paling to white. Plant has well mid green foliage. It is a good, shorter rambler (J. C. Schmidt, Germany, 1899).

Madame d' Arblay : Evolved as a hybrid of *'R. multiflora'* x *'R. moschata'*. Blooms appear on drooping clusters. Flowers have flattish-topped yet slightly cupped. Flowers are randomly arranged and shortish petals. Blooms have fragrance. Flower colour is blush pink paling to white. It is a very vigorous climber with darkish green foliage. Now a days it is quite rare (Wills, U.K., 1835).

Madeleine Selzer : Evolved as a hybrid of 'Tausendsehon' X 'Mrs. Aaron Ward'. Blooms are attractive. It is almost thornless rose with bronzy-grey foliage, bearing tresses of fully double scented, lemon to white flowers. Blooms are quite a spectacle when in full flush. It is an excellent medium growing rambler (Walter, France, 1926).

Mrs. F. W. Flight : Evolved as a hybrid of 'Crimson Rambler' X Unknown. Blooms are small, semi double and rose pink in colour. Flowers are borne in large clusters. It is a short to medium growing plant with large, soft mid-green foliage (U.S., 1905).

Paul's Scarlet : Parentage is unknown. Blooms are double and borne in small spaced cluster. Flower colour is bright scarlet. It is considered as one of the biggest and most popular ramblers of its day. Foliage colour is dark green. Stems are relatively thornless (W. Paul U.K., 1916).

Phyllis Bride : Evolved as a hybrid of 'Perle d' Or' X'Gloire de Dijon'. Blooms are small, slightly ragged and borne in large pyramidal clusters. Flowers have mixed colouring including yellow, cream and pink, sometimes deepending with age and becoming mottled. Foliage is plentiful but small in size. Plant growth is vigorous with relatively thorn free. It is a superb and important rose flowering continuously through out the season, perhaps nearer to the Chinensis subgenus than Synstylae (Bide, U.K., 1923).

Rambling Rector : It is a very old variety. Its origin and parentage is unknown. Blooms are borne in large clusters. Flowers are fragrant, semi double, creamy to begin, the opening white to display rich yellow stamens. Flowers are produced in abundance on a vigorous, healthy, scrambling shrub. Plant has plentiful foliage, small grey-green and downy. It is a superb as a tree or a hedgerow climber. It is very useful for covering unsightly areas.

Rose Marie Viaud : It is a seedling of 'Veilchenblau'. Flowers are very double

and produced in small tresses on a vigorous rambler. Bloom colour is rich purple. Plant has light green foliage and relatively thornless. Shoot colour is light green (Igoult, France, 1924).

Russelliana : Its origin is not known. Probably evolved as hybrid between *'R. multiflora'* and *R. setigera'*. It is also known as 'Old Spanish Rose', 'Russell's Cottage Rose', and 'Scarlet Grevillei'. Blooms are very double, small and borne in clusters. Its colour is a mixture of crimson and mild purple, giving an overall red appearance. It is well worthy of garden space. Foliage colour is dark green. Stem is thorny, belying its *multiflora* ancestry (Probably Spain, 1840).

Sea gull : Its country of origin is not known. Evolved as a hybrid of *R. multiflora* x General Jacyueminot. Flowers have double layer of white petal, which surrounds the bright yellow stamens. Blooms are highly scented and borne in large clusters on a vigorous, well-foliated plant that has grey green leaves. Full flush flowering plant is a sight to remember (Pritchard, 1907).

Tausendschon : It is also known as 'Thousand Beauties'. Evolved as a hybrid of cross 'Daniel Lacombe' X 'Weisser Herumstreicher'. Blooms are large, double and borne in loose clusters. Fowers are pink with white towards their centre. Growth is strong with thornless shoot amply clothed with mid-green foliage (W. Paul, U.K., 1906).

Tea Rambler : Evolved as a hybrid of 'Crimson Rambler' X 'Tea Rose'. Flowers are fragrant, double and soft pink in colour with brighter highlights on a vigorous plant with mid-green foliage (W. Paul, U.K., 1904).

Thalia : It is also known as white rambler. It is quite a good rose, not often seen today. Flowers are white, small, double and highly scented and produced profusely in large clusters. Plant growth is vigorous and it is only moderately thorny. Leaves are mid green and mildly glossy (Introduced by P. Lambert Germany, 1895).

Trier : Evolved as a hybrid of 'Aglaia' X 'Unknown' It is an upright growing climber. It is a tall shrub with small, creamy yellow single or nearly single flowers in clusters. Foliages are small almost daintily so. It is used much by the breeder's earlier this century, especially in development Hybrid Musk (P. Lambert, Germany, 1904).

Veilchenblau : Evolved as a hybrid of 'Crimson Rambler X 'Unknown seedling'. It is a vigorous rambler sometimes called 'The Blue Rose'. Plant bears large tresses of small, semi double flowers of lavender-purple occasionally flecked with white, especially in their centre. Blooms mature to bluish lilac and fade to lilac-grey. Blooms are scented. It is an ideal companion for cream and white ramblers, when respective flower can merge to good effect (J.C. Schmidt, Germany, 1908).

Violette : Parentage is unknown. Flowers are very double, cupped and rosette. Bloom colour is rich violet purple with hints of yellow in their base. Blooms are borne in clusters. Flowers are scented. Foliage is rich dark green. Plant growth is vigorous and shoots have few thorns (Turbat, France, 1921).

White Flight : Origin, date and parentage is unknown. It is perhaps a sport of 'Mrs. W. Flight' Plant growth is less vigorous than most of its type. Inflorescence appears as

huge corymbs of small, single, pure white flowers amid an abundance of smallish, light green foliage. Plant growth is thin, wiry and yet dense.

Modern Shrub Roses

Present day increasing demand for shrub roses all over the globe, has prompted breeder to produce and introduce many and varied tall varieties, all with long flowering seasons. This group also includes modern climbers, small climbers and excellent shrub. Pillar rose are also member of this category. Some of these cultivars make a very good hedging rose. Descriptions of some of the important members are given below :

Alexander : Evolved as a hybrid of 'Super Star' x ('Ann Elizabeth' X 'All Gold'). Buds are shapely, pointed, and open to large, slightly ragged flowers of a very bright luminous, vermilion, displaying creamy yellow stamens to good effect. Foliage is healthy and rich green. Plant growth is upright with strong thorny stems (Harkness, U.K., 1972).

Angelina : Evolved as a hybrid of ('Super Stars' X `Carina') X (`Clare Grammer Strof' X `Fruhlingsmorgen'). It is extremely free flowering shrub rose. Blooms are large fragrant, slightly fuller than single. Flower colour is bright rose pink. Flowers are produced in large clusters on upright stems with dark green foliage (Cocker, U.K., 1976).

Anna Zinkeesen : This shrubby rose has good mid-green foliage. Flowers are fully double. Bloom colour is ivory-white with golden yellow tones in the base. Blooms are borne in clusters. Blooms have distinctive perfume (Harkness, U.K., 1983).

Berlin : Evolved as a hybrid 'Eva' X `Peace'. Blooms are large, single, bright, rich red, paling towards the centre to white. Stamens are pronounced and yellow. Plant growth is upright and tall. Foliage is dark green and crisp. The young wood especially is dark, with lots of thorns (Kordes, Germany, 1949).

Bonica : Parentage is unknown. Blooms are double and attractive due to frilled petals. Flower colour is delicate pink with deeper centres. Stem is arching. Foliage is copperylight green and glossy (Meilland, France, 1984).

Bonn : Evolved as a hybrid of"Hamburg' X'lndependence'. Blooms are freely produced. Flowers are semi double. Bloom colour is orange-red fading rather with age. Plant growth is vigorous and upright. Bush has rich dark green foliage (Kordes, Germany, 1950).

Butterfly Wing : Evolved as a hybrid of 'Dainty Maid' X 'Peace'. It is a beautiful rose with large, refined, single flower of blush-white with touches of red around their edges. Foliage is dark-green. Plant is not over tall (Gob bee, U.K., 1976).

Cardinal Hume : Evolved as a hybrid of ('Lilac Charm' X `Sterling Silver'). x ('Orangeade' X 'Lilac Charm') X ('Orange Sensation' X `All Gold') X *R. californica* X 'Frank Naylor'. It is a most unusual rose. Flower colour is rich tyrian purple. Flowers are double, made up of many narrow petals, and borne in clusters, which remains close to the plant. Foliage is plentiful and dark green (Harkness, U.K., 1984).

Cocktail : Evolved as a hybrid of ('Independence' X Orange Triumph) X `Phyllis Bide'. It is a bright rose with clusters of burnished red petals arranged in single flowers

each with yellow centre. The red colour of the bloom intensifies with age. Plant growth is thorny and upright. Plant has much deep green foliage, which is deeply serrated (Meilland, France, 1959).

Copenhagen : Evolved as a hybrid of 'Seedling' X'Ena Harkness'. Blooms appear in clusters on an upright plant with good, bronze foliage. It can also be used in making a good, short-growing climber (Paulsen, Denmark, 1964).

Dorothy Wheatcroft : Parentage is unknown. Blooms are large, semi double, bright red flowers. Petals are slightly crimpled on their outer edges. These are borne in large clusters on a vigorous, well-foliated thorny shrub (Tantau, Germany, 1960).

Elm Shorn : Evolved as a hybrid of 'Hamburg' X 'Verdun'. Flower appears in large cluster. Blooms are small, double and vivid pink in colour. Bush growth is vigorous. Plant has abundant, slightly crinkled, dark greyish-green foliage. It is very good, free flowering shrub rose which is deservedly popular (Kordes, Germany, 1951).

Fountain : Its parentage is unknown. Flower appears in large cluster on a medium growth. Shrub with thick, dark green foliage. It is a good healthy variety. Blooms are sizable. Flower colour is blood red (Tantau, Germany, 1972).

Fred Loads : Evolved as a hybrid of 'Dorothy Wheatcroft' X'Orange Sensation'. Plant growth is vigorous and upright. Blooms are large, almost single blooms in large impressive tresses. Flower colour is rich bright salmon pink (Holmes, U.K., 1968).

Graham Thomas : Evolved as a hybrid of ('Seedling' X'Charles Austin') X ('Seedling' X 'Iceberg'). Blooms are fully double old-fashioned type. Flowers are cupped and rich yellow in colour. Plant growth is vigorous, slightly arching with good foliage. Blooms are scented (Austin, U.K., 1983).

Grand Master : Evolved as a hybrid of 'Sanger Hausen' X 'Sunmist'. Buds are pointed. Blooms are large, semi double and their colours are apricot pink with lemon shading. Blooms have scent. Plant growth is bushy. Foliage is light green. (Kordes, Germany, 1954).

Heidelberg : Evolved as a hybrid of 'World's Fair' X'Floradora'. It is a very bright rose. Flower colour is crimson scarlet splashed deep orange. Blooms are fully double and produced in large tresses. Foliage is dark green and tough looking (Kordes, Germany, 1958).

Heritage : Blooms are double and of medium size. Flowers are cupped and pure blush-pink. A beautiful rose with superb but unusual scent described by its raiser as reminiscent of lemon. Bush growth is robust with healthy foliage. It blooms throughout the summer (Austin, U.K., 1982).

Hero : Flowers are large, cupped and bright pink in colour. Blooms are fragrant. Flowers are of old-fashioned style and produced on a strong-growing open shrub (Austin, U.K., 1984).

Joseph's Coat : Evolved as a hybrid of 'Buccaneer' X 'Circus'. Variety is often listed as a climber. Its performance is better as a free standing shrub or at most, a pillar rose.

Loosely formed flowers from shapely buds; borne in large tresses. Plant growth is upright with light green, glossy foliage (Armstrong & Swim U.S.A., 1964).

Kassel : Evolved as a hybrid of 'Obergartner Wiebicke' X 'Independence'. Flowers are double, appear on strong stem. The tresses of closely spaced, blooms looks very attractive. Flowers are orange scarlet, turns with age to bright red. Foliage texture is leathery and their surface is slightly glossy. Plant growth is bushy and upright. Stem colour is brown red (Kordes, Germany, 1957).

Kathleen Ferrier : Evolved as a hybrid of 'Gartenstolz' X 'Shot Silk'. Flowers are semidouble, rich salmon pink in colour appear in small clusters. Plant growth is vigorous and upright. Foliage is dark green and their surface is glossy (Buisman, Holland, 1952).

La Sevillana : Its parentage is not known. Plant growth is very healthy. . Blooms are abundant and their colour is rich red. Flowers are semi double and hold their colour well, even in hot sun. Foliage is dark green (Meilland, France, 1982).

Lady Sonia : Evolved as a hybrid of 'Grand Master' X 'Dorean'. Variety is free flowering with semi double flowers. Bloom colour is deep golden yellow. Buds are shapely and well formed when open. Foliage is dark green and their texture is leathery. Plant growth is upright (Mattock, U.K., 1961).

Magenta : Evolved as a hybrid of 'Yellow Floribundas Seedling' X 'Lavender Pinocchio'. It is a moderately vigorous shrub. Blooms are double. Flowers are of unusual shades, purple with pink and lilac highlights, opening flat. Blooms are of old fashioned and produced in large clusters. Foliage is darkgreen and its growth is bushy (Kordes, Germany 1954).

Marchenland : Evolved as a hybrid of 'Swantje' X `Hamburg'. Plant produces very large tresses of well -spaced, almost single flowers that are bright pink with deep shadings. Variety is free flowering. Foliage is dark green and slightly glossy and plentiful. Plant growth is bushy and upright (Tantau, Germany, 1951).

Marjorie Fair : Evolved as a hybrid of 'Ballerina' X 'Baby Faurax'. It is a good, shorter shrub rose, bred from 'Ballerina' which could perhaps be included among the Hyrid Musks. Booms are produced in large tresses. Flowers are small, single and red with pinkish-white eye. Foliage are plentiful and mid green. Plant growth is bushy and tidy (Harkness, U.K., 1978).

Mary Rose : Evolved as a hybrid of 'Seedling' X 'The Friar'. Blooms are large, flesh to rose pink appear in old-fashioned-mould. Flowers are highly scented. Bush is robust and twiggy, with ample foliage (Austin, U.K., 1983).

Nymphenburg : Evolved as a hybrid of 'Sangerhausen' X `Sunmist'. Shrub growth is vigorous and upright. It is a good pillar rose. Flowers are semi double. Bloom colour is salmon pink with lemon and deeper pink highlights. It is a very free flowering variety. Foliage is dark green and glossy (Kordes, Germany 1954).

Parkjuwel : It is also known as 'Park Jewel'. Evolved as a hybrid of 'Independence' x 'A Red Moss Rose'. Shrub growth is vigorous. Foliage is leathery. Flowers are large, very double, globular and light soft pink (Kordes, Germany, 1956).

Poulsen's Park Rose : Poulsen reported from Denmark. Evolved as a hybrid of 'Great Western' X 'Karen Poulsen'. It is an outstanding shrub. Plant growth is vigorous and dense. Silvery pink blooms appear in large shapely tresses. Foliage is dark green.

Rachel Bowes Lyon : Evolved as a hybrid of 'Kim' X ('Orange Sensation x 'All Gold') x '*R. californica*'. Blooms are semi double, peachy-pink flowers of medium size develop in large clusters on medium tall but bushy, well-foliated plants (Harkness, U.K., 1981).

Radway Sunrise : It is a seedling of 'Masquerade'. The shrub is striking and moderately vigorous in growth. It bears clusters of single flowers. These are mixture of flame, cerise-pink and yellow. The colours are very attractive suffused to give the general effects of glowing warmth, eye catching but not gaudy. Foliage is dark green and glossy (Waterhouse Nurseries, U.K., 1962).

Roundelay : It is a striking, moderately vigorous shrub bearing clusters of single flowers. Evolved as a hybrid of 'Charlotte Armstrong' X 'Florida'. Plant growth is upright. It is a free flowering shrub with large tresses of cardinal red flowers. Blooms are fully double and opening to flat. It has good perfume. Foliage is healthy and dark green (Swim, U.S.A., 1953).

Sally Holmes : Evolved as a hybrid of 'Ivory Fashion' X 'Ballerina'. Plant growth is upright. It is a short growing rose, very near to Floribunda-type rose with good foliage. Blooms are in the form of tresses of single flowers of soft, which are pale pink to white (Holmes, U.K., 1976).

Sparrieshoop : Evolved as a hybrid of ('Baby Chateau' X 'Else Poulsen') X'Magnifica'. Plant has pointed buds. Blooms are large. Flower colour is pale pink. Flowers are borne in tresses but sometimes singly. Plant growth is upright and bushy and they posses healthy foliage (Kordes, Germany, 1953).

Uncle Walter : Evolved as a hybrid of 'Detroiter' X`Heidelberg'. Flowers are Hybrid Tea shaped, borne in clusters and opening to an attractively middle shape. Flower colour is bright red. Foliage colour is dark green. It is often listed as Hybrid Tea, but it is too much vigorous and is better placed amongst shrub roses (McGredy. K., 1963).

White Spray : Evolved as a hybrid of 'Seedling' x 'Ice Berg'. It is a superb white rose. Shrub is of accommodating size with good mid green foliage. Flower colour is white to cream, fully double, shapely and produced in large clusters on a bushy plant (Le Grice, U.K., 1974).

Wife of Bath : Evolved as a hybrid of ('Mme Carolin Test out' X `Ma Perkins') x `Constance Spry'. It is a shorter growing small shrub with ample foliage. Blooms are fully double, old-fashioned type and warm rich pink. One of a range of very interesting rose bred by David Austin by crossing older roses with modern Hybrid Teas and Floribundas (Austin, U.K., 1969).

Yesterday : Evolved as a hybrid of ('Phyllis Bide' X 'Shepherd's Delight') X 'Ballerina'. A flower appears in mass. Blooms are small, almost single and rich pinky-purple in colour. Blooms are slightly scented. A bloom appears in large tresses on a sturdy, rather spreading bush (Harkness, U.K., 1974).

R. phoenicia : It is reported from Middle East in 1885. Plant growth is vigorous. It is a slender growing climber with few thorns. Leaves are greyish green. Flowers appear in large corymbs. Blooms are white. Hips are small, round and dark red in colour. Species has a particular liking for dry, sandy soils.

R. polliniana : It is reported from Central Europe in 1880. Flowers are single and blushpink in colour. Plant growth is sprawly with dark green stems and foliage. The stem is moderately thorny.

R. rubus : It is also known as Blackberry rose. It is a vigorous climber with numerous thorns. A stem is greenish-purple in colour and has glossy dark green foliage. Young shoots are a clear purplish-red. Blooms are white and fragrant. A flower appears in large clusters. Hips are small round and red in colour.

R. sempervirens : These were known as evergreen roses in Victorian days. They do retain their lush foliage in most winters. It is reported from South Europe in 17th century. Flowers are white and have fragrance. Blooms are single and produced in small clusters on a very-vigorous plant. Foliage is mid to dark green. Fruits are small and orange red in colour. Some of the important forms and hybrids are Adelaide d'Orleans, Felicite et Perpetue, Flora, Princesse Marie and Spectabilis. Jacques reported most of them from France between 1826 to 1929 and their parentage is unknown. Flower colour ranges from creamy white to powder pink. 'Adelaide d'Orleans', and Felicite et Perpetue and Spectabilis are evergreen climber while 'Flora' has a refined perfume.

R. setigera : It is reported from North America in 1810. It is also known as The Prairie Rose. It is a trailing but shrubby species with lightish green foliage and long arching branches. Flowers are single and produced in clusters. Bloom colour is pink paling to soft pinkish white. Hips are small, globular and red in colour. Some of the important hybrids and forms of *R. setigera* are 'Baltimore Belle', 'Doublooms', 'Erinnerurg a Brod', 'Jea Lafitte' and 'Long John Silver'.

R. sinowilsonii : It is reported from China in 1904. It is a large climbing rose with superb, glossy, heavily veined foliage. Blooms are single, large white and produced in flat tresses. Fruits are small and red in colour.

Wedding Day Climber : It is evolved as a hybrid of *'R. sinowilsonii'* X 'Unknown'. It is an outstanding rose with bright green, glossy foliage and clear green, relatively thornless wood. Blooms are large compared with other such rose. Flowers are single with prominent yellow stamens. Blooms are produced in large tresses. Plant growth is rampant. (Stern, U.K., 1950).

R. soulieana : It is reported from China in 1896. Plant growth is vigorous. Shrubs have thin, arching branches, which bears grey-green, rather fluffy foliage and numerous small spines. Flowers are single and white, produced in tresses. Hips are produced in bunches. Fruit is oval and orange red in colour. There are three important hybrids viz. 'Kew Rambler', 'Ohio' and 'Wick war' that are popularly grown. Flower colour of these varies from pink to red and they are reporter from U.K. and USA.

R. wichuraiana : It is reported from China in 1860. It is an almost evergreen species,

making a dense, procumbent shrub or climber. Foliage colour is dark and glossy. Shoots are dark and pliable. Blooms are single, white, profusely produced, somewhat late. Hips are small, oval and dark red in colour, are much enjoyed by the birds. It has contributed much to the modern roses, being directly or indirectly responsible for many ramblers and climbers, especially those with glossy foliage. There are many hybrids and forms of *R. wichuraiana* Viz. Alberic Barbier, Albertine, Alexander Girault, Alida Lovett, Amethyst, American Pillar, Auguste Gervais, Aviateur Bieriot, Breeze Hill, Chaplin's Pink, Chaplin's Pink Companion, Crimson Shower's, Debutante, Dorothy Perkins, Dr. W. Van Fleet, Easleas Golden Rambler, Elegance, Emily Gray, Ethel, Evangeline, Excelsa, Francois Juranville, Fraulein Etavia Hesse, Gardenia, Gerbe Rose, Golden Glow, Jersey Beauty, Lcontine Gervais, Marry Wallace, May Queen, Minnehaha, Mme Alice, Garnier, New Dawn, Paul Transon, Purity, Rene Andre, Sanders White and Thelma. Most of these forms have been reported from USA, UK, France and evolved as a hybrid. In one case parent is unknown i. e. Excelsa. Flower colour ranges from pink, yellow and white. In all the cases bloom shape is good and it ranges from semi double to double. Plant habit is climbing. The oldest one is Mary Queen 1898 followed by Jersey Beauty reported from USA by Manda in 1899.

Section VII : Indicae (Chinensis)

Stipules are joined to the base of the leaf-stem (petiole) for more than half their length. Styles are protruding from the mouth of the corolla tube. Styles are free from each other.

Rosa chinensis

It is also known as *R. indica, R. sinica* and *R. nankiniensis* and popularly known as China Rose, Bengal Rose etc. Plant growth is very variable. It is usually upright. Plants attain height upto 7meters. Thorn is usually hooked. Foliage has 5-7 leaflets. Blooms appear in clusters. Hip shape is mostly rounded. Sepals drop in ripe stage. The name given to the species thought to have been the parent of wide and varied Chinese hybrids, which reached to Europe by way of India in the early eighteen century. Erratic height and colour variations are the characteristic of several China hybrids. The species dose have chameleon like qualities. All the China roses as stated elsewhere have played a major part in the evolution of modern rose. The main species which are described here, are *R. x borboniana, R. x odorata and R. gigantea.* There are many forms and hybrids of *R. chinensis* viz. Anna-Mariade, Mont Ravel, Arethusa, Bloomfield Abundance, Beauty of Rosemawr, Brennus, Cecile Brunner, Cecile Brunner Climber, Cecile Brunner White, Comtesse Du Cayla, Cramoisi Superieur, Cramoisi Superieur Climber, Duke of York, Fabvier, Fellemberg, Gloiredes Rosomanes, Grussan Teplitz, Hermosa, Irene Watts, Le Vesure, L Ouche, Louise Philippe, Louis XIV, Minima, Miss Awe's Rose, Mme Laurette Messimy, Mutabilis, Old Bush, Papa Herm Ray, Papillion, Perled'or, Pomponde Paris Climber, Pomponde Paris Dwarf Form, Pumila Roulettii, Slater's Crimson China, Sophie's Perpetual and Viridiflora.

The various garden groups which are categorized under this section are China, Tea, Noisette, Bourbon, Hybrid Perpetual, Hybrid Tea (Large flowered roses), Climbing hybrid Tea (large flowered/climbers). Some of the very important and interesting forms and hybrids of *R. chinensis* have been described here.

Cecile Brunner : This variety of rose is also known as 'The Sweet Heart Rose', 'Mignon' and 'Maltese Rose'. It is raised as a hybrid of a Polyantha rose x Mme d Tarta." It is one of the most charming rose. Flower colour is shell pink. Blooms are distinctly scented. Plant growth is short (Pernet-Ducher, 1881).

Cecile Brunner Climber : This variety of rose evolved as a bud sport of Cecile Brunner. It is a very vigorous climber. Plant has dark green foliage. Blooms are freely produced and sometimes covered under dense foliage. Ideal for growing on support of a tree or on unsightly building (Hopp, USA, 1904).

Cecile Brunner White : This variety of rose evolved as a bud sport of Cecile Brunner. It has same attributes and faults as its parent. Blooms are white with hints of yellow and peach. It is quite rare now a days (Fauque, France, 1909).

Cramoisi Superieur Climber : It is a bud sport of 'Cramoisi Superieur'. It is in bush form and makes an extremely good, healthy climber and is well worth a prominent position since few red climber retain their colour so well, even in hot sun (Couturier, France, 1885).

Grüssan Teplitz : It is a complex hybrid evolved as hybrid of (Sir Joseph Paxton x Fellemberg) x (Papa Gontier x Gloire de Rosomanes). It is very difficult to classify. It has enough China characteristics. Blooms are shapely and have crimson colour deepening with age. Flowers are borne in loose clusters but sometimes individually. Foliage is light green. It is used successfully as a small climber. It makes a good hedge (Geschwind, Hungary, 1897).

Irene Watts : Its parentage is unknown. It is very free flowering little rose. Blooms are peachy-pink with hints of salmon. Buds are pointed, opening loosely flat. Foliage is dark green margined with purple. It makes an ideal bedding rose (Guillot, France).

Louis XIV : Its parentage is unknown. Flower colour is deep carmine. Blooms are semi double with attractive golden stamen in full bloom stage. Flowers have fragrance. The variety is relatively thornless (Guillot Files, France, 1859).

Minima : It is also known as *R. Chinensis minima.* "Miss Lawrence's Rose" and "Fairy Rose". Blooms are single and softy creamy pink in colour. Petals are pointed well -spaced. Tips of the petals are slightly deeper coloured. Growth habit is dwarf and spreading. Plants have ample small leaves and few thorns (China, 1815).

Mme Lauretle Messimy : This variety of rose is one of the best hybrid Chinas and evolved as a hybrid of "Rival de Paestum" x "Mme Falcot". Blooms are semi double, bright pink pondering on salmon. Each petal suffused yellow at its base. Shrub is fairly tall. Plant growth is bushy and upright. Leaves are glossy and greyish green in colour. Variety is good for bedding (Guillot, France, 1887).

Mutabilis : It is known as 'Tipo Ideale' and thought by some to be a species and named as *R. turkistanica.* This rose is probably an old Chinese garden hybrid with characteristically mysterious origins. It is an interesting and useful garden shrub, which has a well-developed sense of humor. Plant attains height of 1. 8 m. Blooms are produced continuously. Flowers are single and their colour is honey-yellow, orange and red. Fully open flowers looks like a butterfly. Plant growth is extremely healthy (China, 1932).

Papillon : Parentage is unknown. It is a vigorous growing angular shrub. Flowers are semi double with roughly arranged triangular petals often stand up charmingly like butterfly wings. Flower colour is predominantly shrimp-pink with copper and yellow reflections from a deeper base. Foliage deep green and coppery (France, 1900).

Rouletii : It is discovered in Switzerland and, often acquired history including almost total extinction, eventually became a parent to a race of miniature roses. It is a tiny shrub almost evergreen with small thorn. Flower is fully double. Blooms are clear pink and borne upright in clusters. (Correvon, Switzerland, 1922).

Slater's Crimson China : This variety is known as 'Semperflorens' and 'Old Crimson China'. It is discovered in China. Plant growth is medium to short. Bush has good branching habit with darkish green foliage and sparse broad, flattish thorns. Flowers are semi-double with crimson to red colour petals. Central petals sometimes slightly streaked with white. It is good as a small wall plant (Slater, U.K., 1792).

Viridiflora : It is popularly known as *R. viridiflora* among the rose growers. Its origin and parentage is unknown. This variety is also known as green rose. It is strange and novel rose and easy to grow. Flowers are formed by a multitude of green and brown bracts with no petals in the accepted sense. These are produced quietly, freely, making this rose useful for the flower arrangers collection, especially as they change to purplish-brown with age (China, 1833).

TEA ROSE

Tea roses were very popular garden roses during the latter half of the 19th century. Many popular varieties have now become extinct. Some of them have survived. Beauty of roses lies especially in the high-centred rose. They give excellent performance under glass and for growing in tubs and urns. Lightly pruned plants give best performance. The climbing forms are best felt unpruned.

Adam : Parentage of this cultivar is unknown. Blooms are fully double and large in size. Flower colour is amber and apricot with the tints of pink deep in the centre. The fully open blooms are often quartered. It is said to be the first of the Tea Rose. Bush is vigorous and its growth is better as climber on a stout wall. Foliage is dark green in colour (Adam U.K., 1883).

Anna Oliver : Parentage of this cultivar is unknown. Flower colour is a mixture of flesh pink and deep rose. Blooms have fragrance. Flowers are high centred and shapely. Plant growth is vigorous. Bush has branches with good mid-green foliage (Ducher, France, 1872).

Archidue Joseph : It is a seedling of 'Mme Lombard'. Considered as one of the outstanding Tea Roses. Flowers have many petals and opening is flat. Bloom colour is a mixture of pink, purple, orange and russet with tints of gold and yellow in the centre. Foliage is dark, glossy and abundant. Stem has little thorn. Plant can be used both as a shrub and small climber (G. Nabonnand, France, 1872).

Baronne Henritte de Snoy : This cultivar of rose is a hybrid of 'Gloire Dijon x Mme Lombard'. Blooms are scented. Flower colour is flesh pink with a deeper reverse. Buds

are highly centred and open into double form of flowers. The bush is somewhat angular. Leaves are large and mid-green (Bernaix, A. France, 1897).

Belle Lyonnaise : Parentage of this cultivar is unknown. It is a climbing Tea Rose good for warm climate and sheltered garden. Plant growth is vigorous. Blooms are scented and large in size. Flowers are full, flat, quartered and soft yellow fading to creamy white with age (Levet, France, 1870).

Bon Silene : Parentage of this cultivar is unknown. Flowers are fragrant, fully, double and deep orange red. Blooms are produced in profusion on compact and vigorous growing plant. Stem is moderately thorny with mid-green foliage (Hardy, France, 1839).

Catharine Mermet : Parentage of this cultivar is unknown. Blooms are shapely. Buds are high-centred open into semi double, Lilac-purple flowers appear on longish stems. Bush is healthy with well-foliated mid-green coppery tinged leaves. It is an excellent green house variety but equally at home in an open, sunny warm position. (Guillot Fils, France, 1869).

Clementina Carbonieri : Parentage of this cultivar is unknown. It is considered to be one of the outstanding Tea Rose. Flowers are fully double opening into flat quartered bloom. Flower colour is grand mixture of orange, pink and salmon, all on a bright mustard yellow background. Blooms are freely produced. Flowers are scented. Stem is angular, dense and has dark green foliage. Stems have average numbers of thorn (Bonfiglioli, Italy, 1913).

Dean Hole : Parentage of this cultivar is unknown. Blooms are large by Tea Rose standard. Flower colour is combination of silver-pink, flushed apricot and gold. Plant growth is vigorous and thorny with darkish green foliage (A. Dickson U.K., 1904).

Devoniensis : This cultivar is known as "Magnolia Rose". Parentage of this cultivar is unknown. Blooms are very large, creamy - white with the occasional blush of pink. It is a refined rose and needs planting in a warm, sheltered position or under glass with ample light. Plant has green foliage and few thorns (Fuster U.K., 1838).

Dr. Grill : This cultivar of rose is a hybrid of 'Ophire' x 'Souvenir de Victor Hugo'. Blooms are exquisite pink laid with copper. Buds are high centred but open flowers are flat and full, sometimes quartered. Blooms are fragrant. (Bonnaire, France, 1886).

Duchessede Brabant : Parentage of this cultivar is unknown. Flowers are shapely, double, clear pink to rose. Flower shape is cupped and it is free flowering. The bush has a spreading habit and is well foliated (Bernede, France, 1857).

Etoile de Lyon : Parentage of this cultivar is unknown. Blooms are rich golden yellow. Blooms are held on flimsy flower stalk. Bush is angular with sparse foliage. Flowers have strong scent (Guillot, France, 1881).

Fortune's Double Yellow : The cultivar was discovered in China. The cultivars brought back to Europe by Robert Fortune. Plant is best form with support. Flowers are loosely formed. Blooms are double and buff yellow in colour with faint tints of orange. Blooms are scented. Foliage is dark green and glossy. Stems have few thorns (China, 1845).

Francis Dubrenil : Parentage of this cultivar is unknown. Buds are long and pointed.

Flowers are flat. Bloom colour is carmine and red. Foliage is good, dark green and heavily tinted with red (Dubreuil, France, 1894).

General Gallicni : These cultivars of rose evolved as a hybrid of 'Souvenir de Therese Levet' x 'Reine Emma des Pays-Bas'. It is one of the most popular roses of its day. Main colour of the flower is buff, but heavily overlaid with red and pink with hints of yellow in the base. Plant growth is vigorous and it is relatively free of thorns (G. Nabonnand, France, 1878).

Gloire de Dijon : This cultivars of rose evolved as a hybrid of 'Unknown Tea Rose' x 'Souvenir de la Malmaison'. It is a well-loved old rose variety. Flowers are large scented and full. Buds opening flat and quartered, of buff-apricot to orange, often giving a second flush in the autumn. Foliage is dark green in colour (Jacotot, France, 1853).

Homere : Parentage of this cultivar is unknown. Flowers are shapely, cupped and have a pleasing mixture of soft blush-pink and pure white, sometimes with the margins of the petals blushed red. Bush is relatively thornless with twiggy growth habit and dark foliage (Robert and Moreau, France, 1858).

Hume's Blush Tea-scented China : This cultivar of rose evolved as a hybrid of *'R. chinensis'* X *'R. gigantea'*. Its cultivation is reported from China. This is the first Tea Rose from that country. Probably originated as a result of spontaneous crosses. Flower colour varies from off white, sometimes with hints of lemon to blush-pink. Sometimes almost brownish pink. Blooms are semi-double to almost single. Plant growth is vigorous but erratic. Foliage is slightly glossy, mid green (Fa Tee Nurseries, Canton China, 1810).

Lady Hillingdon : This cultivar of rose evolved as a hybrid 'Papa Gontier' x 'Mme Hoste'. It is an outstanding good rose since its introduction. Buds are long pointed and rich yoky-yellow in colour. Blooms are large, blowsy, semi-double and have lovely perfume. Leaves are glossy, dark purplish green in colour. Stems are relatively thornless (Lowe and Shawyer, U.K., 1910).

Lady Hillingdon (Climbing form) : This cultivar of rose is an outstanding climber. Its plum coloured wood and dark foliage are beautiful. Cultivar needs careful placing (Hicks, U.K., 1917).

Lady Plymouth : Parentage of this cultivar is unknown. This variety of rose is lovely and old. Flower colour is ivory-white to flushed cream and blush-pink. Blooms are well formed and slightly scented. Bush, dense and thorny (A. Dickson, U.K., 1914).

Maman Coehet : This cultivar of rose evolved as a hybrid of 'Marie Van Houtte' x 'Mme Lombard'. This cultivars is a free flowering rose. Initially globular, opening blowsy, pale pink flushed deeper pink with lemon centre. Plant growth is bushy with few thorns. Foliage is dark green (Cochet, France, 1893).

Marie Van Houtte : This cultivar of rose evolved as a hybrid of 'Mme de Tartas' x 'Mme Falcot'. Flower colour is bright pink tinged with orange and suffused cream. Blooms are fragrant and very free flowering. Plant growth is vigorous. Foliage is rich green (Ducher, France, 1871).

Mme Antoine Mari : Parentage of this cultivar is unknown. Flowers are shapely

and fragrant. Bud colour is pink opening to soft flesh pink with lavender lilac high lights. Foliage light to mid-green on an angular but tidy plant (Mari, France, 1901).

Mme Berkley : Parentage of this cultivar is unknown. Bloom colour is a mixture of salmon pink cerise gold. Flowers are initially high centered, opening somewhat muddled, but attractive. Plant growth is vigorous and its habit is extremely free flowering (Bernaix, France, 1899).

Mme Bravy : Parentage of this cultivar is unknown. It is considered as one of the early Teas. Flowers are large, double, creamy white with pink shading. It is very free flowering. Fowers have strong Tea fragrance. Bush growth is dense (Guillot Pere, France, 1846).

Mme de Tartai : Parentage of this cultivar is unknown. This important rose was used extensively in Victorian time for breeding. Flower size is large, full, cupped and its colour is bluish-pink. Blooms are scented. Bush growth is vigorous. Foliage is dark green and leathery (Bernede, France, 1859).

Mme de Watteville : Parentage of this cultivar is unknown. Plant is dense and medium growing. Flowers are double and shapely. Flower colour is soft yellow with pinkish tinge to the petal edges. Blooms are scented (Gulliot Fils, France, 1883).

Mme Jules Gravereaux : This cultivar of rose evolved as a hybrid of 'Reved Or' x 'Viscountess Flokstone'. Variety is climbing in nature. Blooms are shapely, fully double, sometimes quartered blooms of yellowish-buff, and shaded peach with hints of pink as undertones. Flowers are scented. Foliage are lush dark-green and the wood is dark (Soupert and Notting, Luxembourg 1901).

Mme Lombard : It is a seedling of 'Mme de Tartai'. Flowers are full, very double. Bloom colour is salmon with deeper centre. Flowers are scented. Bush growth is vigorous with dark-green foliage (Lacharme, France, 1878).

Mme Wag Ram : Parentage of this cultivar is unknown. Blooms are large and have rosy-red petals with yellow bases. Flowers are fully double and globular. Flowers are borne freely on a healthy bush with dark green foliage (Bernaix, France, 1895).

Mons Tillier : Parentage of this cultivar is unknown. Blooms are large and double. Flower colour is dark red with violet smudges, which are freely produced on a vigorous bush. Plant growth is quite tall (Bernaix, France, 1891).

Mme Campbell Hall : Parentage of this cultivar is unknown. Blooms have creamy-white edges salmon. Flowers have deeper salmon centres. Blooms are quite large. Buds are high centred. Bush growth is vigorous and foliage is dark and has leathery texture (Dickson, U.K., 1914).

Niphetos : Parentage of this cultivar is unknown. Buds are lovely creamy open to pure white pointed petals creating a muddled, star like shape. Foliage is light green in colour. Plant is climber and its growth is vigorous (Keynes, William and Co., U.K., 1889).

Novella Nabonnand Climber : This cultivar of rose evolved as a hybrid of 'Reine Marie Henriette' x 'Bardou Job'. It is a fine variety, buds are globular, yet pointed and

open to a blousy, large, rose of velvety crimson. Foliage is mid-green and quite healthy (Nabonnand, France, 1901).

Papa Gontier : Parentage is unknown. Used extensively as a forcing rose. Flowers are rich-pink, almost red sometimes slightly mottled and with a deeper reverse and semi double in nature. Blooms are slightly scented (G. Nabonnand, 1883).

Parks Yellow Tea-scented China : It is said to be original Tea Rose. Evolved as a hybrid of *R. x odorata ochroleaca*. It is an angular growing climber. Blooms are fairly large, double, cupped flowers. Bloom colour is soft and sulphur-yellow. Blooms are usually perfumed. Foliage is large (China, 1824).

Parley des Jardins : It is a seedling of 'Mme Falcot'. Flowers are many petalled and fragrant. Flower colour is sulphur yellow to buff on a sturdy compact plant. It is apparently quite hardy (F. Levet, France, 1874).

Rival de Paestum : Parentage is unknown. Flowers are fully double and its colour is ivory-white tinged pink. In bud stage colour is very prominent. Blooms are scented. Bush is well foliated with full dark green leaves (Paul, U.K., 1848).

Rosette Delizy : Evolved as a seedling of 'General Gallicni' x 'Comterse Bardi'. Blooms have pleasing combination of rose pink, buff and apricot with deeper colouring on the outside of each petal. Bush is branchy but still refined in habit with good foliage (P. Nabonnand, France, 1922).

Safrano : Parentage is unknown. This rose is one of the oldest of the Tea's. It can be planted in beds or pots. Cultivars are very floriferous. Each flower is fully double, opening flat from high-centred buds. Flower colour is buff and pinkish apricot with sulphur yellow base. Foliage is mid-green and plentiful (Beau Regard, France 1839).

Solfaterre : It is also known as 'Solfatare'. Evolved as a seedling of "Lamarque'. Blooms are beautiful, large, double, pale sulphur yellow in colour. Required warm shelter side for better growth and performance (Boyau, France, 1843).

Sombreuil : It is a climbing rose. A fully double flattish flower. Flower colour is pure white with hints of cream in the base. Blooms are sweet scented and a beautiful rose. Foliage is lush green and shrub growth is dense (Robert, France, 1850).

Souvenir de Elise Vardon : Parentage is unknown. Flowers are shapely. This is a fragrant rose. Petals are cream overlaid with coppery-yellow. Leaves have leathery texture and with glossy texture (Marest, France, 1855).

Souvenir de Mme Leonie Viennot : Parentage is unknown. Flowers are shapely and fragrant. Bloom colour is mixture of primrose yellow with coppery orange overtones. Sometimes veined pink cultivars is free flowering. Flowers are borne sometimes in clusters. Plant growth is vigorous (Bernaix, France, 1897).

Souvenir de UN Ami : Parentage is unknown. Blooms are cupped, fully double. Flower colour is rose pink tinted with deeper pink to salmon. Flowers are highly scented. Foliage is rich green. Plant growth is vigorous (Belot-Defougene, France, 1846).

The Pride : Cultivar evolved as a sport from 'Catherine Mermet'. Flower colour is pure white with a mere hint of pink on each petal edge. It is a first class rose. Plant growth is quite vigorous for a Tea Rose, with good foliage (May, U.S.A., 1885).

Triomphe de Luxembourg : Parentage is unknown. Blooms are fully double and produced in clusters. Flower colour is salmon pink, changing to pinkish buff with age. Foliage is dark green (Hardy, France, 1840).

R. Smith : Parentage is unknown. This cultivars is known by many and varied names over the years. Flowers are creamy white flushed pink with buff and gold at the base, rather blowsy when fully open but produced on a compact tidy plant (Bagg, U.S.A., 1909).

Rosa X borboniana

Rosa X borboniana : It is also known as Bourbon Rose. It is thought that it evolved as a hybrid of 'Old bush' x "Quartre Saison's". This is the first of the Bourbon race, is probably now extinct. The original plant was of medium to vigorous growth with, large, semi-double to double flowers of deep red, repeating in autumn. It is probable synonymous with Edward rose. (France, 1817). The first Bourbons arose from a cross between *Rosa chinensis* or one of its hybrids and *Rosa x damascena bifera*. The autumn damask on the Isle dè Bourbon in 1817. The bourbons reigned supreme during the mid-nineteenth century and this makes excellent shrubs and climbers, many are still available. Forms and hybrids of *R x bourboriana* includes Adam Messerich, Boule de Neige, Bourbon Queen, Charles Lawson, Commandant Beaurepaire, Couped Habe, Fulgens, Gipsy Boy, Great Western, Coros Choux d Hollande, Honorine de Brabant, Kronprimzessin Viktoria, La Reine Victoria, Lewison Gower, Louise Odier, Mme Ernst Calvate, Mme Isaac Pereire, Mme Lauriol de Barry, Mme Pierreoger, Mrs Paul, Parlizierde, Paul Verdier, Prince Charles, Queen of Bedders, Reverend H. d' Ombrain, Rivers George IV, Rose Edward, Souvenir de St Anne's, Variegatadi Bolonga and Vivid. Some of the important forms and hybrids of *R. x bourboniana* are discussed below.

Boule de Neige : Evolved as a hybrid of "Blanche Lafille" x "Sappho". It is a fine shrub with upright growth with dark green glossy foliage and few thorns. Blooms are fully double; globular sometimes tinged reddish purple on the petal edges while in buds, opening to pure white with strong fragrances (Lachame France, 1867).

Bourbon Queen : Its parentage is unknown. It is also known as Queen of Bourbons, Reine des Iles Bourbon, Souvenirdela, and Princess de Labelle. It is a sturdy shrub with thick branches and copious foliage. Blooms are semi-double, large and cupped when fully open. Flower colour is rose pink and it is highly scented (Mau get, France, 1834).

Commandant Beaurepaire : Parentage is unknown. It is a strong dense bush with plentiful fresh green leaves. Blooms are large and double. Flower colour is crimson with streaked of pink and purple and marbled white. It is an interesting rose worthy of a place in any shrubbery (Moreau-Robert, France, 1874).

Couped' Hebe : Evolved as a hybrid of 'Bourbon Hybrid' x 'China Hybrid'. It is a tall shrub bearing attractive leaves which is light green in colour. Variety is very free flowering especially in first flush. Blooms are globular, fully double and have pale pink colour. Blooms have good scent (Laffay, France, 1840).

Fulgens : It is also known as 'Malton' and its parentage is unknown. Thought to have been one parent in the development of hybrid Perpetuals. Flowers are semi

double and their colour is bright cerise-crimson. It makes useful shrub (Guerin, France, 1830).

Gipsy Boy : It is a "Russelliana" seedling and also known as "Zigeunerknabe". This rose is best grown as a shrub, but it can also be grown as a small climber. Leaves are like centifolias. Blooms are double. Flower colour is deep crimson to almost purple-black with primrose yellow anthers (P. Lambert, Germany, 1909).

Great Western : Parentage is unknown. Flowers are large, full, quartered. Flower colour is maroon-purple. Foliage colour is dark green. Shoots are well endowed with thorns (Laffy, France, 1838).

Honorine de Brabant : Its date of origin and parentage is unknown. It is one of the most acceptable stripped rose. Flower colour comprises of delicate shades of lilac with purple marking on a large, cupped flower, which are sometimes hidden by large, lush foliage. Plant growth is vigorous and it has few thorns. It is also successfully grown as a climber.

Kronprinzessin Viktoria : Its origin is unknown. Evolved as a bud sport from "Souvenir de la Malmaison". It has the beautiful petal formation of its parent together with its superb perfume and grace. Flower colour is creamy white with lemon shadings. It is a very free flowering and used in small gardens, but dislike wet weather.

Lewison Gower : It is also known as 'Malmaison Rouge' and originated as a bud sport from 'Sounevior de la Malmaison. Flower colour ranges from bright pink to red with all the virtues and faults of its parent. It is one of the Mr. Arthur Wyatt's rediscoveries (Beluze France, 1846).

Louise Odier : Parentage is unknown. Blooms are very double, almost camellia like. Flower colour bright rose pink. Bush growth is vigorous. Flowers are produced in dense clusters, which sometimes weigh down the slender branches to, given an arching effect. Blooms are superbly perfumed (Margot tin, France, 1851).

Mme Pierre Oger : Evolved as a bud sport of 'La Reine Victorie'. Bloom colour is very pale silvery pink and translucent. Flowers are cupped shape and blooms like small water lilies. Flowers have sweet scent. Bush growth is vigorous and medium (Verdier, France, 1878).

Mrs. Paul : Parentage is unknown. Variety is very floriferous. Flower colour is scarlet crimson that appears on long stem. It is useful for cutting. Foliage is dark green (P. Lambert, Germany, 1909).

Prince Charles : Origin and parentage is unknown. Plant growth is medium tall. Flowers are heavily veined and its colour is crimson to maroon. Flowers are of very considerable size in full bloom stage. Bush has large, thick leaves with heavy texture. Its origin is mystery and exact date is unknown.

Queen of Bedders : Evolved as a seedling of 'Sir Joseph Paxton'. It is a compact growing Bourbon and suitable for the front of shrubberies, and herbaceous borders or for growing in pots. Flowers are shapely, double and deep carmine softening to deep pink with age (Noble, U.K., 1871).

Rose Edward : It is also known as Rose Edouard. Evolved as a hybrid of "Old

Bush" x "Quartre Saison's". It is important in the Bourbon lineage. It could be much older than the date attributed. Blooms are richly perfumed. Flower colour is reddish scarlet (Breon France, Ile De Reunion C, 1818).

Souvenir de la Malmaison : It is also known as "Queen of Beauty". Evolved as a hybrid of 'Mme Desprez' x 'a Tea Rose'. This rose, at its best is the most beautiful of all Bourbon. Flowers are bluish-white with pink shadings. Each bloom beautifully proportioned and opening flat, quartered shape (Beluze, France, 1843).

Souvenir de St Anne's : Evolved as bud sport of 'Souvenir de la Malmaison'. It is a semi double form of 'Souvenir de la Malmaison'. Blooms have fewer petals enable it to open better in wet weather. Like its parent, very free flowering and although not quite as refined is non the less attractive. Flowers are scented (Hilling, U.K., 1950).

Variegata di Bologna : Parentage is unknown. Blooms are double, cupped. Flowers with pronounced, irregular stripes of purple on a creamy-white background. It is a tall bush with somewhat sparse and rather coarse foliage (Bonfiglioli, Italy, 1909).

Vivid : Parentage is unknown. This rose is very brightly coloured of vivid magenta pink to red. Plant growth is vigorous upright and rather prickly (Paul, U.K., 1853).

HYBRID PERPETUAL ROSE

Hybrid Perpetual Rose emerged in the 1830s and were borne from a varied and complex union in which the Perpetuals, Bourbons, Noisette and later the Teas all played their important and significant role. Few were completely Perpetuals, but most were remontant to some degree. They became one of the major groups of roses. Throughout Queen Victoria's reign they led the field as exhibition roses, and as flower shows become fashionable, breeders were impelled to seek even larger more shapely blooms. Despite the quest for size of flower, many very useful shrubs emerged and, as such, have come down to us today.

Alfred Colomb : Evolved as a hybrid of 'General Jacqueminot' x 'unknown'. Blooms are large and full. Buds are high centred. Blooms are blackish red in colour. Petals have flakes of deep pink and carmine. Plant growth is tidy and foliage is in abundance. Highly fragrant (Lacharme, France, 1865).

American Beauty : Parentage is unknown. Variety is having long stem, which makes it ideal for making bouquet. It is a very useful garden plant. Flowers are high centred and its colour is crimson. It looks like a Hybrid Tea in stature (Lacharme, France, 1857).

Anna de Diesbach : Evolved as a hybrid of 'La Reine x Seedling. It is a tall tree with many fragrant flowers of rich, deep rose pink with deeper shadings. Blooms are initially very large and cupped later opening rather flat. Bush is tall and well foliated ((Lacharme, France, 1858).

Archiduchesse Elizabeth d Autriche : Parentage is unknown. Blooms are soft rose pink, fully double and opening flat. This variety enjoys full sun and effective if pruned hard each season (Moreau-Robert, France, 1881).

Ardoisee de Lyon : Parentage is unknown. Blooms are superb, fully double. Flowers

are rich cerise with violet and purple shading. Flowers have rich perfume. Foliage is greyish-green. Plants have numerous thorns (Damaizin, France, 1858).

Ards Rover : Parentage is unknown. It is an excellent old pillar rose. Flowers are shapely. Blooms are crimson colour and have strong scent. Plant has medium stature. It fulfils the role of both wall climber and pillar rose. Foliage is lush and dark green (Dickson U.K., 1898).

Baroness Rothschild : Evolved as a bud sport of "Souvenir de la Reine d' Angle Terre." Blooms are large, full and remain slightly cupped in full bloom stage. Stem is strong, stout and erect. Flower colour is soft to clear rose pink and have a soft silvery texture. Blooms are highly scented. Bush is covered with large grey-green foliage (Pernet Pere France, 1868).

Baronne Précost : Parentage is unknown. Flower colour is deep rose pink. Blooms are scented. Bush is globular and blooms are double. It makes a most useful shrub (Desprez, France, 1842).

Black Prince : Parentage is unknown. Plant growth is vigorous with good foliage. Blooms are large and cupped. Buds are shapely and open into dark crimson to almost black flowers, which are scented (W. Paul, U.K., 1866).

Captain Hayward : It is a seedling of 'Triumph de'l Expedition'. A tall rose, need support as a shrub. Ideal as pillar rose. Flowers are pinkish-crimson which are large and cupped until fully open. Hips are large and rather attractive (Bennett, U.K., 1893).

Champion of the World : Evolved as a hybrid of 'Hermosa' x 'Magnacharta'. Flowers are rosy pink. Bush are of medium stature, leaves are dark green in colour (Woodhouse, U.K., 1894).

Charles Gater : Parentage is unknown. Plant is upright growing. Which can be adjusted in smallest space. Flower colour is bright red, which remain globular throughout their life. Blooms are scented. Foliage is good and strong (W. Paul, U.K., 1893).

Charles Lefelovre : Evolved as a hybrid of "General Jacque Minot" x "Victor Verdier". Blooms are very large and many petalled. Flower colour is crimson shaded maroon. Blooms are high centred and opening cupped, held on a strong stem. Foliage are dark green and sufficient (Lacharme, France, 1861).

Clio : Parentage is unknown. Blooms appear in clusters. Flowers are fully double and initially cupped form. Blooms are fragrant. Flowers are soft silver-pink appeared on strong stem, which is almost arching. Foliage is rich and leathery. Plants have ample thorns (W. Paul, U.K., 1894).

Comtesse Cecile de Chabrillant : Parentage is unknown. Flower colour is mid pink. Blooms are shapely, full and globular. Blooms have strong perfume. Blooms are supported on strong flower stalk. Plant growth is upright. It is a very free flowering cultivars (Merest France, 1858).

Countess of Oxford : Parentage is unknown. Flowers are double, globular and open in cupped shape form. Flower colour is rich carmine red. Blooms are scented. Plant growth is vigorous with ample healthy foliage (Guillot Pere, France, 1869).

Crown Prince : Parentage is unknown. It is free flowering cultivars and have fully double rose of purple and red blooms. Plant growth is tidy and compact with dark green foliage (W. Paul, U.K., 1880).

Dembrowski : Parentage is unknown. Blooms are double and very shapely. Blooms are reddish purple in colour and developed on a strong but medium growing plant with mid green foliage (Vibert, France, 1849).

Dr. Andry : Parentage is unknown. This cultivar produces blooms of very bright red with deeper shading flowers towards the centre. Blooms are fully double. Plant growth is vigorous. Foliage is dark green. Bloom produces slight scent (E. Verdier, France, 1864).

Duke of Edinburgh : This cultivar evolved as a hybrid of 'General Jacquemiont' X unknown. Plant growth habit is spreading. It produces semi double flowers of bright scarlet to crimson colour. Blooms are sweetly scented (Paul, U.K., 1868).

Duke of Wellington : Parentage is unknown. Blooms are large shapely and high centred. Flower colour is deep crimson. Blooms are produced in thick, stout and thorny stem with dark foliage. Plant growth is upright.

Dupuy Jamain : Parentage is unknown. Blooms are large, full cerise-red in colour, which held on strong neck with a good, strong perfume. The shrub is healthy with an abundance of lush, grey-green leaves. The cultivar is relatively free from thorns. Plant growth is upright (Jamain, France, 1868).

Eliza Boelle : Parentage is unknown. It is a vigorous rose with shapely-cupped whitish pink blooms. Flowers are scented with incurving centre petals. Plants are well -groomed with ample foliage (Guillot Pere, France, 1869).

Éclair : This cultivar of rose evolved as a hybrid of 'General Jacquemiont' x unknown. It is well-scented cultivars. Blooms are dark red in colour and looks almost black. Flower shape is rosette and opens into almost flat. Plant growth is upright (Lacharme, Franc,e 1868).

Empereur du Maroc : It is a seedling of 'Geant des Batailles'. Flowers are double, opening flat. Flower colour is deep crimson maroon. A bloom appears in large clusters. Branches are thorny (Guinoisseaur, France, 1858).

Enfant de France : Parentage is unknown. Blooms are fully double and sometimes quartered. Flower colour is silky pink. Blooms are beautiful and have fragrance. Plant growth is upright with plenty of foliage (Lartay, France, 1860).

Eugéne Furst : It is a seedling of 'Baron de Bonstetten' x unknown seedling. Flowers have ragged edge, cupped, crimson purple with considerable size. Blooms are highly scented. Plant growth is upright. Flowers are borne on strong necks. Plants have dark green foliage (Soupert and Notting, Luxembourg, 1875).

Ferdinand de Lesseps : Parentage is unknown. It is an interesting rose bearing shapely flowers of lavender shaded, purple and magenta colours. Flowers have many petals and open into flat *centifolia* form. Bush growth is shrubby and vigorous (Verdier, France, 1869).

Ferdinand Pichard : Parentage is unknown. Bloom colour is rich carmine red,

heavily laced and striped with white, opening large and cup shaped with a distinct scent. Foliage is rich green. Shrub growth is vigorous and healthy. It is one of the best of striped rose available (Tame, France, 1921).

Fisher Holmes : It is a seedling of 'Maurice Bernard in'. Flowers are well formed., double and shapely. Buds are pointed. Flower colour is shades of scarlet and crimson. Blooms are scented. Bush height is medium. Foliage is healthy. Plant growth is vigorous. (Verdier, France, 1865).

Frau Karl Druschki : Evolved as a hybrid seedling of 'Mereille de Lyon' x 'Mme Caroline Testout'. It is the most popular white rose and also known as Snow Queen. Buds have high centre. Blooms are pure white, large, and globular. Shrub growth is vigorous and strong. Foliage is leathery and light green (P. Lambert, Germany, 1901).

Frau Karl Druschki Climbing Form : Parentage is unknown. Its habit is climbing. Bush has healthy growth. Plant growth is vigorous. It is a useful climber (Lawrenson, U.K., 1906).

General Jacque Minot : Evolved as a seedling of 'Gloire de Rosomanes'. It is also known as 'General Jack' and 'Jack Rose'. Flowers are shapely and clear red in colour. Buds are pointed opening to well form scented flowers. Blooms appear on fairly long stem. Shrub growth is vigorous with rich green foliage (Roussel, France, 1853).

George Arends : Evolved as a seedling of 'Frau Karl Druschki' x 'La France'. It is a first class rose. Flowers are large, initially high centred but blowsy flowers with clear rose-pink pailing to soft pink. This free flowering cultivar has fragrant blooms. Shrub growth is vigorous. Plant has plenty of large, grey-green foliage (W. Hinner, Germany, 1910).

Gloire de Bruxelles : Evolved as a seedling of 'Souvenir de William Wood' x 'Lord Macaulay'. Blooms have sixty or more velvety petals. Flowers open flat in large rosette form. Bloom colour is dark red to crimson-purple. Blooms have scent (Soupert and Notting, Luxembourg, 1889).

Gloire de Chedane-Guinoisseau : Evolved as a Hybrid of 'Gloire de Ducher' x 'Unknown'. Flowers are shapely and cupped produced in considerable number. Bloom colour is bright rich pinkish red. Flowers are scented. Plant growth is vigorous and healthy. Foliage colour is dark green (Chedane-Pajotin, France, 1907).

Gloire de Ducher : Parentage is unknown. Flowers are huge, fully double and its colour is deep pinkish-red. Blooms produced freely along long arching branches. Flowers are well scented (Ducher, France, 1865).

Gloire de l' Exposition : Parentage is unknown. Flowers are huge, dark pink and cupped. Blooms are scented. Flower appears on a strong, sturdy, upright growing plant with few thorns (Vilin, France, 1899).

Gloire Lyonnaise : Evolved as a hybrid of 'Baroness Rothschild' x 'Mme Falcot'. Flower colour is creamy white. Blooms are semi-double and open flat. Blooms have good perfume. Plant growth is upright. Stem is strong with few thorns. Foliage is dark green and healthy (Guillot Fils, France, 1885).

Hans Mackarl : Parentage is unknown. Flowers are double. Bloom colour is deep pink opening flat from cupped buds. Stems have few thorns and ample light green foliage (E. Verdier Fils, France, 1885).

Heinrich Schulthris : Evolved as a hybrid from 'Mabel Morrison' x 'E. Y. Teas'. It is Victorian exhibition rose which won many prizes for size alone. Flowers are high centred until fully open, and then cupped flat lopped and slightly ragged. Bloom colour is rich pink with hints of deeper shades in the base. Flowers are scented. Plant growth is vigorous and upright (Bennett, U.K., 1882).

Henry Nevard : Parentage is unknown. Blooms are fragrant. Flower colour is bright crimson. Blooms are cupped and its size is good. Plant growth is bushy. Foliage colour is dark green and texture is leathery (Cants U.K., 1885).

Her Majesty : Evolved as a hybrid of 'Mabel Morrison' x 'Canary'. Flower is huge, fully double and its colour is clear pink. It is a Victorian exhibition rose and well worth growing even today. Foliage is large and grey. Shrub growth is vigorous (Bennett, U.K., 1885).

Horace Vernet : Evolved as a hybrid of 'General Jacque Minot' x 'unknown'. Flower is high centred with rich crimson colour, which retains its shape well upto maturity. Blooms are fragrant. The shrub growth is upright with abundant foliage (Guillot Fils, France 1866).

Hugh Dickson : Evolved as a hybrid of 'Lord Bacon x 'Grüss an Teplitz'. Plant growth is tall. Flower colour is rich dark red. Blooms have powerful perfume. Flowers are borne on long arching stem. Variety is ideal for pillar. Foliage is rich dark green in colour with hints of maroon (Dickson, U.K., 1904).

Jean Rosenkrantz : Parentage is unknown. Blooms are big and neatly formed. Petals are deep pinkish red. Flowers have perfume. Shrub is well foliated. Plant growth is vigorous and upright (Portemer, France, 1864).

John Hopper : Evolved as a hybrid of 'Jules Margot Tin' x 'Mme Vidot'. Flowers are large and fragrant. Bloom colour is combination of bright pink and lilac. Flowers have deep centres and produces on upright vigorous plant. It is a first -class rose (Ward, U.K., 1862).

Jules Margottin : Evolved as a seedling of 'La Reine'. The plant has lot of thick, dark green foliage on strong thorny stems. Buds are pointed opening into large, flattish flower. Bloom colour is deep carmine. Blooms have strong scent (Margottin, France, 1853).

La Reine : Parentage is unknown. Blooms are large, globular and high centred. Buds opening to cupped blooms with flattish top. Flowers have numerous petals. Bloom colour is silvery rose pink with an undertone of lilac. Shrub growth is upright. Stem is well foliated but not too tall (Laffay, France, 1842).

Le Havre : Parentage is unknown. Flowers are double, scented and very healthy. Bloom colour is vermilion-red. Plant growth is strong and foliage is green and has leathery texture (Eudes, France, 1871).

Mabel Morrison : Originated as a bud sport of 'Baroness Rothschild'. Flower colour

is pure white with flecks of pink in hot weather. Mutant is having all the characters of its parent except the short height (Broughton U.K., 1878).

Marguerite Guillard : Originated as a bud sport of 'Frau Karl Druschki'. Flowers have fewer petals than its parent, enabling it to open bettering wet weather. Colour and habit are similar to its parent (Chambard, France, 1915).

Mme Gabriel Luizet : Parentage is unknown. Flowers are fully double, large often quartered. Bloom colour is deep glowing pink with paler petal edges in full bloom stage. Plant growth is vigorous with good foliage and stout strong stem (Liabaud, France, 1877).

Mme Scipion Cochet : Parentage is unknown. Flowers are attractively wrinkled and cup shaped. Bloom colour is deep purple pink paling to softer shades at the edges. Bush growth is good with dark green leaves (S. Cochet, France, 1873).

Mme Victor Verdier : Originated as a hybrid of 'Senateur Vaisse' x 'Unknown'. Buds are huge and shaggy. Flowers are attractive, double and their colour is light crimson to carmine flower. Shrub growth is vigorous and healthy. Foliage is dark green (E. Verdier, France, 1863).

Mrs. John Laing : Evolved as a seedling of 'Francois Michelon'. Plant growth is upright. Leaves are large and grey-green in colour. Plants are healthy and producing abundance of scented glowers. Blooms are shapely and have silver pink petals. It makes an excellent bushy shrub (Bennett, U.K., 1887).

Paul Neyron : Originated as a hybrid of 'Victor Verdier' x 'Anna de Dies Bach'. Plant growth is sturdy strong and healthy. Blooms are very large unfading and have warm pink petals. Flowers are scented. Foliage is large and dark green in colour (Levet, France, 1865).

Paul Ricault : Parentage is unknown. It is a *centifolia* like rose. Blooms are fully double opening flat and quartered. Shrub has vigorous growth with thorny stem (Portemer, France, 1845).

Paul's Early Blush : Originated as a bud sport of 'Heinrich Schultheis'. Flowers are blush-pink as the name suggests. Flowers are large, double and scented. Bloom produced on a strong thorny bush with thick branches. Foliage is dark green (W. Paul, U.K., 1893).

Pierre Notting : Evolved as a seedling of 'Alfred Colomb'. Flower colour is deep crimson. Blooms are globular and highly scented (Portemer, France, 1863).

Prince Camille de Rohan : Originated as a hybrid of 'General Jacqueminot' x 'Geant des Batailles'. It is a fascinating rose variety. Flower colour is deep blackish red. Blooms are of colossal size, opening flat and deepening with ages. Foliage colour is dark green (E. Verdier, France, 1861).

Reine des Violettes : This variety is evolved as a seedling of 'Pius IX'. It is also known as 'Queen of the Violets'. Plant growth is upright and stem is almost thornless. Shrub has stout, erect branches. Foliage is grey-green in colour and soft to touch. Flower colour is soft, velvety violet, opening flat and quartered. Blooms have a lovely perfume. Flower shatters very quickly (Millet-Malet, France, 1860).

Roger Lambelin : This variety is evolved as a bud sport of 'Prince de Rohan'. It is a strange rose. Blooms are double highy fragrant, and their colour is crimson-maroon with white streak and stripes, especially on the edges of the petals (Schwartz, France, 1890).

Roger von Steinfurth : Evolved as a hybrid from cultivars 'Frau Karl Druschki' x 'Ulrich Brunner Fils'. It is also known as 'Red Druschki'. This is an old exhibition variety. Blooms are double and high centred. Flower colour is ruby red fading to cerise. Blooms are cupped when open. Flowers are scented. Bush growth is upright, sturdy with dark green leathery foliage (Weigand, Germany, 1920).

Sidonie : Parentage is unknown. Blooms are slightly fimbriated, fully double flower of medium size. Flower colour is clear glowing pink. Blooms appeared in well-spaced cultivars. Plant growth is vigorous with coarse foliage (Vibert, France, 1847).

Souvenir d'Alphonse Lavallee : Parentage is unknown. It is a lovely full scented rose. Flower colour is made up of several shades of crimson and purple. Inclined to wonder if grown as a shrub unless tethered to a stake or a tripod. Best grown as a climber. The variety has more thorn in stem in comparison to 'Jamin' (Verdier, France, 1884).

Souvenir de Jeanne Balandreau : Parentage is unknown. Flowers are large double and cupped shape. Bloom colour is deep cerise with pink stripes and vermilion highlights. Blooms are shapely and held erect on strong necks. Plant growth is upright. The tidy shrub has dark grey-green foliage (Robichon, France, 1899).

Souvenir de Docteur Jamin : Evolved as a seedling of 'Charles Lefebvre'. This rose variety is superb and need care and perform better if kept away from scorching sun. Flowers are rich ruby red. Blooms are semi double, open to a cupped shaped and sometimes showing off their anthers. Stems are relatively thornless with dark green foliage. Flowers are scented (Lacharme, France, 1900).

Spencer : This variety is evolved as a bud sport of 'Merveille de Lyon'. Flowers are fully double, opening flat from globular buds. Flower colour is soft satin pink with paler, almost white reverse. Plant growth is vigorous with dark green foliage (W. Paul, U.K., 1892).

Surpassing Beauty : This variety is also known as 'Woolverstone Church Rose'. It is an old variety of climbing rose discovered growing at Woolverstone Church, Suffolk. Flower colour is deep red crimson. Blooms are very strongly fragrant. Plant growth is relaxed and vigorous. Date of origin of this variety is unknown. This variety reintroduced by Beales in 1980.

Ulrich Brunner Fils : This variety of rose is also known as 'Ulrich Brunner'. Parentage is confused but probably origin is as a bud sport of 'Paul Neyron'. Flowers are large, plump and initially high centred. Flower colour is rosy carmine fading to pinkish with age. Blooms are sweetly scented. Bush growth is upright with dark green foliage. Stems have few thorns (Levet, France, 1882).

Vick's Caprice : Originated as a bud sport of 'Archiduchesse Elizabeth d' Autriche'. Blooms are large, double, cupped with high centred opening loosely but attractively. Flower colour is combination of pale pink with lilac and white, flecked with

striped deeper pink. Foliage is large, attractive with light green. Stems have few thorns (Vicks, USA, 1900).

Victor Verdier : Originated as a hybrid from cross between 'Jules Margottin' x 'Safrano'. Blooms are large and fully double. Flower colour is pink held on strong neck. Blooms have good perfume. Stem is strong and healthy with dark green foliage (Lacharme, France, 1859).

Xavier Olibo : Originated as a bud sport of 'General Jacqueminot'. All the morphological characters are similar to its parent but its colour is a much darker red (Lacharme, France, 1865).

Yolande d' Aragon : Parentage is unknown. Blooms are flat and double. Flower colour is bright purplish to rich pink. Blooms are scented. Shrub is good and healthy. Stem is strong and upright with light green foliage (Vibert, France 1843).

Section : VIII Banksianae

Plant growth is vigorous. It attains height upto 7meters. Foliages are smooth and consist of 5-7 leaflets. Stipules free or jointed to the leaf and stem only at the base. Plant has few thorns and sometimes none. A bloom appears in singly and in clusters. Flowers are small, in rounded heads, stipules very narrow and pointed. Sepal drops before ripening. Hips are small.

R. banksiae normalis : This is considered probably the true species. It is a climber. Flowers are white and single in nature. Foliage is light green in colour and produced plentiful. Stems are free from thorn (China, 1877).

R. banksiae lutescens : Flowers are single and more sweetly scented. Flower diameter is rather larger than that of *R. banksiae lutea.* Young leaves and shoots are sometimes copper-tinted (China, 1870).

R. banksiae alba plena : It is also known as *R. banksia banksiae* or "Lady Banks Rose" Most of its characters are like *normalis.* Flowers are small, rosette like, double and white. Flowers appear in newly formed lateral shoots (China, 1807).

R. banksiae lutea : It is also known as yellow Banksia. For better performance in flowering it needs sheltered place with sunny spot. It is hardier in nature. Plant and foliage growth is profuse. It produces large cascading tresses of small pale yellow, double flowers in late spring. Blooms are slightly scented (China, 1825).

R. fortuniana : It is not known in wild state and thought to be a cross between *R. banksiae* and *R. laevigata.* Blooms are large, double, white and scented. Plant is almost thornless resembling *R. banksiae.* It has slightly darker green leaves and stem. This most interesting rose needs protection or sheltered, warm position to grow well.

Section : IX Laevigatae

Plant growth is sprawling or climbing. Plant has hooked, irregular thorns. Leaves are large and have three leaflets and in rare cases it goes upto 5. It is almost ever green. Blooms are large, produced singly, stipules are toothed. Hips when formed have persistent sepals.

R. laevigata : It is also known as "Cherokee Rose". Plant is reported from China in 1759 and later naturalized in North America. Blooms are single, very large, white, superb with golden yellow stamens. Leaves are crisp, polished and dark, as is the wood, which is armed with large hooked thorns. Fruits are oval with sparse bristles. Anemone rose, Cooper's Burmese, Romona and Silver Moon are the important forms and hybrid of *R. laevigata.*

Section : X Bracteatae

Plant growth is climbing or angular sprawling. Stems have numerous, hooked thorns and appear in pairs, smaller and scattered. Leaves have 7-9 leaflets. Hips have reflexed sepals, which drop off when ripe. Flowers are with many leafy bracts; stipules deeply lobed, like the teeth of a comb (Pectinate).

R. bracteata : It is also known as 'The McCartney Rose'. Flowers are single, pure white with pronounced golden yellow stamens. Stems are fawny brown and have dark green leaves and slightly downy to touch. It is best grown as a climber (China, introduced 1793).

ROSA SUBGENUS III : PLATYRHODON

Plant has flaky bark and produced prickly hips dropping off when still green. Plants have multiple pinnate leaves. Leaves are small. Platyrhodon has three species i.e. *R. roxburghii, R. roxburghii normalis R. roxburghii plena* and *R. praeluens.*

R. roxburghii : It is reported from China in the year 1814 and known as Burr Rose" and "Chestnut Rose". Plant is quite distinct. Shrub is medium to tall and has leaves composed of upto 15 small, firmly textured, light green leaflets. Stems are tawny-brown and slightly angular, both in structure and direction. Bark is flaky on the older wood. Thorns are quite long and stout, often arranged in pairs. Blooms are single and their colour is shell pink. Hips are spherical, orange-yellow and covered in pronounced, stiff stubble.

R. roxburghii normalis : Plant of this species is taller in comparison to *roxburghii.* Blooms are single in nature and their colour is pure white, sometimes blush-white.

R. roxburghii plena : It is a "brier rose of China", or the "Horse Chestnut rose". Plant growth is less vigorous in comparison to other forms, upto 120 cm long. The leaves are 19 foliate Blooms are fully double and not produced very freely, open flat, lovely, glowing pink in colour.

ROSA SUBGENUS IV. HESPERRHODOS

Hesperrhodos plants have small leaves and their stems are very prickly. Hips are prickly not mearly bristly, persisting on plants over winter. It is reported from Mexico. There are three species of Hesperrhodos viz. *R. stellata, R. stellata mirifica, R. minutifolia.*

R. stellata : It is an interesting species with dense, spiny wood and foliage is gooseberry like. Leaves are light green in colour. Cultivation of this rose is not easy. Blooms are rich pinkish-purple, produced solitary among dense foliage. Hips are like gooseberries, round, amber coloured (USA, 1902).

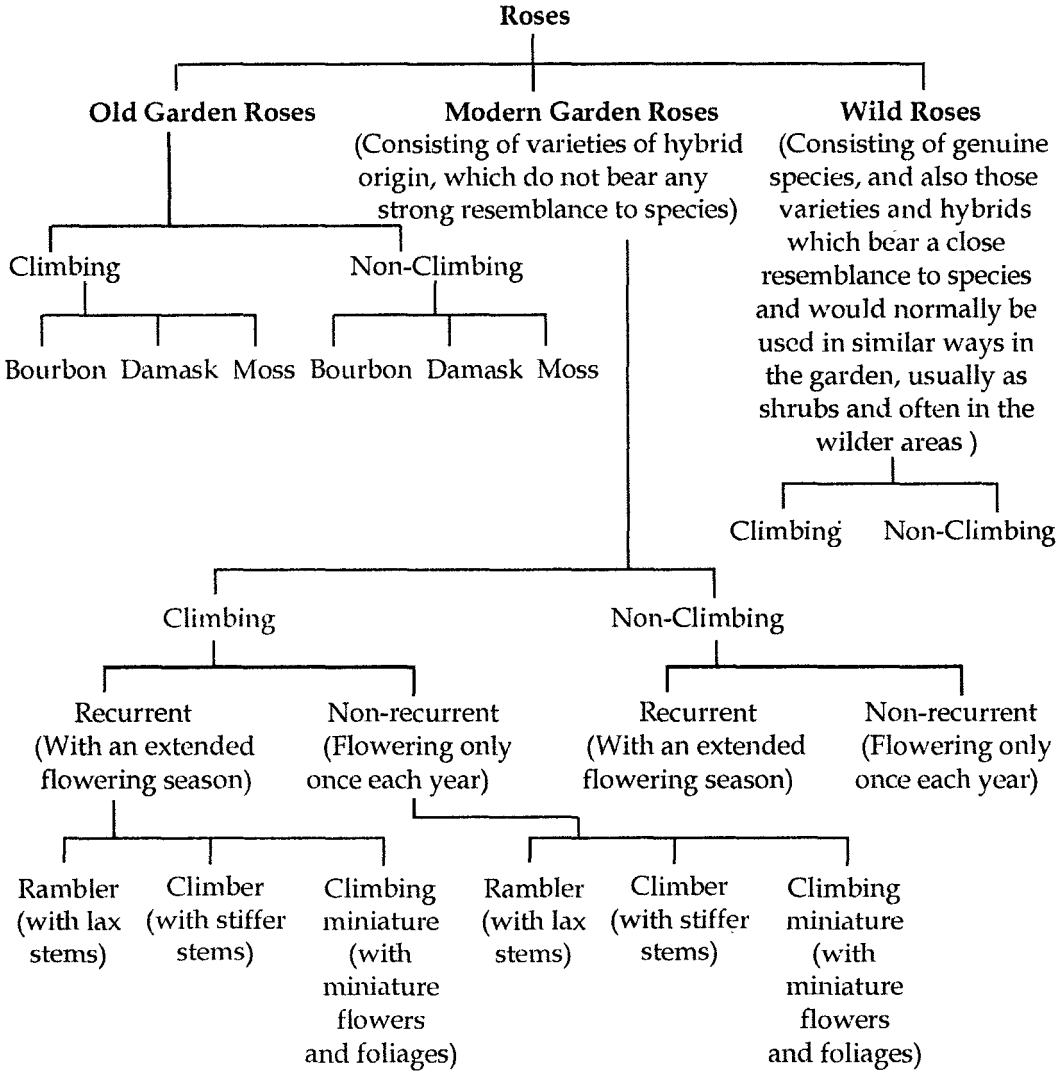
R. stellata mirifica : It is also known as 'The Sacramento Rose'. Plant growth is

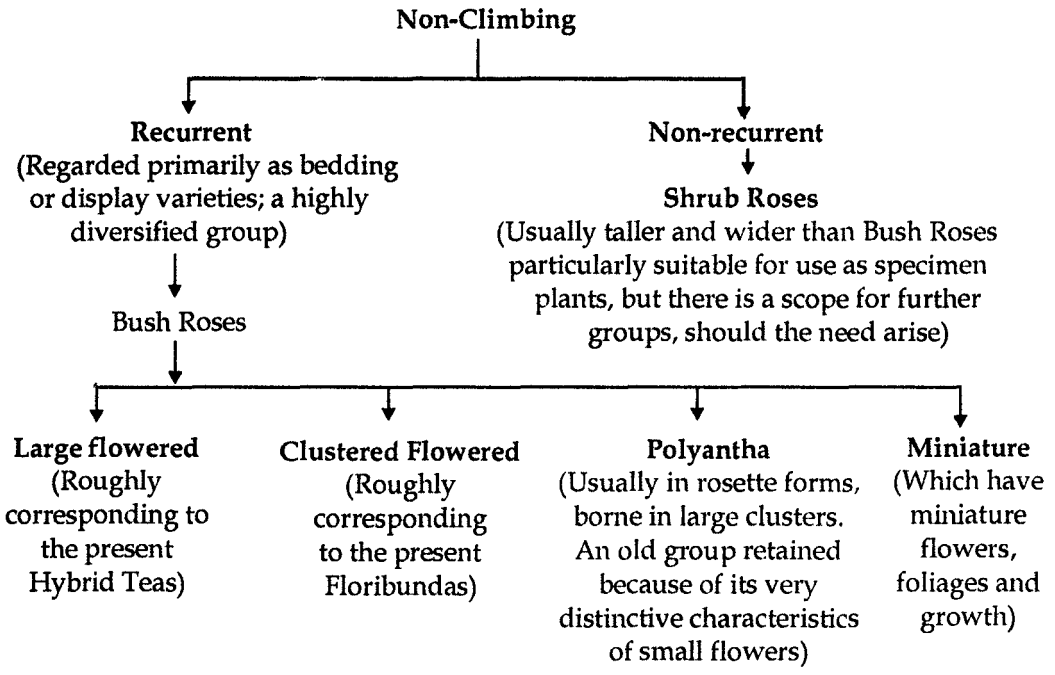
compact. It is slightly vigorous than the other form with many long spines and gooseberry like foliage. Blooms are single and lilac purple in colour. Flower has five petals with prominent stamens. Bush growth is dense and compact. It is easier to grow in garden than *stellata,* but quite difficult for the nurseryman to produce (Green's, USA, 1916).

R. minutifolia : A tender plant, appears not to be in cultivation.

Classification of Roses by Royal National Rose Society, Approved by the World Federation of Rose Societies

This classification is for use by gardeners, so far as modern roses are concerned, is entirely based on the qualities that matter in the garden. This classification indicates how they fit into the garden scheme; for what purpose they are mainly useful; what is the character of their growth and how long they are likely to bloom (Hellyer, 1978).





Main classes of garden roses as suggested by Pal (1966) are given below :

The Hybrid Teas : Obtained by crossing of the Hybrid Perpetual and Tea Roses.

The Hybrid Perpetuals : Obtained by crossing the then existing roses in Europe such as Damasks and Gallicas with the perpetually flowering introductions from China.

The Teas : They are known to have originated from *Rosa chinensis* and *R. gigantea.* They derived their name from their distinct aroma, believed to be felt when a chest of tea leaves is opened.

The Floribunda : Created by crossing the Hybrid Teas and Dwarf Polyanthas.

The Dwarf Polyanthas : Originated from *Rosa polyantha* (Syn. *Rosa multiflora*). From some seeds of this climbing species, sent from Japan to France, were raised number of climbers, but in a further generation some dwarf perpetually flowering forms were discovered.

Grandifloras : Obtained from crosses between Hybrid Tea and Floribunda types.

The China Roses : Derived from *Rosa chinensis.* This group includes perpetually flowering types. It is also responsible for nearly all the present day popular roses and bears red to nearly white flowers in small clusters.

Miniatures : It is said that, this group of roses was evolved from *Rosa rouletti.* It is also believed that French have brought miniature rose from Mauritius before 1810.

Damask Roses : These roses are mainly from the *Rosa damascena* species, and are said to have originated from the cross between *Rosa phoenicia* and *Rosa gallica.*

The Bourbon Roses : These roses are derived from the natural cross between the

China Roses and Damask Roses, in the remote island of Reunion, in the Indian Ocean.

The Cabbage Roses : These roses are belonging to the *Rosa centifolia* species.

The Moss Roses : These roses are evolved as a result of mutation or sports from cabbage Roses.

The French Roses : These are developed from the species of *Rosa gallica.*

The Albas : These were originated from a cross between *Rosa corymbifera* and *R. gallica.*

The Musk Roses : These belong to the species of *Rosa moschata.*

The Noisette Roses : These are hybrids between Musk Roses and China Roses.

The Rugosas : These are belonging to the species of *Rosa rugosa.*

The Scot Briars : They belong to the species of *Rosa spinosissima.*

The Australian Briars : These roses belong to *Rosa foetida* (syn. *R. lutea, R. persica*).

The Wichurariana Ramblers : These belonging to the species of *Rosa wichurariana.*

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4

BREEDING

The rose in terms of plant breeding is a wonderful example of what could be done in hybridization. There is extraordinary range of valuable genetic variation in *Rosa* that could be exploited. The natural evolutionary process of this genus had presented the rose breeders with material valuable in itself, and also highly suitable for short term and long term breeding programmes. There are 120 species in the genus *Rosa,* according to available literature, 15 to 18 species are known to be included in the ascentry of our modern roses. The *Rosa* spp. offer a vast reservoir of untapped genetic material awaiting the hybridist intelligent enough to untangle it. The species roses pose great problems, many are reluctant to cross-pollination others are largely sterile, and some of their crosses acquire defects unknown in the parents. According to literature that it takes 10,000 to 20,000 seedlings to produce a rose worth commercializing. Inspite of all these it is worth mentioning that there are more than 30,000 cultivars in roses. The classic work of C. C. Hurst and Ann Wylie had provided essential basic knowledge in the cytology and genetics of the genus *Rosa* for its logical and most practicable handling in breeding programme.

HISTORY OF ROSE BREEDING IN INDIA

In India rose breeding has started late in comparison to other countries but progressing very fast. B. K. Roy choudhary, a nurseryman of Mihijam is Santhal Parganas, W. B. was probably the first Indian rose breeder who raised the variety "Dr. S. D. Mukherjee" in 1935. Another nurseryman, B. S. Bhattacharjee of Deoghar evolved a variety named "Ramakrishna Dev" in 1941, which is perhaps the second earliest one, (Viraraghavana, 1986). B. S. Bhattacharjee was the first Indian to the recognise the need for rose breeding in warm tropical climate and during 1941-67 he along with his two sons evolved 125 varieties. Some of the important cultivars evolved by them included Hybrid Tea rose cultivars "Ramakrishna Dev', 'Raja Ram Mohan Roy', 'President Radhakrishnan', 'Kalima', 'Heart Throb' and 'Sugandha'; Floribunda rose cv. 'Sir Jagadish Bose', 'Urvashi', 'Pandit Nehru', 'Peetmanjari', 'Muktadhara', 'Menaka', and 'Jai Hind'; and Polyantha rose cv. 'Rishi Bankim', and 'Tara Punja'; climbing rose Deoghar Clg No. 1 and 2, Lalkilla (Chadha and Bhattacharjee, 1995).

The scientific work on rose breeding in India was started by Late Dr. B. P. Pal in 1958, who was Director of IARI, has been one of the well known amateur rose breeders. He was first to mention the parent used in hybridization and thus systemised breeding procedures. His first rose variety was 'Rose Sherbet', a highly fragnant rose, released in 1962. During his 27 years of rose breeding from 1962 to 1989, Dr. Pal evolved 105 varieties.

His contribution to rose breeding has been the most significant in India and is also recognised abroad. Some of his varieties are Hybrid Tea: Rampa Pal, Raja Surendra Singh of Nalagarh, Dr. Homi Bhabha, Mechak, Dr. M. S. Randhawa, Dr. R. R. Pal, Indian Princes, Akash Sundari, Apsara, Ashirwad, Diva Swapna, Shanti Pal, Sir. C. V. Raman, Floribunda: Banjaran, Delhi Princes, Chandrama, Prema, Chitchor, Jantar Mantar, Kumkum, Madhura, Rangini, Rupali, Tarang, Climber : clg. Dr. Homi Bhabha, Delhi white Pearl and Delhi Pink Pearl.

The work on rose breeding is also being carried out at the Indian Agricultural Research Institute (IARI), New Delhi; the scientific breeding of rose was initiated in 1962-63 and first IARI roses were released in 1968 since than roughly 70 varieties have been developed. IARI rose variety "Mohini" a hypertriploid, with its unusual flower colour of chocolate brown has attracted the attention of rosarians and nurserymen in India and abroad and "Mrinalini" has appeared on one of our postage stamp. The National Botanical Research Institute (NBRI), Lucknow is another important centre where significant work has been done on mutation breeding in roses. The Institute has developed and released large number of gamma ray mutants, and also detected some spontaneous mutants.

Besides Dr. B. P. Pal other amateur rose breeders were Raja Surendra Singh of Nalagarh, M. N. Hardikar, M. S. Viraraghavan, Dr. S. Banerjee, Braham Dutt, Y. K. Hande and S. C. Dey. Among the nurserymen, apart from B. K. Roy Choudhary (Mihijam) and B. S. Bhattacharjee and his two sons (Deoghar), Kasturi Rangan of K. S. G. Nursery, Bangalore, J. P. Agarwal of Friends Rosary, Lucknow; Mrs. P. L. Airun and Mr. S. K. Airun of Anand Roses, Jaipur; Doon Valley Roses of Dehradun; Laveena Roses of Meerut and TISCO Nursery, Jamshedpur, and others have evolved a large number of attractive rose varieties in India.

PLOIDY LEVEL IN ROSA SPECIES

The majority of the wild roses are diploid, notably all the Synstylae (Musk roses) Indicae, Laevigatae, Bracteatae, the sub-genera Hesperrhodos (*Rosa stellata and Rosa multiflora*) and Platyrhodon (*Rosa roxburghii*), all but two or three of the Pimpinellifoliae and about half of the Cinnamomeae. A diploid is a plant with 2n = 14 chromosomes, in each of its cells, except that these are reduced to 7 each in the male and female cells appointed to fuse sexually with each other. Thus upon their fusion they restore an embryo with 2n = 14. A triploid has 3 x 7, namely 21 chromosomes. Triploids find difficulty in fusing as a rule, because the odd number prevents equal division. In that case, they are sterile. Tetraploids (2n = 28) and confined to the cinnamomeae, pimpinellifoliae, and gallicanae (one species only). The tetraploid species of the old world cinnamomeae are *Rosa acicularis, R. beggeriana, R. bella, R. caudate, R. davidii, R. davidii elongata, R. fedtschenkoana, R. forrestiana, R. hawrana, R. latibracteata, R. laxa, R. macrophylla, R. moyesii, fargesii, R. multibracteata, R. pendulina, R. pendulina oxyodon.* A pentaploid has 5 x 7, namely 35 chromosomes. Some roses of this nature overcome the difficulty of dividing equally from an odd number, by allowing 7 to fuse with 28. The surplus 21 are carried in the female cell. All the regular hexaploids (2n = 42) are in the cinnamomeae as are very small number of octoploids (2n = 56), of which one form a *R. acicularis* is the best known. The

other octoploids species known as *Rosa tackholmii* and a cross between *R. rudiuscula x R. subglauca*, to which a cultivar name of "Octet' has been given. The Hexaploids has 6 x 7, namely 42 chromosomes, and fuses two sets of 21. An octoploid has 8 x 7, namely 56 chromosomes, and fuses two sets of 28. A poliploid is a plant with many chromosomes, which in effect means it has more than a diploid. C. C. Hurst (*The Mechanism of Creative Evolution, Cambridge, 1933*) has written "in *Rosa* the species in the extreme south towards the equator one all diploids, while poliploids have a more northernly distribution, the octoploid species. *R. acicularis*, which is the highest poliploid species yet found in this genus, being, so far as critically known, usually arctic and circumpolar in its distribution, though it apparently extends south of Lake Baikal in Siberia, where conditions are sub-arctic (Allen, 1979).

The implications for the rose breeder are clearly apparent and are well known: a hybrid between two dissimilar roses may survive and flourish, but if chromosomes are unable to pair up in a regular manner, fertile pollen and egg cells will not normally be produced. "Max Graf", which kordes obtained from America, was thought to have arisen from a cross between *R. rugosa* and *R. wichuraiana*. It is an example of such a sterile hybrid. Against all odds, this hybrid eventually produced a seed which grew into a plant with twice a many chromosomes as the original hybrid. As it was able to perpetuate itself, the new plant was given the specific name of *Rosa X Kordesii*. The chromosome complement of a sterile hybrid can be doubled artificially by applying colchicines to the growing apex of young seedlings (Roberts, 1979).

BREEDING OBJECTIVES

For developing new varieties, the breeding objectives should be clearly defined. Once the objectives are decided, the first stage is assembly of an adequate gene pool and the selection of desirable genes or genotypes, either as parental material for further improvement, or for immediate testing as potential cultivars. The next step is manipulation of the selected genes or groups of genes to generate more favourable combinations, followed by further selection. Then, there is the comparative test to demonstrate the superiority of the selected genotypes, culminating in the release of improved cultivars (Datta, 2006)

According to Pal (1991) the quest for perfection in rose must go on which include greater vigour and hardiness, resistance to diseases and pests and new colours not yet obtained like true blue. In many cases while we already have the characters we look for, they are found scattered in a number of varieties and the rose breeders task is to unite as many of them as possible into a single variety like the exquisitie shape of the bloom of Hybrid Tea with ever blooming characters of Polyantha and Floribunda and unforgettable fragrance of cvs. like "General Mc Arthur" or "Hadley" or even "Nurjahan" with much desired colour of "Super Star" or "Doris Tysterman". The breaders have yet to utilize some of the wild rose species which have not contributed thus far to the genetics of rose.

Objectives of rose breeding, however vary from country to country and region to region depending upon the need. The future in rose breeding could become more complex in their trying to meet the requirements of particular users. Breeding for disease resistance is becoming more important to breeder's plans. It must be kept in mind that breeding of resistant varieties for one country is not the same as breeding of roses for different

climatic conditions, for a while one rose might not suffer the same disease in one country it might well do in another. It will also be very difficult to know what would be the size of the flower or its hardiness under many different climates. Very few roses were good all round the world. However, objectives of the rose breeding should be very specific. Rose breeders are working for greater vigour and hardiness; resistance to diseases and pests, hot-wet climates, high fluctuation of temperature, shady locations and water logging conditions, saline and alkaline soil etc.; and also for better cut flowers, exhibition purpose, floriferous habit, spectacular and new colour, attractive size, shape and form, as well as for delicate fragrance and increased oil content. Rose-breeders were improving the rose and continuing to make striking advances.

RAISING NEW ROSES

New rose varieties are obtained through natural mutation or bud sports, natural crossing, hybridization and mutation breeding. Roses are cross pollinated in nature by insects, especially the bees. Insects are attracted by the colour and the perfume of the flower. Seeds formed through natural pollination may give a variable progeny, specially the modern varieties, possessing a complex pedigree. By raising, these naturally cross pollinated seeds, new forms of roses may be obtained. Through proper selection new rose varieties may be obtained. The variant forms, called mutants or sports appear from time to time, on established varieties naturally, in which a plant of an existing variety putsforth a shoot, where genetical change occurred. New variety can be propagated from mutated branch through vegetative propagation. For example "Kronenburg" and "Chicago Peace" or mutants of "Peace". To develop new varieties with desirable characters cross breeding is one of the most powerful methods. The rose breeders with good judgements and probity are able to raise valuable rose cultivars through artificial and selective cross breeding. Rose hybridization is time consuming require skill, patience and sincere love for roses. As stated by J. L. Harkness in 1973, a rose nurseryman and breeder, after 12 years at breeding roses "My own estimate of our varieties is that we can at present say we have raised only five-first class roses out of the several hundred thousand seedlings. I hope that for all rose growers, whether breeders or not, our days among our roses will help to mold us into creatures who perform their ordained tasks in creation more perfectly".

High energy radiations including X-ray, gamma-irradiation as well as chemical mutagens have been used successfully to generate new varieties. Through these techniques, changes in colour, size, form of flowers and in growth habit of roses have been recorded.

HYBRIDIZATION

Conventional breeding is little bit difficult in rose because of the nature of its sexual reproduction. The success results in rose breeding is very poor because it is known fact that rose is a complex hybrid gone through interspecific hybridization and polyploidy. Rose is highly heterozygous, having very high rate of male and female sterility and blended with various types of chromosomal aberration. Difficulties in breeding is mainly due to hurdle faced by different rose cultivar in every step of breeding, right from the anthesis, pollination, fertilization, seed setting which continued upto seed germination. Germination of rose seed is difficult due to presence of hard seed coat. Pericarp and testa of rose seed possesses ABA that is known to create dormancy.

Before planning rose breeding programme breeder know well that all rose varieties do not set seeds. At this stage parents are selected for crossing programme that are having good seed setting record and possesses viable pollen. Selection of male parent can be successfully achieved by testing pollen viability. Pollen donor can be selected on the basis of results of pollen germination test.

In India hybridization work of rose is mostly undertaken during November to March, as it is a good flowering period when plenty of healthy rose flowers are available and temperature is also ideal. To begin with, the petals of the rose buds which are about to open (selected for hybridization work) should be removed very neatly and carefully in the morning hours at the time of the sunrise. Care should be also taken so that stamens and pistils are not damaged. After removing the petals, anther lobe containing pollen sacs should be removed neatly. Special care should be taken at this stage that not a single anther is left on the flower in order to avoid self-pollination. Stamens thus removed can be stored in polythene bags for 24 hours. Bag should be perforated to avoid evaporation of excessive moisture from it. Name of the variety should be noted in the bags and in a notebook to know about the male parent. Now the hybridization work can be started in the next morning after sunrise. At this stage pollen and stigma, both are mature and ready for hybridization. Pollen collected a day earlier of the the variety desired to be used as male parent, should be carefully transferred on the stigma of the variety selected to be used as female parent taking care that all the pollen should fall on the stigma. Anthers at bursting stage are rubbed gently on the pistil of the female flowers. Alternatively, pollen may be applied by means of the tip of the fore finger or with a small soft brush. A label given the serial number, date and the name of the female parent X male parent should be attached to the stem below the hip. At this stage, to get rid of pollen contamination (natural pollination) the female flowers should be covered with paper bags, celophane bags, butter paper bag or cloth bag. In successful cross, the hip started swelling after second week of crossing. Seed maturation period is generally of 3-7 months that varies from variety to variety, but majority of the varieties mature in 3-5 months. On maturity the hip or fruit become either brownish or yellow or orange or red or even remain green. The matured and dried hip is colleted at this stage along with the label.

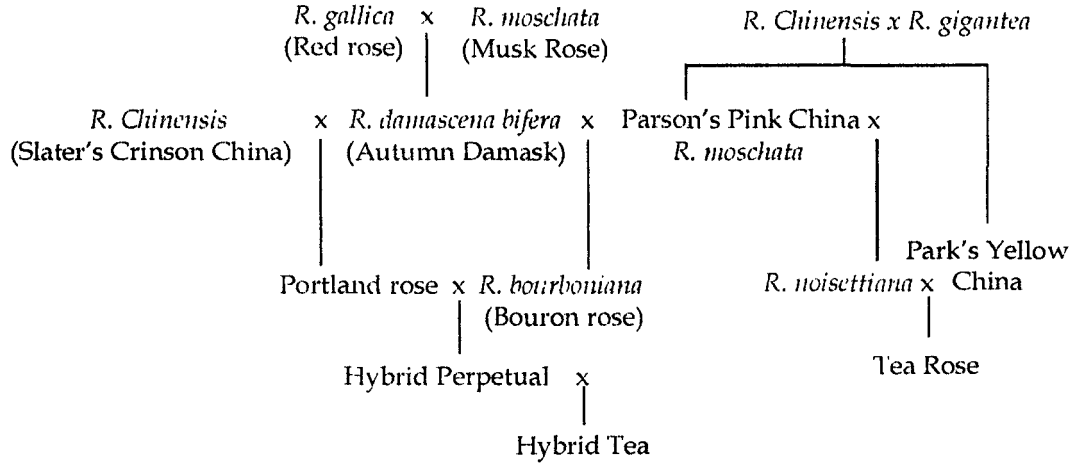
Seeds should be extracted carefully. The seeds should be kept in room temperature for 6-8 weeks and than in a packet it should be stored for 6-8 weeks in refrigerator. This practice should be adopted for better results as most of the breeders are of the opinion that this cold treatment is essential for getting better germination. October to December is the best period for sowing of rose seed. Seeds should be sown 3cm apart and 1. 5-2 cm deep in soil containing light soil mixed with cow dung manure, covering with whole surface with 6-7mm thick mixture of sand and leaf mold (1:1 ratio) either on raised beds or in earthen pots. A label indicating the parentage should be properly tagged on bamboo stick. Germination of seeds may start after 3 weeks from sowing. High percentage of germination can be obtained when the temperature ranges between 7.2°C and 18.3°C. At four leaf stage seedlings can be transplanted in separate pots. To propagate new varieties in large scale, now buds can be obtained from matured seedling as usual process of conventional budding.

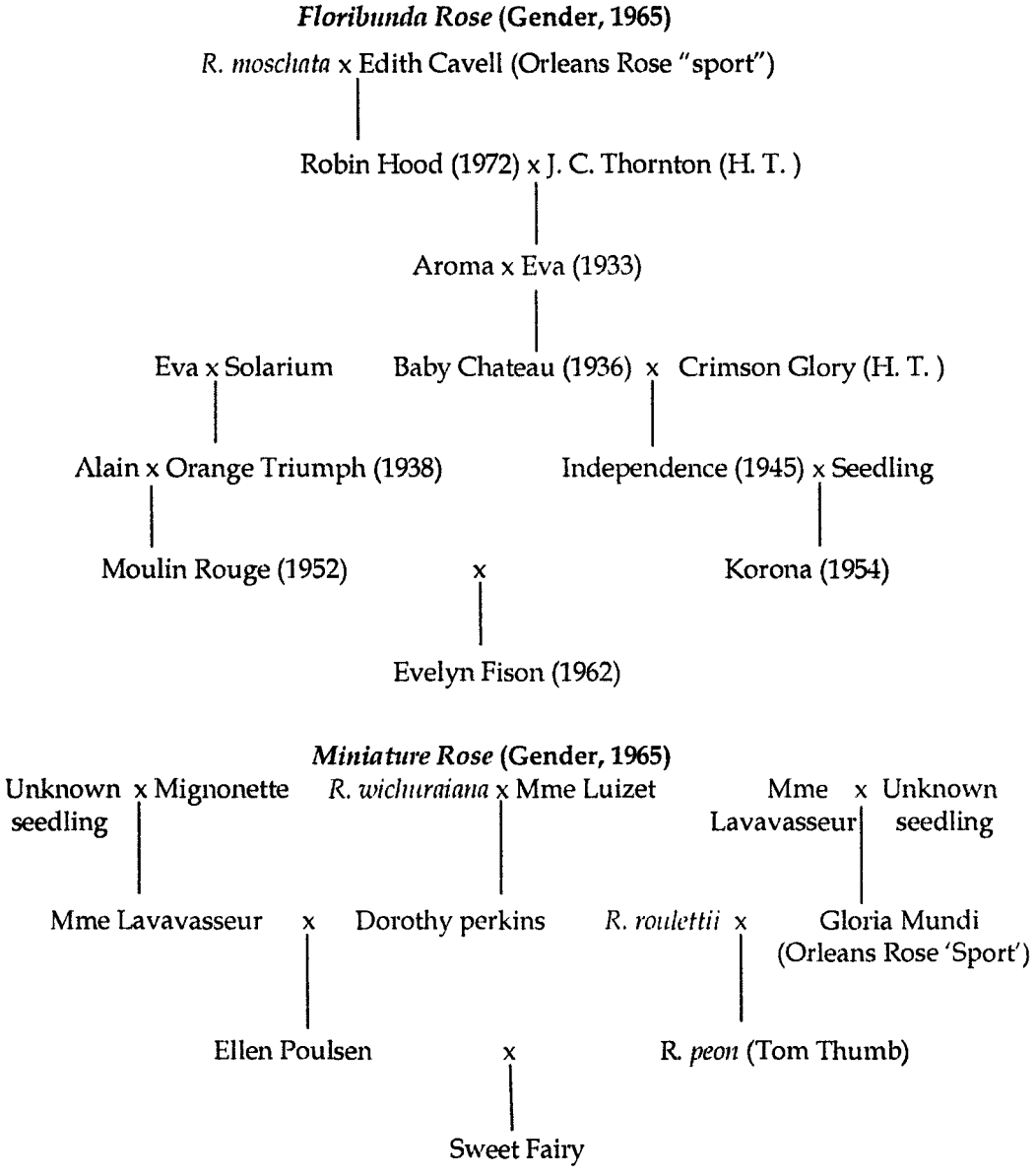
EVOLUTION OF DIFFERENT CLASSES OF ROSES

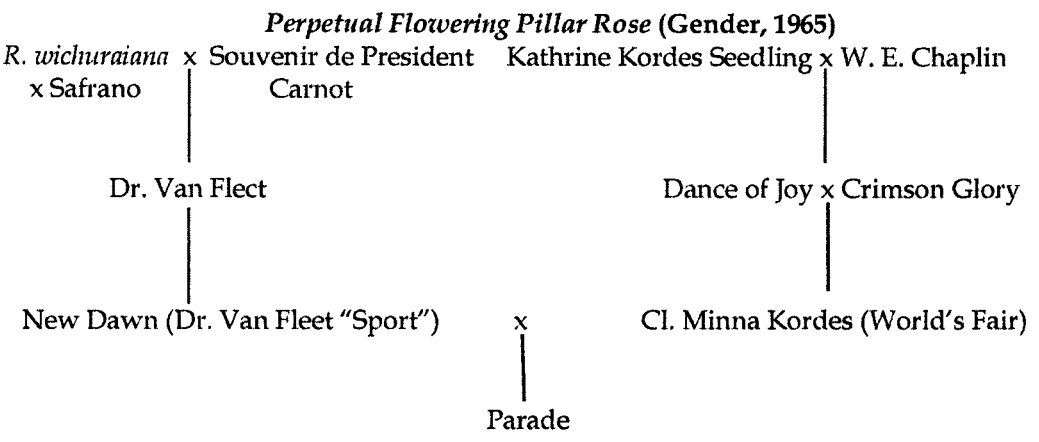
Development of modern rose began with the crosses, made between Chinese and European roses. Results of these significant crosses yielded several types of roses i. e. Portland, Bourbon, Noisette and Hybrid Perpetuals. The crosses between "Parson's Pink China Rose" with *R. damascena bifera* in the Bourbon island resulted in the evolution of "Bourbon" rose. These roses are most attractive and bear abundance of perfectly symmetrical multi-petalled blooms with a delicious fragrance. The Portland Roses are obtained from natural crossing between "Slater's Crimson China Rose" and a plant obtained from crossing the autumn-flowering Damask with the red Gallica rose, noticed by the Duchess of Portland. These are free flowering plant of compact habit with unique fragrance and vivid colouring. The variety "Soleil d' Or" is the first of a new group of bicolours which was later named by the Pernetianas, after their raiser, Pernet-Ducher. Pernetiana group was originally derived from the *R. lutea* in its double form, *R. lutea persiana*, the Persian yellow rose crossed with Hybrid Perpetual. As a result of mating of "Charlotte Armstong" and "Floradora", the variety "Queen Elizabeth" was produced by Dr. Lamnerts, this variety is distinctive in character which are of vigorous, tall growing habit, bearing its Hybrid Tea type flowers singly and in clusters at the end of the long stems. Although this is not first the first Floribunda with Hybrid Tea flowers, this distinctive cultivar has been placed under a new race of plants, called Grandiflora. Pigmy Roses are another group of attractive plant evolved in the USA by Mr. Gene Boerner, Messers Jackson and Perkins which are compact and with exquisite shade of colours and shapes. Dwarf "China Rose Hybrids" are the results of crossing a Tea Rose with *R. multiflora*, while Poliantha Roses were evolved from crossing *R. multiflora* and a China Rose.

The diagrammatic presentation on the evolution of Hybrid Tea, Floribunda, "Miniature" and "Pillar Rose" as given by Genders (1965) are furnished below for the benefit of the readers:

Hybrid Tea Rose (Gender, 1965)




Floribunda Rose (Gender, 1965)
R. moschata x Edith Cavell (Orleans Rose "sport")
Robin Hood (1972) x J. C. Thornton (H. T.)
Aroma x Eva (1933)
Eva x Solarium
Baby Chateau (1936) x Crimson Glory (H. T.)
Alain x Orange Triumph (1938)
Independence (1945) x Seedling
Moulin Rouge (1952)
x
Korona (1954)
Evelyn Fison (1962)
Miniature Rose (Gender, 1965)
Unknown seedling x Mignonette
R. wichuraiana x Mme Luizet
Mme Lavavasseur x Unknown seedling
Mme Lavavasseur
x
Dorothy perkins
R. roulettii x
Gloria Mundi (Orleans Rose 'Sport')
Ellen Poulsen
x
R. *peon* (Tom Thumb)
Sweet Fairy



BREEDING FOR RECURRENT BLOOMING

According to Hurst (1955), presence of one recessive gene in the rose varieties of Chinese origin brought revolution in the cultivation of rose varieties in Europe and other parts of the world. The recurrent blooming in the cultivars of roses is a recessive. While the dominal gene controls non-recurring blooming or restricting blooming to once a year. The transfer of this gene into European varieties through crossing with Chinese varieties has largely helped in evolving recurrent blooming cultivars. Pal (1991) mentioned in his book that there is a variety in Australia called "Lee" which has Chinese origin and flowers continuously there for two years at a stretch. Crossing with such cultivars to achieve the desired objective. Pal (1966) stated that in the presence of the "dominant" from the other form, described as the recessive, does not express itself. This does not mean that the recessive gene is lost forever. It only means that is suppressed for the time beings, but one must wait for it to be passed on through the sex cells to a plant which has received a similar recessive gene from the other parent also. When this happen, the recessive gene express itself, and a character which had hitherto remained masked shows itself.

BREEDING FOR INTRODUCTION OF COLOUR

Pal (1966) reported that the dominant colour in rose is magenta pink or tyrian-rose to rose-red. The pink colour is dominant over dark red, orange yellow, yellow, white and scarlet. Deep yellow colour is recessive to light yellow. White colour is recessive to cream and light yellow. The greenish white colour of cv. "Message" was dominant over pure white of cv. "Virgo", and the crosses among whites or yellows produced hybrids having flower, colours like those of parents only (Swarup *et. al.*, 1973).

Lata (1971) observed that parents having multicoloured or bicoloured flowers produced a range of variability. Cyanidin imparts red colour to flower petals. The pigments like "Chrysanthemin" and "Paenonin" have been identified which produce a red much more brilliant and much less prone to fade than "Cyanidin". To produce the perfect red rose, the breeder may select rose varieties containing large quantities of these pigments in a breeding programme (Datta, 2006). Large quantities of "chrysanthemin" has been found in climbing rose varieties "Dorothy Perkins", "Francois Juraiville" and "Souvenir

de La Malmaison". The rose species like *R. foetida* "bilocour", *R. rugosa* and *R. stellata* and few Floribunda varieties like "Piccolo", "Red Pinocchio" and "Ruby Lips" contain paeonin pigments.

Rosa foetida has provided the genes for the production of an entirely different type of pigment, known as 'Carotenoid", which was responsible for new shades of colours in roses; and it was realised that combining of pelargonidin of the Polyanthas and the carotenoid of the Hybrid Teas should give new types of flower colour (Pal, 1966). While reviewing for the better yellow and orange roses through breeding, Datta (2006) mentioned that Pelargonidin tends to co-exist with the Kaempferol type of yellow rose, but not normally found with the "Quercetin" kind. "Kaempferol" and "Quercetin" are flavonols present in a number of rose species and varieties and generally found in most yellow roses in combination with "Carotenoid" type of pigment. According to him, pigment analysis predicted that a mixture of "Pelargonidin" and "Carotenoid" will produce brilliance of colour in roses.

Marshall and Collicutt (1983) reported that there is positive correlation between cyanin and either or both peonin and pelargonin and many have been due to genes that control the amount of any form of pigment. Such a gene would complicate attempts to eliminate cyanin and concentrate peonina or pelargonin, suggesting that the two pigments complete in some way and, therefore, there would be difficulty in breeding a rose strongly pigmented with both peonin and pelargonin.

Wylie in his Master Memorial Lecture (1955) stated that the recessive factor brought new range of flower colours in the form of brilliant orange hues which was absent in garden roses developed prior to 1930. The pink colour of "Grüss en Coburg" dominated over crimson colour of other parent as represented by three kinds of intervarietal seedlings. Such dominance was also observed by Wylie (1955), Klimenko (1968) and Swarup *et. al.* (1973).

BREEDING FOR DISEASE RESISTANCE

Foliage disease is a problem of ever increasing importance, partly became the appearance of new races of pathogens. Roberts (1979) observed that some varieties of roses standout as being partially resistant to blackspot and some species, like *R. rugosa* and *R. bracteata* seems to be totally immune. Hence to introduce resistant genes in modern varieties is clearly a worthwhile aim and is probably feasible. Sharma and Singh (2002) screened 166 Hybrid Tea roses for Black Spot and observed that none of the varieties was resistant. Despande (1980) reported that nearly 40 varieties of roses showed field tolerance to the powdery mildew diseases of roses.

In an article on recent advances in rose breeding, Gowda (1999) has furnished the following information on disease resistance breeding of roses. The breeding lines "Spotless Gold" (Floribuda, F3 selection, "Goldlocks" x *Rosa Rugosa*), "Spotless Yellow" (Floribunda, F_3 Selection, "Goldlocks" x *Rosa rugosa*) and "Spotless Pink" (Floribunda, F_3 selection "Chic" x *Rosa rugosa*) have been released for used as resistant parents in breeding programmes. Some resistant varieties have been developed through complex hybridisation like "A Mackenzine", "Charles Albart", "Champlan", "William Baffin" etc. resistant to Black Spot and Mildew diseases.

Howden and Jacob (1973) recorded that the *Rosa* species like *R. californica plena, R. devidii, R. fedtschenkoana, R. macrophylla* and *R. spinosissima altacia* possessed resistance to the four different species of rust (*Phragmidium*), this may provide characters useful to rose breeders.

Allen (1970) reported that there is a direct link between powdery mildew resistance and leaf content of anthocyanidins. No such relationship was noted with anthocyanin content.

Field resistance to Black Spot Disease (*Diplocarpon rosae*) depends not only on inherent tissue resistance, but also on conditions of growth, structural and environmental (Saunders, 1966). Resistance is apparently determined by polygenic factors that are inherited independently. According to Steward and Semeniuk (1959) the hybrid polygenic character of modern roses makes the segregation of genetic characters so complex that it is impossible to describe any clear example of Mendelian inheritance of resistance to Black Spot and the inheritance of such resistance is, therefore, nearly impossible to predict. Successful breeding for resistance might be possible by using the more resistant species, such as *Rosa wichuriaina,* and the cultivars of *Rosa* that possess some inherent stability of genetic material during mitosis and meosis. "Allgold" cultivar is one of the few highly resistant roses, but it is not immune. Wylie (1955) concludes that the only way to reach true disease immunity will be from inter-species hybridization, although polyploids and mutations may prove useful.

STRATEGY FOR ROSE BREEDING IN HUMID TROPICS

This would be based on crossing the Noisette "Lamarque" (Syn. "General Lamarque") with *R. clinophylla* Thory (Syn *R. involucrata* Roxb.). Dr. B. P. has described "Lamarque" as "one of the best climbers for the plains" and *R. clinophylla* as "the wild rose of the tropical tracts of India". The first generation should yield heat tolerant climbers and these, when selfed or back crossed on to "Lamarque" would yield recurrent flowered chimbers. Back-crossed with such fertile diploids as "Trier" and "Thisbe" the F2 progeny would include dwarf bedding roses suited to the tropical lowlands (Anonymous, 1977).

MUTATION BREEDING

Mutations are sudden heritable changes in the characteristics of an organism. It is a permanent genetic change, which in trun produces newform. It may be chromosomal, cytoplasmic, or gene mutations. In nature the rate of spontaneous mutation is in very low frequency. In most of the case it is usually recessive, deleterious, random, recurrent in the occurrence and shows pleiotropy due to mutation in closely linked genes. Bud sport and spontaneous mutation has played an important role in origin and evolution of many new and novel varieties of rose. A large number of new varieties evolved as a bud sports or spontaneous mutation in India and abroad which have been reported from time to time.

Roses are very suitable plants for mutation breeding as it plays an important role in producing novelties in flower colour and form. Bi-colour and striped roses developed by this method are very beautiful and added new dimensions among rose cultivars. These value added new roses are in great demand. (Gowda Narayana and Shobha, 1998).

Improvement of rose, (a very heterozygous plant) with complex genetic constituent, through conventional breeding methods is difficult and slow, and does not afford much success indeed, often the gene balance and adaptation of the parent varieties is upset (Kaicker and Swarup, 1972). Mutation breeding offers a new tool for rose improvement where one or two gene can be altered or manipulated without altering or disturbing rest of the genotype. Huang and Chen (1986) while working on mutation breeding in rose detected several mutants with improved characters.

Bud sports and induced mutations have played significant role in origin and evolution of rose. Saakow (1960) studied the history of bud mutation in a number of cultivars and was able to draw some interesting conclusion concerning the time of mutation in relation to the age of the variety, the degree of mutation in relation to the genotype, as well as the tendency for the flower colour to mutate in relation to the flower colour of the initial cultivar. Red and pink colour were generally found to dominate over white, while the degree of filling of the flowers became less with mutations. Climbing types were found to results from mutation rather often.

There was a survey about 5819 rose varieties, marketed from 1937 until 1976, and found that 865 varieties developed from bud sports. Report of the survey revealed that out of 865 varieties 289 were climbing roses. Differences was observed in mutation frequency between classes and varieties. Details of bud sports, their origin, and characters are given in Table 1. Mutation breeding is an ideal method for plant improvement. Physical and chemical mutagen have been successfully used for inducing mutations in rose, however physical mutagens gives better results. Physical mutagens (radiation) like X-ray, Gamma Ray and different chemicals like Colchicines, Ethyl Methane Sulphonate, Methyl Methane Sulphonate, N-nitroso-N-methyl Urethane and Sodium Azide have been widely used by the researchers for evolving new rose cultivars.

X-Rays

Mutation in rose inducing by X-rays has been reported by Gelin (1965). Chan (1966) conducted an experiment on physical mutagenesis on rose. Five rose cultivar viz. 'Peace', 'Queen Elizabeth', 'Better Times', 'Baccara'and 'Tropica' were irradiated with 7 and 8 Krad of X-rays. Number of mutations in flower colour and growth habit was detected after exposure to X-rays. Walther and Saver (1986a, b) reported radio sensitivity of *in vitro* micro-propagated material and determined 4. 5 Krad X-rays as the optimum dose. They used inhibition of shoot as one of the important parameters in this experiment. They suggested that higher dose was needed for induction of flower colour mutations.

Gamma Rays

In India Bhabha Atomic research centre, Trombay, Mumbai, has designed gamma chamber units of different capacities for gamma irradiation. The gamma irradiation source of these units is Cobalt-60. For gamma irradiation bud wood of 13 cm height containing 2 to 4 axillary buds (eyes) are treated with 3, 4, 5 Krad etc. The dose rate and time required for treatment is calculated on the basis of activity of Cobalt-60 source. After irradiation individual eyes are removed and budded on suitable root stocks (Datta, 2006).

Heslot (1966) observed that Gamma Rays have caused a valuable increase in genetic

variation, especially in the Hybrid Tea group. Experiments with Gamma irradiation were conducted by Streitberg (1964, 1966a, b, c, 1967) with 42 cultivars of rose. On the basis of LD50, optimum dose were determined. Differential sensitivity was recorded among the cultivars. Mutation in flower colour and type were also recorded. Desai (1973) and Desai and Abraham (1978) produced flower colour mutation with change in flower petal number in 30 cvs of roses after chronic doses of gamma irradiation.

Nakajima (1965, 70, 73) obtained several mutants from different cultivars of roses (although special attention was paid to cultivar 'Peace'). He studied the effect of different dose rates, including an acute irradiation, with gamma rays and found that 8 Krad (800R/day) gave the highest mutation frequency. By one bud downward cutting back method he observed that the lateral buds develop from fewer cells than other bud and consequently are like to produce apparently non-chimerical mutants. He obtained several promising flower colour mutants such as IRB 480-1 and IRB 480-2 a mutant of cultivar 'Peace' respectively. Bud wood of rose cultivar 'Montezuma' and 'Super Star' along with some scented cultivar were irradiated with different doses of Gamma rays with particular reference to induction of mutation (Gupta 1966; Gupta and Shukla 1971a, b). Mutation in flower colour and shape were detected but could not explain the exact mechanism of somatic mutation and it remains uncertain. They have suggested 4-5 Krad of Gamma rays as optimum dose for induction of mutation. Usenbaev and Imankulora (1974) treated buds of four rose cultivars with 0.5-3 Krad of Gamma rays and detected 20 mutants with change in flower colour and petal number. Lata(1973, 1975) and Lata and Gupta(1971a, b 1975) exposed bud wood (4 Krad) and stem cuttings (2, 4, 6 and 8 Krad) of Gamma rays. Effects of different doses of gamma rays have been studied on oil content of some scented cultivars of Hybrid Tea roses. Survival, cytological features of original and mutant cultivars including their breeding behaviour were also studied.

Lata (1980, 1981) irradiated bud wood of seven cultivars with 3, 4 or 5 krad of Gamma rays and reported the success of budding; shoot length, survival, number of flowers, petal weight, pollen fertility etc. Several mutations in flower were detected, but out of it only three was recorded as true mutants. Gupta and Datta (1983a) included five rose cultivar viz. 'Eiffel Tower', 'Frist Prize', 'Pink Parfait', 'Queen Elizabeth' and 'Super Star' for conducting mutational studies. Bud wood of these five cultivars were irradiated with 3, 4 ad 5 krad of Gamma rays. Reduction in sprouting, survival and plant height and number of leaflets were decreased after Gamma irradiation. Various types of foliage aberrations were observed after irradiation. Somatic mutation in flower colour was induced in the cultivar 'Queen Elizabeth'. Datta and Gupta (1983a, b) and Gupta and Datta (1984) induced yellow flower colour mutant from 3 Krad doses of Gamma rays in rose cultivar 'Contempo'. The original colour of Contempo is orange with yellow eye at the base of petals.

Differential radio sensitivity with respect to sprouting, survival, and plant height were recorded after Gamma irradiation in nine garden rose cultivars (Datta, 1985). Frequency of mutation varied with the cultivar and dose of Gamma rays. In another experiment bud wood of two miniature roses viz. 'Magic Carrousal' and 'Windy City' were irradiated with 3, 4 and 5 Krad of Gamma rays (Datta, 1986a). Reduction in sprouting, survival, plant height and number of flowers and various types of leaf

abnormalities was recorded. Somatic mutations in flower colour were induced in both the cultivars. The original colour of 'Magic Corrousal' is white with red edges, in mutant red colour disappeared from the edges . The colour of 'Windy City' is deep pink and in the mutant colour changed into light pink. Induced flower colour mutations in rose cultivars was recoded in rose cultivar 'Chrysler Imperial' and 'Montezuma' (Kilimenko *et. al.*, 1977).

Preliminary effects of different doses of Gamma irradiation on essential oil contents of *Rosa damascena* has been studied Lata and Murty (1977). Benetka (1985) irradiated rose cutting with 0, 2, 3, 4, and 6 Krad of Gamma rays and on the basis of results, reported 4-5 Krad as the optimum dose. He observed chimera formation after gamma irradiation and found that chimerism decreased with successive vegetative generations due to diplontic dwrift.

Lata (1980) studied the effects of different doses of Gamma rays on different cultivars of roses with particular reference to induction of somatic flower colour mutation. On the basis of her experimental results she concluded that the rose species most often used in producing mutation by radiation are the Hybrid Teas and Floribundas. Gupta *et. al.* (1982) irradiated stem cuttings of *Rosa damascena* with 0, 1, and 2 Krad of Gamma rays. Somatic flower colour mutation was observed after irradiation, which was isolated in pure form.

Datta (1987) irradiated bud wood of two Floribunda viz. 'Nilambari' and 'Sindoor' and nine Hybrid Tea viz. 'Arjuna', 'Golden Time', 'Michelle Meilland', 'Mrinalini', 'Raja Surender Singh of Nalagarh', 'Raktagandha', 'Rose Gaujard', 'Salmon Beauty' and 'Sonia Meilland'. Somatic mutation in flower colour was detected in four cultivars viz. 'Salmon Beauty', 'Raja Surender Singh of Nalagarh', 'Arjuna' and 'Mrinalini'. In another experiment under improvement programme bud wood of seven rose cultivars viz. 'Grenada', 'John F. Kenedy', 'Blue Moon', 'Criterion', 'Garden Party', 'Pasadana' and 'Prestine' were irradiated with different doses of Gamma rays. Induction in somatic flower colour and form were recorded after irradiation (Datta, 1988c, 1989e). Differential radiosensitivity was also observed among the cultivar.

Mutation Breeding work on garden roses by using Gamma irradiation have been extensively carried out (Datta, 1987a, 1988a, 1989a, b, c 1991a and Datta and Gupta 1985a, 1986). Bud wood of rose cultivar 'Mrinalini' (colour Phlox Pink) were irradiated with 3-5 Krad of Gamma rays, along with various morphological characters data were recorded on induction of somatic flower colour mutations (Datta 1988b, 1989d and 1992a). One branch of a plant treated with 3 Krad dose of Gamma rays. Population exhibited mutation in flower colour in the second year after drastic pruning of the branches. The colour of the mutant flower was light pink (Blossom-pink).

Datta (1986b) detected mutant in rose cultivar 'Imperator' after Gamma irradiation in chimeric form and isolated it in pure form. The nature of this mutant is very peculiar because the flower of this cultivar produces bunch of small abnormal flowers at the centre of each flower. Smilansky and Zieslin (1986) studied mutagenesis in roses.

Role of mutation breeding in development of new and novel ornamental plants including rose and its role in floriculture industry was discussed in detail (Datta 1992b). Dohare and Mathew (1991) studied radiobiological effects of 3, 4, 5 and 6 Krad of Gamma

rays on four rose cultivar viz. 'Raktagandha', 'Raja Surender Singh of Nalagarh', 'Jantar Mantar' and 'Neelambari'. In all six types, flower colour mutants were isolated. Analysis of their pigments indicated that change in flower colour was always associated with corresponding change in the cyanidin contents of the petals.

Bud wood of 35 rose cultivars viz. Hybrid Tea 22, Floribunda 9, Grandiflora 2 and Miniature 2 were irradiated with 3, 4 and 5 Krad of gamma rays and budded on rootstock of *Rosa indica* var *odorata* for further growth. Cultivars belong to different group were differentially sensitive to Gamma irradiation. Radiosensitivity of all the cultivars were studied in detail and it was determined from the result that radiosensitivity was genotypically different. LD_{50} dose varied from cultivar to cultivar (Datta, 1991b). In another experiment bud wood of rose cultivar 'Zorina' were irradiated with different doses of gamma rays for induction of somatic flower colour mutation. Datta (1993a) isolated pink colour mutant from rose cultivar 'Zorina' which is Grenadine Red in colour. Datta (1994a) induced creamish yellow flower colour mutant from rose cultivar 'Salmon Beauty' by irradiating bud wood with 4 Krad of Gamma rays.

Mutagenic effects of acute irradiation on Miniature roses have also been studied by the target theory approach. Miniature rose cultivar *Rosa hybrida* bushes of 'Blue Blood' (BB), ' Mountie'(MT), 'Dark Red Mountie'(DM) and 'Pot Luck' (PL) were irradiated with 50, 100 and 200 Gy of Gamma rays to induce mutation. The relation between plant height (H) reduction and absorbed dose (D) could be described as H = A- BD + CD2 in accordance with the production of the multi-hit target theory when A, B and C are constant. The total numbers of mutations were highest in PL. The irradiated plants remained fertile. The range in colour increased substantially for all the cultivars. The number of flowers in an inflorescence decreased for PL, BB and DM but not for MT.

CHEMICAL MUTAGEN

For use of chemical mutagens following three processes are adtoped (Datta, 2006)

(i) About 2.5 cm of a budwood containing 2-4 axillary buds can be dipped in a desired concenration of mutagen for a specific period.

(ii) Axillary buds are removed and dipped in desired concentration of chemical mutagen for a disired time.

(iii) Shoot apex or axillary buds are covered with cotton and chemical mutagen is applied periodically upto the desired time and then cotton is removed.

Heslot (1968) stated that chemical mutagen on vegetative buds of rose proved mutagenic in diploid and polyploid cultivars, he opines that there are better chances of high frequency of mutants in case of spontaneous periclinal chimera. Gupta and Datta (1983a) treated bud wood of rose cultivar 'Contempo' (Orange with yellow eye at the base of petal) with 0. 025 and 0. 125% colchicines for four hours. Reduction in sprouting, survival, sprout height and branch and flower number were recorded after colchicines treatment. Somatic mutation in flower colour was induced. The mutant colour was Tangerine Orange and Empire Yellow. Datta and Gupta (1985b) carefully operated eyes from bud wood of rose cultivar 'Contempo' and treated them with 0. 0625% and 0. 125% aqueous solution of colchicines for four hours. Delay in sprouting and reduction in

survival was recorded after treatment with higher concentration of colchicines. Different types of leaf abnormalities were recorded after the treatment. Somatic flower colour mutation was detected in 0.0625% treated population. The colour of the mutant flower was yellow. Murugesan *et. al.*, (1993) used tuber extract of *Gloriosa superba* to induce mutation in rose cultivar 'St. Boniface'. Mutations were induced for stalk length, flower diameter, petal size and number.

Khalatkar (1986) recommended treatment of axillary buds with different concentration of colchicines or chemical mutagens (Ethyl Methane Sulphonate (EMS), Sodium Azide) for creating novelties in rose cultivar. Datta (1994c) used colchicines for inducing flower colour mutation in rose cultivar 'Contempo'. Results of the experiment clearly indicated that colchicine induces similar mutagenic effects in bud wood of rose as those produced by Gamma rays and other mutagen.

COMBINED TREATMENT

Dommergues *et. al.*, (1967) made an effort to study the combined effects of physical (Gamma rays) and chemical (Ethyl Methane Sulphonate, EMS) mutagens among diploid, triploid and tetraploid cultivars. In this experiment one year old plants were treated with 8-9 Krad of Gamma rays and 0.5 to 0.8% EMS for 24 hours. Differential sensitivity to both the mutagens was recorded among the cultivars. Gamma rays were found to be more effective in inducing mutation especially in polyploid cultivars.

Heslot (1966, 1968) conducted experiments on same line. She was able to induce mutation through Gamma irradiation dose of 4-8 Krad, and suggested that mutation breeding is an ideal method for plant improvement. She treated the material with chemical mutagen i. e. EMS (8ppm) in diploid, triploid and tetraploid cultivars and detected a wide range of mutation in flower colour. Mutation could be explained as consequences of pre-existing periclinal chimerism.

Kaicker and Swarup (1972) irradiated dormant buds of three cultivars viz. 'Christian Dior', 'Kiss of Fire', and 'Queen Elizabeth' with 5, 7.5 and 10 Krad of gamma rays and several chemical mutagens like Ethyl Methane Sulphonate (EMS), N-nitroso-N-methyl Urethane (NMU) and Ethylene a imine (EI). Flower colour mutations were detected from physical and chemical mutagen treated plants. It has been possible to obtain mutation for flower colour in three cultivars of rose after Gamma irradiation, which might be of direct commercial importance. 5-10 Krad of Gamma rays has proved to be the best for treatment of dormant buds. Dormancy of buds is induced after both Gamma irradiation and chemical mutagens. They have reported that physical mutagen i. e. Gamma rays to be more effective and useful for inducing mutations in rose. They explained that irradiation can be a better tool for improvement, where female sterility is the barrier (as in case of some triploid and aneuploid varieties) for conventional breeder as for example, the growth habit of the plant is maternally inherited, and by breeding using aneuploid it will not set any seed.

Arinshtein and Krapivenko (1980) injected rose shoot with N-nitroso-N ethyl Urea (NEU) repeatedly and pruned the shoots by cutting back twice to eliminate chimera formation. Mutations were detected but they were not of commercial grade. Smilansky *et. al.* (1986) treated stem cuttings of rose cultivar 'Mercedes' with Gamma rays and Ethyl

Methane Sulphonate (EMS) and came to conclusion that Gamma rays to be more effective in inducing mutation in comparison to EMS. Results of their experiment, concluded that individual budding on rootstocks was more effective than cutting-back in the isolation of mutations.

TABLE 1
Rose Cultivars Evolved as Bud Sports in Nature

Name of Bud Sport/Group	Original Cultivar	Color, Form and Blooming Behaviour of Bud Sport
"Aba Saheb" HYBRID TEA C.R.Chiplanker (Decospin) 1993	"Modern Art"	Striped bicolour mutant. Petals having light orange stripe painted and streaks on deep orange red with white reverse. Outer petals show stripe of deep red. Showy flowers with perfect shape and form. Named in memory of late Aba Saheb Alias A.G. Kulkarni of Maharashtra.
"Abhisarika" HYBRID TEA.(Stripe) IARI, 1977	"Kiss of Fire"	Petals are having yellow background with striking red stripes. Colours of the petals are so often changing.
"Ahalya" FLORIBUNDA G.Kasturirangan (KSG Son) 1989	"Summer Snow"	White blooms appears in clusters, compact and unbelievable frequency of blooming.
"Anant" HYBRID TEA C.R.Chiplunkar 1991	"Havana"	Perfectly shaped long buds open to medium size lovely blooms. White stripes on soft pink petals with an occasional lilac flush.
"Bella Weiss" FLORIBUNDA Kordes , 1989	"Bella Rose"	Flower is well shaped and appears in large clusters. Colour is white.
"Calcutta 300" HYBRID TEA Swami Vinyananda and K. Bhattacharya, 1994	"Taj Mahal"	Petals are having well marked stripes, streaks and patches of white marks on bright pink. It is a very showy striped rose. Large flowers are very attractive.
"Ceearcee" HYBRID TEA Jayant and Anand Gokhle 1995	"Dolly Patron"	Highly fragrant rose. Petals are having light pink stripes on vermillion, prominently displayed all over the surface.

Contd...

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1	2	3
"Climbing Guitar" FLORIBUNDA G.Kasturi Rangan 1974	"Guitar"	Climbing sport of "Guitar"
"Climbing Kronenberg" HYBRID TEA G. Kasturirangan (KSG Son) 1973	"Kronenberg"	Climbing sport is free flowering and blooms appears in clusters
"Climbing Matangi" FLORIBUNDA C.R.Chiplunkar Decospin 1985	"Matangi"	It is a very free flowering climbing sport of "Matangi"
"Climbing Pussata" FLORIBUNDA B.K.Patil, Icospin 1987	"Pussata"	Flowers are having dark red colour. Free flowering and long lasting.
"Climbing Sonia Meilland"	"Sonia Meilland"	Flowers are very freely produced. It is a climbing bud sport of rose cultivar "Sonia Meilland".
"Cyclamen La Sevillana" FLORIBUNDA Meilland 1992	"La Sevillana"	Hardy plant producing enormous number of blooms in cluster. Very free flowering in well spaced tresses. Flowers are bright pink.
"Deccan Delight" FLORIBUNDA C.R.Chiplunkar 1985	"Anita"	Buds are yellow to apricot in colour. Outer double row of petals orange changing to orange and white bicolour.
"Deccan Delux" HYBRID TEA C.R.Chiplunkar 1988	Dr.B.P.Pal	Flowers are lavender pink in colour with all its characteristics of the parent. Huge, double flowers shaped on long stems. This cultivar is very good for cuttings and exhibition purposes.
"Double Delight Supreme" C.R.Chiplunkar 1993	"Double Delight"	Petals are having mixture of ice cream pink and cream stripe both mix up in central, with bright strawberry red edges of outer petals.

Contd...

...Contd.

1	2	3
"Dr. Noshir Wadia" HYBRID TEA C.R.Chiplunkar 1992	"Norma"	Flowers are having very attractive and unusual stripes on both sides of petals. Colour is dark red with plenty of white and pink stripes giving a white mosaic pattern.
"Durgapur Delight" HYBRID TEA K.D.Gupta 1980	"Montazuma"	Free flowering. Colour of the blooms are light porcelain pink.
"Elizabeth of Glamis" FLORIBUNDA 1982	"Orange Elizabeth Glamis"	Flowers are perfect and orange in colour. Shapely buds open spirally to flowers of good forms and substances, long lasting and free flowering. Enchanting coloured flower is having brilliant, luminous, vermilion petals with white centre and reverse.
"Family Circle" HYBRID TEA Meilland 1978	"Sonia Meilland"	Blooms of the sports are pale rosy pink in colour with all the good habits of parent. Buds open slowly into a classically perfect bloom of exquisite form and shape with petals of substance. Very free flowering and good for cutting.
"Fred Loads" FLORIBUNDA Blestoglivle Ogilivie,1986	"Festival Fanfare"	It is a low growing plant with clusters of flowers borne most frequently. Flower colour is cherry red.
"Halley's Comet" FLORIBUNDA 1988	"Tip Top"	Bud appears in clusters. Flowers are produced from vigorous bush. Blooms are large, shapely well formed and slightly fragrant. Flower colour is pale lilac.
"Ico" HYBRID TEA B.K.Patil Icospin, 1985	Deep Purple	Elegant buds having light chrome yellow colour. Blooms bear perfect shape with high centred blooms of quality, free flowering. Good for cutting and exhibition.
"Ico Ambassador" HYBRID TEA B.K.Patil Icospin 1988	"Ambassador"	Sleek bud having pink colour with high centred flowers. Buds open slowly to high centred flowers having 25-30 petals.
"Ico Beauty" HYBRID TEA B.K.Patil, Iscopin 1985	"Red Planet"	Free flowering. Leaves have glossy surface. Disease resistant variety.

Contd...

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1	2	3
"Ico Delight" HYBRID TEA B.K.Patil, Icospin 1989	"Eterna"	Buds are long open to beautifully formed classical white blooms. Flowers are large, double, slightly fragrant and produced on upright plants. Very good for cut flower and ideal for exhibition.
"Ico Delux" HYBRID TEA B.K.Patil, Icospin 1990	"Mistratine"	Flowers are well formed with broad petals. Colours of the blooms are pale pink.
"Ico Pearl" FLORIBUNDA B.K.Patil, Icospin 1990	"Dearest"	Buds are globular. Flowers are double and large with pink shaded apricot colour. Plant growth is vigorous with bushy habit.
"Ico Talk" FLORIBUNDA B.K.Patil, Icospin 1993	"Double Talk"	Flowers with pronounced light pink stripes on both side of the petals of the bicolour rose. Buds are Hybrid Tea type and blooms freely, borne singly and in clusters.
"Ico Trimurthi" HYBRID TEA B.K.Patil, Icospin 1989	"Yeshwant"	Flowers are striped. Colour is pale rose pink with an outside yellow having white stripes and splashes on inside of the petals. Plant is vigorous and bushy in nature.
"Insat" HYBRID TEA Dr.Y.K.Hande 1985	"Gauri"	Flowers are medium size and very attractive, long lasting and free flowering. It is a superb stripe rose cultivar. Petals are having white streak on dusky red background.
"Invention" HYBRID TEA B.K.Patil, Icospin 1988	"Anvil Spark"	Plant is vigorous. Buds and flowers are generously produced on plants. Shapely buds and flowers are well formed. Flower colour is salmon and deep carmine.
"Jaslok" HYBRID TEA C.R.Chiplunkar 1992	"Blue Ocean"	Flowers are striped. Colour light silvery mauve petals marked clearly, dark mauve stripes. Fully large double flowers with plenty of petallage, shapely, well formed. Named after the famous Jaslok Hospital.
"Joan Bell" FLORIBUNDA J.Bell 1990	"Big Chief"	Strong bush of rose is having lovely buds and flowers, which are shapely and well formed. Flower colour is crimson.
"Jogan" HYBRID TEA O.P.Bansal, 1988	"Folklore"	Buds and Flowers are beautifully shaped and most exquisite. Flower colour is robe-a pale apricot reminding of Jogan (Sanyasin)

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1	2	3
"Kanak" FLORIBUNDA Sunil Jolly 1986	"Charisma"	Free flowering long lasting variety. Flowers are pale yellow with petal edges blended with pale pink. Good for beds and individual planting.
"Kusum" FLORIBUNDA Vasant S.Padhye 1978	"Fusiler"	Clusters of buds appear with pale pink, long lasting flowers, which are produced in amazing frequency.
"Malak-Mahendra Kumar" HYBRID TEA S. Shah 1988	"Admiral Rodney"	Flowers are high centred and shapely. Flower colour is blend of ivory and pale pink. Petals are quite large.
"Mohak" HYBRID TEA C.R. Chiplunkar 1993	"Summer Holiday"	Flowers are having bright as well as pale vermilion splashes and patches on both side of light orange petals with all good characters of the parent.
"Malkar Siddha" HYBRID TEA B.K.Patil, Icospin 1988	"Century Two"	Bushy plant having leathery foliage. Flowers are large and double. Abundant blooms are produced from sturdy vigorous plants. Long pointed buds open to slightly fragrant high centred huge blooms produces on freely upright shoots. Flower colour is porcelain pink.
"Nav Sadabahar" FLORIBUNDA IARI 1980	"Sadabahar"	Flowers are very profuse blooming and very attractive. This bud sport of "Sadabahar" is having creamy white stripes on the pink petals.
"Panch Ganga" HYBRID TEA B.K.Patil 1993	"Yeswant"	Flowers are large, huge, and double. High centred of exhibition standard. Beautiful stripes and splashes appear on pink petals. Named after holy river *Panch Ganga* of Kolhapur District.
"Pink Melody" HYBRID TEA Kasturi and SriRam KGS Son 1993	"Pasadena"	Buds and flowers have perfect shape. Free flowering and very lasting. Flower colour is pale salmon pink and rest of the characters is like parent. Very good as cut flower.
"Papa Pirosha" HYBRID TEA S.P.Bulsara 1990	"Yankee Doodle"	Buds are tight elegant, well formed shapely. Flowers lasting on long cutting stem. The colour of the bloom is unusual greenish yellow.
"Priti" POLYANTHA KasturiRangan (KSG) 1971	"Morgo Koster"	Flowers are having soft pink to white colour. Prolific flowering.

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1	2	3
"Rangatarang" HYBRID TEA C.R.Chiplunkar 1993	"Anant"	Stripe mutant of "Anant" which itself is a stripe mutant of 'Haseen'. Petals are light pink having stripe and splashes of pink on both side of it. Outstanding cultivar, is vigorous and blooms profusely.
"Rare Edition" FLORIBUNDA G.KasturiRangan 1982	Kusum (Pink sport of Fusilier)	It is a most attractive and outstanding stripe cultivar of rose. Flower is having stripe pink shade. Blooms are luminous scarlet with white splashes and stripe, borne in clusters in well-spaced tresses, repeat flowering.
"Ratan" HYBRID TEA S.P.Bulsara 1990	"American Heritage"	Plant growth is robust and upright. Flowers have appealing lemon yellow colour. Well-shaped buds and flowers appear on long canes.
"Rose Bansal" HYBRID TEA Friends Rosary 1974	"Anvil Spark"	It's a very pretty cultivar. The colour of the petals is yellow orche and copper blend.
"Rose City of Nasik" S.P.Bulsara 1990	"Christian Dior"	Flowers are good for exhibition. Flowers are deep pink. named after city of Nasik.
"Rosy Chandrakant" MINIATURE More 1993	"Don Don"	Loads of flowers appear on branches, which are rosette shaped with innumerable petals. Fully double flowers are long lasting.
"Sahasra Dhara" HYBRID TEA Arpi Thakur 1981	"Century Two"	Plant is vigorous. Classic buds are broad in shape. Flower is large and full of fragrances and its colour is deep pink with white stripes.
"Satvika" HYBRID TEA B.K.Patil, Icospin 1994	"The Lady"	Buds are shapely and flowers are lasting and profuse blooming. Petals are having soft salmon with pale yellow shading. Some flowers have streak and splashes of white to cream. No two flowers are alike.
"Shoba" HYBRID TEA Friends Rosary 1988	"Otohime" (Japanese Rose)	The blooms are large, double well formed and repeat flowering. Petals are having beautiful chequered lines of white and salmon orange.

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1	2	3
"Shri Swamy Samsth" HYBRID TEA B.K.Patil 1992	"Gladiator"	It is a superb cut flower rose of west India. Flower colour is pink and rests of the characters are exactly same as parent.
"Siddarth" HYBRID TEA G.KasturiRangan 1973	"Christian Dior"	Beautiful flowers having stripes and splashes of white and cream etched on the red petals making the already well known variety more popular.
"Supriya" HYBRID TEA Dr.N.C.Sen 1982	"Princess Margaret of England"	Flower is pink having cream and white splashes and stripe. Blooms are perfectly shaped and having good perfume.
"Suvarnarekha" HYBRID TEA Tisco nursery 1981	"Soraya"	Plant growth is vigorous. Flowers are well formed. Flower colour is vermilion orange with stripe of golden yellow, pronounced more on the reverse of petal.
"Swagatham" HYBRID TEA B.K.Patil, Icospin 1988	"Surkhab"	Buds are produced on vigorous plant. Plant having globular buds and cup shaped large, double and fragrant flowers, which are freely produced. Colour of the flower is light pink, hand painted strains on inside of the petals with apricot white reverse.
"Super Star Supreme" FLORIBUNDA Weeks 1985	"Super Star"	Flowers are long lasting exceptionally vigorous bush. It has all the desirable characters of the popular rose cultivar with a more reddish orange colour of its own.
"Tapti" HYBRID TEA G.Kasturi Rangan (KSG sons) 1978	"Camelot"	Flowers are delicate pink in colour. Higly centred blooms, which later on turns cupped shaped. Huge flowers lasting with spicy fragrance.
"Tata Centenary" HYBRID TEA Telco nursery 1979	"Pigalle"	Flowers are large, scented, deep purple mauve splashed with pale yellow stripes on inside of the petals with pale yellow on reverse.
"Tenth Rose Convention" HYBRID TEA B.K. Patil, Icospin 1990	"Brandy"	Blooms are free flowering, shapely well formed. Striking deep orche yellow in colour. Flowers are vigorous, fragrant, with broad petals and long lasting.

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1	2	3
"Thornless Beauty" FLORIBUNDA B.K. Patil, Icospin 1990	"City of Lucknow"	Plant is thornless with large semi double flowers appears in big clusters. Blooms are slightly fragrant.
Vishveswaraya HYBRID TEA Gotmare 1987	"Tourmaline"	Buds are elegant, long, tapering. Flowers are white with blends of pink stripes and shading. Blooms are highly centred and well formed. Named after the great Sir M. Vishveswaraya.
"White Queen Elizabeth" GRANDIFLORA K.Alban 1972	"Queen Elizabeth"	It's a white bud sport of "Queen Elizabeth" possessing all its virtues. Flowers are big elegant formed with classical shape.
"Yeshwant" HYBRID TEA B.K.Patil, Icospin 1985	"Suspence"	Flowers are large, double and highly scented. Blooms are bicolour with stripes and splashes of white and yellow on inside the petals. Named in the memory of late Y.B. Chavan

Irradiation have been tried on many varieties of roses in different countries and changes in colour, size and form of flowers and in growth habit have been reported. When scienfific studies have proceeded to the point where the effect of irriadiation on a rose cultivar of a given type can be predicted with reasonable confidence, breeders might be persuaded to use irradiation, in conjusation with conventional breeding techniques, with very execting results.

TABLE 2

Original Parents, Induced Mutants, Mutagen used and Their Flower colour along with Breeders Name and Year of Release as New cultivar

Original Parent/Flower Colour	Mutant Name/Colour	Mutagen Used	Name of Breeder/ Year
"Contempo"/Orange	Yellow Contempo/ Yellow	Gamma Rays	Datta, and Gupta, 1982.
	Stripe Contempo/ Yellow and orange stripes	Gamma Rays	Datta and Gupta, 1982
	Pink Contempo/Pink	Gamma Rays	Datta and Gupta, 1982
	Tangarine Contempo/ Tangarine Orange	Gamma Rays	Datta and Gupta, 1982

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Original Parent/Flower Colour	Mutant Name/Colour	Mutagen Used	Name of Breeder/ Year
"Mrinalini" / Pink	Mrinalini Lighter/ Lighter Pink	Gamma Rays	Gupta *et. al.*, 1989
	Mrinalini Stripe/Pink and White stripes and splashes	Gamma Rays	Gupta *et. al.*, 1992
"Queen Elizabeth"/ Pink	Saroda /White	Gamma Rays	Datta and Gupta, 1984
"Junior Miss"/Pink	Sukumari / Light Pink	Gamma Rays	Datta and Gupta, 1984
"Windy City" /Pink	Windy City / Lighter Pink	Gamma Rays	Datta and Gupta, 1982
"Imperator" / Red	Imperator / Pink	Gamma Rays	Datta and Gupta, 1983
	Twinkle/ Red and white spots	Gamma Rays	Datta and Gupta, 1983
"Arjun"/ Pink	Arjun / White	Gamma Rays	Datta and Gupta, 1983
"Zorina" / Red	Zorina /Pink	Gamma Rays	Gupta *et. al.*, 1993
"Christian Dior"/ Red	Christian Dior /Pink	Gamma Rays	Kaicker and Swarup, 1972
	Christian Dior Stripe/ Red and Pink	Gamma Rays	Kaicker and Swarup, 1972
"Queen Elizabeth"/ Pink	Queen Elizabeth Stripe/ Pink and White	Gamma Rays	Kaicker and Swarup, 1972
"Kiss of Fire"	Kiss of Fire / Stripe	Gamma Rays	Kaicker and Swarup, 1972

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5

BIOTECHNOLOGY

The genetic transformation of ornamental plants will considerably enhance the existing efforts of traditional and *in vitro* breeders in the generation of new crops. Genetic engineering strategies are highly desirable for rose as they facilitate the introduction (or modification) of single traits without disruption of pre-existing commercially valuable phenotype characteristic of the target variety. These new molecular techniques provide opportunity to alter specific characteristic such as plant form, colour, and pest and disease resistance. Traditional plant breeding continues to be principal source of new cultivars and varieties for ornamentals market. Breeders have selected for many phenotypic characters such as flower colour and shape, foliage colour and type, insect and pest resistance, leaf forms, plant stature, plant vigour and scent. Traditional breeding has certain limitation, most obvious being the limited gene pool contained within the species. For example, it is not possible to breed for a blue rose because the gene(s) required for this colour is not present in the gene pool of these plants.

Genetic improvement of *Rosa hybrida* L. cultivars for improved vase life and disease resistance, among other characters, can be more efficiently achieved via genetic engineering efforts using somatic rather than zygotic tissues (Chi-ni-Hsia and Schuyler, 1996). Somatic hybridization can also be used as a tool for plant improvement. This requires efficient protocols for the isolation of protoplasts, re-establishment of colonies of dividing cells and regeneration of plantlets. Despite the potential use of protoplasts for rose improvement, there are few reports of their culture and none concerning their regeneration of plants.

Genetic engineering, the insertion of gene from one plant to another is being to impact the development of important ornamental plants. The key bottleneck of the ability to transfer rose is the difficulty of regenerating a rose plant from a single transformed cell. Mol *et. al.*, (1995) reported that roses are now routinely transformed.

Plant transformation generally consists of three steps:

(a) The transfer of foreign DNA into plant cell

(b) Selection of transgenic cells

(c) Regeneration of complete plants from transgenic cells.

Each step needs careful optimization of different procedures and parameters. They are usually very dependent on species and variety. It has been suggested that when one cultivar is recalcitrant, other available cultivars should be considered as targets transformation.

David (2005) while working with rose cultivars of different ploidy levels, analyzed the regeneration ability of a range of roses varieties as well as progeny indicated that this regenerative ability is genetically controlled. Unfortunately, most cultivars do not regenerate readily.

Regeneration and transformation techniques have been developed for roses (Short and Roberts, 1991), Robinson and Firoozabady (1993), Chakrabarty *et.al.* (2000) and David (2005) . The somatic embryogenic callus line isolated by Noriega and Sondhal (1991) from the hybrid tea rose cultivars 'Royalty' has been transformed by Firrozabady *et. al.*, (1994). They co-cultivated the callus with *A. tumefaciens* **LBA4404/pJJ3931** (pnos **NPTII/p35LUC** or *A. rhizogenes* **15834/pJJ3499** (pons **NPTII/p35SGUS**). Selection of transformed callus was performed using 300 mg ml^{-1} kanamycin. Transgenic plants regenerated from the independent transformed calluses were shown by PCR to contain the transgene. All plant produced were reported to be morphologically normal.

R. persica x xanthina has also been transformed via co-cultivation of protoplast with *A. tumefaciens* **LBA4404** using hygromycin as the selective agent. Transformed callus that stably expresses the GUS gene has been produced (Robinson and Firoozabady, 1993). Many workers have successfully transferred roses, however still with poor efficiency. There is only one another report on successful establishment of long-term, repetitive embryogenic cultures of rose (Noriega and Sondahl, 1991).

The protocol of Noreiga and Sondahl (1991) was effectively utilized for genetic transformation of rose by a novel Agrobacterium mediated system and about 100 of these regenerated, transgenic roses have flowered in the green house (Firoozabady *et. al.*, 1994). They obtained transgenic rose plantlets from embryogenic callus of 'Royalty' but again indicated that induction of embryogenic tissues in rose cultivars was a rare event.

Vander Slam *et. al.*(1997) reported production of **ROL** gene transformed plants of *Rosa hybrida L.* and characterization of their rooting ability was studied by them in detail. They regenerated transgenic plants from roots derived from stem slices of root stock *R. hybrida* cv.' Money Way' following co-cultivation with *A. tumifaciens* strain. GV3101 containing the **nptII** gene and individual **rol** genes from *A. rhizogenes.*

Merchant *et. al.*, (1998) reported biolistic transformation of rose. A reproducible method has been developed for the biolistic transformation and regeneration of transgenic plants from embryogenic culture of rose (*Rosa hybrida* L.) cv'Glad Tidings'. In this case DNA delivery was optimized using **β- glucuronidase** (Gus) gene. The distance between the stopping screen and target explants and supplimentation of pre and post bombardment culture media will 0.25m myo-inositol influence the transformation efficiency. Prior to selection of culture media containing 250mg l^{-1} Kanamycin sulphate, embryogenic calli were bombarded, using optimized gene delivery parameters, with a plasmid carrying the neomycin **phosphotransferase** (npt II) gene. Somatic embryo derived kanamycin-resistant plants were regenerated and subsequently transferred to glass house conditions. Kanamycin resistance of calli and plants confirmed transformation. NTP II ELISA assay and southern analysis. All transgenic plants were morphologically normal and true to type.

'Glad Tidings' and this procedure should be applicable to other rose cultivars. In turn, this DNA delivery option will be evaluated for the introduction of genes relevant to rose improvement, ultimately leading to commercially improved cultivars.

Rout *et. al.* (1999) discussed recent progress in the field of biotechnology of rose. They opined that available methods for the transfer of gene could significantly shorten the breeding procedure and overcome some of the agronomic and environmental problems, which would otherwise not be achievable through conventional method. The recent available techniques along with several other biotechnological approaches designed to enrich the genome of *Rosa* via somaclonal variation and genetic transformation were discussed. Results of their studies clearly demonstrated that all new plant produced were morphologically normal.

GENOMICS OF ROSE SCENT

Floral scent of rose is another important factor in consumer choice. It is said that the current cut-flower roses do not smell as good as old-fashioned roses. There are large varieties of volatile chemical compounds, which act to stimulate and attract pollinators. The floral scent is a complex blend of substances. The scent compounds have been studied chemically, partly because of their usefulness to the fragrance industry.

Ackermann *et. al.*, (1989) studies β-glucosides of aroma components from petal of *Rosa* species . Assay, occurrence and biosynthesis implications were studied in detail. Flament *et. al.* (1993) studied the volatile constituent of rose from living flower emission. They have discussed that specific causes of the loss of fragrance during the course of breeding programme remain unknown. They explained that several solution have been targeted of volatile compounds emitted by old rose cultivars and hundred of different compounds representing the three main pathways. Phenyl propanoids, fatty acid derivatives and terpenoids have been identified in different species and varieties. They have suggested that rose petal represent an excellent system for the application of modern genomic technologies in the search for novel genes involved in fragrance production.

Guterman *et. al.*, (2002) made an attempt to study rose scent and its genomic approach to find out novel flower fragrance related gene. They have used genomic techniques to identify novel scent related genes, using rose flowers from tetraploid scented and non-scented cultivars. An annonated petal EST database of more than 2100 unique genes from both the cultivars was created, and the DNA clips were prepared and used for expression analysis of selected clones. Detailed chemical analysis of volatile composition in the two cultivars, together with the identification of secondary metabolism related genes whose expression coincides with scent production led to the discovery of several novel flower scent related candidate genes, including a **germacrene D synthase** was biochemically determined using *Escherichia coli* expression system.

Their finding clearly demonstrates the advantages of using the high throughput approaches of genomic to detail traits of interest expressed in cultivar specific manner in nonmodel plant. By combining EST database mixing with metabolic profiling and micro assay expression on analyses, they were able to identify several novel genes involved in fragrance production in rose petals. On the basis of their results they concluded that scent

production and emission peak at the advanced stage of flower development, during cell expansion. The large red FC flower possess a strong scent, accumulate anthocyanins and have a short vase life, whereas the small yellow flowers of GG accumulates carotenoids, have a long vase life, and lack a distinct odor.

GENOMICS OF BLUE ROSE

A clear cut understanding of biochemistry of a target species can be of great benefit in developing a genetic engineering strategy for the modification of flower colour. The type and amount of the different flavonoides present in a particular flower can be established using variety of well-developed techniques. Extensive flavonoides surveys have been carried out for some important ornamentals, however similar research for flower colour by carotenoides has only been reported for a very few species of rose (Eugester and Marki-Fisher, 1991).

The chemistry of rose pigment has been studied in detail by Eugester and Marki-Fisher (1991). In the first application of the technology for producing novel commercial plant lines, both sense and antisense genes were constructs used to inhibit the activity of the enzyme **chalcone synthase** (CHS). Co-suppression from sense construct of **CHS** has also been used to obtain a range of lines with reduced flower colour intensity from deep-red coloured *Rosa hybrida* cv. 'Royalty' (Courtney-Guttrerson, 1994). Unexpectedly, from both sense and antisense experiments, plant lines with patterning of floral pigmentation have arisen.

One of the most challenging, important and significant developments of genetic engineering is the tailoring of blue gene with particular reference to synthesis of blue rose. Rose cultivars cannot synthesize blue pigment **delphinidin** due to lack of the enzyme **dihydrokaempferol 3'5' hydroxylse**. Success has been achieved by companies in joint venture on this line when Calgene Pacific Company at Melbourne, Petunia Genetics Group at the Institute National de la Recherche Agronomique, Dijion, France and Suntory Limited of Japan worked jointly and successfully isolated blue gene by using Petunia in first phase of experiment and in second phase standardized the technique to transfer the blue gene to roses. Attempts are going on to introduce blue gene in creamy yellow rose variety and to maintain the alkaline pH of the end product (Dalling, 1991). Petunia flower colour, pigmentation patterns and anthocyanin composition, have been changed with sense or antisense constructs of the **F3'5'H** gene under the control of the **CaMV 35S** promoter (Mayer, 1991; Schimade *et. al.*, 2001).

The Genetic Manipulation Advisory Committee (GMAC, Australia) has announced a Planned Release of approximately 1200 "transgeneic blue roses" from Florigene (**PR-35, GMAC**). This glass house trail was aimed to test the growth and productivity of the transgenic roses under the conditions of the commercial rose flower production. Some of the transgenic plants will also be used as pollen source to fertilize non-transgenic plants, in attempt to introduce the 'Blue Gene" in to other cultivars. To develop a stable species of true blue roses will take some more of time. However the genetic engineering technology might open a new avenue of adding a million beautiful blue roses into various gardens in the next few years.

FLOWER SENESENCE

To determine the value of rose crop, post harvest longevity of cut flowers is very important. This is particularly very true, given the global nature of the flower industry and the necessity for lengthy handling and transformation times. Recent developments in the isolation, manipulation and transfer of gene have resulted in real possibility of delaying senescence. It is now known that flower senescence is highly regulated developmental event requiring active gene expression and protein synthesis. It had already been discovered that phytohormone ethylene regulate senescence and genes in the regulation have been identified (Datta, 2006). Rapid development in molecular techniques for plant transformations, especially identification of ethylene biosynthesis pathways, has opened the way for developing improved varieties with increased post harvest longevity (Adams and Yang, 1979; Woodson, 1991).

PROTOPLAST FUSION

Somatic hybridization or protoplast fusion is an ideal tool for creating new and novel cultivars of plant and very helpful for development of elite varieties. Somatic cells are non sex cell that contains double the genetic content of the gametes. These cells are used in protoplast fusion. The protoplast fusion is a union of two somatic cells from two different selected parents. Fusion of these two somatic cells protoplasm resulted into formation of hybrid cells, which is viable and can grow into a plant. This type of hybrid cells contains the complete genome of both the cells.

A new approach to improvement of somatic hybridization is now possible with recent success in regeneration from protoplasts (Mathews *et. al.*, 1991, 1994). Somatic hybridization is another approach to bring together genes of desired plants. Somatic cells contain double the genetic content of the gametes are used in protoplast fusion. It is also known as somatic hybridization. In this technique one somatic cell each from the two selected varieties are taken and fuse to get a hybrid cell which is viable and can grow in to a full plant.

Pearce and Cocking (1973) obtained only cell wall formation, budding and abnormal cytokines with protoplasts obtained from cell suspension cells of *Rosa x hybrida* 'Paul's Scarlet'. Krishnamurty *et. al.*, (1979) and Strauss and Potrykus (1980) used protoplasts from floral bud callus of *R x hybrida* 'Soraya' and cell suspension of "Paul's Scarlet" rose respectively. In both cases, callus colonies were obtained but no attempts were made to regenerate plantlets from them. The development of a protoplast regeneration protocol in rose is a first step towards using a range of *in vitro* techniques based on protoplast technology in rose breeding, including somatic hybridization, hybridization and direct gene transfer.

In first step plant cell wall (which is made up of cellulose and pectin) is removed with the help of enzyme to obtain protoplast for fusion. A combination of **1.5% cellulysin, 1.5% driselase** and 0.5% macerase allows the isolation of protoplasts out of *in vitro* shoot cultures. Three factors viz. (i) the type of auxine in the preculture medium, (ii) light conditions during incubation of the source material, and (iii) the appropriate phase within the growth cycle of suspensions were found to distinctly influence protoplast yields from cell cultures (Tejaswini *et.al.*, 2003).

Protoplast isolated from non-embryogenic cell suspension cultures of different rose (*Rosa*) species regenerate non-morphogenic callus. They explained in contrast, protoplast isolated from embryonic cell suspension cultures regularly give rise to an embryogenic type of callus. Asymmetric and symmetric fusion of protoplasts is performed by Poly Ethylene Glycol (PEG) mediation after treatment of protoplasts with iodoacetate, rhodamine -6-G or X-rays. Like other ornamental crop this technique is also useful in rose. Schum *et. al.* have tried to exploit new sources of disease resistance in rose breeding by means of somatic hybridization. In first phase of their experiment they have established the protocol as follows:

(i) Generation of protoplasts in a number of rose genotypes.

(ii) Poly Ethylene Glycol (PEG) mediated fusion

(iii) Preferential generation of desired fusion hybrids

They found that protoplasts of *R.canina, R.caudata, R.corymbiferaluxa, R. multiflora,* Elina and Pariser Charme could be grown in tissue culture. They also obtained plants from a hybrid of *R.persica* + *R.xanthia.* Research workers have identified specific genotype of different wild rose species that carries resistant gene against *Diplocarpon rosea* (fungus that causes Black Spot disease). Recently they are concentrating on introduction of these genes in modern rose cultivars. Schum *et. al.* have been successfully produced somatic hybrids from Heckzauber + *R. wichuraiana / R. multiflora and* Pariser Charme + *R. wichuraiana/ R. multiflora/ R. roxburghi* respectively. This team is now evaluating all these hybrids and work on this line is in fast progress. In near future this protoplast fusion / somatic hybridization technique will add new dimension in rose breeding by solving many problems of the rose breeder.

DNA, RAPD AND ISOZYME

Doyle and Doyle (1987) made an effort for DNA isolation and developed a technique for a rapid isolation from small quantities of the fresh leaf tissue. In rose very preliminary data are available about the use of molecular techniques for identification purpose. Hubbard *et. al.* (1992) explained about the restriction of fragment length polymorphism in rose and their use for cultivar identification. Torres *et. al.* (1993) identified rose cultivars using Random Amplified Polymorphic DNA markers. Millan *et. al.,* (1995) reported in detail about varietal identification in *Rosa* by using isozyme and RAPD markers. Assessment of genetic relatedness in roses by DNA finger printing analysis has been standardized by Ben-meir and Vainstein (1994). They opined that in rose very preliminary data are available about the use of molecular techniques for identification purpose.

Vainstein *et. al.* (1995) while working on molecular markers and genetic transformation in ornamental breeding used DNA finger printing approach to genotype identification for rose. The probability of two offspring from crossing of such similar genotypes having identical DNA fingerprints was found $2X10^{-8}$ for rose. It is apparent from these results that DNA finger printing can facilitate cultivars identification .The possibility of establishing genetic distance between genotype based on DNA fingerprints was studied in rose. Such information would not only allow the establishment of their phylogeny, but would also greatly help breeders in selecting genotypes for crosses. A comparison, not only within

but also between categories, based on known genetic history, to genetic relationship deduced from DNA fingerprints, revealed a perfect match for rose. It is very useful technique and can be used for obtaining breeder's rights. Finally they concluded that DNA fingerprints of ornamentals could be used not only for cultivars identification, but also for genetic relatedness and evolutionary kinship.

Matsumoto and Fukuii (1996) identified rose cultivars and clonal plants by random amplified polymorphic DNA. A rose cultivar and three clonal plants were tested for RAPD polymorphic DNA. All the cultivars were identified by using only three primers. However, individual were also distinguished by unique RAPD markers bands.

An attempt has been made for molecular typing of rose cultivars using RAPD's by Gallego and Martiney (1996). A rapid molecular typing method is described in this work. RAPD amplification products are very dependent upon various factors such as source of taq DNA polymerase, thermocycling programmes and DNA concentration. The main objective of their experiment was to establish a suitable protocol. Genomic DNA from 25 cultivars of rose were amplified using RAPD technique with twenty 10 merprimers (**Operon Kit A**). The data reveal no variability within cultivars and a high degree of variation between cultivars. The patterns obtained by two of this primers (OPA-11 and OPA-17) all the rose cultivars were unequivocally identified. The results of their experiment suggest that RAPD profiles provide a simple and efficient way to identify rose cultivars.

Jan *et. al.* (1998) analyzed rose germ plasm with RADP markers. They explained that the genus *Rosa* consists more than 100 species classified into four subgenera Eurosa, Platyrrhodon, Hesperrhodos and Hulthemia and distributed widely throughout the northern hemisphere. The subgenera Eurosa include 11 sections.

The other subgenera are monotypic, some 119 accession and 213 markers of 36 rose species that includes eight sections of the subgenera Erosa and one species each from the subgenera Hesperrhodos and Platyrrhodon were used to calculate a similarities matrix, which was clustered with outweighed pair group method using arithematic means (UPGMA). The RAPD markers distinguished between all the rose accession, and species grouped into their respective section. They explained further that classification of rose using RAPD data generally supports traditional classification.

On the basis of their observation the Asian rose sections (Laevigatae, Banksianae, Bracteatae, Pimpinellifoliae, *chinensis* and Synstylae) were consistently separated from the primarily North American Section (Cassiorrhodons and Carolinae). The cassiorrhodon and carolinae sections were grouped together with the subgenera Hesperrhodos and Ptatyrrhodon. Both subgenera are separated out at the same level as section within the subgenera Eurosa, suggested that they are more approximately classified as sections within the subgenera Eurosa section Cassiorrhodon and Carolinae overlapped and are probably best grouped as one section as previously suggested.

MAPPING OF THE ROSE GENOME

Genome mapping of rose has been attempted by several workers. Fingerprinting of rose cultivars has been reported by Rajapakse *et.al.*, (1993) for identification of rose

cultivars. Rajapakse *et. al.*, (1995a) studied in detail about the DNA markers in rose. They used this technique for cultivars identification and genome mapping. Debner and Mattiesch (1999) used RAPD and AFLP marker for construction of genetic linkage map, maping of genes for petal number and flower colour in roses. Vainstein and Ben-Meir (1994) used mini and microstalelite fingerprinting for finger printing analysis of rose.

Malek *et. al.*, (2000) identified molecular markers linked to **Rdrl**, a gene conferring resistant to black spot in roses. In first stage linkage maps of the *Rosa hybrida* genome was constructed with **RADP** and **AFLP markers** analyzed to locate nearly **278** markers on the 14 linkage groups. Genes controlling two phenotypic characters, petal number (double verses single flowers) and flower colour (pink verses white) have been marked in linkage groups 3 and 2, respectively. The markers closet to the gene for double flowers **Blfo**, and to the gene for pink flower colour, **Blfa**, co segregated without recombinants. Seven **AFLP** markers were found to be linked with **Rdrl** at distance between 1.1 and 7.6 cM. The most closely linked **AFLP** marker was cloned and converted into **SCAR** marker that could be screened in a large population than the original **AFLP** and was linked at a distance of 0.76 cM. The cloned fragment was used as an **RFLP** probe to locate the marker on a chromosome map of diploid roses. Debner *et. al.*, (2001) explained genetic and molecular analysis of important characters in roses. They explained the applied techniques in detail and come to a inference, closely linked Random Amplified Polymorphic DNA (RAPD) and amplified fragment length polymorphism (**AFLP**) markers were identified for gene governing double flowers, pink flower colour, black spot resistant and petal number.

Zhang *et. al.*, (2001) used **AFLP** for indentification of rose cultivars. While Tzuri *et. al.*, (1991) used mini and microsatellite marker for genotype identification of Rose cv. "Mercedes".

David (2005) has surveyed rose species for chromosome morphology, isozymes and molecular polymorphism to assess the genetic relationships among the wild species and cultivated roses. Isozymes and molecular markers have proven useful in the verification of parentage of cultivars and hybrids. David at Texas A & M University in collaboration with Rajapakse at Clemson University are busy in developing micro satellite (SSR's) markers which appears to be the best among the molecular markers with respect to reliability and easy of use.

These markers should be exceptionally useful in a range of work involving variety identification, studies of the origin of rose groups, studies of genetic diversities, development of marker assisted selection procedures and mapping of the rose genome, incorporation of traits from the diploid species into tetraploid rose. Dr. Rajapakse of Clemson University and Dr. Zhang of the Texas A & M University Crop Biotechnology Laboratory corporately working on the mapping of the rose genomes. Dr. Byrene has a map of a tetraploid population using several types of molecular markers and have located gene for no prickles on the petiole on this map. The present focus of this work the development of the additional micro satellite (SSR) markers to consolidate the tetraploid map with diploid map in the Germany and France.

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6

CONVENTIONAL METHODS OF PROPAGATION

Increasing rose plants by different methods of propagation is an important and interesting aspect in its cultivation. Rose may be propagated by seeds and usual vegetative methods of plant multiplication like cutting, layering, sucker, budding and grafting. For production of disease free plants in large numbers techniques of tissue culture is also employed. The use of suitable rootstocks for multiplication of rose to obtain the vigorous and floriferous plants from a particular soil plays an important role.

GROWING FROM SEEDS

This method is employed for propagation of rose species, shrubs, miniature roses and also, in raising of new varieties of rose. The shrub roses, though they will not propagate true by this method, as well as those plants intended for use as root stocks may be raised from seeds which is contained in the hips (Roy Gendens, 1965). Seed setting in rose hybrids is generally poor and there is wide variation in the hips setting among different cultivars (Swarup *et. al.*, 1973). The rose "seed" is technically an achene i. e. a one seeded fruit that consists of an apparently mature embryo enclosed in a thin papery testa (to give the seed proper), which in turn is surrounded by a thick pericarp (fruit wall). The texture of the pericarp varies from species to species; for example it is relatively soft in *Rosa rugosa* but extremely hard and 'bony' in *Rosa canina* (Blundell and Jackson, 1971).

The achene's of most rose species are dormant when mature and require low-temperature after-repining before germination. The species with soft pericarps are generally less dormant than those with hard pericarp. The pericarp imposes dormancy in the mature achene, either by preventing water and gaseous exchange or by acting as a straight-jacket to the growth of the embryo (Blundell and Jackson, 1971). Pre treatments such as prolonged soaking in water, exposure to 100 per cent oxygen, scarification and treating with acid were all tried with little success (Tincker, 1935).

The straight-jacket effect of pericarp on germination is at first sight supported by the fact that when embryos are excised from testa and pericarp, they will usually germinate within a few days if placed in germinator (Barton, 1961; Blundell, 1965) However, it has been shown that any physical repression of germination by the pericarp is combined with the presence, in the both pericarp and testa, of the water soluble growth- inhibitor abscisic acid which probably plays a major role in dormancy. Its effect in delaying germination of excised embryos and seeds can be counteracted by the use of gibberillic acid and benzyl adenine, and it has been suggested that the state of embryo is determined by the internal balance between certain growth inhibiting and promoting hormones (Jackson & Blundell,

1963, Jackson, 1968). The response of achenes to growth promoters is variable and low-temperature stratification is still the only practical method from breaking dormancy.

Fully ripe fruits or "Hips" are harvested and thoroughly dried before the extraction of seeds. Most seeds when mature are in resting condition requiring an after-repining period before germination. It is suggested to stratify the seed at 1.6° to 4.4°C after harvest for 1.5 months to 10 months depending upon the species. The stage of hip-ripeness is an important factor affecting germination. Treatment of seed with H_2SO_4 for 1-2 hours before sowing was reported to improve the germination. To raise the seedlings, clean seeds are sown about 5cm apart in pans or in small pots containing soil and good quantity of well rotten farmyard manure. Though the time of sowing mainly depends on temperature, sowing in the month of October-November is ideal in most places. The germination of seed is influenced by temperature apart from the other factors (Yadav *et. al.*, 1989).

The hips are harvested when turn pink or yellow and dried for 48 hours. Seeds are collected by cutting open the hips. Sometimes for embryo culture fully matured green hips are used to extract seeds. The seeds are scarified in concentrated H_2SO_4 for 30 minutes, afterwards they are removed and washed in running tap water for 2 hours. Then the seeds are stratified. For stratification the seeds are placed in plastic bags containing fine moist seeds or shredded sphagnum moss or vermiculite and the bags are then sealed. These plastic bags are stored at 3 to 4°C for 2 to 3 months till 5% of the seeds show signs of germination. The seeds are then sown in compost media, which readily drains the excess water. Depending upon the condition of the seeds and cultivars, seeds may take 21 days to 180 days for germination and the seed pans require regular watering. In about 3 to 4 months after germination the seedlings are 10 to 12 cm tall bear first flower. The flowers are immediately pinched off at bud stage for proper growth of development of seedling (Mukhopadhyay, 1990).

Seeds are sown reasonably thickly in a frame or in the open in drills made 2.5 cm deep and lined with peat or leaf mold and dusted with super phosphate of lime. A partially shaded portion is suitable. After covering the seeds, the soil is to be maintained in moist condition. The seeds may be covered with fresh moss and kept damp. After germination moss is removed. Overcrowded seedlings are thinned and in a year time seedlings are transplanted in beds, 30 cm apart. Seedlings, which are grown for budding, will be ready after six months from sowing time. The shrub roses raised from seeds are transferred to the final site after being one year in rows, and these seedlings to begin to blooms in another one-year time (Roy Genders, 1965).

Rowley (1956) obtained the best germination for *Rosa canina* in the first year after sowing by using achenes taken from firm, red hips and stratifying them in moist vermiculite for two months in warm green house, followed by two months at approximately freezing. According to Blundell and Jackson (1971), stratification in moist vermiculite contained in nylon bags at a temperature of 5°C, proved to be more effective than stratification in plastic pots at 2°C; autumn sowing gave better germination, however, acid-treated achenes when spring sown gave best results.

Jackson (1968) has shown that chemical exist in both fruit wall and seed coat which

inhibits germination of rose seeds, but these can be removed by chemical means. The seeds germinate readily at 1.6°C and when the germination chamber/frame become too warm, germination stops. Gobbee (1978) observed that the seeds soaked for 24 hours in 200ppm GA_3 solution gave 71.3% germination. Venkatraman *et. al.,* (1990) reported best germination in few cultivars of HT roses and Floribunda roses from the seeds obtained from the hips harvested between 15 to 17 week after pollination. They have also recorded maximum percentage of germination, when extracted seeds were stratified, scarified and treated with GA_3 at 100 ppm.

Prakash *et.al.,* (2002) reported that the rose seed scarified with 75% sulphuric acid for 15 minutes enhanced seed germination; while pretreatment of seeds with GA_3 failed to enhance the germination of seeds.

ROSE ROOT STOCKS

Rootstock is the understock or root system of the plant on which a rose variety is budded or grafted. A good root stock should be easy to bud over a relatively long period; it should produce a vigorous, healthy plant, with adequate branching and abundance of good quality blooms over a long growing season. The plant produced must be fairly hardy and live for a long time. It is also an advantage if the stock does not sucker. The root stocks must be unaffected by diseases and insects (Dick, 1972). Moreover, the rootstocks must be good multiplies, the bark should separate easily from the wood at the time of budding, and must be able to grow well in wider ranges of soils. The choice of rootstock varies from place to place depending on the type of soil and climatic conditions of the place. Mukhopadhyay (1990) had given an account of suitability of rootstocks for different countries. In England the most widely used rootstock is *Rosa laxa* followed by *Rosa canina* and *Rosa rugosa.* There are several cultivars of *R. laxa* and *R. canina* used as rootstock. *R. laxa* is almost thornless and easy to bud. *R. rugosa* is used for budding standards. American nurserymen use *R. manetti* more commonly than others. *Rosa odorata* and *Rosa multiflora* are also used occasionally. In Bulgaria *Rosa canina inermis* appears to have better effect on cut flower production. In Germany also *Rosa canina inermis* performs well. *Rosa canina cv. "Schmidt's Ideal"* performed well under some parts of Europe, while in other parts the cv. 'Pollmer' did better. In Pakistan Edward rose performs well as rootstock.

In India several rootstocks are made for budding, out of which *R. multiflora, R. indica var. odorata, R. bourboniana* (Edward rose) are common. In general, the root stock *R. multiflora* performs well in coastal region of India, peninsular India, Southern slopes of Vindhya mountain range, West Bengal, Bihar, Karnataka, Maharastra, Sub-Himalayan regions of Nainital and Dehradun (Sen, 1990). Swarup and Mallik (1974) and Sharma (1979) reported from Delhi and Hissar respectively that *R. indica* var. *odorata,* as stock was good for plant vigour and flower production. From a trial on thirteen different rootstocks with *Rosa hybrida cv. "Priyadarshini",* under Delhi conditions, Chandramohan and Kaicker (1990) concluded that *R. indica* var. *odorata* was superior for plant vigour and flower production followed by "Thornless", *R. canina, R. manetti* and non flowering *R. bourboniana,* while plant losses on *R. rugosa, R. iaxa* and *R.* 'Dr Huey' were high showing incompatibility.

Pandey and Sharma (1976) reported from Allahabad that the best stock-scion combination was *R. multiflora* and *R. hybrida* cv. "Montezuma". Singh (1972-74) at Saharanpur, U. P. also noticed better performance of *R. multiflora* rootstock. Singh (1977) further reported that *R. moschata* and *R. multiflora* were superior to both strains of *R. bourboniana* (Local and Meerut). In Bangalore, Mukhopadhyay and Bankar (1982) studied the comparative performance of a thornless rootstock as against *R. multiflora* and *R. indica.* It was reported that the largest flower were resulted when cv. "Happiness" was budded either on "Thornless" or *R. multiflora.* Gowda (1992) observed in Bangalore, that among the rootstocks *R. multiflora* preformed better followed by *R. indica* and *R. bourboniana* over *R. canina* and *R. laxa.*

In Scotland, Dick (1972), recommended that in heavy clay soil the use of *R. multiflora* understock seems to give best results since vigorous maidens with greatest performance were obtained and stock can be budded over a long period and it does not sucker. As an alternative, *R. laxa* also does well on a heavy clay soil that is adequately moist, however, the bushes produced are not so vigorous and have fewer blooms. Ordinary *R. canina* can not be recommended owing to the inferior quality of the bushes, but several of its variants give better results with "Pfander's Canina' probably the most satisfactory. For standard either *R. rugosa* or "Pfander's Canina" can be recommended.

According to Roy Genders (1965) *R. canina* are in greater use than any other form of rootstock, tend to be dwarfing in types of plants they produced. It is best understock for heavy soils and for cool conditions. *R. rubiginosa* is a valuable rootstock as it greatly extends the budding season, it is free from diseases and form a vigorous top growth, while its roots possess the same vigour. *R. rugosa* "Boskoop" stock of the Boskoop district of Holland is widely used for budding of standard roses and is specially suited to the roses for forcing under glass. *R. multiflora japonica,* a thornless form of *R. multiflora* is unstable for use in the standard form as the stem is usually too thin and brittle; it is however best for a light, sandy soil which will quickly dry out. Again both *R. multiflora* and "Pollmeriana"stock produced plants which gave 25% longer flowering season than any of the other rootstock. Schmidt's is also a free-flowering rootstock but suckers badly. *Rosa manetti* is seriously damaged by frost. *R. odorata* major is able to tolerate the very warm conditions, extreme heat and dry soil conditions.

Norman (1958) studied that garden roses will grow on the roots of any of the *Rosa* species, but only a few kinds will guarantee that the resulting plants will have a long life. *Rosa canina* is one of the stocks generally favored by commercial growers, usually in the form of seedlings, but sometimes grown from cuttings, and long stem obtained from hedgerows are used for standard. *Rosa multiflora* both seedling and cuttings is preferred by nurserymen whose soil is light. *R. rugosa* is mostly used as stems for standard. *R. laxa* seedlings and cuttings are very similar in habit to *R. canina,* but practically thornless and so preferred by budders on that account.

Yadav *et. al.,* (1989) enumerated the qualities of different rootstocks and noted that *R. bourboniana* is hardy, vigorous, easily propagated, grow straight and useful for budding standards. *R. canina* commonly used as rootstock in Europe in which buds are difficult to germinate and cuttings do not root easily, difficult to handle for existence of prominent

thorns, tends to produce suckers; and this rootstock is adaptable to drought and alkaline soil conditions. *Rosa indica* var. *odorata* is extensively used as a rootstock for green house forcing roses, which can withstand both excessively dry or wet soil conditions and high soil pH. *Rosa laxa* is suited to rich heavy soil and plant budded on it have vigorous growth; can be propagated from seeds and cuttings and posses very good root system. *R. manetti* proved to unsuitable for the production of cut flowers in green houses; these are good for propagating dwarf roses and for planting in sandy soils. *R. rugosa* is widely used in Europe for standard roses, root system is shallow and fibrous, tends to sucker badly, but plants are long lived. The French rootstock"Ragged Robin" is popular in California for outdoor roses; the stock grows vigorously during the summer, permitting the budding at any time. Dr. Huey is the most common rootstock in Arizona and Southern California especially useful for late season budding of its thin bark, a very good stock for weak growing cultivars.

Pal (1966) reported that *R. canina, R. multiflora, R. laxa* and *R. manetta* are used in Europe as stock; while in America, beside *R. multiflora,* which is a predominant rootstock in many parts of the country, "Dr. Huey" and "Ragged Robin" are used in some areas.

STEM CUTTINGS

Growing rose from cuttings is an interesting aspects to study. Multiplication of roses from stem cuttings is one of the least expensive and easiest methods of propagation. Generally Hybrid Tea and Floribunda roses are rather more difficult to propagate successfully from cuttings. There are uncertainty in rooting process, especially with many varieties of Hybrid Tea and Floribunda. There are several points to consider while going for multiplication of these rose types from cuttings and these are :

(a) Whether the resultant plants will ever become comparable in vigour and longevity with budded plants

(b) Longevity of the plants raised from cuttings

(c) Obtaining plants of an acceptable flowering size in reasonable time

(d) Resistance to diseases and unfavourable soil conditions.

On the other hand nearly all hybrid Polyanthas, Polyanthas, hybrid Musk, Rambler and Climbing roses do well on their own roots. As for as Ramblers are concerned, cutting is probably the best way to grow them. This method of propagation is most useful in India only to raise the rootstocks or under stocks.

According to Pal (1966) more vigorous type of roses can be readily propagated from cuttings; some of the Climbers, Ramblers and Polyanthas respond quite well to this method. Some growers prefer propagating Miniature roses from cuttings, because budding tends to make plants too large owing to the great vigour of the under stock.

Plants raised by cuttings are preferred by beginners in gardening, as they are not put to the anxiety to remove suckers and shoots from the stock of budded or grafted plants; Although the cuttings are almost always prepared from the shoots, root cuttings have also been found to form shoots and ultimately a new plant (Yadav *et. al.,* 1989).

The type of cuttings, time of the year when cuttings are made, growing media,

misting and humidity control influence the quality of plants from cuttings. The cuttings may be single, double of triple eyed; the triple eyed cuttings are preferred as there are greater chances of more shoots and better root function. The best kind of cutting is one about a 6-7mm thick; thinner growth than this will take long time to grow into a good plant. Cuttings should be selected from flowering stems, which has just flowered especially for raising Hybrid Tea and Floribunda roses. Cuttings of 20 to 30cm length depending upon the cultivars are preferred. Rooting media like garden soil, compost, course sand and vermiculite are used. High humidity and warm temperature enhance root production in cuttings. Uniform rooted cuttings are quickly propagated can be obtained if mist chamber is available for propagation. Cuttings if treated with 1000 ppm to 2000ppm IBA give high percentage of rooting.

In England cutting taken in November and rooted in open ground seldom produce good sized flowering plants in less than three and half years; while cuttings taken in July, from shoot which have borne first flush of bloom and similarly rooted, will normally produce good plants in just over three years (Witchell, 1971). He further observed bushes on their own root are manifestly inferior for the 2 to 3 years but, but in time most of them will develop into equally vigorous plants. In some varieties, they may even outgrow budded plants; however, it must be admitted that a few will prove to be miserable failures.

According to Roy Genders (1965) the last days of August and early September is the best time for taking cuttings, for they will then have formed at least a few roots before the arrival of the frost. He suggested that cuttings should be taken from new season's wood, about 22.5 cm to 30cm long treated with Seradix B, are inserted 5 to 7.5 cm deep in the compost, in upright position. Yadav *et. al.*, (1989) stated that in India cuttings should be normally taken during the monsoon or spring; and the rejuvenation of rose plants from cuttings is influenced by various factors such as types of cuttings, treatments of cuttings, and environmental conditions during rooting. Moreover, the age or physiological condition of the stock plant exert a strong influence on the development of root and shoots from cuttings taken from such plants.

Success of rooting from cuttings is reported by Iyengar (1961) from based cuttings of roses. Mukhopadhyay (1990) successfully propagated 'Queen Elizabeth' rose from 1 Year old cuttings which were treated with 2000ppm IBA, and the plants have performed well upto 5years; while the efforts to raise similar plants from the cultivars "Happiness" and "Super Star" did not succeed.

Hybrid Tea roses when grown from cuttings have very fibrous roots and will persist in blooming instead of making growth, and, hence, picking the buds off would be a great advantage (Norman, 1958).

Bartram (1975) reported that young soft wood is useless as cutting material; the best is what is usually called "half ripened" wood, the middle of a stem that has just flowered; but the lower half of the stem can be used, although it takes rather longer to root.

The role of different root promoting hormones on rooting was studied by Bhujbal and Kale (1973) with root stocks like *R. multiflora, R. bourboniana* and *R. moschata* and it was observed that maximum percentage of rooting was obtained with *R. multiflora* when

these were treated with 1000ppm each of IBA and IAA. Das *et. al.*, (1978) observed that among the different growth hormones like IAA, IBA and NAA, best rooting was obtained in *R. indica"Odorata"* cuttings treated with IAA at 1000ppm, while in case of *R. multiflora*, IBA at 1000ppm proved to be the best. Balakrishnamurthy and Rao (1989) obtained maximum rooting in *R. bourboniana* when the cuttings were taken during October rather than other months of the year.

Multiplication of H. T. rose "Soraya" by single node cutting was described by Askari *et. al.*, (1987). According to them cuttings taken from 2nd to 5th node give 33.3 to 60.7% rooting success in ascending order.

Adding VA mycorrhizal fungi (VAMF) inoculums into rooting media of Miniature rose cuttings does not always increase root initiation, in some cultivars that combination of VAMF inoculums and rooting hormones can increase the quality of rooted cuttings produced (Scagel, 2001).

One node cuttings of rose were propagated on the first day of every month from December 1997 to August 1998 by Chu *et. al.*, (2002). Cuttings propagated from January to May produced more cut flowers in the early flush, winter season and whole nine months of production. However, the total production of plants propagated in December decreased significantly. It has been concluded that for decreasing the cost of production an earlier and fuller harvest of cut flowers, propagation in May and planting in September was best.

Rosa centifolia and *R. damascena* cuttings produced more roots with 1000ppm IBA used by quick dip method (Akhtar, 2002).

The effects of IBA on the rooting of rose cv. "Red Success" leafy cuttings was demonstrated by Pivetta *et. al.*, (2001). Highest numbers of roots were recorded for "Manuela" and "Flamingo" cultivars of roses on different substrates like sand, perlite and perlite+peat (Bala and Iordanescu, 2002). The original leaf area of cuttings is a good indicator for growth of roots from cuttings and planting material which can determine establishment after transplantation. Leaf area is also a good indicator for growth potential for cuttings and planting material in case of severe reductions (Costa and Challa, 2002). The effects of original leaf area on the growth of cuttings of *Rosa hybrida* were investigated during the first ten weeks by Costa and Costa (2002); and evaluated the relationship between photosynthesis of the original leaf, carbohydrates, rooting and growth of single node leafy stem cuttings of rose. Growth, in general, depended on the length of the period cuttings were photosynthetically active during propagation. Cuttings were able to effectively use reserves for growth. They have also reported that optimum rooting and further growth of cuttings rely on the synthesis of new photosynthates because storage is limised in single node stem cuttings.

Bredmose *et.al.*, (2004) conducted a study on rooting and growth responses of Miniature rose cuttings to 4 propagation temperature, 2 photosynthetic photon flux densities (PPFD) with five IBA concentration, cutting size and cutting position. It has been reported by them that the temperature, cutting size, auxins and their interaction significantly influenced root and shoot growth. A propagation temperature of 24.6°C and IBA concentration between 10-3 and 10-1M, were optimal for root growth. Increasing propagation

PPFD from 46 to 72-micronmol m^{-2} S^{-1} did not affect the parameters. Time to auxillary bud growth and time to first flower were related to time-to-visible root. Hayashi *et. al.*, (2003) investigated the effects of CO_2 enrichment combined with auxins treatment on the rooting and growth of *Rosa* ev. Tinek." The rooting and root growth of the cuttings were promoted significantly by IBA at 4000ppm for 2-3 seconds. However, the growth and development of the new shoots of cuttings were inhibited significantly by IBA treatment. CO_2 enrichment (from 07.00 to 17.00h), promoted the development and growth of both the roots and shoots of cuttings. CO_2 enrichment decreased the depression of the development and growth of new shoots by IBA. It seems that the promotion of photosynthetic rate by CO_2 enrichment contributes to the shortening of the production period for the transplants.

Costa *et.al.*, (2000) from an experiment on rose cuttings concluded that photosynthetic capacity of cuttings is to be considered an important determinant for quality in rose propagation.

Rootone (NAA) treatment induce 100% rooting in cuttings of *Rosa* "Red Velvet", while in "Noblesse" roses IAA at 1000ppm gave good result. Rooting was accelerated and root growth was increased in both cultivars with high intensities (Choi *et. al.*, 2000). The rooting media comprising of 1part peat moss and 2 part coarse vermiculite mixture recorded high rooting percentage and root growth in cultivars "Red Velvet","Noblesse", "Rote Rose", "Little Mabel", "Sweetness" and "Supleasse" (Choi *et. al.*, 2000).

LAYERING

The layering is quite convenient for increasing the number of plants especially for climbing and rambling roses (Pal, 1966). It can be performed during the monsoon or early spring. Layered rose plants, except those of weak growing cultivars, thrive and bloom quite well as budded or grafted plants (Gopalaswamienger, 1970). The technique is similar to that of preparing layers of other shrubs. According to Roy Genders (1965) layering is the best method of propagating shrub roses and it is a valuable alternative to the propagation by cuttings. Layering is seldom done intentionally, but sometimes happens by accident. It is convenient to climbers and few dwarf cultivars. Layering is also most useful with those types of roses that are most readily propagated from cutting under ameteur conditions, like the Banksias. Most Wichuraianas layer very easily. Young wood gives best results (Thomas, 1970). These methods of propagation are of two types : ground layering and air layering.

GROUND LAYERING

This method is applicable to the rose plants in which it is possible to bring the stems into contact with the soil. The quite long stems may be layered where large plant may be obtained in the shortest possible time. Bending the shoots to the ground does the ground layering and thereafter covering it with soil, leaving the terminal end exposed. The partially mature stem is good, possibly about two years old, flexible to bend and will not have become so hard that rooting will be long and difficult. The soil around the plants must be made suitable for layering, and should be given dressing with compost manure and sand which to be racked into the surface (Roy Genders, 1965). Cutting or notching

the underside of the stem is practiced; root-promoting substances, used in cutting can also be applied at the cut point for improving the root formation in layers (Pal, 1966). The branch is then bent to the ground to ascertain both where to dig the hole and which part of the cane will become the actual bend in the layer. The hole of 15cm deep is proper to facilitate for a layer of good topsoil under and above the cane. The "notched" or 'tongued" stem is then pegged in position so that, when covered, it will be 5 to 7.5 cm below the soil surface. It is best to provide two pegs, one on each side of the tongue this prevents sharp kinking (Thomas, 1970). It is important to make layers quite firm in the ground so that the moisture will be retained around the cut end and there will be no drying out. Good sap flow is needed for proper rooting in time. It takes 30 to 45 days to root, and the layered shoots can be detached after root formation in three weeks time. All flower bud should be removed in the first season to prevent flowering and to permit the detached plant to build up a strong rooting system.

AIR LAYERING

It is much superior to taking cuttings, if properly done and plants are not allowed to dry out after planting in the garden. Air layering is second only to budding and in some respect superior, as there is no possibility of sucker's trouble. It is done by removing a ring of bark, about 2.5 cm long from around the shoot to be rooted and covering the end portion firmly along with rooting media. The damp sphagnum moss is tied firmly around the ring portion and covered with polythene film. Application of root promoting hormone enhance root formation in air layer (Yadav *et. al.*, 1989).

Peggy (1972) in Malaysia used the method, which is commonly termed as "Marcot". For this a firmly stiff but not too young stem was selected, preferably branched to form a Y-shape, and an eye. A ring of bark is completely removed just below the eye. Rooting hormone is then applied to exposed woody section of the stem. A small lump of clayey earth on a small rectangular piece of transparent plastic paper is then wrapped around it and tied at both ends with raffia stings- tighter at the lower end to prevent the wrapping from rotating round the stem. About 2 to 4 weeks roots can be seen emerging and visible through the plastic paper. The branch is then cut off from the mother plant and potted. The new plants must be sheded for a week or so before it can be exposed to the sun.

David (1972) through air layering successfully propagated Hybrid Tea roses and these cultivars include "Blue Moon", "Chicago Peace", "Fragrant Cloud", "Kings Ramson", "Mischief", "Peace", "Piccadilly", "Picture", "Pink Peace", "Prima Bellerina", "Rose Goujard", "Royal Highness" and "Super Star". He has successfully propagated following Floribunda roses through air layering like "Ice Berg", "Irene of Denbnark", "Orange Sensation" and "Queen Elizabeth". He further stated that by using air layering method one can obtain a strong growing plant in bloom within about 8 months time after cutting it from parent bush and without the need for further transplanting. According to him it is one of the quickest and most reliable methods of propagating roses.

Girdling, auxins application and etiolation can successfully propagate H. T. Roses, which are difficult to root. Higher total sugar, starch with low nitrogen and higher C/N ratio favoured better rooting in girdled and etiolated shoots of H. T. roses (Gowda, 1992).

SUCKERS

Suckers are shoots, which arise on the plant from below the ground through adventitious bud on the roots. Several rose species like *R. spinosissima, R. nitida* and some shrub roses, particularly the Moss rose and the Scotch rose are readily increased from suckers, which they form in profusion. These suckers are to be carefully removed from the soil along with some roots attached through sharpened knife (Roy Genders, 1965).

BUDDING

In budding, a single bud is used instead of a scion, and more plants can be produced from the same amount of parent wood. It is a quicker method than that of grafting. The rootstocks used for budding should have the desired characteristics of vigour and growth habit. The rootstock must be disease free and easily propagated (Bhattacharjee, 2004). Budding is most commonly used for propagating Hybrid Teas and Floribunda roses. For this method of propagation, preparation of the rootstock on which the desired cultivars is to be budded, selection of a proper budding eye, and the insertion of the budding eye in the rootstock are the important steps employed. "Shield"or "T-budding" is the method ordinarily used for the propagation of roses. Because of the "T-like" appearance of the cut of the rootstock or the "Shield-like" appearance of the bud piece which is ready for insertion in the stock, this method of budding is known by both names. This budding is limited to stocks, which are 0.5 to 2.5cm in diameter with fairly thin bark. The buds are inserted in T-shaped incisions and then tied either with polythene tape, adhesive tape or binding rubber stripes. The incision on the stock should be just enough to accommodate the bud. Plump but not too elongated bud is selected from the middle section of the scion shoot. Budding should preferably be done as low down as possible. When the new shoot from the grafted bud is about 10cm long, the top portion of the stock from above the union is cut off and the tape is removed. To unite the bud, it takes 21 to 30 days. The side branches of the stock are removed which compete with scion for supply of nutrients and water (Yadav, *et. al.*, 1989). The best season of budding differ from place to place. In mild climate like Bangalore, Pune and Nasik budding operation can be carried out almost round the year, but ideal time is in between October and March. In North India, budding is undertaken between early November to middle of March. In Eastern and Southern India the budding operation is carried out during October to March, adjusting the time by avoiding the rains and hot weather (Mukhopadhyay, 1990). For budding to be successful, the sap in the stock must be flowing freely, otherwise there will be failure. The success also depends on the state of the stock and the neatness and speed of operation. The knife must be very sharp. For inserting the bud in the rootstock, particular care should be taken to push it right down to the end of the cut (Norman, 1958).

Rose plants are commercially propagated by budding a cultivar on a rooted rootstock in the field in America, Europe and Israel. The budding operation particularly 'T'budding can be performed more readily than the simplest method of grafting. In addition, budding may result in a stronger union, particularly during the first few years, than is obtained by some of the grafting methods (Hartman and Kester, 1983).

Apart from the 'T' budding, there are several other budding techniques employed

in roses with varying degree of success like "patch", "chip", "skin", "Forket" etc. There are so many variation in the methods adopted by different budders. It is the cutting out of the bud and removal of the sliver of wood in the bud which most beginners find so difficult. Like that of selection of rootstock, the selection of the bud or eye is also important. Majority of the budders prefer those from wood that has borne a bloom. The most accepted method of budding for roses is "T-budding".

Khan (1983) described the preservation of scion wood collected from one year old bush with 8 buds of 20-25cm pieces of rose cultivars "Peace", "Wendy Cussons" and "Sir Lancelot", and wrapped in water proof paper, then soaked in news paper and finally polythene bags. Bud wood stored at 0°C gave better bud take than wood stored at 4°C after 275 days storage, 60-80% and 40-60% respectively.

Maity (1974) employed "Chip budding" and "T-budding" on briar root stocks at weekly intervels during December to January with H. T. and Floribunda scion. He recorded that the method of budding and time of budding did not influence the bud take, while subsequent plant growth was more in T-budding. Pandey *et. al.*,(1991) budded rose cultivars "Show Girl" on to briar rose root stock on 5 dates at 15 days interval between 1st week of January to the last week of March. They observed that budding success was highest (27%) when budding was carried out in the 1st week of January. Simultaneously rooting of rootstocks and bud union in several varieties of H. T. and Floribunda roses was demonstrated by Nanjan *et. al.* (1971). Post budding application of IAA at 25ppm for bud take and for rooting of cuttings of *R. multiflora* was reported by Singh *et. al.*, (1976) who emphasized the usefulness of graft cuttage method in the propagation of roses over other usual methods of budding.

Singh and Singh (2002) observed shield budding (T-budding) in February was best, compared to "patch" and "chip" budding, and September to January months budding. In this experiment *Rosa indica* was used as stock and rose cultivars "Black Prince" was taken as scion.

Ponchia and Zanin (2001) from an experiment on "T-grafting" and "chip budding" of some rose cultivars on *Rosa laxa* and *Rosa canina* root stocks concluded that 'T-grafting' is more suitable for propagation of shrub roses; while "chip budding" was better for tree roses.

A budded cuttings for propagation of roses was demonstrated by Chu (1990) where a scion with a dormant bud and a leaf was budded into single internodes of rootstock. After budding the base of the rootstock was treated for 30 seconds with IBA at 2000ppm. The budded cuttings were rooted in perlite media (where no nutritional solution was added) under a balance type mist system. Rooting of the budded cuttings was satisfactory after 1 month and was comparable with that of grafted cuttings or marcotted plants.

GRAFTING

There are few reports on the propagation of roses by grafting. It is a process by which two different plant cultivars or species are united so that they grow as one, involving rootstock or scion. The rootstock is the lower position of the graft, which develops into the root system of the grafted plant. The scion is the newly installed shoot

on tip of the plant. It is a short piece of detached shoot contaning several dormant buds. For successful grafting, the stock and scion must be in intimate contact with the cambium of the stock. The rootstock and scion must be disease free. Immediately after grafting operation is finished, all cut surfaces must be thoroughly covered with some type of grafting wax, plastic ties or rubber ties. The union takes place within 5 to 8 weeks. After the union is complete the scion shoot is cut below the graft and the rootstock above the graft union. Some of the workers have reported successful "cleft grafting" and "bench grafting" in roses. In eastern India some nurseries resort to approach grafting and the rootstock used for this purpose is *Rosa multiflora*. To obtain the larger plants in the shortest possible time approach grafting is practiced. In this method quite a good number of bud wood is wasted. Since budding is done with one "eye" from the stem; a branch required for inarching will have number of "eye" upon it (Randhawa and Mukhopadhyay, 1986).

van de Pol and Breukelaar (1982) stated that it is possible to propagate plants by growing rootstock that are subsequently grafted in the green house, but this method is expensive. To shorten the time required to produce saleable grafted rose plants, McFadden (1956) suggested combining the production of a stock plant and graftage of a scion into one operation. Later McFadden (1963) modified the multiplication technique by grafting two-leaf scion cuttings to the top of the two-leaf stock cuttings. To reduce the problem of wild suckering, van de Pol and Breukelaar (1982) grafted a scion on just one internode of rootstock.

STENTING

This method involves grafting of selected scion of the desired plant on a piece of stem, which produced good roots. The grafted plants are then placed in a mist chamber. "Whip" or "Cleft" grafting may be used to perform "Stenting". It is used on roses and can produce marketable plant within a short span of time as compared to normally used by budding.

The manipulation of budding on a cutting is termed as "Stenting" and the resultant plant is a stentling. These terms were introduced by van de Pol and Breukelaar (1982) and are derived from Dutch words "stek" (Cutting) and "enten" (grafting), combined as "stenting". van de Pol *et. al.*, (1986) showed that photosynthesis of scion leaves was a necessity for development of roots and shoots of rose during early stentling development. When a rootstock and a scion were stended, graft failure do not occur because the formation of graft union and adventitious roots occur simultaneously (van de Pol and Breukelaar, 1982). Stenting technique is ideal method for screening scion/rootstock combinations and for investigating the interaction between rootstocks and scions.

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7

TISSUE CULTURE

Most of the present day rose cultivars are propagated vegetatively by budding or grafting of the scion on suitable rootstock. Tissue culture or micrpropagation is quick and low cost input oriented method for plant propagation specially suits for ornamental plant like rose which are in great demand in national and international market. Nobecourt and Kofler (1945) developed rose plants through tissue culture. Biochemical and physiological studies of tissue cultures and plant parts from which they derived "Paul's Scarlet" rose, has been explained by Weinstein *et. al.*, 1962. *In vitro* propagation of rose cultivars 'Forever Yours' has been reported (Skievin and Chu, 1979). The effect of plant growth regulating chemicals on rose shoot development from basal and axillary buds have been explained by Carpenter and Rodriguet, (1971). The pectic polysaccharides in cell walls of *Rosa* tissue, cultivated *in vitro* have been studied by Mollard *et. al.*, (1973). Importance of polymer forms of galactose in four strains of *Rosa glauca;* comparison with the initial cambial tissue has been discussed. Mollard *et. al.*, (1973) studied cellulose ultra structure in rose tissues cultivated *in vitro*. Metabolism of glutamate in suspension cultures of "Paul' Scarlet" rose cells has been studied (Fletcher, 1974). Annotated bibliography on tissue culture of roses in the period of 1965-1975 has already been compiled (Anonymous, 1976). The effects of carbohydrate and nitrogen concentration on phenol synthesis in "Paul's Scarlet" rose cells grown in tissue culture has been studied (Amorin *et. al.*, 1977). *In vitro* propagation of 'Forever Your's' rose with formation of root and shoot has been studied (Skirvin and Chu, 1979a,b). *In vitro* propagation of rose has been done successfully (Hasengawa, 1979; Pittet and Moncoucin, 1982). Micro propagation of hardy rose species and hybrids has been successfully achieved (McCown, 1980). Effect of auxins and cytokinin on ethylene evolution and growth of rose callus tissue in sealed vessels has been studied (Wulfer and Sacalis, 1980). Micro propagation of rose has been successfully carried out by Rosten and McCown, 1981. Tissue culture propagation of green house roses has been elaborated by Skirvin and Chu, (1981). A factor affecting *in vitro* propagation of rose has been studied in detail (Bressan *et. al.*, 1982). Many workers have tried tissue culture of rose and on the basis of their experimental results it has been suggested that rose can be propagated through tissue culture even on a commercial scale in short span of time and can be grown on their own root stock (Khosh-khui and Sink, 1982). About 22 years back tissue culture techniques have been successfully applied for rapid propagation of many hybrids rose cultivars (George and Sherrington, 1984). The effect of light quality on root development on *in vitro* grown miniature roses has been studied in detail by Skirvin and Chu (1984). *In vitro* culture of rose has been reported by Tweddle *et. al.*, (1984). Different suitability

for *in vitro* propagation of rose cultivars has been reported (Sauer *et. al.*, 1985). *In vitro* propagation of some rose cultivars has been explained by Curir *et. al.*, (1986). Micro propagation of new and old world rose species, rooting enhancement of *Rosa hybrida* for tissue culture propagation and callus induction and culture of *Rosa* has been worked out (Khosh-Khui and Sink, 1982 a,b,c).

Indolent of ethylene on senescence and vitrification on *in vitro* cultured mini rose has been worked out (De Profit *et. al.*,1987). Micro propagation of several *Rosa hybrida* L. cultivars and regeneration from *Rosa* callus has been studied (Vallus and Baxux, 1987a,b). Growth interaction between calli and explants of rose plants *in vitro* has been successfully done (Zieslin *et. al.*, 1987,Horn *et. al.*, 1988).Comparison of the growth and development of dwarf rose cultivars propagated *in vitro* and *in vivo* by soft wood cuttings has been reported (Dubois *et. al.*, 1988). Tissue culture technique is ideally suited for obtaining disease free material as possibility of eliminating pathogens from infected stock is always there. It also reduces the multiplication time and save time and financial input. Rout *et. al.*, (1989) investigated tissue culture protocol for mass-scale propagation of *Rosa hybrida* cv. 'Landora'. Originally this cultivar showed considerable poor rates of multiplication by conventional methods. On the basis of their experimental results they demonstrated that starting with a single axillary bud of *Rosa hybrida* cv. 'Landora' as explants, it is possible to obtain about 25 plants after 120 days of culture, and this micro propagated plants can be grown in the open with very low mortality. Douglas *et. al.*, (1989) studied micro propagation of Floribunda, ground cover and Miniature roses. Woltering (1990) studied the beneficial effects of carbon dioxide on development of rose plantlets grown *in vitro*. Effects of sucrose on starch accumulation and rate of photosynthesis in rose cultured *in vitro* has already been explained by Capellades *et. al.*, (1990). Mass propagation of the dwarf rose cultivars 'Rosamin' has been successfully achieved (Campos and Pais, 1990). Plant regeneration from Bulgarian rose callus has been reported by Ishioka and Tanimoto (1990).

Effects of agar concentration on water status and growth of rose plant cultured *in vitro* has been studied (Ghashghaic *et. al.*, 1991). *In vitro* propagation of rose cultivars has been reported by Rout, (1991). Various rose (*Rosa* spp) species have been cultured *in vitro* (Horn, 1991, 1992). Effect of media composition and growth regulators on *in vitro* propagation of rose has been studied (Vijaya and Satyanarayana, 1991; Rahman *et. al.*, 1992). The factors in optimizing the multiplication of ornamental and essential oil of roses *in vitro* have been worked out (Kirichenko *et. al.*, 1991). Rooting of cultured rose shoot has been worked out (Bhat, 1990; 1992). Micro propagation of rose (*Rosa* L.) has been reported (Horn, 1992). The effects of growth retardants, humidity and lighting at stage III on stage IV of micro propagation of rose have been studied (Roberts *et. al.*, 1992). *In vitro* regeneration of shoot from callus cultures of *Rosa hybrida* L. cv. "Landora" has been studied (Rout *et. al.*, 1992). Consequences of *in vitro* and *ex vitro* root initiation for Miniature rose production has been explained (Rogers and Smith, 1992). Arene *et. al.*,(1993) studied tissue culture of rose. Somaclonal variation level of *R. hybrida* cv. 'Meirutral' plants regenerated from callus or direct induction from different vegetative and embryonic tissues was compared. Genetic transformation of rose (*Rosa hybrida* cv. "Royalty") via *Agro bacterium tumefaciens in vitro* has been done (Firoozabady *et. al.*, 1991). The regeneration

of plants from protoplasts of *Rosa* has been successfully obtained (Mathews *et. al.*, 1991, 1994). Micro propagation of *Rosa hybrida* has been successfully achieved by Leyhe and Horn (1994). The factor influencing acclimatization of *Rosa hybrida* plants multiplied *in vitro* to green house conditions has been studied (Podwyszyneska and Hempel, 1995).

Similar observations have been recorded from tissue culture experiments in some difficult to propagate rose cultivar (Hasegawa, 1980; Skirvin and Chu, 1979; Bressan *et. al.*, 1982 and Davis, 1980). Several tissue culturists have predicted that in future many important cultivars of roses would be commercially propagated through tissue culture. Effects of liquid culture on the growth and development of Miniature rose (*Rosa chinensis* Jacq. 'Minima') has been studied (Chu *et. al.*, 1993). Importance of iron chelate formula for micro propagation of *Rosa hybrida* 'Money Way' was reported (van der Salm *et. al.*, 1994).

Horan *et. al.* (1995) conducted an experiment on micro propagation of roses and explained the benefits of pruned mother plantlets at stage II and a green house environment at stage III. Mirghis and Mirghis (1995) studied organogenetic response and *in vitro* multiplication of some rose genotypes. Effects of activated charcoal on *in vitro* rooting of cultured rose shoots have been explained (Wilson and Nayar, 1995).

Suharsona (1995) successfully made an attempt for *in-vitro* culture of several new cultivars of rose. He *et. al.*, (1996) studied tissue culture for micro propagation of cut rose variety 'Samantha'. Micro propagation of rose species *in vitro* has also been reported by Yan *et. al.*, (1996). Yokoya *et. al.*, (1996) studied regeneration of rose plants from cell and tissue cultures. *In vitro* propagation of rose has been reported by Syamal and Singh, (1996). Direct coulogenesis and rhizogenesis in miniature roses via *in vitro* tissue culture techniques have been standardized (Jahan *et. al.*, 1997). Micro propagation of *Rosa damascena* has been reported by Ara *et. al.*, (1997). Production of synthetic seeds and plant regeneration in *Rosa hybrida* has been reported by Jayashree *et. al.*, (1997). *In vitro* micro propagation and induction of flowering in Miniature rose 'The Fairy' has been reported (Sahoo and Debata, 1997). Effects of explants length and diameter on *in vitro* shoot growth and proliferation rate of miniature has been reported by Salehi and Khosh-Khui, (1997). They opined that the explants length and diameter played significant roles in proliferation and shoot growth of Miniature roses (*R. chinensis* cv. 'Minima', ' Little Buckaroo', 'Baby Masquerado' and 'Sourati'). *In vitro* propagation of rose has been discussed in detail (Syamal and Singh, 1995; Chakraborty et.al, 1999, 2000, 2002 and Chakraborty and Datta, 2006). Pati *et. al.*, (2001) reported micro propagation, protoplast culture and its implications in the improvement of scented rose. The use of thidiazuran (TDZ) in the micro propagation of *Rosa damascena* has been reported by Kumar *et. al.*, (2001). *In-vitro* micro propagation of rose (Elizabeth cultivars) via tissue culture in test tube conditions has been successfully achieved (Shirzadian and Lotfi, 2002).

Kondratenko and Mitrofanova (2002) studied special features of two-miniature roses clonal micro propagation by tissue and organ culture methods, and discussed the positive effects of benzylaminopurine on the micro propagation of the rose cultivars "Mister Bird Blue" and "Zwergkonig". Pajouhcsh-va-Sazandegi (2002) studied *in vitro* micro propagation of rose (Elizabeth cultivars) via tissue culture in test tube conditions. Carelli and

Echeverrigaray (2002) developed an improved system for the *in vitro* propagation of rose cultivars. Pati (2002) reported results of tissue, cell and protoplast culture studies in *Rosa damascena* Mill. and *Rosa bourboniana* Desp.

Wang *et. al.,*(2002) studied *in-vitro* flower induction in roses. Vegetatively propagated plantlets of six rose cultivars (Binaca Parade, Fiesta Parade, Orange Parade, Scarlet Parade, Viva Parade and RF) were induced to flower *in-vitro* on media containing full-strength Murashige and Skoog (MS) inorganic salts, Gamborg's B5 organic elements with 400 mg myo-inositol l-l and different phytohormone combinations of 6-benzyladinine (BA) with alpha- napthaleneacetic acid (NAA); thidiazuron (TDZ) with NAA; and Zeatin (ZT) with NAA. The most significant flower bud induction (49.1 and 44.1%) was obtained on media supplemented with 0.5mg TDZ l-l (2.27μm) and 0.1mg NAA l-l (0.54 μm) or 0.5mg ZT l-l (2.28 μm) and 0.1mg NAAl-l (0.54 μm) for cultivar "Orange Parade". Scanning Electron microscopy (SEM) showed that *in vitro* flower bud induction occurred mostly between 15 and 30 days (d) in induction medium through the normal flower development processes. With TDZ and ZT as the best choice for the flower induction in all six cultivars tested. Different rose cultivars varied in their responses to phytohormone treatments. Their study also revealed that the total time from the original culture and subculture time before flower induction were two very important factors for *in-vitro* flower induction. Plantlets 156-561 d from original culture and sub cultured for 45 d were the best for flower induction.

Podwyszynska *et. al.,* (2003) studied effect of red light on *ex-vitro* rooting of rose micro cuttings in rock wool. The micro cuttings of rose cultivars "Sonia" and "Sabrina" were rooted *ex vitro* in Rock Wool (GordionSBS) under green house conditions. The shoots were treated with red light at 3μ mol m-2 s-1 photosynthetic photon flux density (PPFD) emitted from fluorescent lamps for 4h during the night for 3,7,14 and 42 nights, while half of micro cuttings were treated with auxins solutions. The irradiation of shoots for 7-14 nights with red light during the *ex-vitro* rooting highly influenced root formation. The seasonal and genotype differences in response to red light were noted. In "Sabrina", red light promoted root formation during planting in March, May and November, increasing the growth of shoots, root system quality and percentage of rooted micro cuttings from below 50% (control micro cuttings) to 80-100%. In, July the best rooting was noted in control micro cuttings, which were not treated with auxins or red light. In "Sonia", there was an observed positive effect of red light on rooting *ex vitro* during winter and summer. Kim *et. al.,* (2003) explained that somatic embryogenesis was induced only when MS basal medium with auxins alone was used for the first four week of the callus induction period.

Kandzezauskaite and Burbulis (2004) studied *in vitro* propagation of *Rosa floribunda.* They have developed a protocol for the *in vitro* micro propagation of rose *Rosa floribunda (R. multiflora)* cultivars "Barbecus" and "Lilli Marlene". The explants were cultured on MS and WPM media supplemented with IAA, benzyl adenine and Kinetin. MS and WPM media supplemented with 0.02μmg 2,4-D/litre were used for *in vitro* rooting. A total of 11.94 and 14.93 plantlets for "Barbecus" and "Lilli Marlene" were obtained per explants cultured on MS medium. The rooting of "Lilli Marlene" was best on MS medium with 2,4-D, while "Barbecus" showed the best rooting on WPM medium without regulators.

Kim-Gyeong Hee *et. al.*, (2004) studied *in vitro* effects of carbon dioxide, nutrient composition and supporting material on the growth of Miniature rose 'Silk Red'. Growth and development of Miniature rose "Silk Red" plantlets *in vitro* as effected by various environmental factors were evaluated. Treatments consisted of 2 levels each of trophic phase (photoautotropic and photomixotrophic) and nutrient composition (half strength MS basal solution and Gato hydrophonic rose solution), and 3 supporting materials (agar, gel rite and Tosilee medium, a commercial plug medium). Photomixotropically micro propagated plantlets excised of roots were used as explants. Explants were cultured for 4 weeks under cool white florescent lamps at a light intensity of 180μmol m^{-2} s^{-1} for 16 hours day-1, at 25^0 C±1 and 70-80% relative humidity. Height, numbers of leaves, branches and flowers, length of the longest leaf, chlorophyll concentration, numbers of main and fine roots, and length of the longest root were promoted with increased CO_2 concentration. Plantlets growth under a photoautotrophic hydrophonic solution compared with agar or gel rite.

Although there is considerable interest in using biotechnology procedure for rose improvement, these goals have been limited by difficulties in regenerating adventitious shoots or somatic embryos from roses *in vitro*, according to available reports, callus initiation from rose tissues required the presence of auxins (mainly 2,4.dichlorophenoxy acetic acid (2,4-D) and α-naphthalene acetic acid (NAA) in the culture medium. Pati *et. al.*, (2006) studied micro propagation of *Rosa damascena* and *R. bourbniana* in liquid culture.

CELL SUSPENSION CULTURE

Minimal organic medium for suspension cultures of "Paul's Scarlet" rose has been worked out (Nesius *et. al.*, 1972). Some important aspects of growth and metabolism of "Paul's Scarlet" rose cell suspension has been studied (Nash and Devis, 1972). Mollard and Barnoud (1976) studied synthesis of a hemi cellulose glucan B, 1-3 in *Rosa lignifies* cell walls cultivated *in vitro*. A hemi cellulose xyloglucan B, 1-6 in Rose "New Dawn" cells cultivated *in vitro* has been reported (Mollard and Barnoud 1976b). Synthesis of Galactans of *Rosa glauca* tissue cultivated *in vitro* has been explained (Mollard *et. al.*, 1976c). Effect of selected aryloxalkaneecarrboxylic acids on growth and level of soluble phenols in cultured cells of *Rosa damascene* has been studied (Lam and Street, 1977). Callus formation from protoplasts of cell suspension cultures of *Rosa* "Paul's Scarlet" has been explained (Strauses and Ptrykus, 1980). Cell suspension culture of rose has been explained in detail (Sakurai *et. al.*, 1997). They observed induction of anthocyanin accumulation in rose suspension cultured cells by conditioned medium of strawberry suspension culture. When rose cells were transferred to conditioned medium *Rosa hybrida* did not produce anthocyanin. When rose cells were transferred to culture medium anthocyanin formation was induced and accumulated to concentration upto 400 μmg/g cell weight. They have suggested that the conditioned medium may be effective for inducing anthocyanin accumulation in cultured cells of other species.

Langar and Nothnagel (1997) conducted an experiment on cell surface arabinogalactan-protein and their relation to cell proliferation and viability. Result of their experiment clearly explained that two "Paul's Scarlet" rose suspension cultures Rosa 57 and Rosa 93 differ in their response to (β-D- $Glcl_3$ a Yariv phenyl glycoside and selectively

binds to arabinogalactan-protein (AGPs). Electrophoresis and compositional analysis showed that Rosa 57 and Rosa 93 differ in both the number and abundance of AGPs in Rosa 93 increased with passage number and reached approximately three times the amount of cell wall associated AGPs in Rosa 57. Smith *et. al.*,(1978) studied polyamine in "Paul's Scarlet" rose suspension culture

EMBRYO CULTURE

In roses, somatic embryo genesis has been obtained from a variety of explants such as calli derived from leaf tissue (DeWit *et. al.*, 1990; Kim *et. al.*, 2004), immature leaf and stem segments (Rout *et. al.*, 1991), immature seeds (Kunitake *et. al.*, 1993), petioles and roots (Marchant *et. al.*, 1996; Roberts, *et. al.*, 1995), and anther filaments (Noriega and Sondahl, 1991).

Regeneration of plantlets via somatic embryo genesis from somatic tissues of *Rosa hybrida* cultivars remains difficult with a low frequency occurrence (Rout *et. al.*, 1991; Noriega and Sondahl, 1991). Induced secondary dormancy of rose embryos has been achieved (Semeniuk *et. al.*, 1963). A few reports on regeneration of shoots and/or plantlets from zygotic embryos and somatic tissues of various *Rosa species* are also available (Lloyd *et. al.*, 1988; Burger *et. al.*, 1990, de wit *et. al.*, 1990, Rout *et. al.*, 1991, Noriega and Sondahl, 1991).

Embryo culture of rose seed has been explained by Asen (1943) in detail. Lammerts (1946) studied the significance of use of embryo culture and while working on use of embryo culture in rose breeding, explained that in roses, where the thick pericarp and growth inhibitors in the achene cause dormancy of the seeds. Breeders used embryo culture to by pass dormancy and to shorten the breeding cycles (Asen, 1943; Lammerts, 1946). Culture of *in vitro* of embryos and parts of achene in *Rosa canina* has been reported by Graifenberg (1973).

Khosh-Khui and Sink (1982a) reported micro propagation of new and old world rose species. Embryo culture of rose has been performed to overcome seed dormancy problem found in rose seeds, but the embryo used in these studies were several weeks to month old. They described the *in vitro* culture, histological examination, organogenesis and regeneration of plants from immature embryo of rose hybrids. They claimed that the system of plant regeneration developed here increases the number of progeny for evaluation that had not been available using conventional breeding technique.

Hu and Wang (1986) reported embryo culture technique. They explained that through embryo culture, it is possible to study embryonic development, by pass seed dormancy, test seed viability and rescue immature hybrid embryos from otherwise incompatible crosses.

Burger *et. al.*, (1990) reported organogenesis and plant regeneration from immature embryos of *Rosa hybrida* L. Intact flowering rose plants have been regenerated *in vitro* from excised embryos of crosses between 'Bridal Pink' (The maternal plant) and several pollen parents. Explanted embryogenic tissues developed into organogenic callus, which formed adventitious shoots after several months only on a modified half strength Murshige and Skoog medium containing 1.0μm, BA and 0.05μm NAA. These shoots could be separated,

grown individually, rooted in a medium with no BA or NAA with 1.0 µm IBA, and transplanted to green house media. Embryo ranging from 21-35 days not pollinated formed organogenic callus that eventually regenerated adventitious shoots. Analysis of population of regenerated plants from different crosses showed differences in flower colour, growth habit, and peduncle length and petal number. They have suggested that this system may be useful for irradiation mutation breeding and for the development of transgenic rose plants using *Agro bacterium tumefacience.* Roberts *et. al.* (1990) studied the protoplasm technology of rose and successfully induced somatic embryos in rose.

Noriega and Sondahl (1991) studied somatic embryogenesis in Hybrid Tea roses and explained that after the transfer of embryogenic clusters (mixture of globular embryos and regenerating embryos) on to MS medium, the clusters developed into a mixture of smooth embryogenic callus tissue, more matured embryos and hard green callus tissue. Embryogenic callus was separated more matured embryos and hard green callus tissue with 2 to 3 subcultures over 8 to 12 weeks to develop lines consisting of just embryogenic callus. Noriega and Sondahl (1991) and Kintzios *et. al.,* (1999) reported that an auxins and cytokines combination was essential for the induction of embryogenic callus in rose tissue from 'Royalty' and 'Soraya'.

Kunitake *et.al.,* (1993) studied somatic embryogenesis and plant regeneration from immature seed derived calli of *rugosa* rose (*Rosa rugosa* Thumb.). They have reported beneficial effect of BA and Kinetin on rose embryogenesis. Arene *et. al.,* (1993) explained a comparison of somaclonal variation level of *Rosa hybrida* L.cv.'Meirutval' plants regeneration from callus or direct induction from different vegetative and embryonic tissues. A somatic tissue consists of anthers, petals, receptacles and leaves. Frequency of regeneration was not mentioned in their findings.

Marchant *et.al.,* (1994) developed the technique for embryo rescue for the production of F-1 hybrid in English rose. Berger (1994) studied the history of *in vitro* culture of rose and discussed recent embryo rescue experiment on the basis of his own experience in the field of tissue culture of rose and narrated briefly the areas for future research. Regeneration of transgenic rose plants from embryogenic tissue has been successfully carried out (Firoozabadi *et.al.,* 1994).

Dubois and de Vries, (1995) reported that the addition of silver nitrate promoted both the regeneration capacity and the time of adventitious bud emergence from leaf explants of glass house grown cut rose 'Madelon', 'Only Love', 'Presto', 'Sonia' and 'Tineke'. *Katsumoto et.al.,* (1995) studied rose transformation system via embryogenic callus. They concluded that transformation of rose embryogenic calli was not difficult if the calli proliferated well and regeneration ability was high.

Hsia and Korban (1996) and Marchant *et. al.,* (1996) while working on somatic embryogenesis of rose explained that pre-incubation on a high 2, 4-D concentration increased the frequency of embryogenesis in *Rosa hybrida, Rosa chinensis minima* and *Rosa hybrida L* cv. 'Trampeter' and 'Glad Tidings' respectively.

Lauzer and Laberge (1996) used *in vitro* embryo culture technique to update and complete a collection of wild roses in the Montreal Botanic Gardens, Canada. Under this programme of *in vitro* embryo culture was used to propagate several rose species, which

are only available as seeds and difficult to germinate conventionally. Using embryo culture technique, it was possible to overcome seed dormancy problem and to rapidly increase the number of species in the collection, and this form a very limited numbers of seeds obtained from Botanical Institutions located around the world. As we know that rose seeds are difficult to germinate under conventional methods, it took more than 20 year to obtain the first batch of 108 species, however it took only one year to obtain 31 new species through *in vitro* embryo culture. Murali *et. al.*,(1996) studied regeneration through somatic embryo genesis in *Rosa hybrida* L. cv. "Arizona".

van der Salm *et. al.*, (1996) studied somatic embryogenesis and shoot regeneration from excised adventitious roots of the root stock *Rosa hybrida* L. ' Money Way'. Fukui and Inaida (1996) while working in somatic embryogenesis in *Rosa hybrida* L. cultivar 'Barka Role' determined that embryogenic callus was derived from the leaf primordial or shoot tip pith on MS media containing 10μm BAP + 1μm GA_3. The callus had meristematic cells, globular embryos and parenchyma and was maintained on MS media supplemented with 30g sucrose/lt, 10μm BAP, 0.1μm GA_3 and 20g gallon gum/lt. They have isolated many embryos from liquid culture containing 0.01μm BAP + 10μm GA_3 on a rotating (100rmp) shaker.

The beneficial effects of BA (above or combined with IAA or IBA) on somatic embryo maturation from rose (*Rosa hybrida* L. cvs. "Trumpeter" and "Glud Tidings") has been studied by Marchant *et. al.*, (1996).

Somatic embryos and isozymes in rose species *Rosa hybrida* L cv. 'King's Ramson' has been studied by Jayasree *et. al.*, (1998). Somatic embryos were obtained from long callus culture of leaf bud on half strength MS medium suspended with 0.5 mg 2, 4-D and 1.0 mg NAA + 0.5mg BAP/lt yielded only non-embryogenic callus. Isozymes pattern were studied to distinguish between non-embryogenic and embryogenic callus and also between non-viable and viable somatic embryos in embryogenic calluses. Specific isoperoxidase and isoesterases were associated with the development of viable somatic embryos.

Somatic embryogenesis from mature leaf of rose (*Rosa sp*) has been studied by Kinttzios *et. al.*, (1999). Several plant growth regulators Gibberallic Acid, Indole Acetic Acid, Kinetin and Naphthalene Acetic Acid alone or in combination, and culture condition were tested for their capacity to induce somatic embryogenesis from mature leaf and stem explants of the commercial rose cultivar viz. "Baccara', 'Mercedes', 'Ronto' and 'Soraya'. Somatic embryos from mature leaf explants from cultivar 'Soraya' on MS medium supplemented with 53.5 μm chlorophenoxy acetic acid and 46μm kinetic, although satisfactory callus induction rates were obtained from all the cultivars. Germination of mature embryos took place after sub culturing on medium of the same composition. Plantlets regenerated from embryo and bearing 3-4 leaves were transfered to a green house.

Somatic embryogenesis in rose has been studied by Dohm *et. al.*, (2001). They have explained one critical stage in regeneration of rose via somatic embrogenesis. It is the continued development and germination of embryos. Kintzious *et. al.*,(2000) studied the effect of vitamin and inorganic micronutrients on callus growth and somatic embryogenesis from young mature leaves of rose.

Kim *et. al.*, (2003) demonstrated control of direct and indirect somatic embryogenesis

by exogenous growth regulators in immature zygotic embryo cultures of rose. Immature zygotic embryos of rose (*Rosa hybrida* L.; cv. "Sumpath") did not form somatic embryos or embryogenic calluses when cultured on half-strength Murashige and Skoog's medium supplemented with various concentrations of 2,4- dichlorophenoxyacetic acid (2,4-D) as the sole growth regulator. However, the zygotic embryos produced somatic embryos without an intervening callus phase at a frequency of 27.3% on medium with 4.44μm 6-benzyladenine (BA) alone. Immature zygotic embryos formed embryogenic calluses at a frequency of 25% on medium with a combination of 1.36μm and 2,4-D and 4.44μm BA. Upon transfer to medium without growth regulators, embryogenic calluses produced numerous somatic embryos that subsequently developed into plantlets. Somatic embryos were induced directly from immature zygotic embryos, or indirectly via an intervening callus phase, by transplanted to potting soil and grown to maturity in a green house.

Kim-Gyeongttee *et. al.,* (2004) explained that somatic embryogenesis was induced only when MS basal media with auxins alone was used for the first four week of the callus induction period. They reported for the first time that ethylene inhibitor is an effective promoter of somatic embryo germination of rose. Genotype was a significant factor influencing explants embryogenic differentiation in culture, since only two of five investigated cultivars produced somatic embryogenesis. A similar genotype response to somatic embryogenesis among *R. hybrida* cultivars has been reported (Dewit *et. al.,* 1990, Hsia and Korban, 1996).

ADVENTITIOUS SHOOT

The induction of *in vitro* of adventitious shoots in *Rosa* has been successfully achieved (Lloyd *et. al.,* 1988). There are few reports of adventitious shoot regeneration from rose (Skirvin *et. al.,* 1990) but most has emphasized unreliable nature of rose regeneration system.

Rosu *et. al.* (1995) developed putative adventitious shoots from chimeral thornless rose (*Rosa multiflora* Thumb ex. Murr) *in vitro.* During the experiment a method has been developed for producing putative adventitious shoots from proliferating shoots of a chimeral *R. multiflora* rootstock. They have successfully established proliferated culture from green house grown axillary buds on Skirvin and Chu's modification of M.S. medium supplemented with BA at 2mg/lt and NAA at 0.1mg/lt. A sample of 119 of these plants were screened for the thorny or thorn less condition. Some parental stem had a few recurved thorn; petioles had small-lignified hairs. All regenerant had thornless stem; but they varied in degree of petiole prickleness. Results of their experiment suggested that a pure thorn less form has been separated from the parental clone. In addition, there is enough variation among regenerants to suggest that somaclonal variation among regenerants has appeared.

Gupta *et. al.,*(2001) studied Axillary and adventitious *in vitro* shoot proliferation in scented roses, *Rosa damascena* and *R.indica.* Rapid and efficient micro propagation protocols through direct and indirect organogenesis involving 2 essential oil-producing species of rose, *Rosa damascena* cv. "Noorjahan" and *R. chinensis* "Landrace" were developed. In the first set of experiments, 12 media combinations, in which basal media was supplemented with different concentrations of 6-benzylaminopurine (benzyl adenine) [BAP] and NAA

were used to induce adventitious shoot regeneration from nodal explants of two species. In the second experiment, different media, gibberellic acid (GA_3) and adenine disulfate (ADS) supplemented to half- strength MS medium + 0.5mg BAP/litre were tested for induction of callus. The effect of different concentrations of BAP, NAA, GA_3 and ADS supplements to the MS basal medium on the shoot regeneration from nodal explants and callus, and the effect of NAA and IBA on the rooting induction *in vitro* developed shoots of *R. damascena* and *R. chinensis* are presented, by them.

AXILLARY BUD

Rout *et. al.* (1989) conducted an experiment in tissue culture of rose. The results indicate that starting with a single axillary bud of *Rosa hybrida* cultivar 'Landora' as explants after 120 days of culture and this micro propagated plant can be grown in the open with very low mortality. They explained that in future many important cultivars of roses would be commercially propagated through tissue culture. Gasper *et. al.*, (1989) studied ethylene production in relation to rose micro propagation through axillary budding. Rapid propagation of Indian bred rose cultivar 'Priyadarshini' by axillary bud proliferation has been successfully done (Chaudhury, 1993). Sahoo and Debata (1997) conducted an experiment on *in vitro* micro propagation in the miniature rose ' The Fairy'. Axillary buds with small portion of internodes tissue were established on basal medium. Shoot multiplication rate was highest on medium containing 0.25mg/lt each of benzyl adenine and gibberellic acid. Floral buds were induced in the third generation of shoots when 0.25mg/lt each of bezyladenine, IAA and gibberellic acid were included in the medium containing 0.25mg NAA and 0.1mg 2,4-D/lt. Rooting was noticed after 15 days. When transferred to a green house and planted in a soil, sand and compost medium 75-80% of rooted plants survived. Development of rose axillary buds *in vitro* has been studied (Marcelis and Scholten, 1995).

Chi-ni-Hsia (1996) reported that leaves and internodes segments of *R. hybrida* 'Carefree Beauty' and Miniature rose *Rosa chinensis minima* 'Red Sunblaze' and 'Baby Katic' derived from *in vitro* grown shoots were used for regeneration experiment raised through axillary bud proliferation. Rahman *et. al.*, (1998) conducted an experiment on *in vitro* clonal propagation of rose through axillary branching. They have explained a method of *in vitro* propagation of rose cultivar 'White Bengal Rose'. The best condition for shoot proliferation was half strength M.S. media supplemented with BA (benzyl adenine) and Kinetin (2mg/lt). The best rooting of shoot was observed in the presence of IBA (2mg/l). Ganga *et. al.*, (1998) reported standardization of chemical environment for multiple shoot induction from axillary buds of rose (*Rosa centifolia* L.) cv. 'Andhra Red'. *Maurya et. al.*, (2004) developed an efficient mass multiplication protocol for rose cultivars 'Benjamin Paul' *in vitro* using axillary buds. They have tried several media with different growth regulators. Maximum (100%) shoot proliferation was achieved on MS modified medium supplemented with 2.0 mg/l BAP + 0.1mg/l NAA. The regenerated shoots were transferred to the rooting media. The highest percentage of rooting was observed in half strength MS basal medium supplemented with 0.5 mg/l IBA. The rooted plantlets were planted into the pots for hardening and transplanted into the field.

SHOOT TIP EXPLANTS

Hill (1967) studied morphogenesis of shoot primordia in cultured stem tissues of garden roses. Jacobs *et. al.,* (1969) conducted an experiment by taking shoot tip explants and studied the auxins and cytokinin effect. Jacobs *et. al.,* (1970a, 1970b) used shoot tip explant for tissue culture experiment and studied auxins and gibberellins effects. Elliott (1970) working with axenic culture of meristem tips of *Rosa multiflora* reported successful culture of isolated shoot tips of rose. Excised shoot tip apices (0.6 or 1.0 mm long) were grown in axenic culture on defined medium including auxins, gibberellic acid and cytokinin. In the presence of Zeatin (10^8 - 10^7m) and 6-benzylamino purine (10^7-10^6m) apices grew into plantlet but two other cytokinins, kinetin and 6-(3methyl but-2-enyl) aminopurine were ineffective. Auxins or gibberellic acid were either inhibitory or had no effect on differentiation. Experiment has led to the successful culturing of rose meristem tips on a defined medium containing inorganic salts, sucrose, thiamine, inositol and a cytokinin.

Graifenberg *et. al.,* (1975) studied the *in vitro* culture of shoot apices of two species of rose i.e. *Rosa multiflora* Thumb and *Rosa indica* Mayor. Hasegawa (1979) cultured rose shoot tips and lateral buds from green house grown rose (*Rosa hybrida* L. cultivar 'Improved Blaze') proliferated multiple shoots on basal medium (MS Salt, Vitamin, Glycine, Sucrose and agar) supplemented with 30mg/lt 6-benzylamino purine (BAP) and 0.3mg/lt Indole acetic acid (IAA). A three-fold multiplication was achieved from freshly explanted terminal shoot tips or lateral buds after eight weeks. Roots could be initiated from about 50 per cent of these shoot after transfer to a medium containing 0.3 mg/lt BA. Regenerated plants were successfully transferred to soil after two weeks. Plant regeneration from cultured rose shoot tips has been successfully worked out (Bressan *et. al.,* 1980).

Stimulation of root initiation from cultured rose shoots through the use of reduced mineral salts has been studied (Hyndman *et. al.,* 1982). *In vitro* propagation of "Golden Time" roses has been studied (Mederos and Enriquez, 1987). Factors affecting shoot tips and axillary bud growth and morphogenesis has been included in the studies. The influence of Ethylene on proliferation and growth of rose shoot cultures has already been explained (Kevers *et. al.,*1992). Standardization of chemical environment for multiple shoot induction from axillary buds of rose (*Rosa centifolia* L) cv. "Andhra Red" has been worked out (Ganga *et. al.,* 1993).

Taslim and Patel (1995) reviewed micro propagation aspect of rose. They have discussed in detail about stage of micro propagation, shoot establishment and proliferation, problem of shoot establishment and shoot proliferation factors effecting *in vivo* and *in vitro* rooting and compared, it and the end performance of *in vitro* plants in the field. Voviatzi *et. al.,* (1995) studied *in vitro* shoot proliferation rates of the rose cv. (Hybrid Tea) 'Dr. Verhage' as effected by apical dominance regulating substances. Podwyszynska and Olszewski (1995) studied the influence of gelling agents on shoot multiplication and the uptake of macro elements by *in vitro* culture of rose. Hsia and Korban (1996) reported that it is possible that glucose is immediately needed for somatic organogenic induction of some genotypes. Several reports on shoot multiplication indicate that glucose is better for shoot proliferation, while sucrose is better for rooting. However the influence of other

types of carbohydrates such as mannitol, maltose and fructose on regeneration of rose is yet to be elucidated and may provide additional insight into plant cell morphogenesis.

Podwyszynska (1996) explained practical method for overcoming shoot senescence and difficulties with rooting of rose shoots propagated *in vitro*. Rooting was studied in micro cuttings of two miniature rose cultivars 'White Gem' (difficult to root) and 'Starina' (Easy to root). Increasing the concentration of Ca, Mg, Fe and Mn in the medium markedly improved the quality of proliferated rose shoots.

Rout *et. al.,* (1996) while working with the problem of tissue culture in rose demonstrated chlorpromazine induced *in vitro* bud break in *Rosa hybrida* cultivar 'Landora'. Shoot segment of rose cultivar 'Landora' were cultured on M S supplemented with BA, Kinetin, GA_3 or the Calmodulin antagonist chlorpromazine (CPZ) at various concentration. All the tested concentration of chlorpromazine (0.25 - 5.0 mg/liter) induced rapid bud break with 4-5 mg/liter being most effective. Shoot elongation showed a similar response to CPZ. The other was not more effective at pH 7.0 than at 4.0 and required calcium in the medium for optimal activity.

Syamal and Singh (1996) explained about *in vitro* propagation of rose in detail. Results of their experiment shows that shoot tip and nodal segments of *R. hybrida* cultivar 'Crimson Glory' proliferated when cultured on modified MS medium supplemented with various plant growth regulators. Nodal segments respond more rapidly and produced more shoots than shoot tips. Proliferated shoots produced the higher number of roots when transferred to half strength basal medium. Rooted plantlets were successfully transferred to pots under natural condition after acclimatization.

Salchi and Khosh-Khui (1997) studied the effects of explant length and diameter on *in vitro* growth and proliferation rate in miniature rose cultivar 'Little Buckaroo' and 'Baby Masquerade' and 'Saurati'. Shoot length and proliferation rate were measured one and four weeks after culture. Best shoot development and proliferation rate was obtained from explant with the greatest length and diameter. In 'Little Buckaroo', a positive correlation was observed between shoot length after 1 week and proliferation rate after four week. Wardrops *et. al.,* (1997) conducted an experiment and demonstrated that carbon dioxide gasseol fluorocarbon enhances micro propagation of rose (*Rosa chinensis* Jacq). During the experiment the incent perflurochemical (PFC) liquid, perflurodecalin (Flutee PPG) was used to increase the CO_2 supply of the culture rose cultivar 'Baby Love" shoots. They have shown that the treatment of cultured shoot with CO_2 gasseol PFC also significantly reduced the accumulation of phenolic compound in roots. The total chlorophyll of aerial parts was unaffected although total protein in shoots and root was significantly lower than the control. The biotechnological implications of this novel cultural regime are discussed for the micro propagation of woody species.

Singh and Syamal (1999) conducted critical studies on the effect of growth regulator on *in vitro* shoot proliferation in *Rosa x hybrida* L.cv. "Sonia" for micro propagation. Singh and Syamal (2000) determined that anti-auxins enhance *Rosa hybrida* L. micropropagation. Shoots of rose cultivars "Super Star" and "Sonia" were multiplied for 10 subcultures at 4-week intervals on solidified Murashige and Skoog medium supplemented with 22.19 μM benzyl adenine + 1.07 μM NAA + 0.05 μM gibberellic acid. Addition of anti auxins

2,3,5-triidobenzoic acid (TIBA; 2.0 μM) and 2,4,6-trichlorophenoxyaceticacid (2'4'6-T; 0.39 μM) into proliferation medium increased number of shoots per explant and length of shoots in both cultivars. Treatment with TIBA also increased number of leaves per shoots and leaf chlorophyll content.

Ganga *et. al.*, (2000) studied *in vitro* rhizogenesis of micro shoots of "Andhra Red" rose (*Rosa centifolia* Linn). Various culture media for the *in vitro* rhizogenesis of micro shoots of rose (*Rosa centifolia*) cv. "Andhra Red" were evaluated in a laboratory. Treatments were ¼, ½ and full strength of Murashige and Skoog (MS) medium supplemented with 1.5% sucrose and with IBA (0.20, 0.50, 1.00 mg/l), IAA (0.10, 0.50 and 1.00mg/l) and NAA (0.10 mg/l). The highest rooting response (56.67%), earliest rooting (20.93 days) and longest roots (5.38cm) were obtained with ½ strength MS medium supplemented with 0.5 mg IAA/1 and o.1 mg NAA/1. The highest number of roots (4.37) was recorded for ½ MS fortified with 1.0 mg IBA/1.

Singh and Syamal (2001) studied the effects of media and physical factors on *in-vitro* rooting in roses. Micro shoots (3.5±0.5 cm.) of two rose cultivars, "Sonia" and "Super Star", were grown in half strength Murashige and Skoog (MS) medium supplemented with 1.0mg IBA/l, 20g sucrose/l, with pH adjusted to 5.7, and were exposed to a 16-h photoperiod from cool white lamps. The rooted plantlets were transferred to glass jars containing peat + soiltrite moistened with ¼ MS macro salts. After a fortnight, the lids were loosened and removed after a second fortnight, the hardened plants were transplanted in pots in glass house. Results showed that medium modification along with auxins had significant effects on rooting of rose micro shoots. Highest rooting (92.5%) was recorded for 'Super Star' with treatment MS (3/4 macro + ½ micro) medium supplemented with 0.5mg IBA + 0.5mg NAA/l. Similarly 'Sonia' responded best (89.8%) with 0.2mg IBA + 0.2mg NAA/l with the same medium modification. Micro shoots of "Sonia" gave maximum rooting (92.6%) with 30g sucrose/l, while for "Super Star"; the best rooting (84.5%) was recorded with sucrose at 2.5g/l. Sandal *et. al.*, (2001) determined an efficient liquid culture system for shoot proliferation.

A liquid culture system using nodal segments was used for shoot proliferation and root induction in *Rosa damascena* and *Rosa bourboniana*, two commercially important species of scented rose (Pati *et. al.*, 2005). For efficient and large-scale induction of roots in micro shoots, a rooting vessel was designed and developed to facilitate the micro propagation protocol. Their work highlights the significance of osmotic potential in relation to enhanced growth and development in liquid cultures, vis-a-vis agar-gelled cultivars, especially in relation to root induction during micro propagation. An additional significant feature of the protocol developed was the high success rate of hardening the micro propagated plants in low-cost hardening chamber upto Ca 96.7% for *R. damascena* and 100% for *R. bourboniana*.

Chakarbarty and Datta (2006) studied *in vitro* meristem tip culture of *Rosa hybrida cultivars* 'Contempo' and 'Mrinalini'. A micro propagation method for these two cultivars were presented using shoot tip proliferation onto Murashige and Skoog (MS) medium with $0.2mgL^{-1}$ indole-3-acetic acid (IAA) along with different concentration of 6-benzylaminopurine (BAP). Percent of explants producing multiple shoots, number of

shoots per responded explants and growth of shoot varied with BAP concentration. The optimum results were recorded in $2mgL^{-1}$ BA. Addition of $AgNo_3$ in the medium reduced leaf abscission of the *in vitro* developed shoots. The regenerated plants were transferred to rooting medium (x ¼ MS with $0.1mgL^{-1}$ IAA, $0.1mgL^{-1}$ indole-3-butyric acid, $30gL^{-1}$ sucrose, and 0.6% agar). The highest percentage of root formation was observed in 'Contempo' (57.1%), whereas very low percentage of rooting (16.6%) was observed in 'Mrinalini'. Rooting medium supplemented with different concentration of activated charcoal, increase in rooting percentage with increasing the concentration was observed in 'Mrinalini'. At the end 21-28 days the shoots were deteriorated due to yellowing of leaflets. When the plantlets were rooted in liquid medium, on the contrary, the percentage of yellowing of leaflets was almost zero. The resulting plantlets were acclimatized and grown in potted soil where they developed normally.

PITH EXPLANTS

Jacobs *et. al.* (1968) studied in detail about the tissue culture of rose. In this experiment they have regenerated the rose plants by using pith explants.

LEAF EXPLANTS

Souq (1987) first reported regeneration from somatic embryos from calli of leaf, filaments and stamens. Subsequently, it was also reported from calli of leaf (de Wit *et. al.*, 1990; Rout *et. al.*, 1991); filaments (Noriega and Sondahl, 1991) and immature seeds (Kunitake *et. al.*, 1993). di *Wit et. al.*, (1990) obtained somatic embryos from callus derived from leaf explants of *Rosa hybrida* 'Domingo' and 'Vickey Brown' with an optimum regeneration frequency of 5.8 and 3.0% respectively. Dubious and Vries (1995) studied the direct regeneration buds on leaf explants of glass house grown cut rose cultivar. In these experiment six types of leaf explants from green house grown cut rose cultivar viz. 'Madelon', 'Only Love', 'Presto', 'Sonia' and 'Tineke' were cultured on M.S. media. After 21 days explant were subcultured on full strength M.S.Media. Regeneration capacity was greatest from explant from a 5 foliate leaf consisting of the base of leaflets subtending petioles or of the leaf sheath with petiole.

Arif and Khatanian (1996) studied *in vitro* morphogenesis from callus of *Rosa hybrida*. They observed that callus of *R. hybrida* cultivar 'Tiffany' was induced in the dark on 5mm leaf disc within two weeks of initial culture on Sehenk and Hildebrandt (SH) medium supplemented with 136μ 2,4-D. In contrast of leaf callus, rose stem section derived callus failed to differentiate using the same condition. Hsia and Korban (1996) explained that callus was induced from leaf explants of 'Heekenzauber' with both auxins alone and in combination with cytokinin. An effect of Indolebutyric acid on rooting of leafy cuttings of *Rosa* cv. "Red Success" has been studied (Rehman *et. al.*, 1998). Ibrahim and Debergh (1999) observed improvement of adventitious bud formation and plantlet regeneration from *in vitro* leaf explants of *Rosa hybrida* L. Kintzios *et. al.*, (1999) while working on somatic embryo genesis from mature leaves of rose (*Rosa* species) reported the use of strong auxins picloram. Dohm *et. al.*, (2001) reported that callus was induced from leaf explants of 'Care Free Beauty' with both auxins alone and in combination with cytokinin. Ibrahim and Debergh (1999) found improvement of adventitious bud formation and plantlet regeneration from *in vitro* leaf explants of *Rosa hybrida* L.

Pivetta *et. al.,* (2001) studied the effects of indolebutyric acid on rooting of leafy cuttings of *Rosa* sp. "Red Success". They have presented the results of an experiment conducted in Sao Paulo, Brazil during March-May 1993 to determine the effects of IBA on the rooting of rose cv. 'Red Success' leafy cuttings.

Kim *et. al.,* (2004) reported somatic embryo genesis and plant regeneration from *in vitro* grown leaf explant of rose. Four commercial rose cultivars *'Rosa hybrida'* 4th July', 'Tournament of Roses', 'Graham Thomas' and 'Sequoia Ruby' and one rose species (*Rosa multiflora* Thumb) were used in this study. Somatic embryos germinated on MS medium containing IBA and BA. Silver nitrate (58.8mm) enhanced shoot formation and germination of somatic embryos. Using *in vitro* grown leaf explants from five genotype of rose, a protocol for induction, maturation and germination of somatic embryos was developed. Somatic embryogenesis was initiated and maintained in two of the five genotypes investigated, demonstrating a genotype specificity that is known to occur in other protocols for the induction of somatic embryogenesis. The addition of silver nitrate in the medium increased the germination of the somatic embryos in the two genotypes that responded to the treatment. Pati *et. al.,*(2004) studied direct shoot regeneration from leaf explants of *Rosa damascena* Mill.

NODAL SEGMENTS

Bressan *et. al.* (1982) studied the factors affecting *in vitro* propagation of rose. The node position from which axillary buds were isolated from shoots of rose (*Rosa hybrida L.*) markedly affected their growth and development in culture. Those buds nearest to and farthest from the apex either failed to develop or took the longest time to develop in culture compared to those buds in the middle position of the stem. If the endogenous cytokinin level is too high, root initiation may be inhibited and if it is too late the shoot undergoes senescence before it becomes cytokinin-autonomous, which occur after root initiation. The effect of BAP and IBA on sprouting and adventitious root formation of "Amanda" rose single-node softwood cuttings has been studied (Devries and Dubois, 1988).

Tanimoto and Ono (1994) studied the development of plant propagation method in rose. Nodal segments were cultured on a solid medium with BA (0.1, 1.0, 3.0 or 10μm) and NAA (0.05 to 1.0 μm). Proliferation was best with 3μm BA only. Chi-ni-Hsia *et. al.,* (1996) reported that internodal stem segment pre incubated in NAA seemed to undergo organogenesis but not embryo genesis. Ishioka and Tanimoto (1990) also observed this phenomenon whereby only adventitious shoot buds were induced on *R. damascena* callus. Therefore, the influence of the type of auxins in the callus induction medium can be useful in morphogenic manipulation studies in roses.

Shirzadian and Lotfi (2002) studied *in vitro* micro propagation of rose ('Elizabeth' cultivars) via tissue culture in test tube conditions. Nodal segment of rose cultivars 'Elizabeth' (2cm) was cultured in modified MS medium containing IAA and BAP (benzyl adenine). Subsequently, several 0.1 mg IAA/liter + 1mg BAP/liter, and 3 subculture stage induced the highest number of new shoots. MS medium containing 0.6mg IAA/litre produced the best roots (75% rooting). The plants were transplanted in mixed medium containing sand : peat at 1 : 1 and kept in the green house.

Iqbal *et. al.,* (2003) studied *in vitro* propagation of Hybrid Tea roses. Shoot tip and nodal segment explants were cultured on MS media modified with different growth regulators for mass propagation of Hybrid Tea rose cultivars "Rosy Cheek" and 'Whisk Mac.' The MS medium modified with BAP (3mg litre-l) + IAA (3mg litre-l) + activated charcoal (5mg litre-l) effectively minimized production of phenolic compounds and gave early shoot proliferations, maximum shoot length and number of leaf per shoot. Nodal segment gave earlier sprouting, higher shoot initiation percentage and longer shoot length compared to shoot tip explants. Proliferated shoots were transferred in different combinations of root initiation media and roots were only regenerated in MS medium supplemented with 0.5mg IBA litre-l after 19 days of sub culturing.

Singh and Dubey (2003) reported an *in vitro* procedure for large-scale multiplication of Miniature rose (*Rosa chinensis*) cv. "Rosamini" by using nodal segment. An average of 18 shoots per culture were obtained on MS medium containing 1mg benzyl adenine/ litre within 23 days of initial culture. Upon subsequent subculture, 16 shoots per cluster could be harvested every three weeks. More than 90% shoots were successfully rooted. Rooted plantlets were transferred to plastic pots containing soil and leaf mould (1 : 1) medium under green house condition before they were finally exposed to external environment. Eighty three percent of the plants survived in the nursery. Uniform flowering were observed upon successful field transfer of the plantlets.

PETAL EXPLANTS

Muralia (1996) while working on regeneration through somatic embryogenesis from petal-derived calli of *Rosa hybrida* L.cv 'Arizona' (hybrid tea) reported the use of strong auxins such as dicamba. Shanthi Murali *et. al.,* (1996) studied regeneration through somatic embryogenesis from petal-derived calli of *Rosa hybrida* L cv. "Arizona" (hybrid tea). This investigation was carried out to examine the extent of embryogenic response for 22 different cut flower rose variety, however, embryogenesis leading to full regenerated plants could be achieved in only one cultivars 'Arizona'. This is the first report on somatic embryogenesis and plantlet regeneration from petal explants of rose (Shanthi Murali *et. al.,* (1996). Somatic embryogenesis in callus cultures of petal explants of rose cv. 'Arizona' is reported. The calli from petal initiated on dicamba containing medium were friable and gave rise to embryos after several subcultures while these obtained from other explants did not show embryogenesis. Abscisic Acid and phloroglucinol were necessary during maturation and plant development, respectively. The individual embryos grew into true to-type plants.

Datta *et. al,* (2002) studied *in vitro* petal culture and callus formation of *Rosa* species. The regeneration of rose petals of seven rose cultivars (Contempo, America's Junior Miss, Manasi, Mrinalini, Preyasi, Sylvia and Queen Elizabeth) in MS and Schenk and Hildebrandt's (SH) media with NAA (0.2, 0.5,1.0 and 2.0mg/litre) +6-benzylaminopurine (Benzyl adenine) (0.0, 0.2, 0.5, 1.0 and 2.0mg/litre) and 2-4, D (0.2, 0.5, 1.0, and 2.0 mg/ litre) + benzyl adenine (0.0, 0.2, 0.5, 1.0, and 2.0mg/litre) was investigated. Calluses that develop in MS medium were hard and dark green. In SH medium, callus were soft, pale greenish, and nodular. The number of calluses in SH medium was lower than that of MS medium except in SH medium supplemented with 2,4-D (2.0mg/litre) + Benz adenine

(1.0mg/litre), in which higher number of callus is formed. In MS medium containing NAA+ benzyl adenine (1mg/litre each), callus formation was 100% in Mrinalini, America's Junior Miss, and Sylvia; 86.7% in Preyasi; 89.5% in Manasi and 94.1% in Queen Elizabeth. In medium with2, 4-D (2mg/litre) +benzyl adenine (1mg/litre), callus formed in 56.2-75.0% of the explants. Somatic embryogenesis or organogenesis was not observed in any of the media. The thin layer chromatography of callus, leaf, and petal explants showed 17 spots of phenolic compounds visible with the unaided eye, under UV light after spraying it with flavones reagents. Spectrophotometer analysis of methanolic extracts from 2-,3-,4-, and 6-months old calluses, young leaf developed *in vitro* or *in vivo*, and mature leaf and petals developed *in vivo* showed 7, 15, 27, 19, 15, 16, 10 and 17 compounds, respectively. Gel electrophoresis patterns for soluble proteins indicated variation in number and intensity of bands within the callus (8 bands) other explants.

ANTHER AND FILAMENT EXPLANTS

Anther culture of *Rosa* has been successfully done (Tulaeezadch and Khosh-khui, 1981). They reported induction of callus from the anthers of two tetraploid *Rosa* species (4n=28). They cultured anthers at various stages of development in different media, with varying concentrations of auxins and kinetin, under different light conditions. The MS media with 2.0g/l IAA and 0.4mg/l kinetin was the best for anther culture of *R.damascena* while the medium with 7.5mg/l IAA and 0.8mg/l kinetin was found to be optimal for *R. hybrida* cultivars. A semi hard callus was induced from filament explants of *Rosa hybrida* cv. 'Royalty' and 14% of the callus formed somatic embryos developed into whole plantlets (Noriega and Sondhal, 1991).

IN VITRO ROOTING

The role of sucrose and nitrogen in adventitious root formation on cultured rose shoot has already been explained (Hyndman *et. al.*, 1982).. Rooting of cultured rose shoot has been studied in detail (Alderson *et. al.*, 1988). *In vitro* rooting of clonally propagated miniature rose cultivars has been worked out (Badzian *et. al.*, 1991). Wilson and Nayar (1995) studied the effect of activated charcoal on *in vitro* rooting of cultured rose shoots. *In vitro* rooting of cultured rose cultivar 'Folk Lore' shoot 3 cm long were placed on M.S. medium supplemented with IAA and NAA in various concentrations for rooting. Combination of these two growth regulators with 2, 4- D and activated charcoal were also tested. The best rooting (19.7%) with 12 roots/shoot and root length up to 5.2 cm was obtained on medium supplemented with 1.0 mg IAA + 1.0mg NAA + 500mg activated charcoal/litre. Rooted plantlets could be transferred to *ex vitro* conditions after 4 weeks on the rooting medium. Siftar (1996) studied the influence of different dilution of the Murashige and Skoog medium on rooting and growth of the *Rosa* cultivar under *in vivo* conditions. Results of the micro propagation experiment on 4 rose cultivar showed that quarter strength of Murashige and Skoog salt solution containing 1.0 mg IBA and 20g sucrose/litre should be used for rooting the proliferated shoot.

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□□□

8

SOIL AND CLIMATE

SOIL

Rose is one of the most accommodating of all plants and can be grown in varieties of soils. They love deeply worked soil, well drained particularly in rainy season and yet will be retentive of moisture during summer and dry season. They must have moisture at roots, and cool condition to. Roses do not like dry and sandy soil, which become hot during sunny periods. They prefer to be cool both below and above the ground. If such conditions cannot be provided, the plant neither be long lived nor will they provide bloom of a quality of which they are capable (Roy Gender, 1965). Roses cannot withstand water logging even for a short duration. The soil should be well drained or easily drained by using tiles and ditches (Bhattacharjee, 1995).

Almost any soil can be made by cultivation in good garden soil, pure quartz sand or degenerated sand stone is almost entirely devoid of plant food; for rose growing these are most unsatisfactory. Blue granite produces very good soils. White granite, limestone and red iron stone usually make poor soil, and these can be improved by addition of humus in sufficient quantities. Shale soils, alluvial soils, and yellow limestone soils are generally good. Rose roots penetrate only as deep as the soil is suitable to them; hence, a fertile layer of surface soil of adequate depth is to be maintained (Thomas, 1970). Rose plants grow well in good fertile soil. They can, however, be grown in all types of soil with proper drainage facilities. Well-drained medium loamy soil having adequate organic matter is ideal (Bose and Mukherjee, 1997).

The best soil reaction for rose should be in the pH range of 6.0 to 6.5. They will do reasonably well at a pH of 7.0 and slightly higher, but some nutritional problems may be encountered from time to time. A pH less than 6.0 is usually too low. A soil, which has been in cultivation and has a depth at least 45 cm, is good for rose growing. The subsoil must have the capacity to retain sufficient moisture, but at the same time permit good drainage. Adverse soil conditions however, affect growth and flowering to a great extent. Budded plants have lesser tolerance to adverse conditions then unbudded rootstocks. Roses fall into the sensitive category of plants with respect to salinity and sodicity tolerance (Bhattacharjee, 1995). With the increase in sodocity level in soils, chlorophyll "a" and "b" content of the rose leaves decreased (Singh and Chitkara, 1984). The land where the external drainage is poor and water stagnates during monsoon should not be selected for rose cultivation. In very heavy soils, gravel and sand may be mixed into the bed to allow drainage. The land with higher water table is not suitable for rose culture (Yadav *et. al.*, 1989).

Rose plants need for their excellent growth, development and flowering a good soil physical environment, good soil structure, optimum soil moisture, soil aeration and good drainage. Rose plants can be grown in soil having pH from 5.5 to 8.0, but they thrive best under slightly acidic condition i.e. pH 6.0. The microorganism present in the cultivated field play a very important role in the nutrient cycling and availability to plants and in the decomposition of organic matter and humus in the soil. If the soil physical condition is good, moisture and aeration status is optimum, the microorganism do their jobs without any extra care. Maintenance of high fertility status of the soil is very important for successful rose growing (Biswas, 1984).

CLIMATE

Rose can be grown successfully in different climatic zones. However, moderate temperature, bright sunshine and high light intensities are good for flower production. The early morning sun should beam over the rose beds for at least six hours a day. Rose bushes not receiving the morning sun perform poorly. In hot weather, however, partial shade during the afternoon when the sun is hot is beneficial. An area protected from hot and cold blast of wind is ideal (Bhattacharjee, 1995). In England, Canada, northern United States of America, Germany and Denmark large number of young plants as well as established plants are lost because of low temperature in winters. The Pernetianas are most subject to loss by freezing. In cold parts of Europe and USA many rose growers protect their plants for over six months each year by elaborate and costly methods. In subtropical climates plants do not get true rest period and lose their virility within a few years. Under tropical conditions very high quality-roses can be grown. Most rose breeding is directed to meet the requirements of the temperate climate. In areas of low rainfall and high summer temperatures, dwarf roses are best (Thomas, 1970). The climatic conditions that prevail in different parts of India are well suited to rose cultivation. In the northern plains, roses flower best during winter, whereas in the temperate hilly regions of the Himalayas, the best rose flowers are produced in summer. The place like Pune, Nasik and Sangri, in the western part of India; and Bangalore in Southern India have excellent agro-climatic conditions for rose growing. The plains of Eastern India are also suitable for cultivation of many cultivars of roses (Yadav, *et. al.*, 1989).

Light

Light intensity is the most important factor affecting the growth of rose plant and flowering. Decrease in light intensity and the duration of light period owing to the seasonal changes or shading reduce the yield of roses. Supplementary lighting or relatively high levels of irradiance, especially during periods of low solar radiation, results in increasing number of flowers (Zeislin and Mor, 1990). Total plant weight, growth of plant and flower production reduces with the low light intensity in roses. Colour of the flower is influenced by light intensity and high light intensity is necessary for anthocyanin formation in rose cultivars. The effect of light on bud sprouting is related mainly to red : far-redratio; while the effect of flower development is related to mainly photon flux density. The duration of light has also pronounced effect on vegetative growth as well as reproductive structure (Yadav *et. al.*, 1989).

Various workers extensively investigated the possible use of supplementary lighting with relatively high levels of irradiance in order to increase the productivity of green house rose. Seasonal fluctuations of solar radiation affects the rose flower production. Flower bud abortion in rose is affected by low light intensity at early stages of shoot development. Nearly 50 to 60 days are required to develop a flowering shoot from bud sprouting until flower harvest. Shading, which is widely used in order to reduce the rise in green house temperature during summer month, frequently results in decrease in flower yield. Generally, stems of the summer flowers are shorter, thinner and have smaller leaves and flower buds with flower petals than winter flowers (Zieslin and Mor, 1990).

Photosynthesis of roses is influenced by light intensity and affected by leaf age, CO_2 levels, temperature, cultivar and water status of plants (Aikin and Hanan, 1975, Jiao *et. al.*, 1988; Pasian and Lieth, 1989). Decrease in light intensity was followed by a decrease in the activity of gibberellin-like substances in the uppermost shoot of the rose stem. This decrease was more pronounced in the lower shoots, which are more prone to flower abortion (Zieslin and Halvey, 1976). Darkening of rose shoot tip reduced its sink strength, while application of BA to the darkened shoot restored the mobilization capacity of the sink (Mor *et. al.*, 1981). The contents of endogenous cytokinins in the darkened shoots were lighter than the shoots exposed to light (Van Staden *et. al.*, 1981), indicating that the darkening may cause inactivation of endogenous cytokinins (Zieslin and Mor, 1990).

Khayat and Zieslin (1982) observed that lateral buds along a rose stem differ in their sensitivity to light according to their position on the stem. There is correlation of flower abortion in roses (blindmass) with seasonal changes in solar radiation. Reduction of light by shading results in flower abortion, which is closely associated with the intensity of light flux. Alteration in colour development, such as fading, bluing, blackening of red and pink petals and greening of yellow ones are affected by variation in intensity and spectral composition of light as well as by other environmental factors (Zieslin and Mor, 1990). The effects of supplementary lighting with various light sources and different composition of light spectrum along with various horticultural practices have been investigated by several researchers. Enhancement of growth and flowering by supplementary lighting obtained in miniature rose cultivars become a common practice (Zieslin and Mor, 1990). Supplementary lighting increases large leaf area (Slootweg and Van Meeteren, 1991) and accelerates flower development in field grown roses (Bredmose, 1993). Cut rose buds grown under low light intensity produces normally coloured petals when treated with sugar solutions, whereas flowers left on plant had a paler colour petal. Zieslin (1989) observed that blackening of rose petals is stimulated by penetration of UV radiation through the covering materials of green house.

Temperature

Growth of the rose plant and the physiological and biological processes occurring in plant is influenced by the temperature, which in turn affect the vegetative growth, flower production and flower quality. Requirement of temperature varies with the cultivars to some extent; and the optimum night temperature ranges between 13.3°C to 21°C depending upon the cultivars for obtaining maximum flowers, heavier and stiffer flower stems of longest length and as well as better flower colour. At low temperature flower production

decreases but better quality flowers are obtained; along with better development of pigments in the leaves, stem and flowers. At higher temperature there is an enhancement of vegetative growth and flower production, but the flower quality deteriorates. The day temperature between 20°C to 28°C is optimum for roses, depending upon the cultivars. Temperature lower than 13°C and above 30°C adversely affects the production and quality of rose flowers.

The effective season of production decrease with the rise in temperature beyond 28°C. In India under natural conditions of Bangalore and Pune, good roses can be obtained for 5 months beginning from December to April. In high Tropics and North-East India the season is for 8 months from October to May, and in subtropical climate, roses can be obtained from November to April (Bhattacharjee and De, 2003).

Shoots growing in short branches at 21°C and a photoperiod of 8 hours under florescent light aborted almost all of their flower buds. Low incidence of abortion occurred in shoots growing on long branches. At a photoperiod of 16h, the incidence of abortion was low at both temperatures and shoot positions. On the other hand under incandescent light, the rate of abortion was high in all temperature, photoperiod and position treatments (Zieslin and Moe, 1985).

The blackening of rose petals is enhanced by the exposure of plants to sub-optimal temperatures and in absent in green houses covered with polyvinyl chloride (PVC) or polyethylene opaque to UV-B radiation shorter than 360 nm, even when grown at sub-optimal temperature (Mor and Zieslin, 1990).

The promotive effects of supplementary lighting were more pronounced at 18°C night temperature than at 15°C and were facilitated by CO_2 enrichment of the green house atmosphere (Langans *et. al.*, 1973; Zieslin *et. al.*, 1986). Reduction in light intensity extended duration of a growth cycle. This effect was influenced by temperature and was more pronounced at higher temperatures than at lower temperatures. A decrease of 65 per cent in light intensity increased the duration of one growth cycle of "Baccara" roses by 3 days at 15°C in comparison with 12 days at 21°C (Moe and Kristoffersen, 1969).

Higher temperature during field conditions decreases vase life and quality of rose cut flowers. At higher temperature, stored carbohydrates of flowers are quickly depleted during respiration and the plant transpires at a faster rate (Bhattacharjee and De, 2005). But a decrease in temperature before harvest from 21-24°C to 15-21°C reduces the vase life of cut roses. The effect of temperature was attributed to an increase in the level of phenolic compounds produced in the leaves (Moe, 1975). The rose cultivars, "Dr Verhage", grown at lower temperature (15°C) develops a greenish tint because of incomplete conversion of chloroplasts to chromoplasts (Halevy and Mayak, 1974). Exposure of rose plant to higher temperature (7 hours) reduces anthocyanin content and increases bluing. A strong reduction of temperature at 4 to 7 days before commercial stage of harvest of "Baccara" roses will increase anthocyanin content and blackening. Rose cv. "Carol" and "Dr. Verhage", grown at high temperature, yield very pale flowers, but produces normal colour when cut at bud stage and kept in sucrose solution (Halvey and Mayak, 1974).

Humidity

Humid atmosphere may cause the development of fungal and bacterial diseases. Importance of humidity lies in the internal water conditions of the rose plants. Low humidity may cause browning of leaf edge of the plants with thin leaves or leaflets. High humidity can maintain water borne pollutants in a condition so that they can be more easily absorbed through the cuticles or stomatas. High humidity damage cut flowers during storage and transport. Damaged rose flowers remove water less quickly and emit ethylene (Bhattacharjee and De, 2005). Certain diseases like mildews are associated with high relative humidity. Wilted plants grow very slowly and by maintaining very high amount of humidity, the internal deficiency of water will be less (Yadav *et. al.*, 1989). Enlargement of cells is caused by water, and therefore, if the loss from the plants could be less, leaves and flowers would be larger and stem longer (Laurie *et. al.*, 1958). Environmental factors especially temperature and relative humidity, can have a strong influence on the entry of applied sprays. The most dramatic cause of humidity affecting entry is that of maleic hydrazide (Crafts *et. al.*, 1958, Smith *et.al.*, 1959). It was also reported that low humidities also suppressed the entry of 2,4-D, amino triazole and some other leaf sprays (Chlor *et. al.*, 1963).

Rose cut flowers show symptoms of *Botrytis* infection after marketing and transportation (Noordegraff, 1995). The air humidity inside the glass house is the factor determining the number of lesions during storage and transportation (Kerasies and Frinking, 1996). So lowering of air humidity by heating and ventilating the glass house is essential. Mortenson and Fjeld (1995) reported that increasing humidity from 65 to 85 per cent has no effect on the vase life of roses, while a further increase to 90 per cent significantly decreased it. This decrease in vase life closely related to an increase in the occurrence of the bent neck and leaf dying at the highest humidity..

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9

GARDEN DESIGN, PLANTING AND MANAGEMENT

GARDEN DESIGN

Where space permits, rose can be cultivated in a special garden. This consists of a number of beds grouped together in simple design. The construction of rose garden involves design, choice of varieties, preparation of soil and planting. In case of formal design, a rose garden needs a focal point. This type of garden need not, of course be of formal design, as roses can be equally attractive in an irregular enclosure and in beds of informal shape, provided that the garden is planned for pictorial effect. The path or space between the beds can be composed of grass, which always forms a pleasing setting to a bright display of flowers of any kind or of gravel or broken flagstones. The length of such a garden may vary from a simple bed of hybrid tea roses surrounded by turf to elaborate designs. This may include climbers and ramblers on walls or rustic arches and fences together with uniform borders of Floribundas, Standards, Weeping Standards and several beds of Hybrid Teas. Miniature and Polyantha roses can also serve a useful purpose in borders and edges. This type of garden will offer good opportunities for growing of many attractive rose species, too (Bhattacharjee, 2004).

Rose can be effective when seen in group and flourish for several years and of course they produce superb individual flowers. The traditional pattern of rose garden dates back to the mediaeval garden, in which the enclosed garden was divided in to small, regular plots around in central dipping well or fountain, and from which herbs and flowers could be picked from the intervening paths. In the later Victorian and Edwardian eras the enclosed garden entirely for roses retained this concept of formal beds cut out of the turf around a central feature of pool, sundial or statute and today in many public parks this is still the pattern. In the present housing development roses are treated as the shrubs or herbaceous plants in the mixed border with three or five bushes in a group in pockets among other plants. This method allows the roses to be set into a background of shrubs or other foliage plants which enhance their blooms. Background colour is very important for an appreciation of roses. Walls of brick or stone or colourwash and timber fencing all need roses of contrasting colours against them for effective results. If the garden is large enough, a more informal or abstract or abstract pattern can often fit better into the site and different sized beds can lend themselves to a more balanced colour palette. Of all the garden plants the rose probably has the more varied applications, for bedding, for hedging, for screening, for ground cover and so on. With the large scale requirements

of public authorities and others, rose growing might, perhaps, encourage the uses of roses for this purpose and the production of a low growing; densely foliaged rose of spreading habit would be of great value. The roses are used as elements of designs, for their massing and foliage colour contrast and not just for their flowers (Clarke, 1977).

Simple and informal design for rose garden with various designs of beds, depending upon the liking of growers is also suggested. However for the maintenance rectangular beds are better, the width should be such that cultural operation becomes easy (Yadav, 1989). It would be sensible to look over the properties to see how to make use of the types of roses to best advantage. There is no need for anyone to execute even a modest plan all at once. After thorough planning the plants may be planted in installments. Some day one will find that a mighty attractive properly built around the beauty and versatility of roses. One can make half a dozen designs for small properties using roses integrated with possible existing plantings. The selected design should be such that which best fit one property. It must be kept in mind that Hybrid Teas are for beds and for cuttings, Floribundas for masses of colour and borders or low hedges, Climbers to screen area or fill them with colour, Shrub or Hedge roses for higher Hedges, Fences or, when used individually as accent plants (Miton,1962).

One of the attractive aspects of planting roses extensively beyond the confines of the open space and parks of the city has been the response of the public. Not just their appreciation of the blossoms and flowers but their practical response in planting roses themselves in their own front gardens. Planting roses adds dash and excitement to the environment. It helped to give pleasure to every one using the urban area and most of all induced a feeling of pride in the community, which reflected itself in higher standards of care both for private and commercial premises. The brighter roses did well in the urban areas and looked at home there. They vied with the other strong colours of the city or town; they were balanced by the brightness of modern road vehicles and by people themselves. In suburban areas, they are matched by other strongly charactered components of the scene (Welch, 1977).

PREPARATION OF LAND

For commercial rose growing, selection of land is an important task. The site for cultivation of roses may be such that rain water from nearby areas should not come and stagnate the rose beds. The land which is used for paddy cultivation is generally not suitable for roses. A site which has soft muram below 45 to 60 cm layer of soil is ideal. The level of nutrients in the soil is very important. Rose beds are seldom deeply cultivated once they are established, unless new space is prepared for replacement. A way to improve aeration in heavy soils is to incorporate organic matter into the soil when preparing the beds. The organic matter also improves the physical condition of the clayey soils. Organic matter promotes the aggregation of soil particles and increases the water holding capacity. Also in sandy soils, organic matter improves the water holding capacity as well as the nutrient holding capacity (Bhattacharjee, 1995).

The initial preparation of rose beds should preferably be done during summer season, so as to expose the soil in sun and air for a longer time, and during monsoon it settle down before planting. Soil should be well pulverised; stones, brick pieces, gravel

and other foreign material removed. All weeds and grasses should be removed by deep digging.

The soil depth is to be increased and alkalinity should be counteracted before roses are planted. The best method of increasing soil depth is to green manure the ground. Biswas (1994) stated that about ten days before planting super phosphate should be added, and the soil should be manured with FYM or compost at the rate of 50 tones per hectare, and beds should be irrigated thoroughly. According to More (1984) pots of 60 cm depth and diameter are to be dug for planting rose plants, and these pits, are filled with equal parts of rotten cow dung manure. If the land is clayey, in the bottom of each pit 2.5cm layer of sand may be added and the pits are filled with 40% soil, 10% sand and 50% cow dung manure. The top soil contains the most nutrients in top 20 to 30cm of soil. In the process of digging, the topsoil should be kept separately and the sub soil is prepared or dug.

To aerate the topsoil and open up the sub soil double digging method is also followed in roses. Sometimes the beds are dug by trenching method for proper digging. While describing the double digging method Mukhopadhay (1990) enumerated that first a trench of 45 cm wide and 30 cm deep is dug at one end of the bed. The top 30 cm soil is transported to the other end of the bed. Then the subsoil is dug at least to the depth of 15cm or preferably 30cm. After this digging is over, the next 45 cm wide trench is dug and the top 30 cm soil from this trench goes to the top of the first trench. The digging proceeds like this and in the last trench top portion is filled with the topsoil of the first trench. In this process of digging roots and suckers of weeds as well as stones are to be removed.

Very great care should be used with weed-killing sprays and expert advice should be sought, they are highly selective, needing special sprays for different weeds (Grice, 1969).

PURCHASE OF PLANTS

Best quality rose plants are to be purchased for complete satisfaction and long years of pleasure. The most reliable way to buy roses is from the growers of the roses or from a trusted garden centre run by nurserymen. Most of the large growers possess authentic catalogue and sell the roses to the consumers directly. One must choose the desired varieties from the pictures and descriptions in the catalogue. Newer roses are advertised towards the front of the catalogue and older roses coming later. Highly reliable rose growers give guarantees for their roses. Nurserymen who run garden centres as their main outlet for plants of various kinds rarely grow the roses they sell. If one have confidence in such a nurseryman and fairly clear idea of what varieties are required, one can buy from them safely (Milon, 1962). Very few are lucky enough to hit upon the best nurserymen the first time, and perhaps there is really no one who can be termed the best, as there are quite a number who supply good bushes. However, always buy from a presumed reputable growers and that is really the first essential step in rose purchasing. As the year go by, more catalogues will be obtained and knowledge for rose plants will be expanding (Barker, 1980). Healthy, pest and disease free, true to the type, one year old budded plants are to be purchased from authentic source.

UNPACKING AND CARE OF NEWLY ARRIVED PLANTS

Nurserymen supply the rose plant either with earth ball wrapped in straw or grasses or bare-rooted plants, roots of which are covered with wet moss and wrapped in polythene. Now-a-days the rose nurseries are very skillful in packing plants, often so skillful as to make them difficult to unpack. Greatest care must be exercised in disentangling rose plants received in bundles. The thorns and branches can become unbelievably intertwined. The budding is often not very firmly united in stock; especially in plants budded only a few months earlier. Hence, dragging or twisting of one plant from amongst others can very easily tear out the budding. All ties should be carefully cut with scissors. Slowly and gently the branches should be untangled. After unpacking, each rose plant should be thoroughly examined (Thomas, 1970).

Soon after arrival, consignment of roses should immediately be kept in a cool, shaded and well ventilated place. All package material is to be removed carefully. On observation of individual plants, if found too dry, good drenching of these plants with water will be beneficial. The plants along with ball of earth are dipped into a bucket or tub of water upto bud union. The water may be mixed with clay or silt from a tank. A fungicide like Captan @ 2gm/l may be added to the water. The plants are kept in such water for 6-12 hours. If the plants appear to have shriveled due to desiccation, the whole plant is to be immersed in water for several hours and soaked thoroughly. Thereafter, the earth-ball is removed carefully without injuring the roots (Mukhopadhyay, 1990).

PLANTING AND TRANSPLANTING

Planting should be done in thoroughly prepared beds. At the time of planting, soil should neither be too wet nor too dry (Yadav *et. al.*, 1989). The soil should be allowed at least a fortnight to become thoroughly settled down before planting. This will prevent any air pockets from remaining about the roots after the roses have been planted. Full contact with the soil is vital for the roots if the plant is to become quickly established (Genders, 1965). The damaged roots or unduly long roots or all broken shoots if any, are to be removed before planting, which will give the rose plants additional vigour. A pit measuring 30 cm in depth and diameter has been found to be sufficient for planting different types of roses (Biswas, 1984). While planting, position of the bud union should be looked into. Better results are obtained if planting is done with bud union 2.5 to 5 cm above the soil level (Pal, 1978).

Rose must be planted firmly so that no air pocket is left around the plant. It is advised to plant roses late in the afternoon, so that the plant gets the long cooler night temperature to recover. Immediately after planting, the plants are to be watered copiously. The plants which are received with a ball of earth around their roots, especially those from eastern India, which contain sticky hard clay, are placed with the ball in water. The clay is removed carefully and roots are exposed without damage. If the rose plants, received for planting are with bare roots, the roots along with the stem upto the bud union should be dipped in water for about 6 hours before planting. This will restore to the loss of moisture which might have taken place during the transit period (Yadav *et. al.*, 1989). It was suggested by Milton (1962) to hill up around the rose canes to a height of at least 20 cm. According to him when the rose bush is planted, it takes a few weeks before the

roots become established to the point where they can begin to feed the plant. During this time, if the canes above the ground are not protected from the drying effect of sun and wind, there may be a setback. The canes will dry out, since the plant is not getting food through root. Hence, plant must recover the healthy condition before it can continue to grow. Healing up the plant at the time of planting prevents such loss of health and promotes faster growth.

Rose plants can be transplanted anytime whether it is dormant or in leaf and bloom. Special care should be taken while transplanting. It is most proper if transplanting is done in cooler months only. To be successful in transplanting, one must take as much of soil around the roots as possible and cut the canes back just as it is done during pruning time. The soil around the plant is watered one or two days before lifting. To loosen the plant from existing bed, digging all around the plant and then lifting the plant out by pulling the spade directly under it. Putting or lifting from above must be avoided. However, the best time for transplant is when the rose is in dormant state (Milton, 1962). On lifting, all foliage should be removed, excess roots trimmed and twiggy and tender growth removed (Randhawa and Mukhopadhyay, 1986). The plant is then placed in the new hole, which have been prepared in advance. The hole is filled in with soil firmly. It is better to mound up until growth is evident.

Planting should never be done before the soil has settled, for there is a risk of subsidence damaging of the roots. With the addition of compost, cow dung manure, blood or bone meal or fine bone meal than with looser material will reduce the subsidence. Fine bone-meal can be added in any soil preparation with advantage to the intended plants and without interfering in any way with the work. Application of optimum amount of manure is advised. Frequent hoeing keeps down weeds, help in settling and leveling, establish aeration, mix evenly the constituent soils, and produce an upper layer of good friable soil (Thomas, 1970).

TIME OF PLANTING

There are many variations in climate from country to country, area to area, from state to state and even within state, and hence it is not possible at all to be categorical about planting time. In very cold parts of the country, spring planting will be better, and in warm parts, late fall into winter is good (Milton, 1962). In India also the time of planting roses varies with the regions. In mild tropical climate, with proper care, it is possible to transplant at the any time of the year. In parts of Maharashtra (Pune and Nasik) and Karnataka (Bangalore, Mysore, Belgaum and Dharwar) planting can be undertaken during late May and June, as well as September to December. In temperate zones, planting is advised in open fields, at any time before October and April (Randhawa and Mukhopadhyay, 1986). Autumn and spring planting was, however, advocated by Pal (1978) in temperate region. In plains of eastern India rose can be planted from October to February (Bose and Mukhopadhyay, 1977), while Biswas (1984) stated that September to December suitable for planting in West Bengal, Bihar and Orissa. In almost all part of South India, October to December planting is a suitable planting time. In most part of the Northern Indian plains, the ideal time of planting is the middle of October, but can be extended upto February.

PLANTING DISTANCE

Plant density is one of the important factors determining the ultimate flower quality and yield, and depends upon the cultivar and also on the soil and environment conditions. Some roses make spreading bushy growth, while other grows tall and upright, they are to be spaced on their growth habit. Certain roses make luxuriant wood and foliage, other appears sparse and of gaunt appearance which may be plant closer together. Wider spacing is also given to the cultivars which are often affected by mildew; this will encourage more free circulation of air around the bushes. As a general rule Hybrid Teas and Polyanthas may be planted 75 cm apart, allowing an additional 15 cm apart for most vigorous Hybrid Tea, Floribunda and Grandiflora roses; while exhibition rose may be planted 105 cm apart (Gender, 1965).

According to Thomas (1970), vigorous growing cultivar should be allowed 120 cm or even 180 cm of space and the Standard be allowed similar spacing. However roses of average growth should be planted about 90 cm apart. Less vigorous types and Floribundas, used for mass effects, can go 75 cm apart. Climbers and pillar rose should be placed 15 to 20 cm out from the supports on which they are to grow.

Grice (1969) stated that ideal distance for planting roses varies with the type, but a general rule would be to allow 60cm x 60cm for each bush. It is better to plant two rows rather than one, and better still, to plant three rows wide, as an impression of density and colour mass is more readily given.

Biswas (1984) suggested a spacing of 60cm x 60cm for Hybrid Teas, Floribundas and Polyanthas; for a very vigorous plants 100 cm apart, and for Miniature planting distance may be 45 cm x 45 cm .Current trend is to ensure that when the plant have grown fully, the ground should be covered with canopy of the foliage.

Mukhopadhyay *et. al.*, (1988) from an experiment in West Bengal on "Montezuma" cultivar, concluded that closer spacing of 20 cm x 30 cm, decreased the number of flowers per plant, but it increased on a per hectare basis being nearly double at highest density compared with lowest density. Malik (1980) reported that a close spacing of 60 cm x 30 cm produced hundred per cent more flowers per unit area than that of 60 cm x 60 cm spacing in "Super Star" roses. Bhattacharjee (1992) from a three year field trial at IARI, New Delhi on "Super Star" roses, with six different spacing viz. 30 cm x 20 cm, 30 cm x 30 cm, 30 cm x 40 cm, 30 cm x 60 cm, 45 cm x 60 cm and 60 cm x 60 cm; recorded that with high density planting treatments flower quality deteriorated. Plant height was more in closer spacing, while the plant spread and number of shoot successively increased with wider spacing. Maximum production of flower per unit area was however, obtained with closer spacing. Longevity of intact flowers and cut flowers were longer with the treatments, where the plants were spaced at wider distances. It was recommended that a spacing of 30 cm x 40 cm with population of 66,670 plants/ha was very effective for obtaining maximum yield of flowers (3.322 million flowers/ha) without affecting the quality of blooms. Gill (1984) from Punjab suggested as close density planting in which three rows of plants are spaced 30 cm apart. After planting 3 such rows a gap of 75 cm is provided, followed again 3 close rows. By this method about 61,750 plants can be planted per hectare.

HOEING

Light hoeing is a very effective way to keep the soil porous so that light, air and water may reach the roots better to improve moisture retention capacity to keep the rose beds free from weeds. Roses are shallow rooted plants and the roots of established plants tend to go near the surface. Hence shallow hoeing is preferred as the deep cultivation destroys the rootlets. Hoeing should be done when soil is moist or dry but not too wet or soggy (Yadav *et. al.*, 1989).

REMOVAL OF SUCKERS AND DISBUDDING

The removal of damaged and surplus new growth in the following weeks after pruning should be followed as a routine. Any suckers appearing from the stock should be removed promptly. In Hybrid Tea roses only one or at best two buds should be allowed to flower upon each shoot so as to have a large sized blooms. All other buds should be removed or disbudded (Randhawa and Mukhopadhyay, 1986).

Sprays developed from basal shoots in Floribunda roses very often. The central bud which appears first, blooms much earlier than the other buds on the spray. To give the spray a balanced look with flowers, central bud may be removed (Biswas, 1984).

PINCHING

It is generally practiced for the return crop and to adjust flowering for a particular season. An examination of rose stem will show that below a flower bud there is strap-shaped leaf followed by 3 leaflets and 5 leaflets leaves in the axils of which there are pointed buds. At the bottom of these all other nodes have rounded buds. If the pinching is done above a pointed bud these will be forced to form a shoot which will bear a short stemmed flower. To ensure a reasonable long stem, pinching has to be done on 5-leaflet leaf with a rounded bud. The shoot selected for later flower production (return crop), are pinched by removing 3-5 cm of terminal growth, after at least 15 cm growth is formed. These shoots may again be pinched after 4 to 6 weeks. This procedure of pinching prevents flowering and encourages the plant to form new growth at the base.

In the Hybrid Tea roses, by which young vegetative shoots developing from the axils of the leaves of the basal shoots and lateral shoots are removed to allow each shoot to develop with only one terminal shoot. The side shoots which developed from the eyes down the stem below the terminal flower bud are also to be pinched off right at the initial stage to get a single bloom of quality and size. All but one of the laterals may be pinched off and the main stem cut back just above the one that has been allowed to remain while removing the terminal flower (Biswas, 1984).

REMOVAL OF FADED FLOWERS

To keep the rose garden attractive faded flowers and spent blooms are to be removed as a daily routine. For obtaining good quality flowers in Hybrid Tea roses removal of faded or spent blooms may be performed by cutting two to three leaves below the footstalk of the flower. This may induce development of two or three laterals. Generally top most laterals are not a strong one, while the next laterals are stronger. In such case, the top most lateral along with the stem should be cut away, just above the next laterals which

are kept for flowering. While in other types of roses, only the faded blooms may be cut back (Biswas, 1984).

REMOVAL OF BLIND SHOOTS

After pruning occasionally some blind shoot appear in rose plants. These are the shoots in which growing point of the shoot terminates without producing flower buds. These shoots draw excess quantity of water and nutrients, and hence, the productive parts of the plant suffer. Blind shoots may appear due to severe pruning, shading of young shoots and content of low auxin or gibberellins level in the shoot.

GROWING GROUND COVER AMONG ROSES

Before thinking for ground cover in the rose plots one must ensure adequate food, for both. The introduced plant must not interfere with the growth of roses, and these should not be harmful at all. It must be seen before planting ground cover that roses are given fair amount of room, and also whether the beds are in grass or stone paving. Care should also be exercised whether roses are newly planted, since the competition from the roots of the other plants would seriously impair the chances of the roses getting established. Violas and pansies are good choice to be grown in company with roses (Norman, 1958).

For additional interest in the rose garden, the period of the year in which flowers are less and qualities deteriorate or not in flower and rose garden is no more attractive, there are plenty of shrubby ground-cover plants that can be grown in conjunction with the roses. Some of the shrubs as under cover for roses suggested by Toogood (1978) are *Crotoneaster horizontalis, C. salicifolium, Prunus pumila depressa, Juniperus conferta, J. horizontalis, J. sabina tamariscifolia, Salix repens argentea, Rubus tricolour, Ceanothus gloriosus* and *Rosmarinus lavendulaceus*. As with the roses, these entire shrub should be pruned as required to keep them within their allotted space.

Gault (1972) while suggesting ground cover plants for roses mentioned about *Viola cornuta, Geranium macrorrhizum, G. endressii, G. ibericum, G. platypetalum, Hebe pinguifolia "Pagei", Stachys olympica (lanata), Alchemilla mollis, Campanula muralis, C. carpatica, C. rotandifolia, Lysimachia nummularis aurea, Helianthemum lunulatum, Armeria maritima, Prunella grandiflora and Lamium maculatum.* According to him under planting does not mean cessation of work; inevitably some overcrowding will have to be curbed, but it will be worth amongst roses and will certainly help to remove the vacuum.

Now a days rose are also used as ground cover for hiding manholes covers, ugly mounds, steep banks of lake or canals, and even for covering sea coast for erosion (Mukhopadhyay, 1990). The ramblers, particularly the *wichuraiana* species, and hybrid like "Albertine", "Chaplain's Pink Climber" are very good for this purpose. Bourbon hybrid "Zephirine Drouhin", *rugosa/wichuraiana* hybrid "Max Graf", "Nozomi" the hybrid shrub rose, *Rosa nitida*, the *arvensis/rugosa* hybrid, *Rosa* x *Paulii, R.* x *polliniana* (an *arvensis/gallica* hybrid) are also suggested by Toogood (1978). It must be kept in mind generally the ramblers and climbers do well in the places where there is prolong cool winter.

CARE IN SUMMER SEASON

During summer months flower quality will deteriorate and plant health will also

be affected, hence, proper care in irrigating the plants, weeding, spraying of insecticides, shading etc. must get prime importance. Protection from afternoon sun and hot wind is necessary.

From rose bed removal of dead wood, faded flowers and suckers to be done on a regular basis. The rose bed should be irrigated after every two to three days. Die back infested stems are to be removed and burnt. Tender rose beds may require protection and if necessary may be shaded with net. Washing of rose bushes occasionally with strong jet of water, especially the both sides of the leaves and stem will keep the plant clean and cool; and this will also dislodge and wash away most of the red spider mites. The water spray will make the plant more vigorous and healthy. To keep the white ant away from the plants, powdered neem-cake preparation in water may be applied to the ground and the plant stems. Spray of insecticides against aphids and green flies to be continued once a month. Sometimes the plants are affected by wind particularly Standard roses, Climbers and Ramblers; proper staking of Standard roses and tying of Climbers and Ramblers will be needed as a preventire measure.

Pot plants are to be watered daily, a forceful and through water spray will be beneficial. Delicate pot plant of roses should be moved under shade nets. During this season new rose beds are prepared, and renovations of the sick beds are also undertaken.

CARE IN RAINY SEASON

With the outset of rain all protection provided during summer should be removed. Rose bushes in beds are to be protected from water -logging. One must be careful about the drainage in beds. For proper drainage if necessary the level of beds should be raised. Removal of faded flowers, dead wood and suckers must continue as in summer season. Diseased leaves, stems, and flowers are to be burnt. Irrigation should be provided only when it is needed. Spraying of insecticides and fungicides must be done thoroughly. During rainy season weed growth is maximum; hoeing should be repeated as usual. Established climbers and ramblers generally require removal of all dead and week stems. In this season flowers will be of poor quality. Moreover, the size and colour of the flower will also not be good. Before rainfall top dressing with lime may be done if necessary. If the lime is not needed, a top dressing of bone meal and wood-ash should be applied with earth cover on the top.

Plants grown in pots should be shifted to sunny location. Drainage wholes at the bottom must be checked, and any kind of clogging must be removed. From the top 5 to 7.5cm layer the pot soil may be removed and replaced with well rotten powdered cow dung manure.

CARE IN WINTER SEASON

Hoeing, weeding, irrigation and desuckering must get priority in the plains of India, where this is the best season for roses, and the rose gardens are in full bloom. Light hoeing is good which must not get deeper than 5 cm below the surface; otherwise the rose roots may be damaged. In the early winter recommended doses of chemical fertilizers must be applied, and to be incorporated with the soil properly. Early winter is also the best time for planting of new rose plants, however, application of chemical fertilizer to these plants

may be avoided in the first year. Watering in the rose beds to be done twice a week in November, while in December and January irrigate the beds once a week. In Hybrid Tea roses disbudding of the additional buds must be done at early stage. After the first flush of flowering is over, another dose of organic manure must be applied to each plant. Care should be taken against the attack of white ants from the soil, and the powdery mildew which appear on leaves. In higher hills, where the winter is severe, the rose bushes require adequate care. It is advised to protect the young plants from heavy snow and the base of the established plants are to be covered by mound of earth and the plant tops with hay and straw. Another practice is to cut the roses back to 40 to 45 cm after the first killing frost. The frost affected young shoots, buds and leaves must be removed (Pal, 1966).

In pot plants during early winter recommended quantity of chemical fertilizer to be added and covered with soil and daily watering is needed. In December and January pot plants will require irrigation on alternate days. Hoeing, weeding and removal of suckers and application of insecticide and fungicide must get attention.

CARE IN SPRING SEASON

It is another very attractive season for roses with second flush of the blooms. Dormant eyes start swelling and burst forth into growth all over the plants. Bushes throw out vigorous shoots and this tendency in growth must be utilized for making the plant symmetrical and balanced. Rose bushes require good protection from powdery mildew and white ants in this season. Suckers and dead blooms are to be removed on a regular basis. Seed pods (hips) should not be allowed to form. Schedule for hoeing, weeding and irrigation must be allowed in time. Application of balanced fertilizer or well rotten cow dung manure during the last week of February will be beneficial.

RECONDITIONING OF NEGLECTED OLD PLANTS AND OLD ROSE BEDS

Rose plants require constant care and attention for proper growth and flowering. The cultural operations like pruning, manuring, hoeing, weeding and spraying of insecticides and fungicides if not done properly in time, the rose bushes will affected very badly and will produce only a few inferior flowers and the plant will look awkward. Such neglected plants can be renovated by transplanting them during planting time of roses, in a well dug out and well prepared beds enriched with nutrients. While transplanting, the bushes are to be appropriately pruned, and all unwanted shoots, roots and leaves are to be removed. It should be kept in mind that rose bushes are very selective in their feeding and each type of plant needs plant food in slightly different proportion. All cultural operation should be followed adequately and timely to get the best renovated bushes (Pal, 1966).

Reconditioning of rose beds is also necessary when the plants are grown for several years continuously in the same beds or rose gardens. Rose bushes are unable to produce good growth in such beds or gardens, which become "crop-sick". Frequent crop- rotation is not possible in rose gardens, since these are perennial plants and some plants are grown in the same plot for fifteen years or more. Something needs to be done to the beds as a whole. It is ideal to take out all the plants and the soils of such a bed to a depth of 30 cm. These soils are to be replaced with a good heavy loamy, virgin topsoil. The bed

is to be dug by several turnings with heavy dressing of bone meal and manure. The new plants or same uprooted rose plants can be planted in the prepared beds after proper pruning. If this is not enough for reconditioning of plants, green manuring in the rose beds is also suggested (Thomas, 1970).

For rejuvenation of neglected old plants and old rose beds, Biswas (1984) suggested that soon after monsoon and prior to the time of annual pruning a trench of 30 cm deep at least 3 cm away from the base of the plant is to be dug and allow it to dry and pulverized, and the soil should be mixed with 20 litres capacity bucket of FYM or half a bucket of activated sludge or decomposed cow dung and should be followed by copious irrigation. The plants must get usual pruning and normal fertilizer dose after pruning. The rose bushes will show sign of picking up vigor. According to him, while digging the trench around the plant, rejuvenation takes place through root pruning, which encourages the growth of many small roots, and the root in turn take up nutrients from the soil and manure and restore the original productiveness of the rose bush.

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10

PRUNING

To ensure excellent blooming and healthy growth of rose plants year after year, pruning operation is performed. It is the removal of unwanted shoots, buds or flowers from plant to make the plant more vigorous and productive. While pruning roses, individual requirements of plants and the need for the operation must be clear in ones mind. However, skill in pruning rose plants is acquired by personnel experience and observation. Roses are pruned basically for the following purpose :

(i) Cutting away all the dead wood and removing the live wood if it interferes with the shape or the condition of plants, so as to induce new growth and stimulate renewed vigour of the rooting system.

(ii) Regular removal of diseased wood for maintaining health of plants.

(iii) Removing of all suckers grow out of the plants root system which eat away nutrition of plants, and suppress the growth of the main scion plants.

(iv) Making all the cuts at 45^0 angel to give less chance of mashing and bruishing the canes.

(v) Sealing to cut ends after pruning to prevent the entry of insect pests and diseases.

(vi) Allowing free flow of air and sunlight in all parts of the rose bush, and the ideal bush is one, which is open in centre with branches growing upwards and outwards to help in improving productivity.

(vii) Encouraging new shoots from the eyes near the base of the plants for adding vigour to the plants and producing good flowers.

(viii) Discouraging overcrowding of the shoots as well as thin and twiggy growth for positioning of best flower twigs on the plants.

(ix) Ensuring greatest possible amount of strong and healthy wood and in so doing to improve the quality of bloom.

(x) Fitting a plant into its position for economic use of planting area.

(xi) Giving desired shape to the plants to enhance beauty.

(xii) Regulating the times of flowering to meet the timely need of the growers.

PRUNING TOOLS

Good quality tools are always preferable for rose pruning. The cut in pruning should

be clean and made under hygienic conditions. A sharp knife can make the cleanest cut with a slightly hooked blade so that softer bark will yield as clearly as the tougher wood. Secateures are more generally used; unless great care is taken the shoot may suffer bruishing. Good secateures may do a little damage, but blunt and worn pair will bruish the shoot, damaging it and causing it to die back and ultimately death of the plant (Grice, 1969). Secateures must be sharp enough to cut the stems smoothly. For removal of suckers and for trimming unwanted or unduly long roots at planting time an efficient pruning knife is also required. Apart from this a long handled prunner or lopping shears are required to prune thick canes or to reach the branches of climbers and tree roses. A pruning saw is also useful in time. A pair of soft leather gloves needs to supple protection. For cold or moist soil a thick kneeling rubber pad may be required. All the dead and waste material including the pruned shoots should be taken away from beds and burnt so as to remove the source of infection from the garden.

TIME OF PRUNING

Pruning time is mainly governed by the climate of the place. In England generally pruning is carried out in spring, since the bud damages due to cold winds and frost will be considerably less than if the plants were cut back during autumn and winter (Genders, 1965). In Israel, autumn pruning was found better for maximum flower yield (Zieslin *et. al.*, 1975). In Colorado, USA, Depauw (1975) reported more flower yield in 15th July pruning. However, the best time for pruning is when the rose plants are dormant (Norman, 1958); while Milton (1962) observed that pruning is best done when the roses are about to breakout of their dormancy. Reduction in flower production and delay in flowering with late pruning is noticed by many researchers.

In most part of India, pruning is done during October. In hills, pruning is done after the dormant winter season, while in Bangalore pruning is done twice a year in June and November. In *Rosa damascena* 15th January pruning induce early flowering and the yield was better as compared to other pruning dates like 15th October, 15th, November and 15th December (Srivastava, 1973). According to Singh (1972-74) best time for pruning H.T. and Floribunda roses in Uttar Pradesh is in the middle of October. From a two year trial on the effect of different dates of pruning beginning from 15th September to 1st December in *Rosa* cv. "Super Star" under Delhi condition, Bhattacharjee (1992) concluded that better vegetative growth and quality of flowers were obtained with the plant pruned during 6th October to 17th November. Highest number of flowers with 6th October pruning, but the largest number of flower stems of 60cm and above were resulted with 27th October pruning. Plant pruned during 13th October to 17th November showed most beneficial effects on the prolonging vase life of cut flowers. It was further reported that pruning of "Super Star" rose plants in different dates was helpful in staggering the harvest of cut flowers. Gopal (1978) pruned the rose plants in Banglaore at monthly intervals from February to May and August to November and obtained maximum flowers yield from February pruning, although flowering was delayed and vase life reduced. He concluded that by sequential pruning, cut flowers were produced round the year without greatly affecting the yield or quality. Gowda (1987) observed that roses can be pruned throughout the year under mild climatic conditions in Bangalore, while best time is during April to May and August to November to get quality blooms.

HEAVY OR LIGHT PRUNING

Since roses are pruned each year, and there are many types and varieties; some respond to light pruning, some to moderate pruning. Hard or light pruning is decided upon by the professional rose growers, and the individual variety will require to be pruned according to it vigour. Very hardy variety can withstand hard pruning, where stems are cut back to about 3 or 4 buds from the base, which leaves about 15cm strong stems of three or four shoots of previous year. With hard pruning number of blooms per plant reduced, but flower size and quality improves. Depending upon the varieties severe or low or hard pruning increase stem length, impart faster rate of bud burst, induce non-parasitic leaf fall and die back disease (Mukhopadhaya, 1990). The hard pruning to the second bud from the base helps in concentrating its total energies on the production of vigorous basal shoots with exhibition bloom, restricts quantity of bloom and delays flowering (Genders, 1965).

Light pruning is practiced in temperate climates in many parts of the world, where healthy shoots are left after thinning of diseased and unwanted parts; moreover, pruning is an all-the-year round process in temperate climates, the more continuous the blooming of a plant, the more continuous is the pruning (Thomas, 1964). In light pruning, the cut is given either at the second or third eye bud immediately below the flower breaking foot stalk (Yadav *et. al.*, 1989). Stems are pruned to two thirds of its length, for light pruning, which means just tipping back the stems only little, after removing all dead or unwanted stems. This kind of light pruned rose plants require short time for the following shoots to flower and results greater number of flowers (Mukhopadhyay, 1990). In such kind of the pruning, quality of the bloom will often be inferior, while the plants will tend to bear most of their bloom in the early part of the season with little or no bloom in autumn (Genders, 1965). For the production of good quality of rose flowers, the National Rose Society of Great Britain recommended light pruning.

Moderate or medium pruning is done by cutting back the ripe and lateral shoots of the previous year's growth at an outward growing eye, at about half the length of growth (Yadav *et. al.*, 1989). In most parts of India, moderate pruning method may be followed, light pruning or "tipping" is not ideal (Mukhopadhyay, 1990). Moderate pruning maintain the shape of the plant, in which the main stem is cut back to 20cm from the base while removing all weakly growth; and such kind of pruning induce reasonably early blooming; and with well feeding and disbudding good quantity exhibition bloom can be obtained right through summer and autumn (Genders, 1965).

PRUNING DIFFERENT TYPES OF ROSES

Pruning methods varies with the type of roses. There are Hybrid Tea, Floribunda, Polyantha, Miniature, Standard, Climber, Rambler, Tree, old-fashioned and shrub roses and species. Many varieties are there under each type. No hard and fast rule can be employed for the type among varieties. Pruning methods differ greatly within the type among varieties. Apart from the intelligent understanding of theory of pruning, this art can be learned by practice and experience. A balanced bush, well pruned will make for satisfactory growth and long life (Grice, 1969).

HYBRID TEA

In the first year plants are pruned to three to four eyes, choosing a bud which points outward. In the second year new growths of the previous year to be pruned to three to four eyes where they have started. The third year onward pruning will be same as that of last year, but at least one shoot should be pruned almost to the ground level each year (Grice, 1969). While pruning Hybrid Tea roses a fair rule to fallow is to cut the bush back to height of 30 to 37.5 cm above the ground; over an above that removal of dead wood, interfering branches and suckers (Milton, 1962). Vigorous growing rose cultivars need less cutting back, then those, which are weak in growth. In temperate climate, it is suggested that one branch every year be pruned to one eye to get some best growth to keep the plant bushy (Mukhopadhyay, 1990). The roses for exhibition purpose are encouraged to grow only with 3-4 stems, which will be specimen blooms (Pal, 1966). There are some cultivars that may even not like moderate pruning, depending upon locality. It is always better to remove an older branch each year, retaining 5 or 6 branches. Removing of one or two older branches means throwing the strength into the production of strong, new, flower producing stems (Milton, 1962).

FLORIBUNDA

These are essentially a shrub type of rose and produce masses or cluster of flowers. Hence, one objective of the pruning Floribundas should be to keep the shape and proportions of shrubs as nearly as possible (Milton, 1962). All weak, twiggy and diseased growth are removed; and pruning should be done 45 cm to 50 cm from the ground. To encourage the strong healthy growth and to regulate shape of the bush, in the first season, pruning may be severe; thereafter pruning should be light. In case of necessity, the older shoots are removed from the base to make room for and to encourage new branches (Pal, 1962).

Hard pruning is never practiced for Floribundas (Mukhopadhyay, 1990). According to Grice, (1969), hard pruning is needed in first year to 2-3 eyes, choosing an outer eye for preference; in the second year the thin growths are removed and secondary growths are kept as long as healthy wood permits; in the third year, wood of second year is removed, cutting to one or two eyes close to the base of the bush, by doing so, the foundation of new basal growth is laid out, which in its turn will be light pruned when twelve months old and almost removed when twenty four months old. So, in the Floribunda bush half of the wood will be younger, lightly pruned and the other half, the older, hard pruned. If planted for hedge, the bush will require less pruning, than were being grown for bedding display (Genders, 1969).

POLYANTHA

These types of roses bear large number of alternative flowers in masses, the shape of the plants are to be maintained. Plants are not to be allowed to become tall and ungainly, must continue to flourish at the same height, however old they are. While pruning, the overcrowded and dead branches are removed; the branches, which have completed flowering, are tipped off to encourage new growth (Pal, 1966). In the first year, however, Polyantha roses are to be pruned as that of Hybrid Tea or Floribunda roses.

MINIATURE

Plants are pruned to one-half size or 15 cm to 25 cm height depending upon the cultivars and the area in which to grow. Dead twigs are to be removed. The strong growing types need pruning back, or heavier growth is removed favouring the smaller growth, if one is willing to keep plants low and bushy. Pinching once or twice to keep the plants from growing too tall is also necessary. After flowering light shearing of tops will ensure a more compact plant for the next bloom. Trimmed or sheared plants bloom again in one or half month's time, depending on cultivars and the time of the year. To delay blooming and to induce branching, miniature types may be pinched or trimed at any time of the year. (Moore, 1966)

CLIMBERS AND RAMBLERS

Pruning in climbers is a matter of common sense. In order to induce the plants to renew itself with virgin growth, thinning or removing of old wood may be practical. There are handy, tender and intermediate climbers of roses. Small flowers borne in clusters, and long and twiggy growth, which belong to multiflora class, characterize the hardiest climbers or to the early race of Wichuraiana hybrids are generally benefited by hard pruning. These roses produce strong new canes from the base of the plant every year and the new canes mature sufficiently in one season to bear a crop of flowers in the following year. While the climbing roses of Tea, Hybrid Tea, Noisette, Bourbon, and such other tender strains bloom very sparingly on new wood; and the finest flowers are produced from short spurs which grow out of two or three years old canes. Hence, these tender roses should not suffer the devastating treatment given to the hardier types. In such tender types, removing of surplus dangling ends and canes which threaten to grow in wrong places should only be removed. The intermediate types are large flowered hardy climbers and according to the growth habit of the cultivars, like vigorous or moderate vigor will need vigorous pruning or light pruning. There is no doubt, that the most careful judgment must be exercised while pruning the climbing roses. Each gardener must work out his own practice to prun his climbers for his own requirements in the garden. (Stevens, 1933)

HYBRID MUSKS

This fascinating but neglected group of roses presents a charming feature in their continuity in blooming. They do not produce non-flowering growth. Cutting out old and weakly growth is only required and the reward will be an abundance of bloom over a long period. (Norman, 1953)

OLD-FASHIONED AND SHRUB SPECIES

Shapely and floriferous plants are needed in this group rather than quality of bloom. Weak wood, sickly growth and loose arching branches are to be removed. Cutting of one shoot every year to get new growth from the base of the plant can be practiced. Over pruning should be avoided. If on observation, a variety flowers on old and young wood then leave as much branches as possible. (Grice, 1969)

TREE ROSES

Suckers from the base of the trunk should be removed. Shapeliness of the head of

the tree rose is to be maintained by removing dead or useless wood. The real beauty of this group lies in its symmetry and proportion. Cutting back to 25 cm to 30 cm, keeping 2 or 3 strong eyes on side branches will be helpful (Milton, 1962)

INTENSITY OF PRUNING

Several researchers have studied the influence of different level of pruning. Light pruning in November resulted in highest number of flowers in *Rosa bourboniana* (Irulappan *et. al.*, 1993). Light pruning in rose cultivars like "Christian Dior", "Montezuma", "Red Devil", "Black Ruby", "Oklahoma" and "Pink Parfait" was also recommended by Gowda and Jayanthi (1985) to obtain maximum number of early flowers and continuous bloom throughout the year. "Happiness" cultivars pruned in May and November to 2,3,4,5 or 7 buds from ground level by Mukhopadhyay *et. al.*, (1987) and reported that pruning at 7 buds (light pruning) resulted in more flowers as compared to 2 or 3 buds (heavy pruning). "Super Star" rose plants pruned at 45 cm length from ground level with four shoots in 15th October markedly improved vegetative growth, induced early flowering with large size flowers, more numbers of petals and maximum flower yield on long stems; over the treatments of 15cm and 30cm length pruning from ground level with two and three shoots (Bhattacharjee, 1992).

"Happiness" rose cultivars pruned once a year (November) recorded taller plants than those pruned in both November and January (Sujatha and Singh, 2003). Retaining the best branches while pruning (free pruning) in "Red Success" and "Sonia" cultivars of roses under green house condition resulted uniform production and higher quality of flowers (Santos *et. al.*, 2002). Among the pruning treatments like hard, light, green bending and disbudding in "First Red" rose grown under greenhouse; green bending treatment resulted in maximum flowering shoots and more number of flowers per plant (Jadhav, 2003). In *Rosa damascena*, Porwal *et. al.*, (2002) observed that 30cm pruning height and spray of 2000ppm cycocel gave highest flower yield per hectare over the treatments of lower pruning heights (10 and 20cm) and higher concentration of cycocel (4000 and 8000ppm).

Retention of highest number of basal shoots while pruning "Gruss-an-Teplitz" rose resulted in maximum leaf and leaf area, dry leaf biomass, lateral shoots, flower weight and yield over the pruning treatments where 3, 5 and 7 basal shoots were only retained (Singh, 2002). Parent shoot diameter (4-8mm) and bending showed positive influence on yield of rose cultivars "Rote Rose" and "Melody" (Kim WonHee *et. al.*, 2003). The rose cultivars "Engelique", "Canadia", "Champagne", "Double Delight", "Love" and "Paradise" showed most promising in terms of growth and yield with 18 inches above ground level pruning over 12 and 15 inches (Zarina, 2001). In "Raktagandha" roses 50% shading during summer and polycovering (October to March) enhanced highest flower production; while pruning at 45cm height produced significantly taller plants than pruning at 60cm height (Malhotra *et. al.*, 2000). The highest yield of marketable stems and quality flowers after one year was reported in "Meiqualis" H.T.roses with shoot removal and pruning during plant formation; whereas the treatment using shoot bending during plant formation and production was associated with a high harvest level, on the thickest stem, produced the largest quantity during autumn and winter (Gudin, 2002). Amongst the treatments

like deshooting, bending down and free development (control) employed in rose cultivars "Black Magic", "Movie Star", "Sophie" and "Vendela"; the bending down method showed promise in first three cultivars, and was a superior method for "Vendela" roses over other treatments (Freitas *et. al.*, 2001). In "Kardinal" and "Fire and Ice" rose cultivars, shoot bending resulted in increased stem length of individual flowering shoots (Lieth *et. al.*, 2001).

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11

NUTRITION

Mineral nutrition of rose plants is of fundamental importance, which is closely related with soil science, plant physiology and biochemistry. Impressive progress has been made in our understanding of the mechanism of nutrient uptake and advances in increasing crop yield by supply of mineral nutrition through manure and fertilizer application in roses. The importance of nutrients needed for the optimum yield of rose can be ascertained only through trials in the open field and as well under the green houses. However, the effect is very much location and situation specific and is dependent on climatic conditions.

Roses, like most other plants, derive their food from air and the soil. By far the greatest amount of food taken up is water, which consists of hydrogen and oxygen. Next, in both quantity and importance, comes carbon dioxide, a gaseous component of carbon and oxygen (Thomas, 1970). Including oxygen, hydrogen and carbon, 16 elements are considered essential for growth and development of roses. Based on the concentration and their role in the dry matter, these elements are differentiated into macro-elements and micro-elements. The macro-elements are defined as those having concentration of more than 1000 μg/g of dry matter, which include H, C, O, N, K, Ca, Mg, P and S. The trace or micro-elements are those, which have less than 100 μg/g of dry matter and those are Cl, Fe, Bo, Mn, Zn, Cu, and Mo. Either supercritical or deficiency lead to morphological variation, which results in low productivity of quality flowers. Hence, balance nutrition, which varies from variety to variety and species to species, has to be standardized to get maximum income by selling larger quantity produce. The deficiency of nutrients even after planting as evidenced by their deficiency symptoms can be corrected through foliar feeding (Manian *et. al.*, 2006).

INFLUENCE OF NITROGEN

Nitrogen is an integral component of many compounds essential for plant growth processes including chlorophyll and many enzymes. It is an essential component of the proteins and related aminoacids, which are critical not only as building blocks for plant tissue but in the cell nuclei and protoplasm in which hereditary control is vested. It is essential for carbohydrate utilization within plants and stimulates root growth and development as well as uptake of other nutrients. Nitrate and ammonium form of nitrogen are the major sources of inorganic nitrogen taken up by the roots of plants (Damke, 1992).

Ledlae (1923) reported that nitrogen increased the size of rose flowers and brightness of colour. Total production of saleable flower was enhanced by increase in soil nitrogen

level upto 80 ppm as nitrate (Kamp and Pokorny, 1958). In "Better times" roses, Kamp and Shanon (1960) recorded 4 more flowers per square feet when supplied with 80 ppm NO_3, over 20 ppm. In "Happiness" and "Christian Dior", Young *et. al.* (1967) found increased trend towards yield and stem length with increased N. While Boodley (1975) reported increased level of applied nitrogen (2800lb N/acre/year) decreased markedly the keeping quality.

El Gamassy *et. al.*, (1977), while working with "Chrysler Imperial" roses found best result by applying 300 kg of calcium nitrate per year per acre in four dressings. Nambisan *et. al.*, (1979) noticed that 40 g N per bush in "Edward" rose resulted in highest yield of flowers upto 53.2 per cent. Armitage and Tsujita (1979) in "Forever Yours" roses recommended supplemental lighting and 200 ppm N for better keeping quality. Borrelli (1981) observed beneficial effects on stem length and flower yield of "Baccara" roses when irrigation and nitrogen both supplied together.

Waters (1968) observed increased plant weight, number of stem, and leaf nitrogen content with high level of nitrogen in "Tropicana" roses. Bik (1970) recorded increased flower yield with more nitrogen in "Baccara" roses.

Barnard (1996) reported that rose absorbs nitrogen mainly as nitrates. Continued application of ammonia may increase sub-soil acidity. Soluble forms of N should be applied in split doses particularly in high rainfall areas. Foliar spray of urea with low bi-uret content is also beneficial (Bose and Yadav, 1989). Shortage of nitrogen leads poor growth, whereas excess leads to too much vegetative growth (Aaron and Alkins, 1977) and poor yield due to accumulation of non-protein nitrogen (Dougell, 1959).

Application of 500Kg N/ha was found to be optimal for enhanced vegetative growth as well as for increased yield and better quality of flowers in rose cv. "Super Star" (Bhattacharjee and Damke, 1994). Marked increase in chlorophyll content of leaves was observed with higher doses of nitrogen in roses (Damke *et. al.*, 1995). Total soluble sugar (TSS) content of leaves was found to increase with increased nitrogen application 500kg/ha in cv. "Super Star". This increased TSS contributed significantly towards higher production of flowers (Damke *et. al.*, 1996). However, nitrogen level below 500 Kg N/ha was beneficial for improving vase life of cut rose cv. "Super Star"(Damke and Bhattacharjee, 1994).

According to Vidhya Sankar (1997) for rose cultivars "Iceberg", "Priyadashini", "Queen Elizabeth" and "Sonia Meilland", 500 Kg N/ha/year was best; whereas the dose of 400 Kg N/ha/year gave the highest flower yield in cultivars "Caramia", "Eiffel Tower", "Arjuna" and "Raja Surendra Singh of Nalagarh". In cultivars "Angelique" and "Dr.B.P.Pal" 300 Kg N/ha/year was found beneficial for growth and flowering of roses.

Soil application of N in rose cv. "Super Star" resulted in increased height and number of branches was explained by Jaya Prasad and Sulladmath (1978). Inadequate nitrogen supply to rose cultivars "Parel van Aalsmeer" resulted in lower weight of stem (Johansson, 1978). Nitrogen deficiency results in stunted growth is underdeveloped plant (Wallace, 1951). Nitrogen is used largely in the synthesis of protein and is a part of chlorophyll molecule (Tisdale and Nelson, 1975).

INFLUENCE OF PHOSPHORUS

Phosphorus is a structural component of cell membranes, chloroplast, mitochondria and a constituent of sugar phosphates, phospholipids and phosphotides. It plays an important role in energy transformation and metabolic processes in plants. Unlike nitrate, phosphate is not reduced in plants but remains in its highest oxidized form (Damke, 1992). Phosphorus combines with organic compounds forming relatively stable high energy complexes such as ADP and ATP which provide the mechanism for trapping, transporting and donating energy so that enzymatically catalyzed reaction can proceed (Renu Rajan, 1994).

Many researchers have emphasized the need for phosphorus application to get vigorous, sturdy and healthy rose plants. This element is important for bud break and formation of buds. Soil application of phosphorus has no effect on either vase life or flower diameter (Maharana and Pradhan, 1976) of cv. "Celebration". Damke and Bhattacharjee (1994) reported that phosphorus in increased doses accelerated flower bud opening and longevity of intact flower of cv."Super Star". They have also reported increased water uptake, flower diameter and longevity in vase with higher dose of phosphorus application in soil.

Application of P as super phosphate resulted in vigorous and sturdy plant and healthy foliage in rose plants (Ledlie, 1923). Adequate P is necessary to break the dormant rose buds in the spring and during the formation of flower buds in the summer. Hence, to harden rose plant sufficient application of P is necessary particularly during autumn (Heatly, 1959). While Dougell (1959) was of the view that more than 50per cent of phosphate is immobilized in one way or another and thereby it was rendered unavailable to the crop. Consequently it was impossible to build up a large reserve of phosphate, hence, frequent dressing were necessary.

Auge *et. al.*, (1986) found in "Samanta" rose higher rate of P fertilization increased plant dry weight three-fold and the leaf area four-fold in non mycorrhizal plants but had no effect on growth characters of mycorrhizal plants except for a depression of colonization levels.

Increased application of phosphorus promoted plant growth (McFadden and Poole, 1967) and stem length of roses (Mukhopadhyay *et. al.*, 1989). Whereas Johansson (1978) observed that at a reduced phosphorus supply the number of flowers, number of petals, weight of stem, root and total growth were negatively affected.

INFLUENCE OF POTASSIUM

Potassium controls enzyme systems that determines photosynthesis and respiration rates, carbohydrate metabolism and translocation of organic acids and non-protein N in plants. It is a primary activator for at least 46 individual enzymes. This element is the most abundant cellular cation and high concentrations are needed to neutralize soluble and molecular anions of the cytoplasm, which has few organic cations, as well as to effect the conformation of many enzymes (Renu Rajan, 1994). It is an univalent cation and its uptake is highly selective and closely coupled with metabolic activity.

Burkhart (1937) reported potassium deficiency of roses caused chlorotic stunted young shoots and dead margins of the old leaves. Laurie and Kiplinger (1944) noted that rose with potassium deficiency exhibited marginal burning of flower foliage, occasionally purpling of leaves, poor colour and weak stems. Culbert and Wilde (1948) stated that the increasing rates of potassium increased vegetative growth, the length of the flowering stem, weight of flower and more valuable grades of flower. The cultivars of roses, "Peter Briarcliff" and "Hildegarde" grown with insufficient supply of potassium produced short flowering shoots, small size flowers followed by a chlorosis resembling that a mild deficiency of iron (Seeley, 1949), while West (1966) was of the view that roses required adequate amount of potassium for better growth. Low doses of potassium inhibited plant growth, flower production and length of flowering stem (Woodson and Boodley, 1982). Increasing the potassium dose recorded least number of days to flowering (Uma and Gowda, 1987).

The soil application of potassium significantly improved the vase life of cv. "Celebration" (Maharana and Pradhan, 1976) and improved the water uptake, flower diameter and longetivity of cv. "Super Star" (Damke and Bhattacharjee, 1994). By increasing potassium concentrations had no significant effect on the keeping quality of cv. "Carol" (Bik, 1972)

INFLUENCE OF CALCIUM

Principal function of calcium is in cell wall and cell permeability. It also acts as buffer. The approximate amount of calcium in the rose plants differs from species to species and cultivars to cultivars. Park (1956) stated that ash constituent percentage in CaO in different parts of rose plants varies, viz roots (40.88%), wood (51.50%), leaves (31.29%), flowers (13.25%) and whole plants (34.23%). Young leaves of terminal buds at first are typically hooked in calcium deficient plants, finally dying back at tips and margins. The later growth is characterized by a cut-out appearance at these points and the stalks finally die at the terminal bud (Mc Murtrey, 1959). In rose the terminal buds die and plants become defoliated, margins of leaflets die, rest of the leaf turns yellowish- green and dark brown patches appear between the mid rib and margin with calcium deficiency. Ultimately, leaves drop off before they are dead. The rose flowers are deformed, reduced in number and have brown spots near margin of petals (Biswas, 1984; Johansson, 1978). It is well documented that the Calcium is an integral part of the cell wall materials; it stimulates root growth and helps in translocation of carbohydrates (Yadav, *et. al.*, 1989). The deficiency of calcium results in hard and stubby growth and is generally associated with low soil pH. The root system becomes short and somewhat thickened (Laurie *et. al.*, 1958). The deficiency of calcium can be corrected by the application of domestic lime and gypsum. Yield increases due to Ca application as nutrients have been recorded in a number of crops and soils (Biswas *et. al.*, 1985).

Application of $CaSO_4$ @ 50Kg/ha in "Raktagandha" roses appreciably increased the primary and secondary shoots, plant height and plant spread, increased the flower yield, improved the flower quality and induced early flowering (Bhattacharjee, 1994).

From a field trial of "Super Star" roses with different doses of NPK, Damke and Bhattacharjee (1997), concluded that soil calcium and rose leaf content was successively

increased upto 75g N in all season, while further increase in N doses drastically reduced the calcium content of soil. Application of P_2O_5 and K_2O was not effective in increasing the calcium content in soil. Maximum calcium content in soil was recorded during summer season and lowest in winter season, irrespective of different doses of fertilizer treatments but minimum calcium in leaf was noticed during winter season. In "Better Times" roses, Carlson and Bergman (1956) observed that the treatments receiving the highest rate of nitrogen and potash fertilizers were lowest in soil calcium content. Furthermore, calcium content in soil was decreased from September to January. Johansson (1978) noticed that calcium content decreased progressively during the growing season in rose leaves. While Carlson and Bergman (1966) in "Better Times" roses recorded more leaf calcium content in September, followed by January and October. In "Pearl van Aalsmeer", Johansson (1978) observed that low N supply increased the calcium content of leaves. Waters (1968) in "Tropicana" rose, however, did not find any favorable effect of N and K_2O on leaf calcium content. Iley *et. al.* (1964) conducted an experiment in "Pink Frill" roses and reported that when there was no competition from potassium, more amount of calcium was taken up by rose leaves. The optimum content in "Buismans Triumph" rose leaves was found to be 0.50 to 0.80 per cent by Knoblauch (1972).

INFLUENCE OF MAGNESIUM

It is a part of the tetrapyrrolic chlorophyll molecule, enzyme activator of hexokinase, phosporylase, carboxylase, dehydrogenase, peptidase and photosynthesis; it also acts as buffer (Manian *et. al.*, 2006). This element aids in the dark green colour of leaves and promotes uptake and translocation of phosphorous and other element (Yadav *et. al.*, 1989). In "Buismans Triumph" rose, Knoblauch (1972) recorded that optimum range of leaf magnesium was 0.45 to 0.53 per cent. Ash constituent of MgO percentage of rose plants in different parts like roots (7.15%), wood (7.62%), leaves (9.23%), flowers (5.94%) and whole plants (7.48%) varies (Park, 1956). Magnesium deficiency causes chlorosis between veins, the stems are reduced in number and flowers are smaller in size and poor in colour (Pal, 1965). Magnesium deficiency symptoms also exhibit mottled or chlorotic leaves, and the stalks become slender (Mc Murtrey, 1959). Reduction of root weight and flower yield was recorded in glass house roses with insufficient magnesium (Johansson, 1978)

From a field trial experiment of "Super Star" roses, Damke and Bhattacharjee, (1997), reported that P_2O_5 and N application to soil did not affect the soil magnesium content significantly in four different seasons. However, there was some significant variation in magnesium content during the onset of rain in respect of N application. Addition of potash significantly increased the magnesium content in soil in all seasons. Furthermore, magnesium content was higher in the onset of rain as compared to other seasons irrespective of fertilizer treatments.

According of Carlson and Bergman (1966), in "Better Times" roses, application of N did not change the soil magnesium. Leaf magnesium content was more in September followed by January and October. Illey *et. al.*, (1964), from an experiment on "Pink Frill" concluded that whenever there was no competition for potassium, more amount of magnesium was taken up by the rose leaves. In *Rosa multiflora*, Alt (1970), noticed that increased application of K_2O had a relatively slight antagonistic effect on uptake of

magnesium from soil. While Johansson (1978), in "Pearl van Aalsmeer" roses noticed that with insufficient phosphorous supply the leaf magnesium content was affected negatively. Magnesium is an important major plant nutrient on light soils and its uptake is reduced by too heavy application of potash (Allen, 1975). Addition of $MgSO_4$@ 50 Kg/ha in "Raktagandha" roses increased the flower bud size, flower diameter, longetivity of flowers and number of petals per flower. This dose of $MgSO_4$ also improved the vegetative growth of "Raktagandha" plants in the field (Bhattacharjee, 1994).

INFLUENCE OF SULPHUR

The deficiency of this element is often confused with N- deficiency symptoms. Responses of over thirty crops to Sulphur have been detected in the field conditions in India, (Tandon, 1986). With insufficient sulphur, young leaves with veins and tissue between veins become light green in colour (McMurtrey, 1959). Sulphur deficiency appears as a yellowing of foliage as stated by Biswas (1984). Ash constituents percentage of SO_3 in different parts viz. roots (1.95%), wood (2.22%), leaves (4.31%), flowers (3.17%) and whole plants (2.19%) varies (Park, 1956). Sulphur helps in chlorophyll synthesis and nodulation in legumes. Sulphur content in leaves of "Super Star" roses varied between 0.80 per cent to 0.91per cent under different doses of macronutrient spray (Renu Ranjan, 1994). Sulphur content of leaves of roses significantly increased at a harvest stage of flowers. Foliar spray of N had no effect on leaf sulphur content. While foliar application of P recorded high sulphur content. Foliar spray of K did not show any increase in sulphur content in leaves. In 'Raktagandha' roses soil application of elemental sulphur at 10 Kg/h increase the vegetative growth significantly. The beneficial effect of elemental sulphur is due to the soil amendatory capacity. The applied S is oxidized to SO_2, which reacts with water and changes into H_2SO_4, the latter helps in decreasing the soil pH (Bhattacharjee, 1994).

INFLUENCE OF ZINC

A primary role of Zinc (Zn) in plant metabolism is the synthesis of tryptophan, a precursor of indole-3-acetic acid (Tsui, 1948). Zinc is a component of carbonic anhydrase (Keilin and Mann, 1940) and dehydrogenases necessary for the glycolysis of sugar in the terminal phase of respiration (Hewitt *et. al.*, 1950; Nason *et. al.*, 1953). Zinc also plays an important role in protein synthesis. Plants have adequate zinc when tissue levels are between 25 and 1000 ppm (Chaponan, 1973). With Zn deficiency, the leaves thickened, internodes shortened in the stalks; spots appear which rapidly enlarge generally involving areas between veins; and eventually involving secondary and primary veins (McMurtrey, 1959). In high pH soil, zinc deficiency occurs, apart from high pH, zinc deficiency may relate to climate conditions. In some areas cool temperature and wet spring season bring about onset of this deficiency (Lucas and Knezek, 1972). In "Raktagandha" roses spray of $ZnSO_4$ at one percent significantly promoted shoot length, appreciably increased flower bud length, flower diameter and flower yield when applied twice as foliar spray, one month after pruning and two months after first spray (Bhattacharjee and Singh, 1992). The leaf content of Zn in this rose variety varies between 43.73 ppm to 65.93 ppm (Singh, 1995).

INFLUENCE OF IRON

Iron is a part of porphyrin compounds, cytochrome enzyme system and chlorophyll synthesis. Iron is involved in activation of several enzyme systems including fumaric hydrogenase, catalase, oxidase and cytochromes. (Salisbury and Ross, 1969). It is commonly found deficient in rose crops. This is due to the oxidation state of iron in most soils and rapid oxidation rate of Fe in the iron salts applied to correct Fe deficiency (Brady, 1974;Tisdale and Nelson, 1975). Tissue leaves of iron should range between 75 and 125 ppm (Joiner and Waters, 1970). Ledlie (1923) reported that application of 28.4 gm $FeSO_4$ together with 28.4 g ammonium sulphate and 56.8 g superphosphate by dissolving in 36 litres of water and spraying 9 litres per plant was very useful to improve the quality of rose flowers. Iron deficiency shows chlorotic young leaves, principal veins typically green, short and slender stalks (Mc Murtley, 1959). In the soils where pH is high, deficiency of Iron is visible. The concentration of N, P, K, Ca, Mg, Mn, Fe, Cu and B in rose cultivars "Better Times" and their correlation with flower yield was determined by Carlson and Bergman (1966). Spray of $FeSO_4$ at 2 per cent, twice markedly improved secondary shoot production, basal diameter of shoots, flower quality and flower yield in "Raktagandha" roses (Bhattacharjee and Singh, 1992). Spray of 2 percent iron sulphate in "Raktagandha" roses significantly increased the uptake of N, P, K and Fe content in leaves (Singh, 1995). In "Raktagandha" roses the content of iron ranges between 235 ppm to 305 ppm (Singh, 1995).

INFLUENCE OF MANGANESE

The principal function of manganese are chlorophyll synthesis, stabilization of H-atoms, and split from H-OH by hydrogenation in photosynthesis, reduction of nitrates to nitrites, activator of arginase, carboxylases, and dehydrogenases (Manian *et. al.*, 2006). It acts as a catalyst in chlorophyll synthesis and is essential in respiration. In the oxidation-reduction phenomena, manganese possibly plays a direct role as an enzyme activator (Singh, 1995). Deficiency of Mn causes deformities in tissue function and development of chlorosis between the veins. The veins, however, remain green (Pal, 1965). Manganese deficiency causes spots of dead tissue scattered over the leaf; smallest veins tend to remain green, producing a chequered or reticulating effect (Mc Murtrey, 1959). Increased prevalence of manganese deficiency was often observed where good growing conditions follow a cold and dry period (Batey, 1977). Carlson and Bergman (1966) have correlated manganese availability in the "Better Times" roses with flower yield. Manganese sulphate at 0.5 and 1.0 percent spray twice, once after one month of pruning and second spray, two months after the first spray enhanced yield of "Raktagandha "roses (Bhattacharjee and Singh, 1992). Leaf content of manganese in "Raktagandha" roses varies between 140 ppm to 160 ppm (Singh, 1995).

INFLUENCE OF COPPER

Copper (Cu) acts in electron transportation in photosynthesis and respiration by undergoing cyclic oxidation-reduction between Cu 2^+ and Cu $^+$. Some experimental data suggest that Cu-containing enzymes catalyze desaturation and hydroxylation of fatty acids and Cu has a function in chlorophyll synthesis (Mengel, 1971). Critical nutrient level of

Cu in plant ranges from 5-15 ppm (Dicky, 1977). In rose plants copper increases vigour, quality of blooms and yield. Mc Fadden and Poole (1967), observed the foliar spray of 53 percent basic $CuSO_4$ at 1.4lb/100 gallons of water resulted in marked improvement in growth and quality and regulated the size of scion of "Baccara" rose. Deficiency of copper leads to the young leaves wilted permanently without spotting or marked chlorosis. The twigs or stalk just below the tip and seed head are often unable to stand erect in later stages when shortage is acute (Mc Murtrey, 1959). Copper deficient parts become dwarf and bushy, the leaves become narrow and twisted and leaf tips turn white. Foliar sprays with a mixture of $CuSO_4$ at 0.3 to 0.5 percent hydrated with lime and water, may correct the deficiency of Cu (Yadav *et. al.*, 1989). In the soils where pH is high, Cu deficiency is a common occurrence. Fertilizer application can also lead to the onset of Cu-deficiency and particularly where high level of N are applied (Reuther and Labanauska, 1966) or with prolonged use of phosphatic fertilizer (Bingham, 1963). In "Raktagandha"roses, foliar spray of $CuSO_4$ at 0.2 % twice appreciably increased flower bud length (Bhattacharjee and Singh, 1992).

INFLUENCE OF MOLYBDENUM

The research carried out during the last sixty years has transformed molybdenum (Mo) from an element of unknown biological significance to a fertilizer- an object of considerable importance. Arnon *et. al.*, (1939) were the first to report a clearest response of tomato plants to molybdenum in water culture. Vanselow and Datta (1949) observed beneficial effect of Mo in citrus and stated that although more Mo is needed for growth with nitrate nitrogen than with ammonia, there is no doubt that Mo is needed by plant for utilization of both forms of nitrogen. Principal functions of Mo are nodulation in legumes, tannin synthesis and reduction of nitrates to nitrites. Sensitivity of molybdenum in roses has been reported. The presence of Mo was recorded when N : P : K ratio in the plant was 1 : 2.5 : 0.60 (Puccini, 1958). Mo is associated with nitrogen metabolism of plants and, hence, deficiency of Mo resembles nitrogen scarcity. The deficiency caused restricted growth of plants; the leaves turn pale and eventually wither. The deficiency can be corrected through foliar application of sodium or ammonium molybdate (Yadav *et. al.*, 1989).

INFLUENCE OF BORON

The role of boron in crop production and nutrition was discussed by Lal and Srivastava (1948). Principal functions of boron are phosphorylation enzymes, glutamine synthesis and nodulation in legumes (Manian, 2006). Boron deficiency in rose plant is most prevalent in alkaline soils. Deficient supply of boron brings about moderate effect on total vegetative growth, decreased in weight of root system and ultimate reduction in flower yield and flower quality of roses. This deficiency affects young meristematic tissues first (Oertli, 1966). Reduction in length of internodes, tan root tips, stabby side roots, chlorotic leaves, malformed flowers, premature defoliation and wilting of plants even under sufficient moisture status of the soil are some of the visual symptom of boron deficiency in roses (Bhattacharjee, 1996). Normally the Boron available to the plants is held by soil organic matter (Follett *et. al.*, 1981). As it decomposes, organic matter releases boron to the salts of Ca, Ca-Al silicates or Na, salts under dry condition. As the pH of

the media increases, boron becomes less available to plant absorption. Absorption of boron and other nutrients in rose have been demonstrated by Haag *et. al.*, (1984). The critical nutrient level of B in the tissue ranges from 25 ppm, to 100ppm, with monocots normally containing less boron than dicots (Chapman, 1973). For high quality rose, leaf tissue content of boron should be between 30 to 60mg/kg. This is based on data of Boodley and White, cited by Mastalerz (1977). Boron is involved in carbohydrate metabolism particularly in the translocation of photosynthate (Katyal and Randhawa, 1983). Boron helps in maintenance of conducting system and water relations (Joiner *et. al.*, 1983). It also helps in translocation of sugar to corolla and delays senescence of petals (Halevy and Mayak, 1981). Boron plays a role in the active salt absorption, buffer action, and precipitation of excess cations and regulation of other elements and that, it is a membrane constituent (Gauch and Duggar, 1954). As the pH of the media increases, Bo becomes less available for plant absorption (Mongel and Kirkby, 1978). Furthermore, boron is regarded immobile in plants, and Oertli and Richardson (1970) attributed this to high local immobility combined with net upward flow of boron in the transpirational stream of leaves. From a field trial experiment in "Raktagandha" rose Bhattacharjee (1996) studied the influence of boron in growth, flowering, post harvest life and nutrient remobilization. It was reported by him that foliar sprays of boron in November and January was found very effective over soil applications. Between the two foliar treatments, boron spray at 0.2 percent markedly improved the vegetative growth, flower yield and flower quality. The treatment significantly improved fresh and dry weight of cut flowers, increased water uptake and lengthened the vase life. Treatment of boron, particularly 0.2% foliar spray, was very effective in increasing the uptake of Fe, Zn and B; while no significant difference was noted with N and K uptake.

INFLUENCE OF INORGANIC FERTILIZERS

A rose receives the food through the leaves and through the roots. If healthy and vigorous growth is to be maintained, there must be correct balance between the two. There are wide variations in the physical structure and chemical composition of soil in the rose growing area of different countries. Hence, feeding and manuring can never be precise and exact under all circumstances. These depend so much on local conditions and on differing individual experiences. Regular feeding of balanced fertilizers in roses at monthly or even more frequent intervals throughout the growing season is essential. Some further feeding is necessary after the first flush to build up the bushes and ensure the good subsequent crop. It is essential to apply fertilizers to rose for sustained production and maintenance of proper growth. Inorganic fertilizers are swifter in their action as compared to organic manure. Nitrogenous fertilizers are more important at proper time. Phosphorus also helps in production of more and better blooms. Adequate supply of potash is needed for production of well-ripened wood to withstand frost and infections from pest and diseases.

INFLUENCE OF NITROGEN AND PHOSPHORUS

Balanced feeding with nitrogen and phosphorus impart vigour to the plant, increase size and brightness of flowers, stimulate flowering, and encourage sturdy and healthy foliage. Maharana and Pradhan (1976) recommended 15gm N and 8gm P_2O_5 per pot of "Celebration" rose for better production.

Te Boskoop (1952) stated that a combination of high N with high P gave the best quality bushes; while Kamp and Pokorny (1958) reported that production of "Better Times" roses increased with increase in N and P level. Yadav *et. al.*, (1985) were of the view that an application of 600 Kg N in four split doses and 200 Kg phosphorus/ha proved very effective in improving the plant growth, yield and quality of "Montezuma" roses.

In "Super Star" roses 175gm each of N and P_2O_5 per 1.44 sq.m markedly increased the plant height and weight of the pruned shoots; while earliest flower bud opening was recommended with the treatment combination of N 25gm and P_2O_5 175gm per 1.44 sq.m. (Bhattacharjee and Damke, 1994). Increased flower diameter in "Happiness" was recorded by Mukhopadhyay *et. al.*, (1989) with the application of 100gm N and 150gm P_2O_5 per 1.44 sq.m..

INFLUENCE OF NITROGEN AND POTASSIUM

Nitrogen provides plants more vigour; dark green leaves and lush growth; while potassium ensure hardiness to plant and increases the quality of the blooms. Application of 16gm each of N and K_2O/plant/year in rose cultivar "Super Star" resulted into maximum shoot length (Uma and Gowda, 1987). In "Baccara" roses optimum leaf contents of N and K were 3.8 per cent and 2.1 per cent respectively (Bik, 1970). In "Carol" roses it was observed that N had a favourable effect on flower yield and stem length but detrimental effect on intensity of flower colour; while increased doses of K had no significant effect on flower yield or keeping quality, but it improved the stem length and slightly reduced colour intensity (Bik, 1973). The best flower yield of "Baccara" rose was obtained when 40mg N and 85mg K per 100gm of soil was applied before leafing out in spring (Skalska, 1977). Use of N K fertilizer at 1 : 1.5 ratios gave the best results in roses (Kaufmann *et. al.*, 1975). Nitrogen and potash fertilizers applied in rose cultivar "Ekstsel'za" before planting and as a top dressing had given best growth and floral quality (Mantrova, 1980). In rose cv. "Forever Yours", Woodson and Boodley (1982) observed that low supply of potassium limited the growth and flower production, regardless of nitrogen supply. Increased flower yield in "Super Star" roses was recorded by Bhattacharjee and Damke (1994) with 75gm N and 100gm K_2O per 1.44sq.m.

INFLUENCE OF PHOSPHORUS AND POTASSIUM

Moderate amount of phosphorus and potassium are required by rose plant for encouraging root growth and ripening of wood. Ticknor and Smith (1965) studied the effects of P,K and B on "Peace" and "Condensa de Sastago" roses and reported that neither variety responded to P_2O_5, whereas growth of rose plant improved with K_2O, P_2O_5 application in soil. Application of K_2O, K_2O + P_2O_5 and B improved vegetative growth of rose cv."Peace" as compared to unmanured plants. Fertilizer application did not produce any effect on "Condensa de Sastago". Application of 175gm P_2O_5 and 100gm K_2O per 1.44sq.m resulted in maximum number of longest flower stems in "Super Star" roses (Bhattacharjee and Damke, 1994).

INFLUENCE OF N, P AND K FERTILIZERS

Rose plants need balanced supply of nutrients supplemented by nitrogen, phosphorus and potassium fertilizers. It is most important of all cultural operations in the rose garden.

As a well fed healthy plant will be less susceptible to disease and pests than a weak undernourished plant.

Roses are gross feeders and hence, manuring should be repeated twice yearly with N, P, K mixture of 5 : 10 : 5 (Hanslow, 1934). According to Taylor, (1945), good manure for roses must contain K and P, and only a limited supply of N and recommended an application of 100 gm mixture per plant containing 5 lb of ammonium sulphate, 15 lb of super phosphate, 10 lb of potassium sulphate and 10 lb of magnesium sulphate. Laurie and Ries (1950) recommend an application of 3lb per sq.ft of a complete fertilizer formula of 10 : 6 : 4 or 6 : 8 : 6 or 1 : 3 : 1 at two to three times during the season. In "Better Times" roses with constant levels of P and K and N at 50, 150 and 300 ppm showed that N at 50 ppm was insufficient in respect of the number of flowers per plant, stem length and vigour (Durkin, 1961).

For rose cv. "Belcanto", Sinha and Motial (1969) found N : P : K at 12 : 12 : 6 ratio produced rose buds of greater size, number and weight and also produced cut flowers of greater longevity and large number of shoots. Mattson and Wilmer (1971) reported that rose plants fertilized with 20 : 20 : 20 NPK solutions produced equivalent or greater flower yields than roses fertilized with 10 : 10 : 10 in dry form.

Gabriels and Meneve (1973) in "America's Junior Miss" roses recorded highest yield of marketable cut flowers with ionic proportions (meq% anionic and cationic nutrients) : 64N, 18S, 18P, 38K, 26Ca, 36Mg at an optimal dose of 510 meq per plant. Treatments of the above composition and showing a ratio anions/cations equal to 1.3 gave the most satisfactory results. Young *et. al.* (1973), obtained highest flower production with 2300 lb of N/acre in "Christian Dior" and 2100 lb/acre in "Happiness" roses; stem length increased with K rates of 1700 lb/acre but flower production decreased; while there was no difference in yield or quality with varying doses of phosphorous. Bakly (1974) observed that higher fertilization levels through increased flower number and fresh weight in "Chrysler Imperial", but delayed flower opening. He recorded highest flower yields and best quality flowers with NPK mixture of 90 : 180 : 30. In a field trial study on *Rosa canina*, Soukup and Stankova (1974) obtained good results with 108Kg N + 180Kg P_2O_5 + 190Kg K_2O per hectare.

In *Rosa promifera*, productivity increased with the application of NPK fertilizer as compared to unfertilized control (Natransky, 1974). In "Super Star" rose, Nijjar and Rehalia (1977) found that flower number, stem length, weight and diameter of flowers increased with the application of 50 gm N, 25 gm P and 25 gm K per plant. According to Mantrova (1977), in Hybrid Tea, Climbing and Polyantha roses grown in derno-podzolic soil, NPK application increased the flower yield and imparted winter hardiness.

In five years field trial with rose cv. "Parel van Aalsmeer", Johansson (1978) concluded that low N and K supply caused a significant reduction in length and weight of stems, weight of root and total growth of plant. Less number of flowers were obtained at low N supply. While at reduced P supply the number of flowers, weight of stem, root and total weight were negatively affected.

Johansson (1979) recommended 60 gm N as ammonium sulphate and 30 gm K as

potassium sulphate per m^2 annually for highest return where the leaf nutrient content averaged 3.04 per cent N, 0.29 per cent P and 2.14 per cent K.

NPK application activated P metabolism in winter hardy climber rose cv. "Dawn" and non-hardy H.T.rose cv. "Gruss an Tepliz" (Mantrova, 1979). He has also reported enhanced P nutrition in the presence of normal N and K rates, increased the sugar phosphate and nucleotide contents in the leave at growing temperatures and accelerated their efflux into the roots at low temperature.

In *Rosa bourboniana*, Irulappan *et. al.*, (1980) recorded highest flower production with 10 kg FYM + NPK at 6 : 12 : 12 gm per plant per year. Foliar application of 2.5 gm each of N, P and K per plant at bimonthly interval has given the highest flower yield in *Rosa bourboniana* (Akbar and Rao, 1982). In *Rosa damascena*, Singh and Ram, (1987), recorded highest flower yield with 100Kg N, 60Kg P_2O_5 per hectare along with 50 ppm NAA where no K_2O was applied.

Application of Chilean nitrate 703Kg, P_2O_5 100 Kg and K_2O 100 kg per hectare in rose plants enhanced plant height, lengthened the duration of flowering, improved flower diameter and longetivity of flowers in rose plants (Sritapradja, 1989). Saini *et. al.*, (1978) recommended 50 gm each of N, P_2O_5 and K_2O per plant for 3 years old bushes of "Super Star" roses for best production. Fertilizer treatments to four different cultivars of roses with 25 gm N and 20 gm each of P_2O_5 and K_2O per plant gave better flower yield (Anamika and Lavania, 1990).

From two years of field trial with fertilizers on high density planting of "Super Star" roses, Bhattacharjee and Damke (1994) concluded that application of 175 gm N, 125 P_2O_5 and 100 gm K_2O/ 1.44 m^2 resulted in maximum vegetative growth; and the treatment combination of 25 gm N, 125 gm P_2O_5 and 100 gm K_2O/1.44 m^2, however accelerated early flower bud appearance, promoted flower bud opening and lengthened the life of intact flowers. They have observed that higher dose of 125 gm each of N and P_2O_5 and 100 gm K_2O/1.44 m^2 resulted in the largest number of flowers of stem length of 60 cm and above; while the treatment combination of 75 gm N, 125 gm P_2O_5 and 100 gm K_2O/ 1.44 m^2 was found optimum for producing more number of flowers between 45 to 59 cm and the highest number of total flowers of different stem length category. The same treatment also significantly improved flower bud size, increased flower diameter and produced more number of petals per flower over other treatments. Hence, a fertilizer dose comprising of 520 Kg N, 868 Kg P_2O_5 and 694 Kg K_2O/ hectare/year (4.7gm N, 7.8gm P_2O_5, and 6.25 gm K_2O/ plant/year or 75 gm N, 125 gm P_2O_5, and 100 gm K_2O/ 1.44m^2/ 16 plants/year) was recommended for high density planting (30cm x 30 cm distance) of "Super Star" roses.

The fertilizer dose of 75 gm N, 125 gm P_2O_5, and 100 gm K_2O/ 1.44m^2/16 plants/ year in "Super Star" roses was helpful in the micronutrient remobilization in the rose leaves in different season of the year (Damke and Bhattacharjee, 1997). The same dose of fertilizer in "Super Star" also resulted in highest total soluble sugar (TSS) in leaves, and the highest percentage of TSS content was in autumn season followed by summer, winter and spring season (Damke *et. al.*, 1996). Chlorophyll content of "Super Star" roses increased with leaf age and was found highest during second flush of flowering (February-

March), and there was successive rise in chlorophyll content with the increased dose of nitrogen from 25 gm to 175 gm N/1.44m^2/year (Damke *et. al.*, 1995). Organic carbon, phosphorous and potash content in soil were increased with the application of N, P, and K fertilizers, respectively and their availability in soil was influenced by different seasons (Damke and Bhattacharjee, 1995). Availability of calcium and magnesium content in soil was influenced by NPK fertilization (Damke and Bhattacharjee, 1997 a). The total number of flowers in "Super Star" roses had shown high positive correlation with number of shoots/plants and basal diameter of original shoots (Damke *et. al.*, 1998).

In "Raktagandha" roses, 60 gm N, 125 gm P_2O_5, and 100 gm K_2O/ 1.44m^2/16 plants/ year was found best for increased yield and nutrient remobilization in plants (Bhattacharjee, 1999). Viradia and Singh (2002) on "Gladiator" roses concluded that combined effect of nitrogen at 40 gm/plant and the lowest plant density of 18,515 plants/ ha (90 cm x 60 cm) were most effective for cut flower production.

SOIL APPLICATION OF OTHER CHEMICALS ALONG WITH N, P AND K FERTILIZERS

Some of the food elements that roses require already exist in virgin soils but they quickly become exhausted and must be regularly replaced by manufactured fertilizers. Account must also be taken of the physical structure of the soil so that roots can grow unimpeded and form a fine network that can readily absorb the nutrients that are available to them. Plants can only take in liquid food and all fertilizers must be in the form of aqueous solution or capable of being broken down and/or dissolved in water (Elwes, 1976). Multiplex fertilizer containing Zn 10 percent, Mo 0.02 per cent, Cu 0.05 per cent and B 0.50 per cent w/w basis applied at 12 gm/plant to rose cv. "Gladiator" significantly improved flower number and bud diameter (Nagaraju *et. al.*, 2003). In *Rosa damascena*, $ZnSO_4$ at 5gm/ plant produced significantly higher flower yield (Joshi and Parekh, 2002). Among the secondary nutrients, soil application of elemental Sulphur 10 Kg/ha, $MgSO_4$ 50 Kg/ha and $CaSO_4$ 50 Kg/ha increased the flower yield and improved the flower quality. The maximum numbers of flowers were obtained in "Rakhtagandha" roses with $MgSO_4$ at 50 Kg/ha/year (Bhattacharjee, 1994).

INFLUENCE OF FERTILIZERS ON NUTRIENT UPTAKE IN ROSE

The rate of uptake of nutrient ions by the roots depends in part upon the rate at which they are transported from the soil to the root surface because this is the slow process of diffusion. The plant factors include root size, density and growth, metabolic demand of the plant, transport from the root to the xylem and physiological condition of cortical and epidermal cells of the root.

Chemical soil analysis indicates the potential availability of the nutrients that root may take up under conditions favorable for root growth and root activity. Plant analysis in the strict sense reflects only the nutritional status of plants. Therefore, in principal a combination of both the methods provide a better basis for recommending fertilizer application than one method only.

Iley *et. al.*, (1964) stated that whenever, there is no competition from potassium more amounts of calcium and magnesium is taken up by rose leaves. According to Kenneth Post and Fischer (1951), although potash deficiency resulted in reduction in vigour and

productivity and size of plant; whereas high potassium in the soil induces higher potassium contents of the plant tissue and results in slight but insignificant decrease in rose production. Hayslip (1967) reported that in leaf, K content was more in higher K_2O level than lowest level in roses. In *Rosa multiflora*, Alt (1970) recorded highest leaf K content with the lowest Mg content in the soil.

Application of 120 Kg or 180 Kg P_2O_5 per hectare in "Cremean Red" roses increased the availability of phosphorous content from 18 to 26 mg per 100 gm soil. These treatments increased P content of both vegetative and reproductive plant organs. Flower yields were increased by an average of 11 percent and oil yield by 12 per cent (Zal'tsfas and Chemarin, 1974). In "Parel van Aalsmeer" roses, chemical composition of leaves was affected by plant age and season. Low N supply increased ash and Ca content in the leaves and at low P, leaf N content decreased and negative relationship between K supply and Ca content was recorded (Johansson, 1978). While studying the influence of rose rootstocks and season on leaf composition of flowering shoots in rose varieties "Brogs Stachellose", "Inermis, Pfander", "Pollmers" and "Baccara", Johansson (1979b) observed that leaf N and P contents were lowest in the middle of summer followed by spring and autumn. The Ca contents decreased progressively during the growing season.

Haag *et. al.*, (1984) reported that a 7-year old "Super Star" rose bush extructed (in gm) 7.8N, 1.6P, 2.9K, 2.1Ca, 0.8Mg and 0.4S and in (mg) 0.2B, 4.7Cu, 81.1Fe, 51.6Mn and 15.7Zn. In essential oil containing roses, Orlova (1985) confirmed that highest yield was obtained when the leaves at bud development contained 3.8 per cent N, 0.90 per cent P and 1.60 per cent K. He stated that leaves from middle of shoot are most suitable for diagnosis of nutrients and in highly productive plantations N, P and K concentrations in leaves decreased by 35 per cent, 67 per cent and 25 per cent from bud development to flowering respectively.

Liaso-Sha (1988) recorded in modern rose that N, P, K, Ca and Mg and water were high at the initial stage of growth and then decreased until flower began to wither. Thereafter, all elements excepts Ca increased again, but water decreased to the lowest level, while Ca content increased with the development of growth and was steady at the reproductive stage and increased after flower withered. In "Mercedes" roses Alvarez *et. al.*, (1988) recommended that the first two leaves of the five leaflets on stem whose buds separated its one sepal should be selected to estimate nutrient status of the plant than the sampling of first two leaves with five leaflets on stems and pea sized buds.

For better growth, Chan (1960) recommended that rose leaves should have 2.8 to 3.0 per cent N, 0.28 to 0.3 per cent P and 2.4 to 2.8 per cent K, while Bik (1970) recommended optimum leaf N and K content of 3.8 and 2.1 per cent respectively in rose cv. "Bacarra" in two years trial. In a factorial experiment with N, K and Mg or cv. "Buismans Truimph", Knoblauch (1972) reported the optimum leaf contents of minerals in dry matter to be 3.9 to 4.6 per cent N, 0.55 to 0.65 per cent P, 1.85 to 2.60 per cent K, 0.5 to 0.8 per cent Ca, 0.35 to 0.45 per cent Mg, 125 to 165 ppm Mn and 20 to 25 ppm B. Hagg *et. al.*, (1984) reported that a seven year old "Super Star" bush extracted 7.8 gm N, 1.6gmP, 2.9gmK, 2.1gm Ca, 0.8gm Mg and 0.4 gm S; and 0.2mg B, 4.7mg Cu, 8.1mg Fe, 51.6mg Mn and 15.7mg Zn.

Nutrient uptake studies in cv. "Super Star" conducted by several workers conclude that up take of nutrients increased with increased application of the corresponding nutrients (Nijjar and Rehalia, 1977; Heisel, 1982; Uma and Gowda, 1987; and Damke and Bhattacharjee, 1977). But in cv. "Caliente" N treatment had no effect on foliar N content (Armitage and Tsujita, 1979b), while in cv. "Forever Yours" 100 and 200ppm N were insufficient to maintain foliar N content at optimum levels (Armitage and Tsujita, 1979a). Increasing N levels to 400ppm resulted in higher foliar N content. Though N and K content of leaves of cv. "Tropicana" increased with increase in N and K fertilization, there was no major effect on the Ca, Mg, P, B, Cu and Fe leaf content (Waters, 1968). In a study with cv. "Forever Yours" leaf K concentration was reduced at lowest K application; increasing K concentration 0.25 to 10 m.e/l had no antagonistic effect on Ca and Mg accumulation in the leaves (Woodson and Boodley, 1982a). Increased K supply from 1.0 to 10.0m.e/l resulted in higher nitrate nitrogen in nitrate nitrogen fertilized plants and lower ammoniacal nitrogen in ammoniacal nitrogen fertilized plant (Woodson and Boodley, 1982b). Varietal differences exist in the uptake of nutrients by roses, and it was also observed that in some varieties, there was excess accumulation of Ca and very low uptake of Fe and Cu (Lopez *et. al.*, 1989).

The nutrient uptake studies reveal certain patterns of uptake, which vary between nutrients within each growth cycle of the rose bush. Koseva *et. al.*, (1978) recorded highest nutrient uptake in "Kazanluk" rose bushes during bud formation to flowering and thereafter the daily nutrient utilization sharply declined. The fertilized plants had taken up N, P and K more intensively as compared to control. In P uptake study on essential oil roses, Zal'tsfas (1974) observed that P uptake was more during bud formation to start of flowering and at the time of second growth flush. P accumulated mainly in roots (70 to 80 per cent) during intensive growth and in the leaves (46 to 47 per cent) during flowering. N P K activated P metabolism in cv. "Dawn" and "Gruss an Teplitz" (Mantrova, 1979). N and K increased sugar phosphate and nucleotide contents in leaves at growing temperature and accelerated their efflux into roots at low temperature.

Nikolova and Kończak (1985) reported that N and P accumulates in flowers of cv. "Sonia" mainly at the expense of their content in the leaves and stems. The K content in flower increases without any change in its amounts in the leaves or stems.

LIQUID FERTILIZERS AND SOILLESS CULTURE

Liquid fertilizers are more or less in absolutely pure and fit state to be taken up by the plants as soon as they are applied in liquid form and are washed down in the soil with water. Therefore, liquid fertilizer should only be given in little quantities and in principal only when the plants are growing and the sap is flowing freely (Bhadri, 1963). To get good blooms for exhibition purpose and for hardening the limp stem, some rose growers practice application of fertilizers to the soil in solution. The liquid fertilizers reach the plant roots immediately after application for utilization. But there is risk of toxicity and fixation of phosphates to the soil, rendering it unavailable to plants. The liquid fertilizers are applied to the moist soil around the plant and should not be used on dry soil on dry weather. As a regular feeding of rose plants, however, this practice seems unnecessary (Yadav *et. al.*, 1989). For green house cultivation of roses liquid fertilization is followed and found useful.

Ledlie (1923) suggested preparing of liquid fertilizer by dissolving 1 oz ammonium sulphate, 2 oz super phosphate and 1 oz iron sulphate in 8 gallons of water and applied at 2 gallons per plant for improving the quality of flowers. According to Park (1956) a fertilizer solution prepared by dissolving 24 oz potassium nitrate, 12 oz ammonium sulphate, 6 oz potassium phosphate in 96 gallons of water and applied at the rate of half gallon per plant, three times a week for a month and thereafter once a weak before the show produced outstanding blooms suitable for exhibition. In an eight-year study with "Super Star" rose grown in hydroponic culture using perlite and gravel mixture, Heisel, 1982, studied the influence of Wopil nutrient solution (1 : 0.44 : 1.33) and in some cases NH_4NO_3 +K_2SO_4 and concluded that plant absorbed more nutrients (390 mg N, 227 mg P, 479 mg K per plant per week) from stronger nutrient solution.

In greenhouse cultivation of roses liquid fertilizers are used efficiently by which productivity and quality of roses improves to a great extent. Moreover, application of fertilizers through fertigation system is economical.

To improve the post harvest quality of cut roses by increasing the resistance against susceptibility of *Botrytis* flower blight, the effects of the solution composition of Ca, Na, K and Mg concentration was studied by Bar Tal *et. al.*, (2001). It was concluded by them that increasing the Ca concentration in the solution from 0.5 to 5.0 m mol/litre increased Ca concentration in flower organs thereby decreased the susceptibility of *Botrytis cinarea* in *Rosa hybrida* cv. "Jagur" and *Rosa chinensis.*

Recycling of nutrient solutions in soiless culture of *Rosa hybrida* did not affect the flower yield, quality and vase life; and management of recycling using EC measurement proved to be reliable (Brun *et. al.*, 2001). Disinfecting of reclycling water with 4 mg/l of active chlorine applied over 30 minutes was found an excellent preventive methods to obtain disinfection of bacteria in rose cultivars (Poncet *et. al.*, 2001). The use of 3 variants of nutrient solutions was suggested in Italy for a closed hydropic system in cold greenhouse of four year old *Rosa* cv. "Anna"; including an NPK ratio of 1 : 0.2 : 1.5 and EC of 2.1 mS/cm from pruning to initial developmental stage of the flowering buds (February to May) : an NPK ratio of 1 : 0.1 : 1 and EC of 1.4 mS/cm during intensive flowering and growth (May to October); and an NPK ratio of 1 : 0.15 : 1.25 and EC of 2.1 mS/cm during autumn winter (Farina *et. al.*, 2001).

The water utilization and nutrient uptake of own-rooted *Rosa hybrida* cv. "Madelon" on coco-soil and pumice was investigated by Syros *et. al.*, (2001). They have suggested plant growth in coco-soil with average inputs of major nutrients in the solution approximately 0.25 m mol 1-1 NH_4^+, 15.7 m mol 1-1 NO_3^-, 1.5 m mol 1-1 P and 4.2 m mol 1-1 K with the amount of fertigation 800 ml per plant applied in 8 equal daily doses gave best results for more flowering. Palai *et. al.*, (2002), recorded in rose cv. "Montezuma" 400 ppm N, 300 ppm P_2O_5 and 200 ppm K_2O supplied with irrigation water at weekly interval produced maximum number of flowers.

The growth and yield responses of rose cultivars grown in rockwool slabs to various ratios of NO_3^- : NH_4^+ nutrient solution was studied by An Dong *et. al.*, (2002), it was observed that during winter, yield of most cultivars increased as NH_4^+ was supplied. However, from spring to summer, yield was high in 10 to 20 per cent NH_4^+ ratio. Pascale

et. al., (2001) studied the water consumption and nutrient uptake of *Rosa hybrida* cv. "Dallas" grown in an open soilless system of two inert media parlite and lapillus, a type of volcanic rock. The concentration of the nutrients in the solution were (in m mol $^{1-1}$) 11 NO_3^-, 1.1 $H_2PO_4^-$, $4K^+$, $5Ca_2^+$, 1.5 Mg_2^+, 2.5 $(SO_4)_2^-$ and 140 μ mol 1-1 Fe_3^+ along with micronutrients. The electrical conductivity and pH were kept about 2.0ds m $^{-1}$ and 6.3 respectively. It was recorded that nutrient and water uptake changed during the growing period with no significant differences between the two substrates. The mean ratio N : P : K obtained by analyzing rose leaves was 1 : 0.08 : 0.63 with no difference between the substrates.

The yield, dry matter partitioning and leaf nutrient status of "Bridal White" rose plants grafted on rootstocks like *R. manetti, R. odorata, Rosa.* "Natal Briar" and *Rosa.* "Dr. Huy" were evaluated under green house conditions. The plants were grown in 16 litre containers filled with a peat : bark : sand growing media and fertilized with complete nutrient solution. Flower and dry biomass yield data collected over four flushes of growth and flowering did not show significant differences between rootstocks, with a decline in uptake after shoot harvest, and an increase during flower development with maximal values towards flower opening (Cabrera, 2002).

The effect of different water regimes and N, P and K concentrations of the nutrient solution on cut flower production of *Rosa hybrida* cv. "Susan" grown in pumice under natural light condition in glass houses were investigated by Malorgio *et. al.*, (2001). The composition of nutrient solution and watering regime affected flower production and quality only slightly. Reduction of N, P and K concentration and water supply led to substantial decrease in the use of both water and fertilizers as well as in amount of nutrient run-off.

The effect of the substrate type (perlite vs. tuff) on water and nutrient uses of "Grand Gala" roses was studied under plastic greenhouse by Martin *et. al.*, (2001). The perlite cultivated plants evapo-transpired slightly more than turf cultivated ones; and water use efficiency increased in autumn and decreased in spring and summer, which is higher in perlite than in turf. The plant nutrient uptake efficiency was also higher in perlite.

The uptake rate of nutrient and potassium in Rose cv "Kardinal" grown under the greenhouse in aero-hydroponics nutrient solution with 3 mM nitrate $(NO_3)^-$ nitrogen and 1mM potassium (K) was investigated by Silberbush and Lieth (2004). There was a cyclic rhythm of both the nutrients' influx rates over time.

Studies were conducted for decreasing nutrient emission from closed nutrient systems by using high irrigation rates to allow lower EC levels in presence of accumulated Na and Cl in rose cv. "Frisco" by Baas *et at* (2004). The growing media used in the 3 litre containers were coir dust and 3 perlite fractions. It has been concluded that NaCl concentrations of 10 mM can be tolerated by cut rose provided nutritional elements are not below certain limiting concentrations. To determine the hourly balance of water and nutrient uptake as a basic information for soilless culture management, a study of a rose crop in a hydroponics recirculating system was carried out by Roca *et. al.*, 2003. A clear synchrony between both fluxes, nitrate and water uptake rate was observed along the

24 hours cycle. However, nitrate uptake concentrations per litre of uptaken water were much higher during the night due to lower plant transpiration.

Rose production is limited by salinity and is highly affected by nitrogen source present in the nutrient solution. The influence of sodium on several aspects of nutrition has been investigated is Rose cv. "Lambada" using different sources of culture (Lorenzo *et at*, 2001). This study showed that the rose plants were more sensitive to saline conditions under NH_4^+ fertilization without detectable effects on growth or in NPK mineral contents in shoots. Nitrate uptake did not show a clear pattern related to nitrogen source. Potassium and phosphate uptake were always lower when NH_4^+ was present in the nutrient solution.

Lykas *et. al.*, (2001) investigated the effect of light and agitation on the availability of iron in hydroponics nutrient solutions in rose crops. They have concluded that in a closed hydroponics systems, agitation is very useful for periods and thus minimizing further addition of iron, while exposure to light does not affect Fe availability.

The yield, quality and nutrient status of rose cv. "Bridal Pink" were evaluated under increasing NaCl and different NO_3 and NH_4 ratios (Cabarera and Agbaria, 2001). NO_3 and NH_4 ratios and NaCl concentration had no main effects on any of the flower yield or quality components. Their results suggest that roses are more tolerant to salinity than what the typical classification of sensitivity indicates. The influence of additional supply of ammonia-N containing hydroponics solution on mineral nutrition of greenhouse grown *Rosa* cv. "Lambada" in hydroponic culture was studied by Lorenzo *et. al.*, (2000). The addition of ammonia-N to the nutrient solution-containing nitrate produced a total nitrogen uptake increase during shoot elongation. Adding ammonium-N to the hydroponics solution caused an increase in K uptake while, NH_4 absorption was constant. Phosphate uptake was higher when both nitrate and ammonium was supplied.

INFLUENCE OF FOLIAR FEEDING

Foliar application of nutrients was also studied as a means of supplying nutrients to plant. It provides economic use of fertilizers in regulated way. It can correct relatively by short time deficiency, increases yield, decreases the energy invested in fertilizer application and protects environment from pollution. According to Biswas (1964) the effect of foliar application is the same as that of soil application and sometimes better under certain adverse soil conditions. This is an effective method and helps in providing healthy and abundant foliage and flowers of enormous size and colour. Foliar feeding is an excellent supplement to root feeding because the leaf can directly absorb the nutrients (Yadav *et. al.*, 1989).

Nanjan and Muthuswamy (1974) recorded largest number of shoots per plant in 3.08 gmN, 1.85 gm P_2O_5, 1.75gm K_2O, and highest yield in 1.93gm N, 1.34gm P_2O_5 and 1.50gm K_2O sprayed on leaves of Edward rose. Sable and Dhakhale (1985) observed that the application of 40gm N +40gm P_2O_5 and 30 gm K_2O per plant along with foliar spray of NPK and minor elements (Mg, Mn, Fe, B) were beneficial for growth and yields of quality flowers of rose cv. " Paradise".

In the rose variety "Sntrix" under greenhouse conditions 250ppm GA_3 alone or combined with foliar fertilizer Sangral at the rates of 0.10,0.20,0.40 and 0.80 per cent were

sprayed by Al Hamid (2001). He obtained highest value of vegetative and flower parameters by spraying the plant with 0.40 per cent foliar fertilizer and 250 ppm GA_3.

Spray application of N, P and K 200 ppm of each at fortnightly intervals was found most beneficial, over soil application of fertilizers in "Super Star" roses (Bhattacharjee and Renu Ranjan, 1995). Combined spray of NPK recorded high leaf nutrient content except that of N, and also reduced leaf Mn content (Renu Ranjan, 1994). Foliar spray of Boron (0.2%) in November and January markedly improved vegetative growth, flowering, flower quality of "Raktagandha" roses, and was very effective in increasing the uptake of Fe, Zn and B, while no significant difference was noted with N and K uptake (Bhattacharjee, 1996). Significant increase in flower yield of "Raktagandha" roses was resulted with foliar spray of 1.0 per cent $FeSo_4$ (Bhattacharjee and Singh, 1992). Foliar spray of $FeSo_4$ at 1.0 per cent resulted in increased total soluble sugar in leaf and stem and decreased total free amino acids in corolla, leaf and stem tissues (Singh, 1995).

For macronutrient spray, the composition of spray solution should be ¼ oz potassium sulphate, 1/2 oz ammonium sulphate, 1 oz potassium nitrate in 8 gallon of water (Roy Genders, 1965). Foliar feeding of rose plant with urea 0.3% (3gm/Litre) in monthly interval is beneficial. Moreover, foliar spray of other nutrients containing a mixture of 15gm manganese sulphate, 20gm magnesium sulphate, and 1gm chelated iron, 5gm borax and 5gm zinc sulphate at the rate of 2gm/litre at monthly interval is also suggested (Bhattacharjee and De, 2003). Spray of NPK in ratio of 12 : 12 : 6 produced rose bud of greater size, number and weight with increased shoots on cv. "Balcanto" (Sinha and Motial, 1969). For higher production of quality flowers, Pal (1972) suggested that 2.25gm each of urea and potassium dihydrogen phosphate are to be dissolved in one litre of water and sprayed on rose plants. Akbar and Rao (1982) observed that application of N, P_2O_5 and K_2O at 2.5 : 1.5 : 1.5 gm per plant gave highest flowers yield of 4,446.2 gm per plant in *Rosa bourboniana*. The essential oil content was highest in plants receiving foliar N, P K at the rate of 1.9 : 3.74 : 3.35 gm per plant, which had a total flower yield of 4,244.2gm per plant.

Foliar feeding responds better when the young leaves are sprayed, these leaves are better able to absorb the plant nutrient than the old leaves. The spraying should be done as early in the day as possible. The stems and buds will also absorbed the nutrients, but in order that all parts of the plant can be made thoroughly wet, a wetting agent should be used with salt. Burning of leaves may result if the dose is exceeded. Foliar feeding in rose is necessary and effective when roses are grown in clay soil, which will be of high alkaline in nature and where the conditioning of the soil may prove difficult. Where the roses are grown in a chalky soil there will usually be the need to provide the plants with supplies of iron and magnesium as foliar spray (Genders, 1965).

According to Allen (1974) do not use any commercial fertilizer mixture as a foliar feed unless it is exclasively recommended for the purpose. So far as possible avoid the use of sequestrenes in foliar feed. Foliar feed can be prepared by mixing 1 per cent urea plus a few drop of wetting agent (10gm urea mixed in 1litre of water) or 1oz urea plus ¼ oz of potassium nitrate and Epsom salts in a gallon of rainwater plus few drops of

wetting agent. Foliar feeding in rose should be regarded as a technique to be used in special circumstances and not as a replacement of traditional manuring.

APPLICATION OF NITROGEN IN SPLIT DOSES

Nitrogenous fertilizer, in general, is readily soluble in water and thereby subject to loss by leaching. Hence application in split doses is of great importance to increase its availability to plant vis-à-vis N use efficiency. Application of 75gm N/1.44m^2/year in three split doses (i.e.@25gmN in October, December and February) was found better over single application of the entire dose in the soil at a time, for increasing flower yield, improving flower quality and decreasing dieback infestation in "Super Star" roses (Bhattacharjee, 1995a).

EFFECT OF NITRIFICATION INHIBITOR

It is well known that nearly 60 to 70 per cent of the total fertilizer nitrogen is lost during transformation of ammoniacal nitrogen into nitrate. Nitrogen losses are in the form of ammoniacal nitrogen, nitrous oxide and nitrogen molecules and a part of nitrogen leaches down to beyond the root zone. To increase the efficiency of N use there is need to limit the rate of ammonium oxidation. Although a number of nitrification inhibitors are available now a day, they all have limitations (Keeney, 1986). It is now well established that acetylene is a potent inhibitor of ammonia oxidation (Berg, *et. al.*, 1982; Mosier, 1980; Walter *et. al.*, 1979). Since the compound is a gas, it is not readily utilizable under field conditions. Banerji and Mosier (1989) described a method of coating calcium carbide grains whereby acetylene is produced when CaC_2 come into contact with water, so that a time-released acetylene source is available. Coated calcium carbide is an effective, well-experimented nitrification inhibitor, which functions over a broad range of soil conditions, is easily prepared, easy to use and inexpensive. Hence coated calcium carbide is used in increasing the availability of nitrogen fertilizer in "Raktagandha" roses. Encapsulated calcium carbide, a nitrification inhibitor @20kg/hectare increased the availability of nitrogen and reduced the nitrogen requirement by nearly 50 per cent (Bhattacharjee and Banerjee, 1994).

EFFECT OF PHOSPHO-PURINE COMPLEX

It is well known that 80 per cent of the applied phosphorus to soil is converted into unavailable form to a plant. Several attempts have been made to increase the efficacy of fertilizer phosphate uptake by plant (Ghosal and Chakraborty, 1969) but the enhancement of phosphate uptake could not be increased beyound 14 per cent. Phospho-purine complex is an anion complex, which has been prepared by using organic compound of purine group isolated from molasses and orthophosphoric acid. This complex is quite stable in soil under both acidic and alkaline conditions. In this technology the phosphate transformation and fixation in soil is considerably reduced. Phospho-purine complex (PPC) used in a field trial experiment with "Raktagandha" roses and compared with single super-phosphate (SP). It has been observed that 50gm PPC/1.44 m^2/year (347.2Kg/ hectare) was an effective as that of 125gm P_2O_5 as SP/1.44m^2 (868Kg P_2O_5/hectare) for improving vegetative growth, flowering and nutrient uptake in "Raktagandha" roses (Bhattacharjee *et. al.*, 1996).

INFLUENCE OF ORGANIC MANURE

Organic manure is an important source of nutrient element for plants. It plays a critical role in improving soil physical condition. It improves soil aggregation, which in turn influence infiltration, movement and retention of soil water, soil aeration, soil temperature, soil strength and root penetration. Higher the organic matter content, the higher will be the microbial activity and higher the availability of nutrient to the plants.

Some of the food elements that roses require already exist in virgin soil but they will quickly become exhausted and must be regularly replaced by natural manures. Physical structure of the soil should also be taken into account so that roots can grow unimpeded and form a fine network that can readily absorb the nutrients that are available to them. Thorough preparation of the ground before planting roses is essential for good results. Green manuring is the best way to improve neglected soils or to bring back into condition a soil, which has become rose sick. Farm yard manure and peat, are excellent which improve water retention on light soil and soil structure on heavy soils. Fish manure, hoofs and horn, meat and bone meal are all good slow acting manure. Dried blood is fairly quick acting and useful stimulant. A fallen leaf added to the compost heap is a source of natural manure. Compost manure is infinitely superior to the others, since the object of composting is to make humus of high food value, and the best humus is made by composting animal and vegetable matters together. Regular application of humus-forming material such as farmyard manure, peat, compost or leaf moulds are beneficial to rose plants. Cow dung manure or horse manure are also used in roses with successes. Organic manure are rendered soluble by soil action, slowly and over a long period.

Organic manure may be applied at ½ to 1lb per rose bush. Commercial fertilizers at 5 : 10 : 5 may be applied at 1lb per 80 sq.ft. This has to be repeated annually. Sandy soils need heavier and more frequent application of organic manures than heavier soils (Anon, 1932). The effect of cattle manure and homlock bark on yield and quality of greenhouse rose cv. "Sonia" was studied by Hayashi (1983), and stated that number of cut flowers or stem length were not affected by either application, whereas poor quality flowers were obtained from manurial plots.

The best time to manure on established plant is at pruning. Immediately after pruning, some soil around the base of the plant is removed and manure is spread evenly and worked into the soil. The dug out soil is returned to its original place and leveled. Supplementary manuring may also be done after the first flush of blooming is over. The rate of application of organic manure depends upon the source and nature of the soil. Usually, sandy soil needs heavier and more frequent application of organic manure than heavier soil. Well-decomposed farmyard manure has been the choice of the organic manure of rose growers. Application of 8 to 10Kg per plant or 4 to 5 tones per hectare has been found useful (Manian *et. al.*, 2006). While application of 30 tones of municipal compost per hectare proved very effective in improving the vegetative growth of roses, as suggested by Bhattacharjee (1959). Application of 100 bullock carts of well rotten cow manure per acre per year along with 300gm of fish meal and 250gm of ralli meal per plant was recommended for commercial production of roses by More (1982). Before preparation of beds, green manuring with *Crotaleria juncea* (sun hemp) and *Sesbania cannabina* (daincha)

is recommended for effective organic practice for rose cultivation (Pal, 1972). Depending upon the size of the plant, farmyard manure, compost or activated shudge at the rate of half a basket or one basket per plant per year can be applied for higher production of quality flowers (Pal, 1978). Cow manure @ 8 to 10kg per bush was suggested by Swarup (1992). According to Bhattacharjee and De (2003) the best time for adding organic manure to rose is before planting and at the time of pruning. Generally, 4 to 5kg of organic manure (Cowdung/compost) per bush is quite adequate. Along with manure, 25gm of bone meal is to be added to each plant. A little Chlordane or Aldrin should be mixed with organic manure to prevent attack of white ant.

Soil fungi and bacteria are reduced to small numbers in soils that are dry or deficient in organic matter. An account of animal manures was given by Thomas (1970) and these are stated below. Cow dung is very slowly oxidized and so it effects in soil are lasting. Horse dung is very rich in plant food if obtained from the stall, for it then contains urine and great quantities of straw, and it is so "hot" at this time that it should not be put straight on to garden beds but should be inter layered with soil in a heap and allowed to stand for couple of weeks. Bird-droppings are the richest of all animal manures, and it is improved in quality and safety if stored in a heap, mixed with earth, under cover for a weak or more. Ship dung is rich in N, P and K as compared to horse or cow dung, but usually contains great number of weed seeds. Pig dung is very rich and must be used sparingly, but its offensive odor makes it undesirable in suburban areas. Blood manure is also very rich and quick in action; it should be used as sparingly as chemical fertilizers, with a maximum dressing of about 3oz to the square yard. Bone meal contains a high percentage of phosphorus, but since its is an insoluble form and manural action is slow, it influence extends over many years.

INFLUENCE OF LIQUID ORGANIC MANURE

For better quality exhibition bloom in roses liquid manure is used. It is applied in wet soil in a very diluted form and is followed by further watering. It is applied to rose plant two to three weeks before the exhibition bloom is required. The most common substance used for making liquid organic manure are a) Cowdung either alone or with bird droppings and blood manure b) Bird dropping alone c) Blood or bone manure alone (Thomas, 1970). This manure contains more of the minor plant food elements. As a result of bacterial action these manures became alkaline and give bad odor on keeping. These changes can be slowed down by keeping the barrel cool and dark in shade and covered by a heavy sack. Addition of nitric acid or phosphoric acid neutralizes the alkalinity and reduces the offensive odor. The liquid manure should be kept well stirred. These manures may be applied to the soil at almost any time or after pruning, before flowering or when the rose plants are in early bud stage.

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12

IRRIGATION

Roses needs plenty of water for their optimum growth and flowering but, they do not like water logging. The frequency of watering is dependent upon the water and nature of soil. Sandy soil needs more frequent water than clay soils. Water requirement of rose depends on the plant size and growth period; and the frequency of irrigation depends on stage of growth, soil texture apart from climate and weather. Biswas (1984) suggested that in loamy and alluvial soils of Delhi, rose beds are to be watered once a week, or ten days in winter, and twice a week during summer. In a climate like Bangalore, having red soil, one heavy irrigation at five day's interval is recommended throughout the year expect during rains when this has to be adjusted depending on the rainfall (Randhawa and Mukhopadhyay, 1986). In eastern India where the rainfall is heavy, no irrigation may be required at all during the rainy season. Jagtap (1990) advocated drip irrigation for commercial cultivation of roses in Maharastra for saving water, excellent growth of plants and reduction of weed to a minimum. Laurie and Ries (1950) have not advised sprinkle irrigation as it brings the feeding roots to the surface and cause burning.

An average sized H.T. rose bush might loose through transpiration about 30 gallons of water during the growing period. A well-established Rambler "Dorthy Parkins" may transpire about 100 gallons of water (Allen, 1956). Misting in the greenhouse is beneficial for faster growth of rose plants. Water loss from the plants in the non-cooled green houses is much higher than in the air-cooled green houses. Cooling in the green houses improves the flower and foliage colour and size, while there may be reduction in flower production with the over-cooling. Experiments were also conducted on surface irrigation and automatic injection of water with variable results.

To decrease the nutrient emission from closed nutrient system by using high irrigation rates (approximately 1, 1.9 and 3.8 litre per plant per day) to allow lower EC levels in the presence of accumulated Na and Cl an experiment was carried out by Baas *et. al.*, (2004). No effects of irrigation frequency or interaction with irrigation frequency with growing media or EC were found on production of roses. They have confirmed that NaCl concentrations of 10mM can be tolerated by cut roses provided nutritional elements are not below certain limiting concentration. Cabrera (1997) studied the water use efficiency in roses grown at different nitrogen fertilization and irrigation regimes.

In rose plants high concentration of salts in irrigation water is harmful. For rose production HCO_3^- ion is highly toxic (exceeding 2mg/l) resulting in chlorosis. Electrical conductivity exceeding 1800 μ mhos/cm reduces the yield. Chloride salt in the irrigation

water more than 500 ppm is injurious, causing interveinal chlorosis, marginal burns, tip burn and die back (Yadav *et. al.*, 1989).

The effect of water availability and quality on photosynthesis and productivity of soilless-grown cut roses has been reviewed by Raviv and Blom (2001). Effect of irrigation control, irrigation water quality and the different factors affecting water availability i.e. soil (or medium), water potential, medium porosity, water uptake by roots, transpiration and draught stress were evaluated by them. In *Rosa hybrida* "Kardinal", Oki *et. al.*, (2001) studied an irrigation control system based on soil moisture tension for potted plants, they were able to reduce the amount of water used to produce commercially acceptable plants. The irrigation control system consisted of tensiometers, modified with high flow ceramic tips and pressure transducers, an analogue-digital signal converter, a computer and custom written software. When the system was installed in a commercial greenhouse, water use in the test area was 26% less than the amount applied by the grower. Productivity (stem harvested/m^2) was 66% greater in the test area. The use of irrigation control system can reduce both water and fertilizer usage when a liquid fed programme is utilized.

In *Rosa hybrida* cv. "Madelon" macroscopic observation showed that stem length as well as the time to reach the different stages of development externally was affected by irrigation and shading treatments. Due to irrigation or shading on the first stage of development, acceleration of flower bud appearance was recorded on the flowering shoots under most severe irrigation treatment. Flowering shoot under this treatment, irrespective of shading, reached the stage of flower bud appearance earlier, with a shorter stem length compared to the flowering shoots under the less severe treatment. While observation under the scanning electron microscope of samples originated from the different irrigation and shading treatments, showed that subsequent development was the same under all irrigation and shading treatments. It was concluded that water stress imposed affected only growth and not development (Chimonidon *et. al.*, 2001).

NaCl applied through irrigation water containing 0,5,10,20 and 30mM in *Rosa chinensis* "Major", *R. rubiginosa* and *R. hybrida* cv. "Kardinal". Necrosis on leaves as a result of NaCl treatment was observed after two months in all the three genotypes. The NaCl treatment also decreased the total and root dry matter in all the three genotypes. Increasing the NaCl concentrations led to a significant reduction in the length of cut flowers cv. "Kardinal" (Wahome *et. al.*, 2000).

Recycling water is an excellent way for pathogens dissemination. To avoid potential risks of plant health, the disinfection of irrigation water is an alternative. Studies conducted by Poncet *et. al.*, (2001) demonstrated that an amount of 4mg/l of active chlorine applied over 30 minutes was necessary and sufficient to obtain disinfections of bacteria and no plant health problem was detected in roses after 3 years of operation. Thus, disinfecting with chlorine gas is an excellent preventive method.

Phytomonitoring technology is now being introduced in commercial rose green houses world wide as a new information tool both for detecting physiological disorders in plants and for the fine-tuning irrigation and climate control. Phytomonitoring in "Golden Gate" roses disclosed unexpected water deficit at night time. Then, it helped to

examine the releiving effect of night time watering. Furthermore, the phytomonitor enabled experts to observe directly the favourable effect of root flushing on plant growth (Kopyt *et. al.*, 2001).

Bare-root rose production with underground drip irrigation was studied by Karlik *et. al.*, (2001). Drip-tape burried at 30 cm depth verses 10,20 or 40cm depth resulted in greatest biomass production in *Rosa* "Dr Huey", *Rosa manetti and Rosa* cv. 'Pink Simplicity'.

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13

MULCHING

To keep the rose ground cool and moist and to prevent weed growth, mulching is done specially in hot, dry periods or cool climates. It provides covering to the soil. The covering of any sort of loose organic material which will let water through, such as hay, straw, peat moss, cocoabean hulls, sawdust, wood chips and the likes (Milton, 1962). Mulching protects the rose roots in very hot weather; it prevents the surface of the ground from becoming baked, helps to maintain moisture to soil and stops the growth of weeds. It creates congenial conditions in the soil for the growth of beneficial microbes and earthworms.

The vegetable mulching material like hay, straw, leaves, chaff, lawn chippings, woodchips, sawdust etc. are excellent manure that helps increasing soil humus and provide plant food. Well rotten garden compost, farm yard manure, peat, ground or whole corn cobs are also used as substitutes for mulching.

Thick mulch should be provided right upto the stems of the plants without causing damage by careless application. Preferably 15 cm thick mulching is needed. If the depth of mulch is less, it will not prevent the evaporation of moisture during summer; neither will suppress weeds, which will grow through the mulch. It will also be unable to prevent frost from entering the soil during winter (Roy Genders, 1965).

To maintain optimum soil temperature, conserve soil moisture, suppress weed growth and supply humus material to the growing rose plants, mulching is done. Various materials are generally used in mulching of roses and these are black polyethene film, sawdust, rock wool, well rotten farm compost, farm yard manure, straw, etc. (Bhattacharjee, 1995).

Mango leaf mulches effectively control weeds like *Cyperus rotundas and Cynodon dactylion* in "Happiness" rose beds (Challa and Ravindra, 1999). Straw mulches reduced the weed population and enhanced flower yield in rose (Han *et al,* 2000). The flower yield in roses was significantly higher by rice straw mulch (Singh and Karki, 2005).

Yadav *et al* (1989) reviewed the influence of mulching on roses as carried out by various workers. Soil mulched with ground corn cobs increased organic matter content, reduced nitrate concentration in the soil, reduced oxygen diffusion but better aggregation of soil particles, retained uniform soil temperature and greatly increased the quality and quantity of rose flowers. Reduction in nitrate and oxygen supply was, however only a temporary effect and the growth of mulched plants were reduced during the first few months, but thereafter the growth was much better in roses. They have also reviewed

that straw mulch in rose beds improved the soil moisture regime, reduced soil compactness, protected the root system of the bushes, provided shoot growth, increased flowering and reduced labour requirement for weeding. Among the mulching substitutes, sawdust controlled weeds better than rock wool and pine straw in rose plots. Improvement in growth and flowering was reported in roses by mulching along plant rows with polyethene film. According to Grice (1969), peat is ideal for mulching and for this purpose; peat should be first broken, thoroughly soaked and spread 2.5cm thick over the whole rose bed. Norman (1958) advocated the mulching of rose beds with peat or grass mowings for keeping the disease in check. The disadvantage with the use of grass mowing is that if annual medow grass is one of the constituents of the lawn, a great deal of trouble is given by seeds of this grass growing in beds. On the other hand, peat has the effect of keeping weed down and at the same time gives a pleasant appearance in the beds.

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14

WEED CONTROL

Control of weed in rose field is one of the most expensive operations in commercial cultivation. Hand weeding is normally taken recourse to keep the rose plant free from weed competition. Hand weeding is laborious, time consuming and expensive, if not properly done damages the plant and root system. The use of herbicides appears to be economical, convenient and efficient in controlling weeds in the rose field.

In a trial on *Rosa hybrida* cv. "Happiness" Rajamani *et.al.*, (1992) recorded better control of monocot weeds with Glyphosate 1.0kg a.i/ha and dicot weeds with oxyfluorfen 0.5 kg a.i/ha. These herbicides, however, neither affected flower yield nor showed any phytotoxic effect on rose plants. Among the trials conducted on weed control in "Super Star" roses, Diuron 2.0 Kg a.i/ha or Oxyfluorfen 0.5kg a.i./ha + Glyphosate 1.0kg a.i./ha were found better in controlling weeds, without any phytotoxic effects on the yield of roses (Yaduraju *et. al.*, 1997).

Among the four herbicides used by Sudhakara *et.al.*,(2002) in roses, Glyphosate at 1.0kg a.i./ha gave excellent control of weeds, subsequently resulting in higher flower yield. Oxyfluorfen at 0.1kg a.i./ha was at par with Glyphosate. Atrazine (1.0kg/ha) and Pendimethalin (1kg/ha) gave moderate weed control and flower yields which were significantly higher than unweeded control. Hand weeding was superior to herbicides both in controlling the weeds and influencing the flower yield in roses. Unweeded control lowered the flower yield by 60%. Bernard (2001) stated that there are opportunities through which culture and chemical control methods can be integrated for a most holistic weed management strategy. Mukesh *et. al.*, (2002) observed that Stomp 30EC at 3.75 litre/ha was most effective herbicide treatment for controlling weed populations in rose cv. "Mirandy".

Herbicides are generally used either as a pre-plant or pre-emergence of weeds after the roses are planted or post-emergence to established weeds. Application of CMU, N' (4chlorophenyl-N, N-dimethyl Urea), DCMU, N' [(3,4-dichlorophenyl) N, N-dimethyl urea] 4 to 5 weeks after planting in late December and early January controlled all weeds. Various mixtures of relatively non-toxic Kerosene with aromatic oil and with dinitro-butyl-phenol were also tested. All formulations were effective against weed and were more or less toxic to roses. The kerosene dinitro formulations were rather more selective than the soil mixtures. Endothal controlled all weeds except *Chenopodium* spp (Day and Russel, 1954), with Na salt of 2,4-D, 25-30 days before flowering effectively controlled broad leaved weeds in essential oil bearing rose plants sprayed at the rate of 2kg per 600litre per hectare (Salimov and Mincov, 1963). Simazine (1.0kg/ha) and Cyanazine (1.5kg/ha), Ustinex Z

(Methabenzthiazuron+diuron) effectively controlled weeds in H.T. and Polyantha roses. Selection of cheap, easily available and effective chemicals, dose, time and method of applications and phytotoxicity are also important consideration for use of herbicides in rose field (Yadav *et.al.*,1989).

The efficacy of various weed control strategies in reducing the weed intensity and increasing the nutrient status in leaves of five year old H.T.rose cv. "Mirandy" was evaluated by Jose *et. al.*, (2001). Highest nitrogen content was observed in the rose plants treated pre-emergence application of Pendimethalin 30 EC (1.50 l/acre) and post emergence treatment of Bentazone (2.00 l/acre) because of the significant control of weed population by these treatments. All treatments with Pendimethalin, Fluchloralin, Glyphosate and Bentazone increased phosphorus content of leaves when compared with control. Highest potassium content was observed with Pendimethalin and Bentazone.

Gonzalez and Karlik (1999) studied injury of rose plant cv. "Summer Dream", when herbicides were sprayed over-the-top at two stages of growth: bud break and full leaf and evaluated the efficacy of the herbicides. The soil residual pre-emergent herbicides Devrinol (napropamide) Goal (Oxyfluorfen) and Dinitroaniline herbicides Surflan (Oryzalin), Treflan (trifluralin) and Prowl (pendimethalin) did no injury to roses when applied at bud break. The herbicides Ornamec (fluazifop-p-butyl), Poast (sethoxydim) and Envoy (Clethodim), which have post-emergent activity, also did not injury roses when applied to roses at bud break or applied in late spring when plants had fully developed leaves. Roses over sprayed at bud break with herbicides Roundup (Glyphosate) and Trimec Classic (2,4-D + MCPA +Dicamba) did not show phytotoxicity symptoms immediately after application, but had significantly shorter shoots beginning six weeks after treatment (WAT). Roses with fully developed leaves which were over sprayed with Roundup and Trimac Classic did show symptoms of injury one WAT and thereafter.

According to Leela (1995) most predominant monocot that occurs in roses under Bangalore conditions are *Cyperus rotandus, C. iria, Digitaria marginata, Setaria spp.* and *Chloris barbata;* while dicots are *Portulaca oleracea, Acanthospermum hispidum, Gomphrena decumbens, Lagasca mollis* and *Euphorbia sp.* Removal of weeds on regular basis and thick mulching is suggested for control. Thomas (1970) advocated adequate thick mulching. Peterson *et. al.*,(1979) observed that saw dust controlled weeds better than bark, rock wool and pine straw mulch. Chemical control of weed is also very effective. Good control of *Lollium sp* of weeds was observed by Ross (1962) with Diuron and Simazine at 2.0 kg a.i./ha as pre emergent treatment in roses. Ewan (1966a and 1966b) confirmed the beneficial effect of Simazine (1.0 to 2.0 kg a.i./ha) in controlling weeds in "Super Star" roses. Satisfactory control of the weed *Agropyron repens* and other grasses by Isocil at 2.0 kg a.i./ha as pre-emergent spray was observed by Kemperman (1969). Simazine 0.2% as pre-emergent treatment in export varieties of roses effectively controlled broad spectrum of annual and perennial weeds; while addition of 2,4-D to Simazine or Dalapon proved synergistic and extended the spectrum of activity of *Cyperus rotandus* (Khosla, 1978).

In *Rosa canina* "Schmid's Ideal" the herbicides like Bladex 500 SC (Cyanazine), Acer 25 EC (Flurochloridone), Arelon 50 (Isoproturon), Butisan 500 SC (Metazachlor), Ronstar 25 EC (Oxadiazon) and Goal 240 EC (Oxyfluorfen) were applied in spring after root stalk

planting but before bud emergence; and it was observed by Gabarkiewicz (1997) that all herbicides were suitable for use in *Rosa canina.*

For grass weed control in rose field 2.0 liters Fluazifop-butyl was found best; treatment combination of 0.75 liters Fomesafen/ha + 1.5 liter Fluazifop-butyl gave good control of broad leaved weeds like *Rumex sp., Plantago sp., Artemisia vulgaris* and *Capsella bursa-pastoris* as well as the monocotyledonous species like *Digitaria sp.* and *Setaria sp.* (Botta and Prando, 1988).

Poa annua is in grafted rose field can be controlled by Propyzamide at 1.25 to 1.5 kg/ha (Himme *et. al.,* 1988). The herbicides like Oxyfluorfen or Oxadiazon was very effective in controlling *Convolvulus sp.* in the rose field without any undesirable effect on yield (Brosh *et. al.,* 1985).

In *Rosa laxa* (*R. cariifolia* cv. "Froebelii") the herbicides Simazine (625g/ha) + Propyzamide (1,000g/ha) gave best control of most weeds (M.G.D., 1983). Terbacil at 2.0 kg/ha and Caragard-combi at 15 lit./ha gave the best weed control in 5 years old essential oil yielding rose plantation on meadow soil; but the treatment reduced the essential oil content of the flowers as well as yield of flowers (Georgieva and Kazakova, 1982).

Weed control is generally achieved by hand weeding or frequent use of hoe. There is no complete substitute for these methods of weed control. However, with suitable chemical herbicides as enumerated above, it is now possible to supplement the traditional methods. The chemicals must control a range of weeds, must not damage rose crops, must not be poisonous either to the operator or animals, must not leave harmful residues, over and above must not pollute our living environment.

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15

GROWING ROSES IN POTS

There is tremendous pressure on the land in cities and towns. The rose growers are required to adjust themselves to the fast growing changes out of the scarcity of land. A large population in the cities stay in multi-storied buildings where there is no scope for growing anything on the ground. Hence, gardening must be restricted to growing plants in pots. Best quality roses can also be grown in pots, and these plants may be enjoyed where there is no garden in which to grow them. Roses in pots may be used in paved courtyard, trellies or lath frames, walls of small courtyard, screens, roof of the house, balcony, and also for hiding unsightly bricks, dust bin or out houses. According to specific situations and purposes, it is possible to grow all types of roses in various types of containers. It is easy to protect the pot roses from hot and cold blast of wind, water logging, insect pests and diseases. Moreover according to the need, the plants can be shifted from one place to the other. There is no denying of the fact that pot roses have advantages and potential which offer great scope for creativity and enjoyment.

CONTAINERS

The pots should be large enough to allow growing room and to ensure adequate water holding capacity. Many types of containers are made of wood, earthen pots, cement tubs, plastic and fibre glass pots, metal, stone etc. Size and shape of the container depends on the types of roses to be planted and their placement in the gardening space. Ordinary red clay pots are very ideal, natural colour of these pots blend well in gardens and patio. Plasting pots are lighter than clay, and are available in an assortment of colours. Painted tin cans are also attractive and suitable for this purpose. Metallic drums or cans may be given protective inside coating with anti-corrosive bituminous paints. Red wood tubs, wooden boxes and brick or concrete tubs can also be used. Red wood and cedar tubs in many sizes and shapes make marvelous containers. Plain earthen flower pots are easily available and are best for planting roses, since these are porous in nature, hold water for longer time and do not become very hot during summer. In big cities and towns cement tubs of various sizes and shapes are found and may be used for this purpose. Some types of roses can be grown in hanging boxes or baskets.

For planting shrub roses, standard roses and climbing roses the suitable size of the pots will be 60 cm in diameter and about 45 cm in height. While for Hybrid Tea and Floribunda roses 45 cm x 30 cm will be proper. Miniature roses can be planted in a post measuring 30 cm in diameter and 30 cm in height. Miniatures may be planted in 10 cm pots even. It should be kept in mind that larger pots will encourage vigorous growth of

all types of roses. Large pots, however, create problems for shifting, rearrangement and repotting. For outflow of drainage water and thorough percolation the drainage holes at the bottom of each pot is essential. Ample drainage is important, and larger sized tubs should have more holes in the base.

CULTIVARS

There are large number of rose cultivars which have proved themselves to be highly suitable for growing in pots. Growers have their own choice for the selection of varieties in their garden. Before making selection one must look into the character of the plant and the flower.

According to Genders (1965), the roses to be used for tub culture should be dwarf, compact in habit, so that 3 to 4 plants may be grown to a large tub. Floribundas may be recommended for tub culture, particularly those which are tolerant to adverse weather and will remain in bloom over a prolong period. He has suggested following cultivars which are highly suitable for growing in tubs:

Hybrid Teas: "Aida", "Chrysler Imperial", "Crimson Glory", "Doreen", "Gertrude Gregory" "Lady Belper", "Manitou", "Melrose", "Piccadilly", "Picture", "Shot Silk" and "Wendy Cussons."

Floribundas: "All gold", "Ame", "Anna Wheatcroft", "Border Coral", "Dickson's Flame", "Evelyn Fison", "Fashion", "Hit Parade", "Meteor Paddy Mc Gredy", "Rumba" and "Woburn Abby".

Norman (1958) was of the view that provided space is allowed, some of Rambler roses could be grown with good effect. He has a choice for "Paul's Scarlet", "Lady Godiva", "Excelsa", "American Pillar", "New Dawn" and "Sander's White" for growing in tubs out of the Rambler roses.

For roof gardens in Kolkata of West Bengal, Bhunia (1994) suggested following cultivars:

Hybrid Teas

Red: "Bimboro", "Ace of Hearts", "Kentucky", "Derby", "Christian Dior", "Toro", and "Mainu Parle."

Black: "Nigrette" and "Black Pearl"

Pink: "Peter Frankenfeld", "Cynthia", "Jadis", "Jouvencelle", "Jimmy Greaves", "Mrinalini" and "Admira Rodney."

White: "Chablis", "J.F. Kennedy", "White Lighting" and "Lousiana."

Yellow: "Yellow Priscilla", "Pfalzar Gold", "Seiko", "Golden Medallion" and "Gold Medal."

Bicolour: "Princes de Monaco", "Double Delight", "Eco", and "Flaming Beauty."

Striped: "Tata centenary", "Sidhartha", "Sahasradhara", and "Calcutta 300."

Mauve: "Paradise" and "Lady X"

Scented roses: "Granadia", "Double Delight" "Admiral Rodney", "Sweet Surrender" and "Snow White."

Floribundas: "Summer Snow", "Ahalya", Judy Garland" "Zorina", "First Edition", "Tiara", "Shocking Blue".

Miniatures: "My Valentine", "DonDon", "Cuddles", "Dream", "Chandrika", "Strawberry Swirl", and "Star and Stripes".

Polyanthas: "Veterlag", "Chattilion Rose" and "Flamboyant".

Mukhopadhyay (1990) emphasised that the rose lovers should have some practical experience of growing roses, before he can choose the right cultivar for a particular climatic zone. He recommended following cultivars for growing in containers:

Hybrid Teas:

Red and Red Shades: "Alac's Red", "Ena Harkness", "Fragrant Cloud" and "Red Devil".

Shades of Pink: "Bonsoir", "Michele Meilland" and "Pink Favourite".

White, off White: "June Bride" and "Memoriam"

Yellow and Yellow flushed pink: "Flaming Sunset" "Grandpa Dickson" "Kings Ramson" and "Mc Greedy's Sunset".

Apricot and Orange: "Fred Gibson" and "Vienna Charm".

Coral: "Montezuma"

Vermillion: "Super Star"

Bicolour: "Caprice"

Novelty: "Careless Love"

Floribundas: "All Gold", "Ascot", "Banjaran", "Delhi Princes", "Flamenco", "Ice berg", "Rumba" and "Zambra".

Besides the above cultivars many of the Polyantha roses and most of the miniatures could be grown in containers. Standards and Half-Standards with adequate staking can be grown in large sized containers.

According to Pal (1966) the cultivars of roses are best for potting which do not grow tall, which grow and branch rather uniformly in all directions and which bloom profusely. All varieties of Miniature are suitable, and incidentally climbing Miniature are also available and these too can be cultivated in pots. He has recommended following cultivars of roses for pot culture.

Hybrid Teas: "Mc Gredy's Sunset", "Fleming Sunset", "Margaret Spaull", "Montezuma", "Caprice", "Nigrette", "Picture" and "June Bride".

Floribundas: "Iceberg", "Rumba", "All gold", "Gold Marie", "Masquerade", "Gertrude Westphal", "Fusilier" and "Flamenco".

Biswas (1984) was of the view that for Hybrid Teas, the choice is limited, in the sense that one should gainfully choose those varieties in which the plants are floriferous

as well as dwarf, erect, upright and compact in growth character, but not robust or too tall. Colour and shade of flower is another consideration. He had suggested some varieties as a guidance for the beginners and these are as follows:

Hybrid Teas: "Buccaneer", "Careless Love", "Christian Dior", "Confidence", "Dr. Valois", "First Prize", "Flamming Sunset", "Ganga", "Gulzar", "Kanakangi", "Lady Frost", "Michele Meilland", "Montezuma", "Picture", "Poornima", "Srinivasa", "Surabhi" and "Surekha".

Floribundas: "Arunima", "Banjaran", "Charleston", "Chitchor", "Delhi Princes", "Flamenco", "Frolic", "Iceberg" "Mohini", "Nav Sadabahar", "Neelambari", "Orange sensation", "Prulude", "Prema", "Princes Michiko", "Rumba", "Rupali", "Sadabahar", "Shabnam", "Shola", "Shringar", "Suchitra", "Tikki", and "Zorina".

Polianthas: "Anjani", "Chattilion Rose", "Echo", "Priti", "Rasmi", "Swati" and "Vatertag".

Miniatures: "Angel Rippon", "Body Masquerade", "Canady Cane", "Chandrika", "Chipper", "Cindrella", "Cri Cri", "Dark Beauty", "Dazzler", "Dazzling Flame", "Dwarf King", "Fine Princes", "Glorigo", "Green Ice", "Janne", "Little Buckaro", "Little Flirt", "Mary Marshall", "Pixie", "Pushkala", and "Rosmarin".

Climbers: "Cocktail", "Joseph's Coat", "Prosperity".

POTTING MIXTURE

Success of pot rose growing largely depends on the potting mixture. The mixture may vary on place to other. The best pH for the potting mixture is in between 6 to 7, slightly on the acid side. There is need to correct alkalinity by adding little iron sulphate or iron chelate. If the soil is used as media, clay loam soil is the best. While collecting soil, the surface soil upto about 15 cm depth is good. From the soil brick pieces, gravel, concretes and pebbles are to be removed and sieved soil is better. Only the soil of best quality should be used. The rose plants cannot tolerate water stagnation. The potting mixture consists of three parts of such soil; one part each well rotten manure, leaf mould and wood ash is good. Generally the soil mixed with white sand and compost improve the porosily. In the potting mixture bone meal, castor cake or any other oil cake; and the chemical fertilizer like urea, single superphosphate and muriate of potash can also be added in little quantity. Small amount of broken charcoal may also be added to maintain a sweet condition in the media. The ingredients should be mixed thoroughly.

Genders (1965) suggested the pot compost consisting of 2 parts fibrous turf loam, preferably sterilized, 1 part decayed cow manure or old mushroom-bed compost, and 1 part coarse sand or grit.

For miniature roses Moore (1966) recommended a potting mixture by volume of 1 part sterilized soil, 1 part peat moss and 1 part perlite (sand may be substituted). To this a small amount of fish emulsion, steer manure or other fertilizer. These are to be moistered and mixed thoroughly.

Soilless rose culture with cinder, gravel, soilrite (a perlite product), Badarpur sand, common river sand, burnt coal ash etc. are gaining popularity.

Swami Vinayananda (2002) has enumerated soilless flower pot rose culture. The advantages of soilless culture are that the same aggregate can be satisfactorily used year after year, there is no wastage of water and fertilizer and entire quantity is utilised by the plant, soil borne fungal diseases are practically nil, there is no possibility of water logging, change of aggregate every year is not essential, and lastly the flower pots do not pose a problem in terms of weight if a light aggregate is used. In the aggregate that is soil rite or Badarpur sand a fertilizer solution of 3 gm ammonium sulphate, 1 gm di-ammonium phosphate, and 1 gm muriate of potash can the added by dissolving in 2 litres of water. Newly planted or transplanted plants need light fertilisation, the 5 gm fertilizer mixture of the above can be dissolved in 4 litre of water in order to make the light solution. The above fertilizer solution of 1 litre may be applied for 6 days in a week. For every 7th day a different fertilizer solution must be applied as normal watering containing 2 gm magnesium sulphate, 1 gm ferrous sulphate and 1 gm Tracel (a micronutrient mixture) dissolving in 2 litres of water. Application method of the above fertilizer mixtures suggested by him is to apply the liquid in 2 parts; the 2nd application to follow after about 15 minutes, this is in order to make an aggregate absorb this quantity of the liquid.

PLANTING IN POTS

Good drainage of water in the pot plants is important. Extra drainage must be provided by placing gravels or bits of broken pots in the bottom of container. Earthen pots are to be soaked in water thoroughly before use and are to be cleaned thoroughly, sterilization of pots will, however, be better. Depending on the size of the container about 5 to 7 cm layer clean broken pots, pebbles, charcoal pieces and stones are to be placed at the bottom of each pot. The compost mixture or pot mixture prepared earlier must be filled in simultaneously along with the plants. The plant is to be kept at the centre of the pot. The filled in pot mixture should be 2 to 3 cm below the rim of the pot. The bud union is to be kept little above the rim of the pot. Adequate care must be taken while planting the plants. A healthy plant with well balanced root system must be chosen for planting. Whenever necessary cleaning, trimming of roots and light pruning of plants may be done. The potting mixture should be just moist but not wet. After planting, pots are to be shifted to a shady place. These plants are then to be watered with watering can, the water is to be poured upto the rim first and wait. Just after planting, the pot mixture will absorb plenty of water, hence, the process of watering by watering can to be repeated till the water stands on the surface of the pot at least for a short time. Thereafter the water will start flowing out through the drainage hole. Depending upon the weather condition and the condition of soil in the pot, watering may be continued at a suitable interval for 3 to 4 days.

Environment

Soon after established of newly potted plants in the shaded location, these are to be shifted without much delay to a sunny location. Roses require plenty of sunshine and air for good growth and flowering.

Watering

Roses require adequate amount of water, however, careful and regulated watering is most important. Water logging and over watering create problem for the average rose growers. Depending of the size of the pot, pot compost, cultivar and weather condition frequency of watering is determined. It must be kept in mind while watering, the soil is to be kept moist but never soggy. Occasionally, the top soil may be allowed to become slightly dry, then water thoroughly. Hoeing is also essential for aeration and it helps in retaining moisture. Between two watering the surface of compost should be hoed, while taking care not to disturb the soil more than one cm deep.

Fertilizer and Manure

Bhunia (1994) recommended old decomposed cow dung, bone meal and horn dust for pot roses as solid feed. Liquid manure prepared from cow dung and 5 days old decomposed oil cake is to be applied once in a week in the season. He has also recommended potassium nitrate and urea (1:1) as foliar spray, mixing 2 tea spoonful in 5 litres of water. Biswas (1984) was of the view that foliar spray with urea (0.2%) along with spreader (soap flakes, det/surf) at fortnighty interval on both sides of the leaves will enhance good growth. This foliar spray, however, should not be given, when the flower buds have started opening. Where liquid manure is used care should be taken to see that this is done after watering.

Transplanting

Pal (1966) suggested that it is desirable every year to remove the top 7.5 cm layer of the soil and add well rotten manure. A pinch of ammonium sulphate is a good tonic, after pruning when new growth has began. He has also suggested that after two to three years, the plants are to be transplanted or better still, start with fresh plants. Repotting should preferably be done by the middle October at the time of pruning.

Pruning

Hard pruning is not suitable for Kolkata, Climate, specially for pot roses. After light pruning it takes about 35 to 50 days to bloom (Bunia, 1994). The principal of pruning the pot roses is the same as that of ground bed roses. The only difference being that the pot roses are to be kept dwarf and hence the pruning has to be harder. While pruning about 3 to 4 good branches are retained and those are pruned to 2 eyes from the point of origin of the new shoot to keep them dwarf. Some cultivars, however, can not withstand hard pruning. In case of miniature roses, just after flowering, the plant tops are lightly sheared to ensure a more compact plant for the next bloom. Sheared plants bloom again in 5 to 6 weeks, depending on the variety and time of the year. Pinching and trimming plants at any time to induce branches or to delay bloom can also be done (Moore, 1966).

Management

Removal of suckers, weeding, spraying of insecticides and fungicides whenever needed, staking of plants, and rotating the pots in a semi-circle to bring the rear side of the plant to the front once in a fortnight are some of the cultural requirements of pot

plants. To get large bloom disbudding is practiced. Removal of faded flowers and spent blooms also increase the vigour of the plant.

Summer Season Care

Pot plants are to be removed to a partially shaded place. One must give adequate water to all potted plants every day. Spraying of water is suggested in the warm evening to keep the foliage clean and also helping the growth considerably. There is no need to apply any fertilizer during summer. Timely removal of suckers, and faded flower, and weeding must be continued. The plants are also to be protected from strong hot wind.

Rainy Season Care

Pot plants are to be irrigated only when there is need for water. Control of weed, and pests and diseases, removal of suckers and faded flowers will be necessary. Careful attention should be given to the drainage holes in the pots which are covered with pieces of tiles.

DWARFING OF POT PLANTS

Growth retarding chemicals can be used for dwarfing of different types and varieties of roses. These chemicals can be very conveniently introduced to restrict plants from out growing their space in a particular design. Rose pot plants in tropical countries, and also under greenhouse cultivation of various climatic conditions often tend to become leggy. Along will all improved cultural practices the use of growth retardants may be recommended to grow attractive pot plants within a very short span of time. This quick and easy change in growth and flowering behaviour will definitely create great interest among rose growers (Bhattacharjee, 1975). This has been discussed in the chapter on "Growth Regulating Chemicals."

DISPLAY OF POT PLANTS

An attractive display of pot roses in the gardens and in various corners of the house will further enhance the beauty of these plants. The pot roses can be arranged according to the types, height, growth and flowering hibits. In roses climbers, ramblers, tall shrubs, intermediate, dwarf and creeping types are available with very many attractive colours, fragrance, shapes and sizes. All these are to be used in creating attractive designs. Apart from roses other pot plants can also be introduced along with pot ross. Several other matching climbers, creepers, flowering shrubs, seasonal flowers and bulbous ornamentals can be judiciously introduced along with pot roses to make year round attractive display. The centre of attraction, of course, will be the roses; other lovely plants will provide colour, attractive pattern and form. Hence, the pot yard or court yard will remain interesting throughout the year even during the off season for the roses.

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16

GREENHOUSE CULTIVATION

Growing international demand for superior quality rose cut flowers in huge quantities throughout the year, and tough competition among the exporters to capture the market necessitated cultivation of roses under protected and controlled environment. According to Dalrymple (1973) a green house is a framed or inflated structure covered with a transparent or a translucent material such that crops could be grown in it under at least partially controlled environmental conditions and which is large enough to permit a person to enter into it to carry out cultural practices. Until the development of plastic films in the 1950s, glass had been the most popular covering material for green houses. Therefore, green houses were generally called glass houses. However, the widespread usage of plastic films and sheets for greenhouse glazing gave rise to such terms as polyhouses, polycarbonate house and fiberglass house. All these plant-growing structures are essentially green houses (Chandra and Gupta, 2006) Microclimate control facilitated maximum crop productivity per unit area; marked improvement in quality of produce free from insect pests diseases and chemical residues and raising of plants anywhere at any time of the year to meet the market demand year round.

William Stevens, a Lea Valley nursery man of England in 1883 first conceived the growing of bush roses in beds in a heated green house on a commercial scale. The first varieties planted in heated green house were Tea roses, "Catherine Mermet" (pink) and "Perledes Jardins" (yellow) to be followed by most beautiful rose "Madame Abel Chatenay" a fragrant deep pink rose. However the variety "Ophela" a wonderful rose of bright salmon pink colour, beautifully shaped, borne on long thornless stems from William Paul in 1912, revolutionized rose growing under glass and quickly become famous for its ability to withstand forcing (Genders, 1965). Discovery of transparent plastic triggered a new phase of green house development after the second world war. More than 90 percent of all new green houses, constructed in the world now use plastic films and sheets as glazing material (Chandra and Gupta, 2006).

SITE SELECTION

Green house should be located in a place which is fairly shadow free, and where sufficient good quality water is available. A well drained area, with wind breaks on all sides free from industrial pollution will be ideal. Availability of sufficient space for further expansion of the facility in future, good motorable road, nearness to the market, electricity and communication facilities connecting with telephone, telex and fax etc must be considered while choosing the site. Selection of site with congenial climatic conditions

for roses to avoid energy cost for heating and cooling will be more economical. In mild climate energy requirements will be lower than at places with extreme climates. For green house operation labourers required throughout the year, hence for big green house complex availability of labourers will be another important consideration.

ORIENTATION

While constructing the greenhouses light levels and prevailing winds are to be considered critically. Plants in the green house must get adequate and uniform light, throughout the year, especially during winter (Nelson, 1985). Moreover, prevailing winds should not adversely affect either the structure or the operation of the facility.

According to Chandra and Gupta (2006) green houses could be located on hill slopes. In Northern Hemisphere, a green house should be located on the south facing slopes for better illumination and protection from northern winds. For availability of sunlight in winter the east-west orientation of free standing greenhouses is better as compared to north-south orientation. The advantage keeps increasing as we move away from the equator.

For areas located above 40^0N latitude, a free standing green house should be built east to West, whereas for areas situated below 40^0N latitude, the ridge of the free standing green house should have a north to south orientation. But for all latitudes, the multi-span green houses should be constructed north to south to avoid the shadow of the structural components. The shadow traverse the floor during the day if the gullers are oriented in the north to south direction, and the production in the specific areas does not suffer. If the orientation of the multi-span green house is in the east to west direction, the shadow persists in some areas, which leads to loss of production in shaded areas (Mukherjee, 1994). While constructing the green house, care should be taken regarding the proper slope of the roof for maximum utilisation of solar radiation (Pallara, 1984) and also to eliminate dripping inside the greenhouse (Sempio, 1986).

Green house orientation should also depend on wind direction of a particular location. In a naturally ventilated green house, the ventilators should open on the lee ward side. A free standing green house should have its long axis perpendicular to the wind direction (Chandra, 1995).

GREEN HOUSE DESIGN, FRAME AND CLADDING MATERIALS

There are different architectural forms of green houses like quonset, modified quonset or elliptical, gothic arch, mansard roof, gable even span, gable uneven span and multi span. The types of cladding materials used are glass, plastic, polyethylene, polyvinyl, fluoride, polyester, fibre glass reinforced panels, acrylic panels and polycarbonate panels. For fabricating the structure of green houses, the most commonly used materials are wood, steel and aluminum. Due to scarcity of wood, prefabricated steel structure of galvanised steel or zinc coated pipes, or aluminium pipes, angles, channels and T-sections are preferred.

The major consideration in the design of the green house has been the design of the shape of the roof. These designs are more convenient for plastic roofs than glass cover. The design should be such that the angle of incidence of solar radiation is never greater

than 40 degrees. The structural design of the green house must provide safety from wind and snow damage, while permitting maximum light transmission to the rose crops. The various loads should be considered to produce structurally sound and economically useful green houses (Jadhav *et. al.,* 2006).

GREEN HOUSE STRUCTURE FOR GROWING ROSES

Generally Quonset type of green houses are constructed. The standard size is 30 m x 40 m with a height of 4 m in the centre and 2.27 m on the side. The roof is made in semi-round shape for easy drainage of rain water. Galvanised iron tubes or square steel tubes are used for the main frame. The covering material most commonly used is UV stabilised polyethelene. The durability of this covering material is however, only two years with light transmission capacity 90 per cent and heat transmission 70 per cent. While other covering material like polycarbonate or double strength glass have light transmission, capacity 90 per cent, heat transmission 5 per cent, durability of which is 50 years and maintenance cost is low. Fibre glass or tedlar coated fibre glass can also be used with relative advantage over UV stabilised polyethylene. Green houses are fitted with fan and pad, exhaust fan, vent opening, fogging, etc. Best covering materials are those which are resistant to ultraviolet and infra-red radiation, wind, discoloration and cracking, with the capacity of maximum transmission of light, low transmission of heat; reduced condensation build up for improved sunlight transmission and high durability which resists tears, punctures and photo-degradation. The enclosed structure of green houses generally retain heat load, and the temperature rises inside. To reduce the temperature, enough vertilation is to be provided and maximum air movement is to be created inside the green house. For maintaining temperature, other methods of cooling adopted are top ventilation through ridge vent, fan and pad system and fogging (Bhattacharjee and De, 2003).

GREEN HOUSE ENVIRONMENT

The green house should provide good light throughout the year, and a temperature range between 15 to 28°C. The night temperature should be between 15 to 18°C, and the day temperature should not exceed 30°C in any case. The growth is slowed down with the fall of temperature below 15°C. If the temperature rises above 28°C, humidity must be kept high. Higher night temperature above 15°C hastens flower development, while lower temperature around 13.5°C delays it. With higher growing temperature above 28°C, quality of flower is adversely affected. During winter months, supplementary lighting is beneficial to improve the quality of cut flowers. Vegetative growth, yield and quality of flowers can also be improved with the introduction of supplementary carbon dioxide upto 1000 ppm. Beneficial responses of CO_2 enrichment, however, depends on proper temperature and light management. Excessive variation of temperature and humidity can cause a high incidence of either powdery mildew in the heat or downy mildew in the cold and wet periods (Bhattacharjee and De, 2003).

Kittas *et. al.,* (2000) suggested that greenhouse roof shading could be avoided under dry climates, because the evaporative cooling process is sufficient to prevent over heating. A simple model, is presented by Dayan *et. al.,* (2002) based on energy and mass balances

at several zones of the green house and, which enables the prediction of the ventilation within commercial greenhouse containtaining rose plants. They have started that by employing intelligent control methods, the model can be utilised efficiently to modify irrigation, CO_2 enrichment and manage energy within the green house.

Kittas *et. al.*, (2001) studied the influence of green house ventilation regime on the micro climate and energy partitioning of a rose canopy during summer conditions. The results indicated the forced ventilation induced a more homogenous vertical field of temperature and humidity by providing a more intensive mixing of the inside atmosphere. It appeared that forced ventilation increased significantly the aerodynamic conductance, but did not influence significantly water consumption when compared to natural ventilation because of the negative feedback between canopy - to - air vapour pressure deficit and stomatal conductance.

Rose plants absorb most of the solar radiation entering the greenhouse. In well-irrigated vigorously growing crop, high transpiration rates during morning and mid-day hours dissipate a large proportion of the absorbed radiation as latent heat. The remaining radiation heats the crop and air. During afternoon, with a similar load of absorbed radiation and higher outside air temperature and wind velocity, the crop transpires less than during the morning, yet it still cools incoming air. Analysis of decoupling coefficients shows that greenhouse plants are more decoupled from ambient climate during morning and noon periods than during afternoons. In decoupled systems, transpiration depends mainly on radiation; canopy resistance and ambient humidity have only a secondary effect. During afternoons, higher wind velocity and lower transpiration rates increase the coupling of the crop to ambient air, resulting in the observed cooling (Dayan *et. al.*,, 2001).

Rose flowers produced in greenhouses during the Israeli summer are of poor quality, due presumably to the high temperature and low air humidity obtained with natural ventilation. It has been observed that cooling treatments hardly reduced average temperatures of air, plant, or flower. Due to morphology, the plant absorbed most of the radiant energy entering the green house, and most of it was removed as latent heat. In comparison to natural ventilation, the commercial cooling methods produced limited additional cooling because each of them reduced the transpiration rates (Dayan *et. al.*,, 2000).

The effect of different air humidity levels on growth, keeping quality, water loss and nutrient concentration of rose cv. "Souvenir" was studied by Mortensen and Gisterod (2000). The effect of raising the relative humidity (RH) from 67 to 94 per cent was in increase in shoot length, leaf size and shoot fresh weight. Roses produced at high RH had a much shorter vase life. Plants grown at high humidity levels had a lower water consumption. No differences was observed in the concentrations of N, P and K of flowers, pedundes and leaves of rose shoots that had been grown at high RH and of those grown at low RH. High RH, however, developed bent nect, brittle leaves and short vase life. Low RH gave long vase life. The concentration of Ca and Mg in the flowers, and Mg in the peduncles were lower in roses produced at high RH compared with low RH.

Mortensen *et. al.*, (2001) also studied the effect of relative humidity (RH) and lighting period (LP) on post harvest keeping quality of cut roses. The 14 cultivars responded very differently to high RH. Vase life of "Frisco" "Golden Gate", "Dream" and "Kardinal" were

moderately reduced; while that of "Orange Unique", "Miracle", "Prophyta" and "Amadeus" was markedly reduced by an increase in RH from 75 to 91 percent with a LP of 18 h/day. The vase life of many of the 14 cultivars was negatively affected by increasing LP from 18 to 24 h/day at 75 per cent RH. Generally the cultivars which were sensitive to high RH were also sensitive to the increase in LP. Long vase life was generally associated with roses from green houses maintained at below 80 per cent RH and a LP of 20 to 21 h/day.

Some cultivars can be grown under low light intensity for which proper screening of cultivars by photosynthetic features, will be useful. On the basis of practical experience, "Grand Prix" rose cultivar is known to be more suitable to low light conditions. At low light intensity "Grand Prix" possesses higher photosynthetic rates, higher chlorophyll contents and higher biomass production than the other cultivar like "Tineke" which require high light intensity (Sevelius *et. al.*, 2001). The effect of CO_2 enrichment on green house CO_2 level and different light intensities on greenhouse grown roses were studied by Pae and Raukas (2004). The addition of pure carbon dioxide increased CO_2 concentration in the Roos greenhouse up to 700 ppm, while at Marga rose farm (control), the concentration dropped below 350 ppm. Photosynthesis light curve analysis showed that cultivar "Frisco" would require higher photosynthetic photon flux than cultivar "Sacha."

GROWING MEDIA

The media for growing roses under polyhouses may be soil, sand, cocopeat and rockwool. The soil-less cultures have less disease incidence and good drainage. With these media very accurate monitoring is needed by which 10 per cent more yield may be obtained. With soil-less culture recycling of irrigation water is possible; this in turn, helps checking run off into the ground that pollute the ground water nitrate. The root temperature should be maintained around 22 to 23°C and soil pH between 6 to 6.5. The EC of the media is to be maintained less than 1.0 (Bhattacharjee and De, 2003).

Blindeman (1999) investigated the effects of 6 types of coir on the growth and quality of *Rosa hybrida* cv. "Golden Gate" in a greenhouse study. Highest levels of entrapped air (> 50%) were found in coir chips, while the lowest level of entrapped air was recorded with cocos peat (< 20%) This was reversed for the of entrapped water (< 40% and > 70%, respectively). Small and medium sized coir chips showed the lowest level of easily available water. No significant differences in number of stems/m^2, stem weight, and stem length were found between substrates.

In *Rosa* cv. "Anna" and cv. "Susan" coconut fibre induced the highest yield and highest quality of harvested flowers for stem length and stem weight (Allera *et. al.*, 2000).

The cut roses cvs. "Sonia" and "Laser" were grown for two years in a recirculating system in either coin or granulated rockwool substrate using either the "arching" or the traditional harvesting techniques. During the first year coir produced about 15.6 per cent more marketable stems as well as 18 per cent more fresh weight than granulated rockwool, while there were no significant differences between the substrates during the second year. The aching technique produced 15 cm longer and 47 per cent heavier but also fewer (29.3%) marketable roses than the conventional harvesting techniques. Fresh weight of

harvested roses was similar for both techniques. There were higher levels of micronutrients in rose stems grown in coir than those grown in rockwool. (Blom and Papadopoulos, 1998).

Maloupa *et. al.,* (1999) evaluated the performance of perlite - zeolite mixtures in a heated plastic green house of "Madelon" ropes installed on a soil less bag system containing zeolite and perlite, at 100 : 0, 25 : 75, 50 : 50 and 75.25 (v/v) ratios. They have observed that plants grown on the 25.75 zeolite : perlite medium produced the highest total yield and the largest number of cut roses with stem length > 70 cm or 50-70 cm.

Blindeman (1998) has grown two hybrid roses "Cream Dream" and "Dream" in coconut fibre 3, 12 and 15 litre pots or 10 litre tanks, or on 30 litre coconut fibre mats, each with 1 to 6 plants (5 to 6 plants/m^2) depending on the system used and their effects on roses were investigated. He has observed that cut flower numbers and weights were highest with the plants grown on coconut fibre mats (mean of 322 and 261 stems/m^2 over the 3 years for the 2 cultivars respectively).

According to Raviv *et. al.,,* (1999) the unsaturated hydraulic conductivity, being a characteristic function of the medium and highly sensitive to moisture variation, indicates better and actual availability of water to the roots. They have grown "Mercedes" roses in yellow tuft (volcanic ash, scoria) and pumice from Italy and Greece.

BED SIZE AND SPACING

Depending on the size of bay, the width and length of the bed is decided. Generally bay length varies from 30 to 50 m and width may be 6.4 m or 8 m. Sometimes, however, in a bed width of 100 cm, 5 rows of plants at a distance of 25 cm are planted and middle row is omitted; the distance between the plants in rows is kept 30 cm apart. The double row bed system is better than that of 3 or 4 row beds. It is extremely difficult to manage 3 or 4 row bed system in India. Between the beds, 60 or 85 cm path is kept. Standard planting distance is 25 cm in rows and spaced 30 cm apart. Some growers adopt spacing of 14 to 18 cm apart in rows. Usually, 60,000 to 70,000 plants are accommodated per hectare (Bhattacharjee and De, 2003).

PLANTING AND WATERING

Plants of one variety have to be planted in the same area for easy cultivation. Plants are placed in position at required distance, with the root straight down and no bend roots, and the furrows are refilled with loose soil or planting media and then pressed slightly. The time between the plant in the furrows and refilling it should not be more than 5 minutes, to avoid drying out of the roots. The depths of the plants should be such that the budded part is placed at the soil level or maximum 1 cm above after refilling the furrows. (Patil and Patil, 2006).

Just after completing one bed, the plants are to be watered, by applying 1 litre of water to each plant. This watering can be done either by hoes pipe or watering can. It is to be checked whether the soil has set around the root. The plants standing too high in the beds must be pushed back or if too deep should be made free from soil; this adjustment is to be done properly at the first instant of watering. The drip lines are also to be checked, so these are placed in the right place. In the first week irrigation through

sprinkler or hoes pipe is suggested. This has to be done several times of necessary, so that the surface does not become dry or may not become muddy. One week after planting drip irrigation is to be started once a day with water and nutrients. With the proper establishment of plants, drip irrigation can slowly replace the sprinkler irrigation. During the first two months plants do not have much roots, hence, the plants have to be watered frequently, 5 to 8 times a day depending upon the condition of the media and the plants. Normal rate of irrigation is to be followed after 2 months when the plants bear enough roots (Patil and Patil, 2006).

It must be kept in mind that plants are to be planted in well prepared beds. Six months old budded plants or one year old plants with at least two shoots are ideal. During planting stage much care is needed and the polyhouse should be kept warm, and high humidity is to be maintained (Bhattacharjee and De, 2003).

FRAMEWORK OF PLANTS

Building up a strong framework of basal shoots is very important for increasing quality flower production. Young plants should not be allowed to flower immediately after planting. The pin sized flower buds are to be removed without removing the leaves. To build up a strong root system, maximum leaf area is required. Number of new shoots are to be encouraged which can produce marketable flowers. To reduce the apical dominance, growers bend down the shoots (Bhattacharjee and De, 2003).

Soon after planting within 1 to 3 weeks depending on temperature 2 to 3 eyes per branch will sprout, which will grow until flowering in 5 to 6 weeks. This first growth will usually be no longer than 20 cm, since the plants do not have many roots to start with. Some of the first growth may be blind shoots. These blind shoots must not be cut or bend, but left upright. Other shoots do form buds. When most of the buds show colour, these buds are to be plucked off. The blind shoots may also sprout as well. After plucking off the buds, the second growth will produce flower again in 4 to 5 weeks. By this time the plant growth will be around 50 to 60 cm in height. This growth is important in order to have enough growing speed in the plant and to have enough foliage for bending. When majority of the branches will show big buds and colour, just at that time bending operation has to be started (Patil and Patil, 2006).

Bending is a major operation for polyhouse roses, which is necessary to get good cut flowers. It should be kept in mind that bending is not breaking. Proper bending is important. The branch which arise from the main shoots of the plant, leaving two healthy leaves, the portion above is pressed hard so as to split the inner stem portion, then again pressed with thumb and bent smoothly towards the path side of the bed with thumb and index finger. This process is repeated. By this process stronger shoots are selected and weak ones left as pinched stems to provide leaf cover. The main idea is to encourage the plant for healthy framework at bottom which will give lengthy stalks. By bending treatment, the dormant buds below the bend get extraordinary inputs, through reduction of apical dominance and thereby produce long shoots with flower. The utility of bending is, however, questioned by some rose growers (Bhattacharjee and De, 2003).

A minimum of 4 stems, either flowering or blind shoots must be bend for each plants.

When bending, it is important to remove the flower buds and for blind shoots the growing tips are to be removed, to avoid the new growth on the top after bending. These bends should be as close as the original bush as possible, maximum 5 cm, without breaking the branches. To avoid breaking, it is advisable to do the bending in the afternoon and to create two 45° bends rather than one 90° bend. The bending should be such that the tops of the stems are laying below horizontal. After bending it is possible that on the bend branches, suckers starts growing. These suckers are to be rolled at least twice a week to avoid diversion of energy into these suckers instead of into the bottom breaks. The bend stems should not be removed during the whole first year of cultivation, since the foliage of the bend stems helps in additional assimilation and growing capacity to the plants. Soon after bending, the first bottom breaks will start coming from the base of the plant. These bottom breaks are most important for the life time of the plant, because they will carry the production of flowers. For second and third crop, the bottom breaks are cut. Then the sprouting will start again very soon, generally with 2 to 3 sprouts. These sprouts will become flowers again within 6 to 7 weeks after cutting the bottom breaks and will give the first good quality production in roses (Patil and Patil, 2006). According to Labeke *et. al.*, (1998) with bending over, there were fewer blind shoots than with pinching in rose cv. "Frisco".

PRUNING

To maintain the plant height and to encourage the strong basal shoot development, pruning is essential. During routine harvesting of cut flowers, the plants are automatically pruned. While harvesting the rose cut flower, there should be at lest 1 to 2 mature leaves with five leaflets left on the plant. This will encourage the new shoots to develop from dormant buds on the remaining stem. Hence, the crop gradually increases in height by this type of routine harvest. While pruning, the height of the plant is reduced by giving a cut just below the joint of the current stem and older stem allows a dormant bud on the old stem to bear the next flowering stem. To get the strong basal shoots, weak shoots are to be removed. It is important to maintain a balance between leaf cover and crop growth. If the overall plant growth is weak, with poor leaf cover, weak shoots be retained and grown to pea size bud stage and pinched. This shoot may be used purely as a leaf cover and source of energy (Bhattacharjee and De, 2003).

RESTING

To build up the plant vigour for the next season during. May to September in India, no flower is taken. Moreover, during this period there is poor market return. Plants are extremely stressed under conditions of high temperature and excessive humidity in these months. The growers stop the application of water and fertilizers after the harvest of last flower. During dry period, lasting for one to two months, most the leaves fall. The plants are the pruned and application of water and fertilisers are resumed. It has been reported that such treatments give few bottom breaks and encourage weak stems. In order to avoid this situation, many growers allow their plants to grow with moderate watering and fertiliser application. The plants are given rest by routinely removing the flower buds at pea stage and pinching out all the subsequent small apical side shoots. Before the next season the plants are pruned by cutting back the shoots to the second main break. The

pruning is done gradually by removing maximum of one-third shoots at a time from one plants to avoid shock to the roots and the resulting die-back. Such treatments give good bottom breaks and stronger stems (Bhattachajee and De, 2003).

FEEDING OF PLANTS

For application of accurate dose of fertilisers, frequent analysis of soil samples is essential. For intensive and economical rose crop production both water and fertilisers are applied to growing crops through drip irrigation system which is known as "fertigation." The fertilization provides nitrogen, phosphorus, potash, calcium, magnesium, sulphur, iron, manganese, zinc, boron, copper and molybdenum directly to the active root zone, thus minimising the losses of expensive nutrients, which ultimately helps in productivity and quality of rose flowers (Bhattacharjee and De, 2003).

The rose cultivars 'First Red', "Escada" and "Mercedes" were grown in rock wool with 0.5, 4.0 or 7.0 mM Ca in the nutrient solution. It has been observed that under Ca-deficient conditions, susceptibility of *Botrytis cinerea* increased, necrosis and abscission of the old leaves occurred, and petal necrosis was slightly higher (Baas *et. al.,*, 2000). Four rose cultivars "Dallas", Royal Velvet, "Samantra" and "Vega" were grown from May to December in sand culture. The plants were irrigated with the same nutrient solution using a recirculation system. "Samanta" and "Vega" exhibited a lower concentration of total N and higher concentration of P in sap than "Royal Velvet" and "Dallas" (Cadahia *et. al.,*, 1998).

Baas *et. al.,* (2004) studied the nutrient emission from a cut rose closed system by high-flux irrigation and low nutrient concentrations. They observed that oxygen deficiency did not occur in the growing media at the relatively high irrigation rates. They also confirmed that NaCl concentrations of 10 mM can be tolerated by cut rose provided nutritional elements are not below certain limiting concentrations. Brun *et. al.,* (2001) investigated the recycling of nutrient solutions for *Rosa hybrida* in soilless culture. Recycling systems based on electrical conductivity (EC) were tested and compared to systems without recycling. It has been recorded by them that flower yield, quality of vase life of *R. hybrida* were not affected by recycling. Management of recycling using EC measurement proved to be reliable. There are good relationships between EC and ions concentrations for supplied solutions and leachate solutions recycled and not recycled.

IRRIGATION

In polyhouses, nozzles and drip system of irrigation is practical. To distribute the water horizontally drip irrigation is used. The drip irrigation system can be sub divided into two main groups according to the location of the emitter (dripper), namely surface and sub-surface drip irrigation. In surface irrigation a single drip line between two rows of plants or one drip line for each row of plants is used. In free drained sandy soils, many drip points are required to supply sufficient water to all plants. In sub-surface irrigation drip lines are laid out 10-15 cm below the soil surface in the root zone of the plants. The sub-surface irrigation allows the water to come in direct contact of the roots. The problems caused by bacteria development, root penetration causing clogging of drippers, pinching of drip lines and damage and plugging the soil injestion forced the

switching over to surface drip irrigation from sub-surface drip irrigation. Depending on temperature, incoming light and relative humidity, water requirement varies. Daily minimum water requirement per m^2 of roses ranges from 2 to 8 litres. In cold and cloudy weather, minimum amount of water is required while in hot and sunny conditions roses consume maximum amount. These plants can, however, tolerate fairly large amount of water, provided the oxygen content in the water is high. In many rose farms micro-sprinklers are installed between rows of plants. For irrigation in each bed, 2 drip lines and one sprinkler line are ideal. The distance between dripper to dripper is kept 30 cm and sprinkler to sprinkler 100 cm. The dripper lines are laid out on the sides of the bed and sprinkler line in the centre of the bed. These sprinklers increase the humidity and decrease the temperature during warm and dry days. For initial good growth of plants, micro-sprinklers are useful. Their frequent use on well grown large plants and if the plants do not dry before evening, encourage mildew infestation (Bhattacharjee and De, 2003).

In rose cv. "Madelon", water stress at petal and stamen initiation reduced the stem length, fresh weight of the flowering shoots, the diameter and length of the flower bud and the number of petals per flower (Chimonidou-Pavlidou) and Papadopoulos, 1999). In rose cv. "Osiana" a linear tendency of increasing the length and diameter of stems, and the length and diameter of the bud with increasing irrigation depth was observed by Folegatti *et. al.*, (2001). Through recirculation of drainage water, there was potential savings of water and fertilizers and the reduction of environment pollution are described by Raviv (1988) in rose cv. "Mercedes'. He observed no negative effect on cut flower yield and quality. Furthermore, frequent monitoring revealed no proliferation of pathogenic micro-organism.

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17

GROWTH REGULATING CHEMICALS

Regulation of growth and flowering of roses through the use of plant growth regulating chemicals is a fascinating and interesting subject to study. These chemicals have been successfully used in roses mainly for seed germination, vegetative propagation, control of growth and flowering, retardation of flower senescence and prolonging the vase life of cut flowers. Auxins, gibberellins, cytokinins, abscisic acids and ethylene play vital role in the regulatory process of growth and development of plants. Apart from these a wide range of plant growth regulating chemicals has been synthesized which display diversity of effects on plant when used in minute quantities. These chemicals are readily absorbed and rapidly move through the plant tissues and find extensive use for modifying the development process of plants. Several growth-regulating chemicals were employed in roses over the years with success and most satisfying results. Among the most commonly used plant growth regulators in roses are Indole Acetic Acids, Indole Butyric Acid, Naphthalene Acetic Acid, which are generally employed for rooting of cuttings and tissue culture, 2, 4-Dichlorophenoxy Acetic Acid for tissue culture; Benzyl Adenine is used for tissue culture, as well as for encouraging lateral branching and inhibition of flower senescence. Gibberellic Acid is widely used for seed germination, flowering, promoting vegetative growth and inhibition of flower senescence. Growth regulating chemicals are also used for retardation of growth, dwarfing and flower initiation (Chlormequet, Daminozide, Ethephon), growth inhibition (Malic Hydrazide, Morphactin and 2, 3, 5-Triiodo benzoic Acid); growth control (Ancimidol and Paclobutrazol); flower production and promotion of lateral branching (Dikegulac Sodium) and promotion of vase life of cut flowers (Kinetin, Gibberallic Acid and Benzyl Adenine). If properly planned, growth regulator can bring in very quick, rapid and distinctive changes in the target plants, and show appreciable improvement with high commercial and aesthetic value; which no other technology can offer in such a short span of time. However, there is need of continuous search for new growth regulators and cost effective technology for modifying the effect of unfavourable environmental conditions, increasing the resistance against pests and diseases, manipulating flowering and improving the post harvest life and quality of cut flower of roses, without neglecting the environmental safety. Very little is known about the regulation of expression of genes involved in petal senescence. An intriguing possibility is that ethylene is involved. Tissue-specific or hormone regulated genes may lead to modification of senescence process through genetic engineering. An effort has been made in this chapter to enumerate briefly the work done on the effect of growth regulating chemicals in roses.

GERMINATION

In most of the cases seed germination in roses is not an easy task. The rose seeds are known as "achene", mostly remain dormant when mature and require after ripening. Moreover, in many species and varieties the pericarp is very hard and bony. The presence of abscicic acid in both pericarp and testa, of the achene play a vital role in dormancy. The chemical, which inhibits the germination of seeds, can be removed by chemical means. Gobbe (1978) reported soaking of seeds in 2000ppm GA_3 solution for 24 hours gave 73 per cent germination. In Floribunda and HT roses Venkataraman *et. al.*, (1990) suggested that extracted seeds are to be stratified, scarified and treated with 100ppm GA_3 for maximum percentage of germination. Prakash (2002) however, noticed that pretreatment percentage of seeds with GA_3 failed to enhance the rose seed germination. In-vitro seed germination of 'Priyadarshini' rose MS medium supplemented with 4mg GA_3/l+2mg BA/l showed 81.88 per cent success after 7 days (Ramesh, *et. al.*, 1993). Delay in germination of excised embryo and seeds can be counteracted by the use of GA_3 and BA (Jackson, 1968). Burger *et. al.*, (1990) reported that explanted embryogenic tissues developed into organogenic callus in *Rosa hybrida* and formed adventitious shoots on half strength modified MS media supplemented with 1.0μm BA and 0.05 μm NAA. Beneficial effect of BA and Kinetin on rose embryogenesis and plant regeneration from immature seed derived from *Rosa rogusa* was also recorded by Kunitake *et. al.*, (1993). Preincubation on a high 2, 4-D concentration increased the frequency of embryogenesis in *Rosa hybrida* and *R. chinensis miniata.* These beneficial effects of BA (alone or combined with IAA or IBA) on somatic embryo maturation in floribunda rose cvs. "Trumpler" and "Glad tiding" have been reported by Marchant *et. al.*, (1996). It was observed by Kim-Gyeongttee, *et. al.*, (2004) that ethylene inhibitor is an effective promoter of somatic embryo germination in rose.

TISSUE CULTURE

The requirement of auxin for root induction in rose is generally specific to cultivars. Different auxins are used for root induction in roses. Many researchers in the culture media employed IAA, NAA and IBA. Sahoo and Debata (1977) propagated miniature rose, "The Fairy" from axillary buds with small portion of internodes tissue through *in-vitro* culture and observed that short multiplication rate was highest on a medium containing 0.25mg/l each of BA and GA_3; and floral buds were induced in the third generation shoots when 0.25mg/l each of BA, IAA and GA_3 were included in the 0.25mg of NAA and 0.1mg 2, 4-D/l. They have noticed rooting after a fortnight. Hasegawa (1979) cultured rose shoot tips and lateral buds of *Rosa hybrida* "Improved Blaze" which proliferated multiple shoots on basal MS medium supplemented with 30mg/l BAP and 0.3mg/l IAA. A three-fold multiplication was achieved from freshly explanted terminal shoot tips or lateral buds after 8 weeks. Roots were initiated from about 50 per cent of these shoots after transfer to a medium containing 0.3mg/l BA.

Ganga *et. al.*, (2002) while studying *in-vitro* rhizogenesis of macro shoots of "Andhra Red Rose" (*Rosa centfolia* Linn) observed highest rooting response, earliest rooting and longest roots in ½ strength MS medium supplemented with 0.5 mg IAA/l or 0.1 mg NAA/l. Chakraborty and Datta (2006) from a study of *in-vitro* meristem tip culture of *Rosa hybrida* cv. "Contempo" and "Mrinalini" using shoot tip proliferation onto MS medium with

0.2mg/l IAA along with different concentrations of BAP; concluded that percentage of explants producing multiple shoots, number of shoots per responded explants and growth of the shoot varied with BAP concentration and obtained optimum results with 2mg/l BA. The highest percentage of root formation was observed in "Contempo", when the regenerated plants were transferred to a rooting medium containing ¼ MS with 0.1mg/l IAA, 0.1mg/l IBA, 30gm/l sugar and 0.6% agar.

Many researchers have taken interest on rose micro propagation and large number of scientific papers is available on this topic. The earliest work on the induction of callus and root in explanted buds of roses was carried out by Nobecourt and Kofler (1945); and the development of root primordial from stem callus was first reported by Hill (1967). Growth regulating chemicals have been used for root induction and a large number of researchers have employed IAA for root induction in micro propagated roses (Collet, 1985; Mederos and Enriquez, 1987; Sauer *et. al.*, 1985). The culture media supplemented with NA between the concentrations of 0.003 to 2mg/l have shown good results for induction of roots (Khosh-Khui and Shink, 1982, Avramis *et. al.* 1982). The culture media supplemented with IBA induced roots in roses (Bini *et. al.*, 1983; Fiorino and Leva, 1981; Leffring *et. al.*, 1984; Curir *et. al.*, 1986; Alderson *et. al.*, 1988). Cytokinin used in multiplication stage of roses in the culture media also induced successful rooting and survival of the rooted plantlets (Bressan *et. al.*, 1982; Podwyszynska and Hempel, 1988).

Pivetta *et. al.*, (2001) studied the effects of IBA on rooting of leafy cuttings of rose cultivars "Red Success". Kim *et. al.*, (2004) reported that somatic tissue of hybrid roses germinated on MS medium containing IBA and BA. The effect of BAP and IBA on sprouting and adventitious root formation of "Amanda Rose" single node soft woodcuttings has been reported by DeVries and Dubois, (1988). Best proliferation of nodal segments cultured on a solid medium with 3μm BA was recorded. Quarter strength of MS salt solution containing 1.0mg IBA/l and 20g sucrose/l for rooting was found best for the proliferated shoots of rose cultivars. Wilson and Nayar (1995) obtained best rooting of "Folk Lore" rose on a medium supplemented with 0.1mg IAA, + 1.0mg NAA + 500mg activated charcoal per litre.

ROOTING OF CUTTINGS

Propagation of roses from stem cuttings is the least expensive method, and the use of growth regulating chemicals has made the multiplication easy and quick. All Hybrid Polyantha, Hybrid Musk, Rambler and Climbers do well on their own root; but Hybrid Tea and floribunda roses pose same problem in proper establishment and ultimate longevity of plants. Hybrid Tea roses when grown from cuttings have very fibrous roots and will persists in blooming instead of making growth, and hence, picking the buds off would be of great advantage (Norman, 1958). Beneficial effects of IAA and IBA on rooting of cutting of *Rosa* species like *R. multiflora, R. bourboniana, R. moschata* and *R. indica* have been reported (Bhujbal and Kale, 1973; Das *et. al.*, 1978). Hard wood cutting of *R. damascena* proved 97 per cent rooting with 3000 mg/l either of NAA or IBA (Hajian and Khosh-Khui, 2000). Dipping the *R. bourboniana* cuttings in IBA accelerate total phenol contents in cuttings (Balakrishnamurthy *et. al.*, 1997). Application of 75 ppm IBA or 75 ppm NAA significantly increased the number of roots per cuttings in *R. multiflora*

(Sutapradja, 1988). Quick dip in 1000ppm IBA of *Rosa centifolia* and *R. damascena* enhanced more rooting in stem cuttings (Akhtar, 2002).

One-year-old "Queen Elizabeth" rose cuttings treated with 2000 ppm IBA established and performed well upto 5 years, while no success was achieved in the rose cvs. "Happiness" and "Super Star" (Mukhopadhyay, 1990). For growing the rose cultivars "Parairie Joy", a hardy hedge rose of Canada, the plant must be propagated from soft-wood cuttings of 1 to 3 nodes in late spring, treated with 3000ppm to 7000ppm IBA and rooted under intermittent mist of water (Collicutt, 1972). The rose cv. "Royalty" is propagated from cuttings with the application of 1000mg/l IBA as a basal dip for 10 seconds, which increased rooting and inhibited bud break (Sun and Bassuk, 1993). Best rooting of one-year-old cuttings of cv. "Red Success" was obtained by the treatment of cuttings taken on 2nd July with IBA at 1000ppm (Fouda and Schmidt, 1994). Rooting percentage of rose cv. "Red Velvet" increased with increasing concentration of IAA, IBA and NAA upto 1000mg/l (Choi *et. al.*, 2000). While investigating the promoting effect of IBA in rose cuttings, it was observed that auxins did not promote rooting when leaves were covered or removed (Costa *et. al.*, 2001). It has been reported by Bredmose *et. al.*, (2004) that the temperature, cutting size and auxins and their interaction significantly influenced root and shoot growth of miniature roses.

DWARFING AND GROWTH RETARDATION

Dwarf, bushy, attractive and floriferous roses have more demand as potted plants in the market. These are also very useful for landscaping and for small gardens where there are limited space. It is possible to produce dwarf and attractive plants by the use of chemicals in H.T., Floribunda and Grandiflora roses. Some of the growth regulating chemicals are very useful in these regards. Foliar spray of B-Nine at 4000ppm once after pruning in early November (When shoots were 4-6 cm long) and second application at blooming stage (90 days after the first application) caused a marked decrease in shoot growth in seven cultivars of HT roses and the dwarfing effect was more prominent in "Eiffel Tower" cultivars (Bhattacharjee and Bose, 1979). Growth retardation in *Rosa multiflora* was achieved with the foliar spray of Atrinal at 5000ppm, MH at 1000 ppm and Ethrel at 500 ppm (Grzesik and Rudnicki, 1985). In the rose cultivars "Sonia" and "Mercedes" two foliar spray of Atrinal at 2500ppm reduced plant height but the flower size decreased (Grzesik and Rudnicki, 1989). Foliar spray of Ethrel at 2500 ppm and 5000 ppm concentration in "Eiffel Tower" roses, retarded plant height and decreased the longevity of intact flowers (Bhattacharjee, 1993a). Chloromequat at 1000 ppm, sprayed in November and January retarded the plant height of *Rosa hybrida* "Raktagandha" (Bhattacharjee and Singh, 1995). In the rose cultivars Gruss-an-Teplitz retarded the growth of the primary shoots with the treatment of Pacloburazol at 20mg/plant as soil drench (Singh and Bist, 2003). Treatment with TIBA at 500 ppm and Chlorphosphonium at 1000 ppm resulted in shorter shoots and internodes (Nanjan and Muthuswamy, 1975).

PROMOTION OF GROWTH

Some of the plant growth regulators were used in rose for promoting the lateral branching, increasing the shoot length, stimulating the number of bottom breaks and

enhancing the flower peduncle length. In "Super Star" roses, BA and GA_3 at 100 and 200 ppm each used as foliar spray produced more number of primary and secondary shoots; and the GA_3 spray have shown pronounced beneficial effect on size of the flower diameter (Bhattacharjee and Renu Ranjan, 1995). In "Raktagandha" rose GA_3 spray at 500ppm significantly increased the shoot length (Battacharjee, 1993). While Nagarajaiah and Reddy (1986) obtained maximum shoot length as well as increased internodes length with GA_3 at 200 ppm. Maximum numbers of shoots per plant in *Rosa damascena* was recorded by Sharma and Farooqui (1990) with the application of 0.06 per cent CEPA (Ethephon) on four year old plant. In *Rosa hybrida* cv. "Eiffel Tower", Bhattacharjee *et. al.*, (1994) observed longest number of secondary shoots with Ethrel at 2500 ppm, and the greatest increase of basal diameter of shoots was noticed with the spray of Ethrel at 5000ppm. Bhattacharjee and Singh (1995) reported significant increase in the numbers of secondary shoots in *Rosa hybrida* cv. "Rakthgandha" with the foliar spray twice(three weeks after the pruning and two months after the first spray) Daminozide at 1000 ppm or Chlormequat at 1000ppm. Joyroe and Newman (1995) used BA and Dikegulac Sodium Salt (DS) in two years old pot grown five cultivars of rose as soil drench, spray or with floral foam. The rose cultivars "Tournament of Roses" had the greater number of basal shoots when BA was applied to cut cane with floral foam cube. The cultivars "Peace" and "Prima Donna" had the maximum number of basal shoots when BA was applied at 250ppm to a cut cane with a floral foam cube. DS increased shoots when applied as drenching or spray to the bud union in the cultivars "Peace" only, and the DS was not effective in other four varieties. Neither growth regulator nor application method consistently promoted basal and axillary shoots in all five cultivars.

Dieleman *et. al.*, (1988) concluded from an experiment on the effect of six different root stocks of "Madelon" HT roses that to improve the performance of root stock exogenous application of cytokinin is helpful, while BA application was found to stimulate the number of bottom breaks, mainly low yielding rootstocks. While investigating the effect of pruning severity, bud position and treatment with growth regulator (IAA, IBA, NAA or BA) on sprouting and flowering of rose buds, Sun *et. al.*, (1988) reported that BA significantly promoted sprouting of first bud. NAA was the most potent inhibitor, followed by IBA and IAA. Auxins affected the apical dominance of axillary buds by promoting sprouting of the second bud and inhibiting sprouting of the apical bud. In the rose cultivars "First Red" maximum plant height, shoot length, flower peduncle length was obtained with the treatment of GA_3 at 300 ppm (Arun *et. al.*, 2000). Soil drenching with 20mg/plant Paclobutrazol in the three years old rose cv. "Black Nigret" increased the number of primary and secondary shoots per plant (Singh, 2002). In "Super Star" rose 125 ppm NAA as foliar spray increased the shoot length, shoot number and number of leaves per bush (Singh, 2003).

FLOWERING

Exogenous supply of growth regulator influence flowering. It is said that growth regulator that breaks flower bud dormancy affect flowering, but do not cause flowering to occur. Flowering is possibly mediated through alterations in the endogenous growth regulators (Murti and Upreti, 1995). Flower control in rose is advantageous and profitable.

Through appropriate use of growth regulators, flower production can be oriented as per market demand and supply. In festival season and special occasions like Valentine Day employing growth-regulating chemicals at proper time of the year can induce flowering. Improvement of flower quality is also possible through such means.

In "Super Star" roses pronounced beneficial effect of size of flower bud, flower diameter and flower yield was recorded with the spray of GA_3 at 200ppm (Bhattacharjee and Renu Ranjan, 1995). In "Raktagandha" roses GA_3 at 500ppm resulted in maximum number of flowers with improved flower bud size, increased diameter of flowers and more number of petals (Bhattacharjee, 1993). In six years old plants of *Rosa damascena* Kinetin at 10mg/litre increased the number of flowers per plant, where as GA_3 inhibited flowering (Farooqui *et. al.*, 1994). GA_3 200 ppm as foliar spray on "First Red" roses advanced flowering and significantly increased the number of flowers; and spray of BA at 1000ppm significantly increased flower yield (Arun *et. al.*, 2000). In an experiment Roberts *et. al.*, (1999) measured the concentration of GA_3 in the shoot apices of "Felicite et Perpetue" and "Little White Pet" roses. It was observed by them that in "Felicite et Perpetue", floral initiation occurred when concentration of GA_3 were low and was inhibited when concentration of GA_3 were high, whereas in "Little White Pet" concentration of GA_3 remain at permissive level throughout the growing season. Nanjan and Muthuswamy (1975) recorded increased flower yield in "Edward Rose" with GA_3 at 200ppm. Maharana and Pani (1982) reported that spray of GA_3 at 200ppm resulted in advanced flowering.

Treatment with TIBA (500ppm) and Chlorphosphonium (1000ppm) enhanced flower number and reduced flower size in "Edward Rose" (Nanjan and Muthuswamy, 1975). Daminozide (SADH) spray at 5000 ppm in the early vegetative stage in rose cv. "Dr. B.P. Pal", induced, early flowering, encouraged large size flowers, increased flower yield and enhanced longevity of intact flowers (Bhattacharjee, 1993a). Chlormequat at 1000ppm, sprayed at November and January enhanced early flower bud appearance, increased flower bud size and flower diameter and also significantly, increased flower production in "Raktagandha" roses over untreated control (Bhattacharjee and Singh, (1995). The treatment with chlormequat recorded higher nutrients in leaves (Singh, 1995).

Foliar spray of SADH at 5000ppm in *Rosa hybrida* cv. "Dr. B.P. Pal" encouraged large-sized flowers, increased flower yield and longevity of intact flowers (Bhattacharjee, 1993). Foliar spray of Ethrel from 500ppm to 5000ppm three weeks after pruning to *Rosa* cv. "Eiffel Tower" delayed the onset of flowering, but no significant difference in flower yield was recorded (Bhattacharjee *et. al.*, 1994). Foliar spray of Daminozide at 1000ppm, three weeks after pruning and two months after the first spray in rose cv. "Raktagandha"enhanced early flower bud appearance, and significantly increased flower production over untreated control (Bhattacharjee and Singh, 1995). In *Rosa damascena*, also foliar spray of Paclobutazol at 150ppm delayed the flower bud appearance in "Black Nigrett" rose cultivars (Singh, 2002). Studies conduted on several varieties of roses with Daminozide and Chlormequal revealed that both the retardants induced early flowering and increased flower size, with foliar application giving better results than soil drench (Bhattacharjee and Bose, 1979).

POST-HARVEST LIFE OF CUT FLOWERS

In the rose cut flower trade, post-harvest methods of harvesting of cut flowers assume great importance. The role of Ethylene in flower senescence has been investigated in detail. Although other natural hormones have also been implicated in flower senescence but their role in the process has not been conclusive. Exogenous application of Cytokinins delays flower senescence, while Absasic Acid accelerates senescence. Rose cultivars with short vase life possess lower level of cytokinin than those with long vase life.

A progressive increase in the free ABA was observed during flower development until full bloom in *Rosa damascena* and *R. bourboniana,* with higher contents of ABA in *Rosa damascena* (Sood *et. al.,* 2003). From an experiment on *R. hybrida,* Ganalevin and Zieslin (2002) recorded that the function of gibberellins in reducing the sensitivity of rose floral organs to ethylene. Chakradhar *et. al.,* (2003) observed in the rose cv. "Gladiator", vase life was maximum with GA_3 at 60 ppm and minimum with BA at 100 ppm. An increased level of internal ABA concentrations in rose often associated with petal senescence (Borochov *et. al.,* 1976) is mediated through ethylene action, since it could be delayed by CO_2 treatment.

Post-harvest life and quality of cut flower of *Rosa hybrida* cv. "Raktagandha" significantly improved by pulsing with MH (1 per cent) for 8hours or Daminozide (500 ppm) for 8 hours De and Bhattacharjee, (1998). Pulsing with MH (1per cent) for 8 hours and dry cool storage (4°C) for four days was found beneficial for lengthening of vase life and improving the quality of *Rosa hybrida* cv. "Mercedes" cut flowers (Kumar and Bhattacharjee, 2003). Among the growth regulating chemicals Kinetin at 2.5ppm as floral preservative was found best in increasing the vase life and enhancing the quality of cur roses cv. "Eiffel Tower". Apart from kinetin, other growth regulators like BA at 5ppm, IAA at 2.5ppm GA_3 at 150ppm in holding solution significantly increased vase life of Rose cv. "Eiffel Tower"(Bhattacharjee, 2000). The best pulsing chemical in enhancing the longevity of dry stored cut rose cv. "Noblesse" at 4°C was BA (25ppm) for 45 minutes, hence, the cut flowers can be stored (upto 6days after pulsing with BA) with this treatment without affecting the ultimate vase life and quality of cut roses at ambient temperature (Bhattacharjee, 2003). The best holding solution, which enhanced the vase life and quality of, pulsed and dry stored cut rose in "Noblesse" was reported to be D-fructose at 3 per cent + kinetin at 2.5 ppm (Bhattacharjee, 2003).

After pulsing with Daminozide (Alar) at 3000ppm for 8hours, the cut roses of "Mercedes" can be stored for 8 days without affecting their ultimate vase life and quality (Kumar and Bhattacharjee, 2004). Alar (Daminozide) at 3000ppm among the beneficial pulsing treatments for cut roses was recommended by Singh (1995), though its mode of action was not clear. Substantial increase in vase life of "Christian Dior" cut roses was achieved with MH treatment (Vasan, 1986). Increase in vase life, water uptake, fresh weight and water conductivity was observed when "Christian Dior" cut roses held in vase solution containing 250mg/l HQS and 0.5 per cent sucrose with 400 mg/l MH (Kesta and Jaijan, 1991).

In "Sonia" roses, holding solution-containing 25 to 50ppm BA did not

show benefit in lengthening in the life of cut flowers (Del Rio *et. al.*, 1989). In" Mercedes" roses, the cut flowers pulsed for 20 hours with solutions containing 20 to 40 mg GA_3/ l, promoted bud opening, while continuous treatment with GA_3 was found detrimental (Goszczynska *et. al.*, 1990). In *Rosa hybrida* cv. "Happiness" pulsing with 250ppm SADH along with sugar for 12 hours resulted increased vase life, while pulsing with 50ppm NAA along with sugar gave minimum vase life (Singh and Tiwari, 2000). The cut rose of "Noblesse", if pulsed with BA (25ppm) for 45 minutes can be dry stored for 6 days at 4^0C without affecting their ultimate keeping quality (Mwangi and Bhattacharjee, 2003). Morphactin is useful at 100ppm for pretreatment of cut roses which prevents undesirable opening of flowers during transport (Mayak *et. al.*, 1972).

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18

POST-HARVEST TECHNOLOGY

INTRODUCTION

The international trade of rose cut flowers is rapidly expanding. Hence, there is increasing interest in post harvest physiology and biochemistry of cut flowers. The post harvest behaviour of rose flowers is an outcome of the physiological processes occurring in leaves, stems, the flower bud, the leafless peduncle or scape connecting the bud to the stem. Some of the processes may act independently to affect the senescence and vase life of cut flowers, but most of them are interrelated and correlated. Rose cut flowers are actively metabolizing living plant parts prone to some basic ageing process as that of plant. Once severed from plant, they are deprived of their natural source of water and nutrient. However, after detaching from the plant, the rose cut flowers carry on all life processes at the expense of stored reserved food in the form of carbohydrates, proteins and fats for their longevity for few more years. According to Halevy and Mayak (1979), two distinct physiological phases have been identified in flowers :

(a) Bud growth and development to full opening and

(b) Maturation, senescence and wilting.

Extension of vase life of cut roses thus involves coordination of two seemingly conflicting processes, the promotion of growth during the first phase and retardation of senescence process during the second phase. In the cut flowers trade, post harvest methods of the handling of cut flowers are a fascinating and rewarding subject of study. Thanks to the recent advances made on post harvest physiology and senescence of rose cut flowers as enumerated in this brief review.

Several factors of preharvest stages including genetic, climatic or environmental and management; harvest factors like stage, method and time of harvest; and post harvest factors such as watering, rehydration, sugar and germicidal solutions, ethylene, precooling, storage environment, packaging techniques, transportation, microorganisms, gamma irradiation etc., influence the post–harvest quality and longevity of cut flowers (Halevy and Mayak, 1979; Bhattacharjee, 1992 a, b & 1993).

COMPONENT OF QUALITY

The various aspects of quality parameters of cut flowers are their keeping quality, flower bud size and shape, stem length and strength, colour, freshness and fragrance; foliage free from dust and spray residues; absence of insect, diseases and bruising injury. However, different products require different criteria for assessment of their quality. The

shape, size and colour of the rose flower should be representative of the cultivars. According to the market demand and the type of flowers, the stem length of rose cut flowers varies from 15 to 120 cm. Healthy, normal and bright foliage is important. The flowers with uniform stage of development and uniform stem length are preferred. They should, however, be strong and straight and capable of holding the flowers in upright position. (Bhattacharjee and De, 2005)

VARIABILITY DUE TO INHERENT AND GENETIC FACTORS

Wide differences in the post harvest life and quality of roses have been observed among different species of flowers (Bhattacharjee and Saxena, 1998) and among cultivars of the same species (Bhattacharjee, 1994). Wide variability in the thirty-two cultivars of cut roses was observed in water uptake, vase life, weight loss and flower diameter. (De *et. al.*, 1999). The D^2 values were significant among these thirty-two cultivars, which were grouped into eight clusters. For vase life, the varieties "Angelique", "Golden Times", "Raja S. S. Singh of Nalagarh", "Sandra" (Cluster IV) and "Sonia Meilland" (Cluster VII) were best. On the other hand, varieties of cluster IV ("Raja Ram Mohan Roy" and "Jawani") had shown the highest flower diameter. Different cultivars vary in their stem diameter and rigidity, which ultimately affect the post harvest life (Nowak and Rudnicki, 1990). Variation in vase life among different cultivars has been attributed to differences in number of thick wall supporting cell in the xylem elements and phloem fibre and presence and absence of complete ring of secondary thickening in flower peduncle (Zamski *et. al.*, 1991). Even stomatal activity especially poor closure of leaves can affect flower vase life (Mayak *et. al.*, 1974). Variation in water uptake among different cultivars of flower is due to differences in the leaf diffusive resistance of leaves in the field (Jodo, *et. al.*, 1989) or differences in bacterial or fungal species gaining predominance in the vase water (De Stigter and Broekhayson, 1986). Increment of vase life of cut flowers may also be due to higher activity of peroxidase, phenylalanine- ammonialyase and lignifications (Zeislin and Ben- Zoken, 1991). Furthermore, variation in vase life, weight loss, flower diameter among different cultivars may be due to differences in senescence behaviour by producing higher amount of ACC, ethylene forming enzyme and ethylene (Wu *et. al.*, 1991) and due to genetic make up of the cultivars (Gelder, 1989). Hence, there is an ever ending need for evaluation of all emerging rose cultivars on the basis of their post harvest quality and longevity, apart from a definite breeding programme in this direction.

SENESCENCE AND POST-HARVEST PHYSIOLOGY

A sequence of changes in flower physiology lead to senescence and these are changes in membrane lipids, a rise in ethylene production and loss of differential permeability generally reflected in increase in ion leakage and finally a reduction in weight due to excessive water loss. The leakage of cell constituents due to loss of structural integrity of the cell membrane results in death of flower.

PHYSIOLOGICAL CHANGES DURING SENESCENCE

The longevity of cut flowers in flower vase depends on the rate of transpiration through open stomata of the leaves and the solutes present in the vase water (Van Doorn, 1997). Aluminum compounds reduce the transpiration of rose cut flowers by decreasing

stomatal conductance (Ichimura and Ueyama, 1998). Loss of turgidity of cut flowers due to cuticular transpiration was also reported by Harkema and Van Doorn (1985). Dehydration causes a decrease in rose water potential from about -1.8 bars at saturation to -13 bars at dry weight loss (Mokhtari *et. al.*, 1995). Cold storage at 4^0C increased the water potential of "Folklore" cut roses and six days storage recorded highest water potential; however, 3 days storage at 4^0C only gave maximum vase life (Palanikumar *et. al.*, 1999). A positive effect of water potential of "Red Sandra" cut roses with 2 per cent sucrose +200 ppm 8 HQS+0.1 mM ethionine was reported by Son *et. al.*, (1997). In cut roses, ethylene production is low at bud stage, increases gradually as the outer petals open and reaches peak at full opening before decreasing (Bhattacharjee and De, 2005).

Rate of respiration has a bearing on length of rose cut flowers. Studies conducted on 11 cultivars of roses revealed that irrespective of cultivars, respiration rates of rose cut flowers increased sharply during flower development and petal expansion stages, declined markedly at senescence after full expansion of flowers (Bhattacharjee and Pal, 1999). The standard method used throughout the flower industry to retard senescence is to reduce respiration by decreasing the storage temperature. The cut flowers of "Raktagandha" roses, which received the treatment of 24 hours cold storage at 4^0C showed minimum rate of respiration (350.68 cc CO_2.Kg/hr) just after treatment. The rate of respiration was significantly lower (545 cc CO_2/Kg/hr) just after treatment with ice-cold water spray for 45 minutes over the untreated control (735 cc CO_2/Kg/hr) (Palanikumar *et. al.*, 2000). After the above precooling treatment, packaging of cut flowers in polyethylene bags (200 gauge thickness and 60cm x 30 cm size) registered maximum total soluble sugar content at senescence and maximum vase life (Palanikumar *et. al.*, 2000a).

In "Raktagandha" cut roses lower rate of respiration was associated with longer vase life recorded by treatment of DMSO (2 per cent) + storage at 4^0C for 4 days + preservative. Generally there was an increase in rate of respiration after pulsing, than reduction after storage and further reduction at senescence (Bhattacharjee, 2003). The rate of respiration of cut roses decreased after wet and dry storage at 4^0C from harvest. Lower respiration rate was associated with longer vase life (Bhattacharjee, 2003).

ULTRASTRUCTURAL AND BIOPHYSICAL CHANGES DURING PETAL SENESCENCE

Wilting is the most common symptom of flower senescence that is loss of turgor pressure of the cells. Senescence is accompanied by the dramatic increase in the leakage of several molecules such as amino acids, sugars, K^+ ions and total electrolytes (Fragher *et. al.*, 1986). At the onset of petal senescence, membrane lipids, including phospholipids and their bound fatty acids, show a continuous gradual decline (Borochov and Woodson, 1989). The vase life of many flowers is limited by an occlusion in the stem due to out flow of latex, gum, mucilage, resin and bacterial growth (Van Doorn *et. al.*, 1999). The increase in microviscosity of plasmalemma, corresponding to an increase in ratio of free sterol to phospholipids, is attributed to an increase in the activity of phospholipids A and C causing a decrease in the phospholipids (Borochov *et. al.*, 1994)..Flower senescence is mediated by lipid metabolites, and kinase activity plays an important role, vacuolar and cytoplasm vesiculation is observed along with dilution of the outer mitochondrial membrane.

BIOCHEMICAL CHANGES DURING SENESCENCE

The two major metabolic and biochemical changes that occur in senescing petals are (1) increase in respiration and (2) hydrolysis of cell components. In cut roses, inner petals exhibit a consistently higher respiratory rate that the outer petals regardless of whether the flower is kept in water or preservative solution or on the plant itself (Marrisen, 1991). In "Rakhtagandha" cut roses, total starch content in petals had a tendency to increase on the third day in the vase over that of first day, and thereafter decreased at senescence. The total soluble sugars (TSS) content of petals increased continuously during the cut flower development and senescence. The reducing sugar (RS) contents in petals also showed a trend of increasing continuously during the cut flower development process and senescence. The total free amino acids (TFAA) contents in petals increased during flower senescence. In general, higher starch content, TSS content, RS content and total phenol contents; and lower TFAA content in petals were associated with longer vase life (Vidhya Sankar, 2001). Protease activity increases in petals of cut "Sonia" roses with a decrease in ovaries, but does not differ between ethylene treated and control flowers. There was no correlation between individual or total free amino acids and protease activity in the corollas of the ethylene treated, cold stored and control flowers (Gorrin *et. al.*, 1989; Lakaszewska *et. al.*, 1989). Cut flowers of "Raktagandha" rose treated with pulsing of sucrose (3 per cent) + 8HQC(150ppm) for 24 hours followed by wet storage (3°C) reduced the protease activity (acid and alkali) significantly in petals and leaf tissues at both the stages, namely, just after storage and on senescence over 8 days of storage, against non pulsing. In general, alkali protease activity was more prominent than acid protease activity in both petals and leaf tissues of cut roses. However, petals had higher enzyme activity than leaves. Reduced enzyme activity (acid and alkali) was associated with longer vase life of cut roses influenced by pulsing treatment (Shiva *et. al.*, 2002).

In general, the lower activity of peroxidase (POD) and catalase (CAT) and higher activity of polyphenoloxydase (PPO) at senescence of "Rakhtagandha" cut roses was associated with longer vase life. The activity of all three enzymes studied showed an increase after pulsing, which decreased after storage and further decreased at senescence. Generally, POD and CAT activity was higher in petals as compared to the leaves, whereas PPO activity was higher in leaves than in petals (Vidhya Sankar, 2001; Bhattacharjee, 2003). In *Rosa hybrida*, cv. "Samantha" cut flowers, catalase activity increased for first two days during vase holding and then decreased rapidly (Xue Qui Hua and Lin, 1999). The involvement of peroxidase activity and phenol substances in regulating peroxidase activity and lignifications for stronger rose peduncles has been reported by Zeislin and Ben-Zaken (1993). In cut roses, the concentration of aspertic acid, histidine, arginine, lysine, valine, serine and methionine increase throughout the vase life. While proline, alanine and isoleucin increase during early period of vase life, then decline. Leucine and phenylalanine increase initially, decline and then increase again. Glutamic acid, glycine, cysteine and tyrosine fluctuate during vase life (Gao, 1991).

Pre-cooling with ice-cold water spray for 45 minutes, pusing with DMSO (2 per cent) for 15 minutes and wrapping with different packaging materials significantly decreased the total starch, total soluble sugars (TSS) and total phenols; while it increased

the total free amino acids (TFAA) in the "Golden Gate" cut rose petal tissue at senescence. Prolonged vase life was associated with maximum starch and total phenol content and minimum TSS and TFAA in the petal tissues at the senescence stage as influenced by precooling, pulsing and packaging. Maximum vase life of "Golden Gate" cut roses was obtained with flowers pre-cooled, pulsed and packed in butter paper packaging material for 6 hours, which has recorded minimum TFAA both on the third day and at senescence stage (Mwangi *et. al.*, 2003).

PIGMENTAL CHANGES

Two major pigments contributing to colour of flowers are carotenoids and anthocyanins. Green chloroplasts are converted into large chromoplast during various stages of senescence (Halevy and Mayak, 1979). An increase in oxygenated carotenoids found in roses with age. In roses, due to increase in anthocyanin levels, orange yellow roses are turned into deep red. The changes in pH of vacuole are an important factor for colour changes in senescing petals. Co-pigmentation with flavonoides and other related compounds determine the intensity of colours in most of the flowers. The bluing of red flowers with ageing and increase in pH may be ascribed to break down of protein and the release of free ammonia. A decrease in pH in some flowers may be due to increase in content of organic acids such as aspertic, malic and tartaric acid. In some flowers senescence is characterized by browning and blackening of petals caused by oxidation of flavones, leucoanthocyanins and other phenols and the accumulation of tannins. The petals blackening of "Baccara" roses have been related to increase in anthocyanins content at low temperature and to the accumulation of oxidation products of polyphenols. Lee and Kim (1994) observed an increase in the flavonol optical density when cut roses were treated with ethephon. Son *et al.*, (1997) recorded in "Red Sandra" roses a positive effect in maintaining petal colour when treated with a solution of 2 per cent sucrose +200 ppm 8HQC+ methionine. Barthe *et. al.*, 1991, recorded that during senescence of rose petals, the relatively acidic pH of vacular sap, unlike that of cell sap, cytoplasmic pH also decreases. Gao and Wu (1990), recorded an increase in the loss of anthocyanine when cut roses are treated with a preservative solution containing 2 per cent sucrose +250 ppm 8HQC+ 500ppm citric acid + 25 ppm silver nitrate. In *Rosa damascena* flower petals, Sharma (1981) observed changes in total anthocyanins, cyanin-3 glucose, and total reducing sugars and other substances at different stages of bud development.

CHANGES IN VASCULAR MORPHOLOGY

De Stigter and Broekhuysen (1986), noticed increase in resistance of water flow through stem segments predominantly in lower most one centimeter of the stems of cut roses. Scanning Electron Microscope (SEM) observations of cut roses have revealed that the cut surface of the stems act as a coarse threaded filters. Only a fraction of microbial cells enters through the vascular system from the vase water and rest remain attached to the submerged cut surface of the stem, thus blocking the uptake of water (Put *et. al.*, 1991; 1992). Degradation of wall structures, injury of vessel pit structures and mucoid materials in the vessel system after the vase life of cut "Sonia" roses was recorded through SEM analysis by Put and Rombouts (1989). While, Van Doorn, (1989) detected amorphous plugs made of carbohydrates, lipid and protein-like materials.

Moreover, Van Doorn *et. al.*, (1989), confirmed that vascular blockage in cut roses is due to presence of bacteria and these bacteria cause xylem-cell wall degradation and blocking of pit membranes. Rajan (1994) identified the vascular blockage in senescing "Raktagandha" rose stems in vases as being pectinacious in nature. They are localized above the water line and all along the cut stem upwards to the base of the receptacle. Van Doorn and Reid (1995) noticed globular bodies covering the vessel cells completely with a white granular layer in rose cultivars with comparatively shorter vase life during senescence.

Studies conducted on different cultivars of roses revealed no evidence of fungi, bacteria or any other materials in the freshly cut surfaces of rose stems examined through SEM. In contrast to the harvest stage, the cultivars "Dr. B. P. Pal" and "Priyadarshini" expressed the blockage symptoms in the vascular system on the third day of the vase life except for the cultivars "Eiffel Tower" with no blockage in vascular system. In the cv. "Arjun" the cut stem of the rose held in tap water for three days showed damage of secondary tissues partly, but with no blockage of xylem vessels. The rose cultivars "Angelique", "Arjun" and "Cara Mia" senesced; there was progressive break down of secondary thickenings of tracheids Globular bodies with partial break down of vessel tissues and covering the vessel cells completely with white granular layer were also observed (Shiva *et. al.*, 2003, 2003 a).

In an investigation of "Raktagandha" cut roses, a freshly cut stem surface showed a clear vascular system. A slight thickening of the xylem vessel walls developed on the third day in vase and at senescence; there was heavier thickening of xylem vessel walls along with severe damage of secondary tissues. When pulsed with DMSO (2per cent) for 15 minutes, the vascular system was comparable to that of freshly cut stems. Only a slight thickening of xylem vessel walls could be observed after 4days of storage at 4±1°C and on the third day in vase. At senescence, there was severe thickening of xylem walls. In "Raktagandha" cut roses stored for 4 days at 4 $\pm$ 1°C without any pulsing also showed a slight thickening, which increased at senescence (Vidhya Sankar, 2002; Bhattacharjee, 2003).

PRE-HARVEST FACTORS

Post harvest life and quality of rose cut flowers largely depends on the growing conditions of the crop. Environment in which the plant are grown, agrotechnology followed and the management practices adopted while in cultivation are considered very important in this regard.

ENVIRONMENT

Flowers produced during low light intensity, age more rapidly than those produced during the high light intensity (Rajan, 1994), cut flowers having comparatively higher amounts of stored carbohydrates show longer vase life. Low light intensity causes excessive elongation of flower stems and delays stem hardening, which results in "bent neck" in roses. Inherent carbohydrate level contributes largely to the longevity of cut flowers. Colour intensity of petals is also influenced by light intensity. Colour intensity of petals depends upon the availability of carbohydrates in the surrounding tissues

(Halevy and Mayak, 1974). Supplemental lighting increases larger leaf area (Slootweg and Van Meeteren, 1991) and accelerates flower development in field grown roses (Bredmose, 1993).

Optimum temperature for quality rose cut flower production is 15 to 20°C (Bhattacharjee, 1995). Higher temperature during field conditions decreases vase life and quality of cut flowers. At higher temperature stored carbohydrates of flowers are quickly depleted during respiration and the plant transpired at faster rates. But Moe (1975) observed that a decrease in temperature before a harvest from 21 to 24°C and 12 to 15°C reduces the vase life of cut roses. Roses grown at lower temperature (15°C) develops a greenish tint because of incomplete conversion of chloroplasts to chromoplasts (Halevy and Mayak, 1974).

Exposure of rose plants to high temperature for 7 hours reduces anthocyanine content and increases bluing. A strong reduction of temperature at 4 to 7 days before commercial stage of harvest of "Baccara" was seen with increase anthocyanine content and blackening. Rose cv. "Carol" and "Dr. Vehrage" grown at high temperature, yield very pale flowers, but produce normal colour when cut at bud stage and kept in sucrose solution (Halevy and Mayak, 1974).

Fungal and bacterial diseases are encouraged by high humidity, which damage cut flowers during storage and transportation. Damaged flowers remove water very rapidly and emit a large amount of ethylene than healthy ones. On the other hand, low humidity may cause browning of leaf edge on plants with thin leaflets. Mortenson and Fjeld (1995) observed that increasing humidity from 65 to 85 per cent has no effect on vase life of roses; while a further increase at 90 per cent, significantly decreased the vase life; and this decrease in vase life was related to an increase in the occurrence of "bent neck" and leaf drying at the highest humidity.

FERTILIZER APPLICATION TO SOIL

Application of chemical fertilizer influence growth and flowering of roses as well as post-harvest life of cut flowers. Damke and Bhattacharjee (1994) reported that a fertilizer dose comprising of 25gN, 175gm P_2O_5 and 100 gm of K_2O per 1.44m^2 per year was most effective for obtaining quality cut blooms of "Super Star" roses with long lasting capacity. This treatment combination of low dose of N was helpful in the proper development and full expansion of cut flowers and in maintaining improved water status over the treatment combinations of higher doses of nitrogen (Damke and Bhattacharjee, 1994). In "Raktagandha" roses, higher doses of nitrogen reduced the longetivity of cut flowers and post harvest life and quality of rose cut flowers, while 40 gm Nitrogen per 1.44 m^2 per year was found better (Bhattacharjee, 1999). In rose cv. "Arjun" cut flowers, longest vase life, increased flower diameter, enhanced water uptake and improved fresh and dry weight were recorded with the treatment of 500 Kg N per year per hectare (Vidhya Sankar and Bhattacharjee, 2000). However, N had no beneficial effect on fresh weight and keeping quality of "Forever Yours" and "Caliente" roses (Armitage and Tsujita, 1979 and 1979 a). Soil application of N decreased vase life of rose cv. "Celebration" (Maharana and Pradhan, 1976). Excessive nitrogen application reduces longevity of cut roses cv. "Super Star" (Bhattacharjee and Damke, 1988). Field grown rose cultivars require different doses

of nitrogen for better yield and longer post harvest life in cut flowers. The lowest nitrogen dose 4 gm N/plant year recorded the longest vase life in cultivars "Iceberg" and "Raktagandha". The treatment of 8 gm N/plant/year resulted in longest vase life, maximum flower diameter, increased fresh weight and dry weight in cultivars "Cara Mia", "Eiffel Tower" and "Queen Elizabeth". In cultivars of "Angelique" and "Dr. B. P. Pal" 6 gm N/plant/year was found beneficial for increased vase life. It was observed that the above nitrogen treatments in recording the longest vase life also resulted in maximum water uptake, improved flower diameter, increased fresh weight and dry weight of cut roses and minimum rates of respiration during different stages of senescence (Vidhya Sarkar and Bhattacharjee, 2000a).

Soil application of P had no effect on the longevity and flower quality of roses cv. "Celebration" (Maharana & Pradhan, 1976), while Damke (1992) recorded that an increase in supply of P accelerates opening of flower buds and keeping quality of intact flowers of rose cv. "Super Star". He also observed that water uptake, flower size and shelf life of cut roses increased with increased doses of P in the soil. Application of phosphopurine complex @ 347.2 kg/ha/year was found most beneficial in improving post harvest life and quality of "Raktagandha" roses (Bhattacharjee, *et. al.*, 1996). The soil application of K has been found to improve vase life of rose cv. "Celebration" (Maharana and Pradhan, 1976) and water uptake, flower diameter and longevity of cv. "Super Star" (Damke, 1992).

FOLIAR SPRAY OF NUTRIENTS

Foliar spray of potassium (200 ppm) at fortnightly interval significantly improved the keeping quality of "Super Star" cut roses follow by those of NPK (200ppm of each) and PK (200 ppm of each). There was marked improvement in vase life, water uptake, flower diameter, fresh and dry weight of cut roses in these treatments (Bhattacharjee and Renu Rajan, 1995).

In "Raktagandha" roses spray of $FeSO_4$ (2%) once in November and another time in January enhanced the post harvest life and quality of cut flowers, which was associated with highest water uptake and minimum loss of fresh weight at senescence. This treatment was better than sprays of $ZnSO_4$, $MnSO_4$ and $CuSO_4$ (Singh and Bhattacharjee, 1977). Foliar spray of boron at 0.2% in November and January in "Rakhtagandha" roses, markedly improved fresh and dry weight of cut flowers, increased water uptake and lengthened the vase life. This treatment was very effective in increasing the uptake of Fe, Zn and B (Bhattacharjee, 1996).

GROWTH REGULATING CHEMICALS

Improvement of flower quality and longevity of flower with the preharvest application of growth regulating chemicals have been reported in roses. GA_3 increased fresh weight of flowers, the length to diameter ratio to bud, elongation of flower pedicel and the receptacle of bud of "Sonia" roses (Gezeszkiewicz and Treder, 1989), neck length of "Queen Elizabeth" rose flower (Nagarajaiah and Reddy, 1986), flower diameter of "Queen Elizabeth" and "Baccara" roses (El-Shafie *et. al.*, 1980), advances flowering of "Kushui" roses (Ma *et. al.*, 1985). "Raktagandha" rose plants sprayed with GA_3 (50 to 500 ppm) increased the water uptake of cut flowers, improved the vase life of flowers, enhanced

the diameter of fully opened cut roses and petal area progressively with increased doses of GA_3 (Bhattacharjee, 1993). In "Super Star" roses GA_3 spray once in November at 100 ppm recorded maximum vase life followed by IAA and BA at 100 ppm (Bhattacharjee and Renu Rajan, 1995). Application of GA_3 (50 to 100 ppm) improved post harvest quality of roses by proper anthocyanin pigmentation. BA induced the formation of lateral shoots and indirectly promoted flower production in roses (Halevy, 1983, Zeislin *et. al.*, 1985).

Application of CCC (Cycocel) two times as foliar spray at 2000 or 4000 ppm resulted in quality flower production with increased longevity in several varieties of hybrid tea roses; the foliar application of the chemical was found better than soil drenching of CCC at 1000 and 2000 ppm (Bhattacharjee and Bose, 1979). Foliar spray of cycocel at 5000 or 10,000 ppm one month after pruning of hybrid tea rose cv. "Celebration" resulted in advanced flowering (Maharana and Pani, 1982). Foliar spray of chloromequat (1000 ppm) twice at November and January in "Raktagandha" roses markedly lengthened the vase life of cut flowers; this treatment significantly reduced total soluble sugar content in corolla, leaf and stem tissues at harvest and on third day in vase, which also resulted marked decrease of total free amino acids in leaf and corolla tissues at all different stages of senescence (Singh *et. al.*, 1996).

Foliar spray of SADH at 2000 or 4000 ppm induced early flowering, increased flower size and improved longevity of several rose cultivars (Bhattacharjee and Bose, 1979). Foliar spray of SADH at 5000 ppm in early vegetation stage of field grown "Dr. B. P. Pal" rose induced early flowering, encouraged large sized flowers, increased flower yield and enhanced longevity of intact flowers over the untreated plants (Bhattacharjee, 1993).

Foliar spray of ethrel at 0.06% applied at vegetative bud formation and flowering stage resulted in great responses to flowering in *Rosa damascena* (Farooqui and Sharma, 1990). Treatment of ethrel (500 to 2500 ppm) in "Eiffel Tower" rose increased flower diameter and decreased the longevity of intact flowers (Bhattacharjee *et. al.*, 1994).

PRUNING

"Super Star" rose plants pruned during 13th October to 17th November under Delhi condition showed most beneficial effects on vase life of cut flowers, while early or late pruning advanced cut flowers senescence (Bhattacharjee, 1992). "Super Star" roses pruned at 45 cm length with 4 shoots markedly improved the post-harvest life of cut flowers, while severe and hard pruning adversely affected flower longevity (Bhattacharjee, 1992a).

PLANTING DENSITY

High density planting treatments in the field grown "Super Star" roses i.e., 30 x 20 cm or 30 x 30 cm adversely affected the quality of bloom and post harvest life of cut roses due to more competition of nutrients and moisture, insufficient light level and reduced photosynthesis (Bhattacharjee, 1992b).

IRRIGATION

Stress due to excessive or inadequate water in the growing medium reduces the longevity and quality of cut flowers. Moisture stress increases the rate of transpiration over the rate of absorption. Higher level of moisture stress affects both quality and yield

of flower, by decreasing cell enlargement. Increasing frequency of irrigation, in general, increases the yield and quality of cut flowers. Moisture stress has been found to cause leaf and flower senescence through its effects on photosynthesis, stomatal closure, protein synthesis and cell division (Bhattacharjee and De, 2005).

HARVEST SEASON

Rose cut flowers of winter and spring season were superior in quality to those of summer and rainy season. In tropical and sub tropical climates, for quality flower production and longest life of intact flowers, winter was found to be more suitable, while the post- harvest life was only next to spring season flowers. Increased growing temperatures in summer and rainy season drastically reduced the vase life and flower diameter of "Super Star" roses (Renu Rajan and Bhattacharjee, 1996).

CARBON DIOXIDE

CO_2 enrichment increases photosynthesis by increasing carboxylation of RUBP and decreasing photorespiration. Roses with more number of petals, longer and thicker stems, more number of lateral shoots and larger number of flowers are produced with enriched CO_2 (De *et. al.*, 1998).

PESTS AND DISEASES

Pests and diseases injure leaves and flowers and ultimately deteriorate the quality of rose cut flowers. Damaged tissues caused by them show wilting and produce ethylene (Nowak and Rudnicki, 1990), which causes early senescence as well as petal and leaf fall. Vascular diseases of floral crops hinder transport; affect their post harvest life and quality (Aarts, 1957).

HARVEST FACTORS

The potential lasting quality of cut flowers is predetermined at harvest. Certain harvest factors like stage of harvest, method of harvest, cut flower stems and leaves, and time of harvest influence the keeping quality of flowers.

STAGE OF HARVEST

Cutting of flowers in the bud stage is preferable, when possible, since they are easier to handle and less susceptible to detrimental environmental conditions like high temperature and ethylene. Flowers cut at an advanced stage have a shorter longevity than younger ones. Flowers cut too immaturely do not open properly, those cut at too advanced stage wither quickly. Generally, the flowers remain in turgid condition for a longer time if harvested at proper stage of development.

Nikolova and Konezak (1985) reported on "Sonia" roses that these flowers should be harvested at a stage when one petal was unfurling. Van Doorm *et. at.*, (1991) observed that roses harvested at cracked bud stage opened better than those harvested at tight bud stage. Gudin (1992), observed that flower stems harvested at the tight bud stage reached a half open stage more slowly, than those harvested at the cracked bud stage, whereas they reached fully opened stage earlier. Potential useful life of "Angelique" and "Super Star" cut roses can be lengthened if buds are harvested at a stage when two petals outcurve

from the tip (Bhattacharjee, 1992c). For better post harvest life, buds should be harvested either at tight bud stage with all calyx outcurved or one petal outcurved from the tip of the flower in "Raktagandha" (Bhattacharjee, 1992 d). Among the eight different stages of harvest in "Priyadarshani" roses, harvesting of flowers at a stage when all calyxes are at right angles to bud and one petal unfurls from the tip is best for obtaining maximum flower diameter in vase and for extending useful floral life (Bhattacharjee, 1993). Irrespective of the stage of harvest, there was a decreasing trend in the total reducing sugar content in the corolla from harvest towards senescence in vase (Bhattacharjee and Rajan, 2001).

Number of Leaves

Nichols and Ho (1979) suggested that as many leaves as possible may be left on the cut stems as they supply nutrients to the developing corolla. Mayak *et. al.*, (1974), reported that defoliation caused a ten-fold reduction in transpiration rates of "Beccara" and "Golden Wave" roses. But maximum vase life of ten days in cut "Sonia" roses was recorded with defoliated stems (Ferreira and Swardt, 1981). Flowers with one, two and four leaves recorded eight, seven and six days of vase life. The number of leaves retained on the stems at harvest of "Super Star" rose had no effect on their longevity in vase. There was decreasing trend of the content of total soluble sugar in both leaves and stems towards senescence. The total and reducing sugar content of the corolla showed an increasing trend towards senescence in vase (Renu Rajan, *et. al.*, 2002).

Stem Length

Studies conducted to correlate the stem length of four different rose cultivars like "Eiffel Tower" (15 cm to 85 cm), "Raktagandha" (15cm to 60 cm), "Super Star" (15 cm to 60 cm) and "Priyadarshini"(10 to 40 cm) with post harvest life and quality of cut roses. Vase life of all cultivar varied significantly with each increment of stem length. It has been observed that longer stem of cut roses added to the longevity of flowers, flower quality and water uptake in vase (Bhattacharjee, 1992 d; 1993; Renu Rajan and Bhattacharjee, 1994). However, Prince *et. al.*, (1980) reported that short-stemmed roses were more valuable to the consumers than medium or long stemmed roses.

Time of Harvest

It has been recorded that flowers harvested between 4 to 6 pm increased the vase life of rose cv. "Priyadarshini" (Bhattacharjee, 1993). The flowers should be transferred to water or preservative solutions immediately after harvest. Howland (1944) reported that roses harvested in the afternoon had a longer vase life than those cut in the morning. In rose cv. "Eiffel Tower" the longest vase life and maximum flower expansion was recorded when cut at 17.00 hours (Renu Rajan and Bhattacharjee, 1994). Flowering stems retain a higher amount of stored carbohydrates if cut in the afternoon.

POST HARVEST FACTORS

Apart from the importance of genetic, environment, pre-harvest and harvest factors; potential useful life of cut flowers largely depends on post harvest handling and management of cut flowers. Water relation and physiological stem plugging, bacterial and fungal plugging of xylem vessel elements, respiration, carbohydrate and nitrogen metabolism,

growth regulators, holding solution, pre-cooling, storage, packaging and temperature etc. influence the longevity and quality of cut flowers of roses.

WATER RELATION AND PHYSIOLOGICAL STEM PLUGGING

A high level of turgidity in necessary for the development of cut flower buds to full bloom maturity. When the flower is removed from the plant in a state of moisture stress, the column of water present under tension in the xylem may pull up and draw air bubbles into the exposed ends of xylem vessels. The stem will quickly recover its turgidity if the air bubbles are eliminated by vacuum infiltration of the end of the stem. This can also be avoided by recutting the stem under water soon after harvest. Apart, from this, physiological stem plugging occurs because of the wound and injury in the cut stem. Adding calcium nitrate or an enzyme inhibitor such as azide or DNP can reduce the severity of the problem. The water relations of cut flowers have been reviewed by Van Doorn (1997).

Good quality tap water significantly improved the longevity of "Super Star" roses over single and double distilled water. The tap water served as osmoticum in the flower tissue for increased longevity (Renu Ranjan and Bhattacharjee, 1993). Furthermore, a holding solution of pH 3.0 was found to be most beneficial in improving the post harvest life of "Super Star" roses. The addition of Tween 20 at 0.001% prolonged the vase life, but higher concentrations were phytotoxic (Renu Ranjan and Bhattacharjee, 1993). Studies on nature of blockage of vascular bundles in cut flower stems of "Raktagandha" roses showed that pectinatious material stained by ruthenium red were responsible for clogging of vascular bundles. Lignin and tannins were ruled out, as there was no staining with pholoroglucinol and ferric chloride, respectively. The blockage occurred all along the stem above the holding solution (Renu Ranjan and Bhattacharjee, 1994a). Vase life of "Christian Dior" cut roses increases in tap water or well water passed through a de-ioniser (Phavaphutanon and Kesta, 1998). Millipore filteration of water enhances flow rate of water through the rose stems, decreases the blockage and increases the hydration of peduncle tissue (Durkin, 1979). According to Phavaphutanon and Kesta, (1989), the optimum pH for extending vase life of "Christian Dior" cut roses varies between 4.0 to 5.0 pH. Wetting agents or surfactants decrease the surface tension of water, increase the lateral water flux, which removes water bubbles and helps to maintain a continuous xylem water column in the cut flowers.

BACTERIAL AND FUNGAL PLUGGING OF XYLEM VESSEL ELEMENTS

Factors attributed to the plugging of rose stem and consequent reduction of water uptake are : a) Organic Occlusions of the metabolic or microbial origin (Burdett, 1970; Parups and Molnar, 1972) and b) Microbial contaminations (Zagory and Reid, 1986; Put and Jason, 1989). Some possible explanation for the action of microorganism against cut flowers include bacterial plugging of flower vessel elements (Van Meeteren, 1978), enzymatic action (Durkin, 1967) or possible endogenous production of ethylene (Van Droon *et. al.*,1989). The bacteria that are predominant in the vase water of cut roses and other cut flowers have been identified as *Pseudomonas, Alcaligen faecalis, Enterobacterium, Aeromonas, Bacillus, Flavobacterium, Acetinobacter, Achromobacter, Erwinia* and *Corynebacteria*

(Van Droon *et. al.*,1991, Put, 1986). The predominant fungal species isolated and identified from vase water are *Botrytis cineria, Fusarium oxysporum, Mucor, Penecillium and Rhizopus stolonifer* (Denmink *et. al.*, 1987; Baayen *et. al.*,, 1988). In "Queen Elizabeth" cut roses, De and Bhattacharjee (2002) observed increased number of bacterial colonies of various shapes and different fungal genera like *Penecillium sp, Aspergillus niger, Alternaria alternata, Rhizopus stolonifera, Acremonium strictum* in vase water which were responsible for early senescence of cut flowers. Fungicide like Captan and bactericide like Streptopenecillin showed positive response in lengthening the life of cut "Queen Elizabeth" roses. Mwangi *et. al.*, (2003) identified the fungal genera in vase water of rose "Noblesse" during different days of vase life were *Alternaria alternata, Alternaria brassicola, Aspergillus flavons, Aureobasidium pullulescens, Acremonium sp;Dreschlera specifiera, Cladosporium cladosporoides, Fusarium pallidoroseum; and* bacteria *streptomyces griseus, Streptomysces albus* as influenced by precooling and pulsing.

Several workers reported reduced microbial population in vase solations with various biocides and have attributed the resulting increase in the vase life to the reduction of microbial numbers. Among the different biocides used in vase water were streptomycin sulphate, $CuSO_4$, Kanamycin, Cycloheximide, Chloramphenicol (Zagory and Reid, 1986); $AgNO_3$, Benzylkene, HQC, DICA (Van Doorn *et. al.*, 1989), HQC and low pH (Van Doorn and Perik, 1990), Chlorine and $Al_2 (SO_4)_3$ (Hoogerwerf and Van Doorn, 1992); DICA and HQC (Jones and Hill, 1993). The slow release chlorine compounds like sodium dichloroisocyanurate (DICA) and 1,3-dichloro-5-5- dimethyl hydantoin (DDMH) found to control bacteria in cut flowers. Greatest improvement in cut flower quality and longevity was obtained when DICA or DDMH were combined with sucrose (Marousky, 1976).

RESPIRATION

The standard method used throughout the flower industry that to retard flower senescence is to reduce respiration by decreasing the storage temperature. Rate of respiration had a bearing on the length of life of any cut flower. Siegelman (1952) observed that there was initial high level of respiration and gradual decrease with time for whole inflorescence of "Better Time" roses. Aarts (1957) stated that the individual flower parts responded in the same way as whole flowers when respiration was measured. Siegelman *et. al.*, (1958) described a definite respiratory pattern in developing rose petals, which consisted of a respiratory rise before opening of flowers, a peak when the flower opened and or drop following a complete opening of the flower. In *Rosa damascena* respiration rate increases as the flower developed; reaching maximum at the beginning of full bloom (Zolotovitch, 1964). In "Velvet Times" roses Coorts *et. al.*, (1965) reported that respiratory rate of flowers cut pre harvest was quite high and reached a maximum at a time when the sepals had folded out from the developed bud. At commercial harvest, when first petals were breaking away from the flower body respiration declined rapidly. The minimum post harvest rate was attained after third day of harvest. The respiration then increased to the sixth or seventh day before beginning to decline again.

Ferreira and Swardt (1980) observed that changes in respiration rate of petals of senescing "Sonia" roses clearly showed a typical climacteric. The cut rose of "Priyadarshini"were pulsed for 24 hours in the solution of different concentrations of

Salicylhydroxamic acid (SHAM) ranging from 0.2 to 1mM and then kept in distilled water. Except at 1mM concentration, SHAM an inhibitor of cynide-resistent respiration, was unable to reduce respiration rates and improving keeping quality of roses, thereby indicating that cynide-resistent respiration, was non-existent in cut roses (Renu Ranjan, 1993). In untreated roses she also observed a typical drop in the respiration rate initially from harvest till the third day and then a small rise towards the end of useful vase life of cut "Priyadarshini" roses. Sivasamy (1998) reported that highest respiration rate in cut roses was associated with shortest vase life, and lowest respiration with longest vase life. In cut roses respiration rates increased sharply during flower development and petal expansion stages. In the cultivars, which held longer vase life, the rates of respiration at different stage of flower development and ageing were comparatively lower than that of cultivars, which lasted for a shorter time (Bhattacharjee and Pal, 1999). The gradual decline in respiration and presumably decreases in respiration efficiency of rose petals are due to progressive inability of mitochondria to utilize the substrate (Kaltaler and Steponkuo, 1976).

The gradual decline in respiration in ageing flowers may be caused by a short supply of readily respirable substrates, mainly sugars. In cut "Better Times" roses, lower storage temperatures were observed to reduce the rate of respiration (Pope, 1960). Serrano *et. al.*, (1992) reported that respiration of rose flower cv. "Visa" decreased during storage at 4°C. The rate of respiration became slower as storage time increased. Vidhya Sankar (2001) recorded that lower rate of respiration at different storages of "Raktagandha" cut roses was associated with longer vase life, resulted with 2 per cent DMSO pulsing + 4Days storage + preservative. Generally there was an increase in the rate of respiration after pulsing, the reduction after storage and further reduction at senescence.

CARBOHYDRATE AND NITROGEN METABOLISM

The carbohydrate status is one of the most essential factor that effect the development (Mor and Halevy, 1979, Halvey and Mayak, 1979; Halvey, 1987) and senescence (Halevy and Mayak, 1981; Zeislin, 1989) and in turn vase life of cut flowers. The final stage of flower development are characterized by a decline in the content of carbohydrates and dry weight of petals (Aarts, 1957; Coorts, 1973; Mayak and Halevy, 1974; Nichols, 1975). Sivasamy (1998) reported that higher starch content during different stages after harvest was associated with longer vase life of cut roses. In general, the starch content declined gradually from harvest to senescence stage. Marissen (1991) recorded a competition between the inner and outer petals for sugar during flower development, as the area and sugar content increased when fewer outer petals were present during vase life. A progressive rise in total soluble sugars content in the petal tissues of roses from harvest towards senescence was observed (Sivasamy, 1998).

Breakdown of protein causes an accumulation of ammonia in the cells, which is responsible for bluing of petals of red roses. An exogenous supply of of sugar delays the onset of excessive protein degradation and also serve as substrate of protein synthesis (Parups and Chan, 1973; Paulin, 1977). However, there is need for further study on the respiratory metabolism and protein recycling in cut flowers.

PLANT GROWTH HORMONES

Ethylene plays an important role in the regulation and coordination of senescence in flower. Production of ethylene is less and stable in floral buds and young flowers. A sharp increase in ethylene evolution is found during flower maturation, opening and senescence. The pattern of ethylene production is composed of three different phases i) a low steady rate, ii) an accelerated rise to maximum emanation and iii) a last phase in which production is decreased. The second phase which indicate the terminal stage of senescence is correlated with the longevity of rose flowers. The second phase starts earlier in short-lived rose flowers (Mayak and Halevy, 1992).

Ethylene, which is implicated in the natural wilting of several cut flowers, has no role in the cut rose. Only when present in the environment where cut rose are placed ethylene hastens wilting of flowers. As the flower petals age, there is small but definite climacteric rise in ethylene production. However, application of ethylene inhibitor such as AOA or antagonists such as STS is ineffective in improving vase life of fresh unstored rose flowers (Bhattacharjee, 1999). Combined application of STS and sucrose prior to storage prolongs the post storage vase life of "Gabriella" rose flowers, but STS and AOA treatments aggravates bluing of stored flowers. When cut flowers are exposed to 0.5ppm ethylene for two days, it accelerates the flower opening in cultivars like "Cara Mia", "Excitement", "Golden Fantasy", "Golden Wave", "Lavender", "Sonia" and "White Success". While in the cultivars like "Coed", "Gold Rush", "Golden Times", "Grace", "Lady Diana" such exposure of ethylene has no effect.

The level of cytokinin in rose petals decreases as the flower ages and the level is lower in a short duration cultivars (Bhattacharjee and De, 2005). In the petals of yellow and red cultivars of cut roses the activity of cytokinins decreases which is marked by a parallel increase in abscisic acid content and ethylene emanation. The additions of cytokinin to vase water or to a preservative solution inhibit petal senescence and prolong the vase life of cut roses following transportation. Gibberellins is not directly involved in control of senescence of rose cut flowers. Post harvest spray of GA and IAA on flower peduncle increases the flower bud size and improves the stress control of rose cut flowers. Growth and rigidity of rose peduncles are affected by Gibberellins and auxins. Increase in vase life and improvement of flower quality in "Raktagandha" cut roses was reported with Kinetin at 1 to 5 ppm, GA at 100 ppm and BA at 10 ppm (Singh, 1995).

Although the involvement of plant growth hormones in senescence process of flowers have been thoroughly investigated, the actual mechanism of action is still not clear. Identification of tissue specific and or hormone regulated genes may lead to modification of senescence process through genetic engineering approaches.

HOLDING SOLUTION

Use of preservative solutions has been known for many years in lengthening the vase life of cut flowers. Preservatives in the form of tablets are prepared from a mixture of chemicals, which are under categories like sugar, germicides, salts, growth regulators etc. Not only chemicals that are employed in preparing holding solutions, but also used during conditioning. The types of conditioners are sugar, biocide, antiethylene compounds

and hydrated compounds. The sugar and biocide solutions are effective for fresh bud cut of flowers to improve their opening and final quality.

CONDITIONING

It is a simple process where the flowers are kept standing loosely in a big container so that air can circulate around the stems. The purpose of this treatment is to restore the turgidity of cut flowers from water stress during storage and transportation. Conditioning is achieved by treating the flowers with demineralized water supplemented with germicides and acidified with citric acid to pH 4.5 to 5.0 but with or without sugar. Hydration is improved when water is de-aerated or acidified or when a wetting agent like Tween-20 at the rate of 0.01-0.1 percent is added (Durkin, 1981). Flower stems should be placed in warm water or in preservative solution in plastic jars at a depth of 2-4 cm and held at room temperature or in cold storage for several hours. More wilted flowers may be immersed in water for an hour and then transferred to plastic containers with stems in warm water and placed in a cold room. Rose cut flowers may be conditioned at 500ppm citric acid in cold storage at 0-1°C overnight (Bhattacharjee and De, 2005).

IMPREGNATION

Sometimes, the cut ends of the flower stems are impregnated for a short time with chemicals. This treatment protects the blockage of the water vessel in the stem by microbial growth and stem decay. Cut roses may be impregnated with $AgNO_3$ or $NiCl_2$ or $CoCl_2$ for 10 to 15 minutes (Bhattacharjee and De, 2005). Impregnation of cut roses with nickel sulphate (10mM) for 20 minutes increases the vase life (Reddy *et. al.*, 1988).

PULSING WITH SUCROSE AND OTHER CHEMICALS

Pulsing is a short-term treatment given to the cut flowers before packing and transportation of flowers, the effect of which should last for entire shelf life of the flowers even when the flowers are held in water. For pulsing, sugar and other chemicals are used. Sucrose is most commonly used for pulsing. Supply of rose cut flowers with exogenous sugar maintains the pool of the dry matter and respirable substrates in the flower petals, which in turn promotes respiration and extends longevity. Sucrose replaces the depleted endogenous carbohydrates utilized during post harvest life of flowers. Applied sugar decreases the sensitivity of rose cut flowers to exogenous ethylene. Addition of sucrose antagonizes abscisic acid induced promotion of petal senescence and modified the effect of other growth regulators (Bhattacharjee, 1999). Different types of sugars were evaluated by Bhattacharjee (1999a) such as sucrose, dextrose monohydrate, glucose anhydrous, D-fructose, D-mannose, maltose and lactose for improving post harvest life and quality of cut rose cv. "Happiness". The most effective treatment, which improved the vase life and increased the fresh and dry weight, was D-fructose at 3 per cent.

Pulsing is found to be of great value in prolonging life, promoting opening and improving the colour and size of rose petals through osmo-regulation (Kuiper *et. al.*, 1995). The treatment is also effective in increasing anthocyanin concentrations in petals (Ichimura, 1998).

Apart from sugar different chemicals tried in "Raktagandha" cut roses for pulsing

with sucrose are STS (0.5mM) for 45 minutes, $AgNO_3$ (1mM) for 15 minutes, MH (1 per cent) for 8 hours, AOA (10mM) for 45 minutes, $CaCl_2$ (1 per cent) for 20 hours, $Na_2S_2O_3$, $5H_2O$ (1000 ppm) for 8 hours and SADH (500 ppm) for 8 hours (De and Bhattacharjee, 1998). Pulsing with DMSO (2 per cent) for 15 minutes in "Raktagandha" cut roses (Singh and Bhattacharjee, 2000a) were found best in increasing the vase life and flower quality. The "Marcedes" cut rose flower pulsed with DMSO (2 per cent) for 15 minutes can be dry stored at 4^0C upto 6 days without affecting the post-harvest life and quality (Kumar and Bhattacharjee, 2003). The "Noblesse" rose cut flowers when pulsed with BA (25ppm) or STS (0.5mM) for 15 minutes can be dry stored at 4°C without affecting their ultimate keeping quality in the vase at ambient temperature (Mwangi and Bhattacharjee, 2003). In "Mercedes" cut roses senescence can be appreciably delayed when the cut roses are pulsed with STS (0.5mM) for 45 minutes or MH (1per cent) for 8 hours and cool dry stored at 4°C for 4 days (Kumar and Bhattacharjee, 2003a). Maximum vase life of "Mercedes" cut roses (13days) was recorded under pulsing with Alar (300ppm for 8 hours) + 3 days dry cold storage; and with this pulsing treatment cut flowers can be dry stored upto 8 days without affecting their ultimate vase life (8.66 days in ambiant temperature) and quality of flowers (Kumar and Bhattacharjee, 2004). It was observed in "Golden Gate" cut rose that pulsing with STS (0.5mM) or BA (25 ppm) for 45 minutes and wet stored for three days at 4°C did not affect their ultimate keeping quality in vase at ambient temperature (Mwangi and Bhattacharjee, 2004). STS at 1mM for 3 hours is more effective pretreatment than $AgNO_3$ at 1mM for 3 hours in cut roses of "Red Sandra" if recutting of basal stem after treatment is considered (Son *et. al.*,2003). In rose cv. " Doris Tysterman", Singh and Tiwari (2002) observed that $AgNO_3$ (300 ppm) pulsing along with 8 per cent sugar enhanced vase life and solution uptake, whereas minimum weight loss and maximum diameter of flowers were noticed with $CaCl_2$ (1000 ppm) along with 8 per cent sucrose.

BUD OPENING SOLUTION

Bud opening is a procedure for harvesting flowers at a stage earlier than that normally considered as "Cutting stage" and then opening the buds off the plant. The appropriate development of small buds may be achieved only with continuous supply of nutrients.

The advantages of the bud opening solutions that has been demonstrated and suggested are :

(a) Reducing the sensitivity of flowers to extreme temperature, low humidity and ethylene during handling and transport.

(b) Saving space during shipment and storage.

(c) Extending the useful storage life of flowers.

(d) Reducing the time of the crop remains in the greenhouse or enabling a "once over" harvesting of a crop.

(e) Improving the opening, size and longevity of the flowers, mainly those grown under poor light or high temperature condition.

(f) Reducing the hazard of damage to the field grown flowers by adverse external conditions like hail storms and extreme temperature as well as by pests and diseases.

The chemical solutions and environmental conditions used for bud opening are in most cases similar to or identical with those of pulsing (Halevy and Mayak, 1981). To facilitate opening of immature flower buds, the flowers are harvested at a stage when buds are loose tipped with no unfurled petals, and sepals unfurled; and remaining at right angles to the axis of flower bud (De *et. al.*, 1996). Tight rose buds of cv. "Sonia" were developed to commercial maturity in vase solution containing 8-HQC at 300 ppm + sucrose at 2 per cent (Goszczynska and Reid, 1985). In four different stages of bud maturity of rose cv. "Super Star" bud solution containing STS (0.2mM) pulsing for 15 minutes + 8HQC (300 ppm) + sucrose (50 ppm); N : P : K (200 : 200 : 200 ppm) + aspirin (200 ppm)+ sucrose (2 per cent); KCl (500 ppm) + $Al_2(SO_4)_3$ (200 ppm) + boric acid (200 ppm) were found to improve the vase life and opening of cut flowers (De *et. al.*, 1996). A bud opening solution containing 4 per cent sucrose +250 ppm $CoCl_2$ + 200ppm HQC is found to be effective for opening of cut buds of rose cv. "Eiffel Tower" to a full extent; while 4 per cent sucrose +100 ppm aspirin is found best for rose cv. "Dr. B.P.Pal" (De and Bhattacharjee, 1997). In "Super Star" tight cut closed buds were developed to commercial maturity in vase solution containing 8 HQC (250 ppm) + acetyl salicylic acid (100 ppm) + D-fructose (1 per cent) (Bhattacharjee, 1997). For "Raktagandha" cut roses, D-fructose (100ppm) + boric acid acid (500ppm) + cobalt chloride (250 ppm) was found to the best bud opening solution (Singh, 1995).

VASE SOLUTION

Use of holding solutions in the flower vase has been known for many years for lengthening the vase life of cut flowers. These solutions generally contain sugar, germicides, mineral salts, growth regulators, ethylene inhibitors and organic acids. The vase solutions or holding solutions can be retained with the wholesaler or the retailer to keep flowers until they are sold to the consumers to use continuously in the vase. Good quality tap water improves the longevity of cut flowers than distilled water. Sucrose, citric acid and quinoline compound are the most commonly used sugars, acidifying agents and biocides, respectively, in vase solutions (Bhattacharjee, 1994). In an experiment, 58 different chemicals belonging to various chemical groups were used in holding solutions to test their efficiacy on the longevity and quality of cut roses. D-fructose at 4 per cent was found best in prolonging the vase life of roses followed by nickel chloride 250 ppm; chrysal 10, 640 ppm; L-ascorbic acid 500 ppm; Kinetin 1-5 ppm; SADH 25-100 ppm; and 8 HQC (150 ppm) in descending order (Singh, 1995).

Several researchers have reported pronounced increase in vase life of different rose varieties with the treatment of various chemicals combined with sucrose. A combination of $AgNO_3$ (2.5 mg/dm^3) + 8HQC (130 mg/dm^3) + citric acid (200 mg/dm^3) and sucrose (30g/dm^3) increased the vase life of cut "Sonia" roses from 7 days to 17 days (Ferreira and Swardt, 1980 a). A vase solution of sucrose at 4 per cent and $AgNO_3$ at 30 ppm was suggested by Aarts (1957). For "Better Times" roses vase solutions containing 8HQC(200 ppm) + sucrose (3per cent) was found best (Marousky, 1969). For cut roses of "Happiness", Sangma (1993) suggested a solution containing 100 ppm $Al_2(SO_4)_3$ +

200 ppm 8HQC + 2 per cent glucose. It has been reported by Bhattacharjee (1999) that $Al_2(SO_4)_3$ at 300 ppm, $FeSO_4$ at 450 ppm, $MgSO_4$ at 150 ppm or $MnSO_4$ at 450 ppm as vase solution markedly increased the longevity and improved the quality of "Queen Elizabeth" cut roses. Among the four sulphate salts, $Al_2(SO_4)_3$ or $MgSO_4$ resulted in maximum post-harvest life of this rose variety. Among the chloride salts, it was recorded by Bhattacharjee (1999a) in "Sonia Meilland" roses that $AlCl_2$ at 100 ppm, $COCl_2$ at 200 ppm, $MgCl_2$ at 200 ppm, $NiCl_2$ at 300 ppm or KCl at 400 ppm in holding solution resulted in increased vase life. Longest post harvest life was, however, observed with $NiCl_2$ at 300 ppm. Among growth regulators, BA (5 ppm), Kinetin (2.5 ppm), IAA (2.5 ppm) or GA_3 (150 ppm) in holding solution significantly increased vase life of "Eiffel Tower" cut roses (Bhattacharjee, 2000). "Priyadarshini" rose kept in holding solution containing 8HQC (250 ppm) + Citric acid (200 ppm) + $Al_2(SO_4)_3$ (50 ppm) + $AgNO_3$ (25 ppm) + Sucrose (1 per cent) markedly improve flower longevity, flower diameter, petal area and water uptake of cut flowers (Bhattacharjee, 1993a).

The combination of 8HQC at 200 ppm and sucrose at 3 per cent was suggested by Ichimura *et. al.*, (1999) for lengthening the vase life of cut roses. Son *et. al.*, (1997) suggested a holding solution for "Red Sandra" cut roses containing 8HQC (200 ppm) +ethionine (0.01mM) + Sucrose (2 per cent). Bhattacharjee (1998) reported that vase solution containing D-fructose (3 per cent) + $AgNO_3$ (25 ppm) significantly enhance post harvest life and quality of cut roses of "Christian Dior". Ajai Kumar and Ranvir Singh (2002) found that paclobutrazol (10 ppm), SADH (5 ppm) and MH (200 ppm) are better than other chemicals of increasing the vase life of cut roses cv. "Super Star". Kesta *et. al.*, (1993) observed that the vase life of cut rose cv. "Christian Dior" was significantly increased by using $AgNO_3$ at 20mg/lit and sucrose at 5 per cent as holding solution. For control of bacteria in vase water and improving quality of cut roses Marousky (1976) suggested 50 ppm DICA + 2 per cent sucrose or a combination of 50 ppm DDMH +2 percent sucrose. Ahn and Um (1991) recorded that 300 ppm $Al_2(SO_4)_3$ + 5 per cent sucrose resulted in better post harvest life of rose cut flower cv. "Marina".

GAMMA IRRADIATION

In agriculture one of the peaceful use of atomic energy, particularly gamma irradiation, is in the preservation of food products such as fruits, vegetables including mushrooms, cereals, pulses, spice and condiments etc. by preventing senescence, insect infestation and microbial contamination. However, experimental evidences on cut flower are very meagre. Gamma irradiation of cut flowers to enhance vase life is a new and novel area of research. Since the radiation sometimes damages even the host commodity, determination of optimum dose of irradiation is also very essential in order to prevent any losses. Tolerance to radiation varies with the species to species and even among cultivars. Variable response of gamma irradiation in roses and carnation with different cultivars were reported by Dupuy (1975). A dose of 50 Krad of gamma rays induced a favorable effect on prolonging the vase life of cut rose var. "Priyadarshini" (Bhattacharjee and Roy, 1994). In rose cv. "Raktagandha" higher dose of gamma irradiation (25 to 100 Krad) inhibited full expansion of cut flowers but prolonged the vase life. On the other hand, at lower doses (2.5 to 10 Krad), maximum opening of flower buds was observed

with better longevity (De *et. al.*, 1997). Increased vase life through gamma irradiation was associated with higher amount of total soluble sugars and lower amount of total free amino acids in the petal tissues of roses during the course of senescence (De *et. al.*, 1977).

In "Angelique" and "Super Star" cut roses treated with 5 Krad was found beneficial (De, 1995). Different doses of gamma irradiation (0.025 to 1.0 K Gy) significantly affected the post harvest life and quality of cut rose cvs. "First Red", "Golden Gate", "Mercedes" and "Noblesse". An irradiated dose of 0.025 K Gy was found best for cut roses and among four different cultivars, the cut rose cv. "Golden Gate" performed well under gamma irradiation (Bhattacharjee, 2003). The total soluble sugar (TSS) and total free amino acids (TFAA) contents of irradiated petal samples were found increased with increase in irradiated dose and at senescence, the TSS content declined, but the TFAA content increased in all treatments. Maximum TFAA content was recorded with 0.8 and 1.0K Gy irradiation rose petals (Bhattacharjee, 2003). Gamma irradiation at 0.025 K Gy increased the respiration rate of "Golden Gate" cut roses, while irradiation fallowed by cold storage (at 4°C) brought down the respiration rate after storage duration of 3 days. The irradiated flowers recorded the lowest amount of respiration at senescence and the vase life was maximum in the irradiated cold-stored flowers (Palani Kumar *et. al.*, 2003). Gamma irradiated (0.025K Gy) "Golden Gate" cut roses, when stored at 4°C for 3 to 7 days, and there after transferred to holding solution containing sucrose (4 per cent) + 8HQC (200 ppm) + $CaCl_2$ (250 ppm) was found best in flower quality and longevity (Palani Kumar, 2002). For loose flowers cv. " Gruss en Taplitz", irradiation dose of 2.5 Krad was found best for improving the shelf life, while storage for 2 days at 4°C after gamma irradiation (2.5 Krad) helped in retaining the freshness of flowers further (Kumar, 2002).

GRADING

In grading room, defective stems are removed. The stems are sorted in different lengths by colour coded boards or automatic grading machine. The long stem varieties are graded from 40 cm onward with a difference of 10 cm, whereas, short stem varieties are graded from 40 cm to 65 cm, with a difference of 5 cm. Leaves should be dark green, healthy; and free from dust, chemical residue, chemical injury, spider mites or powdery mildew etc. The flowers should not be of "Bull Head", too open, too tight, with "bent neck", damaged by thrips or *Botrytis*. Bud size should be representative of the variety. The length of the neck should not be too much. (Bhattacharjee and De, 2005).

PRE-COOLING

After flowers are cut, fast removal of field heat is important before storing. Pre-cooling flowers to optimal storage temperature also prevents moisture from condensing on flowers, reduces the risks of *Botrytis* infection. Pre-cooling is done either by room cooling or by forced air-cooling. Pre-cooling temperature of rose is 1 to 3°C. Pre-cooling is an important post- harvest handling and transport measure of cut flowers; which can be done through dipping in water, water spray, ice-cold water spray and keeping in cold storage at 4°C (Palanikumar and Bhattacharjee, 2000). Pre-cooling of cut flowers by cold storage at 4°C for 24 hours or spraying ice-cold water for 45 minutes over the buds and stems are found to be best techniques for removal of field heat in "Raktagandha" roses, these

treatments significantly reduced respiration rate and increased vase life (Palanikumar *et. al.*, 2000 a). Pre-cooling with cold storage at 4°C for 24 hours and pulsing with DMSO 2 percent in "Golden Gate" cut roses markedly improved flower quality and vase life (Mwangi and Bhattacharjee, 2002).

Gao *et. al.*, (1994) studied the water loss of cut roses during the process of vaccum pre-cooling and concluded that vaccum cooling technique improves the cut flower longevity and maintains the high water potential. Hu-Yu Xiao *et. al.*, (1998) observed on cut rose cv. "Bridal Pink" flowers, which were precooled for 2 hours, and subjected to simulated transport for 2, 24, 48, 72 hours at 20°C or 5°C that when flowers were transported wet in deionized water, they maintained their fresh weight thus prolonging better vase life at 5°C than 20°C. Substituting 0.3mM 8HQC and 0.1M fructose for deionized water during the 72 hours transport period at 5°C prolonged the vase life of cut roses more than two times than that of dry transported ones.

STORAGE

With the expansion of floriculture industry, storage of rose cut flower has gained considerable importance in post-harvest handling methods. Storage of flowers makes it possible to adjust the supply and demand of the market. It regulates the market flow of cut flowers and reduces loss from demand decline. It facilitates appropriate preservation of large volume of rose cut flowers, their transportation and distribution to consumers. There are several factors affecting the storage life of cut flowers. Genetic factors and external conditions during storage determine the length of storage suitable for particular cultivar. Flowers destined for storage must be of very good quality and should be harvested at optimal stage of bud development. Good post-storage quality of flowers also depends on lower rate of respiration; decreased water loss, retarded fungal and bacterial infection, inhibited ethylene production and its action. Most of the rose cultivars are preserved longest in a temperature of 0 to 1^0C. But in such low temperature, all temperature fluctuation must be prevented. A decline in temperature below 0^0C may cause the freezing in water in the tissues and the loss of stored material. To be in safe side, rose can be stored at 1.7 to 4.4^0C. Rose are, however, less sensitive to chilling injury. During low temperature exposure ethylene biosynthesis in rose follows a climacteric course, but ethylene action is prevented, thus explaining the absence of senescence symptoms at low temperature (Bhattacharjee, 1999).

Different storage methods are adopted like cold storage, controlled and modified atmosphere storage, and low-pressure storage. Cold storage of flowers using wet and dry methods has been tested in roses. For shorter storage period wet storage is generally used, when stem bases of cut flowers are held in water or in a preservative solution. But this storage is ineffective in inhibiting the biological activity of flowers. For long-term storage, cut flowers are stored dry, packed lightly in boxes or polythene sacks to prevent loss of moisture. Rose can be stored dry upto a maximum period of two weeks at a storage temperature between 0.5 to 3°C (Staby *et. al.*, 1984). Field grown "Super Star" cut roses can be stored wet for four days at 4°C and 80% RH without affecting its ultimate vase life at ambient temperature. Cut rose buds stored up to four days expanded properly in vase and showed no bent neck. Beyond four days storage, there was an increase in bud

size and fresh weight and decrease in dry weight. Increase in storage period of "Super Star" roses increased the percentage of "Bent Neck" and reduced the vase life at ambient temperatures (Renu Ranjan and Bhattacharjee, 1995). At 4°C cut roses of "Raktagandha" can be stored wet or dry for 5 days. At 8°C, cut rose can be stored for 2 days only retaining the ultimate vase life in ambient temperature (Sivasamy and Bhattacharjee, 2000). Wet storage at 0-1°C for a period of 4 and 7 days to the cultivars "Baccara" and "Sonia" respectively is recommended by De Boer and Hilhorst (1979). A reduction in vase life of "Mercedes" roses was noticed by Faragher and Mayak (1984), if storage (2°C for 10 days and 17 days) was extended, which was accompanied by increasing ethylene production and membrane permeability.

Deambrogio and Garibaldi (1991) found that the cut "Serena" roses stored at 2°C for three days had a vase life of 10.56 days in distilled water, when compared to those stored in refrigerators for 6 and 9 days, which had a vase life of 7.79 and 4.60 days respectively. The cut rose cultivars "Golden Giant", "Raktagandha" and "Queen Elizabeth" can be stored under 4°C for a maximum of 5 days, and under 8°C cut rose can be stored for a maximum of two days without affecting their ultimate keeping quality in vase at ambient temperature (Palani Kumar and Bhattacharjee, 2001). Wet storage of cut rose cv. "Floke Lore" for 6 days at 4°C recorded highest water potential (Palani Kumar *et. al.*, 1999). Gamma irradiation at 0.025 K Gy increased respiration rate of "Golden Gate" cut roses, while irradiation followed by cold storage (at 4°C) brought down the respiration rate after storage duration of 3 days (Palani Kumar *et. al.*, 2003). The cut roses of "Folklore" and "Queen Elizabeth" were pulsed with 3 per cent sucrose and 150 ppm 8-HQC for 24 hours under 20-21°C and then stored (4°C) dry for 4 to 10 days; it was observed that above two varieties can be stored successfully upto 6 days without hampering the ultimate vase life and quality of cut flowers in vases at ambient temperatures (Palani Kumar *et. al.*, 2000). The cut roses of "Noblesse", if pulsed with BA (25ppm) or STS (0.5mM) for 45 days, can be dry stored for 6 days at 4°C without affecting their ultimate keeping quality (Mwangi and Bhattacharjee, 2003).

Pulsing of cut rose cv. "Raktagandha" with sucrose (3%) + 8 HQC (150 ppm) for 24 hours prior to wet storage (3°C) significantly increased the total soluble sugars and total starch contents in petals and leaf tissues in both the stages, i.e. immediately after storage and on senescence, than those treated with distilled water (no pulsing) over 8 days of storage. Irrespective of pulsing treatments and duration of storage, total soluble sugars increased with corresponding decrease in total starch content. Prolonged vase-life of cut rose was associated with increase in total soluble sugars and total starch as influenced by pulsing treatment (Shiva and Bhattacharjee, 2006).

PACKAGING

Packaging is an important aspect in the flower trade and much depends on the proper method of packaging to ensure the garden fresh quality of flowers to consumers. The main principle of the packaging towards long storage life and keeping quality are to lower the rate of transpiration, respiration and cell division during transportation. Packaging of cut flower is directly linked with some important post-harvest treatments like conditioning or hardening, pulsing or loading, pre-cooling etc.; over and above the

proper understanding of the post-harvest physiology and senescence of flowers (Bhattacharjee, 1999). The most suitable package material for rose cut blooms is a corrugated fiberboard box. It is best to use telescopic boxes that are made up of two parts, a bottom and a lid, which fit together. Packaging in corrugated card board boxes lined with polythene film and wet newspaper was found better in some cultivars than packaging in corrugated card board alone. Apart from this, there are enormous ranges of variabilities in interior packaging material like paper, paper board, transparent film, polythene, nails, staples, cooling or refrigerated elements, cushioning, elastic tape or other fascinating devices which are to be studied for their appropriateness and cost effectiveness. It should be kept in mind that attractive packaging could make a high quality product even more appealing. There is need to compare the various packaging alternatives, the associated cost and potential results which may be obtained with better presentation.

Wrapping "Raktagandha" cut roses in a single layer CFB sheet before packaging in telescopic type CFB boxes was found to be most suitable with regards to subsequent vase life and quality (Vidhya Sankar and Bhattacharjee, 2003). Pre-cooling with ice-cold water spray for 45 minutes, pulsing with DMSO (2per cent) for 15 minutes and wrapping with different packaging materials significantly decreased the total starch (TS), total soluble sugars (TSS) and total phenols, while increasing the total free amino acids (TFAA) in rose petal tissues of "Golden Gate" cut roses at senescence; maximum vase life was obtained with flowers pre-cooled, pulsed and packed in butter paper packaging material for 6 hours, which also recorded the minimum TFAA both in third day in vase and at senescence stage (Mwangi *et. al.*, 2003). A significant increase in *Botrytis cinerea* spotting was observed on packed rose flowers cv. "Sonia" which experienced both cooling and slow rewarming in box (Swam *et. al.*, 1996).

TRANSPORTATION

The flowers should be transported at an optimal low temperature. All rose flowers should be cooled as rapidly as possible after harvest and before transportation. Without pre-cooling of rose cut flowers, it is difficult to maintain low temperature during flower transportation even with the benefit of continuous refrigeration. The relative humidity of air during pre-cooling and shipment of cut flowers should be maintained at the level of 95 to 98 percent. When the flowers are shipped in tightly closed, non-ventilated boxes at high temperature, they suffer from ethylene damage. The flowers may be transported in insulated truck without refrigeration after pre-cooling and proper packaging. Air shipment is quickest but usually temperature is not controlled during the flight. Moreover, ethylene concentrations at airports are high. Hence, attention is to be paid for pre-cooling the flowers and these should be pulsed with silver thiosulphate and sugar prior to air shipment (Bhattacharjee, 1999). Transportation of rose cut flower cv. "Mary de Vor" at 5^0C is better than that of 25^0C with regard to the quality and vase life of transported flower (Ann, 1997). The boxes are unloaded at the place of destination into the refrigerated vans to keep the flowers cool. After storage or transportation rose stems are re-cut to basal 2-3 cm and hydrated by putting them in a solution of acidifying agent such as aluminium sulphate (300 ppm) or citric acid (300 ppm) for a few hours. Hydration helps the cut flowers to regain turgidity and increases vase life (Bhattacharjee and De, 2005). Since

flower transportation offers improvement in the profitability of flower industry; additional studies are needed to determine the proper packaging methods, pre-cooling, pulsing, pretreatment, bud opening, refrigeration in the shipment and cost effectiveness of these methods.

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19

ALLIED PRODUCTS

The exquisite beauty of roses and their delicate fragrances has been admired for thousands of years by human being. Over the years roses are utilized in various ways. Rose water, Rose oil, Rose wine, Rose jelly, Rose hip syrup, Rose pudding, Rose gulkand, Rose pankhuri, Rose pot pourri, Rose scented soap, Rose scented cold cream, Rose petal bags, Rose agarbatti and dhupbatti and Rose rangoli are the ways by which allied products of rose are utilized. Rose became popular again for about 200 years as a flavoring agent until eventually replaced in flavour by vanilla. A few species are grown on a commercial scale for the preparation of products like rose water and rose oil (Otto of Rose), which are widely used in perfumery. Petals of several species of roses are used for the preparation of *gulkand.* The fruits, popularly known, as 'Rose Hips' are rich source of Vitamin 'C'. Roses also add beauty to the gardens and landscape with their diversified growth habit, innumerable varieties of brilliant colours; and attractive sizes, shape and forms of flowers.

In India 60-70% of total production of rose is utilized in the production of rose water. Small quantities are used in preparation of *attars, gulkand* and hair oils. A part of the crop of Edward roses is used for the production of rose water and the rest is used for the production of *gulkand, attars* and hair oils (Anonymous, 1972).

ROSE WATER

Dark red roses are best for making rose water. Rose water is made by boiling the rose petals in water. It is allowed to simmer with the lid-on in order to trap the perfume. It is then strained and kept in jar. Now it can be used according to the choice. In commercial scale, it is prepared by steam distillation of the flowers with intact calyx with twice their weight of water, in tinned copper stills fitted with a false-bottom copper condenser and a receiver, which are cooled with running water. It takes 4 to 5 hours time. Rose water owes its scent mainly to phenyl ethyl alcohol. Rose water recovered from the distillation of rose oil is mildly astringent and beneficial for cleansing and refreshing dry, sensitive skin. It is used as perfume, as a vehicle for medicines and in confectionary.

It is also used for softening the flavour of tobacco. For wedding, feast and ceremonial occasions rose water is used. India exports rose water to U.K., USA, Canada, France, Australia, Singapore, Bahrain, Ethiopia, Fizi, Kuwait, Nepal, Oman, East Africa, Malaysia and Saudi Arabia.

The rose water can be prepared from very fragrant rose also like "Ena Harkness", "Charles Mallerin", "Chrysler Imperial", *R. cannina* etc. To make it at home 500 gm of fresh petals of fragrant red rose may be boiled in low heat in a large kattle half filled with water. A length of rubber tube is attached to the spout with the other end leading a jar or bottle. The middle portion of the tube is kept in iced water. The pure rose water will drip in the jar or bottle until almost all water in the kettle has been evaporated. The rose water is then kept in sealed glass container to be used when required (Roy Genders, 1965).

ROSE OIL

Mughal Emperor, Babur first introduced the musk and damask rose in India at his garden near Agra, in 1526. The empress Nur Jahan the wife of Babur's descendant, Emperor Jahangir is believed to have discovered rose oil in 1612. It is said that she noticed drops of rose-oil floating on the surface of water while she was taking bath in a tank full of rose water. She observed that heat of sun had formed a thin film of oil on the top of the water. She ordered that this oil should be skimmed off and put carefully into bottle and sealed. In the era of barter exchange, value of the rose oil is estimated by its five times equivalent weight of gold.

Inspite of thousands of varieties of roses available in nature, only a dozen or so are used for extracting rose oil. The most suitable species are however, *Rosa damascena, Rosa centifolia, Rosa alba* and *Rosa chinensis.* The essential oil is present in the epidermal cells of the inner surface of the petal, which constitute the most highly perfumed part of the flower. The relative concentration of the essential oil in the different parts of the flower of *R.damascena* is as follows: Petals 92.8%, Stamens 4.6%, Ovary with Calyx 2-3% and Stigma 0.3% (Anonymous, 1972). Rose oil is usually extracted from the flowers by steam distillation or by extraction with volatile solvents.

Rosa x damascena is grown in India in nearly 3500 ha in Aligarh, Gazipur, Farrukabad (Kanauj) and Balia districts of Uttar Pradesh, beside smaller areas in Ajmer (Pushkar), Udaipur district in Rajasthan, and also at Palampur of Himachal Pradesh. The cultivars, "Noorjehan" is grown in gangetic plains. The cultivars "Jwala" is recommended for subtropical regions in foothills and "Himroz" is suitable for temperate region (Gupta, 2002). In Uttar Pradesh, two kinds of roses are grown for perfumery. Damask rose i.e. *R. damascena* known locally as 'Fasli', 'Bussorah' or 'Barwara' in Aligarh and Ghazipur and Edward rose i.e. *R. bourboniana* locally known as 'Chenia gulab' or 'Baramasi' in Kannauj and Kanpur. In India rose, oil is obtained not directly from the distillate. Rose water obtained from red Damask flowers is placed in shallow earthenware or metal vessels covered with white muslin cloth and left to lie in the open during night. The fragrant butter like white substance floating on the surface of rose water is collected by means of a shell of feather and stored in glass bottles.

Through hydro-distillation, which is an age-old procedure where 100 litre capacity copper stills are used and given slow but constant heating, it takes 4 to 5 hours to give an yield of 0.25% in commercial units. To recover water-soluble aroma compound of the oil, co-habitation of water is advised to be cycled through filling in the still. Steam distilleries use large steel vessels and may yield upto 0.4% oil content. To obtain high yield of its contents solvent extraction is also carried out. The fresh rose-oil possess very delicate sweet aroma, containing 34% 1-citronellol, 35% geraniol and 12-13% nerol besides a large number of minor aroma components (Gupta, 2002).

Rose oil scent is very strong and it retains for a very longer period. If a needle, which has been dipped in rose oil, touches a handkerchief it will retain the scent for month even after washed. In the French rose oil industry *Rosa centifolia* is used. The oil, pale yellow or yellow-grey in color, is sometimes called 'Rose Absolute' oil to distinguish it from diluted versions. The weight of oil extracted is about one three-thousandth to one six-thousandth of the weight of the flowers, as for example, about 2,000 flowers are required to produce one gram of oil. Today, 70% to 80% of rose oil production happens in the 'Valley of Roses' in Bulgaria. Bulgarian rose Otto is obtained from *R.damascena*, which surpasses all other rose scents and as such is considered to be the standard. Otto of rose with its characteristic perfume is one of the oldest and most valuable perfumery material.

In aromatherapy, rose oil inspires emotional calm and stability without sedative effects. The aroma is powerful and comforting. Its physical actions are mildly astringent and balancing. Following ingredients are required viz. 4 ounces jojoba oil, 3 ounces distilled water, 1/2 ounce bees-wax, 20 drops rose absolute or Otto and 15 drops lavender.

Wax is melted in jojoba oil using a double boiler. Then distilled water is added in a thin stream while vigorously beating the mixture with a wire whisk. It is removed from heat and whisking is continued while adding the essential oils drop by drop.

Rose oils are for external use only and it should be kept away from children. It should be used only in handkerchief perfume or in cosmetics. It is also used in powders and creams. Eye contact should be avoided. Rose oils should not be used during pregnancy. Rose oils are not intended to diagnose, cure, prevent or treat any disease.

ROSE ATTAR OR ITRA

Rose Attars are next to rose water. A large number of different qualities of rose *attars* based on sandalwood oil or Paraffin's oil are produced to suit the taste of various people. Rose *Attar* has been famous in Persia and India for over 5,000 years. *Attar* is a Persian/ Arabic word meaning "fragrance, scent, or essence." It is also referred to as the *Most Exotic Natural Fragrance for the Soul. Attar* is incense, which has a tremendous effect on the olfactory nerves of a person.

Old texts mention that the floral groups primarily used for *attar* manufacture were *rose, bela, jasmine, champa, molesari* and *tuberose* along with roots like vetiver and ginger. Sandal, cinnamon and aloe bark were also used. Heavy odours like musk, myrrh and ambergris, were also used with *khus*. Sandalwood oil forms the base as, during distillation, the original smell of sandalwood vanishes and the oil captures the fragrance of the flower.

Distilled from fresh flowers, the fragrances are bottled in cut glass decanters after a costly and lengthy process.

ROSE OTTO

It is produced through steam distillation of fresh rose flowers. The Otto of Rose is not obtained directly from the distillate, but from the rose water collected during distillation of rose petals. Rose water stored in earthen pot or metallic vassels in cool night in the open collects the fragrant butter like substance i.e. otto floating on the surface of water (Singh *et.al.,* 2003). It is largely employed in perfuming soap and for flavouring of certain types of tobacco, particularly snuff and chewing tobacco. Limited quantities of the Otto are employed in the flavouring soft drinks and alcoholic liquers. It has antimicrobial properties, and has also been reported to be beneficial in the treatment of gallstones. It is hundred percent pure and natural products that are used in creams, lotions and soaps for its mild anti-viral and bactericidal properties, as well as for its fragrance.

ROSE CONCRETE

It is obtained from fresh rose petals through solvent extraction like petroleum ether or Hexane. The fresh petals are dipped in petroleum ether and stirred until the oil in the petals is dissolved in the solvent. The solvent is then evaporated at low temperature and under reduced pressure. The concerete of rose contains waxy residues and essential oils of the rose. Hexane is also used as solvent for extraction of essential oils from rose. The recovery of rose concrete ranges from 0.18 to 0.30 per cent, which is a reddish brown waxy material (Singh *et. al.,* 2003).

ROSE ABSOLUTE

It is produced through a refined liquid chemical extraction of fragrant compounds from fresh rose flower. The wax is separated from the rose concrete with pure alcohol. The absolute of rose is sticky brownish oil, which is the most costly product. It contains essential oil compound. It differs from distilled essential oils. It is a concentration of aromatic compounds including essential oils constituent. Rose absolute is widely used in perfumery, cosmetics, aromatherapy and many other areas.

GULKAND

Gulkand are prepared in large quantities in Aligarh, Puskar Valley (Ajmer), Amritsar and other rose growing area. It is prepared by pounding together a mixture of rose petals and white sugar in equal proportion or as in some areas, in the ratio of 1:2. Edward rose (*Rosa barboniana*) is preferred. The "Cheti gulab", *Rosa centifolia* is also used in small scale. Sepals are removed for this purpose. Gulkand is considered tonic and laxative and useful in sore throat and enlarged tonsils (Pal, 1966).

GUL ROGHAN

Hair oil prepared from rose petal is known as "Gul Roghan". For this purpose til seed (*Sesamum indicum*) are soaked in water to remove their covering, these are then dried in sun. The fresh rose petals and dehusked till seeds are spread in thin layers one over the other for 10 to 12 hours daily; the exhausted petals are replaced daily by fresh flowers for 5 to 7 days till the seeds are completely saturated with rose oil. These seeds are distilled

and the steam distilled vapours are absorbed in sandal wood oil. Or these seeds can be crushed in a press to extract the perfumed oil.

PANKHURI

Dried rose petals are popularly called as "*Pankhuri*". The Rose petals are dried in shade. This is used during hot weather for preparation of cold drinks. It is an important component of *thendai* (Pal, 1966).

ROSE HIP

The rose hip is the incompletely ripe fruit of the rose bush, which forms at the base of the flower. Rose hips are "pods" which contain the seeds of the rose bush. Rose hips vary widely in shape, size, and colour. Most typically they are red or orange, but may be dark purple to black dependent on rose species. They are an excellent source of Vitamin C and are popular for making teas, oils, and syrups. Rose hips can also be used to make yummy jams and jellies. Rose hips from the *Rugosa* species are often said to be the tastiest fruits for consumption. Rose hips contain 400 per cent more vitamin C than oranges. During Second World War, the Ministry of Health launched a campaign to encourage the picking of rose hips for the making of "rose hip syrup" because oranges were very scarce.

ROSE HIP SYRUP

Rose hip syrup is prepared by boiling washed rose hips in water. For this purpose 2kg of rose hips are boiled in water in a pan and simmered until the hips are quite soft, so that they may be pulped. The entire contents are to be placed in muslin bag and squeezed to extract the juice. Then the same pulps are again returned to the pan, boiled in water again and squeezing is repeated. After eliminating all seeds from the juice. 1kg of sugar is to be added to the juice, stirred and boiled for 5 minutes. The hot juice is to be bottled and when cooled. One teaspoon full can be consumed every day as a tonic (Roy Genders, 1965). To cure melancholy and choleric people, rose sytrup can be given (Anthony Ascham, Herbal, 1550).

ROSE HIP JAM

To prepare jam, 2.5kg of hips is washed thoroughly and placed in jam pan to which 1.5 lit of water is added. The content is then boiled and simmered for 15 minutes. The boiled hips are strained. Sugar is added @ 250gm per 500gm of pulp. These are then again boiled and stirred for 20 minutes, and then transferred to jam jars. Then jam jars are sealed and placed in dark cup boards (Roy Genders, 1965). Sir Hugh Platt, in his Delights for Ladies published in 1594 described numerous recipes of rose.

ROSE PERFUME

Rose was the first flower to be used for perfume. First report of extraction of perfume from the rose was of Dean Hole; who reported that Avicenna an Arabian doctor first discovered extraction of perfume from *Rosa centifolia* in eleventh century. Equal credit goes to Greek, Romans and Egyptians who had managed to extract an aroma from the rose by steeping petals in water, oil or alcohol even before Arabians. In the year 1187 when

Saladin conquered Jerusalem he sent men with 500 camels loaded with rose water to wash and purify the Mosque of Omar. From the Middle Ages to the nineteenth century the use of distilled rose water for perfumes was a part of every day house keeping in most parts of Europe. We all know that Avicenna discovered the art of making perfume from roses.

The roses used for perfume were the extremely fragrant damask rose (*Rosa damascena*). Delightful rose perfumes are created from "attar of roses" (or "rose oil"). Crushed rose petals are put in a steaming process that distills a mixture of essential oils. The distilling technique originated in Persia (the word Rose itself is Persian) then spread through Arabia and India. Bulgaria was the main centre of the commercial rose perfume trade. The Bulgarian damask rose were said to have a special fragrant quality, which should be found nowhere in the world. The Kaaba in Mecca is annually washed by the Iranian rose water. In Bulgaria, Iran and Germany, damask roses (*Rosa damascena* 'trigintipetala') are used.

France is the major exporter of rose perfumes, even though it now exports less than half of its output. It was estimated that Europe made about 150,000 gallons of perfume in 1890 and for its manufacture Nice and Cannes used up two and a half million roses. They were mainly the old cabbage roses but also included 'Paul Nabonand', 'Van Moutte', 'Paul Neyron' and 'Frau Karl Druschki'.

The fresh Damask rose has delicate sweet pleasing odor. It consists of 1-citronellol (23.9%), nerol (12.4%), geraniol (34.90%), phenyl ethyl alcohol (7.40%), rose oxide (1.30%), linalool (2.30%), eugenol (1.60%), ethanol (1.20%) and other minor aroma compounds. The oil of *Rosa centifolia* is inferior and it has 1-citronelol (23.89%), geraniol (12.78%), phenyl ethyl alcohol (16.36%), stearopentene (22.10%) with other minor compounds (Nigam *et. al.*, 1959). Guenther (1975) also reported physio-chemical characteristics of average good quality Bulgarian oil in his book on "The Essential Oils".

ROSE WINE

Romans made rose wine. In the process of preparation, first of all best rose petals were collected when the morning dew has dried. White part of the petal is removed. Petals are thread together and dipped in wine for several days. The new one replaces the old threads of rose petals and the same process is repeated after a week. After the third dip the wine was strained and honey is added. In this way rose wine is prepared.

ROSE SCENTED SOAP

The rose scented soap can be made by dissolving a few drops of almost boiling rose oil into a mixture of water and pure-white soap. The liquid is than poured into a container, and once it has cooled and solidified, it will emerge as cakes of rose-perfumed soap.

ROSE SCENTED COLD CREAM

Melting an ounce of white wax, and two ounces of almond oil together can make Rose scented cold cream. Two fluid ounces of rose water is than added. Stirring is required to make sure that all the ingredients are thoroughly mixed. Now they are poured into a container and left to cool and become solid. . Rose and lavender facial cream is excellent for sensitive combination skin. Dabbed onto a freshly washed face this cream is a fragrant, toning emollient.

ROSE POT-POURRI

Strongly scented varieties of rose are good for making pot-pourri. The cabbage rose, *R. centifolia* is considered as one of the best. Sun drying is the easiest and quicker method of preparation of rose potpourri but oil may be lost. Shade drying and warm room drying with well ventilation is perhaps better. Quick drying is essential, as it seems to fix the oils. Wire trays are good and ideal for rose drying. Wire trays ensure a good circulation of air. It is the easiest rose product as far as its preparation is concern. Petals are collected from yet to open buds and placed in basin. Around 3 parts of a basinful of rose petals is taken which posses a rich perfume and which have been dried in airy shadowed room. Than cup full of thyme is added to the petals. Some rosemary, the powdered outer skin of orange, a few bay leaves, half an ounce of crushed cloves and a tea spoonful of allspice is added. These ingredients are merely mixed together and left in a pot-pouri bowl to distil their fragrance over the room temperature. Carnation, *Acacia*, leaves of scented herbs may also be used to add the charm in pot-pourri (Roy Genders, 1965). A brief account of making pot-pourri was also given by Pal (1966).

ROSE PETAL BAGS

When the petals of fragrant roses are at their best, they are to be collected and dried. To this added dried leaves of majoram and powdered cloves. The dried leaves of rosemary and bergamot may also be used along with the above. All these are tied in small muslin bags. These bags can be placed along with clothes and placed below the pillow or may be hanged in the room for flavouring of the clothes, rooms or for peaceful sleep (Roy Genders, 1965).

AGARBATTIES AND DHOOPBATTIES

The left over material after steam distillation or enflurage process may be dried; or exhausted highly fragrant flowers may be dried is shade and employed to import the fragrance of flowers while making the above materials.

ROSE MEDICINES

Rose has made major role in preparation of many medicines. Pliny listed 32 medicines, which could be prepared from roses. In seventeenth century the rose was still being used to cure 32 diseases even the very serious ones. The ailments that rose were alleged to cure included nose bleeding, headaches, upset stomachs and pain around the eyes. Today this practice is continued and rose water is still used as an ingredient of some eye lotions and many face preparations. Colour of the rose is very important to cure. Pliny suggested that rose medicines could cure hydrophobia and disease of the lungs. It was used, as a remedy for the plague in the middle ages when rose was included in almost all European medical recipes. Walafrid Strabo (Botanist and Physician) described it as surpassing all other herbs in virtue and scent. *R. gallica officinalis* has always been used for preparation of medicines. Since 13th century it was grown in the town of Provins, near Paris. Thibaut IV originally collected the plant from the valley of Damascus. It was the centre of the medical rose-growing industry. Provins roses were also used in places as far apart as England and India for medical purpose.

A detail account of rose medicines and their other use are given by Bhattacharjee (2000). The syrup made from rose hips of *Rosa canina* "Dog Rose" is given to children for extra "Vitamin C" and as purgative; and the decoction of the receptacles is used for diarrhoea. The *Rosa centifolia*, rose oil is used for flavouring tobacco, flavouring soft drinks, alcoholic liquors, in cosmetics, handkerchief perfumes, powder and creams. Rose water prepared from *Rosa moschata* "Musk Rose" is used in medicines and perfume is also made out from the flowers. The syrup prepared from flowers of *Rosa sericea* is used to treat epilepsy and insomnia. The flower of Rose species like *R. filipes, R. helenae, R. longicuspis, R. macrophylla, R. macrophylla rubricaulis* and *R. spinosissima hispida* are highly fragrant. Many cultivars of garden roses possess delicate and equisite fragrances. All these species and rose cultivars may be useful for making allied products of rose.

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20

INSECT PESTS AND DISEASES

Roses are prone to a number of insect pests and diseases. The list is so lengthy, which may appear a terrifying and discouraging array of troubles for the beginner in rose cultivation. It is always better to take preventive measures. Prevention of trouble can take numerous paths. Production of healthy vigorous plants which will stand up to adverse conditions and throw off all such troubles should be given foremost priority in rose growing. The best defense against the attack of the insects, pests and diseases lies in planting of good quality-bred rose with proper care and supply of balanced nutrition and water, so that plant grow and remain strong. A well-nourished rose plant in a good growing environment is normally a healthy plant. Good air circulation, proper lighting and feeding, reasonably clear and sanitary growing conditions, appropriate drainage are some of the important measures in rose growing to prevent any attack. Disease free rose cultivars and use of pathogen free propagating materials are of primary importance.

Sanitation must aim in eliminating or reducing the amount of inoculums present in a plant, a field or a green house and also in preventing the spread of the pathogen to other healthy rose plants. This can be achieved by ploughing of land, pruning of infected or dead branches, removing of infected leaves, frequently disinfective secatuers and budding knives, washing of hand and other equipments, removal of infested crop residues and weed destruction. Creating conditions unfavorable to pathogen, by aeration, proper spacing, good soil drainage, soil amendments, appropriate choice of fertilizer, using composted tree bark in the planting medium. By increasing the soil temperature from solar heat, inactivate many soil borne pathogen fungi, nematodes and bacteria near the soil surface and thereby reduces the inoculums and potential of disease. In the new management strategies for commercial rose growing in large-scale, biological methods of control can also be adopted effectively against several plant diseases. Biological control is the direct or indirect manipulation of living natural control agents to increase their attack on pest species.

Preventive spraying and dusting of chemicals is beneficial in roses. Over-spraying is a common fault, and more harm is done by too much spray rather than too little. However, complete coverage with the spray, both upper and lower side of the leaves as well as shoots are essential. Need based use of pesticides rather than calendar based use of fungicide, insecticide or nematicides should be advocated. A pesticide should be chosen on the basis of its effectiveness and minimum effect on useful insects and non-target organism. Formulations, application methods, and timing of application are very important for effective integrated chemical control programme in roses. Mixing of different sprays

should only be done as per direction only; generally separate sprays ensure better results. Some rose growers prefer multipurpose insecticide and fungicide spray to take care of all troubles while expert rosarian's use specific chemicals against specific problem. Sprayers and dusters should be of best qualities. This will facilitate better results with ease. The sprays to the rose plants are found most effective if applied with the nozzle pointing upwards through the plants, so that liquid reaches the under-surface of the leaf. Sprays can be applied in early morning, many sprays will cause damage to foliage if use on hot and dry days. For spraying windy weather is to be avoided. Spray material should be handled with great caution, since many are poisonous and some are lethal. Directions about the spray material given in the packages should be followed strictly; the bottles and packages should be stored in a safe place out of reach of children and pet animals.

During the past 40 years or so, a great deal of research work has been done on insect pests and diseases of roses, both commercially and academically. In this chapter insects, pests and diseases of roses are discussed.

INSECTS AND OTHER PESTS

Aphids : *Aphis gosspii, Chaetosiphon tetrapodes, Macrosiphum rosaeformis, Macrosiphum rosae, Cinera sp, Chaetosiphon tetrapodes* and *Rhodobium Porosum.*

Symptoms : Out of the above *Macrosiphum rosae* is common and widespread. Large dark green or pink-brown aphids feed on buds, shoots and leaves. Colonies may persist throughout the year but are most numerous and troublesome in late spring and early summer. Foliage of infected plants is fouled with sticky honeydew and sometimes with sooty molds and growth may be checked (Sharma and Bhattacharjee, 2002). *Macrosiphum rosaeformis* nymphs and adults suck sap from various plant parts and the damage on leaves is more noticeable (Ullah, 1940). *Chaetosiphon tetrapodes* suck saps from tender shoots (David, 1957). *Cinera sp* of aphid infests shoots of roses (Sood and Kakar, 1990). The different species of aphids are found in clusters on the tender portions of shoots, buds, flowers and leaves. As a result, tender shoots wither, buds fall prematurely and the flowers malformed and fade. Aphids also excrete honeydew on which sooty mould grows and some species transmit viruses (Karuppuchamy and Palaniswamy, 2006).

Management : All species of aphids can be controlled with spraying of Malathion 50EC at the rate of 875 ml or Dimethoate 30 EC at the rate of 750ml or Phosphamidon 85 WSC at the rate of 187.5 ml in 250 litres of water per hectare (Atwal, 1986, Bhattacharjee and De, 2003). Spraying of Methyl Demeton 25EC at 2ml/l or neem oil at 3 per cent or Phosalone 35EC at 2ml/l or application of Carbofuron 3G at 5g/plant also control the pest (Regupathy *et. al.*, 1994). The parasites, *Aphidus rosae* and *Aphelinus sp.* parasitise the aphid and Coccinellid beetle *Coccinella septempunctata* predates upon it (Atwal and Dhingra, 1971, Das, 1918, Dhingra, 1968). The larvae of many species of syrphids can control aphid population rapidly. The larvae of green lacewing, *Chrysoperla carnea,* are voracious feeders of aphids and can consume upto 425 aphids per week (Karuppuchamy and Paleniswamy, 2006).

Thrips : *Lefroyothrips leforoyi, Megalurothrips usitatus, Physothrips andrewsi, Retithrips*

syriacus, Thrips tabaci, Thrips hawaiiensis, Taeniothrips lefroyi, Taeniothrips rhopalantennalis, Rhipiphorothrips cruentatus, Thrips florum, Thrips melanurus, Taeniothrips fulvus, Thrips fuscipensis and *Scirtothrips dorsalis.*

Symptoms : *Megalurothrips usitatus* feeds on flowers of roses (Verma *et. al.*, 1980), while *Physothrips andrewsi* lacerates petals on rose flowers (Bagnall, 1921). *Retithrips syriacus* infestation cause silvery appearance of leaves, turn brown, curl up and fall away (Patel, 1988). With the attack of thrips rose flowers are flecked with numerous light spots and streaks, which latter darken and rot. Roses grown under cover may be severely damaged by infestations developing early in the season (Sharma and Bhattacharjee, 2002). The female lays 60-100 eggs during their life stage. The nymphs hatch in 2 to 7 days, feed during the first two instance and then pass through two non-feeding pseudo-pupal stages in protected parts of the plant such as leaves or flowers, in leaf litter or in soil. The nymph and pupal periods are completed in 9 to 20 days and 2 to 5 days respectively. The female can reproduce with or without fertilization (Karuppuchamy and Palaniswamy, 2006). In green house grown roses, young leaves are more preferred by *Scirtothrips* to mature leaves (Jansi Rani and Sridhar, 2003).

Management : Spray neem oil 3 per cent or fish oil rosin soap at 2.5 per cent or Enodulfan 35EC or Phosalone 35 EC at 2 ml/l of water (Karuppuchamy and Palaniswamy, 2006). Spray Malathion 50EC at the rate of 500 ml in 500 litres of water per hectare (Atwal, 1986). Yellow or blue sticky traps are most useful for detecting the first infestation of thrips especially when rose is grown in green house conditions. The predatory phytoseiid mites, *Euseium* sp., *Neoseiulus* species and minute pirate bug *Orius* sp. feeds on several species of thrips. (Karuppuchamy and Palaniswamy, 2006). In green house regular watering and maintenance of cooler, more humid atmosphere can help to prevent infestation. Infestations in field-grown crops outside are usually worst during hot and dry period, and thrips population are reduced in cool and dry periods. Spray of Vertimex 0.25 or Mavrick 0.4ml/ litre is also recommended to control the thrips infestation (Sharma and Bhattacharjee, 2002).

Scales : *Aspidiotus transparens, Aspidiotus orientalis, Chionapsis sp., Chripomphalusa urantii, Aonidiella aurantii, Iceria aegyptiaca, Iceria formicarum, Ferrisia virgata, Iceria purchasi, Lindingaspis rossi,* and *Saisselia hemisphaericum.*

Symptoms : *Aonidiella aurantii* and *Lindingaspis rossi* causes severe infections before the rainy season, characterized by the formation of reddish brown encrustations on the lower portion of the old stems (Sharma and Bhattacharjee, 2002). Green house as well as garden roses are prone to attack by the pest and often choosy in their preferences to certain cultivars of roses (Rama Krishnan, 1984). *Aspidiotus* species infest shoots and leaves of roses (Nair, 1975). All other species infest tender shoots and twigs of roses.

Management : Insects remain covered with waxy coatings, and hence very difficult to control with severe attack. It is a deadly insect and quite difficult to eradicate. The encrustations of the scale insects can be removed by rubbing with cotton swab dipped in methylated sprit or by toothbrush. Spray of Metasystox (2ml/l) or Rogor (2ml/l) or use of granular insecticide like Phorate or Carbofuron 3G at 15kg a.i/ha was reported to be effective (Sharma and Bhattacharjee, 2002). Pongamia oil paint mixed with Nuvacron

or Metasystox (0.1%) also give good success. Early detection of scales by visual inspection of the plants will help to follow pest management practices. The presence of ants may be an indicator for the presence of scales. Cutting of twigs and leaves infested by scales and burning them will minimize scale incidence (Karuppuchamy and Palaniswamy, 2006). The grubs of green lacewing *Chrysoperla carnea* feed on the immature stages of scales. Several species of predatory lady bird beetles such as *Chilocorus* sp., *Rhizobius* sp., *Cryptolaemus montrouzieri* feed on soft scales in green houses (Rice Mahr *et. al.*, 2001). The infected pruned woods must be burnt.

Mealy bug : *Ferrisia virgata*

Symptoms : The pests appear on the stalks of flowers and buds, suck the sap and hence, the rose flowers bud opening is prevented and flowers whither away (Sharma and Bhattacharjee, 2002). The mealy bug infests shoots of roses (Nair, 1975). These are wingless insects and may become quite troublesome. These insects are encased in whitish waxy cotton like filament. In case of severe attack it is very difficult to control.

Management : It can be effectively controlled by the spray of Nuvacron (1ml/l); Metasystox or Metacid (2ml/l). The infected pruned woods must be burnt.

Red Spider Mite : *Tetranychus urticae, Tetranychus cinnabarinus, Brevipalpus phoenicis,* and *Typholodromus confuseus.*

Symptoms : These are devastating pests on rose grown in polyhouses. These are mites, but not insects, or spiders. They are observed under the surface of leaves and protected by silky web. The damage starts during hot and dry seasons on the lower surface on matured leaves causing symptoms of yellowing in patches on upper surface. In case of severe infestation buds and flowers resulting in discolorations, drying and dropping of affected parts (Jansi Rani, 2001). Feeding of spider mites results in white specks on leaves which later coalesce and produce white patches resulting in reduced photosynthetic activity (Karuppuchamy, 2001). In the polyhouse, the prevailing high humidity and temperature is very favorable for the population buildup of spider mites. Spider mites are found in large colonies on the undersurface of leaves covered with fine silky webs (Karuppuchamy and Palaniswamy, 2006) and as a result of feeding white specks appear on the leaves. With the infestation leaves turn yellow and fall.

Management : Effective control can be achieved with the spray of Wettable sulphur (3g/l), Nuvacron (1ml/l) or Kelthane (2ml/l). However, these acaricides were found not suitable for control of mite in polyhouses (Sharma and Bhattacharjee, 2002). An acaricide, Bifenazate (Flora mile 50WP) was observed to be safe to indigenous predatory mite, *Amblyseius* sp. and non-toxic to rose plants (Jhansi Rani and Sridhar, 2005). Frequent visual inspection of plant parts is the best method for detecting infestation of phytoseiid mite, *Phytoseiulus persimilis* was found to be the most promising predator for controlling *Tetranychus urticae* in rose under both polyhouse and field conditions (Ghosh, 2001). Release of laboratory rared colonies of the indigenous obligatory predatory mites, *Amblyseius longispinosus* has been found to be effective in controlling *Tetranychus urticae* in roses (Mallik *et. al.*, 1998).

Leafhopper : *Edwardsiana rosae, Motschulskyia serrata, Zygina bicornia* and *Amrasca devastans*

Symptoms : Stippling on leaves, yellowing and withering of leaves since these insects suck the sap of the leaves.

Management : Spray of Neem oil (3%) or Methyl Demeton 25 EC (2ml/l) or Phosalone 35EC (2ml/l) or application of Carbofuran 3G (5gm/plant) (Karuppuchamy and Palaniswamy, 2006).

Black Fly : *Aleurocantlius rosae.*

Symptoms : The insect feeds on the sap of rose plants, particularly tender leaves. These are minor insects and occasionally observed in roses. With the attack of insects, the leaves lose their luster and look dry. Crinkling of leaves caused due to sap sucking from leaves. The adults lay eggs on the undersurface of leaves. The nymphs are brownish yellow and the puparia jet-black with a colony fringe all around and globular secretions sticking to the tips of the spine (Karuppuchamy and Palaniswamy, 2006).

Management : According to Atwal (1986) the insects are controlled through the spray of Malathion 50EC (875ml/250lit), or Dithmethoate 30EC (750ml/250lit).

Scurfy Scale : *Aulacaspis rosae*

Symptoms : Round, flat, opaque scales upto 2-3mm across, form dense colonies on woody stems of certain species of rose, both outdoors and under green house conditions. Males are present in this species and the male scales are elongate white fluted scales, which are smaller than females. A female lays eggs in July-August. Nymphs soon hatch and settle to feed before hibernating (Sharma and Bhattacharjee, 2006).

Management : Rub the scales with cotton soaked in Kerosene or Diesel or methylated sprit. Cut and burn the affected branches. Spray of Melathion 50EC (2ml/l) twice, first at the time of pruning and again during March-April gives better results.

Red Cotton Bug : *Dysdercus sp.*

Symptoms : It causes moderate to severe damage mostly to rose flowers (Verghese and Prasad, 1983).

Management : Spray of Quinalphos 25EC (1.5ml/l) or Monocrotophos 36WSC (1ml/l) can control these insects (Karuppuchamy and Palaniswamy, 2006).

Flower Chafer Beetle : *Chiloloba acuta, Oxycetonia versicolour, Oxycetonia albopuncta, Adoratus versutus.*

Symptoms : *Oxycetonia albopuncta* feeds on flowers of rose (Sood, 1990), *Chiloloba acuta* feeds on leaves and flowers; while, *Oxycetonia versicolour* which is a red coloured beetle feeds upon growing points and making irregular holes and punches on the leaves. These insects are most active during wet months of the year. The adult lays eggs in the soil from which larvae develops into large fleshy yellowish-white grubs with strong biting mouthparts. The grub damages the roots and adults feeds on foliage.

Management : Hand picking and destruction of chaffer beetles during day time (Anonymous, 1999). Soil around the trunk to be treated with Carbaryl (10%) at the rate of 30gm/pant (Ramesh, 1994). Methyl Parathion 50EC (2ml/l of water) or Endosulfan 35EC (2ml/l) or Melathion 50EC (2ml/l) can control these insects. By regular hoeing and forking operations the grubs could be brought over the ground and killed.

Leaf Feeder : *Acleris extensana, Cocoecia pomivera*

Symptoms : Yellowish green larva with black head and brown prothorax ties up tender shoots and feeds by scrapping, bores in buds and flowers (Regupathy *et. al.*, 1994).

Management : Spray of 500ml Thiodan 35EC in 250 litres of water (Atwal, 1986).

Bark Eating Caterpillar : *Indarbela tetraonis*

Symptoms : The larvae feeds on the bark of rose stems, making L-shaped hole in stem for shelter. The larvae come out of the hole during night and feed on bark. The faecal pallets of larvae are found embedded in silken web at the site of infestation (Nair, 1975).

Management : For the control of the pest, during February-March, insert insecticide soaked cotton plugs (3ml Thiodan 35EC or 1ml Nuvacron 35WSC in one litre of water) into borer holes followed by plastering from outside with mud (Atwal, 1986).

Digger Wasp : *Crabro sp.*

Symptoms : It attacks the basal portion of the old plant and the pruned rose plants. They make a hole in the pith of the stem through the cut ends of the thick stem and remain there in the nest. The effected stems dry up from the tip downwards.

Management : Application of Dimethoate dropwise into the hole kills the insect. Soon after noticing the tunnels, the effected branch should be pruned to the healthy tissue and the cut ends are to be painted with insecticides.

Jassids : *Amrasca sp.*

Symptoms : Organism sucks juice from the leaves and cause yellowing or whitening of the affected parts. They are light grey or pale pink in colour with wedge shaped wings. Insects are active during April-May.

Management : For controlling insects Monocrotophos (0.05%) spray is recommended. Plants not receiving sufficient sunlight are likely to be attacked more.

Bud Borer : *Argyroploce aprobola, Eucosma Zelota.*

Symptoms : *Eucosma sp.* spines up the leaves and feed on them, while the larvae of *Argyroploce* bores into the bud and feeds on petals of flowers.

Management : The insect can be controlled by spray of Dichlorvos 76EC (1ml/l of water).

Hairy Catterpillar : *Euproctis fraterna, Porthesia scintillans,* and *Orgyia postica.*

Symptoms : The larvae feed on rose leaves cause irregular-shaped holes, and defoliates the leaves.

Management : They are killed by contact or stomach insecticides like Sevin, Nuvan (0.2%) or fenitrothion.

Ash Weevils : *Myllocerus dentifer, Myllocerus discolour, Myllocerus setulifer, Hyperstylus sp.*

Symptoms : It causes moderate to heavy damage to rose, the population of ash weevils increase from April to November and declines thereafter (Nair, 1975; Tewari, 1983). *Hyperstylus sp.* feeds on petals (Sood, 1990).

Management : Spray of Methyl Parathion 50EC (2ml/l) or Endosulfan 35EC (2ml/l) control the insects.

White Ants or Termites : *Microtermes obesi, Odontotermes obesus*

Symptoms : It is a serious pest, very often attack roses, even before they were established in the fields. With the attack a healthy looking plant may start withering suddenly. These insects feed on roots and rootlets of the rose plants. The damage is generally more severe in sand and sandy loam soil. The white ants eat the bark of the rose plants especially in the underground or around the soil. The white ants remain active throughout the year.

Management : As a preventive measure Aldrin dust may be applied to soil before planting new roses. Undecomposed farmyard manure should be avoided. Use of neem cake as manure act as a repellent. Drenching of rose beds with Chlorpyriphos 20EC (0.1%) also recommended for controlling termites in established gardens or before planting (Bose *et. al.*, 1999). Gamaxene (0.5%) dust is effective against white ants.

FUNGAL AND BACTERIAL DISEASES

Black Spot : The disease is caused by *Diplocarpon rosae;* a most common and harmful disease of rose throughout the world.

Symptoms : Black or a brown spot appears on foliage, leaflets turn yellow and it soon drops, there will be drastic reduction in size and number of flowers. This disease is generally observed on mature leaves and stems, though it may gain entry while the growth is young. Spots occur mostly on the upper side of the leaves, rarely on the lower surface. These spots are dark brown to black in colour, the spots are circular or irregular coalescent with characteristic feathery, radiate, fibrillose margins of subcuticular mycelial strands, radiating dark purplish margin. The spot also occur at the junction of the petiole and lamina and occasionally on the top portion of the young stem. Frequently, whole plant of susceptible variety becomes defoliated. Raised, purple-red, irregular blotches develop on the immature wood of the first year canes of susceptible cultivars (Sharma and Bhattacharjee, 2002). The fungus produces ethylene gas, which cause defoliation. An infected leaf contains less auxin than healthy ones. Wani *et. al.*, (1980) demonstrated that fungus produces abscisic acid which results premature defoliation. Bordoli and Ganguli (1963) reported that fungus might survive in the spots of young stem, which will serve as a source of new infection. The disease is most common in the humid coastal areas. Under green house condition where humidity is regulated carefully, this disease is a minor problem, whereas outdoor roses it is a major problem and frequently epidemic. Black spot disease has also been called leafy blotch, leaf spot, blotch, rose actinonema, rose leaf asteroma and star sooty mould (Sharma and Bhattacharjee, 2002).

Management : Dense planting should be avoided to allow good air circulation through leaf canopy. Removing leaves from the ground and pruning canopy that contains lesions will reduce over wintering of the pathogen. Leaves should not be allowed to remain wet or at high humidity for more than 7 to 12 hours. The infected leaves as soon as they are observed should be clipped off and burnt (Sharma and Bhattacharjee, 2002). As a control measure, the plant should be sprayed three or four times at weekly interval with

emulsion of Dithane Z-78 or Hexathane or Dithane M-45. Preventive spray of Bordeaux mixture or Ferbam (Ferric dimethyldithiocarbamate) at 20 days interval is most effective. In some trials Benomyl (Benlate) and Maneb gave equally good protection. Resistance to the causal agent to Black Spot is to be studied. The varieties showing field tolerance to this disease should be considered for cultivation and further breeding. Several researchers have investigated the source of resistance to the disease. Field resistance of roses to *Diplocarpon rosae* depends not only on inheritance, but also on conditions of growth, structure and environments (Saunders, 1966). Resistance is apparently determined by polygenic factors that are inherited independently.

Powdery Mildew : The disease is caused by *Sphaerotheca pannosa* var.*rosae*. It is a major disease of the rose all over the world.

Symptoms : Typical white powdery patches are formed on all the aerial parts of the plant including flower buds and blooms. The first symptom may appear on all parts of the plant as the disease advances. Raised blisters like areas develop on the leaves, which become coated with powdery growth of the fungus. Infected leaves are usually more purplish than healthy ones. New shoots get disturbed. In severe cases of powdery mildew attack, affected tissue on the surface of the leaves die and develop necrotic black areas. The severely affected leaves drop off the plant. The blooms are faded due to discolouration of petals. Infected buds do not open. Plant growth is checked. The fungus may perpetuate as dormant mycelium in vegetative buds (Sahni, 1980), and secondary spread takes place through air borne conidia (Pal, 1972).

Management : Severely infected plant parts should be pruned and burnt. Raking and destroying fallen leaves from around the bushes at the end of the season may inhibit overwintering. In green houses where temperature range in near optimal and humidity is high at night and low during the day, the disease is expected to occur. On outdoor roses powdery mildew can be expected to occur when rainfall is low or absent, the temperature range is near optimal and the humidity is high at night and low during the day (Sharma and Bhattacharjee, 2002). By regular fungicidal spray disease can be effectively controlled. Soluble Sulphur is very effective in controlling powdery mildew. In case of severe infection normally a 0.2% spray is given at weekly interval for 2 to 3 times. Systemic fungicide such as Bavistin (0.1%), Topsin M (0.1%), Benlate (0.1%) and Bayleton (0.1%) sprayed at 30 days interval has given good results (Dharamvir and Raychaudhary, 1973; Sahni, 1980). Non-systemic fungicides such as wettable Sulphur (0.2%), Morestan (0.2%) and Karathane (0.05%) sprayed at 7 to 10 days interval provided good control of powdery mildew in roses (Chacko and Raghavendra Rao, 1984; Upadhay and Bhandari, 1984; Sahni, 1980). The antibiotic formulation Actidione PM have been found to have both protective and eradicant action. There is a direct link between powdery mildew resistance and leaf content of anthocinidins, but no such relationship was noted with anthocyanin content (Allen, 1970). In green houses for preventive control measure lowering of night humidity by fan and or venting or by heat is suggested. Protective sprays are necessary when there is a favourable environment for the spread of disease in outdoor grown roses. Miniature roses exhibit high degree of resistance from powdery mildew, while most of the susceptible cultivars belonged to H.T. and Floribunda roses.

Dieback : A complex nature of disease caused by the association of several fungi e.g. *Diplodia rosarum, Colletotrichum gloeosporoides, Botryodiplodia theobromae, Coniotherium fuckelii, Gloeosporium sundari, Fusarium N Phomopsis species* (Rao and Srivastava, 1963; Shukla and Singh, 1991) a most serious disease of rose.

Symptoms : The disease normally starts from the pruned end of the rose twig and travels downwards, causing the death of affected branches. It appears in maximum severity following pruning of canes after monsoon. The symptoms appear in dark brownish purple patches at the cut end of the branches and ultimately turn black, which manifest by dying of shoots. In severe cases disease spread to the whole plant including twigs, main stem and the roots, and ultimately kill the entire plant. The old plants are more susceptible then young one. Infection is also observed on peduncles of withered blooms and in such cases infection may remain confined to few centimeters from the tip. Some of the diseased twig when cut open has found to be tunneled through the pith from the cut end downwards, showing the presence of Digger Wasp (*Crabro sp.*). The Twigs attacked by the Wasp readily dry up and frequently lead to dieback (Pal, 1972; Dharamvir and Sharma, 1985; Sharma and Bhattacharjee, 2002).

Management : Variation in the susceptibility of rose germplasm to dieback disease has been observed; only some level of tolerance was recorded but not found free of this disease. However, the occurrence of the disease can be greatly reduced by following prophylactic measure. Coating of the pruned end with a fungicidal paint containing 4 parts of copper carbonate, 4 parts of red lead and 5 parts of linseed oil control the disease effectively. Branches with superficial lesions and those partially infected should be pruned to healthy tissues. To reduce the inoculums potential fungicidal spray e.g. Bavistin (0.1%), Captan (0.2%) or Dithane M-45 (0.2%) is recommended. Some researchers suggested Bordeaux paste along with B.H.C. (0.1%) should be immediately coated on pruned end of each shoot. Secateurs may be dipped in 70% alcohol or formaldehyde after pruning of each plant. Fertilizer application may be delayed at least 10 days after pruning. Split dose of nitrogen application is better in roses rather than applying entire dose of nitrogen at a time to control this disease.

Alternaria Leaf Blight : This disease of rose is caused by *Alternaria alternata* (Rao, 1965).

Symptoms : The disease is prevalent in winter months and absent during warmer period. Symptoms show small irregular, dull brown to black spots on the margins and the apex of the leaves. The spots are scattered initially and later enlarge, become confluent and cover the entire leaf surface. Sometimes the individual spots show concentric rings (Rao, 1995). Infected leaves become brittle and the defoliation is quite common which may be upto 60% (Bedi and Singh, 1972). Flower buds and flowers are also infected under humid conditions, but the stems and twigs are not infected. The pathogen survives on the debries buried in soil. The rose varieties differ in their reaction to this disease (Rao, 1964).

Management : To check the disease 4 fungicidal spray at 10 days interval during December to January with Benlate (0.06%), Brestan (0.05%), Orthodifolitan (0.25%), Captan (0.25%) or Polyramcombi (0.25%) was found useful (Sahni, 1973).

Rust : Rust of rose is caused by *Phragmidium mucronatum* and other species like *P. butlen, P. disciflorum, P. ecenulum, P. kamtschatko, P. roseae moschatae* etc. The disease is more common in hills of India (Pal, 1972). In some localities of Rajasthan, the disease has been reported.

Symptoms : At early stages chlorotic spots on the leaf surface is visible. The disease causes a rusty appearance on the affected parts. The pustules of the fungus appear as yellowish to black swellings on the stems, petioles and leaves (Mukhopadhyay, 1990). The infection results in defoliation of the plant. Only uredial and telial stages of this fungus occur on roses. The rust perpetuated through uredial stages, and uredia play an important role in annual recurrence of this disease (Jain *et. al.*, 1979). Temperature between 20-25°C has been reported to be favourable for uredospore germination (Rao, 1995).

Management : Copper fungicide spray like Blitox (0.2%) or Phytolon (0.2%) before the appearance of the disease is helpful to prevent occurrence of the disease. While for infected plant spray with Difolitan (0.3%), Dithane Z-78 (0.2%) or wettable sulphur such as Sulfex (0.2%) at 2 weeks interval is recommended (Mukhopadhyay, 1990). Spray of chemicals like Saprol (0.2%) or Bayleton (0.15%) is effective in disease management (Sharma and Bhattacharjee, 2000). Three sprays at 15 days interval during March to April with Dithane M-45 (0.2%), Vitavax (0.1%), Benodonil (0.1%) and RH 124 (0.2%) were suggested by Jain *et. al.* (1979) to control the disease. Spray of Zineb (2000ppm) at 15 days interval has been recommended for the control of the rust (Dharmavir and Sharma, 1985). During the growing season sprays of Zineb or Maneb are effective. Allen (1970) reported good control results from dormant sprays of 4 per cent Carbolineum (Tar oil Emulsion) or 5 per cent ferrous sulphate.

Leaf Spot : *Colletotricum capsici* and *C. gloesporioides* cause this disease during rainy season.

Symptoms : The disease is characterized by the form of small, circular, blood red spots on the leaves, which increases in size, and cover the entire lamina. Defoliation causes with severity (Rao, 1995).

Management : Protective spray with Ziram; and infected plants to be sprayed with Bavistin (0.1%) or Derosol.

Bud and Twig Blight : The disease is caused by *Curvularia lunata* and *Phomopsis gulabia*

Symptoms : The disease symptoms are noticed in the form of yellowish and defoliation of the leaves, or light brown spots on the leaves.

Management : Foliar spray of Thiobendazole or Ziram is suggested for control of disease.

Botrytis Bud and Twig Blight : The disease is caused by *Botrytis cinerea.*

Symptoms : The disease is also known as Botrytis Blight or Gray Mould or Petal Fire of Botrytis Mould. The disease causes brownish patches on petals of flower buds, which enlarge and cover the entire surface, resulting in rotting. The infection also extends to twigs, killing them partially or wholly. Under humid conditions, abundant whitish grey

fructification appears on all over the blighted area (Rao, 1995). On flowers, infection develops in the form of water soaked lesions, which cause premature fading, discolouration and dropping. The infection is generally seen in the inner whorl of the flowers. In favourable conditions, the infection spread very fast, coinciding with the period of senescence (Sharma and Bhattacharjee, 2002).

Management : Spray of Bavistin (0.2%), Benomyl (0.2%) or Roval (0.2%) at regular interval has been recommended. Since the disease develops fast on wounded and senescent tissues it is advisable to remove crop debris and infected flowers. In green houses and field try to avoid high moisture conditions and free water on leaves and flowers (Sharma and Bhattacharjee, 2002). Spray of Ferbam (0.2%) or Bavistin (0.1%) or Dithane M-45 (0.2%) can control the disease (Bhattacharjee and De, 2003).

Downy Mildew : The disease is caused by *Peronospora sparsa.*

Symptoms : Dark purplish spots appear on the undersurface of the leaves.

Management : Foliar spray of Dithane M-45, Difolitan, Fycol 8E (1.0%), or Blitox are useful for controlling the disease (Mukhopadhyay, 1990).

Glomerella Leaf Blight : The disease is caused by *Glomerella cingulata*

Symptoms : The disease is characterized by circular or irregular spot on the foliage of roses, which later enlarge and become confluent (Rao, 1995).

Management : Spray of Benlate (0.1%) or Difolalan (0.1%) was found effective in controlling the disease (Sharma and Bhattacharjee, 2002).

Botryodiplodia Leaf Blight : The disease is caused by a pathogen *Botryodiplodia jaczevskii.*

Symptoms : The disease is characterized by the distinct, circular to irregular, initially buff brown and later changing to drab cinnamon. Spots are generally observed along margins and tips and occasionally cover the entire leaflet. Infected leaves become chlorotic and defoliate. Symptoms are also noticed on twigs of the plant, which shows heavy leaf infection. The spots on leaves are amphigenous (Rao, 1995).

Management : Collection and destruction of diseased plant part and spraying with Dithane M-45 (0.2%) are remedial measures for the disease.

Wilt : The disease is caused by *Verticillium albo-atrum*

Symptoms : Disease caused stunting of growth with chlorotic leaves and ultimately results in defoliation. In nursery disease hampers the rooting of cutting and their establishment (Bhattacharjee and De, 2003).

Management : Sterilization of soil, drenching of propagation media with Captan and Bavistin and removal and destruction of infected plants are controlling measures of the disease (Bhattacharjee and De, 2003).

Crown Gall : This disease of rose is caused by *Agrobacterium tumefaciens.* It is a bacterial disease.

Symptoms : Cauliflower like galls is produced most commonly at the crown region of the stem at the ground level. Galls are also produced on roots and on stems, wounded

due to harvesting, pruning and other cultural operations (Sharma and Bhattacharjee, 2002).

Management : The disease is a major problem to plant propagators. General control measure like clean nursery practice, use of disease free planting material and removal of infected debries. Commercial formulations consisting of *Agrobacterium rhizogensis (K-84)* is being successfully used in many countries to control Crown Gall (Sharma and Bhattacharjee, 2002).

NEMATODES

Nematodes are soil-born pests, pose both actual and potential problems in high-density planted permanent crops where crop rotation is not possible. Nematodes inhabit the soil and damage the root system of the plants. Rose fields or plots provide a favourable environment for building up high population densities of nematodes. Since, they are microscopic in size, on superficial inspection damage due to nematodes and their adverse effect on growth of the plants is not noticeable. Infected plant material may however, act as a carrier of nematodes. Prasad and Dasgupta (1964) listed the plant parasitic nematodes associated with rose crops in India are *Bitylenchus vulgaris, Hoplolaimus galeatus, Helicotylenchus nannus, Hemicycliohora typica, Meloidogyne javanica, Pratylenchus pratensis* and *Xiphinema diversicaudatum.* Apart from the above, other species of nematodes like *Helicotylenchus labiata, Helicotylenchus dihystera, Longidorus macrosoma, Meloidogyne hapla,* and *Pratylenchus vulnus* are also reported in roses in different parts of the world *(Nagesh and Janakiram, 2006).*

Symptoms : Roses affected by *Hoplolaimus galeatus, Helicotylenchus nannus, Hemicycliophora typica,* and *Xiphinema diversicaudatum* show stunting of growth (Prasad and Dasgupta, 1964). *Pratylenchus vulnus* causes stunting and chlorosis, affected root show patchy discolouration in cortical region, which coalesce and lead to root rotting (Schindler, 1956; Sher, 1957), while attack by *Xiphinema diversicaudatum* cause increased susceptibility to other diseases, crinkled terminals and poor secondary roots, and unproductive flowers of roses (Schindler, 1957). While Muthukrishnan *et. al.,* (1975) observed that Edward rose (*Rosa bourboniana*) and red rose (*Rosa chinensis*) was attributed to the attack of octoparasites *Hemicycliophora labiata* and *Xiphinema basiri,* which caused debilitation and unproductive flowers. Plant parasitic nematode *Pratylenchus zeae* attack induced chlorotic symptoms, poor and stunted growth with necrotic lesions on roots resembling poor growth of the rose plants (Sunderababu and Vadivelu, 1988). *Meloidogyne incognita* is identified by the characteristic root gall formation, show symptom of malnutrition, reduced shoot growth and induced chlorotic leaves in roses (Bhattacharjee and De, 2003). *Pratylenchus vulnus and P. penetrans* cause root decay, stunting growth and chlorotic leaves in roses (Bhattacharjee and De, 2003).

Management : Soil fumigation with Dichlorovos or Carbon Disulphide and application of Nemagon can control attack of *Pratylenchus vulnus* and *P. penetrans. Meloidogyne incognita* is controlled by deep summer ploughing, soil fumigation with Dichlorovos and application of Nemagon (10-12 l/ha) with irrigation (Bhattacharjee and De, 2003). Application of Oxamyl 25 @ 10ppm a.i. in the soil of potted plant or 500ppm a.i. as aerial spray effectively control *Hemicycliophora sp.* and *Xiphinema basiri* in rose

(Muthukrishnan *et. al.*, 1975). Use of resistant varieties for the control of root knot nematode is very important. Integrated management of root knot nematodes using ecofriendly component e.g. oil cakes (neem and pongamia) is suggested. Enrichment of FYM with *Trichoderma harzianum* for large-scale field application; and for this purpose mix 1Kg of *Trichoderma harzianum* with 10kg of neem cake in 1 tonne of FYM, thereafter sprinkle water and cover with polythene sheet and allow for a fortnight.

VIRUS DISEASES

The virus diseases of roses cause considerable damage and the degree of severity of symptoms, which directly affect the output of the plants towards quality and quantity. These diseases either remain localized or systematically spread throughout the whole plant. The viruses are transmitted through aphids, white flies, leafhopper, nematodes, mites, pollinating insects, and fungi or through mechanical means. Weeds also play an important role either as alternative host or natural sources of virus dissemination in rose field. The viruses affecting rose produce mosaic, vein bending, yellow net and stunting. The virus detected by immuno-probes occurring in rose plants through the ELISA diagnostic methods is Apple Mosaic Virus (ApMV) and Prunus Necrotic Ring Spot Virus (PNRSV) (Wong and Horst, 1988). Virus diseases in rose plants are transmitted through virus-infected bud wood or rootstock or by aerial vectors.

ROSE MOSAIC

Symptoms : It is a common viral disease of roses, characterized by the development of chlorotic areas at or near the mid vein and near the base of the leaflets. In some cases clear rings are observed. The symptoms also include mosaic patterns, mottling and growth abnormalities like reduced stem length, few flowers of poor quality. This also causes low survival, leading to transplanting problems and reduced rate of bud success.

Management : Use of disease free buds while propagating.

Streak Pattern Mosaic

Symptoms : Necrotic areas develop in the vicinity of grafted buds, resulting in stem girdling and wilting of leaves. Yellow lines or patches appear on the foliage. The affected parts are less vigorous in growth and produce few flowers.

Management : The disease can be checked or cured by heat treatment. It is advised to use only healthy budding eyes. Heat therapy techniques is employed whereby virus-infected roses are cultivated at 38^0C for four weeks and then stem cuttings are taken with one to three nodes, which are then rooted under mist. A leaf on the stem is necessary for rooting. Such cuttings proved to be 99 per cent free from virus. Indexing of Prunus Ring Spot Virus as achieved using the ornamental cherry "Shiro-Fugen" as test plant and for Yellow Mosaic, LD-1, a specially selected rose seedling. Using this technique six root stock clones and 25 cultivars have been obtained virus free (Allen, 1970).

The virus-affected plants cannot be cured and should be destroyed. General control measures are to be taken with clean nursery stock of mother plants. The propagating material in roses is at high risk and hence best available materials of highest quality standards are to be chosen. Maintenance of virus free nuclear stock *in-vivo* or *in-vitro;*

growing rose plants is fully controlled insect free conditions; destruction of infected plants and use of certified stocks should be given utmost importance. For development of healthy propagating material in roses, virus detection procedures and identification of viruses occurring in rose plants must be emphasized. Regular spray of rose plants with systemic insecticide; and disinfections of budding knives, secateurs and other implements used for propagation and pruning of roses will be helpful to check the spread of viruses.

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Intellectual Property Rights and Patenting of New Rose Varieties

General Agreement of Tariffs and Trade (GATT) was created in 1947, and the protection of intellectual property has assumed considerable significance in the post - GATT scenario. It is in the GATT discussion at Punta Del Este in Uruguary in 1986, populary known as Uruguary Round Talks, the new global trade in agriculture received attention. GATT was replaced with the emergence of the World Trade Organisation (WTO) in January, 1995. The WTO has prescribed a new set of rules in the form of Trade- Related Intellectual Property Rights (TRIPS) which includes the compulsive modification of the existing intellectual property protection legislation with regard to agriculture specially in the developing countries. For Intellectual Property Rights (IPR) in Agriculture, apart from TRIPS agreement, the Convention of the Union of International Pour La Protection Des Obtention Vegetables (UPOV) is also important. The UPOV convention was instrumental in establishment of the International Union for Protection of New Varieties of Plants in Geneva. According to the UPOV Act of 1991, to be eligible for protection the plant variety should fulfil the requirement of novelty, distinctiveness, uniformity and stability (DUS). India is a signatory to the agreement on TRIPS. In the TRIPS agreement, the chapter under Article 27.3 (6) is related to agriculture. The patentable subject matter is given in Article 24 in Part II of TRIPS : The TRIPS Agreement also indicated specifically the possibilities of *sui generis* IPR system, which means the national IPR regimes may be modelled based on specific needs and realities, but must comply with some minimum standards, (Bhattacharjee, 2004).

During the 14th International Horticultural Congress at Scheveningen, the Netherlands, held in 1955, appointed the American Rose Society (ARS) as the International Registration Authority for Roses (IRAR). To be valid, a rose registration must be processed through ARS Registration Committee and printed in an official ARS publication. Registration is a voluntary process but does not in itself provide protection to the hybridizer from duplication of the rose variety to use of its name for commercial purposes. Registration does, however, preclude the use of registered name by others seeking registration with IRAR (Martin Jr and Robert, 1995).

The first International Convention for the Protection of New Varieties of Plants was signed in Paris in 1961. In 1964 an Act of Parliament of England set up the Plant Variety Rights Office (P.V.R.O.) to encourage, protect and reward innovation in plant breeding. In so doing it enabled breeders to obtain an exclusive right in their new varieties and

to collect royalties in return for licences to reproduce the varieties they have raised. The Royal National Rose Society (RNRS), England played an important part in that scheme by assisting P.V.R.O. during growing trials of rose varieties submitted for plant breeder's rights-and by maintaining a reference collection of patented roses at RNRS at St. Albans (Anonymous, 1971).

The rose industry has the distinction of being awarded the largest number of U.S. plant patents among the vegetatively propagated ornamental plants. During 1994, the United States Patent and Trademark Office granted a total of 498 plants patents of which 127 were directed to distinctive new rose varieties. Production of valuable new and novel rose through seed in an extremely difficult process. The number of new roses produced in this fashion with commercial potential is very limited. To get a new rose variety worthy of commercial introduction nearly 50,000 to 60,000 planned and methodical crosses are to be made. It takes 9 to 12 years to bring a new rose to the market after giving time to evaluate, select and build up stock. The investment of time and expense is the reason that legal means for the protection of a rose hybridizer's rights is of concern of the rose industry. The concept of breeder's right for new and novel variety of roses is a 20^{th} century invention. The first major advance arose in the USA in 1930, with the enactment of the Plant Patent Act. This Act, an amendment to the existing US Plant Patent Act, granted the inventor of a new variety the right to collect royalties from anyone producing it by vegetative means for a period of 17 years. The first plant patent was awarded for the rose variety "New Dawn". Prior to June, 8, 1995, a patent was valid for 17 years from the date of its grant. As a result of legislation implementing the Agreement on Tariffs and Trade Treaty signed on December, 8, 1994; the U.S. plant patents now expire in 20 years, (Datta, 2006).

THE PROTECTION OF PLANT VARIETIES AND FARMER'S RIGHTS IN INDIA AND DUS GUIDELINES FOR ROSE

This Bill passed by the Lok Sabha on August 9, 2001, is now the plant Variety Protection (PVP) Act and is the first piece of legislation anywhere in the world that recognises the phenomenal contribution of farm families in conserving biodiversity and developing new plant varieties. India became signatory to the Trade - Related Intellectual Property Rights (TRIPS) Agreement in 1994. A legislation was required to be formulated. This Agreement [Article 27.3(6)] requires the member countries to provide for protection of plant varieties either by a patent or by an effective *sui generis* system or by any combination thereof. Member countries had the choice to frame legislation that suits their own system. India has exercised this option. This *sui generis* system for protection of plant varieties was developed integrating the rights of breeders, farmers and village communities, and it has taken care of the concerns for equitable sharing of benefits.

I. India has decided to adopt *sui generis* system on account of following:
   - Rights of village community
   - Rights of farmers
   - Rights of researchers
   - Need to incorporate equity concern

II. The system has greater flexibility in regard to following:
- Protected genera/species or varieties
- Level and period of protection
- Sustainable development of agro-biodiversity

III. The system has benefit sharing arrangement.

All categories of plants except micro organism are produced under Act PVP of 2001. Government would notify genera and species for their protection provided the variety is new, distinct, uniform and stable (DUS). The protection tenure for plants varies i.e. for a tree it is 18 years and 15 years for other plants and extant varieties. The Indian Act is unique and provides following benefits to farmers:

- It provides right to save, use, exchange, share and sell farm produce of protected varieties (except sale of branded seeds).
- Farmer's recognized as breeders, conservers.
- Registration of extant varieties (including farmer's varieties).
- Farmers to be compensated for lower than specified yield.
- Farmers to be exempted from acts of innocent infringement.
- Farmers exempted from payment of fees.

The act has provision to create gene fund comprising of benefit sharing proceeds, royalties and fees, communities' compensation & contributions.

New varieties shall be registered under this act if it is Novel, Distinct, Uniform and Stable. At the time of filing application this novel variety should not be sold in India earlier than one year in case of tree. If it is vine the time span is six year and for any other case of plant earlier than four years.

Distinctness: If a variety is clearly distinguishable by at least one essential characteristic from any other variety whose existence is a matter of common knowledge in any country at the time of filing the application.

Uniformity: It should be sufficiently uniform in its essential characteristics.

Stability: Stability of new variety denotes if, its essential characteristics unchanged after repeated propagation.

There are two main DUS centre in India viz. Division of Floriculture and Landscaping, IARI, New Delhi and Division of Ornamental Crops at IIHR, Bangalore. They have formulated test guidelines for Rose.

A DUS guideline for rose has been developed on the basis of guidelines of the UPOV during 2003. It is to be implemented in toto or modify the guidelines according to the need of our own Indian condition. Amendment of the original guidelines has been done as to make it more amenable to the Indian conditions.

The rose has been classified into two categories viz. cut flowers varieties and garden display varieties. It has been done for the future requirements for evaluating roses. These test guidelines is applicable to all vegetatively propagated varieties of *Rosa* L., family: Rosaceae. Farmers/ Breeders must indicate the nature of variety i.e. cut flower and garden

display and at the same time condition of testing should be also be declared i.e. green house condition or open field conditions.

The following additional clause was added to suit Indian conditions besides the existing guidelines.

I. Evaluation would be carried out either in green house environment for cut flower varieties or in open field conditions for garden display varieties.

II. From a representative samples nine plants are selected for conducting test instead of six plants as recommended by UPOV.

In existing guidelines of UPOV two additional characteristics i.e. length of peduncle and venation of petals were added, and two characters i.e. plant width and flower side view of lower part were excluded. Plant height, terminal leaf, width of leaf blade, flower diameter are few of the measurable parameters which have been introduced for clarity. Modification were made to reduce and make it more comprehensive. Descriptors in the parameter, which were modified are given in Table 1.

TABLE 1

Rose Descriptors (Source: IARI, New Delhi, 2006)

S.No.	Parameter	Modified Descriptor	Note	Original Descriptor	Note
7.	**Short prickles no.**	Absent	1	Absent or very few	1
		Few	3	Few	3
		Medium	5	Medium	5
		Many	7	Many	7
				Very many	9
8.	**Long prickles no.**	Absent	1	Absent or very few	1
		Few	3	Few	3
		Medium	5	Medium	5
		Many	7	Many	7
				Very many	9
11.	**Leaf: glossiness of upper side**	Absent	1	Absent or very weak	1
		Weak	3	Weak	3
		Medium	5	Medium	5
		Strong	7	Strong	7
				Very Strong	9
13.	**Leaflet: Serration of margin**			**Leaflet: undulation of the margin**	
		Absent	1	Absent or very weak	1
		Weak	3	Weak	3
		Medium	5	Medium	5
		Dense	7	Strong	7
				Very Strong	9

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S.No.	Parameter	Modified Descriptor	Note	Original Descriptor	Note
26.	**Sepal: extension**	Absent	1	Absent or very week	1
		Weak	3	Weak	3
		Medium	5	Medium	5
		Strong	7	Strong	7
				Very Strong	9
31.	**Petal: size of spot at base of inner side**	Small	3	Very small	1
		Medium	5	Small	3
		Large	7	Medium	5
				Large	7
				Very Large	9
36.	**Petal: size of spot at base of outer side**	Small	3	Very small	1
		Medium	5	Small	3
		Large	7	Medium	5
				Large	7
				Very Large	9
45.	**Length of peduncle**	Short	1	–	–
		Medium	2	–	–
		Long	3	–	–
46.	**Venation of petals**	Absent	1	–	–
		Weak	3	–	–
		Medium	5	–	–
		Strong	7	–	–

The Plant Variety Protection (PVP) Authority provided the following rules:

Applicant submitting material from a country other than India must make sure that all customs formalities are complied.

- Eighteen plants for a variety (grafted plant with one shoot for the glass house or one year old plants with at least three shoots in open).
- Thirty six plants for a mutant variety preferably not produced by micro-propagation method.
- Plant material supplied should be healthy and disease free.
- Budded, grafted, and plant obtained by micro-propagation method should be clearly mentioned.
- Rootstock for budded and grafted plants should be mentioned i.e. hardy rootstock *Rosa indica* var. *odorata* for north Indian conditions and *Rosa multiflora*

for south and eastern Indian condition should be adopted and clearly mentioned in the application form.

- The plant material must not have undergone any treatment unless the competent authorities allow such treatment.
- Test duration should normally two independent similar growing seasons for DUS testing.
- The test should be normally conducted at two locations.
- As a minimum, each test should include a total of nine plants for a variety and 18 plants for a mutant variety.
- Evaluation of a variety would be carried out in either green house environment for cut flower varieties or open field conditions for garden display varieties.
- Plant growth habit (dwarf rose, bed rose, shrub rose, climbing rose, ground cover rose) and colour of the flower are the two very important parameters for the breeders for grouping of the varieties, which will facilitate the assessment of distinctness.

PATENTING OF NEWLY DEVELOPED VARIETIES

The distinctive feature of the newly evolved variety should have genetic basis. The variation due to environmental, nutritional and disease factors are not acceptable. In the protected variety if mutation occurs, which by definition has a genetic basis, the new variety that has been created, is outside the grant of original plant patent. The varietal name must be different from a trademark. The grant of plant patent covers a single cultivar as per description and illustration, and does not cover generic protection that will include comprehensively a number of plant varieties. A variety is recognised to be a subdivision of plant species. Any stable, recognisable difference can enable a plant to be recognised as a new variety. These include colour, growth habit, plant size, leaf shape, flower configuration, disease resistance, winter hardiness etc. (Duffett Jr. and Bention, 1995).

Information to be provided along with plant patent applications for obtaining protection of any new variety are identification of the originator, botanical description of the new variety, the process by which the new variety is evolved, genuine differences of the new variety when compared with other known varieties, the manner in which the new plant is asexually reproduced, the place in which the plant has been reproduced, scanning electron microscopy of the diagnostic characters, electrophoresis, DNA finger printing, colour description as per RHS colour chart, coloured photograph of the new variety and artist-prepared colour illustrations of the newly evolved variety (Dutta, 2006).

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ROSE BREEDERS OF THE WORLD

Thousands of breeders all over the world have been responsible for releasing new mutants and hybrids of rose. For many centuries breeders and gardeners have collected rose hips (fruits), sown the seeds, and assessed the resulting seedlings, hoping to find an improved form. Plant possesses sex life was established after 1691 when for the first time it was declared that plant also has male and female organs. First of all, rose growers of France began to take advantage of this knowledge, after a century and even then the process was not systematic and poorly recorded. At that time breeders could only guess at the parentage of their seedlings. It has been said that two roses can combine their genes in 250 colours, shapes and qualities of fragrance, health, freedom of bloom and thornless rose is the combined fruit of breeder's efforts and their success. A few rose breeders along with their brief contributions are mentioned below country wise:

TABLE

Rose Breeders Name/Country	Active Period/Work Place	Varieties Released/Types /Year
UNITED STATES OF AMERICA		
Armstrong David	Active between 1963 and 1972 at Armstrong Nurseries, Ontario, California	Large flowered/Hybrid Tea: Eiffel Tower (1963) Cluster flowered/Floribunda: Joseph's Coat (1964) Large flowered/Hybrid Tea: Aquarius (1971) Kentucky Derby (1972) Cluster flowered/Floribunda: Yellow Cushion (1966)
Dr. Robert Basye	Active since the 1940 in Texas. Innovative raiser of interspecific crosses, Produced, hardiness and thornlessness.	Shrubs: Basye's Purple (1968) Basye's Blueberry (1982) Belinda's Dream (1988)
Frank Benardella	Raising roses since 1980. Specialist in Miniature roses. Involved in	Large-flowered/Hybrid Tea: Black Jade (1985) Jennifer (1985)

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Rose Breeders Name/Country	Active Period/Work Place	Varieties Released/Types /Year
	developing striped large flowered/Hybrid Teas.	Old Glory (1988) Figurine (1991)
Dee Bennett	Raising roses since 1970 in Chula Vista, California. Specialist in Miniature roses.	Miniature : Angel Dust (1978) Hot Shot (1982) And many others
Gene Boerner	Active from 1940-1966 with Jackson and Perkins Nursery, Newark, New York. Utilized Kordes Pinocchio and Hybrid Polyanthas with brilliant result.	Clustered-flowered/Floribunda: Goldilocks (1945) Lavender Pinocchio (1948) Fashion (1949) Masquerade (1949) Apricot Nectar (1965) Diamond Jubilee (1947)
Brownell, Dr. Walter and Mrs.	Active from 1920-1950 in Rhode Island. Worked on hardier roses and raised climbers.	Climbing Rose: Elegance (1937) Golden Glow (1937) Large-flowered/Hybrid Tea: Lafter (1948)
Buck Griffith	Active from 1950-1990 in Iowa. Bred hardier roses, outgrowth includes shrub rose	Shrubs: Applejack (1973) Summer Wind (1975) Carefree Beauty (1977)
Carruth, Tom	Raising rose since 1930 with Weeks Roses Inc., Ontario, California. Includes clustered flowered/ Floribunda, Shrub and Miniature	Clustered flowered/Floribunda: Columbus (1991) Shrub: Flutter Bye (1996) Miniature: Heartbreaker (1990)
Christensen, Jack	Succeeded Swim at Armstrongs and has been active since 1970s. Raised large-flowered/Hybrid Teas and Miniature roses	Large-flowered/Hybrid Tea: Brandy (1981) Gold Medal (1982) Voodoo (1986) Midas Touch (1992) Miniature: Cricket (1978) Holy Toledo (1980)
Davidson Harvey	Working since 1980s in Orinda, California. Aimed to raise thornless roses mostly with Large-flowered/Hybrid Teas	Large-flowered/Hybrid Tea: Smooth Velvet (1986) Smooth Angel (1986)

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Rose Breeders Name/Country	Active Period/Work Place	Varieties Released/Types /Year
Hill, E Gurney & Joseph, H	Since 1900 in Richmond, Indiana. Richmond and Joanna Hill have provied important parents.	Large-flowered/Hybrid Tea: General Mae Arther (1905) Richmond (1905) Joanna Hill (1928)
Haward, Fred	1910s to the 1950s with Haward Smith, Montebello, California.	Sweet Scented Bright Pink: The Doctor (1936)
Jolly, Betty & Nelson	Working since 1970s. Specialist in Miniature	Miniature rose: Chatterh Centennial (1979) Arizona Sunset (1985)
Lammerts, Dr. Walter	From 1940-1957 in Livermore, California. Major success with large flower	Large-flowered/Hybrid Tea: Charlotte Armstrong (1940) Showgirl (1946) Chrysler Imperial (1954) Grandiflora: Queen Elizabeth (1954) Climbers: High Noon (1946); Golden Shower (1957) Polyantha: China Doll (1946)
Marciel, Stanley and Jeanne	Since 1980s based in Aptos, California. Raised the Shrub rose	Shrub rose: First Light (All American Rose Selection winner 1998) for De Vor Nursery
Miller, Alvin	From 1890s to 1910s, with Jackson & Perkins Co. in New York	Ramblers: Dorothy Perkins (1910). Variety has international household name
Moore, Ralph	Working since the 1920s at his Sequoia Nursery in Visalia, California. Specialist in Miniature, Many Miniature raised using his seedling 'Rambler Zee'	Varieties: Bito' Sunshine (1956), Mr. Blue Bird (1960) Magic Carrousel (1962), Stars n' Shine (1975) Stacey Sae (1976), Rise n' Shine (1977)
Morey, Dennison	1950s to 1970s with General Bionomics Inc., Santa Rosa, California.	Large-flowered/Hybrid Tea: King's Ransom (1961) Best yellow of the year Popular Miniature: Popcorn (1973) Climber: Royal Gold (1957) Creeping Climbing Miniature: Temple Bells (1971)

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Rose Breeders Name/Country	Active Period/Work Place	Varieties Released/Types /Year
Saville Harmon	Since 1970s with Nov' east Roses, in Rowley, Massachusetts.	Miniature: Party Girl (1979), Little Jackie (1982) Minnie Pearl (1982), Winsome (1984) Raindrops (1990), Teddy Bear (1990) Moss Miniature: Single's Better (1985)
Swim, Herb	1945 to 1978 Raised rose with Armstrong and Weeks. Superb varieties include 22 All American Rose Selection winners	Large-flowered/Hybrid Tea: Tallyho (1948), Fandango (1950), Sutter's Gold (1950), First Love (1951), Helen Fraubel (1951), Buraneer (1952), Montezuma (1955), Garden Party (1959) Summer Sunshine (1962), Royal Highness (1962), Mister Lincoln (1964) with Ellis: Double Delight (1977) Cluster-flowered/Floribundas: Circus (1956), Pink Parfait (1960) and Armstrong Joseph's Coat (1969)
Twomey, Jerry	Since 1980s in Leucadia, California, aiming for healthy garden roses	Produced all American Rose Selection winners: Sheer Elegance (1989), All that Jazz (1991)
Van Fleet, Walter	From 1890s to 1920s, Physician by profession	American Pillar (1902) Silver Moon (1910), Dr. W.Van Fleet (1910), Mary Wallace (1924)
Von Abrams, Gorden	1950s to 1960s in Oregon and later in Davis, California	Large-flowered/Hybrid Tea: Pink Favourite (1956) Memoriam (1961) Cluster-flowered/Floribunda: Golden Stippers (1961)
Warriner, Bill	Since 1950s, mostly with Jackson & Perkins. Created	Large-flowered/Hybrid Tea: Pristine (1978), Honor (1980),

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Rose Breeders Name/Country	Active Period/Work Place	Varieties Released/Types /Year
	over 150 varieties including 18 All-American Rose Selection Winners	Sheer Bliss (1985), Brigadoon (1991) Cluster-flowered/Floribunda: Intrigue (1982), Simplicity (1978), Tournament of Roses (1988) Climber: America (1976)
Weeks, Ollie	1950s to 1980s in Chino, California.	Large-flowered/Hybrid Tea: Oklahoma (1964), Arizona (1975), Paradise (1978) and jointly with Swim Royal Highness (1962), Mister Lincoln (1964) Angel Face (1968)
Williams, Ernest D.	Since 1960s in Dallas, Texas. Specialized in Miniature	Miniatures: Hula Girl (1975), Dream Glow (1978) Red Beauty (1981), Colourful Single Oriental Simplex (1987)
Zary, Keith	Since Mid 1980s. Worked with Bear Creek Gardens, raising garden and cut-flower varieties	Magic Carpet (1992) with Warriner became UK Rose of the Year in 1996
ENGLAND		
Archer, William	From 1920s to 1940s at Sellindge, Kent. Had commercial success with the single large-flowered Hybrid Teas	Large-flowered/Hybrid Tea: Dainty Bess (1925) Ellen Wilmot (1936) A charming restrained climber: Golden Crest (1948)
Austin, David	Raised roses in 1960s at his nursery to create repeat flowering of old style roses, popularly known as 'English Roses'	Shrubs: Leander (1982), Mary Rose (1983), Graham Thomas (1985), Heritage (1984), Gertude Jekyll (1986) L.D. Braith Waite (1988)
Bentall, Ann	Active during 1920s to 1930s in Essex. Raised Shrubs	Shrubs: The Fairy (1932), Buff Beauty (1939) A chance seedling: Ballerina (1937)
Bennett, Henry	From 1870s to 1880s in Wiltshire and Middlesex.	Valuable future parent roses : Lady Mary Fitzwilliam (1882)

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Rose Breeders Name/Country	Active Period/Work Place	Varieties Released/Types /Year
	Worked out modern methods of planned parent selection, working with Teas and Hybrit Perpetuals to create large-flowered/Hybrid Teas	Mrs. John Laing (1887)
Bossom, Bill	Since 1980s in Enfield, Middlesex.	Cluster-flowered/Floribunda Peppermint Ice (1991) Tender Loving Care (1995)
Cant	Since 1875, produced over 130 named varieties including climbing roses	Climbing Roses: Blush Rambler (1903), Cupid (1915) Large-flowered/Hybrid Tea: Mrs. Oakley Fisher (1921), Just Joey, Alpine Sunset, Gold Star
Fryer, Gareth	Since 1970s with Fryer's Roses in Knutsford, Cheshire. Noted for classic large-flowered Hybrid Tea	Large-flowered/Hybrid Tea: Bobby Charlton (1974), The lady (1985), Velvet fragrance (1988), Belle Epoque (1994), Warm Wishes (1994), Bride (1995), Especially for You (1996) Cluster-flowering/ Floribunda: Sunsilk (1974) Patios: Sweet Dream (1988), Top Marks (1992) Shrub: Biddulph Grange (1988) Climber: Crimson Cascade (1991)
Gregory, Walter	From 1950s to 1970s with E. Gregory & Son, Chilwell, Nottingham	Large-flowered/Hybrid Tea: Wendy Cussons (1959) Climber: Pink Perpetue (1965)
Harkness, Jack	From 1960s to 1990s with R. Harkness & Co. Ltd., Hitchin. His pioneering work with *Rosa persica* produced Tigris (1985), Euphrates (1986) and Nigel Hawthorne (1989)	Large-flowered/Hybrid Tea: Alexander (1972), Rosemary Harkness (1985), Savoy Hotel (1989) Cluster-flowered/Floribunda: Escapade (1967), Margaret Merrill (1977), Anne Harkness (1980), Mount Batten (1982), Amber

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Rose Breeders Name/Country	Active Period/Work Place	Varieties Released/Types /Year
		Queen (1985), City of London (1988), Fellowship (1992), Sunset Boulevard (1977), Betty Harkness (1988), Easy Going (1998), Patio Anna Ford (1980) Climbers: Compassion (1973), Penny Lane (1998). Polyanthas: Yesterday (1974), Marjorie Fair (1978). Shrub: Armada (1998), Jacqueline du Pre (1989)
Holmes, Richard	Since 1960s to 1970s in Stockport, Cheshire. Had success with Floribundas and Shrub	Cluster-flowered/Floribunda: Fred Loads (1967) Shrub: Sally Holmes
Horner, Colin	Since 1970s in Stansted, Essex	Cluster-flowered/Floribunda: Champagne Cocktail (1985)
Le Grice, Edward and Bill	Since 1930s, based in Norfolk. Innovative crosses included novel colour blends. Had commercial success with large flowered Hybrid Tea	Large-flowered/Hybrid Tea : My Choice (1958), Great News (1973) Clustered-flowered/Floribunda: Dainty Maid (1937), All Gold (1956), Lilac charm (1962), News (1968) Shrub: Pearl Drift (1980)
Mattock, John & successors	Since 1960s, output includes large-flowered/ Hybrid Tea, Climbers and Shrubs	Large-flowered/Hybrid Teas: Tynwaid (1979) Climbers: Dreaming Spired (1973) Shrubs: Pink Wave (1983) Northamptonshire (1990)
Mehring, Bernard	Active since 1990s raising roses for Eurosa, Woodle, Berkshire, His aims include health and thornlessness.	Cluster-flowered/Floribunda: Golden Hope (1993) Climber: Jane Eyre (1998) Patio Rose: Make a Wish (1996)
Norman, Albert	A diamond setter by profession, raised roses between 1910s and 1950s in Normandy, Surrey.	Large-flowered/Hybrid Teas: Ena Harkness (1946) Cluster-flowered/Floribunda: Frenshm (1946) Late Flowering Rambler: Crimson Shower (1951)

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Rose Breeders Name/Country	Active Period/Work Place	Varieties Released/Types /Year
Paul George and George Laing	1870s to 1910s in Chestunt, the Paul produces a wide range of roses. 1850s to 1920s in Wathan	Large-flowered/Hybrid Teas: Cheshunt-Hybrid (1872), Goldfinch (1907), Paul's Lemon Pillar (1915) Climbing roses:
Paul William and Arthur William	Cross. Specialized in climbing roses.	Mermaid (1918), Paul's Scarlet Climber (1916) Large-flowered/Hybrid Teas: Phelia (1912)
Pemberton. Rev. Joseph	From 1900 to 1920s in Essex. Raised delightful Shrub roses of Noisette, Polyantha, Tea and large-flowered/Hybrid Tea ancestry	Moonlight (1913), Penelope (1924) and Cornelia (1925)
Penzance, Lord	During 1890s, raised in Surrey a range of Sweet Briar hybrids. Lady Penzance being the best for its scented foliage.	Amy Robsar (1894) Lady Penzance (1894), Lord Penzance (1894) and Meg Merrilies (1894)
Prior, D	From 1920s to 1930s in Colchester, Essex. Raised Polyanthas and two outstanding cluster-flowered/Floribunda still widely grown	Cluster-flowered/Floribunda Betty Prior (1935) Donald Prior (1938)
Robinson, Herbert	From 1920s to 1950s at Hinckley, Leicestershire	Large-flowered/Hybrid Teas: Christopher Stone (1935), Phyllis Gold (1935) Lydia (1949), Doreen (1951)
Scrivens, Len	Since 1970s known for a Shrub like free flowering well foliaged and healthy plant from the *Rosa devidiiclongata* line.	Yellow Patio Rose: Baby Love (1993)
Smith. Ted	Former railway man, Smith has been working with roses since 1970s in Sabdiacre, Nottingshire.	Cluster-flowered/Floribundas: Baby Bio (1970) Summer Serenade (1986)
Tysterman, Bill	From 1960s to 1980s with Wishech Plant Co.	Large-flowered/Hybrid Teas: Doris Tysterman (1975)

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Rose Breeders Name/Country	Active Period/Work Place	Varieties Released/Types /Year
	Tysterman produced a limited but high quality output.	Dutch Gold (1978) Strange parchment-coloured: Julia's Rose (1980) Cluster-flowered/ Floribundas: Fragrant Delight (1978)
Warner, Chris	Innovative breeder of climbing miniature. Active since 1980s in Devon and later in Shropshire.	Climbing Miniature: Laura Ford (1990), Warm Welcome (1991), Nice Day (1994), Good as Gold (1995) Open Arms (1996) Repeat Flowering: Little Rambler (1995) Ground Cover: Path Finder (1993) Shrub: Laura Ashley (1991)
FRANCE		
Barbier	Since 1900 to 1933 in Orleans. Raised *Wichuraiana* climbers, Polyanthas, Hybrid Perpetuals and large-flowered/Hybrid Teas	Alberie Barbier (1900) Paul Transn (1900), Leontime Gervaise (1903) Francois Luranville (1906), Alenxander Girault (1909) Albertine (1927), Wichmoss (1911)
Croix, Paul	From 1950s in Bourg-Argental, Loire. Varieties are little known outside Europe.	Produced prize winning bushes and some climbing roses.
Delbard, Georges and Chabert, Andre	From 1950s trading in Paris. Best suited for warm climates. Produced the excellent single red climber 'Altissimo' in 1966.	Centenaire de Lourdes (1958), Diablotin (1961), Gingersnap (1978), Lancome (1973) and Fragrant like Dioressence (1984)
Ducher, Jean-Claude and Veuve	From 1850s to 1860s in Lyon region.	Noisette' Revedor (1869), William Allen Richardson (1878) Hybrid Tea: Anna Olivier (1872) Podyantha: Cecile Brunner (1880)
Gaujard, Jean	Since 1920 in Lyon region. Raised many large-flowered/Hybrid Teas suited to warm climates	Rose Gaujard (1957) Opera (1950)
Guillot-Jean-Baptiste	From 1850s to 1880s in Lyon region. Famous as the	First large-flowered Hybrid Tea: La France (1867)

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Rose Breeders Name/Country	Active Period/Work Place	Varieties Released/Types /Year
	raiser of the first large-flowered/Hybrid Tea and the first Polyantha and the first pink Polyantha	The tea: Catherine Mermet (1869) The first Polyantha: Paquerette (1875) The pink Polyantha: Goirdes Polyantha (1887)
Hardy, Eugene	During 1820s and 1830s, Hardy was director of the Jardins de Luxembourg, Paris. Raised the first known *Rosa Persica* hybrid with Hardii in 1836.	Fragrant white Damask: Mme Hardy (1832) Tea: Bon Silene Circa (1837)
Kriloff, Michel	From 1950s to 1990s Antibes. The variety Tabriz (1936) have perhaps gained the greatest international recognition.	Large-flowered/Hybrid Teas: Lucy Cramphorn (1960), Touch of Glass (1984) (An All American Rose selection winner) Tabriz (1936)
Mallerin, Charles	A heating engineer by profession was active between 1920s and 1960s in Varce, Pont-de-claux Isere. He raised 130 varieties and tutored Francis Meilland	Large-flowered/Hybrid Teas: Mrs Pierre S du Pont (1929), Virgo (1947), Beaute (1953), Isabelle de France (1956) Climbers: Guinee (1938), Spectacular (1954), Danse des Sylphs (1959)
Meiland, Francis, Marie Lousiette and Allain and Paolino, Marie-Louise	Since 1930s, Mme A. Meilland (1942) better known as Peace of which Francis reported that the original seedling has been a week plant.	Large-flowered/Hybrid Teas: Mme A Meilland (1942) Charles Mallerin (1951), Grand mere Jenny (1950) Edewn Rose (1950), Bettina (1953), Papa Meilland (1963), The Mc Cartney Rose (1991) Cut flower Rose: Baccara (1954), Sonia (1974) Miniature: Darling Flame (1971), Colibri (1958), Orange Sunblaze (1981) Ground cover: Swang (1977) Shrub: Bonica (1981) Cluster-flowering /Floribunda: La Sevillana (1982) Climber: Clair Matin (1960)

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Rose Breeders Name/Country	Active Period/Work Place	Varieties Released/Types /Year
		Rose of old style flower: Romantica series
Pernet-Ducher, Joseph	From 1870 to 1920 in the Lyon region. He was known as the Wizard of Lyon. His variety, "Mme Carline Test Out" was commercially successful.	Large-flowered/Hybrid Teas: Mme Caroline Test Out (1890), Antoine Rivoire (1893), Mme Abel Chatenay (1893), Soleil d' Or (1900), Rayon d' Or (1910) Mme Edward Herriot (1913)
Verdier, Eugene	From 1860s and 1890s in Paris. Verdier raised 222 hybrids.	Hybrid Perpetual: Prince Camilla de Rohan (1861)
Vibert, Jean- Pierre	From 1810 to 1850 in Angers. Vibert was responsible for the Bourbon, Noisette and Damask among some 600 other.	Bourbon: Gloire des Rosomanes (1825) Noisette: Almec Vibert (1828) Damask: La Ville de Bruxelles (1849)
ITALY		
Alcardi, Domenico	Since 1930s to 1950s in San Remo, "Signora" from 1936 is still grown and loved and has proved a useful parent.	Large-flowered/Hybrid Tea: Signora (1936)
AUSTRALIA		
Clark, Alister	From 1910 to 1940s in Bulla, Victoria. He had over 120 releases including many vigorous but tender climbers. Also bred a tough and popular climber.	Climber with *Rosa gigantea:* Kitty, Kininmonth (1922), Nancy Hayward (1937) Tea Rose: Lorraine Lee (1924) Tough and Popular Climber: Black Boy (1919)
SCOTLAND		
Cocker, Alec and Ann	Since 1960s with James Cocker & Son, Aberdeen. Alec Cocker obtained a rare seed of *Rosa Persica* in 1960s.	Large-flowered/Hybrid Teas: Alec's Red (1970), Silver Jubilee (1977), Remember Me (1981), Abbeyfield Rose (1985) Clustered-flowered/Floribunda: Anne Cocker (1971), Rob Roy (1971), Plat Boy (1976), Toprose (1991), Gordon's College (1992), Friendforlife (1993) Patio: Conservation (1988)

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Rose Breeders Name/Country	Active Period/Work Place	Varieties Released/Types /Year
		Climber: Morning Jewel (1968) White Cockade (1968)
SPAIN		
Dot, Pedro and Simon	Since 1920s near Barcelona. Their pioneering work with Miniature is well known.	Large-flowered/Hybrid Teas: Condesa de Sastago (1932) Shrub: Nevada (1927) Climber: Mme Gregoire Staechelin (1927) Miniature: Rosina (1935), Baby Gold Start (1940), Pour Toi (1946), Coralin (1955)
AUSTRIA-HUNGARY		
Gaujard, Jean	From 1860s to 1910. Aimed to breed for hardiness. Had an output of 140 varieties although his work is sometimes credited to others.	Rambler: Theano (1895) Bourbons: Gruss an Teplitz (1897), Gipsy Boy (1909)
GERMANY		
Hetzel, Karl	Since 1970s in Beutclsbach. Developed an innovative line.	Repeat flowering rambler: Super Dorothy (1986), Super Excelsa (1986), Super Fairy (1992)
Kordes, Wilhelm, Reimer and Willi	Since 1900, their versatile output is well known	Large-flowered/Hybrid Teas: Geheimrat Duisberg (1933), Crimson Glory (1935), Independence (1950), Perpecta (1957), Royal William (1984) Polyantha: Orange Triumph (1937) Cluster-flowered/Floribunda: Pinocchio (1947), Korona (1956), Iceberg (1958), Lili Marlene (1959), Friesia (1977), Anna Livia (1986) Hardy strain of Shrub: Fruhlingsgold (1937) Others: Dortmund (1955), Lever Kusen (1955), Wasterland (1969), Grouse (1984), Surrey (1985), Roselina (1992)
Lambert, Peter	Since 1890s to 1920s in Trier. Produced a wide	Large-flowered/Hybrid Teas: Frau Karl Druschki (1901)

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Rose Breeders Name/Country	Active Period/Work Place	Varieties Released/Types /Year
	output of roses including an ancestor of modern garden rose.	Polyanthas: Leonie Lamesch (1899), Katherina Zeimet (1901) Shrub: Trier (1904)
Noack, Werner	Since 1970s, raised bush, climbing and especially ground cover and Shrub roses.	Flower carpet (1991), White Flower Carpet (1991)
Tantau, Mathias, Mathias Jr.	Includes first rate garden roses from Germany	Large-flowered/Hybrid Teas: Prima Ballerina (1957), Tropicana (1960), Fragrant Cloud (1963), Blue Moon (1964), Whisley Mac (1967), Polar Star (1982) Cluster-flowered/Floribunda: Paprika (1958), Topsi (1972), Miniature Baby Masquerade (1956) Shrub: Braodlands (1930), Cerise Bouquet (1958) Climber: City of York (1945), Awinia (1980)
BELGIUM		
Lens, Louis	Since 1930s in WavreNotre-Dame. Produced innovative crosses as the ground cover "Green Snake"	Large-flowered/Hybrid Teas: Dame de Coeur (1958), Paseali (1961) Ground Cover: Green Snake (*R. arvensis* X *R. wichuraiana*) Shrub : Running Maid (1982), Pink Robin (1993)
NETHERLANDS		
De Ruiter, Gerrit, Gijis, Leendext etc.	From 1920s to the present in Hazerswarde. Have released notable cultivars	Polyanthas: Gloria Mundi (1929), Cameo (1932), De Ruiter's Herald (1949) Cluster-flowered/Floribunda: Rosemary Rose (1954), Sweet Repose (1955), Orange Sensation (1961), Europeana (1965) Unusual: Compacta Seven Dwarf Roses (1954-56)
Hsink, Peter	Since 1970s, produced many graceful Shrub-roses including 'Red Blanket'	Shrub roses: Red Blanket (1979), Rosy Cushion (1979), Smarty (1979), Robin Red Breast (1983), Lavender Dream

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Rose Breeders Name/Country	Active Period/Work Place	Varieties Released/Types /Year
		(1985), Eye Opener (1987), Euphoria (1998)
Leenders	From 1900s to the 1970s in Tagelen, raised large number of varieties.	Large-flowered/Hybrid Teas: Comtesse Vandal (1932) Cluster flowered/Floribunda: Nathalie Nypels (1919)
Verbeek, Gijsbert	From 1940s to 1960s in Aalsmeer.	Large-flowered/Hybrid Teas: Dr. A.J. Verhage (1963)
Vershuren, Jaxcques and Hens	From 1910s to 1940s Raisers of famous cultivars.	Large-flowered/Hybrid Teas: Golden Scepter (1950) Etoile de Hollande (1919)
NORTHERN IRELAND		
Dickson, George, Alex, Pat and Colin	Since 1880s in Hawlmark and Newtownwards. Won the First National Rose Society Gold Medal, 'Mrs. W.J. Grant'.	Large-flowered/Hybrid Teas: Betty up Richard (1922), Shot Silk (1924), Dame Edith Helen (1926), Grandpa Dickson (1966), Red Devil (1970), Freedom (1984), Elina (1985) and Lovely Lady (1936) Cluster-flowered/Floribunda: Dickson's Flame (1958) and Anisley Dickson (1983)
Dickson, Hugh	From 1890s to 1930s in Belfast. Noted for "Hugh Dickson" (1905).	Patio Roses: Peek a Boo (1981), Sweet Magic (1987), Cidarc Cup (1988) and Marry Me (1998) Hugh Dickson (1905)
McGredy, Sam II, III and IV	Since 1880s with S.Mc Gredy & Son, raised large number of rose varieties.	Large-flowered/Hybrid Teas: Mr. Herbert Steven (1910), Emma Wright (1918), The Queen Alexandra Rose (1918), Mrs. Henry Morse (1919), Charles P. Ketham (1926), Mrs. Sam Mc Gredy (1929), Pietare (1932), Mc Gredy Yellow (1933), Heetert Deans (1938), Cythia Brooke (1942), Piccadilly (1959), Mischief (1961), Olympiad (1983), New Zealand (1990) Cluster-flowered/Floribunda: Elizabeth of Glamis (1964), Arthur

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Rose Breeders Name/Country	Active Period/Work Place	Varieties Released/Types /Year
		Bell (1965), Evelyn Fison (1962), Paddy McGredy (1962), Trumpter (1977) Miniature: Snow Carpet (1980) Climber: Casino (1963), School Girl (1964), Handel (1965), Pantry Boy (1967), Dublon Bay (1976) Colour Breaks: Grey Pearl (1945) Hand Painted Rose: Picasso (1971), Eyepaint (1975), Maestro (1980) Oranges and Lemons (1992)
IRELAND		
Mc Cann, Sean	Since 1960s in Dublin, Mc Cann has been known as lecturer and garden writer with practical experience as a raiser of Miniature roses.	Variety: Kiss n' Tell (1989) Lovers Only (1989) Lady in Red (1990)
JAPAN		
Onodera, Toru	A geologist by profession, Onodera has been active since 1960s in Urawa.	Climbing Miniature: Nozomi (1968) Nozomi seedling: Suma (1989)
Suzuki, Seizo	Since 1960s with Keisei Nurseries, Yachiyo-shi. He holds an extensive species collection from which he has obtained a remarkable Shrub and prize winning large flowered Hybrid Tea.	Shrub: Ferdy (1984) Large-flowered/Hybrid Teas: Olypie Torch (1966) Mikado (1984)
Teranishi, Kikuo	Since 1960s in the Itani Rose Nursery. He is perhaps the best known internationally for the exhibition of large-flowered/Hybrid Teas.	Large-flowered/Hybrid Teas: Amatsu-otome (1960) Lavender Mme Violet (1981)
DENMARK		
Pernille	In the Foulsen firm, has been active since 1990s. Raised Polyantha and the novel Polyantha large flowered cross.	Polyantha: Ellen Poulson Polyantha/large flowered cross: Rodhatte (1912)

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Rose Breeders Name/Country	Active Period/Work Place	Varieties Released/Types /Year
Svend	Seeking hardy roses, and developed Floribundas, since 1920s	Clustered-flowered/Floribunda: Else Poulsen (1924), Kirstern Poulsen (1924), Poulsen's Yellow (1938), Rumba (1958)
Neil	Mostly clustered flowered Floribundas, since 1960s	Clustered-flowered/Floribunda: Chinatown (1963), Pernille Poulsen (1965) Large-flowered/Hybrid Teas: Troika (1972)
Olesens	Raised diverse varieties with large-flowered/Hybrid tea, a novel range of Patios, old style roses and Miniature, since 1970s	Large-flowered/Hybrid Teas: Ingrid Bergman (1984), Modern Art (1985) Cluster flowered/Floribunda: Christopher Columbus (stripped) (1992), Fre Densborg (1995) Old Style Rose: Queen Margrethe (1995) Miniature: White Bells (1980), Pink Bells (1983), Red Bells (1983)
CANADA		
Svej da, felicitas	Using *Kordesii* and *Rugosa* roses to obtain winter hardy shrubs and climbers. Worked with the Canadian Department of Agriculture from the 1960s to 1980s.	Varieties: John Cobot (1978), William Baffin (1983), Henry Kelsey (1984), John Davis (1986)
NEW ZEALAND		
Simpson Nola	Simpson is a computer scientist who has been raising roses in Palmerston North since the 1970s. Her "Hot Chocolate" won a New Zealand Gold Medal.	Large-flowered/Hybrid Teas: Hamish (1979) Cluster-flowered/Floribunda: Hot Chocolate (1986)

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23

A Selected List of Exotic Varieties

HYBRID TEA ROSES

These groups of roses are also known as 'Large Flowered Rose', the Hybrid Teas. In this group numbers of 'Pioneer' varieties are now extinct, many are still surviving; but some of these have lost their initial vigour. Continuous vegetative propagation having proved incompatible with their hybridity. The early Hybrid Teas are of complicated origin but are more accurately described by there designated collective name. Many early Teas have survived, although few stand up to the competition of the modern Hybrid Teas.

Aalsmeer Gold : This variety of rose produces many flowers. Buds are pointed, high centred. Flowers are medium sized and their colour is yellow (Kordes, 1978).

Abbaye de Cluny : This is a floriferous variety. Blooms are very large, attractive and long lasting. Flower colour is orange apricot (Mielland, 1993).

Abracadabra : It produces flowers of various colour shades. Bloom size is large. Flower bud colour is dark pink with yellow base (Warriner, 1991).

Acapella : This cultivar of rose produces well-formed attractive flowers. Blooms are bicolour. Flowers are high centred. Petals have bicolour blend of rose red. Reverse side of petal is peachy white. Buds open slowly to beautiful flowers (Tantau, 1994).

Ace of Hearts : This cultivar of rose is producing long lasting large blooms. Flower colour is crimson red with a shin of velvety scarlet. Variety is considered as one of the best rose among red (Kordes, 1981).

Africa Star : Plant growth is strong and its habit is spreadings. Flowers are double. Bloom colour is mauve and sometimes it is flushed with rosy mauve. Flowers appear in single or in clusters (West 1965).

Agnes Bernauer : Flowers are shapely and pleasantly fragrant. Buds open slowly. Flower colour is clean rose with yellow base. Petal texture is crisp (Kordes, 1989).

Agnes Winchel : Evolved as a hybrid of "Dorothy Anne" x "unnamed" seedling, buds are pointed. Blooms are double and have light pink with deep pink border. Flowers are high centred and are of exhibition quality. Flowers have 28 petals. Bloom size is medium and it is borne singly. Blooms have slight fruity fragrance. Foliage is medium dark green and semi glossy in nature (J. Winchel, Coiner Nursery, 1990).

Aida : Plants are compact, good as bedding plant. A cup shaped bloom of deep

rose pink in trusses. Even performed well in cold and wet climate and sunless days (Boerner, Jackson and Perkins, 1960).

Akebono : It is a Japanese cultivars and it possesses excellent beauty. Blooms are of exquisite form, high pointed, fragrant. Flower colour is light yellow. Petals are flushed and its edges are carmine (Kawai 1964).

Alaska : Plants are upright with glossy foliage, evolved through cross between "Peace" x "Blanche Mallerin". Blooms are large, attractive, and white with shaded gold at base (Meilland, 1954).

Alec's Red : It is a cross between "Fragrant Cloud" and "Dame de Coeur". Plant is bushy; its growth is strong with ample glossy leaves. Flowers are huge and well formed and fragrant. Bloom colour is deep crimson. This cultivar is a Harry Edland Memorial Medal winner of 1969 due to its superb fragrance and also winner of the Press. Int. Trophy & Gold Medal of 1970 (Cocker, 1970).

Allegro : Plants are tall. Flower buds are long, elegant, attractive, geranium-orange in colour, long lasting. Good as cut flower (Meilland, 1962).

Always Mine : Evolved as a hybrid of "Visa" x "Sassy". Buds are pointed and tapering. Flowers are deep red in colour and possess 39 petals, cupped, large and borne singly. Blooms have spicy fragrance. Leaves are large, dark green and glossy. Plant growth is upright (S. Marciel, De Vor Nurs, 1989).

Amalia : Shapely flowers, scarlet crimson in colour. Foliage is medium green in colour. Good for cutting and exhibition (Meilland, 1986).

Amanda Marciel : Variety is evolved as hybrid of "unnamed" seedling x "Pink Puff". Buds are slender and tapering. Flower is large, colour is delicate pink and it has 26 petals, fragrant. Foliage is medium dark green with glossy surface. Plant growth is upright and tall (S. Marciel, De Vor Nurs, 1989).

Amatsu-otome : A lovely Japanese cultivar with attractive yellow flowers. Bloom size is medium and its shape is fine (Teranish, 1960).

America's Classic : Plants are upright, produce classic blooms, shapely, fragrant. Flower buds are large and double, well formed. Blooms are dark rich red (Joe Winchel, 1988).

American dream : Flowers appear singly on long stem. Blooms have high centred with damask fragrance. Flower colour is deep velvety red (Winchel, 1987).

American Heritage : Plant is having vigorous upright growth and its foliage is attractive. Good blooms appear during rainy season. Flowers are beautifully shaped, high centred with reflexing petals. Flowers are large and their colour is creamy yellow, tinted with pink or even vermilion and crimson (Lammerts, 1965).

American Spirit : Plant growth is vigorous and upright. Flower quality is of exhibition type and its size is huge. Bloom colour is velvety red. Buds are perfectly shaped, borne on long stem. Good for cut flower (J & P, 1988).

Americana : Blooms are very large, superb red high centred. Petals are broad and reflexing (Boerner, 1960).

Angara : This variety of rose is mutant of cultivars, 'Montezuma'. All the morphological characters are same except the flower colour. Bloom colour is deep orange, (NBG Lucknow, 1971).

Angel : This variety is also known as 'Flora-Tea'. Flower colour is white. Blooms look very delicate and compared with angel's gown. Petals are lovely and like angel's wings (Delbord, 1982).

Angel Wings : A highly scented rose with long golden buds opening to large creamy white blooms tinted and shaded pink at the petal edges. Good as cut flower (Lindquist, Howard's Nursery, 1958).

Angel's Delight : Flower buds are perfect, attractive and high centred. Bloom colour is salmon with apricot buff (Fryer, 1976).

Angelique : An attractive variety with shapely long buds and long lasting. Blooms are of exhibition quality. Flower colour is luminous bright vermilion orange (Kordes, 1981).

Angkor : Flowers are produced in single and also in clusters, gold colour with dark red edges. In full bloom stage flowers look very attractive (Noak, 1938).

Ann Watkin's : A vigorous free flowering tall and upright plant, evolved through cross of "Ena Harkness" x "Grand Mere Jenny". Leaves are dark green semi glossy, bloom is apricot with cream shading, sometimes flushed pink. Flowers are full shapely (Watkins Roses Ltd., 1963).

Anne Letts : Plant growth is bushy and its foliage is glossy and exceptionally free blooming cultivars. Buds are beautifully pointed and blooms are of exhibition quality, slightly fragrant. Flowers are large, double and have rose-pink colour with silvery reverse. It is a cross between "Peace" and "Charles Gregory" (Letts, 1954).

Anticipation : Blooms are large, shapely perfect and fragrant. Two toned flowers, darker reddish and lighter pink in red blend (Burks, 1990).

Anvil Sparks : This cultivar is also known as Ambossfunken, and has unusual flower colour. Petals have splashes, stripes and spots of yellow on coral red background. Blooms are shapely and fragrant. Cultivar is ideal for cutting (Meyer, 1961).

Apollo : This cultivar originated as a seedling of 'High Time' x 'Imperial Gold' which is All America award winner of 1972. Plant growth is very vigorous and it has well branched twigs with dark green foliage that are disease resistant. Buds are slender, long, pointed and produced on long thornless stems. Buds open into large flowers having charming fragrance of an old fashioned Tea rose. Blooms colour is lasting sunrise yellow (Armstrong, 1972).

Apricot Silk : Plants are free flowering, upright and medium growth, with glossy medium green foliage. Evolved through hybridization "Souv. de Jacques Verschuren" and "unknown". Flowers are full, slightly scented, apricot, tinted red on reverse (Gregory, 1965).

Apricot Spice : Buds are well formed and exquisitely shaped. Petals are broad and flowers are of attractive shape. Blooms are orange apricot in colour (Sanday, 1985).

Aquarius : This cultivar is classified as Grandiflora in America and it has been selected in the All American Selection for 1971. Buds appear on long stem and pink colour. Petal colour is light pink and edge of petals is deep pink in colour. Flowers are mildly fragrant (Armstrong, 1970).

Arc Angel : Named for the Arthritis and Rheumatic Council. Plants are bushy and healthy. Blooming with abundance of beautiful flowers. Blooms are large, shapely, well formed and fragrant with lovely shades of coppery salmon (Fryer, 1996).

Arianna : This cultivar of rose is having strong Tea scent. Flowers are high centred and large in size. Bloom colour is warm coral, lightly splashed with rose, carmine on the outer petal (Meilland, 1968).

Arizona : This variety of rose produces medium sized flowers with mild fragrance. Blooms are high centred and double in nature. Flower colour is blend of golden-copper and scarlet (Weeks, 1980).

Arkansas : Plant growth is vigorous and healthy, stem is glaucous. Buds are pointed and open into exhibition quality flowers, petals rolled over. Flower colour is striking paprika red orange (Weeks, 1980).

Arlene Francis : It is a very popular cultivar among yellow roses. Blooms are beautiful, large, double and have high centred. Flowers have strong fragrant. Blooms are golden yellow in colour and freely produced on a vigorous bush that is covered with dark green glossy foliage. Buds are long and pointed (Boerner, 1957).

Arles : This cultivar of rose is good for bedding and cutting, vigorous and free flowing. Flowers are very large and light salmon orange in colour. Flowers have good shape and possess plenty of petals. Cultivar is also known as "Fernand Arles" (Gaujard, 1949).

Arnold Greensitt : Buds are well formed and shapely. Blooms are very large, deep non fading yellow (Greensitt, 1988).

Arpege : Plants with dark green foliage and most beautiful flowers of paeony-shaped blooms, shades of pink flushed with golden apricot (Boerner, 1960).

Artistry : Flowers are perfect, large, fragrant, and shapely produced several times in a year. Blooms are coral orange with tinge of cream on the reverse (Zary J & P. 1997).

Astree : It is a cross between "Peace" and "Blanche Mallerin". Buds are long, well shaped open into large blooms. Flowers are double and fragrant. Blooms colour is salmon-pink shaded orange. Stem is very strong and flowers remain upright on it (Croix, 1955).

Audrey Hepburn : An attractive variety of elegant shaped flowers. Blooms are lovely pink in colour, reverse side of the petals are light pink (Twomey, 1996).

Autumn : It is cross between "Sensation" x "Souv. De Clandius Pernet". Plants are tall and upright, free flowering with dark glossy foliage. Blooms are cupped, full, burnt-orange colouring streaked with red (Coddington, 1928).

Autumn Gold : Pant growth is vigorous. Buds are beautiful and open to shapely blooms. Flower colour is butterfly-cream and pale yellow in full bloom stage. Petals have darker colour in inner and lighter colour on its outer surface (Weeks, 1960).

Avon : The plant growth is vigorous and its habit is bushy. This cultivar is good for bedding and cutting and may occasionally provide exhibition bloom. It also makes a strong well-balanced standard rose. Extremely beautiful buds appear on long stem. Flowers are large and deep crimson in colour with moderate number of petals (Morey, 1961).

Awareness : Plants are vigorous and healthy; produce blooms singly or in clusters all through the year. Flowers are fragrant, well-formed, bright pink in colour (Fryer, 1997).

Aztec : It is a cross between "Charlotte Armstrong" x "Unnamed" seedlings. Free flowering, fragrant with dark green leathery foliage. Long pointed buds are plum coloured, opening to salmon pink with 22-28 petals (Swim, Armstrong Nurseries, 1958).

Azura Sea : This cultivar of rose produces beautiful flower. Buds are long pointed. Bloom colour is mauve with ruby tinge. Flowers are scented (Christensen, 1984).

Babylon : This variety produces delicately fragrant flowers. Blooms are large and well formed. They are suitable as cut flower. Bloom colour is rich coral vermilion (Bees, 1977).

Baccara : It is hybrid between "Happiness" x "Independence". An upright plant with dark leathery foliage. Buds are globular shaped developed into cut flower, opening flat, with 72 to 82 petals. Blooms are bright geranium-red, good for cut flower (Meilland, 1956).

Bacchus : A vigorous plant with fragrant flowers. The buds are long, shapely. Flowers are with 25 petals, full, carmine pink in colour (A. Dickson, 1951).

Bajazzo : A vigorous growing upright plant. Blooms are high pointed centre, very large, full, purplish red inside with reverse white (Kordes, 1962).

Ballet : Plant growth is vigorous and bushy. Cultivar is good for bedding and cutting. It is ideal for exhibition. Blooms are large, double and very good in shape. Flower colour is deep pink (Kordes, 1958).

Barbara Bush : It is a vigorous, disease resistant plant. Flowers are remarkably large, exquisitely formed long lasting, lovely coral pink in colour (J & P, 1993).

Battle of Britain : Plants have medium size flowers. Blooms have petals, flushed with salmon and flame on its edges. It gives striking effect to flower (Gandy, 1969).

Bayadére : It is a cross between "R.M.S. Queen Mary" x "Unnamed" seedlings. Plants are tall, vigorous with dark bronzy foliage. Flowers are very large, high centred, double, with 52 petals. Blooms are multicoloured, salmon pink to canary-yellow tinted pink (Mallerin, 1954)

Beauté : It is a cross between "Mme Joseph Perroud" x "unnamed" seedling. The cultivar is ideal only in cooler regions. It is good for cutting and exhibition. Buds are

long and beautiful. Flower colour is apricot and has a peach flush that opens quickly. Flowers have moderate number of petals (Mallerin, 1953).

Bel Ange : This cultivar is originated as a result of double cross hybrid (Independence x Papillion Rose) x (Charlotte x Flora Dora). Plant growth is vigorous and variety is a free bloomer. Blooms are large in size, double and have two-toned pink colour. Flowers have fragrance (Lens, 1962).

Belami : This variety of rose is very floriferous and produces exhibition type bloom. Flower colour is medium pink. Blooms are scented, high centred and perfect (Kordes, 1985).

Belle Epoque : Flowers are highly fragrant and produce in abundance. Buds are long. Flowers are perfectly formed, golden bronze inside and darker shades of nectarine bronze on the reverse (Fryer, 1994).

Ben Hur : It is a vigorous and strong growing variety. Buds are pointed and flowers are deep velvety-red rose (Meilland, 1955).

Bettina : It is a hybrid between "Peace" x ("Mm Joseph Perrand" x "Demain"). It bears orange coloured flowers that are overlaid with red and bronze, beautifully veined petals. Blooms are exquisitely shaped and large in size. Flower colour is extremely variable. Sometimes it looks almost like light pink. Cultivars have a tendency to get infected with dieback and black spot disease (Meilland, 1953).

Beverly Hills : Flowers are high centred perfect with broad petals. Bloom is deep lustrous vermilion orange. Good as cut flower (Delbard, 1986).

Billy Graham : Evolved as a hybrid of "Honor" x "Color Magic". Plants are tall and attain height upto 155 cm. Leaves are large and glossy. Stem is long and ideal for cutting. Flowers are big and produced in abundance. Flower size is 13 cm across. Blooms have 25 petals and slight fragrance; colour is simmering glowing clear pink (Keithzary, 1999).

Birmingham Post : It is evolved out of the cross between "Queen Elizabeth" and "Windy Cussons". Plant are upright, vigorous growing; with large semi glossy, medium green foliage. Blooms are pale pink with deeper reverse (Watkins, 1969).

Blessings : Blooms of this cultivar are elegantly shaped. Flowers have new shade of delicate warm coral pink. Blooms have fragrance (Gregory, 1967).

Blondie : This variety produces strong bush and elegant buds. Blooms are perfect and high centred, salmon coloured (Leperriere, 1988).

Blue Moon : This variety is evolved out of the cross of "unnamed seedling" x "Sterling Silver". Plant growth is vigorous, tall and upright. Foliage is green small and glossy. This cultivar is also known as 'Mainzer Fastnacht' and 'Sissi'. Buds are long, slender and spherically appealing. Flowers are silvery lilac in colour (Tantau, 1964).

Blue Perfume : It is a free bloomer. Fragrant variety. Buds are large in size and open into huge flower. Flower colour is lavender mauve (Tantau, 1979).

Blue River : It produces attractive fragrant flowers. Flower colour is deep mauve with darker reddish edges, which is prominent in petals (Kordes, 1984).

Blue Sky : Flowers are fragrant and exhibition quality. Variety is ideal for cutting. Artistic buds are produced on stem, which are high centred. Flower colour is lavender mauve (Suzuki).

Bond Street : A hybrid between "Radar" x "Queen Elizabeth". A vigorous growing, tall and upright plant with semi glossy, medium-green foliage. Flowers are pink with deeper tones at the edges of petals (Mc Gredy, 1965).

Bonne Nuit : This cultivar of rose is said to be one of the darkest rose. Bloom colour is very dark velvety blackish red. Flower does not fade or burn after full bloom. Blooms are full and well formed. Flowers have fragrance (Combe, 1956).

Bonsoir : It is evolved as cross of Seedling x Seedling. A bud of this cultivar is long and tapered. Flowers are of well shaped and have fullness, very fragrant. During winters when night temperature is very low, the flowers exhibit clestogamous tendency. Flowers are peach pink in colour (Dickson, 1968).

Brandenburg : This cultivar exhibit double, high centred blooms. Flowers are striking deep salmon colour (Kordes, 1965).

Brandy : Plant growth is vigorous and bush is healthy. Buds are long and burnt orange in colour and unfurl to golden apricot flowers. Blooms are borne on still stem (Christensen and Swim, 1982).

Brasilia : It is a cross between "Perfecta" x "Piccadilly". A vigorous growing upright plant with medium sized green foliage. Blooms are scarlet and reverse is silver and gold (Mc Gredy, 1968).

Brazil : Plant growth is vigorous with healthy foliage. Cultivar is excellent for cutting and bedding. Flowers are large and produce freely. Bloom colour is yellow, flushed with orange and reddish shade (Caron, 1947).

Breathless : Highly fragrant well formed and high centred flowers. Flower colour is deep rose pink (J & P. 1994)

Bridal Blush : Flowers are fragrant, white. Blooms are perfect with many petals (Twomey, 1990).

Brilliant : It is a cross of "Poinsettia" x "Crimson Glory". This free flowing cultivar is also known as 'Schlosser's Brilliant' and 'Detroiter'. Buds are long and pointed. Flowers are large in size, double and high centred. Blooms are fragrant. Flower colour is carmine, overcast with spectrum red. It produces blooms of excellent quality (Kordes, 1952).

Britannia : Produces perfectly formed, shapely blooms, which are fragrant and borne freely like floribundas. Blooms are apricot and gold coloured and open to refreshing nectarine and orange (Fryer, 1998).

Buccaneer : It is a cross between "Golden Rapture" X (Max Krause x Capt. Thomas). Plant growth is vigorous and its height is exceptionally tall. In USA, it is classed as a Grandiflora. Blooms are of large size and rich gold in colour. Buds are fine. Flowers have moderate number of petals up to 30 nos. Colour of the blooms fades with age (Swim, 1952).

Burnaby : It is evolved out the crossing of "Phyllis Gold" x "President H. Hoover". A vigorous tall growing plant with dark glossy foliages. Flowers are slightly fragrant large, very full, with 56 petals, high centred. Blooms are canary yellow with creamy outer petals (Eddie, 1954)

Cabaret : It is a fragrant, long lasting and charming French rosé. Flowers are high centred. Bloom colour is creamy white. Petal edges are blended with carmine red colour (Laperriere, 1992).

Camelot : It is a vigorous; tall and disease resistant variety. In USA, it is classified as Grandiflora. Blooms are large and well formed. Flowers have elegant petal formation; colour is luminous coral-pink with a remarkable iridescence (Swim and Weeks, 1964).

Canary : Buds are long, sharp and yellow in colour. With tinge red opening to shapely blooms. Flower is golden yellow in colour and has fragrance (Tantau, 1976).

Canasta : Blooms are intensely perfumed. Buds are very long and their colour is fiery scarlet. Buds open in to perfectly formed flowers. Petals are reflexed (Gaujard, 1966).

Caprice : This cultivar of rose is also known as 'Lady Eve Price'. Plants are vigorous but dwarf in habit. It is good for bedding. Produces several flashes of blooms in a year. Buds open into Camellia like blooms, which are beautiful. Petals are bright plum red in colour with ivory reveres (Meilland, 1948).

Cara Mia : Plants are vigorous and upright. Blooms are long lasting, fragrant and non-fading. Flower colour is glowing red (Armstrong, 1975).

Careless Love : Plants are very strong and vigorous, and produce camellia like blooms. Flower colour is predominantly pink with fancy white stripes on the petals surface (Conklin, 1955).

Carmousine : A free flowering variety, flowers are high centred. Bloom colour is scarlet red and light crimson. The variety is good for exhibition and also as cut flower (Leperriere, 1984).

Cary Grant : This variety produces fragrant flowers. Blooms are very large in size. Plant growth is erect and bloom appears on long stem. Flower colour is luminous orange and reverse side of the petal is yellow which gives bicolour effect to flowers (Meilland, 1987).

Catherine Denevue : Plants are floriferous. Blooms are perfect and long lasting, and colour is blend of salmon (Meilland, 1981).

Celebrate America : It is a sturdy variety and free bloomer. Flowers are elegant and well formed, with lovely shades of red colour (J & P, 1991).

Century Two : Blooms are high centred, large fragrant and well shaped. Flower colour is deep pink (Armstrong, 1971).

Cerise Dawn : Variety is evolved as a hybrid of "Carina" x "Angel Face". Buds are urn shaped. Flower colour is magenta and its reverse side is tyrian purple. On ageing, there is no discoloration. Flowers are double and have 30 petals. Blooms are globular,

large and borne singly. Flowers have slightly damask fragrance. Foliage is large, dark green and semi glossy. Plant growth is tall and upright (S. Marciel, De Vor Nursery, 1989).

Chalis Gold : This variety of rose is good for every purpose. Buds appear on long canes, which are elegant. Flowers are with high pointed centre, long lasting, deep yellow in colour (Greensitt, 1986).

Challenge : Evolved as a hybrid of "Jacqueline" x unnamed seedling. Bud shape is ovoid. Flower colour is dark red and its reverse side is medium red. Blooms are double and have 25 petals. Blooms are urn shaped, high centred, medium and borne in spray of 2-3. Blooms have moderate fragrance. Foliage is medium and semi glossy. Plant growth is medium and upright (D. Tracy, De Vor Nursery, 1987).

Champagne : Buds of this cultivar are long and pointed open into very large and well-shaped blooms. Flowers have buff colour with apricot shading which is an unusual colour (Lindquist, 1961).

Champs-Elysses : It is a cross between "Monique" and "Happiness". A very vigorous and bushy variety. Flowers are produced in abundance. Blooms are large, double and well formed. Flower colour is rich-crimson red. Blooms are slightly fragrant (Meilland, 1957).

Chantre : It is a cross between ("Luis Brinas" X "Spek's Yellow") and "Anthéor. This cultivar is excellent for exhibition. Buds are very large and high centred. Flower colour is very attractive and commonly called as Chinese orange. Blooms are borne on long stems, which are lovely, apricot orange in colour (Kordes, 1958).

Charles Mallerin : This variety of rose is evolved from a hybrid seedling or (Rome Glory x Congo) x Tassin. Plant growth is vigorous but it tends to grow on one side making the bush unbalanced. Blooms are large in size and double in nature. Flower colour is velvety blackish crimson. Blooms are very fragrant (Meilland, 1947).

Charles William : Evolved as a hybrid of "Brandenburg" x "Command Performance". Buds are urn shaped. Flower colour is carmine rose and its reverse side is lighter yellow. Bloom is double and has 50 petals, reflexing large and borne usually singly. Flowers have very little fragrance. Plant growth is upright and tall (R.F. Cattermole, 1988).

Charlotte Armstrong : It is evolved out of crossing of "Soeur Therese" x "Crimson Glory". This is free flowering cultivar. Buds are beautiful long and pointed which opens into larger flower. Bud colour is blood red, flowers are perfectly formed and fragrant. There are 35 petals, which are deep carmine red in colour. Blooms are borne on long stem (Lammerts, 1940).

Chateau d' Amboise : Evolved as a hybrid of [unnamed seedling of "Super Star" x "Rome Glory" x "Impeccable"] x ("Rouge Meilland" x "Soraya"), flower colour is dark red. Blooms have 23-30 petals, which are long. Flowers have slight fragrance (Delbard and Chabert, 1988).

Cherry Brandy : This cultivar has a large flower that opens quickly. Bloom colour is light vermilion on a gold base. Flowers are fragrant (Tantau, 1965).

Cherry Velvet : This variety produces strong canes, which are covered with healthy and green foliage. Flower appears on strong canes. Blooms are large in size and shapely. Flower colour is deep pink (Poulson, 1988).

Chicago Peace : This cultivar is a bud sport of 'Peace'. Buds are of high quality and open into very charming double flowers. Blooms are attractive pink blended with cannary-yellow or copper (Johnston, 1962).

Christian Dior : It has been evolved out of the crossing ("Independence" X "Happiness") X ("Peace" X "Happiness") one of the outstanding varieties among red roses. Plant growth is very vigorous, tall and upright with leathery and semi-glossy leaves. Flowers have no fragrance. Blooms are large and velvety red. Flowers open slowly and their shape remains unaltered for several days (Meilland, 1958).

Chrysler Imperial : It is a cross between "Charlotte Armstrong" X "Mirandy". These are upright vigorous plants with dark green leathery leaves. Blooms are produced freely. Flowers are large and their colour is glowing crimson. Blooms have rich fragrance, which resembles with rose water. This cultivar is strongly recommended for places where night temperature is not very low (Lammerts, 1952).

Clair De Lune : This cultivar of rose is temperature sensitive and may not open during very cold nights. Flowers are large and highly scented. Flower colour is new shade of pinkish lilac (Gaujard, 1967).

Classic Beauty : Flowers are well shaped, slightly fragrant, large and very attractive. Blooms are the blend of cream and dark pink and petal base are yellow (Winchel, 1994).

Classic Touch : It is evolved as bud sports of "Touch of Grass". Blooms are fragrant, perfectly shaped and are of exhibition type. Flower colour is light petal pink (Heffner, 1991).

Cleopatra : It is a cross between ("Walter Bentley" X "Condesa de Sastaga") X "Spek's Yellow". Flowers are fragrant, perfectly formed, and attractive bicolour. Petals are scarlet with old gold reverse (Kordes, 1955).

Clochemerle : Plant growth is bushy and vigorous. Evolved as a hybrid of unnamed seedling x ("Michelle Meilland" x "Karla") x unnamed seedling. Flower colour is medium red. Blooms are double and possess 38 petals. Flowers are large, cupped and slightly fragrant (Delbard and Chabert, 1988).

Clovelly : This cultivar of rose is free flowering and has vigorous growth habit. Buds are very fine, carved on long and upright stems. Cultivar is excellent for cutting. Flower colour is carmine-rose shaded salmon (Hicks, 1924).

Coalite Flame : It produces perfectly formed blooms. Flower colour is rich vermilion and look like that of a burning flame (Dickson, 1974).

Colour Magic : It produces huge size buds of apricot pink colour in large number, which opens into enormous blooms. Flower colour is ivory pink shade ranges to an exquisite clear coral and red (Wariner, 1978).

Colour Wonder : This cultivar of rose is also known as "Koningin der Rosen". The flowers are large in size, full, shapely and very attractive. Flower colour is glorious orange-salmon and yellow (Kordes, 1964).

Columbus Queen : It is a cross between "La Jolla" x "unnamed" seedling. The cultivar is vigorous upright and floriferous in nature. Buds are beautiful and open into well-formed flowers on long and strong stem. Bloom colour is lovely shade of pink. Buds are deep pink in colour while flowers are lighter pink (Armstrong, 1963).

Comanche : This cultivar produce blooms either singly or in small clusters on stems. Ideal as cut flower. Flowers are double and high centred. Bloom colour is fiery scarlet (Swim and Weeks, 1968).

Condesa de Sastago : It is evolved as a cross between ("Souv. De Claudius Pernet X Marechal Foch") X "Margaret McGredy". Plant growth is vigorous and bushy. Cultivar is useful for bedding and for cut flowers. Blooms are large and loosely formed. This rose is having unique characteristics, as inside of the petals is red while outside is yellow. Flowers are full and flat, produced in small clusters (Dot, 1932).

Confidence : It is a cross between "Peace" and "Michele Meilland". Plants are vigorous and bushy. This cultivar is good for bedding, cutting or exhibition purpose. Flowers are high centred, very large, fragrant, freely produced and beautiful in shape. Flower colour is pearly light pink. Blooms have scent, somewhat similar to that of 'La France' (Meilland, 1951).

Coral Star : It is a cross between "Super Star" and "Stella". Plants are vigorous and upright. This cultivar has flowers with fragrance. Blooms are large in size; fully open. Flowers are soft, coral pink in colour with deep salmon shadings on their petal surface (Robinson, 1967).

Cover Girl : Plant growth is upright and good for bedding. Blooms are full and large in size, open quickly. Flower colour is glowing coppery orange and petals are tough and leathery (Von Abrams, 1960).

Crimean Night : This rose cultivar is considered as a Floribunda in USSR. Plant growth is vigorous and blooms are long lasting. Flower colour is very dark wine red with purplish sheen. It is one of the darkest rose known (Klimenko, 1965).

Crimson Glory : It is a cross between "Cathrine Kordes" seedling X "W.E. Chaplin". Plant growth is vigorous, spreading and the foliage is semi glossy medium green. Ideal for exhibition, bedding and as cut flower. The plant also makes one of the best standards. Light pruning is recommended. Flowers are exquisite in shape, large and fragrant. Flower colour is rich-velvety-crimson (Kordes, 1935).

Dainty Bess : It is vigorous and free flowering Plant. It has flowers that are very useful for decorative arrangements and very attractive. Flowers are very large and soft pink in colour, single and five petalled (Archer, 1925).

Dame Joycee Frankland : Evolved as a hybrid of ("Honey Favourite" x "Dr. A.J. Verhage") x "Pot o' Gold". Buds are globular and greenish yellow in colour. Flower colour is medium yellow. Blooms have 32 petals. Flowers are urn shaped, large and borne singly. Blooms have slight fragrance. Leaf size is large and their colour is medium green. Leaf surface is glossy. Plant growth is bushy (Colin P. Horner, 1988).

Day Dream : Flowers of this cultivar are scented. Buds are long and open into large

blooms on strong stems. Flowers are lovely and have deep pink colour with a splash of gold at the centre (Armstrong, 1969).

Deep Secret : This variety produces attractive well-formed bloom. Flower colour is very deep crimson almost towards black (Tantau, 1978).

Delicia : It produces very good quality flowers, which have fragrance. Buds are elegant and open into spiral flowers of good form. Flower colour is creamy yellow. Petals have blended pink colour on their edges (Kordes, 1985).

Delightful Kiwi : Evolved with the cross of "Silent Night" x ('Prima Ballerina" x "Irish Mist"). Leaves are large, light green and have shiny surface. Plant growth habit is upright and branching. Buds are tapering. Flower colour is blush pink aging to creamy pink. Blooms are double and have 45 petals and urn shaped. Medium sized, borne singly or in spray of up to 5. Flowers have slight fragrance (R.F. Cattermole, S. Pacific Rose Nursery, 1988).

Delsulan : It is a cross of "unnamed" seedling x ("Michele Meilland" and "Karla"). Leaves are bright. Plant growth is vigorous and bushy. Flower colour is pink magenta. Blooms are double and have 11 petals. Flower is long, large and has slight fragrance (Delbard and Chabert, 1988).

Denman : Evolved as a hybrid of "Mildred Reynolds" x "Arthur Bell". Plant growth is upright with large dark green glossy foliage. Blooms are creamy yellow, double and have 35 petals. Flower shape is urn like. Blooms are large and borne in spray of 2-3. Flowers have heavy fragrance (Sealand Nurseries Ltd., 1988).

Derek Nimmo : Plants are strong and vigorous. Buds are well shaped and open into large size blooms. Flower is bicolour having salmon-pearl combination on petals (Mc Gredy, 1981).

Diamond Jubilee : It is a hybrid between "Maréchal Niel" x "Frau Pernet Ducher". Plant growth habit is upright and compact, having leathery foliage. Flowers are in doubles, beautiful and large. Blooms are very fragrant and their colour is buff-yellow. It is a superb variety (Boerner, 1947).

Diorama : It is a cross between "Peace" and "Beauté". A vigorous tall and bushy plant. Blooms of this cultivar are very well shaped. Flowers are large and beautiful. Bloom colour is golden apricot; guard petals flushed pink, high pointed, full and fragrant (De Ruiter, 1965).

Dolly's Sister : This variety is evolved as a bud sport of "Dolly Portion". Flower size is medium and its colour is coral pink (T. Taylor Michigan Mini Roses, 1989).

Doris Tystermann : Plants are healthy and vigorous. Flower colour is tangerine and golden, which deepens to orange at the edges of the petals (Wisbech, 1975).

Dorothy Peach : It is a cross between "Peace" x "Lydia". Bush growth is vigorous with dark green glossy foliage. It is free flowering cultivar. Flowers are beautiful, high centred and double in nature. Blooms have fragrance. Bud colour is deep yellow with flushed pink, opening to yellow edged buff, full and well formed flower (Robinson, 1958).

Double Delight : This variety is hardy and disease resistant in nature. Bloom colour is vanilla dipped in strawberry juice and looks very charming. Flowers are very attractive and highly scented (Swim and Elice, 1977).

Dr A.J. Verhage : It is a cross between "Tawny Gold" x ("Baccara" x seelding). Plant growth is upright and vigorous. This cultivar is also known as "Golden Wave'. Stems are erect and strong, ideal for cutting. Flowers are well shaped and double in nature. Bright yellow blooms, which are full and shapely (Verbeck, 1961).

Dr. Debat : It is a cross between "Peace" x 'Mrs. John Laing". This cultivar is also known as "La Rosee". Plants are vigorous and upright. Foliage is dark green in colour and its texture is leathery. Buds are ovoid and pointed, open into very large flower. Blooms are double, high centred and fragrant. Flower colour is bright pink (Meilland, 1948).

Dr. Dick : This variety produces flowers of exhibition type. Variety is ideal for cutting. Plant growth is vigorous and healthy. Blooms are of high quality. Orange coral flowers appear on healthy stem (Cocker, 1986).

Dr. Valois : This cultivar of rose is also known as "Doeteur Valois" and this is most popular in bedding. It has striking bicolour effect. The growth is vigorous and possesses dark green glossy foliage. It is supposed to be one of the brightest garden roses. Blooms are large in size. Colour of the flower is bright geranium, shaded vermilion with yellow reverse. Flowers have pleasing fragrance, being reminiscent of "Freesias' (Mallerin, 1950).

Dresden : It is a cross between seedling of "Ophelia" and "Catherine". This cultivar is also known as 'Mathe Altery'. Plants are vigorous. A free flowering cultivar having soft, pinkish, white flowers and delightful fragrance (Robinson, 1960).

Duet : It is a cross between "Fandango" and "Roundelay". A vigorous bush, which is free flowering. Flowers are produced in clusters. This variety is lovely in nature and producing a delicate bicolour effect. Blooms are high centred and large. Flower colour is soft salmon pink with rich rose pink on the reverse (Swim, 1960).

Duke of Windsor : This cultivar is also known as "Herzog Von Windsor". Flower colour is light vermilion. Beautiful flowers are produced on long stem (Tantau, 1968).

E.G. Hill : Performance of this cultivar is very well in warmer weather and during rainy season. Flowers are large and are of good shape. Bloom colour is glowing crimson red, with dark shadings in cool weather. Flowers are very fragrant (Hill, 1929).

Eiffel Tower : It is a cross between "First Love" and "Unknown" seedling. A vigorous tall growing plant, foliage is semi glossy and leathery. Buds are extraordinary long and pink colour with 30 to 40 petals. Buds appear in long stems, flowers are highly fragrant. These are good as cut flower (Armstrong, 1963).

Elcid : Plants are sturdy and spreading type. Flower colour is dazzling orange which are produced on strong stem (Armstrong, 1969).

Elfe : It produces florist rose. Blooms are of classic shape. Buds appear on long stem. Flower colour ranges from white to light pink, which is subtle porcelain light pink (Tantau, 1985).

Eliane : Plant growth is strong and vigorous. Blooms are well formed, beautiful and large in size. Flower colour is bright salmon shaded pink (Gaujard, 1954).

Elida : Plant growth is vigorous, tall and branching. This variety is very beautiful and is of exhibition type. Flower colour is lovely shades of burnt orange with a tinge of tangarine. Buds are long and exquisitely shaped. Blooms are slightly fragrant (Tantau, 1966).

Elizabeth Harkness : It is a cross between "Red Dandy" x "Piccadilly". Plant growth is upright bushy with medium green semi glossy foliage. Plant produces flowers of soft colour. Bloom colour comprises of pastel shades. Outer petals have creamy buff while the centre is rose to rosy amber (Harkness, 1968).

Embassy : A cross between "Gavotte" x ("Magenta" x "Spek's Yellow"). Flowers are large, beautiful, exquisite shape and fragrant. Bloom colour is light-gold, veined apricot and pastel carmine (Sanday, 1967).

Ena Harkness : It is evolved out of the cross of "South Point" x "Crimson Glory". Plant growth is vigorous, and branching. Flowers are very fragrant, which is variable in nature, full and well formed. Large blooms developed from exquisite buds and then freely produced. Flower colour is rich crimson. Crimson scarlet colour developing a velvety texture especially in cool weather (Norman, 1946).

Endearment : Evolved as a hybrid of "Gladiator" x "First Prize". Buds are pointed. Foliage is large and medium green in colour. Plant growth is tall and upright. Blooms are creamy pink and reverse side of petal is coral pink. Flowers are semi double and have 10 petals. Bloom size is large, borne usually single or in sprays of 1-3. Flowers have light sweet fragrance (T.Taylor, Michigan Mini Roses, 1989).

Ernest H. Morse : Plants are vigorous, tall and upright, with semi-glossy, dark green foliage. Blooms are large and high centred. Flower colour is brilliant Turkey red and drenched with perfume, full and well formed (Kordes, 1964).

Erotika : It is also known as "Eroica". Plants are very vigorous, upright and foliage is dark green. This variety of rose is also known as 'Eroica'. Flower colour is deep crimson. Blooms are large, full, with 39-40 petals, high centred with reflexing petals. Flowers are very fragrant (Tantau, 1968).

Esmerelda : This variety of rose is considered as a standard for future rose. Plant growth is healthy flowers are borne on long stem. Bloom colour is luminous rose pink. Flowers are perfect and sweetly scented (Kordes, 1980).

Eterna : This is an excellent variety for cut flowers and exhibition. Blooms are of good shape, form and size. Flower colour is soft pink, and long lasting (Delbard, 1979).

Etoile de Hollande : A cross between "General McArthur" X "Hadley". The variety is tall and has sparse foliage, which is reddish green in colour. Buds are long and flowers have large petals. Flower colour is deep velvety-crimson and it is very attractive. Blooms are having sweet fragrance. This old rose is still favourite and continues to be popular. Good for bedding (Verschuren, 1919).

Eve : A vigorous plant produces profuse blooms. Buds are pointed, long and open into very large flower. Flowers have fragrance. Blooms are double and its colour is coral-red-shaded with yellow (Gaujard, 1954).

Eventail : Evolved as a hybrid of "Sonia" x "Miyabi". Leaves are medium, semi glossy and slightly denticulate. Plant growth is upright and tall. Buds are ovoid. Flower colour is light yellow to pink. Blooms are double and have 50 petals. Flower size is medium and they are borne singly. Blooms have slight fragrance (Yoshito Kino, 1989).

Fascination : It produces well-shaped pointed buds. Colour of bud is apricot and ivory. Bud opens to spiral of golden-coral to orange to rose in full bloom stage. Flowers have delicate fragrance (Warriner, 1982).

Femina : Buds are perfect and develop into large, very nicely formed double bloom. Flower colour is brilliant pink with ochre-orange shading. This variety is excellent as cut flower (Gaujard, 1963).

Ferry Porsche : It produces durable and long lasting flowers. Flower colour is deep blood red (Kordes, 1971).

First Love : It is evolved as a cross of "Charlotte Armstrong" x "Show Girl". It is very charming and also known as "Premier Amour". It is a vigorous tall growing and branching type of variety with medium green pointed foliage. Buds are long and pointed. Blooms are of medium size. Flower colour is rose to pink. Blooms have slight fragrance. Variety blooms profusely (Swim, 1951).

First Prize : This variety of rose produces enormous buds, which are of exquisite shape. Buds open into extra large long lasting blooms. Flower colour is lovely blend of light red and deep rose (Boerner, 1970).

Flair : Evolved as a hybrid of "Pristine" x "Ink Spot". Foliage is medium, dark green and semi glossy. Plant growth is medium and upright. Buds are pointed. Bloom colour is medium red to dark red, reverse side of petal is lighter. Blooms are double and possess 38 velvety petals, light centred, exhibition type, and medium in size and borne singly. Blooms are slightly fragrant (P.E. Cummings, 1991).

Flaming Beauty : This variety produces medium to long buds opening to lovely and large blooms. Flower colour is yellow with orange-red border on petals. Flowers are long lasting (Winchel, 1980).

Flaming Sunset : This variety is evolved as a bud sport from cultivar. 'Mc Grady's Sunset'. It has all the qualities of its parent except the colour. Flowers are deep orange in colour on inside and yellow on the reverse side of the petals. This bi-colour rose variety is very attractive (Eddie, 1947).

Fontainbleu : This variety of rose is very striking tall and grows upright. Blooms are very large and their colour is rich magenta rose (Delbard-Chabert, 1947).

Forever : It produces shapely, non-fading blooms. Flowers are large and colour is crimson red (Armstrong, 1974).

Foster's Wellington Cup : Evolved as a hybrid of "Sexy Rexy" x "Pot of Gold"

Flower colour is white. Blooms are double and have 20 petals and fragrant. Flower size is medium. Plants are bushy and leaves are large medium green and semi glossy. (Mc Gredy Rose Int. 1989).

Fragrant Cloud : It is evolved as a cross between 'seedlings' X "Prima Ballerina". Plant growth is vigorous upright; foliage is glossy, dark green and large. This outstanding variety of rose is also known as "Duftwolke" and "Nuage Parfume". Blooms have very nice fragrance and free flowering. Flowers are large in size and have very beautiful shape. Blooms are rich-coral-flame in colour (Tantau, 1963).

Fragrant Dream : Evolved as a hybrid of ("Eurorose" x "Typhoon") x "Bonfire". Foliage is medium green and glossy. Plant growth is upright. Flower colour is apricot blended with orange. Blooms are double with 20 petals. Flower size is large. Blooms are very fragrant (P. Dickson, Nursery, 1989).

Fragrant Hour : It is a cross between "Arthur Bell" x ("Spartan" x "Grand Gala"). Flowers are large and orange pink in colour. The fragrance is said to be reminiscent of strong spice and fruit. Variety won the James Alexander Gamble Fragrance Medal by the ARS Prizes and Awards Committee (Mc Gredy, 1973).

Fragrant Surprise : Evolved as a hybrid of "Silver Jubilee" x "Dr. J. Verhage". Foliage colour is medium, green and its surface is glossy. Plant growth is bushy. Buds are ovoid and reddish apricot in colour. Blooms are apricot with pink tints, which are very prominent on petals. Flower is double and possesses 46 quartered petals. Blooms are cupped, large, borne singly or in sprays up to 5. Flowers have fruity fragrance (R. Harkness; R. Harkness & Co. 1990).

Francis Phoebe : This variety of rose produces flowers of exhibition quality. Blooms are well formed. Flowers appear on compact plant. Bloom colour is white (Legrice, 1979).

Frau Karl Druschki : This variety is also known as "Snow Queen", 'Reine des Neiges' and 'White American Beauty'. The plant growth is very tall and extra vigorous. Sometimes it is classified as a Hybrid Perpetual. Buds may have splash of pink on the outside of petals but flowers are pure white. Blooms are very large and beautifully oriented. Flowers have no fragrance (Lambert, 1901).

Fred Gibson : This variety is very attractive. Blooms are of perfect shape. Flower colour is deep apricot (Sandy, 1966).

French Perfume : It produces excellent flowers. Blooms have intoxicating perfume and fantastic colour. Blooms are well formed and perfect. Flowers are long lasting and are of exhibition type. Bloom colour comprises of lovely shades of yellow to pink and red at margins of petals (Keisei, 1992).

Friendship : It produces deep coral buds opening into large size flower, which is long lasting. Blooms are high centred. Flower colour is glowing pink with a touch of salmon around petals edges. Blooms have sweet fragrance. Flowers are borne on strong graceful stems (Lindquist, 1979).

Fukuyama : Evolved as a hybrid of "Pristine" x "Takao". Buds are pointed. Leaves are dark red and turn green with ageing. Plant growth is tall and upright. Flower colour

is salmon pink which turns darker with ageing. Blooms are high centred, large and have slight fragrance (K. Tagashina, Hiroshima Rose Nursery, 1988).

Funkhur : This variety has compact growth habit. Blooms are perfectly shaped. Flower colour is golden and petals have pinkish edges (Kordes, 1984).

Gail Borden : It is a cross between "Mev.H.A. Verschuren" x "Viktoria Adelheid". Plant growth is vigorous and upright. Blooms are large, lovely and high centred. A flower appears on strong stem and their colour is delicate pale gold with peach to salmon-rose inside (Kordes, 1956).

Garden of the world : This variety produces well-formed flowers, which are bicolour, and looks very attractive. Petals have blend of rose and white along with market deep pink and red (J & P, 1993).

Garden Party : The parentage is "Charles Armstrong" x "Peace". Plant does not grow tall but bloom freely. Flowers have large white petals, which are lightly brushed with shades of pink and rose. Flowers are in well shape and its centre is high, outer petals are flaring, slightly fragrant (Swim, 1959).

Gay Gordon's : This variety is free flowering, colourful and its growth habit is bushy. Flower colour is brilliant red and yellow. The colour resembles with 'Piccadilly' but yellow colour is deeper in this variety (Cocker, 1969).

General D. Mc Arthur : Plant growth is vigorous and blooms profusely and tolerant to most adverse weather. This variety is having good fragrance, which is exceptionally strong, and very much resembles with rose water. Blooms are double and somewhat flattened. Flower colour is rose red (Hill, 1904).

Geordie Lad : Evolved as a hybrid of 'Prominent" x ("Champagne Cocktail" x "Alpine Sunset"). Foliage is medium green in colour. Plant growth is medium and upright. Buds are ovoid and red in colour. Bloom colour is mahogany red; yellow at base, reverse side of petal is lighter red. Blooms are double, cupped, medium and borne singly and in sprays of 4-6. Flowering is moderate. Blooms have fruity fragrance (Colin P. Horner, Batter Sky Roses, 1990).

Gina Lolabrigada : This variety is prolific bloomer, and massive flowers appear on the plant, which are long lasting. Flower colour is clear deep yellow (Meilland, 1989).

Godfrey Winn : This variety of rose is having shining foliage with blooms of deepest-shade of the mauve and lavender among the H.T. roses. Buds are beautiful and open into large flowers. Flowers have many petals and highly fragrant (Dot, 1968).

Gold Crown : This variety of rose is also known as 'Couronne D' Or', 'Gold Krone' and 'Corona de Oro'. The parentage is "Peace" x "Spek's Glow". Plants are tall, upright, vigorous and foliage is dark green, large and leathery. Plant is susceptible to die back disease. Buds are high pointed and borne on long stems. Flowers are big and cream yellow in colour with light bluish pink flush. Flowers are susceptible to damage caused by very cold weather (Kordes, 1960).

Golden Choice : This variety of rose is bud sport of 'My Choice'. Blooms are large

and well shaped. Flower colour is blend of pink and gold. Yellow shadings are predominating in flower (Bar Dill Nurseries, 1967).

Golden Giant : Plants are very vigorous, tall and upright; foliage is small, medium, green, free flowering. This variety of rose is suitable for bedding. Blooms are slightly fragrant, full and large in size and their colour is golden yellow (Kordes, 1960).

Golden Masterpiece : The parentage is "Mandalay" x "Spek's Yellow". Plants are strong and upright. Plant produces largest golden yellow rose and probably the best among yellows. Blooms are highly fragrant and its form is superb. Plant produces fine shaded flower (Boerner, 1954).

Golden Melody : It is evolved out of the cross of "Mme Butterfly" x ("Lady Hillingdon" x "Souv. De Clandius Pernet"). A vigorous plant bears very fragrant yellow flowers (La Florida, 1934).

Golden Splendour : Plant is having vigorous growth. It is good for bedding and as cut flower. Buds are large well shaped and high centred. Blooms have deep creamy yellow to deeper shades. Some time flushed with apricot and peach colour. Flowers have moderate number of petals (Jones, 1960).

Golden Times : Its parentage is "Fragrant Cloud" x "Golden Splendour". This variety produces pointed long buds that open to full, high centred well shaped big bloom. Flower colour is pure light gold with delicious fragrance (Cocker, 1970).

Goudvlinder : This cultivar of rose is also known as 'Donatella' or "Golden Butterfly" and semi double flower. Foliage is attractive and shining especially in young shoots. Leaves are bronze coloured. Bloom colour is shining deep golden yellow at the time of opening but colour bleaches rapidly in strong sunlight (Van Rossem, 1926).

Graceland : This variety of rose is abundant bloomer. Flower colour is exceptionally bright yellow. Blooms are of high centred with ruffled petals (Warriner, 1989).

Granada : This is an outstanding variety having spicy fragrance and multicoloured. Buds are long and urn shaped. Flowers have varying shades of scarlet, nasturtium-red and lemon yellow colour (Lindquist, 1963).

Grand Marshall : Evolved as a hybrid of 'Futura' x 'Olympaid'. Foliage is medium green and glossy. Plant growth is medium and bushy. Buds are ovoid and pointed. Flower colour is medium red and it has 35 petals. Blooms are double, high centred, large and borne usually singly. Flowers have slight fragrance (J. Christensen, Michigan Bulb, 1989).

Grandmére Jenny : This variety of rose is originated from 'Peace'. Performance of this variety is better in the plains of India. Blooms are large and perfectly shaped slightly fragrant. In cool weather best flowering and exquisite beauty can be seen in blooms. Flower colour is apricot yellow, with edges flushed pink (Meilland, 1950).

Grandpa Dickson : It is evolved as a cross between ("Perfecta" x "Governador Braga da Cruz") x "Piceadilly". This cultivar of rose is also known as "Irish Gold'. Blooms are large and their shape is classic. Petals are reflexed. Bloom colour is light lemon with yellow shade (Dickson, 1966).

Grussan Berlin : This variety of rose is also known as 'Greetings'. It is considered very good for exhibition bloom. Flowers are long, pointed and borne on strong stems. Flower colour is light red (Kordes, 1963).

Hadley : This variety of rose is supposed to be one of the best-scented rose. It is good as a general garden rose and also equally popular for exhibition. Flower shape is good. Blooms are large and its colour is deep crimson (Montgomery, 1914).

Happiness : It is a cross between ("Rome Glory" x "Tassin") x "Charles P. Kilham" x ("Charles P. Khilam" x "Capucine Chambard"). Plants are vigorous and upright. This variety is also known as 'Rouge Meilland'. Flowers are well formed, petals are reflexed. Bloom colour is bright crimson red. It is free flowering and bear flowers on long stem. It is one of the best red rose. Blooms have slight fragrance (Meilland, 1949).

Harmonie : It is considered as one of the best rose of the century. Buds are large and high centred. Flower colour is shimmering salmon orange pink (Kordes, 1981).

Hawaii : It is a cross between "Gold Masterpiece" x unnamed seedling. Plant growth is free, erect and excellent. It blooms profusely. Buds are long and elegant, opens into fully developed large flowers. Blooms are fragrant. Flower colour is intense orange- coral (Boerner, 1960).

Headliner : This variety of rose produces flowers, which are used in every purpose. Buds open slowly revealing its beauty. Petals are long pointed edged cerise. Flower colour is creamy white (Warriner, 1990)

Heart 'O' Gold : A very attractive, perfect, shapely and well formed yellow flowered rose (Mc Gredy, 1995).

Heather Honey : Evolved as a hybrid of "Favorite" x "Southampton". Leaves are medium green and glossy. Plant growth is medium and bushy. Buds are ovoid and have bronze colour. Blooms are apricot yellow in colour. Reverse side of the petal is apricot. Blooms are double and have 25 petals. Flowers are urn shaped, medium, borne usually singly or in sprays of 5-7. Flowering is moderate. Blooms have fruity smell (Colin P. Horner; Le Grice Roses, 1990).

Heaven : A long lasting, sweet scented shapely rose of remarkable quality. Colour is white with pink streaks and violet edges on broad petals (Warriner, 1995).

Hebe : A strongly fragrant pale salmon-pink coloured rose, good for bedding (Alex Dickson, 1949)

Hector Deane : Its parentage is a cross of "Mc Gredy's Scarlet" x "Lesley Dudley". A viscous tall growing plant. This variety of fine rose is very sweetly scented. Buds have flush of orange selmon colour while the bloom colour is deep pink which turns with age into deep carmine. The variety was awarded the Clay Challenge Vase for Perfume (Mc Gredy, 1938).

Helen Traubel : It is a cross between "Charlotte Armstrong" x "Glowing Sunset". A vigorous and tall plant. This floriferous variety of rose grows vigorously. They are suitable for bedding and exhibition purpose. Blooms have light sparkling pink colour with

luminous apricot tones. Buds are long and magnificent; they open into large blooms and have few petals (Swim, 1951).

Héléne De Roumanie : Plant growth is vigorous and upright. Bush has dark green foliage. Flowers are very large, globular and fragrant. Flower colour is pink-shaded golden yellow (Meilland, 1950).

Helmut Schmidt : This variety is supposed as one of the best yellow produced so far. Blooms are of exhibition type. Variety is ideal for cutting. Flowers are striking yellow long lasting and well shaped (Kordes, 1979).

Henry Ford : It is evolved as a cross between "Pink Dawn" x "The Doctor". Plant growth is healthy and vigorous. Buds are exquisite, long and pointed. Flowers are well formed. Bloom colour is brilliant unfading peach-blossom pink. Flowers have moderate numbers of petals (Howard, 1954).

Heure Mauve : It makes a compack, bushy, dwarf plant of darkest green foliage. This variety of rose is having mauve coloured blooms. Flowers are well shaped. Blooms are of medium size and scented. (Laperriére, 1963).

Hidalgo : It produces fragrant flowers, blooms are of exhibition type, perfect and shapely. Buds are conical shape and opening into large flower. Flower colour is dark velvet red (Meilland, 1979).

High esteem : It is a fine exhibition variety. Blooms are very fragrant. Flowers are pointed and open into very large high centred flowers. Bloom colour is phlox pink, with silvery reverse (Von Abrams, 1961).

High Society : Plants are compact, good for bedding. A very attractive brightest crimson coloured rose, free flowering. Blooms are high centred and last longer (W. Kordes, 1961).

High Time : Plant growth is vigorous and upright. Foliage is dark green. Buds are large pointed and beautifully formed. Blooms are high centred and their colour is claret-rose while the reverse side of the petals have a blend of pink and yellow. Flowers are borne singly. Blooms have good lasting quality with a strong spicy fragrance (Swim, 1959).

Hishami : A classic rose, perfect and attractively shaped rose which are large, full and are with lovely shade of light pink (Harada, 1988).

Hoagy Carmichael : Fragrant, velvety red flowers are superbly shaped (Mc Gredy, 1990).

Hondo : Flowers are exquisitely shaped, yellow with red at tips ageing to purple. Blooms are large, double, fragrant and are exhibition type (Perry, 1990).

Honest Red : Flowers are large, full, perfect and shapely with fine form. Blooms are deep red and most dazzling. (Wambach, 1995).

Horticolor : Flowers are having broad petals, fragrant with good shape and form. Colour is blended yellow to rose pink (Laperriere, 1989).

Hunter Noon : It is evolved out of the cross of "Sastago" x "Gorgeous". Flowers are pale moonlight yellow in colour (Mc Gredy, 1949).

Ideal Home : The variety is also known as *Idylle*. Bush is vigorous in growth and has dark green foliage. Flowers are of medium size. Bloom colour is ivory overlaid with pink, shading to light crimson at the petal edges. Flower is full and well formed (Laperriere, 1959).

Illona : It produces long pointed buds opening slowly into high pointed, perfect bloom. Flowers are long lasting. Bloom colour is blood red (Verbeck, 1977).

Imagination : Flowers are double, large, long lasting, and best shaped. Blooms are apricot orange on the inside with a clear yellow reverse (Winchel, 1992).

Impertrice Farah : Flowers are high centred. Blooms are elegant. Flower colour is pure white with pink blend, which is very prominent on petals (Delbard, 1992).

Incense : Bud of this variety is blackish crimson in colour. Flower colour is deep glowing red. Blooms are perfumed (Le Grice, 1968).

Inge Horstmann : Bush growth is vigorous. Buds are long high centred and open into large flowers. Blooms are fragrant and colour is very elegant bicolour, with charming blend of cherry-red and ivory reverse (Tantau, 1964).

Innoxa Femille : Variety evolved as a hybrid of "Red Planet" x "Eroica". Buds are flat, half-rounded at opening. Flowers are large in size and fragrant. Bloom colour is cardinal red. Flowers are borne singly. Plant growth is bushy (Harkness, 1983).

Intrepid : Flowers are unique shaped and bold and are rich deep red coloured. These are classic exhibition type of roses (Aster Perry, 1999).

Isobel Harkness : It is a cross between "Phyllis Gold" x "Mc Gredy's Yellow". A vigorous and branching plant. Flowers are deep yellow (Norman, 1957).

Jacaranda : Plant growth is vigorous and produce very long canes. Buds are big in size and elegant. Buds open into pinkish mauve coloured flower (Kordes, 1985).

Jacques Prevert : A superb rose with scarlet crimson flowers and deeper cardinal red reverse. Good for cut flower (Meilland, 1992).

Jadis : It produces fragrant flowers. Buds are of good form and substance. Flower colour is pink with mauve touch, which is prominent on petals surface (Warriner, 1974).

Jane Pauley : A very large flowered, exhibition bloom, exquisitely shaped, colour is orange red (Weddle, 1993).

Jean Gaujard : Buds are well formed opening into large and double bloom, colour is brilliant deep red (Gaujard, 1978).

Jean Giono : Evolved as a hybrid of ("Meipsilon" x "Landon") x "Ausmas". Plant growth is medium and bushy, attains height of 150 cm. Blooms are very attractive and bring sunshine to garden. Flower colour is golden yellow suffused with bright tangerine orange. Blooms are extremely double. Flowers have spicy and clove like fragrance. Flower size is 7.5 cm, petal number is 110-120 (Meilland, 1999).

Jema : It produces very beautiful flowers and the blooms are of non-fading nature. Flower colour is of deep orange (Percy, 1983).

Johann Strauss : Flowers are delicately perfumed, well formed and classic shaped. A pestal coloured whitish pink flower which is deeper at centre (Sauvageot, 1989).

John F. Kennedy : Evolved as a hybrid of an unnamed 'seedling' x "White Green". Plant growth is very vigorous. Buds are long, pointed and greenish white in colour. Flowers are large and double. This variety of rose is a profuse bloomer (Boerner, 1965).

Jolie Madme : It is a cross between "Independence" x "Happiness". Plant growth is vigorous and upright and it is good for bedding. Blooms are fragrant and large in size. Flower colour is bright, deep orange salmon. It is a fine flowering cultivars and often appears in clusters (Meilland, 1959)

Josephine Bruce : It is a cross between "Crimson Glory" x "Madge Whipp". Blooms of this variety is of exhibition quality. Plant growth is spreading and its habit is dwarf. Variety is good for bedding. It is a free flowering cultivars. Flowers are double and their size is large. Bloom colour is velvety blackish crimson. Flowers are very fragrant (Bees, 1952).

Jour 'D' Ete : This variety is an exhibition type, buds are long and pointed. Flower colour is turkey red to geranium-red (Combe, 1964).

Jouvenelle : This variety is considered to be a very promising and the blooms are classic shaped, large and double produced on strong stem. Flower colour is rose pink (Gaujard, 1970).

June Park : It is a cross between "Peace x Crimson Glory". Pant growth is vigorous, bush has dark green foliage. It is a fine flowering variety. Blooms are well shaped and large. Flower colour is clear rose pink (Park, 1958).

June White field : A vigorous plant bear well formed gloriously multicoloured flowers. Blooms are having bold tones of scarlet and gold overlying peach-pink (Oleson, 1996).

Just Joey : It produces fragrant flower. Blooms have fine forms with frilled petals. Flower colour is coppery orange. Variety is vigorous growing and floriferous in nature (Cant, 1974).

Kabuki : Plant growth is vigorous. Stem is strong and still has few thorns. Flowers are huge. Flower colour is deep yellow (Meilland, 1968).

Kaiserin Auguste Viktoria : The pure white variety of rose is also known as "K.A. Viktoria". It is supposed to be one of the old roses and listed in nurseries in Europe and America. It is popular and used in cut flower trade. Blooms are very large, perfect and have reflexing white petals (Lambert, 1891).

Kardinal-84 : Blooms are produced on long and strong stem which are perfectly shaped and long lasting. Flower colour is glorious red, and very attractive. Good as cut flower (Kordes, 1985).

Karen Blixen : A vigorous plant with high centred attractive white buds. Blooms are fragrant, perfect, shapely and exhibition type (Oleson, 1996).

Karl Herbst : Plants are vigorous, free flowering. Flowers are splendid, large, well shaped, slighty fragrant, red with lighter reverse (Kordes, 1950).

King's Ransom : It is a cross between "Golden Master piece" x "Lydia". Plant growth is very vigorous, dwarf and bushy. The foliage is dark glossy green and longer. Flowers are large in size and shine like spun gold in full bloom stage. Bloom colour is pure, true chrome yellow. Buds are long and slender. It is ideal for bedding (Morey, 1961).

Kiss of Fire : It is very attractive due to the multicolour nature of the flowers. Flowers are well formed medium-sized and have creamy petals with deep pink at edges and yellowish at base. Flowers are fragrant (Gaujard, 1960).

Kiwi : This variety is evolved as a hybrid of "Judith Morton" x ("Paxali" x "Blue Moon"). Leaf colour is dark green and shiny. Plant growth is tall and upright. Buds are pointed. Bloom colour is pink, opens to creamy white. Blooms are double and have 32 petals. Flower is reflexed, pointed, medium borne usually singly and with slight fragrance (R.F. Cattermole; S. Pacific Rose Nursery, 1989).

Klaus Stortebeker : It is having brilliant red flowers. Blooms are large, shapely, full and borne on long, strong and stout stems (Kordes, 1962).

Kleopatra : A free flowering, long lasting, attractive large rose. Flowers are shapely and well formed, fragrant and the colour is red with yellow base (Kordes, 1992).

Konrad Adenauer : It is a cross between "Crimson Glory" x "Hans Verchuren". Plants are bushy with pale green foliage. Flowers are large, fragrant, bright crimson in colour (Tantau, 1954).

Kronenbourg : It is evolved as a bud spot of 'Peace'. Plants are vigorous and free flowering, and foliage is glossy, dark green and large. It is attractive in bud stage. Blooms are rich crimson red with a straw coloured reverse. Blooms are large in size and double in nature (Mc Gredy, 1965).

Kupferkonigin : Plants are standy and free flowering. Buds are long and attractive. Flowers are bright bronze yellow, very large and petals are broad (Kordes, 1996).

La France : This variety is considered to be the first Hybrid Tea rose but is still popular. Pant is having vigorous growth. Blooms have exquisite scent. Flowers are large, shapely globular and have reflexing petals. Bloom colour is lovely shade of silvery pink (Guillot 1867).

La Jolla : It is a cross between "Charlotte Armstrong" x "Contrast". Bush growth is vigorous. Foliage is green and glossy. Buds are exquisite, long and pointed. Blooms have fragrance. Flower colour is made up of soft shades of pink, salmon rose and yellow. Petals are 45 in number (Swim, 1954).

Lady Diana : Plants are stardy and profuse flowering type. Buds are pale pink and attractive. Blooms are well shaped and of good form (Hoy, 1987).

Lady Frost : Plants are stardy with leathery foliage. Blooms are double and large in size, colour is deep rose. Flowers are highly fragrant (Bees, 1935).

Lady Helen Maglona : Flowers are red and sweetly scented as well as attractive (Dickson, 1926).

Lady Hillingdon : A free flowering rose cultivar, delicately scented. Blooms are medium sized, the colour is apricot-yellow (Lowe and Shawyer, 1910).

Lady Like : A vigorous plant with fragrant flowers. Buds are full, well formed, and open to large size. Flowers are deep pink (Tantau, 1989).

Lady Luck : These are vigorous and free flowering cultivar. Buds are lovely and well formed, open into large flower and very fragrant. Bloom colour is soft dawn pink (Miller, 1956).

Lady Marine : This variety is evolved as a hybrid of unnamed "seedling" x "Tropicana". Buds are urn shaped. Blooms are high centred. Flower colour is dark orange-red. Blooms have medium fragrance. Plant growth is medium but it is a prolific bloomer (De Lashmutt, 1981).

Lady Michel : Plants are vigorous, produce bright, rose red blooms of exhibition size (Harkness, 1991).

Lady Seton : It is a cross between "Ma Parkins" x "Mischief". Plants are vigorous and tall, foliage are glossy, dark green and leathery. Performance is excellent in the hills. Flowers are large in size and fragrant. Bloom colour deep rose pink (Mc Gredy, 1966).

Lady X : This variety produces huge size flowers, blooms are high centred and flowers are fragrant. Flower colour is silvery lavender-pink (Germain, 1967).

Lagerfeld : Flowers are borne on long stem, which are fragrant. Flower colour is lavender mauve. Blooms are double, well formed with broad petals (Armstrong, 1986).

Lancome : Buds are well-shaped and opening into elegant flowers. Flower colour is glowing cyclamen-rose. Variety is free bloomer very good as cut flowers (Delbard, 1975).

Lancome : This variety of rose produces flowers of exhibition quality. Blooms are very good and shapely. Variety is ideal for cut flowers. Flower colour is pink (Delbard, 1975).

Landia : It is evolved as a hybrid of "Mild Red Reynolds" x "Arthur Bell". Foliage is medium dark green and semi glossy. Plant growth is bushy and upright. Buds are pointed. Flower colour is apricot and reverse side of the petal is pink ageing to apricot. Blooms are double and possess 38 petals. Flowers are urn-shaped, medium, borne in spray of 3-4 (Sealand Nursery Ltd., 1988).

Landora : This variety is prolific flowering, blooms are elegant, full double and high centred. Flowers have luminous non-fading yellow colour (Tantau, 1978).

Las Vegas : It produces high centred pointed buds. Flowers are glowing orange with yellow reverse (Kordes, 1991).

Laura : This variety produces lovely, well-shaped buds open into very large flowers. Blooms have high centred. Flower colour is luminous vermilion red with an ivory-white base and yellow reverse (Meilland - Kordes, 1991).

Laurent Carle : It is generally grown for its beautiful damask fragrance. Plant is having tendency to branch out somewhat side ways. Flowers are large, bloom colour is velvety carmine (Pernet-Ducher, 1951).

Legend : Plant growth is healthy and vigorous, and produces long canes. Flowers

are of exhibition quality, buds appear on long cane and opening into superb blooms. Flower colour is red (Warriner, 1992).

Lemon Sherbet : This variety was sported from a white rose. Plant produces blooms of exhibition quality with 36 petals. Blooms are creamy yellow in colour and look fresh, reminds of refreshing lemonade in summer (Kern, 1973).

Lilac Time : It is a cross between "Golden Dawn" x "Luis Brinas". Plant growth is upright and branching. Flowers are prefect in shape and have 34 petals. Blooms are fragrant and their colour is pure lilac with pleasing silver shades on the reverse side of the petals (Mc Gredy, 1956).

Lisa Maree : This cultivar is originated as a bud sport of "Esther Goldenhueys". Flower colour is deep pink and its reverse side is lighter (Mrs. Moree Gowper; Cherry Wood's Nursery, 1989).

Liverpool Remembers : It is evolved as a hybrid of "Corso" x "seedling". Plant is tall and upright and has almost climbing habit. it produces scented flowers having 40 petals. Buds are long. Flower colour is glowing vermilion. Borne mostly singly on a very long stem, foliage is mud green and glossy. (Fryer, 1990).

Lord Louise : It is evolved as a hybrid of "Queen Elizabeth" x Unnamed seedlings. Buds are pointed. Flower colour is light crimson. Blooms are borne several together. Flowers have medium fragrance. Plant growth is vigorous and variety is hardy. It is a free bloomer (Gregory, 1982).

Lotte Gunthart : The variety is a decorative type. Blooms are large is size and have 80-100 petals. Full bloom looks like paeony flower. Flower colour is bright red (Armstrong, 1964).

Louisiana : Plants are healthy with shinning green leaves. Buds are elegant in shape and opening into large, creamy white-to-white flowers (Weeks, 1975).

Louqusor : It is also known as "Louksor". This variety is tall and free flowering. Blooms are large and double. Flower colour is golden coral (Delbard-Chabert, 1967).

Love : This variety is a hybrid of "Seedling" x "Redgold", produces star shaped flowers, which are very attractive. Buds are immaculately balanced and open into lovely flowers. Flower colour is red. Petals have silver colour on their reverse side (Warriner, 1980).

Love Song : It is a cross between "Peace" x "Orange Nassau". Variety produces pink and yellow bicolour blooms. Plant produces enormous double blooms of good colour in hot weather. Plant resembles with the variety "Peace" but its size is smaller. Blooms produces freely. An outstanding American rose (Fisher, 1955).

Lovita : This variety of rose is very popular in the cut flower trade of Europe. Buds are very large and ovoid in shape. Blooms are double and bright red in colour (Meilland, 1965).

Lucy Cramphorne : It is a cross between "Baccara" x "Peace". It is also known as 'Maryse Kriloff'. Plant growth is erect and bushy. Foliage is dark green and glossy.

Buds are crimson coloured and open into pure geranium red flowers. Blooms have an attractive luminous quality and fragrant. Flowers are well formed and borne on a strong stem (Kriloff, 1958).

Macsupeat : Evolved as a hybrid of "Sexy Rexy" x "Yabadabadoo". Foliage is dark green and semi glossy. Plant growth is bushy. This variety produces yellow blend blooms. Blooms are double and have 20 petals. Flower size is medium. Blooms have slight fragrance (S. Mc Gredy, 1990).

Madame Violet : This variety produces fragrant flowers and blooms are of exhibition quality. Petals are broad and have lavender mauve colour. Flowers are well formed (Taranishi, 1985).

Magic : Evolved as a hybrid of "Macvolar" x "Tonight". Foliage colour is medium green. Plant growth is tall and upright. Buds are pointed. Flower colour is medium red. Blooms are double and possess 24 petals. Flowers are high centred, medium, borne usually singly (R. Stralite, Carlton Rose Nursery, 1987).

Magic Lantern : This variety is obtained as a bud sport of 'Gold Medal'. It produces healthy canes. Blooms are of enormous size and of exhibition quality. Buds appear on healthy canes and blooms are of high quality. Flowers are golden orange in colour (Royon, 1989)

Maid of Honour : This variety produces large flower apricot colour buds opens into cream flowers (Weddle, 1984).

Manuela : This variety produce flowers of bewitching shade of cherry rose pink with deeper veining in petals. Flowers are large and of perfect shape (Tantau, 1968).

Marcelle Gret : It is a cross between "Peace" and "Princes Beatrix". Plants are free flowering with long pointed flower buds. This variety is having very beautiful flowers. Buds are very attractive and open into large, loosely formed flowers. Blooms have rich yellow colour at the time of opening (Meilland, 1947).

Marco Polo : Variety is evolved as a hybrid of 'Memorium' x 'Elizabeth Frankhausen' and is considered as one of the best among bright medium yellow flowers. Buds are elegant and opening into well-formed bloom. It is good for cutting (Frankhausen, 1971).

Maria Callas : This variety is also known as "Miss All American Beauty". Flowers look excellent at the time of full bloom stage. Flowers are well shaped and are of giant size. Blooms are freely produced on a vigorous growing plant. Flower colour is deep rose pink (Meilland, 1965).

Marianne Tudor : Plants are strong and vigorous. Buds are elegant, produces blooms, which have bright translucent regal red colour. Flowers are large in size (Fryer, 1990).

Mascotte : It is evolved as a hybrid of "Michele Meilland" x "President Herbert Hoover". Plant growth is compact and entire plant is covered with glossy foliage. It produces large buds, which are bicolour. Flower colour is red and have yellow centre. Reverse side of petal is yellow. This combination of colour gives glowing effect to the blooms (Meilland, 1951).

Matter Horn : Plant growth is tall and upright. Flowers are borne on long stem. Foliage is extra large in size. Buds are long, shapely and of majestic size. Flower colour is white. Petals are having white surface with golden shading, which looks like a sunrise on a snowy peak (Armstrong and Swim, 1965).

Mauve Melodie : It is evolved, as a hybrid of "Sterling Silver" x "Seedling". It is free flowering in nature. Flowers are long lasting. Bloom colour is lavender mauve and petal edges are deeper (Reffel, 1962).

Mc Gred's Sunset : It is a cross between "Margaret Mc Gredy" x "Mabel Morse". This variety is supposed to be one of the best among the decorative roses. Plant growth is vigorous and attains medium height, with glossy bronze foliage. Blooms are deep yellow flushed with orange and scarlet and the reverse is clear butter cup yellow. Petals remain fresh, look beautiful even when they drop on ground (Mc Gredy, 1936).

McGred's Ivory : It is a cross between "Mrs Charles Lamplough" x "Mabel Morse". A vigorous growing plant with dark glassy and leathery foliage. This variety of rose is also known as 'Porta Down Ivory'. It is free flowering in nature. Flowers are of huge size and have perfect shape. Bloom colour is creamy white and fragrant (Mc Gredy, 1930).

Medallion : The variety is a hybrid of "South Sea" x "King's Ransom". It produces large perfect blooms. Foliage is dark green and has leathery texture. Growth is vigorous, healthy and upright. Flower colour is apricot. Blooms are fragrant (Warriner, 1973).

Meduse : This variety produces large sized classic flowers, the shape is excellent and its type is ideal for exhibition. Bloom colour is unusual pink (Goujard, 1982).

Megan Dolan : Evolved as a hybrid of "Angel" x "Independence 76". Leaf colour is medium dark green. Plant growth is tall and upright. Buds are urn shaped. Flower colour is medium pink. Blooms have 18 petals. Flowers are cupped, small, borne singly and have slight spicy fragrance (S. Marciel; De Vor Nursery, 1989).

Melrose : Plant growth is vigorous and bushy. Colour of the bud is carmine shaded with cream. Blooms are double and change their colour to silvery cream. Petals are deeply edged and flushed with carmine. Flowers are fragrant (Dickson, 1963).

Memoriam : Plant growth is moderate. This variety is good for exhibition. Flowers are very large and blooms are perfect and attractive. Bloom colour is ivory white and sometimes a pink flush can be observed on petal surface (Von Abrams, 1961).

Message : It is a cross between ("Virgo" x "Peace Seedling') x "Virgo". This variety is also known as 'White Knight'. Plant growth is upright and healthy. Plant attains medium height. It is a shy bloomer. Variety is good as cut flower. Flowers have a cool and quite look. Bloom colour is white tinged with a green (Meilland, 1955).

Michele Meilland : It is cross between "Joanna Hills" x "Peace". This is supposed to be one of the best varieties for bedding or for exhibition. Buds are very beautiful, perfect, translucent, delicate and soft salmon pink in colour. Appearance of bud is like as it is made up of porcelain. Flowers are very fragrant (Meilland, 1945).

Midas Touch : Growth is tall, upright and bushy. This variety of rose is evolved as a hybrid of "Brandy" x "Frer Sesohne". It has long pointed buds that open into glowing

bright yellow flowers. In full bloom stage flower changes its colour to clear yellow dominating over all the other colours. Blooms are fragrant (Christensen, 1992)

Mirato : Buds are well shaped, open into perfect flowers. Bloom colour is salmon to shell pink. Plant is vigorous growing. Flowers are very fragrant (Tantau, 1978).

Mischief : This variety of rose is raised from cross between 'Peace' x 'Spartan'. Plant growth is vigorous and bush is covered with dark green leaves. Buds are fine and open into well-formed flower, salmon pink colour. Blooms are small, with less than 30 petals, beautifully shaped. Flower colour is startling coral-salmon shaded nastertium orange. Blooms are fragrant (Mc Gredy, 1961).

Miss Harp : Buds are beautifully shaped. Flowers are large in size. Bloom colour is deep golden yellow, borne on long stem (Tantau, 1973).

Miss Ireland : It is a cross between "Tzigane" and "Independence". Plant growth is vigorous and bush is healthy. Variety is good for cutting. It is a decorative type of rose. Flower colour is rich orange-salmon, reverse is creamy yellow. Blooms are lovely and appear on strong and erect stem. Flowers have mild fragrance (Mc Gredy, 1961).

Miss Universe : Plant growth is vigorous and bush is healthy. Flowers are fragrant, large and exquisitely shaped. Bloom colour is luminous orange red with a hint of copper on the reverse side of the petal. Blooms are produced freely (Gaujard, 1956).

Mission Supreme : Evolved as a hybrid of "City of Gloucester" x unnamed Seedling. Plant growth is bushy, vigorous, attains medium height, and is free flowering. Buds are pointed and open into pale peach-pink to apricot flowers. Blooms borne singly and have approximately 30 petals (Samday, 1981).

Mister Lincoln : Plant growth is robust with dark green foliage. They are superb for back row rose bed. Flowers are borne on a long stem. This variety has been evolved as a result of cross between "Charles Mallerin" and "Chrysler Imperial". Blooms are large and their shape is perfect. Flower colour is brilliant red, and are highly pronounced fragrance (Swim 1964).

Mitzi : Plant is bushy covered with dark green leaves. This variety of rose is free flowering. Blooms are well formed and decorative in nature. Flowers have pearly tints flushed with mauve-rose colour, and have fragrant (Meilland, 1956).

Mme Jules Bouche : This variety is good for bedding, cutting and exhibition. Flowers are large very full and have good form. Bloom colour is white, sometimes slightly touched with rose pink (Croibier, 1911).

Mme Louise Laperriére : Plant growth is upright and bushy and foliage is dark green. Flowers are of medium size, well formed and dark crimson in colour. Plant is free flowering. Blooms are very fragrant (Laperriere, 1951).

Modern Art : This variety is also known as 'Prince de Monaco' and it produces double, bicolour flowers with 25 petals. Flowers are borne on long stem and petals are bright orange with cheerful streaks but the underside of the petals are much paler and this adds to the attractive hand painted effect. Flowers have slight fragrance (Christensen, 1981).

Monika : This variety is very attractive and produces long sharp buds. Flowers are shapely and their colour is vermilion with golden base. Blooms are produced singly on long stem (Tantau, 1985).

Montezuma : It is a hybrid between "Fandago" and "Floradora". Plants are tall, upright and produce dark leathery foliage. This variety of rose is free flowering and classified under the Grandiflora group in America. The variety is named after the famous emperor of Mexico. It is ideal for exhibiton as blooms opening out very slowly and blooms keep its exquisite form for a very long period. Buds are pointed plum coloured having 33 petals. Flowers have slight fragrance. Bloom colour is deep coral and its size is large, petals are thick. It is also good as cut flower (Swim, 1956).

Montreal : This variety of rose produces bicolour flowers of excellent shape, size and form. Plant growth is healthy and vigorous. Flower colour is a blend of bright pink and white. Buds are high centred large. Blooms ore with reflexed petals, fragrant and good for cut flowers (Gaujard, 1984).

Moon Drops : It produces fragrant flowers. Flowers have mauve colours with pink shading which is prominent on petal surface (Delforge, 1985).

Moonbeam : It is a cross between "Seedling" x "Mc Gredy's Yellow". This variety is good for bedding. It is a free flowering variety. Plant growth is bushy. Blooms are large and have high centre. Flower colour is golden-yellow and flowers are magnificent (Robinson, 1950).

Morning Sun : It is excellent for cutting and free flowering cultivar. Plant produces flowers of good shape yellow colour blooms (Christensen, 1983).

Mount Shasta : This variety has been classified as a Grandiflora in America. It is ideal for cutting and bedding. Flowers are well shaped. Buds are long and pointed and open into white flower of exhibition quality (Swim & Weeks, 1962).

Mr. Chips : It is evolved as a hybrid from 'Grandma Dickson' x 'Miss Ireland'. Flowers appear on compact plant. Growth is healthy. Buds are shapely. Blooms are of exhibition quality and have 45 petals that hold the colour and shape extremely well. Flower colour is yellow (Dickson, 1970).

Mrs. Pierre S. du Pont : Flowers are produced in great profusion. Blooms are of medium size. Flowers are well shaped, and colour is deep orche-yellow (Mallerin, 1929).

Mrs. Sam Mc Gredy : It is evolved as a cross between ("Donald Macdonald" x "Golden Emblem") x (Seedling x "The Queen Alexandra Rose"). Plants are moderately vigorous, upright bear reddish bronze glossy foliage. Flowers are fragrant, large, full, well shaped, scarlet copper orange with reverse flushed red (Mc Gredy, 1929).

Mullard Jubilee : This variety is having delightful fragrance. Flowers are borne in clusters. Flower colour is Cerise-pink (Mc Gredy, 1970).

Musashino : Evolved as a hybrid of "Garden Party" x "Diamonji". Foliage is medium green, oblong and semi glossy. Plant growth is medium and upright. Buds are ovoid. Flower colour is orange pink, changing to pink. Blooms are double and have 35 petals. Flowers are urn shaped, high centred, large and borne usually singly (T. Takahashi, 1989).

My Choice : It is a cross between "Wellworth" and "Ena Harkness". Plant growth is vigorous and healthy. Buds are deep yellow and splashed with vermilion. Flowers are large and their colour is cherry-salmon with a dark primrose background. Blooms are highly fragrant (Le Grice, 1958).

My Lady : Plants are strong, vigorous, bushy, and dark leathery foliage. Flowers are full, high centred with 45 petals. Blooms are fragrant, apricot flushed gold (Robinson, 1956).

My Love : Blooms of these cultivars is delightfully fragrant. Flowers are large with a high centre. Flower colour is deep crimson (Anderson, 1960).

Mystique : Evolved as a hybrid of "Samantha" x "Royalty". Foliage is large, medium green and semi glossy. Plant growth is tall and upright. Buds are pointed, slender tapering. Flowers are bright red in colour. Blooms are double and have 28 petals. Flowers are cupped, large, borne singly having musky fragrance (S. Marciel, De Vor Nursery, 1989).

National Trust : It is a cross between "Evelyn Fison" x "King of Hearts". Plants are tall and upright, foliage matt, dark green. Blooms are very full with 60 petals, borne singly or several together, flowers are red (Mc Gredy, 1976).

Neue Revue : This variety is having strong fragrant blooms. Flowers are huge and are of exhibition quality. Petals have yellowish white colour with pronounced pinkish-red border (Kordes, 1969).

Neville Gibson : Evolved as a hybrid of "Red Planet" x ("Carina" x "Pascalli"). Plant growth is healthy and strong. Buds are globular and open into shapely flowers. Blooms are of medium size and their colour is pink (Harkness, 1982).

New Style : Plant is tall growing and bush is vigorous. Buds are lovely and develop into well-shaped blooms, which are produced in abundance. Flower colour is rich pink, suffused with cherry and red (Meilland, 1962).

New Year : Also known as 'Arcadian', this variety of rose is evolved as a hybrid of "Merry Summer" x Seedling, and produces flowers of orange shades. Flower colour is mixture of yellow and red, pink and tones. Colour of the bloom changes as it attains maturity (Mc Gredy, 1983).

New Yorker : It produces red coloured flowers, which are very dazzling bright in sunlight. Plant produces good quality flowers, fragrant. It is free flowering (Boerner, 1947).

Night Time : Blooms appear on smooth and long stems. Flowers are of attractive shape. Blooms are deep crimson coloured (Weeks, 1974).

Nigrette : Plant attains medium height. It is also called as Black Rose. Blooms are medium sized, very dark red in colour. Flowers are semi double (Krause, 1944).

Nocturne : It is in cross between "Charlotte Armstrong" x "Night". Plant growth is vigorous. Bush is upright and has dark green, leathery foliage. Buds are long and pointed. Blooms are large, double, cupped and have fragrance. Flower colour is cardinal red shaded chrysanthemum crimson (Swim, 1947).

Nogawa : This variety is evolved as a hybrid of "Garden Party" x "Kordes' Perfecta".

Buds are ovoid and flower colour is cream, fringed with pinks. Blooms are double and have 30 petals. Flowers are high centred, large, borne usually singly. Flowers have moderate fragrance. Foliage is medium, dark green and semi glossy. Plant growth is tall and bushy (T. Takahashi, 1989).

Norman Hartnell : It is evolved as a cross between "Ballet x "Detroiter". Plants are vigorous and upright and foliage is dark green. Blooms are full with 21 petals and good form, flower is crimson red in colour (Kordes, 1964).

Numero Un : It is free flowering variety. Plant growth is vigorous and healthy and has bronze coloured foliage. Buds are round in shape and opens into large, well-shaped flowers. Blooms are vermilion in colour (Laperriere, 1962).

Oklahoma : This variety is originated as a hybrid of "Chrysler Imperial" x "Charles Mallerin". Foliage is dark matt green. Plant growth is vigorous. Buds are long pointed and open into large flower. Blooms are high centred and dark red in colour. Flowers are highly scented, double and have 45 petals (Armstrong, 1963).

Old Time : Blooms of this cultivar are quite large, full and high centred. Flowers have remarkable colour of amber-yellow which terns into pleasing luminous bronzy apricot in full bloom stage (Frey, 1969).

Olympiad : It is evolved as a hybrid of "Red Plant" x "Pharaoh", and is considered as one of the top luminous red. Flowers have 35 petals and look very attractive and charming even in full bloom stage. It is a disease resistant variety (Mc Gredy, 1982).

Only You : It is a free bloomer, buds are elegant, open into perfectly shaped flowers. Bloom colour is shell pink, and are slightly fragrant (Meilland, 1975).

Opening Night : This variety evolved as a hybrid of "Olympiad" x "Ingrid Bergmann", and produces bright red coloured flowers. Blooms are high centred and have symmetrical forms. Foliage is dark green. Plant growth is vigorous and tall (Zary, 1998).

Opera : It is a cross between "La Belle Irisee" x unnamed seedling. Plant growth is vigorous. Bush is erect, free blooming and with light green leathery foliage. Buds are long, pointed and open into very large flower. Flowers are double and have fragrance. Bloom colour is light scarlet-red with yellow tinge (Gaujard, 1950).

Ophelia : It is a vigorous and bushy cultivar with leathery foliage. Flowers are well shaped, salmon-flesh tinted yellow in centre, and are fragrant (Paul, 1912).

Orchard Masterpiece : These are bushy plants, produce most attractive flowers with broad petals. The blooms are of lovely shades of orchid mauve (Boerner, 1961).

Orient Express : This variety produces blooms with sweet fragrance. Buds are elegant that open into well shaped, large blooms. Flower colour is glowing orange vermilion with yellow reverse. Plant has vigorous growth (Wheatcroft, 1978).

Osiria : Evolved as a hybrid of "Snowfire" x "Seedling". Plant growth is healthy and upright. It produces long pointed buds, flowers are dark red in colour and have 50 petals. Petals have silver colour on their reverse side (Kordes, 1978).

Our Shirley : Evolved as a hybrid of "Judith Morton" x "Sylvia". Foliage is small,

medium and dark green, growth is upright. Buds are pointed. Blooms are double and have 28 petals. Flowers are medium sized and borne singly (George D. Wilson, 1989).

P. Falzer Gold : This variety produces blooms of exhibition quality. Plant is covered with dark green and healthy foliage. Flower size is huge and its colour is medium yellow (Tantau, 1981).

Pace Maker : It produces fragrant flowers on firm and long stems. Blooms are large in size, have rich shade of reddish pink (Harkness, 1981).

Pacific Belle : This variety is evolved as a hybrid of unnamed seedling of "Peer Gynt" x "Josephine Bruce". Foliage is light green, veined and glossy. Plant growth is bushy and upright. Plant has branching habit. Buds are pointed. Flower colour is light pink and its reverse side is deeper pink. Blooms are double and possess 31 petals. Flowers are reflexed, pointed, medium, borne usually singly and have slight fragrance (R.F. Cattermole, 1989).

Pacific Princess : Evolved as a hybrid of "Pink Parfait" x "Red Planet". Foliage is dark green, semi glossy and veined. Plant growth is branching and upright. Buds are tapering. Flower colour is medium pink. Blooms are double and have 56 petals. Flowers are medium sized, globular, borne usually singly or in sprays of 3-4. Flowers have strong fragrant (R.F. Cattermole; S. Pacific Rose Nursery, 1988).

Papa Meilland : It is a cross between "Chrysler Imperial" x "Charles Mallerin". Plant growth is vigorous and it is free flowering cultivars. Foliage is glossy, dark green and plenty. Blooms have strong fragrance of well-loved old-fashioned rose. Flowers are borne on erect long stem. Blooms are well formed and are of exhibition quality. Flower colour is dark crimson (Meilland, 1963).

Papageno : This variety is evolved as hybrid of "Freude" x ("Anytime" x "Eye Paint") x "Stars 'n' Stripes". Plant growth is sturdy. Blooms are considered as hand painted striped novelty. Buds are lovely and well formed. Petals are beautiful crimson with stripe and splash on their surface, which looks very attractive.(Mc Gredy, 1990).

Paradise : Foliage is glossy dark green. Plant growth is tall. In moderate climate, it performs well throughout the year. This variety produces blooms with fragrance having long lasting quality. Buds are beautifully shaped and open into elegant large blooms. Flower colour is lavender. Petal edge is magenta and delicately brushed with pink at the centre. Blooms have 28 petals (Weeks, 1979).

Paramount : Plant growth is excellent. It produces immensely variable colours. Sometimes orange-buff, or sometimes almost cream white. Flower form is superb (Swim, 1950).

Paris Match : The cultivars is a free flowering, the growth of the bush is vigorous and it has leathery foliage. Blooms are double, beautiful and have darker centre. Flower colour is carmine to rose (Meilland, 1957).

Parthenon : It is considered to be one of the loveliest rose, and is very free flowering. Bloom colour is pink and creamy-white (Delbard-Chabert, 1967).

Pasadena : Blooms are produced in profusion. Flower is large, high centred and long lasting. Flowers have glowing bright red orange colour (Kordes, 1981).

Pascali : It is a cross between "Queen Elizabeth" x "White Butterfly". This variety is considered as one of the best among white rose. Flowers are beautiful, well formed. Plant growth is vigorous. Flowers are produced on a vigorous bush (Louis Lens, 1963).

Patriot : This variety is a hybrid raised as a seedling of 'Pink Parfait' x 'Pink Peace'. Bush growth is vigorous and strong. Plants have abundant healthy leaves. Buds are well shaped open into deep pink to creamy white satin soft flowers. Blooms are large, fully double edged with lovely blush of pink. Flowers have delicate old-fashioned fragrance (Meyer, 1972).

Peace : "Joanna Hill", "Charles P. Kilham", "Margaret Mc Gredy" and *R. lutea* (*R. foetida* "bicolour") are reported in the parentage of this outstanding cultivar. This variety of rose is also known as "Mme A Meilland", "Gioia", and "Gloria Dei". It is a popular and famous variety in Europe and America and sometimes referred as the rose of the century. Flowers are very attractive light yellow and sometimes deep yellow with strong shading of cerise-pink on the edges of petals can be seen. Flowers are cup shaped, very large, full and slightly fragrant. This famous rose which with light pruning will make a large bush of 2m tall (Meilland, 1942).

Peer Gynt : This variety is having large, full flowers of deep canary-yellow colour with pink flush on the outermost row of petals (Kordes, 1968).

Pent House : It is evolved as a hybrid of "Seedling" x "Ferry Porsche" and plant growth is healthy. Blooms are double, with 24 large petals and are of exhibition quality. Blooms are well formed and large in size. Flower colour is pink and possess pleasing fragrance (Mc Gredy, 1988).

Peppermint Swirl : Foliage is medium, dark green and semi glossy. Plant growth is tall and upright. Buds are slender and tapering. Flower colour is currant red and discolour slightly with ageing. Blooms are double and have 30 petals. Flower is cupped, large and borne singly. Blooms have slight spicy fragrance (S. Marciel; De Vor Nursery, 1989).

Percy Thrower : Plant growth is vigorous. It bears glowing rose pink flowers, petals are with silvery edges. Blooms are of good size and shape (Gregory, 1964).

Perfect Moment : This variety is evolved as a hybrid of "New Day" x Seedling. Plant growth is vigorous and it attains tall height. Blooms are shapely, bicolour, gorgeous and fragrant. Flower colour is yellow orange-red (Kordes, 1991).

Perfume de Franche Comte : Flowers are shapely and have good petalage, bloom colour is pink, highly fragrant (Souvageot, 1988).

Peter Frankenfield : Plant is vigorous. Blooms are perfect, high centred and well formed. Flower colour is rosy pink (Kordes, 1966).

Piccadilly : It is a cross between "Mc Gredy's Yellow" and "Karl Herbst". This variety is ideal for bedding as it can resist bad weather. The bud growth is vigorous. It is a free flowering variety with attractive green and glossy foliage. Buds are perfect, bright scarlet on the inside and gold on the reverse. In full bloom stage the colour of the flower is scarlet suffuses through the gold. It is one of the world's best rose (Mc Gredy, 1959).

Picture : Plant is vigorous growing. The percentage is unknown. It is a most beautiful rose. Blooms are double and high centred. Flowers have slight fragrance. Flower colour is velvety rose-pink (Mc Gredy, 1932).

Pilgrim : This variety of rose is mildew resistant. Flowers are borne in the strong stem. Blooms are large and dark red in colour. Flowers have light fragrance (Armstrong, 1970).

Pink Charming : Plant growth is vigorous and it is very floriferous, flowers are of exhibition type. Bloom colour is deep pink and having deeper tones at the base. Blooms are loose and have 36 petals, and are fragrant (Swim, 1960).

Pink Favourite : It is a cross between "Juno" and ("George Arendo" x "New Dawn"). Plant growth is healthy and vigorous, and upright. Plants have bright green glossy leaves. Flowers are beautiful and double. Bloom colour is neyron-rose (Von Abrams, 1956).

Pink Peace : It is a hybrid cultivar of ("Peace" x "Monique") x ("Peace" x "Mrs. J. Laing"). Plant growth is vigorous and bush is very healthy. Blooms are freely produced. Flowers are huge and solid and having more than 60 petals. Blooms are deep-dusty pink in colour (Meilland, 1959).

Polarstern : Plants are vigorous. This variety produces long pointed buds that are very beautiful. Flowers are white (Tantau, 1982).

Polly : It is a cross between "Ophelia" x Seedling x "Mme Colette Martinet". Plant growth is upright and vigorous and flowers are highly fragrant. Buds are pale yellow long pointed. Flowers are high centred, large, double, cream in colour, the centre is pink or light orange, and fades to white, possess 40 petals (Beckwith, 1927).

Polo Club : It is evolved as a hybrid of 'Gingersnap' x 'Young Quinn'. This variety produces elegant, well formed buds with changing hues of golden yellow and burnt orange colour (Christensen, 1986).

Polynesian Sunset : This variety is having exquisite buds, which are rich coral in colour. Buds open into large coral orange flowers. Blooms are of great beauty, which comes in clusters during warm weather (Boerner, 1965).

Precious Platinum : It is evolved as a hybrid of "Red Planet" x "Franklin Englemann". This variety is good for cutting and ideal for exhibition. Pant is very robust, stem possess very little thorns. Flower colour is deep velvety red. Blooms are double, full and high centred and have thick textured petals. Blooms are slightly fragrant (Dickson, 1974).

President Dr. h. c. Shröder : Flowers are large and well formed. Flowers are borne on strong stem singly and in trusses which are crimson coloured (Kordes, 1959).

President Herbert Hoover : It is a cross between "Sensation" x "Souv de Claudius Pernet". Plant is vigorous, and upright. Buds are beautiful. Flowers are large and well formed and freely produced. Bloom colour is glowing orange-yellow-shaded scarlet and pink. Flowers are fragrant and having 25 petals (Coddington, 1930).

President Leopold Senghor : This variety produces very attractive flowers on long

stem. Plant growth is vigorous and bushy. Foliage is large, glossy and dark green in colour. Blooms have 25 petals. Flowers have slight fragrance. Flower colour is deep violet crimson (Meilland, 1979).

Prima Ballerina : This variety of rose is also known as "Premiere Ballerine". Buds are long, pointed and open into large and semi double blooms. Flowers are fragrant. Bloom colour is cherry pink. It is a free flowering and has a fine habit of growth. Flowers are of exhibition quality (Tantau, 1957).

Prima Donna : Blooms are of exhibition quality, buds are elegant and flowers are well formed and perfect. Plant produces long canes and loaded with blooms. Flower colour is stable pink (Shiakawa, 1984).

Princess : Plant growth is vigorous and bush is healthy. Flowers are large, double and high centred, borne on upright stems. Bloom colour is purest vermilion red, which is supposed to be one of the brightest colours among the rose cultivar (Laperriere, 1964).

Princess Margaret of England : It is very free lowering and an extremely elegant rose. Flower is bright and luminous pink and highly fragrant (Meilland, 1969).

Pristine : It is evolved as a hybrid of "White Masterpiece" x "First Prize". Blooms are fragrant. Flowers are very shapely. Buds are tall. Blooms have 25-30 petals. Flower colour is ivory with pink. Plants do well in beds, and suitable for exhibition (Warriner, 1978).

Quebec : It is also known as "Mme Marie Curie". A compact plant with dark glossy foliage, good for bedding. Flowers are medium sized yellow and exhibition quality (Goujard, 1943).

Queen Fabiola : It is also known as 'Fabiola'. Plants are vigorous and free flowering. Buds are beautiful and urn shaped. Flowers are well-formed, Dutch-vermilion in colour. Blooms have similarity with "Montezuma" cultivar (Hazenberg, 1961).

Raketa : Plant growth is vigorous. Flowers are produced freely on stem. Blooms are large in size and shapely. Flower colour is buff to pale orange (Shtanko, 1952).

Reba Mcentire : Plants are strong with glossy dark green foliage and a tinge of red. It is very floriferous, flowers are deep orange (Mc Gredy, 1997)

Red Chief : This variety produces exhibition type of flowers. Flower colour is medium red. Blooms are high centred and have 35 petals (Armstrong, 1967).

Red Devil : Flowers are of classic shape and borne on stout stem. Plants have leathery green foliage. It is suppose to be one of the best exhibition rose. Flowers are richly fragrant. Blooms are very large and crimson-scarlet in colour. Patels are having slightly paler colour on the reverse side (Dickson, 1967).

Red Ensign : It is a cross between "Crimson Glory" and "South Port". Plant growth is upright and leggy, foliage is dark. Flowers are very large and are of exhibition quality. Bloom colour is deep crimson. Flowers have strong Damask scent. Flowers are full and high centred (Norman, 1947).

Red Masterpiece : This variety produces flowers of huge size, which are perfectly

formed and have beautiful shape. Flowers are fragrant. Bloom colour is velvety, deep red. Flowers are non-fading type (Warriner, 1974).

Red Planet : Plant growth is upright and uniform. It is a cross between "Red Devil" x ("Brilliant" x Seedling). It is very outstanding in performance and won several awards. Blooms are large, very full, with 49 petals and attractive. Flower colour is scarlet shaded crimson. Petals have paler colour on their reverse side (Dickson, 1970).

Rina Herholdf : It is an outstanding and lovely cultivar. Flowers are attractive, well shaped and are of medium size. Flowers are bicoloured. Flowers are freely produced on strong stem. Petals are white and have deep pink edges and yellow base (Herholdt, 1959)

Rose Gaujard : It is hybrid cross between "Peace and "Opera" seedling. Plants are very healthy and have ample bronze-green foliage. Blooms are freely produced on strong and straight stems. Flowers are unique bi-coloured very handsome and bold. Petal colour is white edged pink to red. Flowers are large, highly pointed, shapely and long lasting (Jean Gaujard, 1958)

Rouge Meilland : It is evolved as a hybrid of ("Queen Elizabeth" x "Karl Herbert") x ("Pharoah" x "Antonia Ridge"). Growth of the plant is erect and it is disease free. Foliage is bright and bloom colour is luminescent red. Plant is always loaded with flowers. The variety is good for exhibition and cutting purpose. Blooms have 40 petals. Flowers have very little scent (Meilland, 1982).

Roundelay : Plant is very vigorous growing tall, upright with dark glossy foliage. Evolved as a hybrid of "Charlotte Armstrong" X "Floradora". Blooms are double, high centred and medium to large in size. Flowers are highly fragrant and contains nearly 65 petals. Colour is currant red to cardinal red (Swim, 1956).

Royal Amethyst : Evolved as a hybrid of "Angel Face" x "Blue Moon". Foliage is medium green and glossy. Plant growth is tall and upright. Buds are pointed and heavy. Flower colour is lavender. Blooms are double and possess 32 petals. Flowers are large in size and are borne singly, and have fruity fragrance (P.De Vor, De Vor Nursery, 1989).

Royal Canadian : This variety is having fragrant flowers, which are large and urn shaped. Buds are rich velvety-ruby red, which opens into large, cupped blooms. Flowers have good lasting quality (Morey, 1968).

Royal Highness : It is a hybrid of "Virgo" x "Peace", and All America winner for 1963. This variety is also known as "Königliche Hoheit". It is considered as a rose of perfection with classic form and great beauty. Bush is of moderate vigour and have luxuriant shining foliage. Flowers are beautifully formed, high centred and have long lasting blooms of dainty pink shades. Flowers are freely produced on a bush (Swim & Weeks, 1962).

Rubaiyat : This variety of rose is evolved as a result of double cross hybrid ("Mc Gredy's Scarlet" x "Mrs. Sam Mc Gredy") x (Seedling x "Sir Basil McFarland"). Plant is very vigorous growing. Buds are long, pointed. Flower is large, double and high centered. Blooms are fragrant. Flower colour is a unique shade of pestal pink, salmon shading with light reverse. (Mc Gredy, 1946).

Sabine : This variety is also known as "Sabine Sinjen". It is excellent for cutting and exhibition. Buds are slim and tapering, developed into large, well-formed flowers. Blooms are double and lovely deep-cherry pink in colour (Tantau, 1962).

Sabrina : Plant growth is moderate, foliage dark green. Flowers are of exhibition standard and highly fragrant. Flowers are beautiful and well formed and bicoloured. Bloom colour is rich crimson with the reverse of amber yellow (Meilland, 1960).

Saium : This variety is multicoloured, orange yellow and crimson. Blooms are very attractive, large, full, shapely buds (Keise, 1980).

Saiun : Buds are large in size and their colour is red. Flowers are shapely, multicoloured, orange yellow and crimson (Keisel, 1980).

Samourai : This variety of rose is also known as "Scarlet Knight". It is excellent for bedding purpose. Blooms are freely produced on a tall growing plant. They perform quite well even in extremes of weather. Flowers are velvety, huge and blackish red in colour (Meilland, 1966).

San Diego : Plant growth is vigorous, foliage is leathery and healthy. Very attractive buds are produced on long stems containing 50 petals. Flower colour is voluptuous yellow (Armstrong, 1968).

Sandra : Bush growth is vigorous. Buds are long, opening with high centred flowers. Blooms are long lasting and produced on long and straight stem (Kordes, 1981).

Second Chance : Evolved as a hybrid of "Carefree Beauty" x "Sonia". Foliage colour is medium green to maroon and its surface is semi glossy. Pant growth is slightly spreading and bushy. Buds are ovoid. Flower colour is coral-orange and petal tips are orange red and its reverse side is deep pink, ageing to medium pink with red edges. Blooms are double and have 35 petals. Blooms are urn shaped, high centred, large, borne usually singly and in sprays upto 3. Flowers have Damask fragrance (L. Stoddard, 1991).

Secret : It is evolved as a hybrid of "Pristine" x "Friendship". Plant produces flowers of exhibition type. Blooms are well-formed and creamy white with rich pink in colour. Flowers have fragrance (Tracy, 1992).

Serenade : Plant growth is vigorous and upright. Leaves are green, glossy and have leathery texture. Blooms are large, double, cupped and freely produced on a stem. Flowers are slightly fragrant. Flower colour is burnt-orange in bud stage, which changes into coral-orange in the full opened flowers (Boerner, 1949).

Shannon : This variety of rose performs well in the rainy season. Flowers are well formed, large and deep pink in colour (Mc Gredy, 1965).

Sheer Bliss : This variety of rose is evolved as a hybrid of "White Masterpiece" x "Grand Masterpiece" and is classically high centred. Buds are shapely and are of exhibition type. Blooms are borne on single stems and they are creamish white with pale pink at the centre in colour. Flowers have 35 petals. Blooms have a spicy fragrance (Warriner, 1985).

Shot Silk : This variety is having glossy foliage, which are slightly curled, compact

in habit and good for bedding. Flowers are lovely, double and light centred and are borne on strong stem. Blooms are fragrant and their colour is cherry-cerise shaded gold at the base (Dickson, 1924).

Show Girl : It is a cross between "Joanna Hills" x "Crimson Glory". This variety is vigorous, bush is having green foliage with leathery texture. Blooms are of exhibition quality, which are borne on long stem. Buds are pointed, exquisite and long, developed into large flowers. Blooms are well shaped, full and fragrant and have deep pink colour (Lammerts, 1946).

Shreveport : Variety produces mildly fragrant flowers. Blooms are well formed and double. Flower colour is blend of orange, salmon cream and yellow shades, produces on long stems (Kordes, 1982).

Shrewsberry Show : It produces attractive flowers which are long lasting, and unfading. Blooms colour is brilliant glowing crimson, good as cut flower (Kordes, 1982).

Signora : It is a cross between "Julien Potin" x Sensation". This variety is also known as "Signora Picro Puricelli". The bush growth is vigorous. Plant produces glossy foliage. Buds are beautiful, long and pointed. Bud colour is orange red, which opens into large orange-apricot, turning into suffused gold. Blooms have magenta pink outer petal. Flowers are double, cupped, and fragrant (Aicardi, 1936).

Silver Lining : It is a hybrid evolved out of the cross "Karl Herbest" x "Eden Rose" seedling. Plants are vigorous, tall, branching, leaves are dark green small, and leathery plants are free flowering. Flowers are light rose with silver lining, reverse is silvery. Colour of the outer petals is deeper rose. This beautiful rose possesses nice fragrance (Dickson, 1958).

Sir Winston Churchill : Bush is dark green and covered with glossy foliage. Blooms are fragrant and produced on a dense bush. Flowers are large, double and highly centred. Bloom colour is salmon pink (Dickson, 1955).

Sizzle Pink : Foliage is large and dark green, plant growth is tall and upright. Buds are slender and tapering. Flower colour is deep pink. Blooms are double with 25 petals. Flowers are cupped, large and borne singly. Blooms have slight fragrance (S. Marciel, De Vor Nursery, 1989).

Smooth Velvet : It is evolved as a hybrid of "Smooth Sailing" x ("Polly" x 'Peace" x ("Circus" x "Red Devil"), and is a florist's delight. It produces excellent flower. Blooms appeared on long stem. Flower colour is deep red (Davidson, 1986).

Solvang : Evolved as a hybrid of unnamed seedling x "Vision". Foliage is large and slightly fragrant, dark green and glossy. Pant growth is bushy and vigorous. Flower colour is dark red. Blooms are semi double and possess 6-14 petals. Flower is large and slightly fragrant (Mogens and Pernille Ollesen, Poulsen Rosery APS, 1987).

Sonia Meilland : It is very attractive and excellent cut flower. Variety produces large well-shaped and perfect flowers. Flower colour is pure salmon pink (Meilland, 1970).

Sophia Loren : Blooms are velvety bright, non fading red. Flower size is large, long lasting, good as cut flower. Blooms are long lasting (Tantau, 1967).

Sophia's Song : Evolved as a hybrid of "Emily Post" x "Prominent". Plant is tall and upright. Buds are slender and tapering. Flower colour is coral. Blooms are double and have 32 petals. Flowers are high centred, large borne singly. Blooms have slight fruity fragrance. Foliage colour is dark green and its surface is glossy (S. Marciel, De Vor Nursery, 1989).

Soraya : It is a hybrid evolved on the crossing of ("Peace" x "Floradora") x "Grandme're Jenny". This variety is free bloomer. Plant growth is vigorous and bush is covered with glossy foliage. Buds are pointed and beautiful. Blooms are produced in long and strong stem. Flowers are double, cupped and slightly fragrant. Flower colour is dusky scarlet orange and reverse side of the petal is crimson- red (Meilland, 1955).

South Seas : It is also known as 'Mersdusud'. It is supposed to be one of the best bedding variety, particularly for warm weather. Plant growth is vigorous. Flowers are produced very freely on a healthy bush. Buds are lovely and deep shell pink coloured. Colour of the bud slowly changes into luminescent coral pink as the flower opens. In full bloom stage deeper-red overtones can be seen in the huge, majestic and ruffled flowers. Blooms are long lasting (Boerner, 1962).

Southern Lady : Evolved as a hybrid of "Lady" x "Flaming Beauty". Leaves are dark green and semi glossy. Plant growth is medium and upright. Buds are pointed. Flower colour is light pink, centre flesh tones and reverse side is lighter pink. Bloom is double and has 40 petals, high centred, exhibition type, medium and borne singly. Flowers have moderate fragrance (D. Bridges, Roses, 1989).

Souvenir De J. Verschuren : It is a cross between "Katherine Pechtold" x "Orange Delight". Foliage is blue green. Buds are elegant long, apricot orange in colour. The cultivar is floriferous (Verschuren, 1950).

Souviens Toi : This variety produces soft yellow multicoloured rose. Blooms are in good form and size. Flower colour changes to carmine and deeper red at petal edge with ageing (Krilloff 1987).

Sparkling Orange : Evolved as a hybrid of "Sonia" x "Prominent". Foliage is large, dark green and glossy. Pant growth is tall and upright. Buds are tapering. Flower colour is vermilion and reverse side of the petal is scarlet. Blooms are double and have 23 imbricate petals. Flowers are large and borne singly. Blooms are heavy and have musk fragrance (S. Marciel; De Vor Nursery, 1989).

Spek's Yellow : It is a cross between "Golden Rapture" x unnamed seedling. This variety is also known as "Golden Sceptre' in America. Bush is having moderate growth. Foliage is green in colour and have glossy surface. Leaf texture is leathery. This variety is supposed to be one of the brightest among yellow roses. Buds are pointed and opened into large, double and high centred flowers. Blooms are fragrant and freely produced on bush (Verschuren 1947).

Spun Glass : Evolved as a hybrid of unnamed seedling x "Angel". Foliage is large, dark green and have glossy surface. Pant growth is tall and upright. Buds are pointed. Flower colour is white. Blooms are double and have 50 petals. Blooms are cupped, very large, borne singly and have slight spicy fragrance (S. Marciel; De Vor Nursery, 1989).

Stella : Raised from two "Horstmann's Jubilaums-rose" x "Peace". Plant growth is tall upright and vigorous, foliage are large, leathery and glossy. This variety is classified as a Grandiflora in America. Flowers are of exhibition type. This magnificent rose is having peach-pink flowers, which are suffused with cerise towards the margin shading almost white at the centre (Tantau, 1959).

Sterling Silver : A hybrid of "seedling" x "Peace". It is also known as "First Lady". This variety is having moderate plant growth and excellent for cutting. Blooms are full and large in size. Flowers are lovely and their colour is distinct silvery lavender. Flowers have delightful fragrance (Fisher, 1957).

Summer Holiday : It is evolved out of the crossing of "Super Star" x unknown seedling. This variety is free flowering. Plant is tall and its growth is vigorous. Bush is covered with dark green foliage. Blooms are large, well form, with 45 petals and fragrant. Flowers colours is shades of scarlet-vermilion, with paler reverse (Gregory, 1967).

Summer Sunshine : It is cross between "Buccaneer" x "Lemon Chiffon". This variety of rose is also known as 'Soleil d' Ete'. This variety is supposing to be a valuable addition to the top quality yellow. Plant attains medium height and blooms are freely produced. Flowers are delightful and borne on long stem, colour is pure yellow. Flowers are perfectly formed and lustrous (Swim, 1962).

Sun Downer : Plant growth is vigorous and healthy. Buds are gleaming orange open into full golden-orange blooms. Flowers have good spicy fragrance. Blooms borne in clusters on tall stem (Mc Gredy, 1979).

Super Star : It is a cross between (seedling x "Peace") x (Seedling x "Alpine Glow"). Plants are vigorous, tall, upright, with medium green, matt foliage. This variety is also known as 'Tropicana'. It is one of the most outstanding rose ever raised and created a sensation when introduced. It won many international awards. Flowers are of medium sized but exquisitely formed. blooms are produced freely on vigorously growing tall bushes. Flower colour is pure light vermilion without shading, full, perfectly formed and fragrant (Tantau, 1960).

Suspense : Plant growth is strong and upright. Bush is covered with handsome green foliage. It is most striking rose and blooms are like paeonies. Flowers are beautiful, large and bicolour. Bloom colour is deep red. Petals have deep colour in their surface and light yellow on their reverse side (Meilland, 1960).

Suzon Lotthe : It is a cross between "Peace" x ("Signora" x "Mrs John Laing"). Plant is tall growing outstanding cultivar, stem is thornless. Flower size is very large and globular and high centred. Flowers have delightful fragrance. Blooms have rose of pearly, pastel tints. Flowers have occasionally splashes of deeper pink (Meilland, 1951).

Swarth more : Flowers are of exhibition type. Blooms are huge and perfectly shaped. Flower colour is rose red, which varies from lighter to deep pink in warmer weather. In cool weather the outer petal exhibit blackish margins. Flowers are lightly fragrant (Meilland, 1963).

Sweet Surrender : This variety produces tight buds with high centre. Blooms are

borne on long stems and open into full, large, silvery-pink blooms. Flowers are fragrant. Plant growth is vigorous (Weeks, 1983).

Taffeta : It is a cross between 'Mrs. Sam Mc Gredy" x "President Hoover". A splendid rose with delicious fragrance. Flowers are carmine-red shaded with bronze (Lammerts, 1947).

Tahiti : It is evolved out of the crossing of "Peace" x "Signora". A plant with tall and thick stem and dark foliage. Blooms are large and loosely formed. flower colour is cream, gold orange and pink blend into a glorious blend of colour. Flowers have delightful fragrance, a most delightful rose (Meilland, 1947).

Tallyho : It is a cross between "Charlotte Armstrong" x unnamed seedling. Plant growth is vigorous and upright. Bush produces leathery foliage. Buds are urn shaped and open into large, double and high centred flower. Flowers are fragrant and beautiful. Bloom colour is rose red with cardinal red colour on the reverse side of the petals. It is a splendid rose (Swim, 1948).

Tanya : A magnificent cut roses, with long slender buds on long stems. Flowers are tangerine shaded with salmon (Meilland, 1958).

Tapestry : It is a cross between "Peace" x "Mission Bells". A beautiful rose. Plant is vigorous, produces shining leaves. Flowers are very large and decorative. Blooms have lovely blends of colours, which include canary yellow, rose pink and bright red combination (Fisher, 1958).

Teenager : It is a hybrid evolved out of crossing of "Ena Harkness" x "Sutter's Gold". This variety is bicoloured and very attractive. Blooms are well formed, medium sized and pleasantly scented. Flower colour is pink and cream and base is golden colour. Blooms open quickly and are freely produced on a strong bush. Stem growth is firm and upright, with black green foliage. Good as cut flower (Arnot, 1958).

Tequila Sunrise : Evolved as a hybrid of "Bonfire Night" x "Freedom". Foliage is medium green and glossy. Plant growth is vigorous and bushy. Flower colour is red blend. Blooms are double and have 40 petals. Flowers have slight fragrance (P. Dickson; Dickson Nursery, 1989).

Thais : It is a hybrid between "Mme Kriloff" x ("Peace" x "Geneve"). This variety is also known as 'Lady Elgin' in America. The bush is vigorous in growth with dark green and leathery foliage. Buds are beautiful, ovoid, long pointed have reddish apricot colour. It opens into large, double, and well-formed blooms, which are golden yellow streaked with crimson. Flowers are borne on long stem and possess orange and apricot coloured petals (Meilland, 1954).

The Doctor : It is a cross between "Mrs. J.D.Eiselle" x "Los Angeles". This variety blooms several times in a year, if it is timely pruned lightly. Pruning makes this variety into a large bush which will produce lovely cut flower crop. Enormous flowers are produced with 38 petals. Flowers are pure pink in colour. Blooms have exquisite shape and lovely fragrance (Howard and Smith, 1936).

Touch of Kiwi : This variety is evolved as a hybrid of "Kiwi Queen" x "Command

Performance". Buds are tapering and flower colour is creamy yellow with ¼ th wide orange margin on petals that makes the blooms very attractive. This wide margin increases as flower ages. Reverse side turns red with ageing. Blooms are double and have upto 60 imbricate petals. Blooms are medium, borne usually singly and in sprays of 2-3. Flowers have slight fragrance. Leaves are medium green. Plant growth is upright (R.F. Cattermole, S. Pacific Rose Nursery, 1989).

Touch of Raspberry : It is evolved as a hybrid of "Love Affair" x "Paul's Pink" Foliage is large, deep green and semi glossy. Plant growth is tall and upright. Buds are slender and tapering. Bloom colour is deep pink. Flowers are double and have 30 petals. Blooms are cupped, large borne singly and have slight fruity fragrance (S. Marciel; De Vor Nursery, 1989).

Touch of Velvet : Evolved as a hybrid of ("First Prize" x "Gypsy") x unnamed seedling. Foliage is medium, dark green, plant growth is tall and upright. Buds are pointed and long. Flower colour is magenta red with lighter tones. Blooms are double and have 31 petals. Blooms are high centred, exhibition type, borne usually singly and in sprays of 1-3. Flowers have moderate fragrance (C. Leon; John Carringg, 1987).

Touch of Venus : Plant is having upright growth with relatively few thorns in stem. Buds are long, pointed and their tips are pink brushed. Buds open into very large flowers. Bloom colour is white with delicate pink centre. Flowers have rich fragrance (Armstrong, 1970).

Tuxedo : Evolved as a hybrid of "Portland Trailblazer" x "Olympiad". Foliage is medium, green and semi glossy. Plant growth is upright. Buds are ovoid. Flower colour is dark red. Blooms are double and have 45 petals. Flowers are urn shaped, large and borne singly (J. Christensen; Bear Creek Gardens, 1988).

Tyriana : A spectacular variety with exquite form, free flowering and delightfully fragrant. It is considered as one of the best variety for bedding. Flowers are produced in profusion. Blooms are lovely have rose pink colour. It is good for hedges (Meilland, 1960).

Tzigance : A splendid variety for garden decoration and exhibition. Plant growth is vigorous and has glossy foliage. Flowers are lovely, biocolour, and their colour is bright scarlet red and chrome yellow reverse. Blooms are large, well formed and have fragrance. Flowers are freely produced on bush (Meilland, 1950).

Ultimate Pink : Evolved as a hybrid of unnamed seedling x "Fragrant Memory". Buds are exquisite, long, elegant and tapered, they open in perfect spirals. Flowers are produced freely on a handsome upright plant. Flower colour is pink and its size is 12.5 cm in diameter. Flowers have 30 petals. Plant attains height up to 150 cm. Blooms have light damask fragrance. Jackson and Perkins 1999 Rose of the Year have selected the variety. Bear Creek Gardens Inc. has introduced the variety (Keith Zary, 1999).

Una Wallace : An attractive variety and very popular. This variety is having very vigorous and tall plant growth. Flowers are freely produced. Blooms are of exquisite shape and size. Flower colour is clear cherry rose, and are sweetly scented (Mc Gredy, 1921).

Uncle Walter : It is a cross between "Brilliant" x "Heidelberg". A vigorous plant with unfading blooms. Flowers are brilliant red and have velvet like petals (Mc Gredy, 1963).

Valencia : It is having fragrant flowers. Buds are elegant and open into beautiful flowers. Blooms are large in size. The colour is red apricot orange with bronze over tones (Kordes, 1967).

Velsheda : It is having abundant flowers, which are borne on long stem. Blooms are beautiful, large, double and well formed. Flowers have fragrance and their colour is soft pink (Cant, 1936).

Velvet Fragrance : Foliage is large, dark green and semi glossy. Plant growth is upright. Flower colour is deep crimson. Blooms are double and have 45 petals. Flowers are large and very fragrant (Fryer Nursery Ltd. 1988).

Vick's Caprice : A beautiful old variety with strong arching stems and fragrant flowers. Flowers are lilac rose striped white and carmine (Vic, 1891).

Vienna Charm : It is a cross between "Golden Sun" x "Chantre". Plants are tall, upright, vigorous, and foliage are green, leathery and glossy. This variety is also known as "Wiener Charme", "Charmie de Vienne" and 'Charming Vienna'. Flowers are long lasting. Bloom colour is orange brown. The most exciting variety of rose (Kordes, 1963).

Violaine : Flowers are freely produced fragrant, flower colour is unique and new colour for hybrid tea roses. Bloom colour is lovely mauve violet pink (Gaujard, 1968).

Virgo : It is a cross between "Pole Nord" x "Neige Parfum". Plants are vigorous, upright, foliage are dark green, leathery and matt. This variety is also known as "Virgo Liberationem". Blooms are pure white. Flowers are most exquietly shaped. Buds open into large blooms. It is considered as one of the best rose among white rose and most freely produced (Mallerin, 1947).

War Dance : It is a cross between "Roundelay" x "Crimson Glory". A robust variety with spreading habit and green foliage. Flowers are fragrant, orange scarlet (Swim and Weeks, 1961).

Well Worth : A dwarf plant, suitable for bedding and cut flower, with attractive grey green foliage. Flowers are urn - shaped, peach-pink shaded with yellow (Le Grice, 1956).

Wendy Cussons : It is a cross between "Independence" x "Eden Rose". Plants are tall vigorous branching and foliages are leathery dark green and glossy. Blooms of this variety is having true Damask fragrance. This rose is very lovely and has shades of cerise scarlet and rose red. Blooms are highly centred, perfectly shaped and are freely produced (Gregory, 1959).

Western Sun : It is very handsome, flowers are deep yellow in colour, and are large in size (Poulsen, 1965).

Westminster : It is a cross between "Gay Crusader" x "Peace". It is a tall, branching, exquisitely scented rose, and received the Clay Challenge Vase and Gold Medal for the

best scented rose in 1961. It produces flower freely on a bush, which is moderate vigour in growth. Buds are beautiful and open into large, well-formed long lasting blooms. Blooms are bicolour having attractive coppery salmon and old gold petals (Robinson, 1960).

Whisky Mac : Parentage of this variety is unknown. Plants are bushy and compact. It has strong fragrance. Juvenile foliage is bronze coloured and very attractive. The flowers are cupped and open quickly. Flower colour is unusual gold-shaded bronze and apricot (Tantau, 1967).

White Delight : Evolved as a hybrid of "White Masterpieice" x "Futura". Foliage is medium, dark green and matt. Plant growth is medium and upright. Buds are ovoid and pointed, colour is pink with blush, which are prominent, on petal surface. Blooms have 38 petals and their nature is double. Flowers are high centred, large and borne usually singly. Blooms have slight fragrance (W. Warriner, Jackson and Parkins, 1990).

White Knight : It is a cross between ("Virgo" x "Peace") x "Virgo". This variety is also known as "Message". Medium growth with green leathery foliage. Flowers are slightly fragrant, double with 28 to 35 petals, high centred. Blooms are white faintly shaded cream.

White Lightnin : It has strong fragrance, buds are pointed and looking beautiful in pure creamy-white colour. Flowers open to radiant blooms of white with slight pink glow on the edge of the petals (Armstrong, 1981)

White Masterpiece : It produces magnificent buds, which open into high centred, large flower. Bloom colour is white (Warriner, 1972).

White Queen : This variety of rose is free flowering and bush growth is vigorous. Buds are long pointed and their shape is beautiful. Buds open into large, double and mild white blooms, flowers are borne singly and in clusters (Boerner, 1958).

White Swan : It is evolved as a hybrid of "A.Kaiserin Auguste" x "Victoria seedling". Blooms are of exhibition quality, pure white blooms are produced on long stem. Flowers have light pleasing fragrance. Plant growth is vigorous, bushy and healthy (Verschuren 1952).

William Harvey : It is a hybrid between "South Port" x "Crimson Glory". A most attractive exhibition type of rose, with crimson scarlet flowers (Norman, 1948).

Wimi : A strongly fragrant flower, which are well filled, perfect colour is beautiful silver pink (Tantau, 1983).

Wisbech Gold : A cross of "Piccadilly" x "Golden Sun". A dwarf variety popular for bedding. Flowers are cup shaped, bright golden yellow in colour (Mc Gredy, 1964).

World's Fair Salute : Blooms of this variety is very large, well formed and fragrant. Flowers colour is velvety red (Morey, 1963).

Yakimour : An attractive variety with bicolour flower. Buds are elegant and shapely. Flowers are scarlet red and yellow (Meilland, 1985).

Yankee Doodle : This variety is evolved as a hybrid of "Colour Wonder" x "King's Ransom". Buds are urn-shaped open into blooms having colour of apricot to peach-pink on upper surface of petal and butter-yellow in reverse (Kordes, 1974).

Yorkshire Bank : An unique variety with fragrant white flowers, petals are broad and shapely (De Ruiter, 1979).

Youki San : It is also known as "Mme Neige". Growth of the plant is moderate. Flowers are large and their formation is classic. Flower colour is pure white (Meilland, 1965).

Yuki Matsun : Evolved as a hybrid of ("Dolee Vita" x "Royal Highness") x "Nobility". Foliage is medium, dark green and glossy. Plant growth is medium. Buds are avoid. Flower is white, double and have 42 petals. Blooms are urn shaped, high centred, large and borne usually singly. Flowers have moderate fragrance (Kiyoshyokota, 1989).

Yusai : This variety is evolved as a hybrid of (unnamed seedling of "American Heritage" x "Christian Dior") x 'Miss Ireland". Buds are ovoid. Flower colour is yellow with reddish fringes, reverse side changes to red with sunshine. Blooms are double and have 30 petals. Flowers are urn shaped, high centred, large and borne in sprays of 2-3. Foliage is medium, dark green with bronze tinge, slight denticulate and glossy. Plant growth is bushy and spreading (Kaichiro Ota, 1989).

Zitronenjette : A classic rose, elegantly shaped buds with fragrant yellow flowers (Kordes, 1986).

FLORIBUNDA ROSES

Foribunda roses owe their large clusters of flowers to one of their early ancestors, *R. multiflora*. They are of very mixed pedigree like Hybrid Tea. Flowering season are long. They are also known as dwarf Polyanthas and grown as charming little bedding roses. Poulson of Denmark in the early 1920s crossed these with Hybrid Teas which resulted into producing the hybrid Polyanthas, which are renamed 'Floribunda' in the 1950s. Floribunda and Hybrid Teas have been interbred so much that it has become difficult to separate them. For the benefit of the nurseryman, growers and gardeners a new rose classification was prepared in 1971. A new term was introduced for Floribunda i.e. Cluster Flowered Roses. These are the natural successors in line from the Polyantha roses. They are grown as small shrubs in shrubberies and herbaceous borders. They also make attractive hedges. A brief description of some of the important cultivars of Floribunda roses are given below.

African Star : A dwarf spreading plant with, dark green bronze tinted leaves. Blooms are full, slightly fragrant and lilac coloured (West, 1965).

Alain : This is evolved out of the crossing of ("Guinee" x "Whilhelm") x "Orange Triumph". Plant is vigorous and tall. Foliage is dark and glossy. This variety is one of the best of the dark red group. Bloom appears in enormous clusters of glowing crimson colour. Flower is semi double and produce several times in a year (Meilland, 1946).

Alamain : It is a cross between "Spartan" and "Queen Elizabeth". A spectacular scarlet flowering Floribunda, which are free flowering and semi double (Mc Gredy, 1963).

Alibi : A pure white flowering variety with dark foliage (de Ruiter, 1960).

Allgold : This is a cross between "Goldilocks" and "Ellionor Le Grice". Plants are robust and bushy. Among deep yellow Floribunda rose, it is considered as one of the

best. Flower colour is deep and relatively unfading yellow. Blooms are semi-double with 15 to 22 petals, produced singly or several together, slightly fragrant (Le Grice, 1956).

Amberlight : An attractive cultivars of outstanding merit. Flowers are well formed with shades of golden-buff, changing to honey brown (Le Grice, 1962).

Angel Face : Plant produces ruby buds, which open into rich, deep, sparkling rosy-lavender flowers. Petals have wavy, ruffled edges set off by an edging of royal ruby. Flowers are large and usually appear in clusters. Blooms have exquisite perfume (Swim and Weeks, 1968).

Angela : It is evolved as a hybrid of "Masquerade" x "Spek's Yellow" crossing. A free flowering, tall upright cultivars with dark glossy foliage. The flowers are double, 28 petalled, golden yellow shaded crimson (Kordes, 1957).

Ann Elizabeth : Plant is vigorous and tall growing. Flowers are pretty. Bloom colour is rose pink, are borne in long elegant sprays (Norman, 1962).

Anna Wheatcroft : Plants are compact with black green foliage, produce most beautiful roses. Buds of this variety are pale-vermilion in colour, which opens into exquisite flowers. Bloom colour is rich-rosy-salmon. Flowers have golden stamens. Floral tresses exhibit nice display (Tantau, 1959).

Anne Cocker : It is a cross between 'High Lights" x "Colour Wonder". Plant growth is upright and vigorous. Flowers are produced in medium size clusters with 36 petals. Flower colour is luminous orange vermilion (Cocker, 1971).

Arabian Nights : It is a cross between "Spartan" and "Beauté". This free flowering variety is tall and vigorous in growth with large dark green foliage. Flowers are beautiful and double in nature. Bloom colour is orange-salmon, fading to red (Mc Gredy, 1963).

Arthur Bell : It is a cross between "Clare Grammerstorf" and "Piccadilly", and produces flower of HT type. Plants are vigorous tall with dark green large foliage. Flower colour is striking rich yellow, which fades with age into lighter yellow colour. Blooms have delightful fragrance (Mc Gredy, 1965).

Ascot : It is a cross between "Brownie" x seedling. A beautiful variety. Plant is having rounded growth habit. Variety is ideal for border front. Flowers are soft salmon pink. Blooms are large and displayed on a well shape head (Dickson, 1962).

Athlone : It is a cross between "Circus" x "Tantau's Triumph". Plants are dwarf, bushy with medium green small leaves. Blooms appear in clusters, which comprises of white, yellow, rose pink and crimson blend of flowers. Blooms look very attractive (Mc Gredy, 1965).

Beatrice : It produces flowers in great profusion. Blooms are glowing deep rose colour. Flowers are borne in well-shaped tresses (Mc Gredy, 1968).

Betty Boop : A hybrid of "Play boy" x "Picasso". It is naturally rounded medium to tall plant with flowers and foliage to the ground, making an ideal landscape plant. Flower colour is ivory yellow with a red edge. The brightly coloured clusters of flowers dance among deep green leaves. Additionally, the plant offers an attractive, moderately fruity, sweet fragrance. Long, elegant and pointed buds mature into 10 cm flowers with

a petal count of 6 to 12. "Betty Boop" is the fourth AARS winner for 1999 (Max Fleischer's, 1930).

Bobbie Lucas : Flowers of this variety appear on plant in well-shaped tresses. Blooms are large and deep salmon orange in colour (Mc Gredy, 1967).

Border King : This variety of rose is also known as "Roides Bordures." Plant growth is very vigorous. Sometimes it is considered as a Polyantha. Blooms are semi double and borne in large clusters. Flower colour is deep red (de Ruiter, 1950).

Border Queen : This variety is also known as "Reine Des Bordures". Flower colour is very attractive. Blooms are single and salmon pink in colour. Stamens are golden coloured (de Ruiter, 1949).

Bridal Pink : This variety of rose is bushy in nature and free flowering. Plant growth is low. Blooms are large and H.T. shaped. Flowers are lovely and their colour is soft organdy-pink (Boerner, 1967).

Bugle Boy : This variety is evolved as a hybrid of "Sun Sprite" x (unnamed seedling of "Katherine Loker" x "Gingersnap"). Foliage is medium green and very glossy. Plant growth is medium and bushy. Buds are ovoid and pointed, flowers are double., deep yellow in colour and have 35 petals. Blooms are cupped, medium and borne in spiral of 5-6. Flowers have slight tea like fragrance (J. Christensen, Bear Creek Gardens, 1988).

Cabaret : Flowers of this variety appear in large clusters. Blooms are good in shape, and colour is vermilion salmon (de Ruiter, 1963).

Celebration : It is a cross between "Dickson's Flame" and "Circus". Plant are vigorous and bushy with medium green foliage. Blooms of these cultivars produced in well-shaped tresses on a strong and healthy bush. Flowers are delightful, salmon red with an ivory disc at the base. The reverse side of the petal is having peach blossom shading. Blooms are long lasting and double (Alex Dickson, 1962).

Charleston : Plant growth is vigorous. This variety is unique and change colour with ageing of flower. Blooms change colour from yellow to orange and pink and ultimately velvety-dark-crimson (Swim, 1963).

Circus : It is a cross between "Pinocchio" x "Fandango". This variety of rose is one of the multicoloured Floribundas with a spectacular show. Flower colour changes from buff, yellow, orange, apple blossom pink and light red as it approaches maturity in full bloom stage. Blooms are large with plenty of petals. These are free flowering with delicious spicy perfume (Swim, 1956).

City of Belfast : It is a cross between "Evelyn Fison" x ("Korona" x "Circus"). Plants are bushy to upright with glossy medium green foliage. This variety is good for bedding. Bloom colour is signal red. Flowers are of medium size. Blooms appear in tresses on strong stem (Mc Gredy, 1968).

City of Leeds : It is a hybrid between "Evelyn Fison" x ("Spartan" x "Red Favourite"). Plants are vigorous, upright with medium green, matt foliage. This cultivar is an unusual fine Floribunda. Flowers are of H.T. type. Blooms are very attractive. Flowers appear on clusters on stem. Bloom colour is rich salmon (Mc Gredy, 1966).

City of Springfield : Evolved as a hybrid of "Pink Parfait" x "Roman Holiday". Plant growth is bushy and hardy. Flower colour is red blend and its nature is non-fading. Blooms are double in nature and possess 34 petals. Flowers are borne in sprays of 6-10 (P. Pencil, 1939).

Clos Fleuri Blanc : Evolved as a hybrid of "Milrose" x ("Legion d' Honneur" x "Candeur"). Plant growth is vigorous and its nature is semi climbing. Leaves are bright. Flower colour is white. Blooms are double and possess 40 petals. Flowers are large and have slight fragrance. (Delbard and Chabert, 1988).

Clos Fleuri Jaune : It is evolved as a hybrid of "Orleans Rose" x "Goldilocks") x "Parure d' Or". Plant growth is vigorous and its nature is semi climbing. Flower colour yellow shaded ochre opening to yellow amber. Blooms are double and possess 18 petals. Flowers are large and slightly fragrant (Delbard and Chabert, 1988).

Clos Fleuri Rose : Originated as a hybrid of ("Zambra" x "Orange Sensation") x ("Robinson" x "Virgo"). Foliage is bright. Plant growth is vigorous and bushy. Flower colour is medium pink. Blooms are double and have 30 petals. Flower size is medium. Blooms have slight fragrance (Delbard and Chabert, 1988).

Cocorico : It is a cross between "Alain" x "Orange Truimph". Plant growth is vigorous and tall. Foliage is dark green. Blooms appear in large clusters and several times a year. Flowers are very bright and poppy red in warm weather and during winter the colour changes to crimson (Meilland, 1950).

Contempo : Blooms are displayed attractively in well-shaped clusters. Among Floribunda rose, in this variety flower size are comparatively large. Flower colour is glowing copper-orange (Armstrong, 1970).

Copper Delight : It is a cross between "Goldilocks" x "Ellionor Le Grice". Plants are vigorous and spreading, with olive green foliage. Flowers are freely produced, coppery orange, large, semi double with 14 petals (Le Grice, 1956).

Copper Pot : Flowers are neatly formed and large in size. Blooms appear in small clusters. Flower colour is striking copper orange (Dickson, 1968).

Cyclamen : It is a cross between "Frau Karl Druschki" x "Orange Triumph") x "Tonnere". Plants are vigorous with dark green foliage. Blooms are cyclamen pink with slight fragrance (Delbard, 1961).

Daily Sketch : It is a cross between "Ma Perkins" x "Grand Gala". Plant growth is vigorous and tall. Attractive, plum, silver bicolour appear on bush. Flowers are perfectly formed and large in size. Blooms are produced in well-shaped clusters on strong shoots (Mc Gredy, 1960).

Dainty Maid : It is a cross between ("Poulsen's Pink" x "Ellinor Le Grice") x "Mrs. Pierre du Pont". Pant growth is vigorous and bush is compact with dark green foliage. Leaves have leathery texture. Flowers are produced in clusters. Buds are beautiful, pointed and open into single, silvery-pink blooms. Reverse side of the petals has carmine colour (Le Grice, 1938).

Dearest : It is a cross between unnamed seedling x "Spartan". A bushy outstanding

Floribunda with plenty of dark leaves. This variety is very floriferous. Flowers are borne in large well shaped clusters on strong upright bushes. Blooms are very lovely and pink shaded with salmon, double and having 30 petals (Dickson, 1960).

Diamant : It is a cross between "Korona" x "Spartan". This variety of rose is vigorous in growth. Flowers are borne in large clusters in tall bush. Blooms are perfectly formed. Flower colour changes from brilliant vermilion to orange-scarlet (Kordes, 1962).

Dickson's Flame : It is a cross between "Independence" seedling x "Nymph". Plant growth is vigorous. Flowers are large and semi double. Blooms have slight fragrance and freely produced in tresses. Flower colour is dazzling flame scarlet (Dickson, 1958).

Dimples : Blooms are very beautiful and attractive. Flowers are double. Flower colour is creamy-white with golden centre, that is very charming (Le Grice, 1967).

Dominator : It is a cross between "New Yorker" x "Sweet Repose". Plant is having strong bush, growth is upright. This variety is free flowering. Buds are beautifully shaped and open into semi double flower. Blooms are fragrant. Flower colour is deep pink with white shading (de Ruiter, 1961).

Dorothy Wheatcroft : Plant growth is vigorous and bush is tall growing. Blooms appear in huge tresses of medium size. Flowers are semi double. Flower colour is bright orange-red (Tantau, 1960).

Dr. Faust : It is a cross between "Masqurade" x "Spek's Yellow". This variety is also known as "Faust". Flower gives multicolour effect. Blooms are large and double. Flowers are fragrant. Blooms have mingling shades of golden yellow and orange pink (Kordes, 1957).

Dusky Maiden : It is a cross between ("Daily Mail" scented "Eliole de Hollande") x "Else Poulsen". This variety is a free bloomer. Plant growth is vigorous and bush has dark green foliage. Flowers are large, single and fragrant. Blooms are produced in tresses. Flower colour is deep crimson scarlet. Anthers are golden (Le Grice, 1947).

Elizabeth of Glamis : It is evolved out of the crossing of "Spartan" x "Highlight". This variety is also known as "Irish Beauty". Plant growth is upright and vigorous. Foliage is semi-glossy and dark green. It is free flowering. Bloom colour is deep orange-salmon. Flowers are large, full and fragrant (Mc Gredy, 1964).

Else Poulsen : It produces semi double flowers in enormous tresses. Flowers are sparkling rose pink in colour. Young foliage is coppery. Ideal for cutting (Poulsen, 1924).

Elysium : Bush of this cultivar is vigorous and tall growing. Foliage is plentiful, mild green in colour and their surface is glossy. Blooms are large, high centred and perfectly formed. Flowers have lovely shade of light salmon pink colour, which are freely produced and fragrant (Kordes, 1960).

Escapade : It is a cross between "Pink Parfait" and "Baby Faurax". Plants are bushy, vigorous with glossy light green foliage. Flowers are produced in large heads. Blooms are virtually single and fragrant. Flower colour is rose-magenta with white centre, which looks attractive (Harkness, 1971).

Europeana : It is evolved out of the crossing between "Ruth Leuwerik" x "Rosemary

Rose". Plant growth is vigorous. Foliage are bronze-green in colour that are attractive. Lovely young brownie red foliage is very charming. Flowers are large, well shaped and borne in huge tresses. Bloom colour is brilliant red, flowers are rosette shaped, slightly fragrant (de Ruiter, 1963).

Evelyn Fison : It is a hybrid of "Moulin Rouge" x "Korona". This variety is also known as "Irish Wonder". Bush growth is strong and vigorous which has dark green foliage. Blooms are double and carried in large, well-shaped tresses. Bloom colour is unfading brilliant red. This is one of the best in this colour (Mc Gredy, 1962).

Fairy Dancer : Plant growth is average and it is attains medium height. Blooms are freely produced. Flower colour is pale amber-pink (Cocker, 1969).

Fashion : It is a cross between "Pinocchio" and "Crimson Glory". This variety produces semi double flowers in large clusters. Plant growth is vigorous and foliage is neat. Flower colour is glorious shade of soft salmon pink that changes into deeper in some season. Blooms possess pronounced fragrance and there are 24 petals (Boerner, 1949).

Fire King : It is evolved out of crossing of "Moulin Rouge" and "Fashion". Plant growth is vigorous and upright. Variety is free fowering and has dark green, leathery foliage. Blooms are medium sized, double and fragrant. Flower colour is a dark geranium red suffused with vermilion. Clusters of flowers are well shaped and produce a wonderful fiery effect. Flowers are high centred and have musk fragrance (Meilland, 1959).

Flamenco : It is evolved as a hybrid of "Tantau's Truimph" and "Spartan". This cultivar is considered one of the best roses for garden display and for potting. In warmer weather performance of this variety is outstanding. Blooms are produced in lovely tresses, which keep their colour all the time. Flower colour is lovely deep salmon. Flowers are full, have 21 petals and opening flat (Mc Gredy, 1960).

Fragrant Apricot : Evolved as a hybrid of "Impatient" x "Amber Queen". Foliage is dark green and quite large. Plant attains height up to 130 cm and its growth is upright. Plant growth is vigorous and compact. Flowers are produced in abundant. Bloom size is large. Flower colour is apricot yellow, they are fragrant and appear in clusters. Bloom size is 10 cm and it has 30 petals. Flowers have Damask musk fragrance (Keith Zary, 1999).

Fusilier : The hybrid is evolved out of crossing of a red Polyantha rose seedling x "Crimson Glory". This variety is also known as "Grenadier" and "Red Soldier". Flowers are semi double in nature and borne in heavy clusters. Plants are tall and bushy. Brilliant shade of crimson red appears in large tresses. A most popular Floribunda rose (Morey, 1957).

Gay Princess : Bloom of this variety is large H.T. type. This is an outstanding variety. Blooms have lovely shade of shell pink and are produced in clusters on a tall vigorous plant (Boerner, 1967).

Gene Boerner : Blooms are deep pink in colour, double and H.T. type. Flowers are produced freely in clusters. This is considered as one of the most promising rose (Boerner, 1968).

Glengarry : It is a cross between "Evelyn Fison" and "Wendy Cussons". Plant growth is bushy, upright and a free flowering cultivar. Flowers are large and well formed with 32 petals. Flower colour is vivid vermilion red (Cocker, 1969).

Glory of Ceylon : This variety is free flowering. Flowers have sweet scent. Blooms are semi double and their colour is tea yellow, flushed with orange red (Harkness, 1967).

Golden Fleece : It is a cross between "Diamond Jubilee" x "Yellow Sweetheart". A very attractive Floribunda rose. Buds of this variety are ovoid in shape and their colour is golden yellow or straw yellow colourings. Buds open into large, double cupped, buff yellow blooms. Flowers have fragrance. Blooms have 26 petals and are wavy, which possess unusual fruity smell (Boerner, 1955).

Golden Jewel : This variety of rose is also known as "Bijoud" or "Gold Jewel". Flowers are beautiful, non fading and fragrant. Bloom colour is golden yellow. Flowers are produced in a dwarf, healthy bush with glossy-green leaves. An outstanding variety of Floribunda (Tantau, 1959).

Golden Slippers : It is a cross between "Goldilocks" and "seedling". This variety produces dwarf bedding plant. Foliage is bronzy green. Flowers are bicolour. Flower colour is blend of orange and golden yellow. Blooms appear on dwarf plants. (Von Abrams, 1961).

Goldilocks : It is hybrid between unnamed seedling x "Doubloons". Plant growth is vigorous and bush has abundant glossy, leathery foliage. Flowers are large, double and fragrant. Bloom colour is deep yellow to fading cream. Flowers are produced in abundance on bush. Flowers have 45 petals, which are fragrant (Boerner, 1945).

Guitare : This variety of rose is vigorous in growth. Blooms are borne in clusters and of good lasting quality. Flower colour is very striking yellow orange. Blooms are red coloured from the top (Gaujard, 1963).

Heat Wave : This variety is also known as "Mme Paule Giusez" Plant growth is vigorous upright. Bush has dark green, semi-glossy rounded foliage. Buds are beautiful and urn shaped, open into large and double flower. Blooms are slightly fragrant. Flowers are borne in clusters and their colour is orange-scarlet. (Swim, 1958).

Heaven Scent : The variety is vigorous and free flowering. Blooms have remarkable fragrance. Flower colour is delicate fresh pink (Poulson, 1968).

Heinz Erhardt : Blooms of this cultivar is freely produced in well-spaced tresses. Flower is small and its colour is deep red produced on well-spaced tresses (Kordes, 1962).

Highlight : It is a cross between "Seedling" x "Independence". The Bush is vigorous, flowers are very attractive and semi double to double in nature. Borne singly or in clusters on bushes. Bloom colour is orange-scarlet, very bright and intense when young. Plant produces fragrant flowers in large clusters (Robinson, 1957).

Hit Parade : Plant growth is low and bush is healthy, foliage is glossy. Flowers are produced in big clusters and very attractive. Flower is double in nature, bicolour, scarlet orange, shaded gold on reverse (Dickson, 1962).

Iceberg : It is a cross between "Robin hood" and "Virgo". This variety of rose is also known as *"Schneewittchen"* and *"Feedes Neiges"* and considered as one of the best

rose of the Floribunda in white group. Flowers appear on tresses of small white flower. In bud stage slightly tinged pink colour can be seen. Blooms are borne on vigorous bushes, which have exceptionally healthy foliage. A brilliant variety with elegant sprays (Kordes, 1958).

Independence : It is a cross between "Baby Chateau" and "Crimson Glory". This variety of rose is also known as "Sondermeldung", "Korde's Sondermeldung", "Geranium" and "Beina Elisenda". It is one of the most striking roses. The bush is free flowering, vigorous with coppery foliage. This cultivar also shows good performance in warm weather. Flower colour is orange scarlet and their size is large for a Floribunda blooms appear in small or large clusters. Flowers are well shaped like Hybrid Teas and have large number of petals (Kordes, 1950).

Irish Mist : It is evolved as a cross between "Orangeade" x "Mischief". Plant growth is medium and foliage are small and dark green. Flowers of this variety are well formed and freely produced on bush. Bloom colour is very lovely orange salmon, which is very attractive (Mc Gredy, 1967).

Ivory Fashion : It is evolved as a hybrid of "Sonata" x "Fashion". Plants are moderate vigorous, upright, free flowering. Foliage is matt, large medium green. Flowers are large in size and semi double in nature. Buds open into fragrant flowers. Blooms are ivory white, moderately full, slightly fragrant (Boerner, 1957).

Jiminy Cricket : It is a cross between "Goldilocks" x "Geranium Red". Plant growth is vigorous and healthy. Buds are bright orange in colour and open quickly in flowers of coral rose. Buds are very attractive and excellent for buttonholes use. These are ideal bedding plants, and received All American Award in 1955 (Boerner, 1954).

Johann Strauss : Evolved as a hybrid of "Flamingo" x ("Meihartfo" x "Tip top"), flower colour is pearl pink. Buds unfurl to an old fashioned heavily petalled bloom with fresh sliced apple fragrance. Bloom size is large and it has 45 petals. Leaves are olive green and lustrous. Plant attains height of 150 cm and its growth is bushy (Meilland, 1999).

Junior Miss : It is also known as "America's Junior Miss". Buds are graceful and very lovely. Buds are organdy-pink coloured and are produced in profusion in clusters. In full bloom stage shading of yellow in the depths can be clearly visible (Boerner, 1964).

King Arthur : It is a cross between "Pink Parfait" x "Highlight". Blooms of this variety look like Hybrid Tea type rose. Flower colour is deep salmon pink. Plant growth is vigorous, attains tall height and the variety is free flowering (Harkness, 1967).

Lavender Pinocchio : It is a cross between "Pinocchio" x "Grey Pearl". Growth is bushy and vigorous and foliage is leathery. This variety produces clusters of cinnamon brown buds with a pink tinge. Buds open into smoky lavender flowers. Blooms have yellow stamens. Blooms are full, produced in clusters (Boerner, 1948).

Lavender Princess : Plant growth is vigorous and well branched. Buds are tight and open into multipetalled flowers. Flowers appear in clusters. Bloom colours are pleasing combination of orchid, tan and lavender and are delightfully fragrant (Boerner, 1960).

Lavendula : It is a vigorous, well-branched plant. It produces large flowers, mostly

in singles. Bloom colour is reddish-lavender. Flower colour is striking but changes quickly (Kordes, 1965).

Lilac Charm : Plants are dwarf, bushy with mild green foliage. Blooms are single or semi single. Flowers are produced singly and in clusters on a short and strong bush. Flower colour is pastel mauve with a light golden zone at the base of the petal. Anthers are of prominent golden colour and their filaments are crimson coloured. It has fresh fruity perfume. A very attractive rose with symmetrical flowers (Le Grice, 1961).

Lilli Marlene : Plants are vigorous, bushy, and compact with abundant foliage. An outstanding variety of great popularity. Flowers are semi double and borne in profusion in well-spaced tresses of medium size. Flower colour is bright scarlet-crimson (Kordes, 1959).

Little Darling : Plant growth is very vigorous and tall. Buds are attractive and its colour is delightful. Flowers are double and of medium size. Blooms are produced in clusters in abundance. Flower colour ranges from red-orange to rose pink, with yellow base (Duchrsen, 1956).

Magenta : It is a cross between seedlings x "Lavender Pinocchio". Plants are vigorous, tall, lax, branching with dark green glossy foliage. This variety is also known as "Korde's Magenta". It is one of the most unusual Floribunda. Flowers are fragrant. Flowers are large and multipetalled. Flowers are borne in large tresses. Bloom colour is pale-mauve (Kordes, 1954).

Manjana : This variety produces flowers of H.T. type. Bloom is very delicate and their colour is apricot-peach pink. Flowers are produced in large number with great freedom. (de Ruiter, 1969).

Marlena : Parentage is unknown. Plant growth is vigorous, low branching, foliage are small, dark green, plentiful, tinged with bronze, and free flowering. This variety is ideal for bedding and is dwarf. Plant produces velvety dark red blooms moderately full, cupped (Kordes, 1964).

Meteor : This is a cross between "Feurio" and "Gertrud Westphal". This variety of rose tends to produce single flower during cool weather, which are large in size. Petals are many and arranged symmetrically in blooms. Flower colour is dazzling red-vermilion. During colder season, velvety red sap appears on petals and making the flower more attractive. In warm weather, flowers are borne in clusters and their size is smaller (Kordes, 1958).

Molly Mc Gredy : It is a hybrid evolved out of "Paddy Mc Gredy" x ("Mme Leon Cuny" x "Columbine"). Plant growth is vigorous; variety is relatively disease free, foliage is glossy dark. Flowers are of Hybrid Tea type. Presence of bicolour flowers makes the variety very attractive. Bloom colour is cherry red and silver reverse. Flowers are produced in well-spaced clusters, blooms are full, with 35 petals (Mc Gredy, 1969).

Moonsprite : Plant growth is dwarf and bushy. Foliage is semi glossy and their texture is leathery. It is having medium sized flowers, which are borne on round clusters, blooms are double, cupped and very fragrant. Flower colour is creamy white with pale gold centre (Swim, 1956).

Moulin Rouge : It is a cross between "Alain" x "Orange Triumph"; a famous cross and received awards. Growth is upright and bushy. Flowers are produced in well-spaced tresses on an attractive bush. Bush has dark green foliage. Blooms are bright, spectrum red to rose pink in colour. Flowers are semi double, cup shaped, with 20-25 petals, produced in generous tresses (Meilland, 1952).

New Europe : It is also known as 'Nouvelle Europe' and 'Neues Europa'. Flowers are non-fading and freely produced in tresses. Flower colour is brilliant orange. Bush is attractive with dark green foliage (Gaujard, 1964).

News : This variety of rose exhibit an exciting new colour in Floribunda. Buds are red and open into rich clear purple flowers and lightened by the gleaming golden anther (Le Grice, 1968).

Oh-La-la : It is a seedling of "Fanal". Plant growth is tall, vigorous and it is ideal for bedding. Foliage is dark green and glossy. Bud colour is dark red velvety and their shape is pointed. Buds open into semi double flowers, which are borne in large clusters. Flowers have golden stamen. Blooms are long lasting (Tantau, 1956).

Orange Sensation : Plant is compact, vigorous and branching and deep greenish foliage, which are plentiful. It is very striking and dependable variety of rose. Flowers are freely produced in large clusters. Bloom colour is orange or light vermilion, sweetly fragrant with 24 petals (De Ruiter, 1961).

Orange Silk : It is a cross between "Orangeade" x ("Ma Perkins x "Independence"). Plants are moderately vigorous, and foliage is glossy medium green. Flowers are large, full and Hybrid Tea type. Bloom colour is bright orange-vermilion, which is borne in clusters (Me Gredy, 1968).

Orangeade : It is a cross between "Orange Sweet Heart" x "Independence". A very attractive and popular rose for all time. Plant growth is very vigorous which forms a large and tall bush. Flowers are single to semi double and borne on nicely spaced tresses. Bloom colour is dazzling Dutch Vermilion, turns to reddish orange tone while fading (Mc Gredy, 1959).

Paddy Mc Gredy : It is a cross between "Spartan" x "Tzigane". Plant growth is vigorous, branching, very free flowering, foliage is dark green and its surface is glossy. Flowers are well shaped with a high centre and petals are reflexed. Flowers colour is deep rose pink with warm-salmon overtones, lighter reverse, slightly fragrant (Mc Gredy, 1962).

Paint Box : It is a cross between "seedling" x "St. Pauli". This variety of rose is profuse bloomer. Plant growth is vigorous, tall, branching and free flowering. Flowers are highly coloured and larger 'Masquerade', red and golden yellow changing to deep red (Dickson, 1963).

Paprika : It is a cross between "Marchenland" and "Red Favourite". An outstanding rose ideal for bedding. Plant growth is moderately vigorous. Foliage colour is dark green. Flowers are borne in cluster, freely and abundantly. Flowers are semi double and their colour is bright Turkey red, shading to lighter towards the centre, semi double (Tantau, 1958).

Pernille Poulsen : It is a cross between "Ma Parkins" and "Columbine". Plants are compact, branching with medium green long leaves. Blooms of this variety are medium

to large. Flowers have captivating shades of scarlet pink and produced in well spaced clusters (Poulsen, 1965).

Pink Parfait : It is a cross between "First Love" and "Pinocchio". A beautiful cultivars ideal for bedding. This free flowering variety is tall, vigorous have compact growth. Blooms have blend of delicate pinks, from pale dawn-pink to a rich rose pink at the petal edges. The colour of the blooms darkens considerably with the age of the flowers. Buds are dainty, petite and perfect open into graceful medium sized flowers. Flowers are slightly fragrant and moderately full (Swim, 1962).

Pinocchio : It is evolved out of "Eva" and "Golden Rapture" crossing. Flowers are salmon pink with 30 petals borne on large clusters. This is ideal for bedding (Kordes, 1949).

Polka : It is a cross between "Moulin Rouge" and "Fashion". Plants are vigorous and bushy with dark green foliage. Blooms are double, high centred, claret rose in colour with mild fragrance (Meilland, 1960).

Poulsen's Bedder : It is a hybrid of "Orleans Rose" x "Talisman". Plants are vigorous and compact and foliage is bronzy. Flowers are semi double, rose pink in colour and slightly fragrant (Poulsen, 1948).

Poulsen's Pearl : Plant growth is vigorous and tall. Leaves are light green in colour. Flowers are single and pearly pink in colour. It is a free blooming variety where flowers appear in tresses (Poulson, 1949).

Poulsen's Pink : It is a cross between "Golden Salmon" x a yellow Hybrid Tea. Plants are vigorous; foliage is light green and glossy. Flowers are fragrant, semi double, produced in clusters and pink in colour (Poulsen, 1939).

Princess Michiko : It is a cross between "Sparton" and "Circus". This free flowering variety is having bushy plant growth. Flowers are well formed and semi double in nature. Bloom colour is lovely orange red (Dickson, 1966).

Queen Elizabeth : It is a cross between "Charlotte Armstrong" and "Floradora". Foliage is dark, glossy, large and leathery. Stems are almost thornless. This variety of rose is very popular in America and classified their as Grandiflora. Variety is also known as 'Nouvelle Europe'. Plant growth is vigorous and tall. Variety is ideal for making hedge. Blooms are of medium size, double, highly centred to cupped and borne singly and in clusters on strong stems. Flower colour is soft carmine rose, dawn pink. Blooms are fragrant (Lammerts, 1955).

Red Dandy : It is a cross between "Ena Harkness" and "Karl Herbst". Plant growth is vigorous, upright, and free flowering. Bush possesses healthy foliage. Flowers have slight fragrance. Blooms are produced in large clusters. Flower colour is velvety crimson-scarlet and reverse side of petals slightly silvery (Norman, 1960).

Red Favourite : It is a cross between "Karl Weinhausen" and "Cinnabar". This variety of rose is also known as 'Hollander in', 'Sault A La Suisse' and 'Schweitzer Gruss'. This free flowering variety produces slightly fragrant flowers. The bush growth is vigorous. Plant is covered with dark green and glossy foliage. Texture of the foliage is leathery. Flowers are of medium size, semi double and are borne in tresses. Bloom colour is velvety ox-blood red (Tantau, 1951).

Red Gold : This variety of rose is also known as 'Rouge etor'. It is considered as one of the best floribunda rose, which is very striking. Plant produces very lovely buds. Bud colour is gold with red edging, produced singly or several together (Dickson, 1967).

Red Wonder : It is a cross between "Better Times" x a Polyantha seedling. Blooms are highly fragrant, cherry crimson in colour. Plants are vigorous and bushy with glossy leathery foliage (De Ruiter, 1955).

Rita : A tall plant with glossy foliage. Flowers are borne in large tresses. Flowers are double, deep pink in colour (Fryen, 1960).

Rodeo : Plants are bushy with pale green foliage. Flowers are red, with 40 petals appear in large tresses (Kordes, 1960).

Roman Holiday : This variety produces clusters of flowers during warm weather. Flowers have gay combination of orange red and flushing yellow (Lindquist, 1966).

Rumba : It is a cross between ('Poulsen's Bedder" x "Floradora") x "Masquerade". The bush growth is well balanced. Blooms are small in size. Flower colour is cherry-yellow flecked and edged bright red. Blooms appear in clusters. The small individual flowers can be used as gay button holes. It is one of the best bedding rose with compact habit and plenty of glossy foliage (Poulsen, 1959).

Sarabande : It is a cross between "Cocorico" and "Moulin Rouge". This is variety is ideal for bedding and can also be planted in front of border. It does not grow tall. Blooms are of medium size, semi double and produce freely in clusters. Flower colour is brilliant orange scarlet. It is a first class bedding rose with dwarf uniform habit (Meilland, 1957).

Saratoga : It is a winner of All-America for 1962. It produces pure white flowers. Blooms have great good keeping quality with fragrance. Cultivar is very prolific bloomer. Leaves are green and their surface is glossy. Flower looks gardenia like Floribunda (Boerner, 1963).

Scarlet Queen Elizabeth : It is a cross between "Korona" seedling x " Queen Elizabeth". Plant growth is vigorous and resembles with its parent "Queen Elizabeth" in habit of growth and foliage morphology. Blooms are produced in profusion. Flower colour is brilliant flame-scarlet. Flowers are full with globular centre and slightly fragrant (Dickson, 1963).

Scented Air : It produces superbly scented flower. Blooms are large in size and flower colour is geranium-lake. Variety is disease resistant (Dickson, 1965).

Sea Pearl : It is a cross between "Perfecta" x "Montezuma". This variety is also known as "Flower Girl". Buds are long which opens into extremely beautiful flowers. Flower colour is blend of pearly pink, peach and gold. Blooms are borne on strong and upright stems. Variety is outstanding H.T. type Floribundas (Dickson, 1964).

Sir Lancelot : It is a cross between "Vera Dalton" x "Woburn Ebbey". Plants are vigorous, medium, branching; foliages are light green matt and small. This variety produces semi double flowers in well-spaced clusters. Flower colour is an unusual apricot yellow. In cool weather flower colour tends to be in deeper shades (Harkness, 1967).

Siren : Plant growth is vigorous and compact. Leaves are leathery in texture. Flowers are semi double and are produced in large clusters. Bloom colour is scarlet red (Kordes, 1953).

Spartan : It is a cross between "Geranium Red" x "Fashion". Plants are vigorous, upright and foliages are semi glossy, small and bronze tinted. This variety is also known as "Spark". Flowers are very fragrant. Flower size is large for a Floribunda and its shape is HT type. This variety produces single flowers on a stem but occasionally clusters are also produced. Bloom colour is orange red to reddish coral (Boerner, 1955).

Summer Meeting : It is a cross between "Allgold" x "Circus". A dwarf, compact, bushy plant with glossy medium green leaves. Blooms are full, with 45 petals, yellow and borne in tresses (Harkeness, 1968).

Summer Snow : This variety produces very attractive light green leaves. Flowers are snow white in colour. Blooms are double and are produced in remarkable profusion in clusters (Perkins, 1955).

Summer Song : It is a cross between unnamed "Seedling" x "Masquerade". A dwarf variety with large glossy foliage. It bears double blooms of dazzling orange and gold in tresses (Dickson, 1962).

Summer Times : It is a cross between ("Little Darling" x "Goldilocks") x "Munchen". Plants are compact, bushy, dwarf with dark green small leaves. Flowers are deep pink, full, with 28 petals (Mc Gredy, 1971).

Sweet Repose : It is a cross between "Golden Rapture" and unnamed Floribunda "Seedling". Plants are vigorous, with leathery foliage. This variety is also known as The "Optimist". Flowers are full, medium sized with 27 petals. Blooms are maize yellow tinted carmine changing completely to carmine with age. Flowers are sweetly fragrant. (De Ruiter, 1955).

Tambourine : It is a cross between "Independence" seedling and "Karl Herbst". Plants are dwarf, bushy, vigorous with dark reddish green foliage. Flowers are H.T. Type, semi double with 18 petals, bright cherry red and yellow in colour (Dickson, 1963).

Taora : It is a cross between "unknown seedling" x "Super Star" seedling. Plants are bushy, compact, foliage are medium green and semi-glossy. Flowers are with 32 petals, borne in tresses, signal red and the reverse is cherry red (Tantau, 1968).

The People : Plants are bushy and vigorous with light green foliage. Flowers are produced in large tresses, crimson shaded deep pink, with slight fragrance (Tantau, 1954).

Tiki : It is a cross between "Mme L. Cuny" x "Spartan". This variety produces single flower in Northern India. Blooms have an extremely lovely blend of soft pink shades, and petal edges are shell pink (Mc Gredy, 1963).

Tip Top : Parentage is unknown. This variety produces blooms freely, on vigorous dwarf bushy plants. Bush is low growing. Bloom colour is salmon pink. Flowers are large, full, fragrant and borne in tresses (Tantau, 1963).

Titan : Plant growth is vigorous and it attains extra tall height. Flowers are produced in tresses. Blooms are very large and double. Flower colour is light red to crimson (Riethmuller, 1950).

Tom Tom : Plants are compact, ideal for bedding. Flowers are borne in large clusters, bright warm pink in colour (Lindquist, 1959).

Tombola : It is a cross between "Amor" x ("Ena Harkness" x "Peace"). Plants are upright, vigorous with large, glossy dark green leaves. Flowers are fragrant, deep salmon to carmine pink, shaded gold (De Ruiter, 1967).

Toni Lander : It is a cross between "Independence" and "Circus". Bush growth is vigorous and strong. Flowers are beautiful and well shaped. Bloom colour is bright salmon orange. Reverse side of petal is having lighter colour. Blooms are produced in large, well-spaced tresses on a strong stem. Blooms are full petalled and slightly fragrant (Poulsen, 1959).

Traumland : This variety of rose is also known as "Dreamland" as it is German name. (Trauma means dream in German language). Blooms are very lovely. Flower colour is soft peach (Tantau, 1958).

Travesti : It is a cross between "Orange Sensation" and "Circus". This variety is brilliant multicoloured. Plant attains low to medium height. Foliage is semi-glossy, green and small. Blooms are semi double and are well formed. Flower colour is peach flushed with cherry red, with yellow colour on the reverse side of the petal (de Ruiter, 1965).

Trivoli : It is a cross between "Paulsen's Supreme" x ("Souv. De. Claudius Denoyel" x "Hvissinge-Rose"). Plants are vigorous, tall, with dark green foliage. Flowers are medium sized, 24 petalled, produced in clusters, fragrant; warm rose pink with yellow centre (Poulsen, 1955).

Ulstar Queen : An attractive bi-colour rose, ideal for bedding, free flowering. Flowers are deep salmon pink with a paler salmon reverse (Mc Gredy, 1958).

United Nations : It is a cross between "Natalie Nypels" x "Rosamunde". A unique rose, ideal for bedding. Flowers are with 26 petals, attractive shell-pink colour, shaded in gold (Leenders, 1949).

Valentine : This variety is ideal for landscape. Bush is semi-spreading type and its growth is low and compact. Blooms appear in large tresses and their colour is fire engine red. Flowers are fragrant (Swim, 1951).

Valeta : A unique variety, with H.T. type flowers. Flowers are produced in large tresses, which are delicate orange in colour (De Ruiter, 1962).

Vera Dalton : It is a cross between unnamed seedling and "Queen Elizabeth". It is vigorous in growth and ideal for cutting. It is equally demanding for garden display. Flowers are double, well shaped and freely produced in tresses. Flowers are in shade of pink. It has dark green foliage. Blooms are moderately full and slightly fragrant (Norman, 1961).

Vesper : Parentage is unknown. Plants are vigorous and upright, foliage is dark green, tinted bronze. This variety produced flowers in small clusters that are HT Type. Bloom colour is unusual. Flower colour is burnt orange (Le Grice, 1966).

Vienna Maid : A bushy and compact variety, suitable for bedding. Flowers are H.T. type, with 30 petals, deep yellow in colour (De Ruiter, 1960).

Vilia : Plant growth is moderate and bushy, dwarf. Flowers are produced in small clusters. Blooms are pale scarlet with slight yellow as base of the petal (Robinson, 1958).

Violet Carson : It is a cross "Mme Leon Cuny" and "Sparton". Plants are vigorous branching, foliage are semi-glossy, dark green, bronze tinted. This variety is considered as one of the best and loveliest of the HT type floribundas. Flower colour is an exquisite peach and biscuit colour with a silvery reverse. Flowers are full and slightly fragrant (Mc Gredy, 1963).

Vogue : It is a cross "Pinocchio" and "Crimson Glory". Plant growth is vigorous. Flowers are beautiful double and borne in huge clusters on strong stem. Flower colour is purest pink (Boerner, 1949).

White Bonquet : A very attractive variety with plants of dark glossy foliage. Flowers are large, fragrant, sparkling white, produced singly or in clusters (Boerner, 1949).

White Pinocchio : It is a cross between "Mrs. Finch" x "Pinocchio". A very popular strongly fragrant rose. Blooms are pompon shaped, white, with 50 petals (Boerner, 1954).

Winifred Coulter : Blooms appear in huge clusters. Buds are deep carmine-pink with silvery reverse. Blooms are double. In full bloom stage flower exhibit light pinkish mauve effect (Van Barneveld, 1962).

Woburn Abbey : It is a cross between "Masquerade" x "Fashion". Plant growth is vigorous and upright. Flowers appear in tresses and are carried on strong, upright stems. Blooms are double and well formed. Flower colour is pleasing tangerine, softening into deep warm apricot (Sidey, 1961).

Yellow Hammer : It is a cross between "Poulsen's Yellow" and unnamed seedling. Ideal for bedding. A very unique yellow coloured Floribunda, which are free bloomer (Mc Gredy, 1954).

Yvonne Rabier : It is a cross between *"R. wichuraiana"* x a Polyantha. Plants are vigorous and bushy, with rich green slender foliage. Flowers are semi-double, loose, flat, medium sized produced in tresses, fragrant. Blooms are pure white and the base is slightly tinted sulphur yellow (Turbat, 1910).

Zambra : An outstanding variety, is ideal for bedding. The bush growth is strong and healthy. This sensational rose variety is floriferous in nature. Flower colour is pure orange and reverse side of the petal is bright yellow. In full bloom stage, it brightens up the garden. Flowers are semi-double, with striking colour and slight fragrance (Meilland, 1961).

Zorina : Flowers are produced in large tresses on a strong plant. Bloom colour is luminous deep orange. Flowers are Hybrid Tea type (Boerner, 1963).

MINIATURE ROSES

The miniature roses are known for many years, and rose growers are taking much interest in them. They are little flowers borne on little bushes and mostly look like Floribunda roses. These lovely little gems are fast winning their rightful place in the gardens. The blends of colours, texture, and the subtle differences in shape and form, delicate fragrance, as well as little height encourage gardeners to use them for edging

rose beds, in paved terraces, in the crevices between the slabs of paving, in the flower beds of small and big gardens, at the seashore, mountains, in pots, window boxes, hanging baskets and tubs; and also for very many uses in landscaping. Fascinating with these roses many hobbiest and commercial growers are specialising on these group of roses only. One can employ miniature roses in the gardens for various plans and patterns to arrange large number of varieties into a pleasing and meaningful picture.

Ace of Diamond : This variety is evolved as a hybrid of "Trickster" x Selected Pollen. Plant attains height up to 45-60 cm and produces clear, medium-red blooms of good form and substance on sprays of 3-5 blooms. Flowers are very fragrant. Blooms have 20-25 petals (Dennis Bridges, 1999).

Acey Deucy : This cultivar is having red blooms. Reverse side of the petals have a black underlay. It looks like H. T. type (Saville, 1983).

Air France : This cultivar is free flowering. Bloom colour is fresh morning pink (Meilland, 1982).

Amberglo : The variety is evolved as a hybrid of "Tom Brown" x "Twilight Trail". Foliage is small, dark, green and glossy. Plant growth is sturdy and bushy. Blooms are double, russet and have 34 petals. Flowers are small and very fragrant (E.Williams, 1988).

Amulette : Plant produces lovely blooms. Flowers are full with numbers of tiny petals. Bloom colour is pleasing rose pink (Tantau, 1991).

Amy Grant : The variety is evolved as a hybrid of "Loving Touch" x "White Masterpiece". Plant growth is upright. Foliage is glossy and dark green in colour. Variety is ideal for garden, exhibition and for cut flowers use. Plant attains height up to 60 cm and produces lovely light pink blooms. Flowers are of Hybrid Tea type and perfectly formed. Flower size is 3.75 cm. Blooms have 17-25 petals (Robert Tucker, 1999).

Amy's Delight : The variety is evolved as a hybrid of "Little Darling" x "Little Chief". Plant is bushy compact and its growth is symmetrical. Buds are ovoid in shape and open into intricate aestivation. Flowers are pink and borne usually singly, sometimes in groups. Blooms are very stable (Williams, 1980).

Andrea : It is considered as a miniature climber. Flowers have carmine pink on petal surface and their reverse side is silver colour (Moore, 1981).

Antique Rose : This slight fragrant variety of rose evolved as a hybrid of "Baccara" x "Little Chief". Plant growth is vigorous and upright. Buds are pointed and open to high centred medium sized flowers. Bloom colour is rose pink and it has 30-40 petals. Flowers are borne singly or sometimes-in three or more per clusters (Moore, 1980).

Apache Princess : This variety is evolved as a hybrid ("Cricket" x "Christ 78") x unnamed seedling. Foliage is medium green and semi glossy. Plant growth is medium and upright. Buds are ovoid. Flower colour is bright orange. Flowers are double and have 38 petals. Blooms are cupped, medium and borne singly. Flowers have slight fruity fragrance (J. Twomey, De Vor Nursery, 1990).

Apricot Crème : Variety is evolved as a bud sport of "Yellow Doll". Bud shape is pointed. Flower colour is light apricot, and petal edges are cream coloured. Reverse side of the petal is apricot to cream (Douglas and Judy Bell, Michigan Moni Roses, 1989).

Arizona Sunset : This variety is evolved as a hybrid of "Orange Sweetheart" x "Zinger". Foliage is small, medium green and semi glossy in nature. Variety is ever blooming. Flowers of this variety is having yellow and red blend colour. Flower appears on huge clusters and lasting long (Jolly, 1985).

Artie Sunrise : It is evolved as a hybrid of "Snow Carpet" x "Tranquility". Foliage is small, medium and green with glossy surface. Plant growth is low and spreading. Buds are pointed. Flower colour is white. Blooms are double and have 30 petals. Flowers are small, flat and borne in sprays of 40-60 (F.H.Barrett, 1989).

Autumn Splendour : Variety evolved as a hybrid of Seedling x Selected pollen. This is a most striking mini rose and attains height of 90 cm. Flower colour is brilliant yellow, gold, orange with an occasional touch of red which demand attention. Petals are reflexed and symmetrically arranged to form outstanding exhibition quality blooms. It is large in size for miniature. Bloom size is more than 5 cm. Flowers have 30-40 petals and have slight fragrance (Michael C. Williams, 1999).

Baby Blanket : This variety is a superb ground cover rose, bursting with dozen of lovely soft pink blooms. This cultivar is an exciting breakthrough for the rose gardens. Plant are free flowering and bushy (Kordes, 1993).

Baby Darling : It is a cross between "Little Darling" and "Magic Wand". Plants are bushy dwarf, foliages are glossy dark green. Flowers are small, with 20 petals, moderately full and orange-pink colour.

Baby Gold Star : It is a cross between "Edwardo Toda" x "*R.rouletti*". This variety is also known as "Baby Gold" and "Estrellita de Oro". Plant and flower size is rather longer for this class. Leaves are small and texture is soft. Flowers are semi double, open into golden yellow blooms and are slightly fragrant (Dot, 1940).

Baby Masquerade : It is a cross between "Tom Thumb" x "Masquerade". This cultivar is also known as "Baby Carnaval". Plant growth is vigorous and compact. Flowers are small, double and open free with recurrent blooming. Flower colour is lemon chrome progressing to rose red as flower matures (Tantau, 1956).

Bambino : This cultivar is a bud of sport of 'Perla de Aleanada'. Flowers are small in size. Bloom type is semi double. (Dot, 1953)

Bee's Knees : Plant growth is healthy and vigorous. Variety produces blooms of golden yellow blended pink. Flowers are attractive due to its unique colour combination (Jackie, J&P, 1988).

Bell Ringer : It is evolved as a hybrid of ("Fragrant Cloud" x "Avandel") x "Bonny". Foliage size is medium and colour is medium green. Leaf surface is semi glossy. Plant growth is bushy and upright. Flower colour is deep pink and silver at base. Blooms are small and possess 34 petals. Flowers have slight fruity fragrance. (C.Bell, Kimbrew Waller Roses, 1989).

Belle Meillandiana : This variety of rose is ever blooming. Flower colour is red vermilion (Meilland, 1983).

Bellissima : It is evolved as a hybrid of "Pink Petticoat" x "Lady Rose". Leaves

are medium green; semi glossy and plant growth is upright. Flower colour is orange red and dark along edges. Blooms are double and have 40 petals. Flowers are of exhibition quality. Flower size is medium and it is borne singly. Blooms have no fragrance (H. Zipper, Magic Moment Mini Roses, 1989).

Benson and Hedges Special : It is also known as "Dorola" and "Macshanana". This variety of rose produces shapely flowers. Bloom colour is pure gold. Flowers are non-fading in nature (Mc Gredy, 1982).

Bianco : This variety of rose is also known as "Cocablance". Plant growth is healthy and its nature is dwarf. Blooms are of good shape and form. Flower colour is white (Cocker, 1983).

Bill Cone : It is evolved as a hybrid of "Heartland" x "Anita Charles". Leaves are medium green and semi glossy. Plant growth is tall and upright. Buds are ovoid in shape. Flowers are double and medium red in colour. Blooms have 35 petals cupped, medium borne usually singly (W. Nillianes, The Rose Garden, 1989).

Billy Boy : This variety of rose is evolved as a hybrid of "Anytime" x "Happy Hour". Foliage is small, medium green, matt and dense. Plant growth is low to medium and bushy. Buds are pointed and short. Flowers are medium red. Blooms are full and have 15-18 petals, cupped, small and borne usually singly. Blooms have slight fragrance. (R.Moore, Sequoia Nursery/Moore Miniature Roses, 1990)

Birthday Party : This variety of rose produces high centred buds and flower. Flower colour is light pink. Reverse side of petal is comparatively darker in colour (Moore, 1981).

Biscay : The variety is evolved as a hybrid of "Summer Spice" x unnamed "Seedling". Foliage is medium green and semi glossy in nature. Plant growth is medium and upright. Buds are ovoid. Flowers are medium pink and its reverse side is slightly darker. Blooms are double and have 26 petals. Flowers are high centred, medium borne usually singly. Flowers are slightly fragrant (D.Bridges, Bridges Roses, 1989).

Bit O' Spring : The variety is a hybrid of "Tom Brown" x "Golden Angel". Plant growth is upright, bushy and symmetrical. Buds are long and pointed. Flowers are high centred and slightly fragrant. Bloom colour is pink with yellow- orange-buff blend. Reverse side of the petal is smoothing yellow-pink. Flowers are borne usually singly with about 45 petals (Williams, 1980).

Bit O' Sunshine : This variety of rose is profusely blooming. Foliage is healthy and bright green. Plants are dwarf and bushy. Bush growth is compact. Flowers are small and semi double in nature. Buds are shapely open to fragrant bloom. Flower colour is bright yellow (Moore, 1956).

Black Jack : This variety is evolved as a hybrid of "Tom Brown" X "Over the Rain bow". Variety is also known as "Benback" and produces flowers with deep maroon colour, which looks almost black. Blooms are shapely. Variety is free and repeat flowering (William, 1988).

Black Jade : This variety is evolved as a hybrid of "Sheri Anne" X "Laguna". It justifies the name, as blooms are closest to black. Actual colour is deep velvety blackish red. It is a free flowering variety (Barnadella, 1985).

Blue Blood : This variety is free flowering in nature and flower colour is pleasantly shaded red (Lever, 1984).

Blue Mist : It is evolved as seedling of unknown parents. Plant growth is bushy, rounded and well branched. Flowers are produced in plenty in all season. Buds are short and rounded in shape. Bloom is double and has 13-25 petals, which appears in clusters. Flowers are very fragrant. Bloom colour is soft pink -lavender. Sometimes, it is misty - blue in colour (Moore, 1970).

Blue Peter : This variety of rose is also known as "Bluenette". Variety produces lavender blue coloured blooms. Blooms are freshly produced (de Ruiter, 1984)

Bobikopf : This variety produces very descent flowers. Blooms are shapely. Flower colour is lavender pink (Tantau, 1985).

Bonny : This variety is evolved as a hybrid of "Zorina" x unnamed "Seedling". Plant growth is moderate and dwarf in nature. Blooms are globular, small and double. Flower colour is pink. Blooms are slightly fragrant (Kordes, 1974).

Boy's Brigade : This variety is also known as "Cocadikun", and it produces beautiful flowers. Flower colour is crimson. Petals have crimson colour with white eyes, which looks very attractive (Cocker, 1984).

Breezy : This variety is also known as "Savbreez". Flower colour is breezy splash of rust orange. Reverse side of the petal has yellow colour (Saville, 1984).

Bright Side : This variety is evolved as a hybrid of "Persian Princess" x "Seedling". Plant growth is bushy and upright. Buds are long and pointed. Flowers are high centred and orange red in colour. Flowers are borne singly and occasionally in clusters. They have slight fragrance. Plant growth is bushy and upright (Moore, 1974).

Button 'N' Bow : This variety is evolved as a hybrid of "Mini Poul" x "Harriet Poulsen". Flowers are beautiful. Plants are loaded with flowers during blooming period. Flower colour is medium pink. Flowers usually borne singly or in small spray. Variety is popular through out the world due to its fast and repeat flowering behaviour in every climate (Poulsen, 1981).

By Joe : Blooms are borne singly. Leaves are medium and dark green. Plant growth is tall and bushy. Buds are pointed. Flower colour is ivory white. Blooms are double with 25 petals. Flowers are high centred and medium (Joe Getty, and Keith Keppel, 1990).

Cachet : It is evolved as a hybrid of "Seedling" X "Seedling". Blooms are long lasting and their size is 5 cm. Plant attains height up to 90 cm and its growth is upright. Foliage is medium green in colour. Blooms are formed perfectly (Robert Tucker, 1999).

Carmen Papandrea : This cultivar of rose evolved as a bud sport of "Magic Carrousal". Flower colour is deep pink (J. Papandrea, 1988).

Carolina Morning : This variety is evolved as a hybrid of "Rise 'n' Shine" x "Rainbow's ed". Foliage is small, medium green, and semi glossy. Plant growth is medium and bushy. Buds are pointed. Flower colour is red with yellow centre, ageing to red. Blooms are double, high centred, small and have 20 petals. Borne singly and in sprays of 4-7 (M.William, The Rose Garden, 1990).

Cart Whell : Originated as a hybrid seedling of "Libby" x unnamed "Seedling". Foliage is medium green and matt. Plant growth is low and bushy. Buds are ovoid in shape. Flower colour is red and white picotee. Blooms have 20 petals. Flowers are cupped, small, borne singly and have slight fragrance (W. Warriner, 1990).

Castle Hill : This variety is evolved as a hybrid of "Sheri Anne" x "Red Devil". Foliage is medium green and semi glossy. Variety is highly mildew resistant. Plant growth is low and bushy. Buds are pointed. Flowers are deep pink with mauve under tone; shading is lighter towards the base. Flowers are double and have 25 quilled petals. Blooms are high centred and are of exhibition type. Borne usually singly and in sprays of 2-3 (H.Zipper; 1990).

Center Piece : This variety is free flowering in nature. Flower colour is deep velvety red. Blooms are shapely (Saville, 1981).

Chasin Rainbows : It is evolved as a hybrid of "Zorina" x "Rainbow's End". Foliage is small, dark green and semi glossy. Plant growth is bushy low and very compact. Buds are ovoid; flowers are very brilliant yellow, edge red with scarlet becoming more prominent when blooms open. Flowers have 21 petals, high centre and are of exhibition quality. Small flowers are borne singly and in spray of 23-24 or more. Blooms have slight spicy fragrance (F. Flarmon Saville, 1988).

Checkers : This variety of rose is evolved as a hybrid of "Deep Purple" x "Happy Hour". Foliage is small, medium green and semi glossy. Plant growth is low and bushy. Buds are pointed. Flowers are medium red, ageing darker. Blooms are semi double with 20 petals. Blooms are high centred and are borne singly. Flowers have slight, spicy fragrance (Lauren Chaffin, 1990).

Chick-a-Dee : This variety is evolved as a hybrid of "Cecile Brunner" x ["Dortmund" x "Fairy Moss"] x ("Little Darling" x "Ferdinand Pichard"). Foliage is small, medium green, matt to semi-glossy. Plant growth is bushy, low and compact. Buds are pointed. Flowers are medium pink with occasional white stripes. Reverse side of the petal is similar. Blooms are double and have 50 petals. Flowers are high centred, exhibition type and borne usually singly or in sprays of 3-9. Flowers have slight fragrance (R.Moore, 1990).

Child's Play : This variety is free flowering in nature. Flowers are ivory white and edge of the petals is deep pink. Blooms are lovely and shapely (Saville, 1993).

Chipper : It produces beautiful blooms, which are coral to rose red in colour (Meilland, 1966).

Cho Cho Centinial : It is evolved as a hybrid of "Rise 'n' Shine" x "Grand Opera". Plant produces blooms in clusters. Flower colour is light pink. Flowers are lasting in big clusters and repeat flowering in nature (Jolly, 1980).

Church Mouse : It is evolved as a hybrid of "Angle face" x "Plum Duffy".. Foliage is large, medium green and matt. Plant growth is bushy and compact. Buds are pointed. Flower colour is tan brown with yellow at the base, aging light lavender brown. Blooms are double and possess 20 petals. Blooms are urn shaped, loose, and large borne usually singly and in spray up to 3 flowers. It has moderate sweet fragrance (B. Jacobs, 1989).

Cinderella : It is a cross between "Cecile Brunner" x "Peon". Plant growth is upright. This variety of rose is having thornless stem. Blooms are small and double. Flower colour is satin white. Edge of the petal develops pale pink colour (de Vink, 1952).

Cindy : It produces full double blooms. Flower colour is deep purple pink (William, 1984).

Confection : Evolved from a cross of unnamed "Seedling" x unnamed "Seedling". Foliage is medium sized and dark green in colour. Plant growth is low and bushy. Buds of this variety are ovoid and pointed. Flower colour is pink with yellow to cream base. Blooms are double and have more than 100 petals, high centred to flat. Flower size is medium, borne usually singly and in spray of 2-3. Blooms have slight fragrance (W. Warriner, 1988).

Coral Sprite : It is evolved as a hybrid of "Mere's" x "Party Girl". Leaves are of medium size and green in colour. Plant growth is low, spreading and bushy. Buds are ovoid and pointed. Bloom colour is medium pink. Flowers are double, urn shaped, medium and borne in sprays to 3-18. Blooms have the fragrance (W. Warriner, 1989).

Coralin : It is a cross between "Mephisto" x "Perla de Alcanada". This variety is also known in different names such as "Carolin", "Carolyn" and "Karolyn". Plants are dwarf, foliage and semi-glossy light green, bronze-tinted, abundant. Blooms are small and well shaped. Flowers are beautiful and double in nature. Bloom colour is red orange (Dot, 1955).

Cotton Tail : This variety produces pompom shaped flowers. Blooms appear in clusters form. Flower colour is white (Strawn, 1983).

Cream Puff : This variety is hybrid of "Little Darling" x "Elfinesque". Plant has bushy growth. Buds are ovate in shape and opens into decorative blooms, which are semi double. Flowers are borne singly. This variety is an excellent bloomer and produces creamy colour with delicate blush in blooms. Cream colour of the blooms turns white with age and the blush spreads over the petals, pink blend (Bennet, 1980).

Crème Glacee : It is a cross between "June Laver" x "Summer Butter". Leaves are small and medium green. Plant growth is bushy. Buds are pointed. Bloom colour is light yellow. Flowers are double and have 2-3 petals. Blooms are small, urn shaped and borne singly. Flowers have fragrance (K. Laver, 1990).

Cricket : This variety produces well-formed flowers. Bloom colour is bright orange (Armstrong, 1972).

Cricri : It is a cross between ("Alain" x "Independence") x "Perla de Alcanada". Plants are dwarf, very bushy and foliage is leathery. Flowers are small and double. Variety is profusely blooming. Flower colour is salmon shaded coral (Meilland, 1957).

Cuddles : It is evolved as a hybrid of "Zorina" x "Seedling". Plant produces flower of coral pink colour. Blooms are double in shape. Flowers are long lasting and repeat flowering in nature (Schwartz, 1978).

Cufe Ote : This cultivar of rose is evolved as a sport of "Winter Magic". Foliage is large, medium green and dull to semi-glossy. Plant growth is vigorous, upright and

tall. Buds are pointed. Flowers are russet, very double and have more than 50 petals. Blooms are cupped, medium to large and borne singly or in sprays of 3-5. Flowers have moderate spicy fragrance (R.Moore, Sequoia Nursery, 1990).

Cup Cake : This variety is evolved as a hybrid of "Gene Boerner" x ("Gray Princess" x "Yellow Jewel"). The variety produces blooms of high centre. Flowers are double. Bloom colour is non-fading and clear pink (Spies, 1981).

Cutie Pie : It is evolved as a hybrid of "Tangerine Mist" x "California Girl". Leaves are small, dark green and glossy. Plant growth is low and bushy. Buds are ovoid. Flower colour is light to medium yellow. Blooms are double and have 23 petals. Flowers are small, borne singly and in sprays of 2-3. Blooms have moderate fruity fragrance (B.F. Rennie, 1989).

Daniella : This variety produces shapely blooms. Flowers are full and double, and colour is light rose pink (Kordes, 1987).

Darling : Buds are pointed and blooms are small and double. Flower colour is orange to orange-pink (Moore, 1964).

Day Glow : It is evolved as a hybrid of "Petticoat" x "Red Jewel". Leaves are dark green and medium in size. Plant growth is low. Buds are ovoid and pointed. Bloom colour is deep pink and changed its colour to lighter due to fading. Blooms are double and have 60 petals. Flowers are high centred to flat, medium borne usually singly. Blooms have slight fragrance (W.Warriner, 1988).

Dazzler : This variety is evolved as a hybrid of "Rainbow's End" x " Kristin". Plant produces beautiful cineraria like flowers. Blooms appear in huge clusters on bushes. Flower colour is dark pink with a prominent white centre (Kelley, 1997).

Dee Bennett : It is evolved as a hybrid of "Zorina" x "Sheri Anne" x ("Yellow Jewel" x "Tamango"). Leaves are medium, dark green and glossy. Plant growth is medium and bushy. Bloom colour is yellow and orange and becomes orange yellow in full bloom stage. Flowers are double and have 25 petals. Blooms are high centred, medium, borne singly and in sprays of 3-8. Flowers have slight fruity fragrance (F.Harmon Saville, 1989).

Deep Velvet : It is evolved as a hybrid of "Grand Opera" x "Jimmy Greaves". Plant is bushy and its growth is compact. Buds are high centred and urn shaped. Bloom colour is dark red velvet. Flowers are slightly fragrant, borne 2-3 per clusters on single stem. Flowers have 30-32 petals (Jelly, 1981).

Dian : Plant growth is vigorous, bushy and a free bloomer. Leaves are small, dark green and their surface is glossy. Growth habit is bushy. Flowers are small in size. Blooms are double and have fragrance, colour is light red (Moore, 1951).

Don Marshall : This variety produces shapely flower. Flower colour is rich red and reverse side of the petal is comparatively darker in colour (Moore, 1983).

Double Bubble : The variety is also known as "Jacpoly", and produces flowers singly in clusters. Blooms are cute pink in colour (J and P, 1996).

Dream Glow : It produces full blooms in good form. Flower is bicolour and looks very attractive. Bloom colour is bright red and white (E.D.Williams, 1978).

Dru : This variety produces blooms of exhibition quality. It repeats flowering. Flower colour is deep yellow. (Hunt, 1985)

Due Meillandiana : It is also known as "Melperyld". Blooms are lovely and shapely. Flower colour is neyron rose pink (Meilland, 1986).

Dusty Rose : It is evolved as a hybrid of "Amy Vanderbilt" x "Cecile Brunner". Variety is disease resistant. Plant growth is sturdy and upright. Buds are pointed open to full high centred blooms. Flowers are double and have 40-50 petals. Flower colour is reddish-purple. Blooms are borne singly with occasional side bud. Flowers have spicy fragrance and last long on bush. Bloom quality is of exhibition type (Morey, 1974).

Dwarf King : It is a cross between "World's Fair" and "Tom Thumb". This variety is also known as "Zwergkonig". It is a profusely blooming variety. Flowers are borne singly and in clusters. Leaves have glossy surface. Plant growth is compact. Flowers are double and their size is small. Bloom colour is carmine (Kordes, 1955).

Dwarf Queen : This plant is similar to that of "Dwarf King" but the colour is different. This variety produces flowers that are double in nature. Bloom colour is a lovely shade of soft rose pink (Kordes, 1955).

Earth Quake : This variety is also known as "Morquare". Beauty of this variety is appreciated, as no two flowers are alike. Flowers have revolutionary colour, i.e. exciting blend of red and yellow stripes (Moore, 1983).

Eleanor : It is a cross between (*R.wichuraiana* x "Floradora") x (seedling x "Zee"). Plants are vigorous, dwarf, upright and foliages are glossy and medium green. Blooms of this variety are small in size, and double. Bloom colour is coral pink. Flower colour changes and becomes darker as they age. Flowers are very attractive (Moore, 1960).

Elfin Charm : This variety is evolved as a hybrid of ("R.wichuraiana" x "Floradora") x "Fiesta Gold". Plant growth is bushy, compact rounded and healthy. Variety is easy to propagate. Buds are short pointed and open into full double blooms. Flowers have up to 65 petals. Blooms are rosette of 15-20, small petaloid around pistil. Flower colour is pink. Blooms have sweet fragrance. Flowers are borne in clusters (Moore, 1974).

Emjay Skiba : This variety is evolved as a hybrid of "Sonia" x "Pink Petticoat". Foliage is large, dark green edged red and semi glossy. Plant growth is tall and bushy. Buds are pointed. Flower colour is medium pink and outer petals are lighter. Blooms are double and have 45 petals. Flowers are high-centred, exhibition type, large and borne usually singly. Flowers have moderate fruity fragrance (N.A.Skiba, 1990).

Endless summer : It is evolved as a hybrid of "Paul Shirville" x "California Dreaming". Leaves are small, dark green and semi glossy. Plant growth is low and bushy. Buds are pointed. Flower colour is shrimp pink and reverse side of the petal is light pink. Blooms are double and possess 33 petals. Flowers are high centred, small, borne singly and have slight fragrance (B.F. Rennie, 1989).

Ernie : It is evolved as a hybrid of "Blue Nile" x "Blue Mist". Buds are ovoid and flower colour is light mauve. Plants are tall and its growth is bushy and upright. Leaves are medium green and semi glossy. Blooms are double and have 48 petals and are urn

shaped, medium, borne occasionally, singly or in sprays of 6-12. Flowers have moderate fruity fragrance (De Bennett, 1989).

Evelyn Rogers : It is evolved as a hybrid of "Tom Brown" x "Over the Rainbow". Foliage is small, medium green and glossy. Plant growth is upright and bushy. Flower colour is medium pink. Blooms are double and have 34 petals. Flowers are small. Blooms have slight fragrance (E. Williams, 1988).

Fairhope : Evolved as a hybrid of "Azure Sea" x unnamed seedling. Leaves are of medium size, green and have semi glossy surface. Plant growth is medium and bushy. Buds are pointed. Flower colour is light yellow, blooms have 22 petals. Flowers are high centred and are of exhibition type. Bloom size is medium and it's borne singly. Flowers have slight fragrance (Peta and K. Taylor, 1989).

Fairlane : This variety of rose produces double flower. Bloom colour is apricot yellow (Schwartz, 1981).

Fairy Changeling : This variety of rose evolved as hybrid of "The Fairy" x "Yesterday". Variety is also known as "Hamumerose". Flowers are of rosette type and appear in clusters. Flower colour is rose pink to magenta (Harkness, 1981).

Fairy Gold : This variety of rose produces well-formed flowers in great abundance. Flower colour is golden bronze (Fryer, 1992).

Fairytale : This variety of rose produces highly appealing flowers in clusters on bush. Plant growth is vigorous. Flower colour is rose pink. It is highly appealing. Blooms are formed freely (J& P, 1993).

Fancy That : This variety of rose is evolved as a hybrid of "Rise 'N' Shine" x "Rainbow's End". Foliage is medium green and semi glossy. Plant growth is medium, upright and spreading. Buds are pointed. Flower colour is different shades of pink. Reverse side of the petal is pink yellow blend. Blooms have 68 petals. Flowers are high centred, exhibition type, medium borne, usually singly and in sprays of 3-5. Blooms have slight spicy fragrance (M. Jolly, 1989).

Finger Print : It is evolved as a hybrid of "Orangeade" x "Little Artist". Foliage is medium green and have semi glossy surface. Plant growth is low to medium, spreading and bushy. Buds are short and pointed. Flower colour is orange blend, yellow base with light yellow reverse. Flower colour turns yellow to white with ageing. Flowers are semi double and have 12-14 petals, borne usually single and in sprays of 3-5 (R.Moore; Sequoia Nursery/Moore Miniature Roses, 1990).

Fire Princess : This variety of rose produces very attractive blooms. Flower colour is bright orange (Moore, 1969).

Floranne : It is originated as a bud sport of "Crazy Dottie". Foliage is dark green glossy and dense. Blooms are of exhibition quality. Flowers are medium yellow with a distinct red circle at the base of the flowers and classic single presentation opens quickly and holds its colour well (Florence Pratt, 1999).

Free Gold : This variety is very beautiful; the flower colour is deep yellow blend (Mc Gredy, 1983).

Fringette : This variety has very attractive foliage. Flowers are small in size and double, colour varies from pink to rose pink (Moore, 1964).

Frosty : It is an outstanding miniature rose, with good perfume. It has vigorous growth, compact and has spreading habit. Leaves have glossy surface. It is a profusely blooming variety. Flowers are very small and borne in clusters. Blooms are double and their colour is white (Moore, 1953).

Funny Girl : It is also known as "Jae Fun" and it produces excellent flowers that are very pretty. Flower appears in abundance. Blooms are clear pink in colour (J&P, 1981).

Gentleman's Agreement : This variety is originated as hybrid of "Purple Dawn". Blooms are large and cherry red in colour. It is of exhibition quality. Flowers appear on tall plants. Foliage is dark green in colour and disease resistant. Usually blooms singly. Flower size is 3.25-5 cm. Flowers have 38-40 petals. Blooms have slight fragrance (Dennis Bridges, 1999).

Ginny : This variety is evolved as a hybrid of Little "Darling" x "Toy Clown". Plant growth is compact, upright and symmetrical. Buds are high centered and HT like. Blooms open into flat flower. Petals are white edged in red-yellow tinge and borne singly (Bischoff, 1981).

Glimmer : It is evolved as a hybrid of "Party Girl" x unnamed seedling. Foliage is medium green and semi glossy. Plant growth is medium and upright. Buds are pointed. Flower colour is bright, medium red, yellow at base; reverse side of the petal is slightly darker. Blooms are double and have 24 petals. Flowers are high centered, exhibition type, medium, borne singly. Blooms are slightly fragrant (D.Bridges, Bridges Roses, 1989)

Glori Glo : The variety is bicolour. Flower is double; bloom colour is lovely orange and yellow (Williams).

Glory : It is evolved as a hybrid of ("Arther Bell" x "Orange Honey") x "Baby Diana". Foliage is small and medium green. Plant growth is low and bushy. Buds are pointed. Flower colour is bright orange yellow. Blooms are bicolour, double with 24 petals. Flowers are high centred, exhibition type, medium and borne singly (G. King, 1989).

Gold Fever : It is evolved as a hybrid of ("Sheri Anne" x "Gold Badge"). Plant growth is medium, upright and bushy. Buds are pointed. Flower colour is medium yellow, ageing lighter. Blooms are double and have 50 petals. Blooms are cupped and exhibition type. Medium blooms are borne usually singly or in spray of 3-5. Flowers have spicy fragrance (R.Moore, 1990).

Golden Angle : It is a hybrid of "Golden Glow" x unnamed seedling. . Bush growth is compact, rounded and spreading. Variety produces excellent cut flowers. Buds are pointed and short. Flower is double and has fragrance, colour is yellow. Flowers are long lasting. Blooms appear on stem singly and several together (Moore, 1975).

Golden Century : This variety is evolved as a hybrid of ("*Rosa wischuraiana*" x "Floradora') x ("Sister Therese" x miniature seedling). It is a climbing rose. Plant produces hundreds of gold yellow buds that open into nice flowers. Flowers are fragrant. It is a repeat flowering variety (Moore, 1978).

Golden Gardens : This variety is evolved as a hybrid of "Little Darling" x ("Yellow Magic") x "Gold Bedge". Foliage is medium green and semi glossy. Plant growth is upright. Buds are ovoid. Flower colour is bright, clear, medium yellow and their reverse side is slightly lighter. Blooms are double and have 28 petals. Flowers are cupped, medium, borne in sprays of 3-5 (R.Moore, 1989).

Goldlite : It is evolved as a hybrid of unnamed seedling x "Excitement". Foliage is medium, dark green and semi glossy. Plant growth is tall and upright. Buds are urn shaped. Flowers are canary yellow and the reverse side of the petal is buttercup yellow. Bloom is double and it possesses 29 imbricate petals. Flowers are medium, borne usually single. Blooms have slight must fragrance (S.Marciel, De Vor Nursery, 1989).

Granate : It is also known as "Granata". Blooms are small in size. Flower colour is velvety-deep-red. Blooms have often white streaked on petal surface, which looks more attractive (Dot, 1947).

Green Diamond : It is a hybrid of unnamed seedling x "Sheri Anne". Plant growth is bushy, healthy and upright. Variety produces blooms repeatedly until frost. Buds are medium long and pointed. Blooms are double, colour is dusky pink, changing to soft green. Flowers are long lasting and it is excellent for arrangements (Moore, 1975).

Green Ice : This variety produces attractive blooms, colour is pure white or pale green and it turns pale cream after full bloom stage (Moore, 1975).

Guiding Spirit : It is evolved as a hybrid of ("Blue Moon" x unnamed seedling) x "Little Prince". Foliage is small, dark green and semi glossy. Plant growth is low and bushy. Buds are ovoid. Flower colour is deep pink and its reverse side is lighter. Blooms are double and have 22 fluted petals. Blooms are flat, medium, borne in sprays of 3-9. Flowers have slight fragrance (R.Harkness, 1989).

Happy Trails : This variety is also known as "Jaccasps". Flower colour is bright pink and it appears in cascading clusters on stem. It blooms all through the season. Variety is ideal for hanging baskets or for window boxes (Warriner and Zary, 1993).

Harvander : It is evolved as a hybrid of "Clarissa" x (unnamed seedling x "Mozart"). Buds are pointed. Foliage is small, medium green and semi glossy. Plant growth is low and bushy. Flower colour is pale rose pink and reverse side is same. Blooms are double and have 85 thin petals. Blooms are rosette, medium, borne in sprays of 3-15. Blooms are slightly fragrant (R. Harkness, 1989).

Harvee : This variety is evolved as a hybrid of "Clarissa" x ["Wee Man" x ("Southampton" x "Darling Flame")]. Foliage is small, medium green and semi glossy. Plant growth is low and bushy. Buds are urn shaped. Flower colour is blood red with yellow base. Reverse side of the petal is same, ageing orange, carmine. Blooms are double, rosette and medium. Flowers have 25 long petals. Blooms are borne in 3-9 sprays. Flowers are slightly fragrant (R.Harkness, 1989).

Heart Breaker : It is evolved as a hybrid of "Crystalline" x "Magic Carrousal". Foliage is small, dark green and glossy. Plant growth is vigorous, upright and bushy. Buds are pointed. Flower colour is deep pink with white base. Blooms are high centered, exhibition type, small and borne in sprays of 3-5. Flowers have slight fragrance (T. Carruth, 1990).

Heather Leigh : Evolved as a hybrid of unnamed seedling x "Azure Sea". Foliage is medium green and semi glossy. Plant growth is bushy, medium and upright. Buds are pointed. Flower colour is medium pink, reverse slightly darker in shade. Blooms are double and have 38 petals. Flowers are high centred, exhibition type, medium, borne singly (P. K. Taylor, 1989).

Heavenly Days : This variety produces double and shapely flowers. Bloom colour is lovely apricot and yellow (Saville, 1937).

Hoddy Toddy : This variety is evolved as a hybrid of ("Alain" x "Seamp") x "Seamp". Foliage is small and medium green. Plant growth is low and bushy. Buds are pointed. Flower is dark red and petal tips are darker. Blooms are double and have 28 petals. Blooms are cupped, small and borne singly and in sprays of 2-3 (G.King, 1989).

Hollie Roffey : This variety produces dainty flowers. Bloom shape is rosette and its colour is warm rose pink (Harkness, 1986).

Hombre : It produces flowers of good quality. Flower colour is beautiful shade of pink and it always remains in blooms (Saville, 1982).

Home Coming : It is evolved as a hybrid of "Tiki" x "Party Girl". Foliage is medium green and semi glossy. Plant growth is tall and upright. Buds are pointed. Flowers are medium pink with slightly darker petal edges. Blooms are double with 35 petals. Flowers are high centred, medium, borne usually singly (M.William, 1989).

Honey Bunch : This variety produces flowers in clusters. Lovely blooms of honey yellow look very attractive in full bloom stage (Union, 1991).

Honey Comb : It is a hybrid of ("*R. wichuraiana*" x "Floradora") x "Debbie". Plant is bushy, rounded and have high growth. Buds are pointed and ovoid. Blooms are full and high centered, borne in clusters. Colour of buds is soft yellow (honey colour) turns near white as bloom ages. Flowers have moderate fragrance. Variety blooms freely and repeats all season (Moore, 1974).

Honey Hill : This variety produces flowers having reflexed petals. Flower colour is honey yellow to apricot (Hill, 1989).

Hot Tomale : It produces beautiful flowers and very free flowering variety. A blend of growing yellow base and reverse side makes the flowers attractive (Zany, 1994).

Hula Girl : This variety produces vibrant flowers of vivid orange (Moore, 1974).

Hullabaloo : It is evolved as a hybrid of "Rise n' Shine" x unknown seedling. Foliage is small, medium green in juvenile stage ageing to maroon. Leaf surface is semi glossy. Plant growth is low and bushy. Buds are pointed. Flower colour is light orange or yellow with yellow reverse, ageing to dull yellow blend. Flowers are double and have 20 petals. Blooms are urn shaped. Blooms are small borne in sprays of 2-3. Flowers have moderate fragrance (Lou Stockyard, 1990).

Ice Fairy : This variety produces flowers in masses. Blooms appear in huge clusters, and size is tiny. Flower colour is ice white (Sandey, 1984).

In the mood : It is evolved as a hybrid of "Rise 'n' Shine" x unnamed seedling. Foliage is medium green and semi glossy. Plant growth is bushy. Flower colour is yellow

streaked pink. Blooms are double and it has 20 petals. Flowers are small and slightly fragrant (Sean. Mc Cann, 1988).

Inner Glow : It is evolved as a hybrid of "Ann Moore" x "Rainbow's End". Foliage is medium green and semi glossy. Plant growth is medium and bushy. Buds are ovoid. Flower colour is red with golden yellow base, yellow reverse and red veining towards outer edges. Blooms are double and have 40 petals. Flowers are high centred and exhibition type (L. Chaffin, 1991).

Innocent Blush : It is evolved as a hybrid of "Paul Shirville" x "Party Girl". Foliage is medium green. Plant growth is medium and upright. Buds are ovoid. Flowers are pale bluish pink and reverse side is white. Blooms turn white with ageing. Blooms are double and have 40 petals. Flowers are high centred, exhibition type and medium in size. Blooms are borne usually singly and in sprays of 5-7 (B.F. Rennie, 1990).

Ione : Buds are ovoid. Flower colour is white with pale yellow centre. Foliage is medium green and semi glossy. Plant growth is medium and bushy. Blooms are double and have 50 petals. Flowers are of exhibition type, medium and borne singly and in sprays of 2-5. Blooms have slight fragrance (P. Jerabek, 1990)

Irish Heartbreaker : It is evolved as a hybrid of "Rise n' Shine" x ("Oonagh" x "Siobhan"). Foliage is medium green and semi glossy. Plant growth is upright. Flower colour is red blend. Blooms are full and have 26-40 petals. Flower size is small. Blooms are slightly fragrant (Sean Mc Cann, 1989).

Ivory Palace : This variety produces flowers of good form and produces large number of flowers, which appear in clusters. Flower colour is ivory white (Moore, 1991).

Jama : It produces beautiful flower, colour is blend of deep pink and white (Moore, 1970).

Janice Tellian : This variety is a profuse bloomer. Buds open into blooms of pink colour (Moore, 1930).

Jeane Lajoie : This variety is evolved as a hybrid of "Casa Blanca" x "Independence". It is a climbing miniature. Blooms are double and well formed. Flowers have 40 petals. Flower colour is pink. Blooms have hint of fragrance (Sima, 1975).

Jeannine Michelle : It is evolved as a hybrid of "Rise 'n' Shine" x unnamed seedling. Foliage is medium green and semi glossy. Plant growth is upright, bushy, medium and hard. Buds are pointed. Flower colour is deep gold yellow, ageing to pale yellow. Blooms are double with 30 petals. Flowers are high centred, exhibition type, medium in size and borne usually singly and in sprays of 2-5. Flowers have moderate, fruity fragrance (M.Frock, 1989).

Jennifer : It produces fragrant flowers, colour is pale porcelain pink and reverse side of petal is white (Bernadelle, 1985).

Jenny Robinson : It produces flower of glistening bright yellow and red colour, which turns deep with age (Robinson, 1988).

Jet Trail : This variety is evolved as a hybrid of "Little Darling" x "Magic Wand". It produces double flowers. It is a repeat flowering variety. Bloom colour is white (Moore, 1984).

Jim Dandy : This variety is evolved as a hybrid of "Rise 'n' Shine" x "Marina". Leaves are medium, green and have glossy surface. Plant growth is medium, upright and bushy Buds are pointed. Flower colour is medium red and reverse side is yellow flashed red and gets lighter while ageing. Blooms are high centred, exhibition type, medium and borne usually singly and in sprays of 3-5, slightly fragrance (F.Benardella, 1989).

Jitter Bug : This variety is a free bloomer and produces blooms of bright vermilion orange. Reverse side of petal is white. Blooms are well shaped (J&P, 1993).

Juliet Anne : It produces full and lively blooms. Flower colour is primrose yellow. Flower shape is rosette and their size is good. Blooms have plenty of petals. Entire plant is covered by blooms and looks very beautiful (Harkness, 1990).

Kaikura : It produces blooms, which are very attractively displayed on plants. Flower colour is bronze scarlet red (Mc Gredy, 1930).

Keely : It is evolved as a hybrid of "Party Girl" x unnamed seedling. Foliage is green, medium in size and have semi glossy surface. Plant growth is medium and bushy. Buds are pointed. Blooms are bright, orange-red and its reverse side is slightly darker. The colour fades while ageing. Blooms are double and have 20 petals. Flowers are high centred, exhibition type, medium and are borne usually singly (D. Bridges, 1989).

Lady in Red : It is evolved as a hybrid of "Rise 'n' Shine" x "Siobhan". Leaves are small, medium green and have semi glossy surface. Plants have bushy growth. Flower colour is red with touch of white at base of petals. Blooms are double and have 15-25 petals. Flowers are small and slightly fragrant (S.Mc Cann, 1988).

Lavalier : It is evolved as a hybrid of "Loving Touch" x ("Honest Abe" x unnamed seedling). Foliage is small, medium green and disease resistant. Plant growth is low bushy and prolific. Buds are rounded. Flower colour is deep mauve pink and its reverse side is medium pink. Blooms are double and have 50 petals. Flowers are cupped, small and borne singly (K. Laver, 1989).

Lavaluck : This variety is evolved as a hybrid of "Blueblood" x "Julie Ann". Foliage is small, medium and green. Plant is disease resistant. Buds are pointed. Flower colour is vivid, deep, cherry pink, ageing to fuchsia. Blooms are double and have 28 petals. Blooms are urn shaped, small, borne singly and have no fragrance (K. Laver, 1989).

Lavamaze : It is evolved as a hybrid of "Loving Touch" x "Pot Luck". Foliage is small, medium green to red in colour. Plant is disease resistant. Plant growth is bushy and low. Buds are ovoid. Flower colour is light pink with deeper centre. Reverse side of the petal is light pink. Blooms are double and have 80 petals. Flowers are of exhibition type, full, small and borne singly. Flowers have moderate fragrance (K. Laver; 1989).

Lavaway : This variety of rose is evolved as a hybrid of "Tabris" x "June Laver". Leaves are small and dark green in colour. Plant is disease resistant. Plant growth is bushy, low and compact. Buds are ovoid. Flower colour is ivory and reverse side is white. Complete flower changes into ivory to white with ageing. Blooms are double and have 55 petals. Blooms are urn shaped, small, borne usually singly. Flowers have slight fragrance (K. Laver, 1989).

Lavbound : It is evolved as a hybrid of "June Laver" x "Black Jade". Foliage is

medium green and has glossy surface. Plant is disease resistant. Plant growth is low, bushy and upright. Buds are pointed. Flower colour is coral to orange-pink, outer petals are pink -apricot in colour and reverse side is pink with yellow base. Blooms are double with 53 petals Flowers are high centred, exhibition type, medium and borne singly (K. Laver, 1989).

Lavender Jade : This variety produces beautiful lavender mauve blend blooms. Flowers are lasting. Blooms are shapely and free (Bernadella, 1987).

Lavender Jewel : It is evolved as a hybrid of "Little Chief" x "Angel Face". The variety is repeat flowering type and produces blooms of exhibition quality. Flowers are produced in abundance. Bloom colour is Lavender (Moore, 1978).

Lavender Star : It is evolved as a hybrid of unnamed seedling x "Lavender Simplex". Foliage is small, dark green and semi glossy in nature. Plant growth is upright bushy and dense. Flower colour is mauve blended lavender-tan. Blooms are singly and possess 5 petals. Flowers are small and very fragrant (E. Williams, 1989).

Lavjoy : This variety is evolved as a hybrid of ("Moulin Rouge" x unnamed seedling) x "Party Girl". Foliage is small, medium green and disease resistant. Plant growth is low and upright. Buds are pointed. Flower colour is blush pink edged deeper pink. Reverse side of the petal is white. Blooms are double and have 22 petals (K. Laver, 1989).

Lavlemo : It is evolved as a hybrid of "Dorola" x "Genevieve". Foliage is small, medium and green. Buds are ovoid. Flower colour is lemon yellow. Blooms are deeper in centre. Flower is double and possesses 28 petals. Blooms are high centred, medium, borne usually singly (K.Laver, 1989).

Lavmoth : This variety is evolved as a hybrid of "Breezy" x "June Laver". Leaves are small, medium green and glossy. Plant growth is bushy, upright, strong and low. Buds are pointed. Flowers are light orange in centre with pink outer petals. Reverse side of the petal is pink with yellow base. Blooms are double and have 33 petals. Flowers are high centred, exhibition type, small and borne singly. Flowers have moderate fragrance (K. Laver, 1990).

Lavtrek : It is evolved as a hybrid of "June Layer" x "Genevieve". Foliage is small, dark green and disease resistant. Plant growth is low, compact and upright. Buds are pointed. Flowers are rich, deep yellow, reverse side is medium yellow. Blooms are double and possess 45 petals. Flowers are of exhibition type, small, borne singly with moderate fragrance (K. Laver; 1989).

Lemon Twist : This variety is evolved as a hybrid of "Gold Badge" x "Great Day". Foliage is medium green and glossy. Plant growth is medium and bushy. Buds are pointed. Flower colour is deep yellow. Blooms are double and possess 25 petals. Flowers are high centred, exhibition type, medium, borne usually singly or one spray of up to 3. Flowers have slight tea fragrance (B. Jacobs, Four Seasons Rose Nursery, 1988).

Libby : The variety produces white flowers that look very attractive. A tinge of pink colour is nicely bordered on the petal edges (Saville, 1981).

Little 't' : It is evolved as a hybrid of "Cinderella" x unnamed seedling. Foliage is small and medium green. Plant growth is bushy. Buds are pointed. Flower colour is

white tinged pale pink and reverse side of the petal is white. Blooms are double and possess more than 50 petals. Flowers are cupped, small, borne in sprays of 4-6 blooms (L. Travis, 1989).

Little Artist : This variety produces beautiful flowers that look like hand painted colour on petal surface. Petal surface is crimson splashed with white colour. (Mc Gredy, 1986)

Little Buckaroo : It is a cross between (*R. wichuraiana* x "Floradora") x ("Oakington Ruby" x "Floradora"). Plants are vigorous and foliage is leathery, bronzy and glossy. Blooms are lovely and bright. Flower colour is velvety-red (Moore, 1956).

Little Eskimo : The variety produces very attractive flowers. Blooms appear in clusters. Flower colour is white. It is free flowering (Moore, 1981).

Little Flirt : It is a cross between (*R. wichuraiana* x "Floradora") x ("Golden Glow" x "Zee"). Plant growth is vigorous. Flowers are double and small in size. Blooms are borne in clusters. Flower colour is orange-red. Reverse side of petals have yellow colour which gives striking effect (Moore, 1961).

Little Lemmy : It produces shapely buds and flowers, the colour is lemon yellow (Kordes, 1988).

Little Prince : This variety produces multicoloured flowers. Flowers are bright orange red and yellow. Petals look very attractive and add beauty to the flower (Cocker, 1983).

Little Sizzler : It is evolved as a hybrid of unnamed seedling x "Funny Girl". Foliage is large, dark green and semi glossy. Plant growth is bushy and medium. Buds are ovoid and pointed. Flower colour is medium red and it has 38 petals. Blooms are cupped, large, borne usually singly and in sprays of 16-20 (W.Warriner, 1989).

Little Sunset : This variety produces very attractive flowers, which are produced in clusters. Bloom shape is star like. Flower colour is salmon pink on yellow background, which is very prominent on petal surface (Kordes, 1967).

Little Tease : This variety evolved as a hybrid of "High Spirits" x "Charmglo". Foliage is small, medium green and semi glossy in nature. Plant growth is bushy and compact. Flower colour is yellow to cream; base suffused with clear pink, darker at the edges, exhibition type. Blooms are small in size and borne singly (H. Zipper, 1989).

Little Tiger : It is evolved as a hybrid of "Golden Angel" x "Pinstripe". Buds are short and pointed. Foliage is small and medium green. Plant growth is bushy and round. Flower colour is red, yellow and white stripes of varying patterns. Reverse side of the petal is more yellow, with age it turns to white, red and pink. Blooms are double and have more than 90 petals. Flowers are high centred, medium, borne singly or in sprays of 3-5 (R. Moore, 1989).

Little Tommy Tucker : This variety is evolved as a hybrid of "Rise 'n' Shine" x "Captivation". Plant is bushy and blooms continuously. Foliage is medium green in colour and disease resistant in nature. Flowers are mini and its colour is yellow. It is excellent for borders or any place. Flowers have 17-25 petals, which is double in nature (Robbie Tucker, 1999).

Lollipop : It is a cross between (*R. wichuraiana* x "Floradora") x " Little Buckaroo". This variety has vigorous growth habit. Plant is bushy and produces bright red flowers, which looks very beautiful and attractive. Flowers are full, small, with 30 to 40 petals and slightly fragrant (Moore, 1959).

Lovely Fairy : This cultivar is evolved as a bud sport of 'The Fairy'. Flower colour is deep pink. Plant growth is compact. It produces enormous numbers of blooms. Variety has repeat flowering habit (Moore, 1983).

Loving Touch : The variety produces exhibition quality of blooms. Flower quality is excellent. Beautiful apricot colour buds appear on stem and open into beautiful blooms (Jolly, 1983).

Luis Desamero : The leaves are medium green and semi glossy. Bush growth is tall and upright. Buds are ovoid. Flower colour is pastel yellow. Blooms are double and have 28 petals. Flowers have high centred, exhibition type, medium in size and borne usually singly and in sprays of 3-5. Flowers have slight fruity fragrance (Dee Bennett, 1988).

Lynne Gold : This variety of rose is evolved as a hybrid of "Elten Poulsen" x "Yellow Jewel". The variety produces thornless plants. Buds are tiny and pointed. The variety is free flowering in nature. Plant produces rich yellow flowers (Moore, 1983).

Macmillan : It is evolved as a hybrid of "Sea Spray" x "Wanaka". Plant growth is low and bushy. Buds are ovoid. Flower colour is light salmon pink and reverse side is lighter. Blooms are double and it has 23 petals. Flowers are cupped, small, borne in sprays of 20-25. Blooms are slightly fragrant. Leaves are small, medium green and semi glossy (S. Mc Gredy, 1989).

Maids of Jubilee : This variety is evolved as a hybrid of "Azure Sea" x unnamed miniature seedling. Leaves are medium, dark green and semi glossy. Plant growth is medium, upright and bushy. Buds are pointed. Flowers are bright deep pink with cream base. Reverse side of the petal is a blend of cream and pink. Blooms are double and have 28 petals. Flowers are high centred, exhibition type, medium in size and borne singly (Pete & K. Taylor, 1989).

Maidy : It produces bicolour flowers that are very attractive. Primary flower colour is dark red (Kordes, 1984).

Majorette : This variety is evolved as a hybrid of "Magic Carrousel" x ("Grumby x "Seariella"). Plants have healthy green foliage, which are lustrous. Stems are strong and straight. Wonderful flowers are produced which are cardinal red in colour. Bloom colour is weather proof in most of the climate. Repeat bloom cycle is fast and takes about 23 days (Meilland, 1986).

Mandarin : This variety produces multicoloured flowers and the colour is mandarin orange and yellow. Flowers last for a long time and are double in nature (Kordes, 1987).

Marica : This variety of rose is evolved as a bud sport of "Ginza Komachi". Flower colour is pink, reverse side of the petal is white (Yoshito Kono, 1989).

Marilyn : The plant attains medium height and its growth is compact. The variety

is named in remembrance of a lovely person, the plant is also equally charming. Flowers are borne in clusters. Bloom size is small and its nature is double. Flower colour is deep pink (Dot, 1955).

Maud Nunn : It is evolved as a hybrid of "Rose 'n' Shine" x "Rose 'n' Shine". Foliage is medium green with semi glossy surface. Plant growth is bushy and medium. Buds are pointed Flower colour is creamy yellow and changes into lemon yellow with ageing. Flowers are semi double and have 46 petals. Blooms are high centred, loose, small and borne in sprays. Blooms have slight fragrance (W.E. Driscoll, 1988).

Maurine Neuberger : This variety is evolved as a hybrid of ("Prominent" x "Zinger") x "Centerpiece". Foliage is medium and green. Plant growth is average and upright. Buds are pointed. Flower colour is medium red. Blooms are double and have 30 petals. Flowers are high centred, exhibition type, medium and borne singly. Blooms have slight fragrance (R. Spooner, 1989).

Meillandiana : It produces shapely blooms, flower colour is sparking current red (Meilland, 1976).

Merit : This variety is evolved as a hybrid of ("Prominent" x "Zinger") x unnamed seedling. Leaves are small, dark green and semi glossy. Plant growth is low and bushy. Buds are pointed. Flower colour is brilliant orange and yellow at base. Reverse side is yellow. Blooms are double and have 17 petals, high centred, exhibition type, small and borne singly. Flowers have no fragrance (R. Spooner, 1989).

Merrimac : This variety is evolved as a hybrid of ("Alain" x "Scamp") x "Lilli Marker". Foliage is medium and green in colour. Plant growth is medium and upright. Buds are pointed, flower colour is dark red, and petal tips are deeper. Flowers have 18 petals. Blooms are high centred, exhibition type, medium and borne usually singly and in sprays of 2-3. Blooms have slight fruity fragrance (G. King, 1989).

Midget : It is evolved from a famous "Ellen Poulsen" and "*R. peon*" cross. This variety is unique in its foliage morphology. It produces fern like leaves. It forms a round bushy plant. Stem is short and thorn less. Plant is dwarf. Flowers are small and double in nature. Blooms have slight fragrance. Flower colour is carmine red and have white eye (de Vink, 1940).

Mimi : Plant growth is vigorous and bushy. Flower size is small, double and their colour is light red (Dot, 1947).

Minnie Pearl : The variety produces shapely flowers. Bloom colour is light pink. Flower colour deepens with age (Saville, 1983).

Miss Daisy : It produces large number of flowers. Blooms are full, pretty yellow and their colour is sunny bright (J&P, 1991).

Miss Perfect : This variety is evolved as a hybrid of "Over the Rainbow" x "Lavender Lace". Leaves are medium, green and semi glossy. Plant growth is low and spreading. Buds are ovoid and pointed. Flower colour is light pink to nearly white which can be seen at edge of the petals. Reverse side of the petal is lighter. Flowers are double and have more than 60 petals. Blooms are cupped, medium, and borne in sprays of 25-35 blooms. Flowers are slightly fragrant (W. Warriner, 1989).

Miss Valentine : The variety produces full and attractive blooms, the colour is bright rich red in colour (Moore, 1976).

Mollie Claire : This variety of rose is evolved as a hybrid of ("Evelyn Fison" x "Magic Mist") x "Baby Diana". Foliage is small and medium green. Plant growth is low and bushy. Buds are pointed. Flower colour is white with pink edge blushing towards centre, reverse side is white tipped with pink, and with ageing it turns to picotee. Blooms are double and have 28 petals. Flowers are high centred, exhibition type, small and borne singly. Flowers have no fragrance (G. King, 1989).

Moon Light and Roses : It is evolved as a hybrid of unnamed seedling x unnamed seedling. Its parentage is not known. Plant attains height up to 65 cm. Foliage is dark green and glossy. Flower colour is mauve blend. Blooms are of exhibition type and have rich lavender with a cherry red overlay. Blooms are borne on long stem. Flower size is 3.5 cm. and number of petals varies from 30 to 35 in a bloom (Dennis Bridges, 1999).

Mother's Love : It is evolved as a hybrid of "Futura" x "Party Girl". Foliage is medium green and semi glossy. Plant growth is medium, bushy and upright. Buds are ovoid. Flower colour is pastel pink blending to soft yellow at base. Blooms are double and have 23 petals. Flowers are high centred, exhibition type, medium, borne singly or in spray of 3-5, and have slight fruity fragrance (Dee Bennett, 1988).

Naughty Patricia : Evolved as a hybrid of "Rise 'n' Shine" x "Red Gold". Foliage is large and medium green. Plant growth is tall and upright. Flower colour is medium pink. Blooms are double and have 29 petals. Outer petals are quill shaped. Blooms are large and of exhibition type. Borne usually singly and in clusters of 3-5. Flowers have slight fruity fragrance (Jack M. Bilson, JR.& Jack M. Bilson, 1989)

New Adventure : It is evolved as a hybrid of "Sheri Anne" x "Safrano". Leaves are small and medium green. Plant growth is medium, bushy and upright. Buds are pointed. Flower colour is creamy white. Blooms are double and have 25 petals, flat, medium, borne singly and in sprays of 3-5 (R. Moore, 1989).

New Beginning : The variety produces bright hot orange colour and reverse side of the petals have yellow colour. Buds are of show quality and flowers are bright and full (Saville, 1989).

New Hope : This variety of rose is evolved as a hybrid of "Party Girl" x unnamed seedling. Foliage is medium, dark green and semi glossy. Plant growth is medium and bushy. Buds are pointed. Flower colour is creamy white with slight pink edge. Blooms have 19 petals high centred, exhibition type, medium, borne usually singly (D. Bridges, 1989).

New Penny : It is a cross between *R.wichuraiana* x "Floradora" x unnamed seedling. This variety of rose produces lovely flowers, which are attractive. Bloom colour is orange red to coral pink (Moore, 1962).

Nickelodeon : It is evolved as a hybrid of "Roller Coaster" x [("Freude" x {"Anytime" x "Eye paint"} x "Stars 'n' stripes")]. Foliage is small, dark green and semi glossy. Plant growth is bushy. Blooms are red in colour, semi double and have 6-14 petals, small and have slight fragrance (S. Mc Gredy, 1989).

Night Hawk : This variety is evolved as a hybrid of "Quinella" x "Poker Chip". Foliage is medium green. Plant growth is medium bushy and upright. Buds are globular and pointed. Flower colour is medium red. Blooms are double and have 22 petals. Flowers are high centred, medium and borne singly and in sprays of 3-5, are heavy and have damask fragrance (D. Hardgrove, 1989).

Night Music : It is evolved as a hybrid of "Tamango" x "Pink Petticoat". Foliage is large green and semi glossy. Plant growth is upright. Flower colour is deep pink. Blooms are double and have over 40 petals. Flower sizes are medium, borne singly and in sprays, and are very fragrant (H. Zipper, 1989).

Old Glory : This variety is evolved as a hybrid of "Rise 'n' Shine" x "Harmonie". Variety is considered as top class miniature. Flower colour is medium red and yellow bicolour. Blooms are very pretty and large, and are free flowering variety (Benardella, 1988).

Olive Taylor : Flower colour is vermilion red with yellow edge. Foliage is medium, dark green and glossy. Plant has bushy growth. Blooms are double and have 20 petals. Flowers are small and have slight fragrance (C.A. Pearce, 1988).

Olympic Gold : It produces yellow blooms, which are very beautiful. Petal edges are comparatively lighter in colour (Tolly, 1983).

Orange Honey : Variety produces orange coloured blooms, which looks very attractive due to presence of different shades of orange (Moore, 1980).

Orange Jewel : This variety produces flowers, which are double and have many tiny petals. Blooms are full and have bright orange red colour (Kordes, 1987).

Pace Setter : It is evolved as a hybrid of "Ma Perkins" x "Magic Carousal". The variety produces flowers, which are perfect in nature. Buds are long and pointed, colour is pink white. It is a repeat flowering variety (Schwartz, 1979).

Pallas : Plant produces very attractive shiny pointed little leaves. This little rose is very delightful. Flower colour is a combination of apricot and peach mixture of shades (Harkness, 1989).

Perla de Alcanada : It is a cross between "Perla de Rouges" and *R.roulettii*. Plants are bushy upto 30 cm tall. Foliages are light green and glossy. Flowers are carmine red in colour (Sr. Dot, 1944).

Perla De Montserrat : It is a cross between "Cecile Brunner" and "*Rosa roulettii*". Plant attains medium in height. Foliage is matt, light green and plenty. Blooms are double in nature. Fully open flower exhibits pink colour. Petal edge is pink with creamy colour blend (Dot, 1945).

Petite Four : This variety produces tiny flowers, which appear in clusters. Flower colour is clear pink (Lisink, 1982).

Phoenix : It is ever blooming, and flowers are very bright and cheerful. Bloom colour is ruby red which are decorated with golden centres (Harkness, 1989).

Pink Cascade : This variety of rose evolved as a hybrid of (*Rosa wichuraiana* x "Floradora") x "Magic Dragon". This is a climbing miniature. Blooms are cascading pink in colour (Moore, 1981).

Pink Mandy : It is evolved as a hybrid of "Ellen Poulsen" x "Little Chief". Plant is low, bushy and somewhat spreading. Growth is healthy and it is a disease resistant variety. Variety is a continuous bloomer and very free flowering. Buds are rounded and open full to double blooms. Flowers are borne in clusters and their colour is fuchsine-pink (Moore, 1974).

Pink Symphonic : This variety produces beautiful rose pink flowers. Plant growth is vigorous and robust. Blooms appear in superb clusters. Flowers are shapely. Variety is ever blooming and produces flowers of lasting quality (Meilland, 1987).

Pink Wheel : This variety is evolved as a hybrid of Seedling x Unnamed seedling, parentage is unknown. Flower colour is pink and white blend resembling a dogwood bloom. It blooms profusely, most borne one to a stem. Flower diameter is 5 cm. Petals curl tightly in final stage and then fall clearly away. Petals are five and form a circle. Plant attains height upto 55 cm. Blooms have light spicy fragrance (Jerry Justice, 1999).

Pink-a-Ling : This variety is evolved as a hybrid of "Tamango" x "Avandel". Foliage is medium, dark green and glossy. Plant growth is upright. Flower colour is white and petal edges are deep pink. Blooms are double and have more than 40 petals. Flowers are small and are borne singly in sprays. Blooms have slight fragrance (H.Zipper, 1989).

Pixie : It was raised from the "Ellen Poulsen" and *R.peon* cross. This variety of rose is also known as "Princesita" and "Little Princess". It is profusely blooming. The tiny pink buds are borne in clusters, amidst lace like foliage. Plant growth is compact and its habit is dwarf. Blooms are small, double and slightly fragrant. Flower colour is white and its centre is faint pink. Stem is soft and short (De Vink, 1940).

Platinum Lady : This variety is evolved as a hybrid of unnamed "Lavender" seedling x "Lavender Jade". Foliage is small and dark green. Young foliage edges are red. Leaf surface is semi glossy. Plant growth is medium, bushy and upright. Buds are pointed. Flower colour is light lavender and reverse side is white. Blooms are double and have 21 petals. Flowers are high centred, exhibition type, borne singly and slow to opening (K. Laver, 1990).

Plum Dandy : It produces informal form of blooms. Plant growth is compact. Flowers are quite large and tidy, blooms are rich plum in colour (J & P, 1991).

Poker Chip : It is evolved as a hybrid of "Sheri Anne" x ("Yellow Jewel" x Seedling of "Tamango"). It produces bicolour blooms. Flower colour is scarlet and yellow. Blooms are beautiful. Variety is repeat flowering type (Saville, 1979).

Portland Dawn : It is evolved as a hybrid of "Rise 'n' Shine" x ("Copper Pot" x "Maxi"). Foliage is small, medium green and semi glossy. Plant growth is bushy. Flower colour is veined pink and bronze. Blooms are small double and have 20 petals. Flowers have slight fragrance (S. Mc Cann, 1988).

Potluck Red : This variety is evolved as a hybrid of "Breezy" x "June Laver". Foliage is small and dark green. Young leaves have red edges. Plant growth is low and upright. Buds are pointed. Flower colour is deep red. Flowers are double and have 35 petals. Blooms are compact, full, small and borne singly (K. Laver, 1989).

Pour Toi : It is a result of crossing of "Edouardo Toda" with *Rosa roulettii*. This

variety of rose is also known as 'Para Ti', 'For You' and 'Wendey'. It is one of the best of all the miniatures. Plant is very bushy. Leaves have glossy surface. Flower colour is white and its base is tinted yellow. Flowers are borne on long graceful stem and are excellent for cutting (Dot, 1946).

Presumida : This variety is also known as 'Baby Talisman', 'Peter Pan' and 'La Presumida'. A most attractive rose of dwarf size with dark green foliage. This is free blooming cultivar. Blooms are small and double in nature. Flower colour is rich apricot orange and its centre is yellowish (Dot, 1948).

Pride 'N' Joy : This variety of rose is having well-rounded growth. Lots of colourful blooms are produced on a plant. Flower colour is glowing orange with a tinge of yellow (Warriner, 1992).

Prince Charming : Plant growth is dwarf. A tiny gem of a plant upto 22cm tall. Foliage has tinted red colour. Blooms are small and double in nature. It produces attractively coiled buds. Flower colour is bright crimson (De Vink, 1953).

Prince Meillandiana : This variety is evolved as a hybrid of "Padrador" x "Mogral". The variety is also known as 'Red Sunblaze', 'Prince Sunblaze' and 'Meirutred'. It produces flowers of long lasting quality. Blooms continuously adorn the plant. Bloom colour is deep velvety red. Flower appears in compact bunch. It is a repeat flowering variety (Meilland, 1988).

Prom Date : This variety is evolved as a hybrid of "Sheri Anne" x (unnamed seedling x "Fairy Moss"). Plant growth is medium, bushy and upright. Buds are short and pointed. Flower colour is deep pink which turns lighter with ageing. Blooms are double with 38 petals. Flowers are globular, medium and borne singly. Blooming is profuse (R.Moore, 1989).

Puppy Love : This variety produces excellent blooms. Flower colour is pink, yellow and orange blend. Blooms are showy and very attractive (Schwartz, 1978).

Rainbow Cerise : This variety is evolved as a hybrid of "Scarlet Sunblaze" x unnamed seedling. Foliage is medium, dark green and glossy. Plant growth is medium and bushy. Buds are tapering and slender. Flower colour is deep pink. Blooms are double with 45 petals. Flowers are cupped, medium borne singly and have slight fruity fragrance (S. Marciel, 1989).

Rainbow Eclipse : It is evolved as a hybrid of "Scarlet Sunblaze" x unnamed seedling. Leaves are dark green and semi glossy. Plant growth is medium and bushy. Buds are pointed. Flower colour is crimson pink. The centre of flower is very light whitish pink. Fading to white with ageing. Blooms are double and have 40 imbricate petals. Flowers are medium and borne singly. Blooms have slight fragrance (S. Marciel, 1989).

Rainbow End : It produces Hybrid Tea type blooms, the colour of flower is bright yellow with scarlet (Saville, 1984).

Rainbow Hot Pink : It is evolved as a hybrid of "Orange Sunblaze" x unnamed seedling. Foliage is small, dark green and semi glossy. Plant growth is medium and bushy. Buds are long and urn-shaped. Flower colour is deep pink. Blooms are double and have 35 imbricate petals. Flower is small and borne singly (S. Marciel, 1989).

Rainbow Pink : This variety is evolved as a hybrid of "Orange Sunblaze" x unnamed seedling. Foliage is medium, dark green and semi glossy. Plant growth is medium and bushy. Buds are pointed. Flower colour is deep pink. Blooms are double with 32 whorled-imbricate petals. Flowers are small, borne singly and have slight spicy fragrance (S. Marciel, 1989).

Rainbow Red : It is evolved as a hybrid of "Scarlet Sunblaze" x "Rumba". Foliage is dark green and glossy. Plant growth is medium and bushy. Buds are pointed. Flower colour is medium red. Blooms are double and have 32 flat imbricate petals. Blooms are small, borne singly. Flowers have slight spicy fragrance (S. Marciel, 1989).

Rainbow Stanford : It is evolved as a hybrid of "Candia" x unnamed seedling. Foliage colour is dark green and glossy. Plant growth is medium and bushy. Buds are pointed and slender. Flower colour is bright red orange. Blooms are semi double and have 15 imbricate flattered petals. Blooms are medium, borne singly and have slight fragrance (S.Marciel, De Vor Nursery, 1989)

Rainbow Sunrise : This variety is evolved as a hybrid of "Amber Flash" x "Rumba". Foliage is small, medium green and glossy. Plant growth is medium and bushy. Buds are pointed. Flower colour is orange with a tinge of red, ageing turns to a pleasant pink tone. Blooms are double with 18 imbricate petals. Flowers are small, borne singly and have slight spicy fragrance (S. Marciel, 1989).

Rainbow Yellow : This variety is evolved as a hybrid of unnamed seedling x "Amber Flash". Foliage is medium green. Plant growth is medium and bushy. Buds are pointed and urn shaped. Flowers are tangerine orange and turn light with age. Blooms are double and have 55 imbricate petals. Blooms are small and borne singly. Flowers have fruity fragrance (S. Marciel, 1989).

Raspberry Ice : It is evolved as a hybrid of "High Spirit" x "Charmglo". Foliage is medium dark green and semi glossy. Plant growth is medium and bushy. Flower colour is white brushed with red. It is deeper at petal edges. Blooms are double and have 40 petals (S.Marciel, 1989).

Raspberry Sunblaze : This variety is evolved as a hybrid of ("Meiji Katar" x "Meirutral") x Rumired. Plant attains height up to 70 cm. Blooms are double in nature and their colour is raspberry pink. Flower colour is vibrant against deep green foliage on a dense and compact structure. Variety is easy to grow in gardens. Flower size is 3.5 cm in size and it has 35 petals (Meilland, 1999).

Razmatazz : It produces flowers in clusters. Flower colour is smoky orange to lovely coral rose that are very attractive (J& P, 1981).

Red Ace : It produces dark velvety red flowers. Blooms are very beautiful and eye catching (Saville, 1980).

Red Cascade : This variety is evolved as a hybrid of (*Rosa wichuraiana* x "Floradora") x "Magic Dragon". It is having spread growth habit. It is a climbing miniature rose. Flowers are full. Bloom colour is cherry velvet red (Moore, 1976).

Red Elf : This variety is also known as 'Elf'. Blooms are small in size and double. Flower colour is dark crimson in full bloom stage (de Vink, 1949).

Red Rascal : It produces HT type blooms. Flower colour is bright red and blooms have good petalage (J&P, 1988).

Red Tag : Blooms of this variety is double, flower colour is velvety red. Reverse side of petal is white in colour. Flower appearance is very charming (Williams, 1979).

Red Wagon : It is evolved as a hybrid of "Little Darling" x "Little Chief". Plant growth is vigorous and its habit is bushy. Buds are pointed and blooms appear on stems, 1-3 or more per clusters. Flower colour is bright orange- red (Moore, 1980)

Renny : This variety is evolved as a hybrid of "Anytime" x "Renace". Foliage is medium green. Plant growth is low, bushy and upright. Buds are pointed. Flower colour is medium rose pink and its reverse side is lighter. Blooms are double and have 25 petals. Flowers are old fashioned, medium and borne in sprays of 3-7,and have moderate fragrance (R. Moore, 1989).

Rise 'N' Shine : This variety is evolved as a hybrid of "Little Darling" x "Yellow Magic". Variety produces double flowers. Bloom colour is deep yellow. Flowers have 35 petals (Moore, 1977).

Robin : It is a cross between "Perla de Montserrat" and "Perla de Alcanda". This dwarf variety of rose is free bloomer. Plant growth is vigorous and bushy. Leaves have leathery foliage. Flowers are borne in clusters and very free flowering. Blooms are small in size, 60 to 70 petals, double in nature. Flower colour is dark red (Dot, 1956).

Rose Marin 89' : This variety produces attractive blooms, flower colour is pink. Blooms are of lasting quality (Kordes, 1989).

Rosina : It is a cross between "Eduado Toda" and *R.rouletti.* This variety is also known as 'Josephine Wheatcroft' and 'Yellow Sweetheart'. Plant is dwarf and its growth is compact. It is a profusely blooming variety, and well shaped. Double flowers are borne in clusters. Leaves are light green and have glossy surface. Flower colour is golden yellow (Dot, 1951).

Rosmarin : This variety is very attractive among the miniature cultivars. Flower colour is lovely lighter pink and centre of the flower has deep pink colour (Kordes, 1965).

Royal City : It is evolved as a hybrid of "Goldmare" x "Pink Sheri". Buds are ovoid. Foliage is medium green and semi glossy. Plant growth is tall and upright. Flower colour is dark red. Blooms are double and have 23 petals. Blooms are urn shaped, exhibition type, medium, and borne singly (B.F.Rennie, 1990).

Salmon Sunblaze : This variety is evolved as a hybrid of "Meichanso" x ("Meilarco" x "Korwerk"). Plant attains a medium height of 45 cm. Foliage colour is deep olive green satin which provides a perfect contrast to the glorious blooms. Flower colour is freshly grilled salmon. Flower size is 3.5 cm. and it has 35 petals (Meilland, 1999).

Sassy Lassie : It produces bicolour blooms, which looks very attractive, flower colour is red and yellow (Williams 1988).

Savacop : This variety is evolved as a hybrid of "Acey Deucy" x "Rainbow's End". Foliage is medium dark green and semi glossy. Pant growth is upright, medium and with angular growth. Buds are pointed. Flower colour is coppery orange, flushed orange red,

reverse side is medium red. Blooms are double and have 21 petals. Flowers are high centred, exhibition type, long, pointed, medium borne in sprays of 3-15. Blooms are slightly fragrant (F. Harmon Saville, 1988).

Scarlet Gem : This variety is also known as 'Scarlet Pimpernel'. Plant growth is bushy. It is free blooming cultivars. Blooms are small and cupped. Flower colour is orange -scarlet (Meilland, 1961).

Sea Breeze : It produces blooms of medium pink with a hint of yellow, which is very prominent on petal surface. Flowers look attractive at full bloom stage (Lamnow, 1978).

Sequoid Gold : It produces fragrant, yellow flowers. Plants are low growing, prolific bloomers (Moore, 1987).

Sgt. Pepper : Plant growth is vigorous, compact and upright. Blooms are very bright, lustrous orange red. This cultivar is free flowering (Kordes, 1993).

Shelly Renee : This cultivar is a bud sport of 'Spice Drop'. Flower colour is salmon pink and its reverse side is peach. Colour changes from light pink to white with ageing (F.H.Saville, 1989).

Shine On : This variety is a repeat flowering type. Blooms appear in huge clusters or single, and long lasting. Flower colour is superlative bright orange pink (Dickson, 1994).

Short Cake : It is also known as 'Keibelme', which is bicolour. It is very sweet variety. Plant growth is upright. Plants bear flowers in single and also in clusters. Flower colour is bright red and white (Keisel, 1991).

Shy Girl : This variety is evolved as a hybrid of "Petticoat" x "Red Minimo". Foliage is medium, dark green and semi glossy. Plant growth is spreading, low and upright. Buds are ovoid and pointed. Flower colour is white. Blooms are very double and have 80 petals. Flowers are high-centred, medium, borne usually singly and in sprays of 2-4. Flowers are slightly fragrant (W.Warriner, 1988).

Silver Phantom : It is evolved as a hybrid of "Shocking Bluce" x "Angel Glo". Foliage is dark green and semi glossy. Plant growth is bushy, upright and tall. Buds are pointed. Flowers are silver lavender. Blooms are double with 33 petals. Flowers are high centred, exhibition type, large, borne usually singly and have slight licorice fragrance (B.F. Rennie, 1989).

Silver Tips : Plant growth is vigorous and bushy upto 22 cm tall and one of the best of all miniatures. Buds are pointed and open into small double flowers. Flower colour is pink and reverse side of the petals are silvery. Flower colour turns soft lavender in full bloom stage and as it attains ageing (Moore, 1961).

Simple Simon : Plant is very dwarf upto 15cm tall. It produces clusters of camellia like blooms. This variety produces double flowers. Flower colour is lovely rose pink with white shading which is very prominent on petal surface. The colour provide a pleasing contrast (de Vink, 1955).

Sitting Pretty : Plant growth is bushy and compact. Variety is hardy and disease

resistant. It is free flowering cultivar. Blooms are shapely. Flower colour is soft peach pink (Bernet, 1986).

Small Miracle : It is very free blooming type. Buds are lovely and blooms are shapely in nature. Flower colour is pure white with crimson (J&P, 1993).

Smoky Mountain : It is evolved as a hybrid of "Black Jade" x unnamed seedling. Foliage is dark green and semi-glossy. Plant growth is medium and upright. Buds are pointed. Flower colour is deep mauve. Blooms are double and have 24 petals. Flowers are high centred, exhibition type, medium and borne singly. Blooms have slight fragrance. (D.Bridges, 1989).

Snow Carpet : It is evolved as a hybrid of "New Penny" x "Temple Bells". It produces high quality flowers, and is a repeat flowering variety. Flower colour is pure white (Mc Gredy, 1980).

Sonnenkind : This variety produces golden yellow flowers. Blooms are full and compact (Kordes, 1986).

Springwood Gold : This variety is evolved as a hybrid of "Rise 'n' Shine" x "June Laver". Foliage is small, medium green and semi glossy. Plant growth is medium, upright and bushy. Buds are pointed. Flower colour is deep, buttery yellow, reverse side is lighter. Blooms are double and have 20 petals. Flowers are high centred, exhibition type, medium, borne usually singly. Blooms have slight fragrance (K. Laver, 1989).

Star Trail : It is also known as 'Meideuver'. Its parentage is unknown. The variety produces golden yellow flowers edged and veined colour of petal is orange red (Meilland, 1976).

Starina : This variety is considered as one of the outstanding among miniature roses. Plant growth is very healthy and vigorous. Flowers are full, perfect and their colour is oriental red. Reverse side of petal has golden colour. Flower colour is very striking and attractive (Meilland, 1965).

Stars 'N' Stripes : This variety is evolved as a hybrid of "Little Chief "x ("Little Darling" x "Ferdinand Pichard"). Variety is repeat flowering and has bicolour flowers. Flower colour is uniquely striped with red and white (Moore, 1975).

Strawberry Delight : This variety is evolved as a hybrid of "Little Darling" x "California Dreaming". Foliage is medium, dark green and semi glossy. Plant growth is medium and spreading. Buds are pointed. Flower colour is white with pink freckles; reverse side is white with pink edges. Blooms are double with 28 petals. Flowers are high centred, exhibition type, medium, and borne singly (B.F. Rennie, 1990).

Strawberry Swirl : It is evolved as a hybrid of "Little Darling" x seedling of miniature rose. Plant produces multicoloured flowers. Petals are striped blend of red, pink and white which looks very attractive (Moore, 1978).

Sugar Elf : Evolved as a hybrid of (*R. Wichuraiana* x "Floradora") x "Debbie". Plant growth is bushy. Buds are pointed and medium to long in size. Flower colour is pink and gold blend and changes to deeper pink with ageing before petal falls. Blooms are slightly fragrant (Moore, 1974).

Sun Hit : This variety is also known as 'Poulsen'. It is very colourful and produces amazing number of blooms. Flower colour is bright yellow to apricot yellow and its lovely bright shade makes it more attractive (Poulsen, 1994).

Sun Maid : It produces lovely flowers, blooms are bright golden yellow in colour with orange shade (Kordes, 1975).

Sun Smile : This variety is evolved as a hybrid of "Spanish Sun" x "Cal Gold". Plant growth is bushy, spreading, compact and vigorous. Buds are ovoid. Flower colour is medium yellow. Blooms are double and have 48 petals. Flowers are high centered, medium, borne singly and in sprays of 2-3. Blooms have slight fragrance. Foliage is medium green and semi glossy. (W. Warriner, 1989).

Sun Splash : It is evolved as a hybrid of "Rise 'N' Shine" x "Sun Flare". Foliage is medium green, very glossy and attractive. Plant growth is tall, upright and spreading. Buds are ovoid and pointed. Flower colour is deep yellow, ageing to pale yellow. Blooms are double and have 43 petals. Flowers are cupped, high centred, exhibition type, borne in sprays of 18-21. Blooms have slight fragrance. (W. Warriner, 1989).

Sunday Brunch : This variety is also known as 'Mordey,' and produces cream to soft yellow coloured flowers that look very attractive due to their changing colours. After full bloom stage flower changes its colour to pink (Moore 1974).

Sweet Butterfly : It is evolved as a hybrid of ("Dwarf King" x "Baby Katie") x ("Small Slam" x "Mountie"). Foliage is medium green. Plant growth is low and bushy. Buds are rounded. Flower colour is mauve pink. Blooms are semi double and possess 12-15 petals. Flowers are flat, pointed, open, loose, medium, star like form and borne singly, and have heavy fragrance (K. Laver, 1989).

Sweet Caroline : It is evolved as a hybrid of seedling x selected pollen. Plant growth is slightly spreading which spread 60 cm to 82 cm. Buds are long pointed and open slowly to beautiful, high centred exhibition quality flowers. Plant blooms continuously. Usually one bloom per stem is produced. Flower size is 3.5 cm and it has 20-25 petals (Michael, C. Williams, 1999).

Sweet Fairy : It is a seedling from "Peon". Foliages are light green, pointed and matt. Plant growth is dwarf, plant are free flowering. Leaves are small and dark green. Blooms are very small, and sweetly scented. Flower colour is apple-blossom pink (de Vink, 1946).

Sweet Petite : This variety is also known as 'Fryxquisite'. Plant shape is rounded and growth is healthy. It is the most exquisite miniature and looks very pretty. Flower colour is salmon pink. Variety is ever blooming and produces shapely well formed and long lasting flowers (Fryer, 1994).

Sweet Raspberry : It produces well-shaped flowers. Bloom colour is raspberry pink (Jolly, 1984).

Sweet Symphonie : It is also known as 'Debut' and 'Mebbanke'. Blooms are full and well formed, double and ever blooming and long lasting. Flowers are slightly fragrant; colour is glorious blended with wide edged red, which is very prominent on petal surface (Meilland, 1988).

Swinger : It produces shapely flowers with reflexing petal edges. Plant growth is spreading type with multitude of lovely flowers spread on the stem tips. It is ever blooming. Flower colour is deep yellow turning slightly paler at full bloom stage (Jolly, 1984).

Ta Ta : It is evolved as a hybrid of "Tom Brown" x "Over the Rainbow". Plant growth is bushy. Flower colour is medium pink. Blooms are double and have 33 petals. Blooms are small and have no fragrance. Foliage is medium green, semi glossy and dense (E. Williams, 1988).

Tampa Bay : This variety is evolved as a hybrid of ("Arthur Bell" x "Orange Honey") x "Baby Diana". Foliage colour is medium green. Plant growth is medium and upright. Buds are pointed. Flower colour is orange and edges ageing darker. Blooms are double and have 18 petals. Flowers are high centred, exhibition type, medium, borne singly and have slight fruity fragrance (G. King, 1988).

Tattletale : It is evolved as a hybrid of "High Spirits" x "Charmglo". Foliage is small, dark green and semi glossy. Plant growth is compact and bushy. Flower colour is deep pink. Blooms are double and possess 33 petals, flowers are small, borne singly and in sprays (H. Zipper, 1989).

Tear Drop : This variety is also known as 'Dicomo'. It is a hybrid of "Pink Spray" x "Bright Smile". Foliage is small, medium green, and glossy. Plant growth is bushy. Flower colour is white. Blooms are semi double and have 6-14 petals. Flowers are flat, small and slightly fragrant (P. Dickson, 1989).

Teeny Bopper : This variety is evolved as a hybrid of "Little Squirl" x unnamed seedling. Foliage is small, medium green and semi glossy. Plant growth is bushy. Buds are ovoid. Flower colour is white with red blush on outer petals, ageing red with white at base. Flowers are semi double, cupped, loose, borne singly. Blooms have slight damask fragrance (Dee Bennett, 1988).

The Garden Editor : It is evolved as a hybrid of "Gold Badge" x "Yellow Jewel". Foliage is small, medium green and glossy. Plant growth is bushy and upright. Flower colour is deep yellow. Blooms are double and have 33 petals, flowers are small and fragrant (E.Williams, 1988).

Tickle Me Pink : It is evolved as a hybrid of "Osiria" x "Magic Carrousel". Foliage is small, medium green and semi glossy. Plant growth is low and bushy. Buds are pointed. Flower colour is medium pink to soft cream at base, reverse is cream blush, ageing darker. Blooms are double and have 33 mottled petals, flowers are urn shaped, medium, borne singly, moderate and have spicy fragrance (L.Chaffin, 1989).

Tiffe : Plant produces large number of blooms. Flower colour is pale shell pink (Bennel, 1982).

Tinker bell : Plant growth is vigorous, dwarf and profusely blooming. Leaves are small in size and their texture is leathery. Flowers are small, double, cupped and bright rose pink in colour (de Vink, 1954).

Tobo : This variety is evolved as a hybrid of "Arther Bell" x "Rise 'N' Shine". Foliage is medium, light green. Plant growth is medium, bushy and upright. Buds are pointed.

Flower colour is deep yellow. Blooms are double and have 32 petals. Blooms are high centred, exhibition type, medium and borne usually singly and in sprays of 2-3. Flowers have slight fruity fragrance (G. King, 1989).

Tom Thumb : It is the first seedling from *R.roulettii.* It is produced from a crossing with Polyantha rose "Gloria Mundi". This variety is also known as 'Peon'. Plant is very dwarf. Foliage is light green in colour. It is a fine bloomer. Flowers are small, semi double and have deep crimson colour and their centre is white. The plant received a certificate of merit from the American Rose Society and created a sensation in USA when first exhibited. (de Vink, 1935).

Tomboy : It is evolved as a hybrid of "May Time" x "Poker Chip". Leaves are dark green and semi glossy. Plant growth is spreading and upright. Flower is medium pink, single and has 5 petals. Blooms are small (H. Zipper, 1989).

Torch of Liberty : This variety is also known as 'Moortorch'. Plant produces Hybrid Tea type flowers. It is a free flowering variety (Moore, 1986).

Touch Down : This variety of rose is evolved as a hybrid of "Sheri Anne" x "Anita Charles". Foliage is small and medium green. Plant growth is low and upright. Buds are ovoid. Flower colour is medium red and its reverse side is red with white centre. Blooms are double and it has 40 petals. Blooms are urn shaped, small, borne singly (M.Jolly, 1989).

Touch of Elegance : It is evolved as a hybrid of ("Gavolle" x "Buccaneer") x unnamed miniature seedling. Plant growth is tall and upright. Foliage is medium green and semi glossy. Buds are pointed. Flower colour is white creamy with yellow center. Blooms are double, high centred, exhibition type, large and borne in sprays of 1-3. Blooms have slight fragrance (C. Leon, 1987).

Touch of Fire : This variety is evolved as a hybrid of "Tangerine Mist" x "California Girl". Foliage is small, medium green and semi glossy. Plant growth is bushy. Buds are ovoid. Flower colour is orange yellow. Reverse side is light orange and ages to apricot orange. Blooms are double and have 25 petals. Flowers are urn shaped, small and borne singly, have moderate spicy fragrance (B.F. Rennie, 1989).

Toy Clown : It is evolved as a hybrid of "Little Darling" x "Magic Wand" and produces very attractive semi double flowers. Bloom colour is white and edges of the petal in crimson. Variety is repeat flowering in nature (Moore, 1966).

Tropical Twist : It is evolved as a hybrid of unnamed seedling x "Pink Polyantha". Flowers have orange colour with creamy yellow reverse. It blooms continuously. Usually one bloom per stem is formed. Flower size is 3.5 cm and it has 20-25 petals. Plant growth is vigorous. Blooms have slight fragrance. This variety of rose is also known as 'Jacorea'. Blooms are very lovely. It is very free flowering variety (John Walden, 1999).

Tutu : This variety produces full and double bloom. Flower colour is mauve, which appears in clusters. Variety is repeat flowering in nature (Delbard- Chabert, 1963).

Twinkie : This hybrid is evolved from cross of (*R. wichuraiana* x "Floradora") x "Eleanor". Plants are bushy, healthy and have compact growth habit. Buds are pointed and open to full blooms. Flower colour is carmine- rose changing to light clear pink. Bloom appears in clusters, and is good for cut flower purpose (Moore, 1974).

Twinkle Toes : This variety is evolved as a hybrid of unnamed seedling x unnamed seedling. Foliage is small, dark green and dense. Variety is highly resistant and tolerant of cold temperatures. Plant attains height up to 40 cm. Plant growth is compact. As a cut flower it is an excellent variety for container. Most of the blooms are borne in clusters. Fading process is slow while repeat flowering is fast. Flower size is 3.5 cm and it possesses 35 petals. Blooms have spicy fragrance (Sean Mc Cann, 1999).

Twinkle Twinkle : This variety is evolved as a hybrid of "Contempo" x "Sheri Anne". Buds are decorative and pointed in shape. Flower colour is white with apricot-bashed on edges. Flowers appear singly and have tea fragrance (Bennet, 1931).

Ultimate Pleasure : This variety is evolved as a hybrid of "Gene Boerner" x "Jean Kenneally". Plant growth is tall and its habit is bushy. Plants are huge and extremely healthy. Flowers are long stemmed and their colour is soft pink. Reverse side of the petal is deeper pink. Flower display is wonderful. Bloom size is 3.5 cm. and it has 25-35 petals. Blooms have fruity fragrance. Tiny Petals nursery has introduced the variety (Dee Bennett, 1999).

Virginia Lee : This variety of rose is evolved as a hybrid of "Rise 'N' Shine" x "Baby Katie". Foliage is medium, dark green and glossy. Plant growth is slightly spreading and medium. Buds are ovoid. Flowers are creamy yellow with pink border; reverse creamy yellow, ageing pink. Blooms are double with 30 petals, cupped, usually borne singly (M.William, 1989).

Vixen : It is evolved as a hybrid of "Petticoat" x "Red Minimo". Foliage is medium green, small and semi glossy. Plant growth is low, bushy and spreading. Buds are ovoid and pointed and their colour is green with reddish brown. Flower is red orange with yellow base, ageing red orange to pink orange. Blooms are double and have 28 petals, cupped, medium, borne in sprays of 5 -35 (W.Warriner, 1990).

Wanaka : This cultivar of rose is free flowering, bloom colour is bright scarlet red (Mc Gredy, 1980).

Whistle Stop : It is evolved as a hybrid of "Mighty Mouse" x "Hurdy Gurdy". Foliage is medium green and semi glossy. Plant growth is healthy. Flower colour is red. Blooms are semi double and have 6-14 petals, small and slightly fragrant (S.Mc Gredy, 1989).

White Charm : It is evolved as a hybrid of "Tom Brown" x "Over the Rainbow". Foliage is small, medium green and glossy. Plant growth is bushy. Buds are long. Flower is white, double and possess 33 petals, high centred, small and very fragrant (E.Williams, 1988).

White Cloud : It is evolved as a bud sport of 'Buttons 'N' Bow'. Blooms are white with pale pink colour (Nor' East Min. Roses, 1988).

White Dream : This variety produces blooms in good clusters. Flower colour is pure white (Kordes, 1988).

White Feather : It is also known as 'Morfeat' and produces flowers, which is very delicate and looks like feather. Bloom colour is white (Moore, 1981).

White Madonna : It is evolved as a hybrid of (*R. wichuraiana* x "Floradora") x ("Little

Darling" x unnamed red miniature). Plant growth is bushy, clean and upright. Variety is disease free in nature, continuous and free bloomer. It is good for pot culture. Buds are long and pointed open to full white blooms that are borne in cluster. Buds and opening flowers may be pale pink during cool weather. Blooms have slight fragrance (Moore, 1973).

Whiteout : It is evolved as a hybrid of "Sexy Rexy" x "Popcorn". Foliage is small and medium green and semi glossy. Plant growth is bushy. Flower colour is white. Blooms are double and have 20 petals. Flowers are small and slightly fragrant (Sam Mc Gredy, 1989).

Wild Plum : This variety is a free bloomer. Plant produces lovely perfect HT type blooms. Flower colour is true lavender (J&P, 1995).

Winsome : It produces full and double flowers. Bloom colour is cerise with lavender shade (Saville, 1984).

Winter Magic : This variety is having beautiful flowers. Flower colour is very unusual soft lavender grey (Jacob, 1986).

Wit's end : It is evolved as a hybrid of "Rise 'N' Shine" x "Siobhan". Foliage is small, medium green and semi glossy. Plant growth is bushy. Flower colour is red with yellow reverse. Blooms are double and have 20 petals, are small, borne in sprays of 3-5, slightly fragrant (S. Mc Cann, 1988).

Yantai : This variety is evolved as a hybrid of "Portrait" x "Party Girl". Foliages are medium green and semi glossy. Plant growth is bushy, spreading, tall and vigorous. Buds are ovoid. Flower colour is pastel, yellow, deeper yellow in centre and highlight of pastel pink. Blooms are double and have 28 petals. Blooms are high centred, exhibition type and borne usually singly and in sprays of 3-5. Flowers have moderate fruity fragrance (Dee Bennett, 1988).

Yellow Fairy : It is also known as 'Poulfair'. It is most free flowering cultivars. It is infact a shrubby miniature. Plant is loaded with flowers. Flower colour is pale yellow. It blooms throughout the year (Oleson, 1988).

Young Mistress : This variety produces shapely, full and double flowers. Blooms appear in clusters, colour is bright pink (Kordes, 1988).

Yumeotome : This cultivar is evolved as a bud sport of 'Miyagino'. Foliage is small and dark green. Plant growth is bushy. Buds are ovoid. Flower colour is pink changing to white. Blooms are double and have 38 petals, and have slight fragrance (Kazuhisa Tokumatsu, 1989).

Zwergenfee : This variety produces excellent flowers and bloom colour is orange blood red (Kordes, 1979).

CLIMBING AND RAMBLER ROSES

To screen the unsightly views, for covering pergolas, walls, fences, trellis and banks, to train on bare trees, and for landscaping large and small areas, these groups of plants play important role. Climbers other than rambler, can be divided into natural born climbers and the bush roses changed to the climbing habit through sports. A very large proportion of bush roses in Hybrid Teas and quite a number in Floribundas have thrown climbing

shoots. Hence in climbing roses both types of bloom Hybrid Tea and Floribunda are found. The climbing sports are of two types, the rampant, once flowering and the less vigorous but twice flowering sorts climbers possess the upright climbing habit. Rambler roses are vigorous plants, bearing small flowers in big clusters. Climbing roses bear their bloom on the lateral growth made in the previous season, while ramblers produce flowers on the wood formed during the same season. The rambler roses produce new woods entirely from the base or from the main stem. Ramblers may also be used as bedding plants for ground cover. Ramblers usually flower once in a year, but a few varieties are repeat flowering. A remarkable break in rambler roses was brought by Withelm Kordes. These are bred for hardiness and containing *Rosa rugosa* in its ancestry. *Rosa Kordesii* yielded a number of vigorous and short climbers which flowered in different seasons providing a spectacular mass.

Albertine (Barbier & Cie, 1921). A very vigorous and hardy *Wichuraiana* climber. Flowers are large over 7.5 cm across, semi-double, coppery pink shaded with yellow, paling to silvery pink with increase in age.

Allen Chandler (Chandler, 1923). It is a H.T. climber evolved through a cross between "Hugh Dickson" x unnamed variety. Flowers are large, single or semidouble with long pointed buds, brilliant crimson with slight fragrance. Suitable for wall.

Allen's Fragrant Pillar. (A.J. & C. Allen, 1929). Free flowering, vigorous and attractive climber with bronzy foliage. Flowers are H.T. type, large, double, well shaped fragrant, clear cerise flushed with golden yellow.

Aloha (Jackson and Perkins, 1949). This is a cross between "Mercedes Gallart" x "New Dawn". This is a pillar rose upto 3m tall. The foliage is leathery and deep green. A free and recurrent flowering variety. The flowers are full, large, upto 8.5 cm across, rose-pink in colour.

Altissimo (Delbard-Chabret, 1966). A spectacular climber covered with dark-green healthy, serrated foliage. Flowers are scarlet velvet, single with seven petals instead of usual five and 10 cm across. The stamens are deep gold.

America (Bill Warriner, 1976). To start with it is slow-grower in the first year thereafter with increase in age the plants grow very satisfactorily on a fence or trellis. Flowers are fragrant, coral-pink, with H.T. size blooms.

Anci Bohm (J. Bohm, 1929). A *multiflora* climber, almost thornless, wiry habit. Flowers are borne in big clusters, small, ruffled, rosy-red with lilac shades.

Ardon (E. Turbat & Cie, 1925). A *Wichuraiana* climber. Flowers are produced in large bunches, pink and white.

Aurelien Igoult (M. Igoult, 1924). A *multiflora* climber, produce violet tinted flowers with reddish tone.

Auriel Dombasle (Meilland, 1992). A free flowering climber with medium sized blooms in clusters. Flowers are rich vermilion with citron yellow shade and reverse.

Autumn Sunlight (Lowe, 1988). A hardy disease resistant climber. Flowers are with rich fruity fragrance, apricot gold in colour.

Berries N Creams (Oleson, 1988). A beautiful climber where large sprays of flowers appear in clusters with great abundance. Flowers are deep rose pink striped cream.

Black Boy (A. Clark, 1919). A Bourbon climber, vigorous and prolific. Flowers are semi-double, dark glowing red, overlaid with a sheen of velvety black.

Bloomfield Courage (Capt. Thomas, 1925). A *Wichuraina* climber, vigorous. Flowers are produced in loose clusters, small, single, blackish crimson with quilled petals.

Bloomfield Exquisite (Capt. Thomas, 1924). It is a finest ever blooming climber with H.T. type flowers. Flowers are double, pink.

Breeze Hill (Dr. W. Van Fleet, 1926). A vigorous plant with small hard foliage. Flowers are very large, double, pale salmon, flushed lightly with orange and buff.

Chaplins' Pink Climber (Chaplin Bros., 1928). This is evolved as a cross between "Paul's scarlet Climber" x "America Pillar". A vigorous free flowering climber with glossy green foliage, suitable for training up bare tree - trunks or for archway, or pillar. Flowers are semi-double borne in large clusters, medium sized, bright rich pink with golden stamens.

Chastity (F. Cant & Co. 1924). A very lovely Hybrid Perpetual climber. Flowers are star-shaped, semi- double, sowy white.

Clair Matin (Meilland, 1962). This variety is a semi climber type evolved through crosses between "Fashion" x ("Sondermeldung" x "Orange Triumph") x "Phyllis Bide". The flowers are semi-double, produced in clusters, slightly fragrant. This is a suitable variety for pillar.

Cocktail (Meilland, 1957). It is a hybrid climber, evolved from a cross between ('Independence x "Orange Triumph") x "Phyllis Bide". A moderately vigorous pillar rose, large spreading type. Flowers are produced in clusters, medium sized, single, rich crimson, shading to deep yellow in the centre.

Conrad F. Meyer (Muller, 1899). A semi climbing variety produced through crossing of *Rosa rugosa* hybrid x "Gloire de Dijon". Leaves are leathery and large, plants are vigorous very thorny and attain a height upto 3 m. Flowers are produced in clusters, very fragrant, silvery pink in colour. Blooms are cupped and full as well as large.

Danse des Sylphes (Mallerin, 1957). A vigorous climber evolved through a cross between "Dense du Feu" x "Tonjours". Flowers are bright orange red, cupped, medium sized, borne in clusters. This variety is suitable for wall or pillar.

Danse du Feu (Mallerin, 1954). This variety of climber is a hybrid and evolved through a cross of "Paul's Scarlet" Climber x unnamed *Rosa multiflora* seedling. This variety is also named as "Spectacular". A hardy and vigorous plant with scarlet-red, medium sized, double fragrant flowers. It is suitable for walls.

Day dream (A. Clark, 1925). A profuse bloomer and a hardy climber. Flowers are large, ruffled, semi-double, light blush-pink at the edges, blending to pale yellow and white at centre.

Della Balfour (Harkness, 1994). A robust climber suitable for walls and fence.

Flowers are delightfully fragrant, beautiful, blended rose with a mixture of peachy Tones and primrose yellow.

Don Juan (Michele Malandrone, 1958). It is a vigorous free flowering climber with HT type blooms. Flowers are deep crimson in colour.

Doris Downes (A. Clark, 1932). Flowers are H.T. type, very large, well shaped sweetly scented and pink in colour.

Dortmund (Kordes, 1955). It is a Kordesii climber which is cross between seedling x *R. Kordesii.* A vigorous climber best suited as pillar rose. Flowers are borne in clusters, very large, single fragrant. Blooms are red in colour with white eye.

Dynamite (Warriner). A free blooming climber. Buds are long pointed open to high centre, H.T. type bloom. Flowers are bright red with fiery colour.

Easlea's Golden Rambler (W. Easlea & Sons, 1932). A *R. wichuraiana* climber. Flowers are very large, double, lemon yellow flamed with orange and coppery tones.

Excelsa (Walsh, 1909) A very attractive rambler and vigorous. Flowers are produced in clusters, full and large, bright crimson in colour.

Flammentanz (Kordes, 1955) A vigorous and hardy climber attain a height of 5m, produced through hybridization between "Johannes" x *R. rubiginosa magnifica.* Flowers are produced in clusters, fiery red with velvety blush colour.

Fourth of July (Carruth, 1999). A spectacular climber which is ever blooming. Flowers are red striped with white with golden stamens, long lasting, sweetly fragrant.

Gardenia (W.A. Manda, 1898). A vigorous grower with extremely handsome foliage and a *wichuraiana* climber. Flowers are large, pale yellow in the bud, almost white when open.

Golden Emblem (Armstrong Nurs, 1927). A very popular and spectacular climber with HT type flowers. Blooms are golden yellow in colour.

Golden Showers (Walter Lammerts, 1956). It is a cross between Charlotte Armstrong x Capt Thomas. It is a pillar rose, hardy and ever-blooming. Flowers appear on upright, strong stems, yellow in colour.

Guinee (Mallerin, 1938) It is a hybrid H.T. type climber, evolved through a cross between "Souv. De Clandius Denoyel" x Ami Quinard. Leaves are leathery. Flowers are deep garnettee, large and double.

Handel (Mc Gredy, 1965). A vigorous climber, both hardy and resistant. Blooms are ivory with a halo of rose pink.

Heart of Gold (Dr. W. Van Fleet, 1924). It is a cross between *R. Wichuraiana x R. moyesi.* Flowers are large, single, dark red white in the centre produced in large clusters.

High Noon (Lammerts, 1946). The variety is produced through a cross between "Soeur Thérése" x "Capt Thomas", which is in H.T. type climber. Leaves are glossy and leathery. Flowers are lemon yellow flushed red, buds are medium size and double, fragrant. It is a good pillar rose.

Ile De France (A. Nonin, 1922). A pillar rose from *Rosa wichuraiana.* Flowers are borne in huge clusters, vivid pink, semi-double.

Jacotte (Barbier & Cie, 1920). A spectacular large flowered *R. wichuraiana* climber with beautiful foliage. Flowers are H.T. type, large, bright-orange-yellow in colour.

Joseph's Coat (Swim and Armstrong, 1964). It is a spectacular climber where all the colours in a single cluster can be seen. Plants are thorny, with heavily-toothed, light green foliage. Flowers are smallish fluffy that start out golden yellow and go through all the changes from salmon to pink until they turn crimson.

Killy Kininmonth (A. Clark, 1922). It is a Hybrid Perpetual climber with Gigantea strain, hardy, vigorous and beautiful. Flowers are well shaped, pink, produced in large numbers.

Lady Waterlow (Nabonnand, 1903). It is a cross between "La France" x "Mme Marie Lavalley". Plants are moderately vigorous attain a height of 3 m. This is a H.T. type climber. Flowers are salmon pink edge with carmine. Blooms are full, large and fragrant.

Le Reve (Pernet-Ducher, 1923). A magnificent vigorous climber with attractive foliages. Flowers are large, clear yellow, produced in profusion.

Leverkussen (Kordes, 1955). It is a Kordesii climber. Plants are vigorous and suitable for pillar, grow to a height of 3 m. Flowers are slightly fragrant, semi-double, golden yellow in colour.

Los Angeles (Howard & Smith, 1925). A free flowing climbers, fairly hardy and vigorous. Flowers are coral pink, salmon and gold.

Maigold (Kordes, 1953). It is produced through crossing between "Poulsen's Pink" x "Fruhlingstag". Flowers are bronze yellow in colour, semi-double, cupped. An attractive climber with excellent flowers.

Max Graf. (J.H. Bowditch, 1919). An excellent trailer, good as ground cover. Flowers are large, single, bright pink. It is a hybrid between *Rosa rugosa x R. setigera.*

Meg (Gosset, 1954). It is evolved as a cross of "Paul's Lemon Pillar" x "Madame Butterfly". It is a spreading and vigorous pillar rose can be used as hedge. Flowers are semi-double, large, 10 cm across, apricot yellow with pink shading and red stamens.

Mermaid (Paul, 1918). It is a cross between *Rosa bracteata* x yellow Tea Rose. A vigorous climber, attain a height of 10 m. Flowers are large, single, sulphur yellow in colour.

Mme. Edouard Herriot (Ketten Bros. 1921) A vigorous H.T. type climber. Flowers are coral-red flushed yellow and bright rosy scarlet, semi-double fragrant.

Mme., Caroline Testout (1901). It is a cross between 'Mme de Tartas" x "Lady Mary Fitzwilliam". A vigorous climber, upto 7 m tall, with rich green and soft foliage. Flowers are fragrant, large and full, satiny rose edge carmine pink.

Mrs Pierre S. Du Pont (Hillock, 1933). It is a climbing sport from Mallerin's rose of the same name. A free flowering vigorous climber. Flowers are 40 petalled, full, fragrant and deep golden yellow in colour.

New Dawn (Somerset Rose Nurseries, 1930). This is a sport from "Dr. W. Van Fleet", a vigorous pillar rose upto 3.5m in height. Flowers are produced on long stems semi-double, fragrant, in clusters of small and large, pale-pink in colour.

Noella Virebent (P. Nabonnand, 1922). A large *gigantea* climber. Flowers are large, semi-double, peach-blossom-pink.

Nora Cuningham (A. Clark, 1920). A Hybrid Perpetual climber with thin and delicate foliage. Flowers are large, semi-double, rose pink, produced in abundance for a long period.

Parade (Boermer, 1953). It is a cross between "New Dawn" seedling x "Climbing World's Fair", a vigorous pillar rose upto 3m height perpetual flowering. Flowers are large, full, fragrant, light crimson in colour.

Paul Buatois (E.M. Buatois, 1931). A free flowing climber with large H.T. type flowers. The blooms are silvery red, shaded yellow and fading to purplish.

Paul's Lemon Pillar (Paul, 1915) The variety is evolved through a cross between "Fraukarl Druschii" x "Marechal Niel". A vigorous H.T. type climber suitable as pillar rose. Flowers are large, full, fragrant, lemon yellow faded to white.

Paul's Scarlet Cliber (Paul, 1916) A rambler rose, moderately vigorous and attain a height upto 3m. Flowers are semi-double, scarlet and slightly fragrant.

Penny Lane (Harkness, 1998). Easy growing climber, healthy, abundant blooming, old fashioned roses with refreshing fragrance. Flowers are honey champagne in colour.

Polka (Meitosler, 1992). A charming climber with large, pastel orange mandarin coloured flowers which have sweet smelling.

Purezza (Mansuino, 1961). It is a hybrid Banksiae, parentage not known, a vigorous climber suitable for pillar or pergola. Flowers are small, full, white in colour, plants are free flowering.

Romeo (W. Easlea, 1919). A *wichuraiana* climber which is rigid and erect. Flowers are borne in clusters, crimson in colour.

Rosy Mantle (Cocker, 1968). A perpetual flowering climber, blooms freely evolved through a cross between "New Dawn" x "Prima Ballerina" Plants attain a height upto 3m. Foliage is dark glossy and very healthy. Flowers are H.T. shape, large, fragrant, double warm rosy pink in colour, lasts well when cut.

Sander's White Rambler (Sanders and Sons, 1912). A *wichuraiana* climber with attractive clusters of flowers. Blooms are white, sweetly scented, well formed.

Seagull (Pritchard, 1907). A very vigorous climber and a profuse bloomer. Ideal for growing up through trees, it grows out through the top of the tree, it starts to hang down and looks like a gigantic "Weeping Standard". Flowers are fragrant, pure white, large and produced in clusters.

Soldier Boy (Le Grice, 1953). It is a cross between unnamed seedling x Guinee. A vigorous semi climber type of rose, with rich glossy green leaves, good as pillar rose. Flowers are large, single and scarlet in colour.

Sunrise (Kordes, 1988). A vigorous and healthy climber. Flowers are coppery orange in colour, produced in abundance.

Sweet Sultan (Eacott., 1958). It is evolved as a cross of "Independence" x "Honour

Bright". A vigorous pillar rose and a H.T. type climber upto 3 m tall. Flowers are borne in clusters, crimson shaded maroon.

The New Dawn (Dreer, 1930). A pillar rose, large bushy also may be used as hedge. Flowers are double, fragrant, soft flash pink in colour.

Thelma (W. Easlea & Sons, 1927). A very handsome *wichuraiana* climber and huge clusters of flowers. Blooms are single or semi-double, pale-salmon in colour.

Unique (F. Evans, 1928). It is a climbing Poliantha with spectacular cluster of flowers. Blooms are orange-salmon in colour.

Vanity (Rev. J.H. Pemberton, 1920). It is a large shrubby climber, free flowering. Blooms are rose-pink in colour.

Vintage Wine (Poulsen, 1983.) Plants are hardy, long, strong stems with oversized, medium green foliage. The spiralled buds open to almost dinner-plate size, and have no side bud. Flowers are huge, burgundy red with a creamy reverse.

White Cockade (Cocker, 1969) A lovely free flowering climber, with parentage of "New Dawn" x "Circus". Flowers are of medium Floribunda size, and truly beautiful H.T. form with good petalage. Blooms one white, with pleasant fragrance.

Winsome (Dobbie & Co. 1931). A free flowering climber. Flowers are HT type, large, fragrant, cherry-red in colour.

Yvonne (F. Cant. & Co. 1921). A *wichuraiana* climber. Flowers are borne in clusters, blush-pink in colour very attractive.

Zephirine Dronhin (Bizot, 1868). A vigorous but not rampant climber, suitable as bush pillar, hedge, wall or for pegging down. It is a hybrid Bourbon, plants attain a height of 4m, frequently known as thornless rose. Flowers are semi-double, very fragrant, carmine pink in colour.

SHRUB ROSES

These are excellent for hedging purposes or as specimen plants. In the garden these plants may be mixed with other kind of shrubs. In most of the varieties flowers are freely produced. There are extensive range of shrub roses. Plants are vigorous and well branched which makes them bushy, and do not require great deal of pruning. The flowers are large or small, borne or twos and threes, or in big clusters, more or less continuous flowering. There are old shrub roses and the varieties derived from the species like *R. alba, R. bourboniana, R. centifolia, R. centifolia muscosa R. damascena, R. gallica* etc. While modern shrub roses are the result of crosses between *Rosa moschata* and various modern roses commonly known as Hybrid Musk. Shrub roses are a specialized branch of rose growing which when fully established provide a delightful display in the gardens. Many shrub roses have finely divided foliage which is pleasing when the bushes are out of flowers. The foliage assumes rich tints of colours in some shrubs, and this is embellished in many cases with brilliantly coloured heps, in range of colours, sizes and shapes.

Ballerina (Bental, 1937). It is a beautiful shrub belongs to Hybrid Musk roses upto 120 cm tall. Flowers are fragrant, appear all single blooms in large panicles, apple-blossom-pink with white eye.

Blanche Moreau (Moreau Robert, 1880). It is a cross between "Contesse de Murinas" x "Quatre Saisons Blanc". Plants are 2m tall, Blooms are very fragrant, double long stalked clusters of pure white flowers, double.

Bonn (Kordes, 1949). A vigorous shrub attain a height of 2 m. Flowers are freely produced, semi-double, large, rose-red suffered with vermilion.

Captain John Ingram (Laffay, 1956). Plants are bushy with neat leaves, upto 150 cm tall. Flowers are small, double, velvety maroon mottled and shade with a variety of tints, lilac-pink button centre.

Cecile Brunner (Ducher, 1880). It is classed under China roses, the variety is also known are "The Sweetheart Rose", "Mignon", Mlle. Cecile Brunner. This variety is evolved through cross of *R. multiflora* x "Mme de Tartas" The flowers are tiny, exquisitely shaped, Ophelia- pink with quilled petals.

Dorothy Wheatcroft (Tantau, 1960). It is a tall and upright shrub upto 120 cm tall, with large bright green foliage. Flowers are medium sized semi-double, with 17 petals and 6.5 cm across, slightly fragrant, produced in large clusters, deep red in colour.

Elmshorn (Kordes, 1951). Plants are with light green foliage with long stems but rather straggly, upto 2 m height, is a cross between "Hamburg" x "Verdun". Flowers are produced in large tresses, pompon shaped, 20 petalled, small, full, deep pink in colour does not posses much fragrance.

Erfurt (Kordes, 1939). A vigorous shrub of 2m tall with bronzy and wrinkled foliage, evolved as a cross between "Eva" x "Reveil Dijonnais". Flowers are highly scented, large, semi-double, citron yellow edged carmine.

F.J. Grootendorst (De Goey, 1918). It is a hybrid between *R. rugosa rubra* x unknown Polyantha, makes a good hedge or specimen plant, up to 2 m tall, vigorous and bushy. Flowers are slightly fragrant, petals are serrated at edges, bright red in colour. Blooms are small, double.

Felica (Pemberton, 1928). It is originated from Hybrid Musk roses, upto 2 m in height. Flowers are beautiful, double warm pink and highly scented.

Frau Dagmar Hastrup (Fan Dagar Hartopp, 1914). It is a *Rugosa* rose, attain a height of 150 cm, free flowering and continuous bloomer. Flowers are clear rose pink, single. Hips are large and red in colour.

Friedrich Heyer (Tantau, 1956). An upright shrub of 90 cm tall with dark green glossy foliage. Flowers are fragrant, produced in large clusters, 10 petalled, large, bright orange in colour.

Friedrich Heyer (Tantau, 1956). It is a rose plant with vigorous growth, classified as a Floribunda but better recognised as small shrub, produce dark green foliage. The blooms are semi-double borne in large clusters, rich scarlet coloured.

Frühling sanfang (Kordes, 1950). A vigorous and bushy shrub, upto 3 m tall with glossy foliage, evolved as a cross between "Joanna Hill" x *R. spinosisima altaica.* Flowers are large, single, ivory white in colour.

Frühlings gold (Kordes, 1937). The parentage is 'Joanna Hill" x *R. spinosisima hispida.*

Plants are vigorous with long arching stems upto 2.5m tall. Leaves are large light soft. Flowers are single, large. Buds are nasturtium red turns to golden yellow after opening.

Frühlingsmorgen (Kordes, 1942). A vigorous shrub up to 150cm tall, produced through a cross between ("E.G. Hill" x "Catherine Kordes") x *Rosa spinosisima altaica.* Flowers are medium sized, single, cherry pink shaded yellow at base.

Frühlingstud (Kordes, 1948). A vigorous and bushy shrub upto 150 cm tall, is a hybrid between "Joanna Hill" x *R. spinosisima altaica.* Flowers are highly scented, large, full, opening flat, lemon yellow shaded with pink and apricot.

Gay Vista (Riethmuller, 1957). Plants are upto 1m tall with average growth. Flowers are large, produced in clusters, light pink in colour.

Golden Wings (Shepherd, 1956). A beautiful shrub with long arching stems, upto 150 cm tall. Flowers are very large, single, in a delicate shade of pale canary yellow.

Grand Master (Kordes, 1954). A straggly shrub up to 150cm tall, produced through a cross between "Sangerhausen" x "Sunmist". Flowers are large, flat, semi-double, apricot coloured.

Gustav Frahm (Kordes, 1958). It is a hybrid between "Fanal" x "Ama", a vigorous and upright shrub upto 100cm tall. Flowers are medium sized, semi-double with 25 petals, glowing crimson in colour.

Heidelberg (Kordes, 1958). A vigorous shrub up 90cm tall, suitable for hedging or specimen plant, parentage is derived from a cross between "Sparrieshoop" x "World's Fair". Flowers are produced in tresses, very large, double, bright red in colour.

Henry Morse (Kordes, 1958). A vigorous and much branched shrub upto 90 cm in height. Flowers are semi-double, medium sized, slightly fragrant, deep blood red shaded scarlet.

Kassel (Kordes, 1958) It is originated from Hybrid Musk, the bush reaches a height of 2 m. Flowers are borne in large clusters, semi-double, deep cherry-red in colour.

Kathleen Ferrier (Buisman, 1952). Its parentage is "Gartenstolz" x "Shot Silk", very upright and vigorous shrub of 90 cm height, suitable for hedging. Flowers are medium sized, semi-double, 18 petalled fragrant, deep salmon-pink in colour.

Lady Sonia (Mattock, 1960). It is evolved as a cross between "Grandmaster" x "Doreen", a spectacular bushy shrub of 120 cm tall. Flowers are medium sized, semi-double, 20 petalled, deep golden yellow in colour.

Laneii (Laffay, 1845). The variety is also known as "Lanes Moss". Plants attain a height of 150 cm. Flowers are fragrant rosy-crimson tinged purple, fragrant.

Lavender Lassie (Kordes, 1959). A vigorous and bushy shrub upto 1m tall. Flowers are fragrant, 65 small petalled, medium sized, lilac pink in colour.

Little White Pet (Henderson, 1879). This is also known as "White Pet" or "Belle de Teheran". It is an attractive little rose, is a perpetual flowering dwarf "sport', from "Felicile' et Perpetue". Flowers are fragrant, creamy white, flat button type.

Madame Hardy (Hardy, 1832). One of the most lovely old roses in existence. Flowers

are full, petalled like a camellia with incurred centre and revealing a tiny green eye. Blooms are large, pure white, highly fragrant.

Madame Plantier (Plantier, 1835). It is a cross between *R. alba* hybrid x *R. moschata,* but parentage is disputed. A splendid garden shrub upto 2 m tall, slender and arching stems, making a thicket of branches. The foliage is light green, is smothered under clusters of small double blooms of creamy white.

Nevada (Dot 1927). It is a hybrid between "Giralda" x *R. moyesii.* A vigorous bushy shrub upto 75 cm tall. Flowers are large, 35 petalled, to bright velvety scarlet in colour.

Nuits De Young (Laffay, 1845). The variety is also known as "Old Black". The plant is 150 cm tall. Flowers are double, darkest velvety black purple, slightly fragrant.

Nymphenburg (Kordes, 1954). It is a cross between "Sangerhausen" x "Sunmist". A free flowering shrub, vigorous, upto 150 cm tall with large glossy foliage. Flowers are large, semi-double, salmon pink in colour.

Old Blush (Parsons, 1796). It is classed under China roses and perhaps one of the best of Chinas. Other names are "Common Monthly Rose", "Old Pink Daily" "Old Pink Monthly", "Parsona Pink" China. A fragrant rose, attain a height of 120 cm, lovely fresh silvery pink blooms, crimson flushed.

Orrniston Roy (Dorenbos, 1953). It is a hybrid between *R. spinosisima x R. xanthina.* Plants are bushy upto 90 cm in height. Flowers are large, single, deep yellow in colour.

Parfum de l'Hay (Gravereaux, 1901). It is a hybrid between (*R. damascene x* "Gen. Jacqueminot") *x R. rugosa.* Plants are vigorous, upto 120 cm tall. Flowers are highly scented, globular, full, produced freely, bright rosy-carmine in colour.

Penelope (Pemberton, 1924). It is a cross between "Ophelia" x "William Allen Richardson". A beautiful shrub, good for hedge and speciment plant, attain a height of 2 m. Flowers are medium sized, semi-double, borne in clusters, shall pink in colour fading to white with lemon at centre.

Penelope (Pemberton, 1924). It is a vigorous well branched shrub and most popular of all the Hybrid Musk roses, attain a height of 2.5 m. Flowers are semi-double delicate shell-pink in colour, highly fragrant.

Prestige (Kordes, 1957). It is a hybrid between "Rudolph Timm" x "Brilliant". A dense foliaged shrub upto 90 cm tall. Flowers are large, flat, semi-double, light crimson.

Prosperity (Pemberton, 1919) The parentage is "Marie Jeanne" x "Perle des Jardins". Plants are vigorous, bushy, upto 150 cm tall. Flowers are creamy white, large and borne in clusters.

Radway Sunrise (Waterhouse, 1962). It is a hybrid between "Masquerade" x unknown seedling. Plants are vigorous and bushy, upto 150cm tall, with dark and glossy foliage. Flowers are single, large, produced freely in large tresses, yellow at base shading through orange to cherry red.

Rogosa Hansa (Schaum x Van Tol, 1905). A bushy shrub upto 150 cm in height. Flowers are highly scented, produced on short weak stems, crimson coloured.

Rosa Damascena "Versicolor" (Monardes, 1551). It is also known as "York and Lancaster". Plant are spindly bushy with light green leaves. Flowers appear loosely, rather small and demi-double, blush-white occasionally flanked with pink. This rose played prominent part in "the brawl in the Tempe Garden" between Lancastrians and Yorkists.

Sally Holmes (R. Holmes, 1976). The parentage of this variety is "Ivory Fashion" x "Ballerine". Plants are bushy and compact. Huge tresses of fragrant creamy white flowers formed on huge heads.

Sarah Van Fleet (Van Fleet, 1926). It is a cross between *R. rogusa x "May Maryland"*. Plants are compact and bushy upto 2.5 m tall. Flowers are large, semi-double highly scented, rose pink coloured.

Schneezwerg (Lambert, 1912). It is also known as "Snowdwarf". This variety is evolved through a cross between a white Polyantha x *R. rugosa*, free flowering. The flowers are semi-double, pure white in colour. Hips are scarlet.

Vanity (Pemberton, 1920). It is a cross between "Chateau de Glos Vougeot" x seedling. It is a vigorous shrub with strong arching stems, upto 2.5 m tall. Flowers are highly scented, single, flat, rose pink coloured.

Variegata Di Bologna (Bonfiglioli, 1909). A free flowering plant belong to Bourbon roses. Flowers ore with globular full-petalled, borne all along the branches and the plant attain a height of 2.5 m. Blooms are highly fragrant, blush white with neat and vivid purple stripes.

Will Scarlet (Hilling, 1952). An attractive bush, up to 2m tall, sometimes regarded as a Hybrid Musk rose. Flowers are brilliant scarlet in colour, semi-double, faintly fragrant.

Zigeuner Knabe (Lambert, 1909). It is also known as "Gipsy Boy". A vigorous and bushy shrub upto 150 cm tall. Flowers are medium sized, full petalled, dark violet purple in colour.

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Ace of Hearts

Adolp Horstmann

Alees Red

Alpine Sunset

Anne Harkness

Anurag

Artistic

Arunima

Avignon

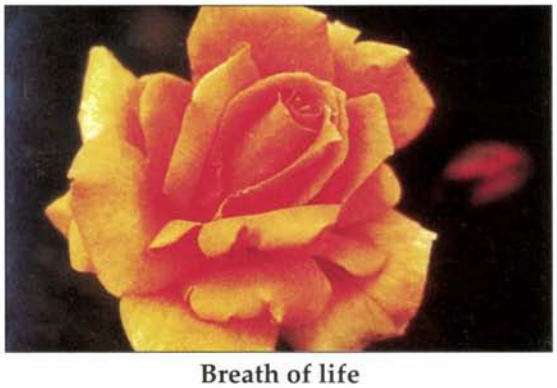
Bing Crosby

Blue Nile

Blue Perfume

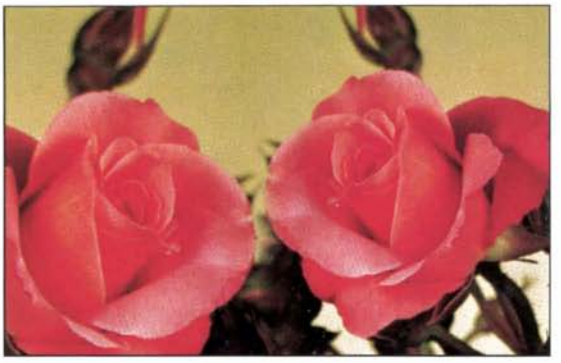
Bobby Charlton

Brandy



Breath of life

Cairngorm



Cathedral

Champion

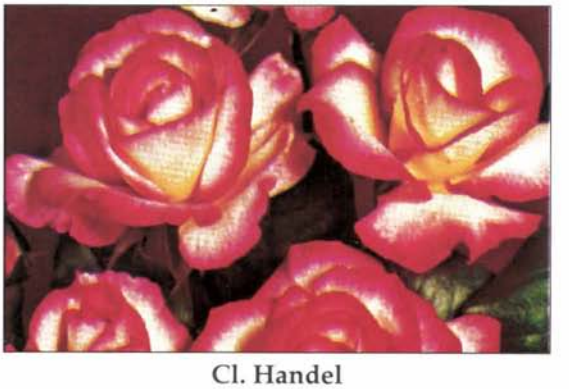
Cherish

Chicago Peace

Chivalry

City of Belfast

Cl Altissimo



Cl. Handel

Cl Vintage Wine

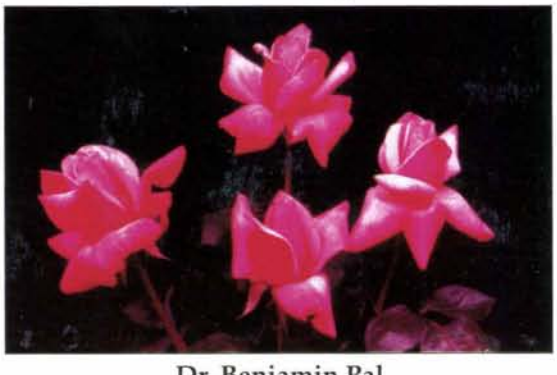
Congratulations

Court Jester

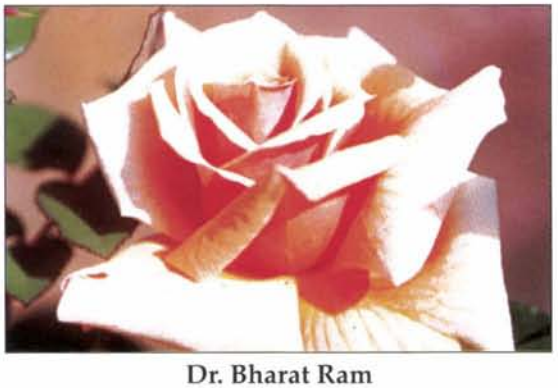
Delhi Princes

Double Delight

Dr. B.P. Pal



Dr. Benjamin Pal



Dr. Bharat Ram

Duftzauber

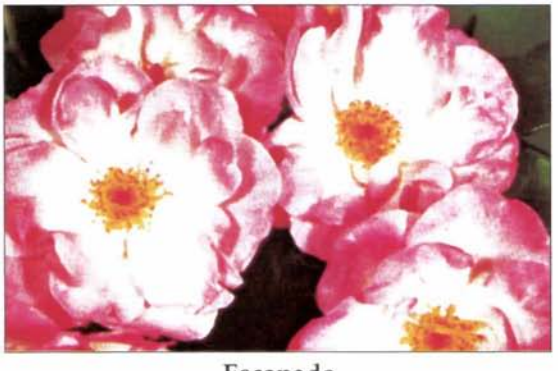
Dutch Gold

Echo

Elizabeth Harkness

English Miss

Eroica



Escapade

Europeana

Eva Gabor

Evening Star

Eye Paint

Eyecatcher

Fashion Flame

Ferry Porsche

First Prize

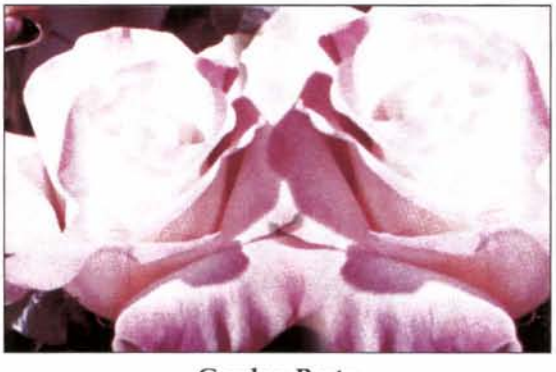
Fragrant Delight

Fragrant Gold

French Lace

Friendship

Galiath



Garden Party

Gold Medal

Golden Jubilee

Golden Year

Grand Magan

Happiness

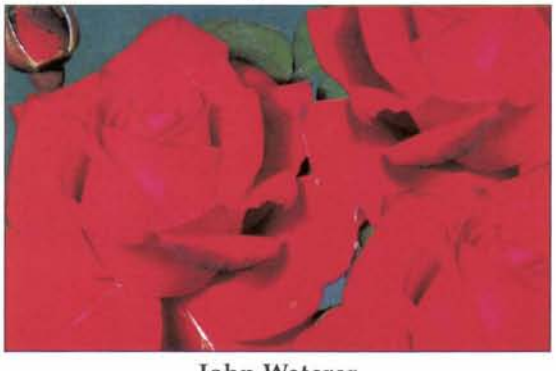
Harry Wheatcroft

Highfield

Honor

Impatient

Intrigue



John Waterer

Just Joey

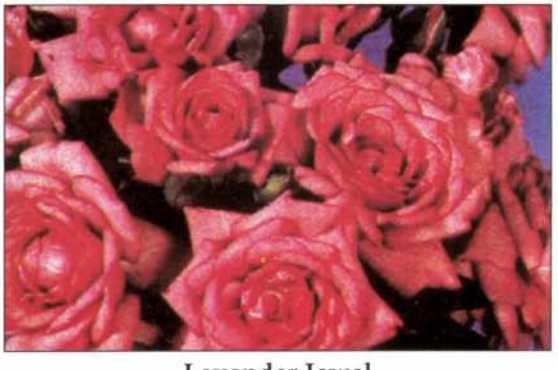
Julia's Rose

Korresia

Lahar

Largerfeld

Las Vegas



Lavender Jewel

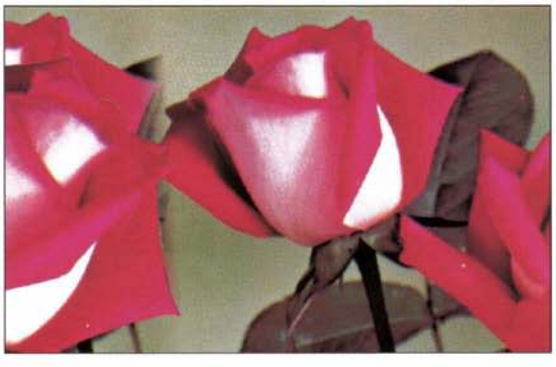
Little Jewel

Lolita

L'Oreal Trophy

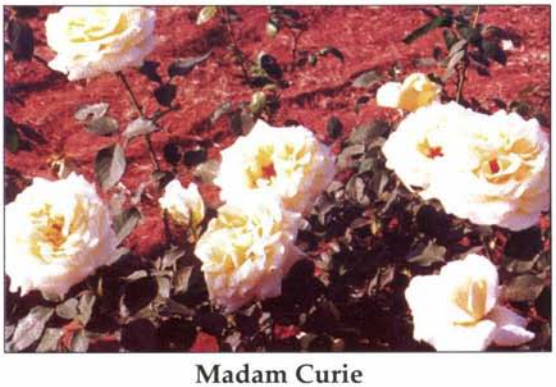
Lori

Louisiana

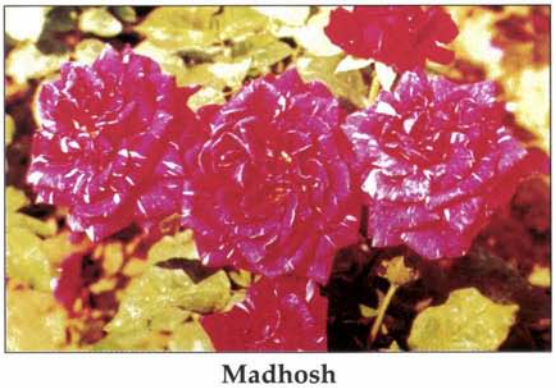


Love

Lovers Meeting



Madam Curie



Madhosh

Manuela

Margaret Merril

Marina

Miss Harp

Mon Cheri

Montreal

Mother Teresa

Mountbatten

Mrinalini

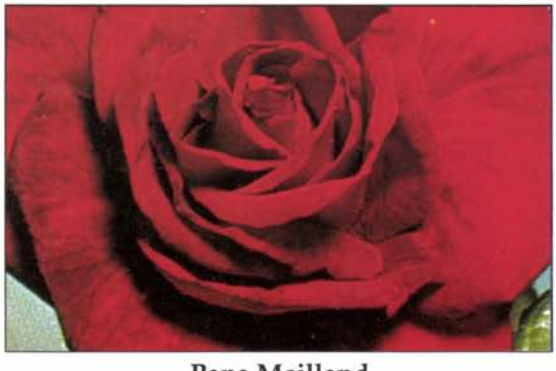
Navneet

Neelambari

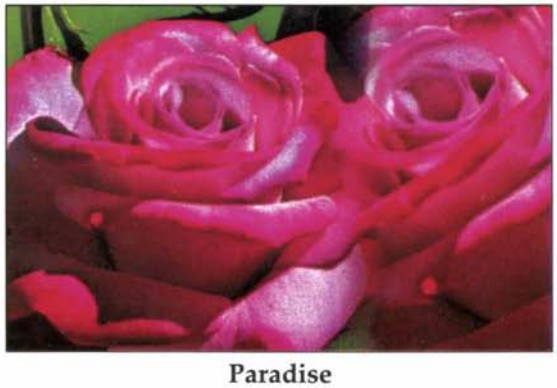
Nehru Centenary

Neue Revue

Oregold



Papa Meilland



Paradise

Pascali

Peer Gynt

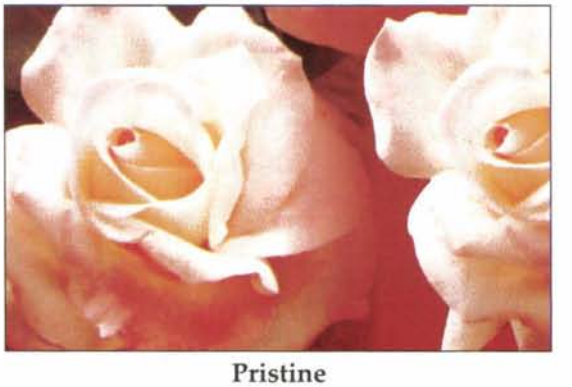
Portland Trailblazer

Pot O Gold

Precious Platinum

Princess Margaret

Priscilla Burton



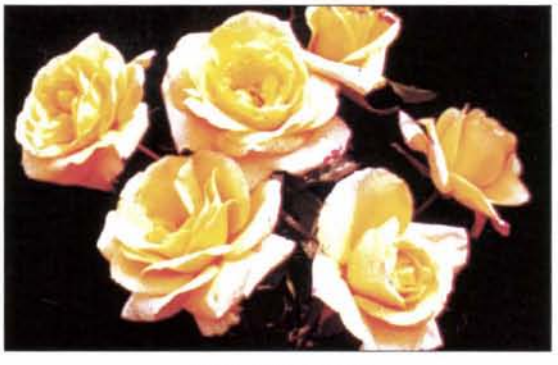
Pristine

Priyadarshini

Prominent

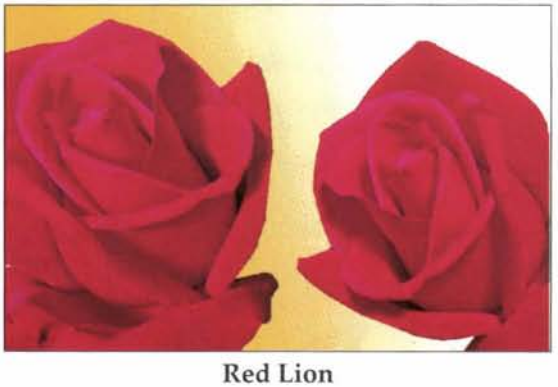
Purple Splendour

Pusa Bahadur

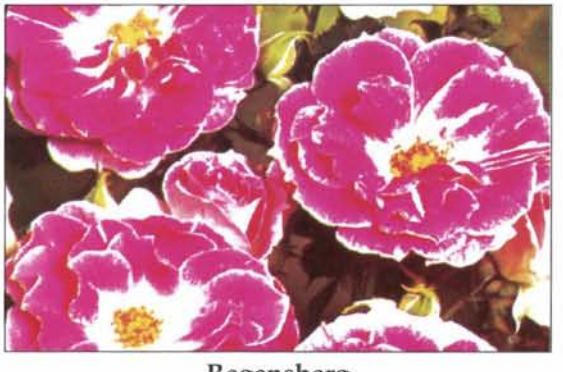


Pusa Pitamber

Red Devil



Red Lion



Regensberg

Rose Yercaud-1

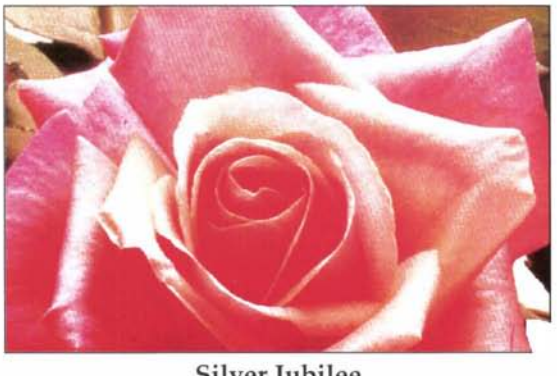
Sahashradhara

Sea Pearl

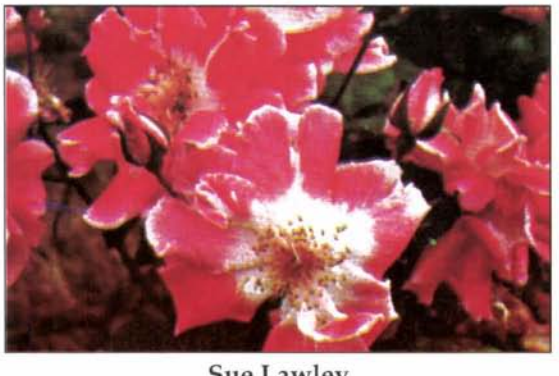
Shona

Shreveport

Shreyasi



Silver Jubilee



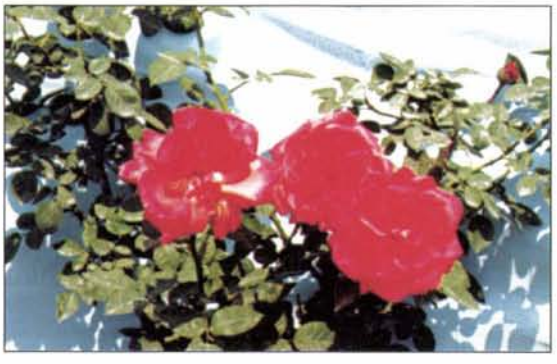
Sue Lawley

Sun Flare

Sunblest

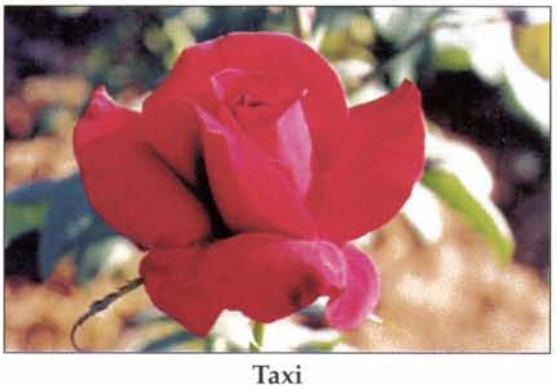
Sundowner

Sunsprite



Super Star

Sweet Surrender



Taxi

Taboo

Talisman Stilkrose

Tequila Sunrise

Texas Centennial

Thais

Thelma Barlow

Thomas Barton

Tiki

Tivoli

Touch of Velvet

Touch of Venus

Toulouse Lautrec

Ultimate Pink

Uncle Walter

Valencia

Valentine

Valeta

Vanity

Victorborge

Wee Jock

Westernsun

Whisky Mac

White Cockade

Will Scarlet

Wini Edmunds

Yercaud-3

Zambra

Evaluation of Raktagandha cut flowers in test tubes

Rose cut flowers are covered with corrugated sheets before packing

Packed flower bunches of different cut rose varieties

Bundled roses arranged in packing boxes

Rose cultivation in poly house

A view of a rose garden

24

ROSE BREEDERS OF INDIA

Rose has played significant role in our society. It draws attention of gardeners, hobby oriented growers, nurserymen, floriculturist, plant breeders, tissue culturist, molecular biologist and plant physiologist. Rose breeding has resulted into evolution of many new cultivars. According to Dr. B. P. Pal, a renouned rose breeder and an eminent scientist, first Indian bred rose is the cultivar 'Dr. S. D. Mukherjee'. This cultivar of rose has been evolved as a hybrid of 'Hadely' X 'Fascination' by Late Binoy Krishna Roy Chowdhury from West Bengal. This was the first successful attempt in the history of rose breeding in India. Rose breeding has become a passion among the rose growers in the country. Late Dr. B. S. Bhattacharjee poineered the breeding of roses in India. Dr. B. P. Pal (1972) reported about the Indian rose breeders and rose cultivars evolved by them. His list includes the name of following: Mr. J. P. Agarwal (Friends Rosary, Lucknow), Mr. B. Arora, Mr. S. Banerjee, Mr. A. M. Bhattacharjee, Mr. B. S. Bhattacharjee, Mr. S. M. Bhattacharjee, Mr. R. K. Deshpande, M/s. K. S. G. Nursery, Mr. M. R. Muniswamy, Mr. A. K. Roychaudhury, Mr. B. K. Roychaudhury, Mr. D.D. Soman and Mr. M. L. Vasisht. He again wrote in Indian Rose Annual, 1985 an article on a brief Survey of Rose Breeding in India. In this article more new names have been added and these are P.L. Airum, Braham Datt, S. C. Das, Doon Valley Rose Nursery, K. D. Gupta, Y. K. Hande, M.N. Hardikar, R. S. Jagtap, Lovelena Roses, P. Saxena, Telco Nursery, M. S. Viraraghvan.

On the basis of available literature, various nursery booklets, catalogues and Rose Annuals, The Indian Rose breeders are : Dr. B. P. Pal, B. S. Bhattacharjee, Swami Vinayananda, M. S. Viraraghavan, J. P. Agarwal, O. P. Bansal, P. Bhattacharjee, Brahm Datt, H. P. Bulsara, G. Kasturi Rangan & K. Sriram, C. R. Chiplunkar, B. K. Patil, S.C. Dey, Diby's Nursery, Friends Nursery, Gayatri and Laxminarayan, J. A. Gokhlae, Horticultural Arena Nursery, I.A.R.I., More Chandrakant, Hardikar, Hande & R.R. Jagtap, S. G. Londe, V. S. Padhye, B. K. Pahl, Pavri Nadi, G. K. Phadtare, Pushpanjali Nursery, Ramson Nursery, M. C. Shah, R. P. Singhal, N. V. S. Shastry, K. Bhattacharjee, Tejganga Nursery, Telco Nursery, Arpi Thakur, Kalyan Chakrabarti, K. P. Mukherji, Nemai Mukherjee, N. C. Sen, K. D. Gupta, Subrata Ghosh, Sandhya Ghosh, Pronabir Maity, and Sekhar Datta. Apart from the above a few institutions and universities have also evolved new varieties of roses. In the present chapter contribution of some important Indian Rose Breeders is discussed. Efforts are also being made to give names of the important varieties released by them. Many of the rose cultivars have been evolved as a bud sport or spontaneous mutation. It has been observed that majority of new varieties evolved and developed as a hybrid belongs to Hybrid Tea group of rose.

LATE MR. B.S. BHATTACHARJEE

Mr. B. S. Bhattacharjee along with his two sons worked very hard and played significant role in producing new varieties of rose in tropical condition. He was pioneer rose breeder and produced large number of new varieties. Most of the varieties evolved by him along with his son were lost in due course of time, however few are still grown today. His *Bawan-bigha* in Baidyanath Deoghar, Santhal Parganas, was in Bihar state. In between the period of 1940 to 1950 most of the rose cut flowers sold at Kolkata were from Madhupur, Simultala and Deoghar indicates that he belonged to Bengal. Most of his varieties are described in "Indian Rose" chapter. Dr. Zakir Hussain, President of India and the then Governor of Bihar were invited to *"Bawan-bigha"* rose garden developed by B. S. Bhattacharjee. An eminent rose lover Dr. Zakir Hussain was surprised to see that one of the rose beds with profusion of large carmine rose flowers was named "Dr.Zakir Hussain". During 1941-1967, Mr. Bhattacharjee along with his sons raised 125 new rose varieties of which 86 were H.T., 33 Floribunda and 6 climber. Roses raised by Bhattacharjees were exhibited as Roses from India at the International Rose Conference in London during 1958. Some of his varieties are mentioned below :

Hybrid Tea : Ambica, Basanti, Champa, Deshbandhu, Rev Andrews, Deepak Rag, Deepti, Dr. Budhan, Dr. K.Biswas, Gourth, Gulabi Atar, His Highness, Jimutban, Kamala, Kanchanjangha, Karunamoyee, President Radhakrishnan, Raja Ram Mohan Roy, Kishori, Madam Emma, Magenta Queen, Pitambar, Radha Rani, Rakth Beej, Ramakrishna Dev, S. Percy Lancaster, Tamralipta and Vidyapati.

Floribunda : Shimantak, Jai Hind, Menoka, Muktadhara, Pandit Nehru, Peetmanjari, Sir Jagadish Bose, Urvashi.

Polyanthas : Rishi Balmiki, and Tarapunja.

MR. A.M. BHATTACHARJEE

Mr. A.M. Bhattacharjee developed many new rose cultivars. Details of the cultivar have been explained in "Indian Rose" chapter. A few rose varieties released by Mr. Bhattacharjee are given below:

Hybrid Tea : Avra, Bapuji, Bharat, Dilkhus, Heart Throb, Kailash, Kalima, Kamalini, Krishna Bhattacharjee, Michael Madhusudan, Netaji Subhas, Parijat, Patliputra, Purabee, Rajaji, Rajendra Prasad, Rana Pratap, Rani Jhansi, Samrat Ashok, Sarojini Naidu, Shanti, Shyama Prasad, Sri Babu, Sri Ma, Sithal Kamal, Suvra, Swami Vivekananda, Tamishra, Tansen, Tapan, Tilottama, Tulsidas, and Dr. Zakir Hussain.

Floribunda : Afrat, Agni Veena, Bahar, Gurudev Tagore, Jai Hind, Jharna, Kazi Nazrul, Meenakshi, Menaka, Sharbari, Soor Das, Sundaram, Timir and Vichitra.

MR. S.M. BHATTACHARJEE

Mr. Bhattacharjee's contribution in development of new varieties of rose will be remembered among the breeders. He has evolved many new varieties of rose, which is discussed in detail in "Indian Rose" chapter. Newly raised rose varieties by Mr. Bhattacharjee are as follows:

Hybrid Tea : Baiju Bawara, Bidhan Babu, Birat, Chittaranjan, Chocolate, Ferzaan,

Gaurik, Haridra, Joy, Jyotish, Kajal, Lal Bahadur, Lal Kamal, Lalima, Megh Mallahar, President Radhakrishnan, Shakuntala, Sir Ashutosh, Sir Aurobindo, and Sugandha.

Floribunda : Ashawaree, Bahurupee, Balaka, Laxmi, Lalit, Manjula, Niharika, Peet Manjari, Sudha Rani, and Toohin.

DR. B.P. PAL

Dr. Pal has evolved many new and novel cultivars of roses. He appreciated the need for varieties suited to our tropical climate and initiated rose breeding research at IARI. As a rose breeder he possessed the rare quality of artistic mind, ardent lover of roses, sound scientific knowledge and vast experience in practical genetics and plant breeding. He kept appropriate names for each and every varieties evolved by him. The varieties evolved by him are mentioned below :

Hybrid Tea : Akash Sundari, Apsara, Aruna, Ashirwad, Cham di Kali, Dark Boy, Delhi Airport, Delhi Debutante, Delhi Pestel, Dil Ki Rani, Dilruba, Diva Swapna, Dr.Homi Bhabha, Dr.Randhawa, Dr.R.R.Pal, Dulhan, Eastern Princess, Golconda, Golden Afternoon, Gulbadan, Homage, Indian Princess, Jawani, Kanakangi, Lal Makhmal, Lalima, Madhumati, Maharani, Madhushala, Mechak, Meghdoot, Mrs K. B. Sharma, Nandini, Nayika, Pahari Dhun, Palehand, Pat Rani, Poornima, Raja Surender Singh of Nalagarh, Raj Hans, Rampa Pal, Ranjana, Rosy Evening, Rat Ki Rani, Ratnaar, Sandeepani, Scented Bowl, Shanti Pal, Sharmili, Sir C. V. Raman, Surkhab, Sweet Innocense, Uma Rao, and White Nun.

Floribunda : Akash Nartaki, Azeez, Banjaran, Belle of Punjaḅ, Chamba Princess, Chingari, Chit Chor, Deepak, Delhi Brightness, Delhi Maid, Delhi Pink Powderpuff, Delhi Rosette, Delhi Princess, Delhi Sharbet, Fugitive, Janki, Kumkum, Loree, Madhura, Manmatha, Nut Khut, Orange Cup, Paharan, Panchu, Parwana, Ragini, Raj Bala, Rose Sherbet, Sandhya Bela, Sailoz Mookherjea, Saroja, Stanza, Suhashini, Surya Kiran, Tarang, and Temple Flame.

Miniature : Delhi Scarlet.

Climbing Rose : Delhi White Pearl, Delhi Pink Pearl, Clg. Dr. Homi Bhaba.

MR. M.S. VIRARAGHAVAN

Mr. Viraraghavan has contributed most of his time in creation of new varieties and has developed new varieties of Hybrid Tea, Floribunda and Climbing roses. Some of his varieties are mentioned below :

Hybrid Tea : Ahimsa, Annapurna, Bodhi Sattawa, Chitralekha, Dharampuri, Kanchi, Kovlam, Our India, Priyatama, Rajani, Rose Avil, Soma Sila, Tambrabarani, Tipu's Flame, and Vamsadhara.

Floribunda : Amarapali, Bhagmati, First Offering, Kadambari, Mahadev, Nayantara and Vanamali.

Climbing Rose : Climbing Kanya Kumari

KASTURI RANGAN, SRI RAM AND KGS (SONS)

Kasturi Rangan and his group at KGS (Sons) nursery have evolved many beautiful roses at their centre. Mr. Kasturi Rangan has evolved several varieties of their group, few along with Sri Ram and majority under the name of KGS (Sons). They have the rich

collection of rose cultivars in their nursery. Most of their new varieties are the products of extensive breeding work and few are mentioned below :

Hybrid Tea : Aditya, Adora, Agnihotri, Ambika, Anupam, Arati, Archana, Ashwini, Bhanu, Bhargav, Bhawani, Blue Delight, Cauveri, Chitra, Chitrangini, Chitttaranjini, City of Panjim, Classic, Diversity, Godavary, Gomathi, Harangi, Kaladi, Kavini, Kalpana, Kalyani, Kanchani, Komla, Krithika, Lavanya, Lemon Time, Neeta, Padmawati, Painted Melody, Pestal Delight, Pink Fantasy, Pink Melody, Red Recker, Shatranj, Rose KSG Centinary, Siddarth, Srinivasa, Sukanya, Swagatham, Tapti, Tungbhabhadra, Vaishnavi, Vasavi.

Floribunda : Ahalya, Arkavati, Devdasi, Hemvathi, Jambun, Jwala, Kamini, Kolar Princess, Kushal, Mahadev, Narmada, Netravathi, Prakash, Priya, Rare Edition, Salmon Splash, Sharvathi, Sushma, Swapna, Varsha, Veena.

Polyanthas : Anjani, Bharani, Nartaki, Pink Spray, Priti, Rashmi.

Miniature : Kasturi KSG, Chandrika, Dazzler, Dazzling Flame, Pushkala.

Climbing Rose : Climbing Korenburg, Climbing Tata Centinary, Clg. Guitare, Clg. Vaterag.

MR. C.R. CHIPLUNKAR

Mr. Chiplunkar has evolved many new varieties of rose. In 1999 he has compiled the list of rose varieties developed by him and published an article 'Silver Jubilee of my rose hybridization' in *The Indian Rose Annual*. He has given details of twenty-five rose cultivars evolved by him. He has also reported bud sports of rose. He observed these sports in branches of rose plants growing in his field. He has isolated those bud sports in pure form and released them as a new variety. First rose bud sport observed by him was in a branch of rose cultivars 'Anita' a Floribunda rose. His first release was mutant rose 'Deccan Delight' in 1985. An excellent rose cultivar 'Polybag Joshi' was named to honour Shri N.A. Joshi of Pune a well-known rosarian personality of India and famous for his invention of poly bag method of rose propagation. New and novel varieties of rose developed by Mr. Chiplunkar are as follows :

Hybrid Tea : Aba Saheb, Anna Saheb, Ahena, Anant, City of Ichalkaranji, Datta ji, Decan Delux, Die Della, Double Delight Supreme, Dr. Kidwai, Dr. Nosurwadia, G.K.Rose, Ichal Karanji 100, Jaslok, Mohak, Piroja, Polybag Joshi, and Rang Tarang.

Floribunda : Akash Deep, Decan Delight, Indramani, Neel Kanti, Pushkarni, and Shatdhara.

Climbing Rose : Climbing Matangi.

Mr. B. K. PATIL

He has evolved good number of rose varieties, the names of which are given hereunder :

Hybrid Tea : Balaji, Ico Ambassadar, Ico Beauty, Ico Delux, Ico Tripathi, Invention, Mahalaxmi, Malkar Siddha, Panch Ganga, Pride of Ichal Karanji, Satvika, Savkar, Shri Swamy, Samrath, Speckled Delight, Tenth Rose Convention, Yeshwant.

Floribunda : Ico, Ico Pearl, Ico Talk, Thornless Beauty.

Climbing Rose : Climbing Pussata, Delhi Pink Pearl.

Mr. R.S. SINGH

He has produced several varieties of Hybrid Tea and Floribunda roses, names are mentioned below :

Hybrid Tea : Chanderi, Ghaza, Heer, Kurwal, Nazre-e-Nazar, Rukhsaar, Yamini, Krishna Murthi.

Floribunda : Gopika, Kessi, Patasha, Patiala Darbar, Saroor.

Mr. SHIVPRASAD BANERJEE

He was a well-known rose breeder of his time and released Hybrid Tea and Floribunda roses that were very beautiful. Varieties developed by Mr. S. Banerjee are as Follows :

Hybrid Tea : Argha, Chamak, Chitra Bhanu, Sugandha, Sushama, Uday Bhanu,

Floribunda : Bijoy Krishna, Jyoti .

Mr. HARDIKAR

He is a keen lover of roses, reputed rose grower and released few interesting new cultivar of rose, majority of them belonged to Hybrid Tea type, while one of them is from Floribunda group. Following varieties of rose has been evolved by Mr. Hardikar :

Hybrid Tea : Cynosure, First Rose Convention, Narmada, Lahari, Shreyasi, Sada Ranga, Shree Dayanand.

Floribunda : Bright Garbs.

LATE SRI K. P. MUKHERJEE

Late Sri K. P. Mukherjee worked very hard and established Shikherpur Kamala Nursary of North 24 Parganas of lower part of West Bengal. His able and expert son Mr. Nimai Mukherjee also joined him in this work. They bred several varieties, which are as follows:

Hybrid Tea : 7Akasbani, Agnisikha, Bijoya, Dr. Bidhan Chandra, Indraneel, Kumkum, Pink Marigold, Rajarshi.

CAPT. SUBIMAL CHANDRA DEY

Capt. S. C. Dey developed many new cultivars of rose, a well-known rose grower. He has developed hybrids, also detected bud sports in rose and released them as new cultivars. His newly developed Hybrid Tea cultivars 'Martin Luther King' and 'Sun God' became famous among the growers. He has evolved following important new varieties of rose :

Arena 92, Arena 93, Arena 94, Arena 95, Colour Wonder, Fragrant Mauve, Red Vatertag.

SEKHAR DATTA

Mr. Sekhar Datta has evolved a few cultivars of roses. His contribution includes breeding of disease free rose and evolution of heat resistant varieties. He has also developed dwarf rose varities.

Touch of Heart, Asha, Sudha, Master.

Mr. AND Mrs. SUBROTO GHOSH

Mr. Subroto Ghosh and Mrs. Sandhya Ghosh are rose loving couple. They have bred many new and novel cultivars of roses at Durgapur. Some of their varieties are registered with American Rose society. They have produced more than 50 varieties of rose. List of the released varieties by Mr. and Mrs. Ghosh till 2004 are as follows:

Hybrid Tea Rose : Akash, Amma, Anannya, Abani Kanta, Ajit Dhawan, Andromeda, Anirvan, Arindam, Bahurupi, Barna, Bay of Bengal, Bengal Rose Society, Bihanga, Biva, Black, Christmas Carol, Cobra, Bride's Maid, Butter Lite, Chumki, City Beauty, Colour Harmony, Cutie, Devine Perfume, Dolly, Dr. Shiba Prasad Banerjee, Durgapur Jubille, Esa, Fresh Air, Garden of Eden, Glamour Girl, Green Light, Lilac Charm, Lonely Heart, Hasina, His Highness, Holiday Mood, Hoima Shree, Indian Princess, Kajal, Kali The Goddess, Krishna Pada Mukherjee, Mainak, Maya, Melody Queen, Memory of D.M. Roy, Morning Mist, My Friend (Sakha), My Lady, My Love, Netaji Subhash, Nilima, Nina, Pink Marble, Pink Perfume, Planet Mars, Plum Cake, Priti Rani, Rose Bengal, Santa Claus, Scarlet Queen, Shakuntala, Shalimar, Silky Petal, Sir J.C. Bose, South Wind, Sova, Spring Time, Suman, Sunanda, Suprabhat, Taser Bibi, Tathagata, Tender Love, Tupa, Urmibala, Vinayak, Viola, Week End, Yogi.

Horticultural Arena, Jhargram, Midnapore, West Bengal

Most of the newly developed cultivars are raised from open pollinated seeds from the choicest female parents. Some of the new cultivars evolved as spontaneous mutations in flower colour. New released varieties of rose include large flowered, Hybrid Tea, clustered flowered and Floribunda and few are listed below :

Bina Pani, Blue Bird, Brahmajee, Fraternity, New Herald, Red Perfume, Salmon Queen.

DR. KALYAN CHAKRABORTY

Dr. Chakraborty has released new and novel cultivars of roses. Most of his work confined to hybridization. Majority of the roses bred by him is appreciated by the judges at different flower shows. One of his newly developed variety at Kolkata, 'Tribute' which is highly fragrant can compete with any of the world class rose. He has released new varieties in Hybrid Tea, and Floribunda group :

Hybrid Tea : Anusuya, Aroop Ratan, Aristocrat, Beauty Temple, Birendra Nath, City of Joy, Classic Calcutta, Lady's Choice, Lavender Deu, Long March, Rangoli, Roop Bani, Shubham, Saraswaty, Silver Toss, Tribute, Tropic Snow and Viswakalyan.

Floribunda : Assemblys Jubilee, Paper Flower, Ramtanoo and William Carey.

PUSHPANJALI NURSERY

The Maity brothers of Pushpanjali Nursery have bred several classic cultivars. Their new developed varieties earned the name and can be seen all over India. They have bred more than 30 cultivars.

A. K. Mishra, Baba Jhogewar, Begam Kidwai, Candle Light, Comrade Sukumarda, Elfin Bush, God Gift, Governor Kidwai, Hey Day, Jamuna, Kansavati, Kshudiram,

Midnapur Delight, Mrs. Daves, Mrs. Abraham, Noble Birth, Open Sesam, Pink Marshal, Pink Princess, Pranabanandajee, Radha Nath, Rupnarayan, S. Pandey, Stealthy Kiss, Velvety Veil, Manju Pandey, Smiling Girl.

Mr. NEMAI MUKHERJEE

Nemai mukherji is son of Mr.K.P.Mukherjee of Shikherpur Kamala Nursery. During 2000 and 2001 and he has released two excellent varieties of rose and these are "Mr. K.P. Mukherjee" and "Pride of Mukherjee".

Mr. GOURI SHANKAR MANDAL

Mr. Gouri Shankar Mandal at present is associated Swadhashib Nursery, in west Midnapur district of West Bengal. He has learned rose breeding from Late Birendra Nath Bhowmick.

He has used hybridization and mutation breeding technique for improvement of roses and development of new cultivars. Mutagenic treatment yielded several new rose cultivars. Some of his varieties are : "First Class", "Las Vegas" "Carmousine".

Mr. K. D. GUPTA

Mr. Gupta is a rose lover who reported one bud sport, and released it in the name of "Durgapur Delight" in 1980.

BISWAS NURSERY

He has selected a bud sport from "La Mersailles" and named it as 'Kamalakant'.

DOON VALEY NURSERY

Mr. Arpi Thakur of Doon Valey roses reported several new varieties of roses. Mojority of his newly developed varieties belong to Hybrid Tea and one variety belong to Floribunda group. Following new varieties have been evolved by Doon Valey Nursery :

Hybrid Tea : Ajanta, Banaras Dawn, Sahasradhara.

Floribunda : Rangoli

Dr. N.C. SEN

He has selected a bud sport from "Princess Margaret of England" which is named as "Supriya". He is a well-known rose grower.

RAJA SURENDRA SINGH OF NALAGARH

He was a keen lover of roses a very reputed rose grower and a famous personality. He has developed Hybrid Tea and Floribunda roses, which were highly appreciated.

Hybrid Tea : Ghajal, Nazr-e-Nazar, Yamini Krishnamurty.

Floribunda : Gopika.

SWAMY VINAYANANDA AND Mr. K. BHATTACHARJEE

They have selected a bud sport from the cultivars "Taj Mahal" and released it in the name of "Calcutta 300".

Mr. SANATAN MUKHERJEE

He has produced a hybrid in the Floribunda group, named as "Lakshmishree".

DIBY'S ROSE GARDEN

They have good collection of roses in their nursery. They have released two varieties of roses and these are "Surya Sikha" and "Good News".

FRIENDS ROSERY

Mr. J.P.Agarwal who was a keen grower and lover of rose established 'Friends Rosary' in Lucknow. From this nursery hybrids and bud sports have been reported time to time. A thorn less rose variety 'City of Lucknow' has been reported by Late J. P. Agarwal is a unique variety as it is a thornless variety of rose which belongs to Floribunda group and evolved as a result of spontaneous mutation. Some of their varities as named below :

Hybrid Tea : Girija, Kasturi Rangan, Manu Mukherjee.

Floribunda : Anand Rao, City of Lucknow.

TEJGANGA NURSERY

This group has also released new varieties of beautiful roses. Evolved varieties included Hybrid Tea and Climbing roses. Following new varieties are developed by Tej Ganga:

Hybrid Tea : Maharishi, Sweet India.

Climbing Rose : Climbing Ole, Climbing Show Biz.

TELCO NURSERY

Telco nursery is growing fast and cultivating promising rose cultivars mainly for cut flowers. They have also very good collection of quality roses. The variety released by the nursery is a Hybrid Tea : "Tata Centinary".

Mr. CHANDRA KANT MORE

Mr. More is rose lover a well-known grower and developed new rose varieties. His varieties included Hybrid Tea and Miniature. Following new varieties has been released by him :

Hybrid Tea : Courageous India

Miniature : Jimmy

MRS. PREM. L. AIRUN AND MR. SURAJ KARAN AIRUN OF ANAND NURSERY, JAIPUR

Mrs. and Mr. Airun's names are listed in the rose literature for creation of new roses. They are well known rosarians and worked together for more than 40 years for the development of roses in Rajasthan. Mr. Airun has published a book entitled "Beauty Thy Name is Rose" which has been highly appreciated by the rose lovers. They have released Hybrid Tea and Miniature roses. Their varieties are quoted by Dr. B.P. Pal. The varieties released by them are :

Hybrid Tea : Devine Light

Floribunda : Golden Days, Mahak

Miniature : Dark Beauty

Mr. A. K. ROYCHOUDHURY

Mr. Roychoudhury is a rose breeder and a lover of roses. He has developed several new and novel cultivars of roses. Most of his released varieties of rose belonged to Hybrid Tea group. Following varieties have been evolved by him :

Hybrid Tea : Bagha Jotin, Dr. P. Banerjee, Dr. S.D. Mukherjee and Muzibur.

DR. N. V. SHASTRI

Dr. N. V. Shastry is a well-known rose grower and evolved new varieties at his Nagpur centre. Most of his newly developed varieties belong to Hybrid Tea group of roses. He has given Shanker Jaikishan name to one of his developed variety to honour the great Indian music Director of the Hindi cinema. It highlights his affection and interest towards the music besides breeding as a background and hobby. Following varieties has been released by him :

Hybrid Tea : Brahm Datt, Golden Biotech, Prof. Madhab Chandra Nath, Shankar Jaikishan.

Y.K. HANDE

A famous rose grower, who has evolved several varieties of roses, these are as follows :

Indian Pearl, Perfumer, Ajanta Caves, Gauri, Good Morning and Pink Wave.

BRAHM DATT

He is a well-known rose grower and has evolved new varieties of roses. Dr. B.P.Pal has mentioned his name in his book. He has developed hybrids in Hybrid Tea and Miniature group of roses. Following new varieties of rose has been evolved:

Hybrid Tea : Don Nielson, Gond Beauty, Indian Festival, K.K. Thakur, Soft Touch, Marie Palit, Pride of Nagpur, and Sugandha Raj.

Miniature Rose : Twinkler

OTHER INDIAN ROSE BREEDERS

Many of the Indian rose breeders have developed one or two new varieties of rose either from Hybrid Tea , Floribunda , or Polyanthas. They are all expert rose growers and well known for their work on roses. Their names have appeared from time to time in rose literature, which include books, research papers, bulletins, nursery booklets and popular articles. List of the rose breeder along with their newly evolved varieties are as follows :

Hybrid Tea

Roser Breeder		**Varietal Name**
S.K. Singh	:	Yaaden
G.K. Phadtare	:	Balwant
Karnad	:	Swarna Rekha
B.Arora	:	Maini Ava

S.P. Bulsara	:	Ratan , Rose City of Nasik and Neena
Arpi Thakur	:	Ajanta, Landour
Gayatri and Laxmi Narayan	:	Agni, Black Delight
L.M.Vasisht Lavenna Roses	:	Lucknow Peace, Laveena
Mahendra Kumar S. Shah	:	Malak
R. K. Desh Pandey	:	Venu Vaishali
S. G. Londha and Gokhale	:	Manas
Nadir J. Pavri	:	Meher
Tarang Rose	:	Kirang, Rama Rao
S. Jagtap	:	Chandra Lekha
R P. Singhal	:	Indu Singhal
Anand Gokhale	:	Jayant
Floribunda		
Sunil Jolly	:	Konarak
Bhowmik	:	Ulka
B. D. Soman	:	Jayant Tilak
V. S. Padhey	:	Kusum
Polyanthas		
M. R. Muniswamy	:	Pink Shower
Climber		
Laveena Roses	:	Clg. Eiffel Tower, Clg. Golden Giant

VARIETIES EVOLVED AT INDIAN INSTITUTIONS

Indian Agricultural Research Institute, New Delhi

Hybrid Tea : Abhisarika, Anurag, Arjun, Bhim, Charugandha, Chitra, Chitralekha, Chitwan, Dr. Benjamin Pal, Dr. B.P. Pal, Dr. Bharat Ram, Ganga, Gulzar, Hans, Jawahar, Madhosh, Maharani, Mother Teresa, Mridula, Mrinalini, Nayika, Nehru Centinary, Nurjehan, Preyasi, Priyadarshini, Pusa Bahadur, Pusa Christina, Pusa Garima, Pusa Gaurav, Pusa Priya, Pusa Sonia, Pusa Sonora, Rajhans, Rat Ki Rani, Raj Kumari, Rakta Gandha, Raktima, Rangasala, Shreyasi, Soma, Sugandhini, Sujata, Surabhi, Surekha and Vasant.

Floribunda : Arunima, Banjaran, Belle of Punjab, Chandrama, Deepika, Deepshikha, Delhi Princess, Dr. B.B. Bhatnagar, Hemangini, Kavita, Lahar, Manasi, Mohini, Nav-Sadabahar, Navneet, Neelambari, Prema, Pusa Barahmasi, Pusa Pitambar, Pusa Virangana, Rupali, Sadabahar, Shabnam, Shola, Shringar, Sindoor, Suchitra and Usha.

Polyantha : Swati

Climbers and Rambler : Clg. Sadabahar

National Botanical Research Institute, Lucknow

Hybrid Tea : Kronenburg Mutant, Light Pink Prize, Mrinalini Lighter Mutant, Mrinalini Stripe, Pink Montezuma, Summer Holiday Mutant, Winter Holiday Mutant, Girija Mutant.

Floribunda : Angara, Curio, Pink Contempo, Pink Imperator, Salmon Beauty Mutant, Sharada, Sukumari, Tangerine Contempo, Twinkle, Yellow Contempo, Striped Contempo, Zorina Mutant.

Miniature : Windy City Mutant

Climber : Clg. Cricri

Indian Institute of Horticultural Research, Bangalore

Hybrid Tea : Dr. G.S. Randhawa, Kiran

Tamil Nadu Agricultural University, Yercaud Centre

Floribunda : YCD-1, YCD-2 and YCD-3.

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25

VARIETIES EVOLVED IN INDIA

Many of the present day beautiful roses have been evolved in our country by the efforts of nurserymen, hobby oriented growers and plant breeders. Mr. B. S. Bhattacharjee of Deoghar (Bihar) was the pioneer rose breeder of our country who evolved a large number of roses in India. Dr. B. P. Pal in the field of rose breeding has made first scientific attempt. He took up rose breeding as a hobby and shared his experiences with his countrymen. He has published a book entitled 'The Rose in India'. Under his leadership planned work on rose breeding started at Indian Agricultural Research Institute, New Delhi resulted into evolution of more than 100 varieties of rose (Biswas, 1984). Inspired by the popularity and importance of new varieties developed by Mr. B. S. Bhattacharjee and Dr. B. P. Pal, several rose growers and nursery-men of our country started breeding work to evolve new varieties. Many of the new outstanding rose varieties have been developed in our country by G. Kasturi Rangan, M. S. Viraraghavan, J. P. Agarwal, M. N. Hardikar, S. M. Bhattacharjee, A. M. Bhattacharjee, Smt. P. L. Airun, C. R. Chiplunkar and Shri Arpi Thakur, Raja Surendra Singh, B. K. Patil, S. Banerjee, K. P. Mukherjee, S. C. Dey, S. Ghosh, K. Chakraborty, B. K. Roy Choudhury, Brahm Datt, Swamy Vinyananda and several others. The Indian bred roses are briefly described below :

HYBRID TEAS

Aba Saheb : It is a mutant of rose cultivar 'Modern Art'. Flowers are bicolour. Petals are broad and having splashes and streaks of paler orange on either side looks like hand painted modern art. This cultivar is dedicated to Sir Aba Saheb alias Sri A. G. Kulkarni, distinguished parlamentarian and pioneer of Co-Operative movement in Maharashtra (C. R. Chiplunkar, Decospin 1993).

Abhisarika : It is a striped bud sport of 'Kiss of Fire'. This cultivar of rose is a profuse bloomer. Flower colour is apricot changing to deep pink on ageing with silvery reverse of petals. Deep pink to light purplish streaks are present on petal surface. In bright sun shine it looks very attractive. Bloom shape is fine (IARI, 1977).

Achantha : This cultivar of rose is having well-shaped flowers. Bloom colour is lustrous dark red (M. S. Viraraghavan, 1987).

Aditya : It is a hybrid seedling developed from cross between rose cultivar 'Shugestu' and 'Lemon Elegance'. Blooms are high centred and having deep yellow colour. Flowers are well formed and long lasting (Kasturi and Sriram, KSG Sons, 1990).

Adora : This cultivar of rose is having lovely buds with perfect shapely flowers.

Bloom appears on long stems. Flowers are having adorable luminous coral orange colour and sometimes it looks deep vermilion (Kasturi Rangan, 1986).

Agni : This cultivar of rose is having deep orange coloured flowers with blackish sheen. Blooms have high centre. Flowers are borne on long stem (Gayatri and Laxminarayana, 1985).

Agnihotri : Buds are elegant and huge open into large flower. Colour of the petal is red with lighter overtones at the edges of petals. Blooms are huge and voluptuous. Flowers are high centred and lasting on stiff stem (Kasturi Rangan, 1981).

Ahimsa : The main beauty of this cultivar is its thornless bush nature. It is probably the first ever-yellow flower thorn less Hybrid Tea rose cultivar. Elegant golden buds open to spectacular shapely large flowers. The clear yellow blooms have dark centre. Flowers appear on thorn free bush. This cultivar is also known as Oriental Silk (M. S. Viraraghavan, 1997).

Ajanta : It is a hybrid seedling of ' Lady X' seedling x 'Memoriam'. Flower colour is bluish glaucous with light grape green veins. Base of the petals are grape green in colour. Blooms are large, high centred and having lingering perfume. Petals are broad, reflex, thick and approximately 40 in number. Flower stem is long with very scare and thin thorns. Plants are of medium height with green glossy and large foliage (Doon Valley Roses, 1978).

Akash : This cultivar of rose is developed as a hybrid of 'Lady x' and 'Lagerfeld'. Cultivar is free flowering and having beautiful high centred flowers of splendid form. Blooms have soft satiny petals. Flowers open slowly and last long (Mr. and Mrs. S. Ghosh, 1998).

Akash Sundari : A delightful rose with high centred bud, double flowers with slight fragrance. Bloom colour is Lilac pink with deeper reverse displaying an attractive silvery lilac and at later stages with red flushes on the outer petals. Flowers are of exhibition grade and last very long even when cut. It looks very gorgeous in artificial light. (Dr. B. P. Pal, 1982).

Ambica : Flowers are large in size. Bloom colour is deep red to crimson. Petal number is moderate (B. S. Bhattacharjee, 1959).

Ambika : It is a hybrid seedling of 'Courtisane' X 'Taranga'. Flower colour is deep vermillion orange. Flower shape is elegant and its form is good (Kasturi Rangan, 1976).

Andromeda : This cultivar is free flowering and has attractive foliage on its bush. Buds are long and very shapely, opens into exceptionally large flowers. Flowers are medium pink in colour and petals are lighter colour on the reverse side (Mr. and Mrs. S. Ghosh, 1998).

Annapurna : This is a very attractive rose cultivar and also known as 'Sunlit Snow'. Buds are long and pointed. Colour of the bud is white with a hint of pink on the edges of petals. Exquisitely shaped huge blooms appear on long stem (M. S. Viraraghavan, 1999).

Anna Saheb : This cultivar is a hybrid of 'Tynwald' X "Kanchi'. This cultivar is profuse bloomer and dedicated to shri Anna Saheb Karale on his 75th birthday. Blooms

are well shaped. Flower colour is fresh ice cream pink. Reverse side of the petal is having dull pink (C. R. Chiplunkar, 1993).

Angar : It is a sport of rose cultivar 'Montezuma'. Flower colour is red. Cultivar is having all the good qualities of parent. Exquisite buds open into large flower. Blooms are freely produced and shapely long lasting. Flowers are very attractive (National Botanic Garden, Lucknow, 1977).

Anupama : It is a progeny of 'World's Fair Salute' X 'Happiness'. Elegent buds open into large, fully double, crimson red flowers of perfect form and shape. Petals are prominently veined darker crimson (Kasturi Rangan, 1971).

Anurag : It is a hybrid seedling of 'Sweet Afton' X 'Gulzar'. Bush is medium and balanced with upright growth. Plants are vigorous and very hardy. Cultivar has shapely blooms of high centre, tyrian rose in colour with high fragrance. Flowers are borne on strong shoots singly and attain exhibition size bloom (IARI, 1980).

Apsara : It is a hybrid seedling of ' Sonia Meilland' X 'Sabine'. Imaculate buds are produced on very long upright stems. Flower colour is flesh pink with lovely salmon shading. There, being one flower to each stem, which is vigorous and floriferous. Buds open slowly to beautiful multipetalled shapely blooms, which are long lasting. It is a good variety for cut flowers (IARI, 1983).

Arati : It is a hybrid seedling of 'Columbus Queen' X 'Roundelay'. Blooms are high centred and slightly fragrant. Petals have two-toned pink, inside of petals a clear pink with reverse of the petals a deeper rosy pink (Kasturi Rangan, 1975).

Aravali Princess : This cultivar of rose is raised from natural cross of 'Sonia'. Bloom is lovely and having porcelian pink petals. Flowers are high centred, open into big size flower and have very large number of petals. Petals are arranged very beautifully and systematically on flower in imbricate fashion. The outer most petal whorl sometimes have a flush of deep pink (Dr. B. P. Pal, 1983).

Archana : It is a hybrid seedling of 'Gracious Lady' X 'Tyrius'. Flower is bicolour pink, a rare combination with good shape and quality (Kasturi Rangan, 1977).

Argha : A hybrid seedling of ' Sugandha' X 'Friedrich Schwarz'. Flowers are long lasting, sweetly scented and dusky red in colour (S. Banerjee).

Arjun : It is a hybrid seedling of of 'Blithe Spirit' X 'Montezuma'. Flowers are large beautifully shaped and porcelain red in colour. Blooms are borne in very long shoots of medium thickness emerging from the base. Flowers are very attractive, long lasting and are of export quality. Plants are hardy, extra tall and upright in growth. Cultivar is tolerant to most diseases and pests. Cultivar is suitable for export of cut flowers (IARI, 1980).

Aruna : It is a seedling of rose cultivar 'Independence'. Plant growth is vigorous and produced plenty of flowers. Flowers are medium sized and freely produced in warm weather. Blooms are produced mostly singly. Small clusters are occasionally formed. Flower colour is brilliant shade of velvety orange scarlet (Dr. B. P. Pal, 1968).

Asha : This cultivar of rose is a bud sport of 'Wendy Cussons'. Plant bears high

centred huge fragrant flowers. Blooms are of exhibition type. Petal colour is blend of salmon yellow and pink (Friends Rosary, 1968).

Ashirwad : This superb cultivar of rose is very attractive. Flower colour is bright current red. Base of the petal is golden. Buds open into large and double flowers. Blooms are high centred. Petals are broad and recurved in nature. It gives attractive looks to the flowers. Blooms are slightly fragrant (Dr. B. P. Pal, 1984).

Ashwini : It is a hybrid seedling of 'Roter Champagner' X 'Milord'. Flowers are excellent in shape and brilliant ruby red in colour. It is the deepest blackish red rose. Blooms are huge and having many petals (Kasturi Rangan, 1972).

Avra : Flowers are double and having good form. Petal colour is silvery mauve to pink (A. M. Bhattacharjee, 1967).

Bagha Jatin : It is a hybrid seedling of 'Crimson Glory' X 'The Doctor'. Flowers are sparkling red in colour and have sweet scent (A. K. Roychoudhury, 1952).

Baijubawara : The cultivar is having huge blooms of lemon white to pure white. Petal edge is mauve to carmine pink in colour (S. M. Bhattacharjee, 1966).

Balaji : This cultivar is a bud sport of 'Srinivasa'. Blooms are classical and freely produced. It is a bicolour rose with attractive look. Flowers are pinkish salmon and reverse side of petal is pronounced cream to white. Blooms are very shapely and have high centred (B. K. Patil, 1998).

Balwant : It is a budsport of 'Christian Dior'. Bloom colour is non-fading apricot. Flowers have excellent shape and form reminiscent of "Christian Dior'. The huge flowers last for a long time on the plant and when cut. It is good for exhibition and as cut flowers (G. K. Phadtare).

Banaras Dwan : Flowers are very floriferous and appears on long stem. Blooms are apricot coloured rose with gold base with as many petals as in cultivar 'Medallion'. Flowers are shapelier, much deeper and have more fragrance (Maj. Saxena, Doon Valley Roses).

Bapuji : Flowers are large, double and scented. The colour of the bloom is white with cream to milky white centre (A. M. Bhattacharjee, 1959).

Basanti : Blooms are large and their shape is flat. Flower colour ranges from amber yellow to intense yellow (B. S. Bhattacharjee, 1962).

Belle of Punjab : Blooms of this cultivar appears in single or in clusters. Flower colour is warm salmon pink. Flower size is good (Dr. B. P. Pal, 1969).

Bhairavee : Blooms are double. Flower colour is brownish orange with carmine colour on the reverse side of the petals (A. M. Bhattacharjee, 1967).

Bhairavi : It is a hybrid seedling of 'Oklahoma' X 'National Trust'. Blooms are large and strongly scented. Flower colour is dark blackish red. Petals are reflexed (Kasturi Rangan, 1977).

Bhanu : This cultivar of rose is having well formed flowers with good petallage. Flower colour is blended with cream to yellow with pink. Blooms are having good fragrance (Kasturi Rangan (KSG Sons), 1990).

Bharat : It is a large flowered cultivar. Blooms are double with bright silvery pink petals with yellow base (A. M. Bhattacharjee, 1960).

Bharati : This cultivar of rose is released in the name of second daughter of Mr. O. P. Agarwal of Freinds Rosary. Flowers are blushing pink in colour. Blooms are majestic and will please any connoisseur. This cultivar of rose can be planted in any situation (Friends Rosery, 1984).

Bhargav : This cultivar of rose is a superb and known for its classical shape of the blooms. Buds are elegant and perfect. Flowers are shapely and well formed. Bloom colour is very light unusual coral pink. Blooms are lasting with mild fragrance (Kasturi Rangan KSG Sons, 1993).

Bhavani : It is a hybrid seedling of 'Cral Sunset' x 'San Antonio, Bloom colour is carmine to salmon orange. It is a free flowering cultivar with good petallage. Flowers are scented (Kasturi Rangan, KSG Sons, 1975).

Bhim : It is a hybrid seedling of 'Charles Mallerin' x 'Delhi Princess'. Bush is very vigorous and dense with dark green foliage. Blooms are huge, well formed and are held on strong stem. Flowers have many petals. Flower colour is scarlet red. Blooms are scented, long lasting and stand well in severe cold climate. This variety is highly recommended (IARI, 1970).

Bidhan Babu : Buds as very long. A flower open with hundred petals, flowers colour is dark red to crimson. Flowers have sweet fragrance. Ideal for warmer regions (S. M. Bhattacharjee, 1964).

Birat : It is large flower cultivar. Flower colour range is pastel-pink to delicate coral (S. M. Bhattacharjee, 1964).

Black Delight : This is a free flowering cultivar of rose. Flower colour is deepest blackish red. Blooms are shapely and well formed and almost black (Gayathri and Laxminarayan, 1985).

Blue Delight : It is a hybrid of 'Lady X' x 'Clarie de Lune'. The colour of bud is lavender gray with a pink tinge. Flowers are perfectly shaped with good petallage and have strong fragrance. Colour of the blooms is orchid mauve. Plant growth is vigours and sturdy. Flowers have beautiful reflexed petal edges (Kasturi Rangan (KSG Sons), 1980).

Blue Ocean : This cultivar of rose is having high centred flower with perfect shape. Bloom colour is light mauve. Edge of the petal devlopes deeper mauve colour (Dr. Y. K. Hande, 1983).

Bodhi Sattwa : This cultivar of rose is having very vigorous and healthy bush that can grow to shrub like proportion. Buds are elegant and their shape resembles with lotus. Colour of the buds ranges from pink to white, which opens in to very large flower. Colour of the blooms is white with pinkish red margins. It is clearly visible on petals. Name in honour of Sri B. S. Bhattacharjee, India's premier hybridiser. This cultivar is also known as 'Magic East' (M. S. Viraraghavan, 1988).

Brahm Datt : It is a hybrid seedling of rose cultivar 'Sahasradhara' and 'Pristine'. Variety is good for exhibition and was named after the grand old man Brahm Datt who was one of the leading breeder and lover of roses. Plant is bushy with glossy foliage and

highly floriferous. Elegant buds are very exquisite and open to shapely well-formed fragrant flower. Flower colour is lovely cream flushed and blended with pink (Dr. N. V. Shastri, 1998).

Calcutta : This cultivar is a superb striped bud sport of 'Taj Mahal'. Stripes and streaks are very prominent on petal surface. This striped rose is having patches of white, etched on broad petals on bright pink surface, which is very showy. This free flowering cultivar is having shapely large flowers, which are well formed (Swamy Vinyananda and K. Bhattacharjee, 1994).

Cauvery : It is a hybrid seedling of 'Roundelay' x 'Oklahoma'. Flower colour is non-fading blackish crimson red. Blooms are double and are of medium size. Plant blooms very freely (G. Kasturi Rangan (KSG Son), 1973)

Ceearcee : This cultivar of rose is a bud sport of 'Dolly Parton'. Striped mutant is having light pink stripes on vermilion background, which is prominently displayed on petal surface. Flowers are highly fragrant. This cultivar is dedicated to the rose breeder Sri C. R. Chiplunkar of Ichalkaranji (Jayant and Anand Gokhale, 1995).

Chaitra : It is a hybrid seedling of 'Percy Pilcher' x 'Orangeade'. Blooms colour is vivid and lustrous fiery red, which is non-fading. Flowers are of medium sized. The shape and form of the flowers are faultless (Kasturi Rangan 1972).

Chamak : It is hybrid seedling of 'Mirandy' X 'Sugaudha'. Blooms are of medium large size. The colour of flower is light pink. Blooms are fragrant (S. Banerjee)

Champa : Buds of this cultivar is long pointed. Blooms open in clusters (Possibly more a Floribunda) (B. S. Bhattacharjee, 1956)

Chanderi : It is seedling of 'Peace'. The cultivar is having fine buds, which possess a blend of light pink, and pale green colour flowers are of large size (R. S. Singh, 1968)

Chambe di Kali : This cultivar is very vigorous and floriferous. It has very large centered pink buds, reminiscent of 'Princess Margaret of England' and they open into large blooms on extended straight stems. Flower colour is glowing rose pink. Plants are vigorous in growth and have handsome shiny foliage. Blooms have light fragrance (Dr. B. P. Pal, 1983).

Chandralekha It is a bud sport of 'Siddartha', which retains all the characters of 'Christian Dior'; except the colour deep coral pink with a shade of salmon. Blooms are of wonderful shape and forms. Flowers are scented (Rama Rao S. Jagtap).

Charugandha : It is a hybrid seedling of 'Delhi Princes' X 'Eiffel Tower'. Blooms crimson red with velvety sheen on petals. Blooms are very large & well formed. Blooms are borne singly on strong shoots in winter; highly fragrant (IARI, 1972)

Chitra : It is a bud sport of tea rose variety 'Janina'. Blooms are striped and spotted. Blooms are very attractive due to presence of creamish white, white and golden yellow coloured stripes and spot on vermilion orange base of petals. Plant is vigorous and produces long and elegant buds, which opens into large size fragrant flowers. Bloom possesses beautiful yellow centre. Flowers are not affected during winter months. In spring season the flowers are produced in large bunches and foliage looks attractive due to development of different shades of green and brown pigments (IARI, 1995).

Chitra Bhanu : It is a hybrid seedling of 'Mirandy' X 'Friedrich Schwarz'. Blooms are large in size. Flower colour is dark red (S. Banerjee).

Chitralekha : It is a hybrid seedling of 'Montezuma' X ' Baccara'. Flower colour is Ruby red, which gives smoky effect during cold winter. Blooms are large in size and borne freely on long strong shoots. Plant growth is vigorous (IARI, 1972).

Chitrangini : It is seedling of 'Grand Opera 'X' Unknown'; it is vigorous variety, produces flower freely. Blooms are multicolored with blends of light yellow suffiused pink, turning to orange and red with ageing. Flowers are scented (G. Kasturi Rangan, 1970).

Chittaranjan : Flower is this cultivar exhibits orient red to vermillion red colour. Flowers are double in nature. Blooms are flat and appear in small clusters (S. M. Bhattacharjee, 1967).

Chittaranjani : This cultivar of rose is having multicolour flowers. Blooms are shapely with good petallage. Flower colour is ivory white with tinge of pink. Colour of the bloom turns deeper and turning to deep rose red with aging (G. Kasturi Rangan (KSG Son), 1985).

Chitwan : It is hybrid of 'Western Sun' X 'Golden Splendour'. Buds are beautiful and have yellow colour that turns to primrose yellow at opening. Blooms are large, shapely and are borne freely. Flower appears in compact bushes, singly in large number. Plant growth is vigorous. It is an ideal cultivar for bedding (IARI 1971).

Chocolate : Flower of this cultivar have dark crimson colour with blend of dusky chocolate shade; blooms are intensely fragrant (S. M. Bhattacharjee, 1964).

City of Panjim : This cultivar of rose is dedicated to the people of Goa, whose capital is Panji. Blooms are bicolour. Flower colour is pink and off-white (G. Kasturi Rangan (KSG Son), 1972).

Classic : Plant growth of this cultivar is vigorous. Flower possesses strong fragrance. Blooms' colour is glowing deep pink. Massive bloom appears on plant. Flowers are well shaped, developed from shaping lovely buds with broad petals (G. Kasturi Rangan and Sriram (KSG'S rose), 1997).

Colour Harmony : This cultivar is a free bloomer. It is a hybrid raised after cross of 'Headliner' X 'Gold medal'. This is a lovely blended rose cultivar and bears long tapering buds, open slowly to nicely formed flowers. Bloom colour is cream blended light pink turning to deep pink. Petal edges are reddish pink (Mr. and Mrs. S. Ghosh, 1998).

Courageous Indira : This cultivar is striped novelty of 'Summer Holiday'. Blooms are shapely and perfect. Petals are having dazzling orange vermilion colour on background through which striking white stripes and streak run (Chandrakant More, 1991).

Cynosure : It is hybrid of 'Scarlet Knight' X 'Festival Beauty'; it is a bicolour cultivar. Blooms are having purple pink stripes on red petals background, flowers are of medium sized one or more on long stems; it is an abundant and continuous bloomer, Plant growth is vigorous, upright. The cultivar is disease resistant. Foliage is small deep green glossy surface (Hardikar 1971).

Dark Boy : It is seedling of 'Nigrette'. Flowers are velvety, very dark maroon red

in colour (almost black in cool weather). Size of the flower is medium. Blooms are freely produced on plant (Dr. B. P. Pal, 1965).

Decan Delux : This cultivar of rose is a bud sport of 'Dr. B. P. Pal'. Flowers are shapely and appear on long stem. Bloom colour is pale pink. Cultivar is good for cutting and exhibition (C. R. Chiplunkar, 1988).

Deenabandhu Rev. Andrews : It is a free flowering cultivar of rose. Buds of this cultivar is perfect. Flowers are loose. Colour of blooms is chamois-yellow to buff-pink (B. S. Bhattacharjee, 1959).

Deepak Rag : The colour of the flower is intensive vermillion-orange to flame orange. Blooms are of medium size. Flower is informally shaped. This Floribunda-type flower produces a good colour effect (B. S. Bhattacharjee, 1959).

Deepti : It is large flowered cultivars of rose. Flowers are large and loose. The colour of the blooms ranges from flame-orange to salmon pink (B. S. Bhattacharjee, 1962).

Delhi Apricot : The cultivar produce apricot yellow to light coppery orange buds which open to decorative blooms. The plant growth is vigorous and the cultivar is floriferous in nature (Dr. B. P. Pal, 1964).

Delhi Debutante : The flower colour is clear medium pink. The buds are beautifully shaped and open to medium large flowers. Blooms are having delightful fragrance (Dr. B. P. Pal, 1964).

Delhi Pastel : It is seedling of 'Una Wallace'. The cultivar is of exhibition type. The colour of the bloom is pale pastel pink. Remaning of the character are like "Una Wallace" except the colour. The colour of "Una Wallace" is of much deeper in nature (Dr. B. P. Pal, 1964).

Delhi Sun Shine : It is seedling of 'Mme Charles Sauvage'. Flower colour is deep unfading cream, sometime flushed pink outside imbricated. Blooms are somewhat flattened and large. The arrangement of petals in flower is extremely regular which provides attractive look to the flower. The edges of the petal are frilly. It is profusely blooming cultivar and suitable for warm weather (Dr. B. P. Pal, 1963).

Dharampuri : It is a hybrid seedling of "First Prize" X ('Gruss an Teplitz' X unknown) X 'Samouri'). Flower colour is shades of brick red. Forms of the blooms are unusual (Viraraghavan, 1978).

Dick Della : This cultivar is bud sport of 'Ace of Heart'. Flower colour is dark pink and remaining of the characters are same as the parent. Elegant pointed buds open in to large, huge centred classic blooms. Flowers have fragrance. Cultivar is good for exhibition. This rose is dedicated and named after Dr. Dick Balfour past President of World Federation of Rose and his wife Mrs. Della (C. R. Chiplunkar, 1996).

Dilkhus : It is a large flower cultivar of rose. Flowers are double and their colour is bright red. Blooms are very fragrant (A. M. Bhattacharjee, 1964).

Dil- Ki- Rani : The flower colour is a combination of lovely shade of ethereal pink with a tinge of lavender. Buds are long and beautiful and open into large high centred blooms. Flowers have exquisite shape. Blooms are of exhibition quality. Bush is vigorous. Cultivar is very floriferous and bear perfect flowers (Dr. B. P. Pal, 1985).

Dilruba : This cultivar is having glorious blackish velvety crimson colour flowers which borne on strudy erect and hardy plant. Buds are elegant. Blooms are high centered with many attractive petals. Flowers are highly fragrant and having very good keeping quality when cut. Bloom size is large. Plant is having variegated leaves which provides additional beauty to the plant (Dr. B. P. Pal, 1984).

Diva Swapna : This cultivar is progeny of rose cultivar 'Sonia'. Flower colour resemble with cultivar 'Dream'. Flower colour is blend of shimmering silvery pink and white. Bloom possesses good fragrance. Buds are lovely and open on stiff stem. Flowers are beautiful and long lasting. Petals are reflexing. Flowers are good for cutting and exhibition (Dr. B. P. Pal, 1981).

Devine Light : It is a seedling of 'Paddy Mcgredy'. Colour of buds is crystal white with lighter touch of bluish pink in the centre. Blooms are borne on strong stems and have high centre. Like its parents 'Devine Light' have thick branching, low spreading habit and prolific blooming. Flowers are very attractive (Mrs. P. L. Airun, 1981).

Diversity : The name diversity was given to this cultivar because no two flowers of the plant are alike. Flowers are shapely and are of medium size. Petals have pale salmon base. Many of the blooms are bicolour i. e. scarlet and yellow with well-marked stripe of yellow. This cultivar is a free flowering in nature (Kasturi and Sriram, 1995).

Dr. Benjamin Pal : This hybrid is raised from cross between 'Sweet Afton' and 'First Prize'. Plant is upright growing and vigorous in nature. Buds are long pointed and deep pink in colour, which opens into large flowers. Blooms are slightly fragrant and have lighter shades in the centre. In the open blooms, petals of the inner side produces bicolour effect, as base of the petal is paler in colour. Flowers are produced in very long and strudy stems and have more than 45 petals (IARI, 1993).

Dr. B. P. Pal : This cultivar of rose is named to honour leading rosarian of India. Plant is vigorous and upright in growth. Growing bush possesses abundant flowers. This variety is developed from seedling number 350C. Flowers are large, slightly fragrant and possess approximately 77 petals with high centre. Blooms appear on long and straight shoots. Flowers have attractive, luminescent pink colour. Shape of blooms is compact. Flowers have good lasting quality. Flowers are not affected by frost. Lasting flowers are abundantly produced (IARI, 1980).

Dr. Budhan : This cultivar possesses large flowers. Bloom colour is glowing crimson. Flowers have fragrance (B. S. Bhattacharjee, 1957).

Dr. Homi Bhabha : It is a seedling of rose cultivar 'Virgo'. Buds are white but sometimes possesses faintest shades of cream or amber. Shape of bud is beautiful. Colour of the blooms is white. Flowers have approximately 60 petals. It is better than most of the white varieties of roses. It can withstand low temperature of the winters and warm weather in early summer (Dr. B. P. Pal, 1968).

Dr. Kidwai : It is a seedling of rose cultivar 'Paradise'. Hybrid seedling is a product of cross between cultivar 'Paradise' X 'Oklahoma'. Flower is lustrous pale pink in colour. Outer petal edges are blended with magenta. It gives superb outlook. Blooms are classic high centred and formed from shapely buds. Flower appears on vigorous plant (C. R. Chiplunkar, 1988).

Dr. K. Biswas : Plant is having tapering buds. Blooms are large, flat and fragrant. Flower colour is yellow. Petals edges are splashed pink in colour (B. S. Bhattacharjee, 1956).

Dr. M. S. Randhawa : Seedling is raised from a cross between 'Sabine' and 'Kiss of Fire'. The flower size is large and has more than fifty petals, which gives the flower double appearance. Out side of the petal is creamy white and inner side is having splashed. Edge of the petal is deep pink on a white background. Flower is having pleasant fragrance. Plant is vigorous and having upright growth with floriferous nature (Dr. B. P. Pal, 1989).

Dr. Noshir Wadia : It is a bud sport of attractive rose cultivar 'Norma'. This stripe mutant is having stripes on both surfaces of the petals. Petals are dark red in colour with plenty of white and pink stripes. It gives mosaic appearance (C. R. Chiplunkar, 1992).

Dr. P. Banerjee : It is a bud sport of rose cultivar 'Queen Fabiola'. Flower colour is light pink (A. K. Roy Choudhury, 1970).

Dr. R. R. Pal : Plant growth and flowering of this cultivar is excellent. Bloom colour ranges from very deep rose to dark velvety red. Bloom size is large with plenty of petals, which are very attractive (Dr. B. P. Pal, 1983).

Dr. S. D. Mukherjee : It is a seedling of 'Hadley' X 'Fascination'. Flower colour is vermilion and pink (A. K. Roy Choudhury, 1965).

Dulhan : It is a seedling of 'Bonne Nuit' and 'Ena Harkness'. Growth habit of this cultivar is free and it looks very robust just like its parents. Blooms are large, arractive and fragrant in nature. Flower colour ranges from rose red to red. Base of the petals are having cream colour. The colour of the bloom changes with ages. White streaks and splashes may appear in advance stage of flower growth. It looks very clear at the edges of the petals. Plant is tall and its growth is vigorous. It blooms freely (Dr. B. P. Pal, 1983).

Durgapur Delight : It is a bud sport of rose cultivar 'Montezuma'. This vigorous bush is having plenty of green foliage. The most free flowering cultivar has all the characteristic of 'Montezuma' except the flower colour. Colour of the bloom is porcelain pink (K. D. Gupta, 1980).

Durgapur Jubilee : This is a free flowering cultivar of rose, which has balanced vigorous bush. Flowers are having light pink petals with deeper pink edges. Buds open in to high centred flower that are long lasting. Petals are having reflexing tendencies with prominent veins, gives it additional beauty (Mr. and Mrs. S. Ghosh, 1998).

Eastern Princess : This cultivar of rose is free flowering and has vigorous growth with purplish red foliage. Flower colour is novel orange coral with gold base, provides luster to the blooms. Buds are beautiful, elegant and open slowly keeping the high pointed centre. Petals are large and reflexed beautifully as the blooms opens. Flower possesses strong scent (Dr. B. P. Pal, 1984)

Ferzaan : This cultivar of rose is suitable for growing in warmer regions. Buds are tapering. Flower colour is rosy pink to magenta pink. (S. M. Bhattacharjee, 1964).

First Rose Convention : It is a hybrid seedling of 'Kronenbourg' X 'Helen Traubel'.

Plant growth is upright and vigorous. Stem is strong. It is a disease resistant cultivar. This large flower cultivar possesses dark red blooms with very dark colour at edge of petal (Dr. M. N. Hardikar, 1971).

Fragrant Beauty : This cultivar of rose is having strong plant with good perfume. Flower colour is bright luminous scarlet crimson. Large flower opens from elegant buds and have perfect shape. Cultivar inherited its perfume bearing characters from its parent 'Hidalgo' (Mr. and Mrs. S. Ghosh,1998).

Gairik : Flower colour ranges from saffron orange to salmon pink. Blooms are double and globular in shape (S. M. Bhattacharjee, 1966).

Ganga : It is a seedling of rose cultivar 'Sabine'. This cultivar is very floriferous and has golden yellow flowers. Buds are medium, pointed and looks very attractive. Flowers are borne freely and singly on straight stem and blooms throughout the season. The bush is vigorously growing and full of flowers (IARI, 1970).

Gayatri : It is a hybrid of ' San Antino' X 'Trade Winds'. Flower colour is deep ruby red. The petals have creamy base and reverse side of it is paler. The flower have high centre (G. Kasturi Rangan, 1973).

Ghazal : Blooms of this cultivar are shapely. Flowers are charming and have high centred. Colour of the flower is rose pink with light shades. The plant growth is upright and compact. Cultivar possesses healthy foliage (R. S. Singh, 1970).

Girija : This cultivar of rose is very beautiful and attractive. Flower colour is crimson red. Blooms are of classic shaped. Named after Mrs. Girija Viraraghavan, well known in rosarian circles in the country and the wife of the breeder Sri M. S. Viraraghavan (Friends Rosery, 1988).

G. K. Rose : This cutivar of rose is bicolour. Petal colour is dark crimson and its base and reverse side is white cream. Flower is of huge size and possesses lots of petals (C. R. Chiplunkar, 1989).

Glamour Girl : This cultivar of rose is having a wonderful colour blend. It is a hybrid seedling developed from cross of 'Akibono' and 'Peace'. Blooms are deep yellow in colour. Petals have flushed red and pink combination with deeper veins. Large star shaped blooms of unique colouring appears on strong stem that have glossy foliage. Flowers are having good shape and form (Mr. and Mrs. S. Ghosh, 1998).

Godavari : It is a seedling of rose cultivar developed from the cross of 'Alegro' and 'Agnihotri'. This cultivar of rose is having elegant buds which opens in to shapely well formed flowers. Flower colour is vibrant vermilion (G. Kasturi Rangan (KSG Son), 1987).

Golconda : It is a seedling of 'Mme Charles Sauvage'. Flower colour varies from pale yellow to deep apricot. Centre of the blooms are usually deep. Flowers are large, attractive and have pleasing light fragrance. Plant growth is vigorous (Dr. B. P. Pal, 1968).

Golden Afternoon : This cultivar of rose is very floriferous in nature and possesses strong spicy fragrance and good glossy leaves. Blooms have glorious colour. Petals have golden apricot and orange colour on the upper surface and rich coppery colour on the outside (Dr. B. P. Pal, 1983).

Golden Biotech : This cultivar of rose is having free and lasting flowers on long canes. Buds are long and sleek and golden yellow in colour. Exquisitely shaped blooms are having lovely blend of yellow. Petals are broad and have pink flush. Released from Nagpur University to commemorate the Golden Jubilee of Biochemistry (Dr. N. V. Shastri, 1998)

Gomathi : It is a hybrid seedling developed from the cross between 'Sonia Meilland' and 'Apsara'. Bloom colour is flesh pink. Petals are blended with darker pink. Shape of the flowers is perfect. The cultivar is ideal for exhibition and cutting (G. Kasturi Rangan (KSG Son), 1987).

Gourth : The cultivar possesses perfectly shaped large flowers. Flower colour ranges from butter yellow to lemon yellow. Petal edges are tinted pink (B. S. Bhattacharjee, 1960).

Gulabi Attar : This cultivar of rose has medium size flowers. Blooms are full and compact. Colour of the flower is magenta red. Flowers are delightfully scented (B. S. Bhattachajee, 1956).

Gulbadan : The plant possesses large flowers. Bud colour is light yellow and peach pink shaded with dark red. Bloom colour is creamy white and edges of the petals flushed with pink. It gives very striking effect to the flowers. Blooms are fragrant (Dr. B. P. Pal, 1976).

Gulzar : It is a hybrid seedling of 'Kiss of Fire' X 'Prelude'. Bush is compact. Flower colour is deep magenta red. Blooms are borne on strong shoot, which are exquisitely formed. Flowers normally appear in bunches and tend to become more bluish in colour. Flowers have fragrance (IARI, 1971).

Hans : It is a hybrid seedling of 'Meassage' x 'Virgo'. Flowers borne in a long shoot. Bush is growing upright with light green foliage. Flowers are white, blooms shapely and are not damaged by cold (IARI, 1970).

Harangi : It is a hybrid seedling of 'Bengali' X 'Peehtold Flame'. It is a free flowering cultivar and suitable for cool climate. Flower colour is spectrum red overshot coppery orange. Reverse side of the petal is yellow (Kasturi Rangan, 1976).

Harida : It is a large flower cultivar. Flower colour is intense yellow. Blooms have fragrance (S. M. Bhattacharjee, 1966).

Haseena : It is a hybrid seedling of 'Youki San' X 'Balnese'. Plant attains medium height. Flowers are perfectly shaped. Buds are long and open into large and lovely blooms. Flower colour is soft pink. Occasionally with a light lilac flush. Blooms are fragrant and long lasting (IARI, 1979).

Heart Throb : This cultivar of rose possesses very large flowers. Flowers are double. Blooms are scarlet red in colour and very fragrant (S. M. Bhattacharjee, 1964).

Heer : Plant growth of this cultivar is upright. Flowers are classic shaped appears on strong stem. The colour of blooms is rose pink (R. S. Singh, 1969).

His Highness : This cultivar is a massive bloomer. The colour of the flower is a mixture of pastel pink and cream (B. S. Bhattacharjee, 1960).

Homage : It is a hybrid seedling of 'Sonia' X 'Princess Margaret of England'. Plant

growth is vigorous and cultivar blooms freely. Buds are cerise red in colour and open into large and double flower. Bloom colour is deep warm pink. Reverse side of the petal is lighter in colour. Back side of the petal is pink lavender and with age it turns into lilac pink. Flower possesses about 30 petals. Flowers are borne on long stem and their shape remains fresh for a long period. Blooms are of exhibition quality with high centre and remain fresh and attractive for a long period (Dr. B. P. Pal, 1986).

Ichalkaranji 100 : This cultivar of rose is named in commemoration of centenary of Ichalkarangi Nagarpalika. Flower of this cultivar is huge and its colour is lavender pink. Outer petals edges and its reverse side is darker hue. Blooms are of well shape (C. R. Chiplunkar, Decospin, 1993).

ICO Ambassador : It is a light chrome yellow colour bud sport of rose cultivar "Ambassador". Buds are of elegant shape and open in to shapely flowers. It is a free flowering cultivar and produce quality blooms. It is good for cutting and exhibition (B. K. Patil, Icospin, 1985).

ICO Beauty : This cultivar of rose is a bud sport of 'Red Planet'. Bloom colour is pink. Flowers are high centred. It is a free flowering cultivar (B. K. Patil, Icospin, 1985).

ICO Delight : This cultivar of rose is a bud sport of 'Etema'. Buds are of elegant shape. Flowers are large, double, classical and pure white in colour. It is very good for cut flower and can be used for exhibition purpose (B. K. Patil, Icospin, 1989).

ICO Delux : This cultivar of rose is a bud sport of 'Mistraline'. Flower colour is pale pink. Blooms are well formed and have broad petals. Cultivar is free flowering and last long (B. K. Patil, Icospin, 1990).

ICO Trimurti : This cultivar of rose is a striped bud sport of 'Yeswant'. Colour of the flowers are rose pink with peripheral side yellow, having white stripes and splashes on inside of the petals (B. K. Patil, Icospin, 1989).

Indian Princess : It is a hybrid seedling of 'Super Star' x 'Granada'. Plant growth is vigorous. Buds are long and open into large, well-shaped flower. Bloom colour is a vibrant carmine vermillion. It is very attractive and striking. The colour of outer petal is light red while the inner petals are carmine pink with silvery edge. Flowers have fragrance (Dr. B. P. Pal, 1980).

Indu Singhal : This cutivar of rose is a charming bud sport of 'Queen Elizabeth . It is a superb striped and attractive cultivar of rose. Flower colour is delightful pink. Petals are broad and marked and etched with white stripes (R. P. Singhal, 1995).

Invention : This cultivar of rose is a bud sport of 'Anvil Spark'. Shapely buds open into flowers, which are generously produced. Bloom colour is salmon and carmine (B. K. Patil, Icospin, 1988).

Jaslok : This cultivar of rose is a bud sport of 'Blue Ocean'. This striped mutant is very attractive and have light silvery mauve blooms marked clearly, dark mauve stripes. Flowers are fully double. Blooms have plenty of petallage. Flowers are shapely and well formed. The cultivar has been named after the famous hospital Jaslok (C. R. Chiplunkar, 1992).

Jawahar : It is a hybrid seedling of 'Sweet Afton' x 'Delhi Princess'. Plant growth is upright and vigorous. Developing buds changes its colour from greenish white into creamish white. Flowers are very large with high centered. Blooms are well formed and appear singly or in small bunch of two or three on strong shoot. Petals are spirally arranged in flower that enhances its beauty. It is a very good exhibition rose. The tall upright growing bush has light green foliage. Flowers have strong fragrance (IARI, 1980).

Jawani : The hybrid is raised from a cross between 'Scarlet Queen Elizabeth' and 'Louisiana'. Cultivar has all the good quality of its parents. Flower colour is orange red. Flower is long lasting. Blooms are large in size and their shape is attractive and good. Fully open blooms exhibit imbricate forms. Cultivar is having strong growth and eye catching colour (Dr. B. P. Pal, 1985).

Jayant : This cultivar is a striped bud sport of "Maharshi' which itself is a vermilion coloured bud sport of rose cultivar 'Kardinal'. Petals are deep vermilion in colour having white predominant stripes on its surface. This is a very bright and outstanding cultivar of rose. Blooms are shapely and well formed. The cultivar has been named in memory of late Sri Jayant Gokhle, eminent roserian of Indore (Anand Gokhale, 1998).

Jayatsen : This cultivar of rose is a hybrid evolved as a result of cross between 'Princess De Monaco' and 'Only You'. It is a very attractive and distinctive cultivar having bicolour blooms. Flowers are deep pink in colour and have white colour on the reverse side of the petals. Buds are very shapely, opens very slowly into large flowers, which possesses plenty of petals. Plant growth is vigorous. It is good for exhibition (G. K. Kasturi Rangan and Sriram, 1998).

Jaypee Rose : This cultivar of rose is striped bud sport of 'Bicolette'. Cultivar is having look of a hand painted rose. Blooms have a lovely bicolour of rusty red and creamish yellow reverse displaying pink and white stripes on red. This lovely rose named after great old man Sri J. P. Agarwal of Friends Rosery (Jayant and Anand Gokhale, 1996).

Jimutbahan : Growth of this rose cultivar is moderate. Flowers are of medium size. Bloom colour is milky white. Flower possesses very sweet perfume (B. S. Bhattacharjee, 1960).

Jogan : This cultivar of rose is a bud sport of 'Folklore'. Blooms are of beautiful shape and colour reminding Jogan i. e. rode a pale apricot (O. P. Bansal, 1988).

Joy : Blooms of this cultivar is very large. Flower colour is dark pinkish red. Petals have dull white colour on its reverse side (S. M. Bhattacharjee, 1964).

Jyotish : Buds of this cultivar is short which opens into large, flat, and compact flowers. Flower colour is orange red. Petal colour is soft yellow on reverse side (S. M. Bhattacharjee, 1967).

Kabini : It is a hybrid seedling of 'American Home' X 'Sherry'. Flower colour is mehagony red. Petals have smoky shading on their surface, which provides attractive look. Flowers are highly centred (G. Kasturi Rangan, 1978).

Kailash : Flower of this cultivar is globular. Blooms are white and have greenish flush. Blooms are fragrant (A. M. Bhattacharjee, 1960).

Kajjal : The cultivar possesses bud, which is dark velvety crimson colour. Flower size is large. Flower is flat when fully open. This cultivar is having highly perfumed flowers (S. M. Bhattacharjee, 1964).

Kaladi : This cultivar of rose is having flowers with salmon colour and with yellow base and reverse. Bloom develops deeper tone of apricot orange red with aging of flowers. Blooms are well formed, freely produced and last long. Kaladi has been named after the sacred birthplace of Sri Adi Shankaracharya (G. Kasturi Rangan and Sriram (KSG Son), 1988).

Kalima : It is a profusely blooming cultivar of rose. Blooms are bright and velvety blackish crimson colour. Reverse side of the petal is red (A. M. Bhattacharjee, 1959).

Kalpana : It is a hybrid seedling of 'Roundelay' X 'Allegro'. Flower colour is carmine cinnabar red. The blooms have 70 petals, which are very long lasting (G. Kasturi Rangan, 1968).

Kalyani : This cultivar is a hybrid evolved as a result of cross between 'Diorama' and 'Angel Delight'. Exquisite big buds open slowly to large, big flowers of good shape and form. This lovely and unique rose flowers have broad petals which have rich salmon creamy yellow base and reverse (Kasturi and Sriram, 1995).

Kamala : It is a large flower cultivar of rose. Flower colour is deep orange salmon with golden base. (B. S. Bhattacharjee, 1959).

Kamala Devi Chattopadhyay : It is a seedling raised from a cross between 'Sonia' and 'Kathleen O' Rourkee'. Plant growth is vigorous with good foliage. Flowers are borne on long and upright stems. Blooms are large and double in nature. Flower colour is brilliant orange salmon. Blooms open slowly. Flowers are long lasting and have fragrance (Dr. B. P. Pal, 1989).

Kamalini : It is a beautiful cultivar of rose. Flowers are large and satin pink in colour. Reflexed edge of petal makes the flower more attractive. Plant growth is vigorous (A. M. Bhattacharjee, 1964).

Kanakangi : It is a seedling of 'Mme Charles Sauvage'. This cultivar possesses blooms having richest shades of gold and apricot colour. Blooms are decorative and have unique lovely colour. Flower possesses delicious Tea type fragrance (Dr. B. P. Pal, 1968).

Kanchani : It is a bud sport of rose cultivar 'Lemon Chiffon'. Buds are of elegant shape and open into perfectly shaped flowers. Blooms are bright yellow in colour with flushed and splashed of red pigment (G. Kasturi Rangan, 1968).

Kanchanjunga : This cultivar of rose has tapering buds, which opens into not very compact flower. Blooms colour is golden yellow. Flowers are very fragrant (B. S. Bhattacharjee, 1960).

Kanchi : It is a seedling of rose cultivar 'Gruss an Teplitz'. Flowers are usually large. Flower appears on strong bush. Bloom colour is magenta purple. Flowers have Tea fragrance. Flowers are good for rose garland (M. S. Viraraghavan,1976).

Kanva : It is a hybrid seedling of 'Proud Land' X 'Lancastrian'. Bloom colour is enchanting salmon pink. Flowers are very elegant (G. Kasturi Rangan, 1976).

Kirang : This cultivar of rose is a bud sport of 'Tata Centenary'. Flowers are deep pink with yellow and white streaks and stripes on petal surface. Blooms are double in nature (Taranga Roses, 1995).

Karunamoy : This cultivar of rose is having carmine pink colour flowers. Petals possesses coppery pink colour on its reverse side (B. S. Bhattacharjee, 1959).

Kasturi Rangan : This cultivar of rose is having dusky mauve flowers with yellow base. Cultivar is always in blooming condition. Pointed, elegantly shaped buds open to flower. Blooms have fragrance (J. P. Agarwal (Friends Rosery), 1983).

Kattambomman : This cultivar of rose have tapering buds. Flowers are big in size. Bloom colour ranges from velvety scarlet to glowing red. Flowers have good fragrance (B. S. Bhattacharjee, 1960).

Kishori : Flowers of this cultivar is bicolour. Carmine and yellow colour gives very attractive look to the flowers. Blooms have good fragrance (B. S. Bhattacharjee, 1966).

Kokanada : This free flowering cultivar of rose is having large size flowers. Blooms are having brilliant crimson colour (B. S. Bhattacharjee, 1960).

Komala : This cultivar of rose is having well formed flowers with broad petals. Flowers have unique pink colour. Petals have rosy pink with almond colour. Buds are ovoid in shape and open in to shapely, huge and double flowers (G. Kasturi Rangan, (KSG Son),1989).

Komla : It is an offspring of 'South Seas' X 'Sweet Afton'. Buds are shapely. Buds appear on long erect stems and opens into large size flower. Flower colour is pale rose pink. Blooms are scented and long lasting (G. Kasturi Rangan, (KSG Son), 1971).

Kovalam : It is a hybrid seedling of ('Amber Light' X 'Traumland') X 'Western Sun'. Bud is round and have light amber colour tone which opens into double and fragrant flowers. Flower colour ranges from white shading to cream. Amber colour is present in the centre of flower (M. S. Viraraghavan, 1976).

Krishna : This cultivar of rose possesses double flowers. Bloom colour is glistening velvety blakish crimson. Flowers are very fragrant (A. M. Bhattacharjee, 1967).

Krithika : It is a hybrid seedling of 'Klesmentina' X'Gracious Lady'. Flower of this cultivar is of exhibition quality. Colour of the bloom is pale flesh pink with buff yellow shading. Quality of the flower is good. Blooms have strong fragrance (G. Kasturi Rangan, 1975).

Kulu Belle : It is a seedling of 'Sabine'. Bud of this cultivar is long tapering which opens into a large flower. Blooms have equisite shape and form. Flower colour is dark pink (Dr. B. P. Pal, 1972).

Kurwal : This cutivar of rose possesses elegant pointed buds, which opens into blooms of equisite shape. Flower is bicolour. Petals have shining pink colour on their surface and its reverse side is cream coloured (R. S. Singh, 1971).

Lal Bahadur : It is a vigorous and free flowering cultivar. Blooms are of large size and have brilliant colour. The colour changes into dark velvety tones in a cool weather. Shapes of the flowers improve during winter months (S. M. Bhattacharjee, 1967).

Lal Kamal : This cultivar of rose is free flowering and vigorous in growth. Flower colour is glowing crimson scarlet. The large flower cultivar looks attractive during winters. Flowers are very fragrant (S. M. Bhattacharjee,).

Lal Makhmal : It is a seedling of the rose cultivar 'Samourai' which is commonly known as 'Scarlet Knight' in the USA. Flowers are large in size and symetrical in shape. Blooms are borne on long upright stem and are very attractive due to its rich glowing colour. Flower colour is very dark velvety red. Petals are ebony red with a scarlet sheen (Dr. B. P. Pal, 1983).

Lalima : This cultivar of rose is having tapering buds. Flower colour ranges from reddish carmine to clear red. Flowers are very fragrant (S. M. Bhattacharjee, 1966).

Lalima : This cutivar of rose is a hybrid seedling, possesses deep rose pink elegant pointed buds which opens into large flower. Bloom colour is light carmine red which is very attractive. Plant growth is vigorous and upright. Blooms are slightly fragrant (Dr. B. P. Pal, 1978).

Lavanya : It is a hybrid seedling of 'Roundelay' x 'Peter Frankenfled'. It has deep rose pink and rose red flowers of medium size. Blooms appear in profusion like Floribunda. Flowers have high pointed center and good shape. Flowers have strong fragrance (G. Kasturi Rangan, 1976).

Laveena : It is a decorative rose cultivar. Blooms are of medium size. Flower colour is light yellow and petals have often tinged with pink colour (Laveena Roses, 1969).

Lemon Time : This cultivar of rose is having large, voluptuous, blooms. Flowers have strikingly lemon yellow colour with green tinge. Buds open to perfect and full flowers. Petals are broad and attractive (G. Kasturi Rangan (KSG Son), 1985).

Lohit : This cultivar of rose is having short buds. Blooms are globular. Flower colour is bright scarlet (B. S. Bhattacharjee, 1960).

Lucknow Peace : It is a bud sport of rose cultivar 'Peace'. Flowers are large and full Blooms are vividly colourful. This variety of rose is very good for exhibition (L. M. Vasisht, 1970).

Madam Cama : Flower of this cultivar is large and moderate. Flower colour is glowing crimson. Petals have crimson colour with scarlet overtone (B. S. Bhattacharjee, 1964).

Madhosh : It is a bud sport of rose cultivar 'Gulzar'. It is a superb variety. This cultivar is very attractive due to it bicolor nature. Blooms are deep magenta red with mauve coloured faint and broad streaks on the surface of the petals (IARI, 1975).

Madhumati : It is a seedling of 'General MacArthur'. Flower size is large. Bloom colour is deep pink. Flower shape is good and produced on a medium tall plant. Flowers have very good fragrance of old rose (Dr. B. P. Pal, 1973).

Madhushala : It is a seedling of 'African Star'. Flower size is large and double. Flower colour is medium deep mauve and its different shades. Plant growth is bushy and more upright in comparison to rose cultivar 'African Star' (Dr. B. P. Pal, 1973).

Magenta Queen : The flower of this cultivar is having magenta flushed with

magenta pink colour. It looks very attractive in half open stage. Blooms are fragrant (B. S. Bhattacharjee, 1959).

Mahalaxmi : This cultivar is a striped bud sport of 'Yeswant'. Flowers are huge, double, high centred and are of exhibition standard. Blooms colour is yellow blended splashed and streaked red yellow and cream. Rose cultivar is dedicated to the famous Goddess of Kolhapur (B. K. Patil, 1988).

Maharani : It is a seedling of "President Macia". Two toned pink, large buds opening into very large, long lasting double flowers of majestic shape, on strong stem (Dr. B. P. Pal, 1986).

Maharshi : This cultivar of rose is a bud sport of 'Kardinal 84 '. Flower colour is glorious vermilion orange. Blooms are shapely and high centred just like its parent. It is a repeat flowering cultivar and good for cut flowers (Tejganga Roses,1995).

Mahasweta : This cultivar of rose possesses high centered buds, which open into large flowers. Bloom colour is pure white and shape of flowers is classical. Flowers have some fragrance (B. S. Bhattacharjee, 1959).

Malak : This cultivar of rose is a bud sport of 'Admiral Rodney'. Blooms are shapely and have high centred with full petalled. Petals are large in size. Flower colour is ivory and pale pink (Mahendra Kumar C. Shah, 1988).

Malkarsiddha : This cultivar of rose is a bud sport of 'Century Two'. Flowers are very attractive and slightly fragrant. Blooms are huge with high centre and their colour is porcelain pink. Petals are broad and etched with white stripe (B. K. Patil, Icospin, 1987).

Malwa 94 : This cultivar of rose is a striped bud sport of 'Eiffle Tower'. Blooms are very attractive and fragrant. Petals are broad pink etched with white stripes. It's a free flowering cultivar (Jayant and Anand Gokhale, 1994).

Maini Ava : It is a bud sport of rose cultivar 'Anvil Sparks'. Flowers are well formed and have high centred. Flower colour is brilliant chrome yellow with a slight tinge of bonze (B. Arora, 1971).

Manas : It is a striking striped bud sport of rose cultivar 'Folklore'. It is a very attractive cultivar of rose. Flowers are well formed and open from elegant buds. Petals are broad and their colour is salmon, which possesses bold stripes and blotches of white and red on their surface. Flowers are long lasting and appear on hardy vigorous bush (S. G. Londha and Gokhales, 1977).

Manu Mukherjee : It is a bud sport of rose cultivar 'Fragrant Cloud'. Flower colour is deep yellow. Flowers have excellent shape. Blooms have nice scent (Friends Rosery, 1974).

Marie Palit : This is a free flowering and long lasting cultivar of rose. Flowers are shapely and its colour is blended with pink and white. Petals are broad and their edges are deep colour and blended beautifully (Brahm Datt, 1988).

Martin Luther King : It is a seedling of 'Oklahoma'. This vigorous bushy plant is also known as black rose. Flowers appear on strong and erect stem, which never droop. Blooms are majestic and large. Buds are elegant and have strong delicious perfume (S. C. Dey, 1981).

Mechak : It is a seedling of rose cultivar 'Samourai'. Buds are beautiful, long and have blackest red colour. It open into high centred, partly shaped flowers. Blooms have deep clony red colour with blackest velvety shading. It produces lasting flowers very freely (Dr. B. P. Pal, 1977).

Meghdoot : It is a seedling of rose cultivar "Virgo'. Buds of this cultivar are long urn shaped which opens into large flower. Bloom colour is shining white. Petal texture resembles with poppy flower very much. Plant growth is very vigorous and height is tall (Dr. B. P. Pal, 1972).

Meghomallar : Buds of this cultivar is slightly globular. Blooms are large in size. Flower colour is velvety crimson to purple crimson. Blooms are scented (S. M. Bhattacharjee, 1967).

Meher : This cultivar of rose is a hybrid, evolved by the cross of 'American Heritage' and 'Paradise'. Flowers are shapely and classical and have broad petals. Colour of the petals is pinkish red and their reverse side, has pronounced yellow. This free flowering rose possesses mild fragrance (Nadir J. Pavri, 1995).

Melody Queen : This cultivar of rose is a hybrid, evolved by the cross of 'Chab' and 'Akibono'. It is a free flowering cultivar. Buds are elegant and high centred and open into graceful blooms of perfect shape and form. Blooms are quite massive in size (Mr. and Mrs. S. Ghosh, 1998).

Memory of D. M. Roy : This cultivar of rose is a hybrid, evolved by the cross of 'White Masterpiece' and 'Mrinalini'. Buds are tall, sleek and conical in shape. Buds open in to classically formed bloom, which are enormous and are of high quality. Flower colour is greenish white to pure white with a hint of light pink glow (Mr. and Mrs. S. Ghosh, 1998).

Michael Madhusudan : This rose cultivar is having large size flower. Colour of the bloom is bright scarlet and they are very attractive (A. M. Bhattacharjee, 1964).

Mohak : It is a striped bud sport of ' Summer Holiday'. Flower colour is bright as well as pale vermilion. Splashes and patches are present on the both side of light orange petals. Remaining characters are same as of parents (C. R. Chiplunkar,1993).

Mother Teresa : It is a hybrid seedling of 'Sweet Afton' and 'Frist Prize'. Plants are vigorous and upright growing. This tall cultivar of rose bears blooms freely on a long and strudy stem. Buds are long and pointed and soft pink in colour. Blooms are large exquisitely formed and its colour is pinkish white which almost changes into white with pink edge as it grows old (IARI, 1994).

Mridula : It is hybrid seedling of 'Queen Elizabeth' X a seedling of 'Sir Henery Segrave'. Buds are very long shapely and their colour is pinkish white. Blooms open into large size flower on a very vigorous bush, which have abundant green foliage. Flowers are fragrant (IARI, 1975).

Mrs. K. B. Sharma : It is hybrid seedling of 'White Masterpiece' X Michele Meilland'. Buds are long and white in colour, open into large flower. Petals are large and long. Blooms are lightly scented (Dr. B. P. Pal, 1989).

Mrinalini : It is hybrid seedling of 'Pink Parfait' X 'Christan Dior'. Buds are very long pointed which opens into large flower. Flower colour is phlox pink. Vigorous bush is having pink flowers. Blooms are large, well formed, and shapely and have reflexed petals. Flowers are slightly fragrant (IARI, 1972).

Mrinalini Lile : This cultivars of rose is having all the good characteristic of cultivars 'Mrinalini'. Blooms are large and posseses different shades of pink colour (Friends Rosary, 2002).

Muzibar : It is hybrid seedling of "Camelot" X "Memoriam". Blooms are high centred with light orange colour. Petals have light orange colour suffused with pink. Blooms are of exhibition type (A. K. Roy Choudhury, 1970).

Nandini : This cultivar of rose is very floriferous in nature. Plant growth is medium. Flowers are large in size and have large centre. Blooms are very attractive due to presence of two colours on petals. Upper surface of petal have phlox pink and reverse side of the petal is light creamy yellow (Dr. B. P. Pal, 1983).

Narmada Lahari : It is a mutant of rose cultivar 'Shree Dayanand'. Blooms appear on short strong stem. It is a free blooming cultivar and blooms continuously. Flowers are very large in size and have fragrance. It is a striped cultivar. Flower colour is deep pink with red, light pink and whitish stripes evently distributed over all petals. Plant is bushy dwarf, spreading vigorously and disease resistant (Hardikar, 1976).

Nayika : Flower colour of this rose cultivar is coral orange. It is very attractive and eye catching cultivar. Flowers are long lasting with reflexed petals and have high centred. Blooms are slightly perfumed (Dr. B. P. Pal, 1975).

Nazneen : It is seedling of 'Queen Elizabeth'. Blooms are profusely produced on long upright stem singly or in small clusters. Blooms are large and delicate. Flower colour is transluscent shade of pink (Dr. B. P. Pal, 1969).

Nazr-e-Nazar : Flowers are borne freely on a vigorous bush. Blooms are large sized and shapely. Flower colour is medium pink (R. S. Singh, 1968).

Nehru Centenary : It is a vigorous growing bush of rose, which possesses dark green and large foliage. It is a hybrid seedling from the cross between 'Christon Dior' X 'Avon'. Buds are large and pointed and borne on a long straight and strong shoot. Blooms are large and have high centre and have slight fragrance (IARI, 1989).

Neela 89 : This cultivar of rose is a bud sport of 'Paradise'. Buds and flowers are shapely. Flower colour is pale lavender with tinge of pink. Petal edges are deeper lavender in colour (Kasturi and Sriram, (KSG Son), 1989).

Neena : This cultivar of rose is a bud sport of 'Queen Elizabeth'. Flowers are shapely and well formed. Bloom colour is a light pale pink but still lustrous in nature (S. P. Balsara, 1990).

Nefertiti : This cultivar of rose is having attractive apricot peach colour flowers. Blooms are shapely and high centred. Fascinating shades of pastel, bronze and wheaten gold during the various stages of flower development adds charm to this cultivar (M. S. Viraraghavan, 1985)

Netaji Subhas : Flowers are large. Bloom colour is dark velvety maroon. Flowers are globular and have very strong fragrance (A. M. Bhattacharjee, 1956).

Nishada : Plants are vigorous in growth and somewhat spreading. Buds are shapely and very long and borne on long stem. Flowers are large. Colour of the flower is rich pink with orange shading. Blooms are very fragrant (Dr. B. P. Pal, 1983).

Nurjehan : It is hybrid seedling of 'Sweet Afton' x 'Crimson Glory'. Flowers are large, delicate and have translucent shade of pale pink. Blooms are produced on long upright stem either singly or in small clusters. Plant growth is upright (IARI, 1980).

Our India : This cultivar of rose is having long pointed buds of creamy white. Buds open into exquisitely fragrant flowers of ivory colour. Petals edges are lilac (M. S. Viraraghavan, 1998).

Padmavati : This cultivar is having double shapely flowers. Bloom colour is pastel pink on the inside of the petals and white outside. Flowers are long lasting (G. Kasturi Rangan, 1969).

Pahadi Dhun : It is seedling of 'Lady X'. Flowers are medium sized with high centred. Blooms are borne in long stems. Petals are reflexed. Buds are dark purple, which opens into silvery flowers. Edge of the petals is deeper mauve in colour. Reverse of petal is clear pink mauve. This free flowering cultivars have pleasant fragrance in blooms (Dr. B. P. Pal, 1981).

Painted Melody : This cultivar of rose is a bud sport of 'Yakimour'. It looks like a hand painted rose. Flower colour is light yellow with pink and red blend. Flowers are beautiful and very attractive. Petal edges sprinkled and splashed with deeper red patches and stripes. It is a free flowering cultivar and flowers are long lasting (Kasturi and Sriram, (KSG Son, 1993).

Pale Hands : It is seedling of 'Mc Gredy's Sunset'. The cultivars have very large flower. Bloom colour is Ivory white to shades of pale yellow, buff and peach. Buds are exquisitely shaped. This cultivar is good for decoration and exhibition (Dr. B. P. Pal, 1965).

Pampa : This cultivar of rose is perhaps the best of the Indian raised yellows. Flowers are radiating deep yellow. Blooms are well formed, large and with broad petals. Rose cultivar has been named after the sacred river Pampa (Kasturi Rangan and Sriram (KSG Son), 1988).

Panchganga : This cultivar is a superb striped bud sport of 'Yeshwant'. Beautiful stripes and splash are spread on pink petal surface. Blooms are having high centred and are of exhibition type. Rose cultivar has been named after the sacred river Panchganga in Kolhapur District (B. K. Patil, 1993).

Papa Pirosha : This cultivar of rose is a bud sport of 'Yankee Doodle'. Buds are tight and elegant. Blooms are well formed, shapely and long lasting. Flowers are borne on long stems (S. P. Bulsara, 1990).

Parijat : This is a large flower rose cultivar. Bloom colour is very light pink to silvery pink. Flower possesses delicate scent (A. M. Bhattacharjee, 1962).

Pastel Delight : This cultivar of rose is remarkable for its form and shape. This rose is also known as "Lady's Rose". Buds are elegant and uniform. Flowers are known

for its remarkable form and shape. Blooms are delicate soft pastel pink in colour. This cultivar is good for cutting and exhibition (G. Kasturi Rangan (KGS Son), 1984).

Patliputra : Flower of this cultivar is very large. Bloom colour is bright cerise pink (A. M. Bhattacharjee, 1960).

Patrani : Blooms appear on long stem, which have double tone pink colour. Buds are long and tapering open into perfect flowers. Petals are reflexed (Dr. B. P. Pal, 1981).

Peetambar : Flower appears in bunches. Blooms are deep golden yellow which fades in fully open flowers (B. S. Bhattacharjee, 1960).

Pink Fantasy : This cultivar of rose is most free flowering cultivar and originated as a progeny of 'Mme Denise Galloise'. Flower colour is glowing pink and it is non- fading. Buds are tapering and open to shapely flowers of high quality (Kasturi and Sriram, 1995).

Pink Melody : This cultivar of rose is free flowering and originated as a bud sport of 'Pasadena'. Flower colour is pale salmon pink and very lasting as a cut flower. It is having all the qualities of its parent except the change of colour. Buds and flowers have perfect shape (G. Kasturi Rangan and Sriram (KSG Son) 1993).

Pink Montezuma : It is a bud sport of rose cultivar 'Montezuma'. All the characters of 'Pink Montezuma' are similar to 'Montezuma' expect the flower colour which is spinal pink. Colour of the 'Montezuma' is vermilion. It has been suggested that name of this cultivar should be changed as there is already another variety bearing identical name is existing (IARI, 1980).

Piroja : This cultivar of rose is a profuse bloomer and originated as a result of cross between 'Blue Moon' X 'Heirloom'. Bloom colour is deep purple mauve. Flowers are shapely, medium sized and non fading in nature. Flowers are scented (C. R. Chiplunkar, 1992).

Poornima : It is seedling of 'Fernand Arles'. Buds are long open into large blooms. Flowers have many petals. Buds are light yellow in colour, which turn deeper after opening (Dr. B. P. Pal, 1971).

Polybag Joshi : This cultivar of rose is a profuse flowering and has flowers of beautiful blend of soft pink, dark in the centre and lighter tones towards outer petals. Blooms are huge, shapely with lots of petals (C. R. Chiplunkar, 1995).

Preysai : It is a hybrid seedling of ' Chandrama' x 'Queen Elizabeth'. Blooms are formed in abundance. Flowers are pink in colour. Bloom size is large and it is highly centred. Plant growth is vigorous. Bush nature is tall (IARI, 1991).

Pride of Ichalkaranji : This cutivar of rose is a bud sport of 'Yeshwant'. Exquisitely formed buds have light yellow colour. Outer petals are flushed and edges have carmine colour. Flowers are of exhibition type (B. K. Patil Icospin, 1989).

Pride of Nagpur : This cultivar of rose is having dark dusky red flowers. Blooms are large in size and well formed. Flowers have sweet rose water fragrance (Brahm Datt, 1983).

Priyadarshini : It is a hybrid seedling of "Pink Parfait' X 'Frist Prize'. Blooms are produced in great profusion on medium and long shoot. Flower colour is rhodamine pink,

suffused with deeper pink towards the outer edges of the petals. It provides bicolour effect. Blooms are slightly fragrant (IARI, 1986).

President Radhakrishnan : This cultivar is having beautiful buds, which opens into large flower. Flower colour is glistening pink. The cultivar is famous for its outstanding fragrant flowers (S. M. Bhattacharjee, 1964).

Priyatma : Buds of this cultivar are elegant which open into centred flower. Bloom colour is white which changes to warm and passionate ruby red during winter. Flowers have excellent shape and form. This cultivar is first Hybrid Tea to be introduced in India in the 'Hand Painted' strain. Each bloom is hand painted original in subtle blends and dazzling contrast of white and pink velvety red (M. S. Viraraghavan, 1981).

Prof. Madhab Chandra Nath : This cultivar of rose is having medium height and it is highly floriferous. Flower colour is pink mauve. Blooms are very shapely and perfect and have delicious fragrance (Dr. N. V. Shastry, 1998).

Pornima : It is a bud sport of rose cultivar 'Elida'. The flower is highly centred, well shaped and huge in size. The flower colour is salmon pink with deeper shades (O. P. Agarwal, Friends Rosery).

Poornima : It is a seedling of rose cultivar 'Fernand Arles'. Buds are light yellow in colour, long and blooms into large flower. Blooms are having many petals. Flower colour is deeper in comparison to bud colour (Dr. B. P. Pal, 1971).

Purabee : This is an exhibition variety. Blooms have high centred bud of dazzling white with a greenish base. Flowers are large and well centred. Blooms have moderate number of petals (A. M. Bhattacharjee, 1967).

Pusa Christina : This cultivar is a bud sport of 'Christian Dior'. Flower colour is fuschine pink. Petals have yellow colour on their base (IARI, 1975).

Pusa Sonia : This cultivar is a seedling of 'McGredy's Yellow'. Flower borne in singles on long and strudy stem. Flower blooms freely and are very attractive. Flower colour is bright golden yellow. During summers flower colour changes into yellow. The plant is medium size bush with attractive foliage (IARI, 1968).

Pusa Sonara : It is a hybrid seedling of rose cultivar 'Queen Elizabeth' and 'First Prize'. Blooms are produced on long and sturdy stem. Flower colour is soft pink and it has high centre. This cultivar is vigorous and having upright growing bush (IARI, 1983).

Raat ki Rani : This cultivar is a seedling of 'Scarlet Knight'. Bud is large pointed and opens into good quality of flowers. Bloom colour is velvety crimson red. This cultivar is free flowering. Growth of this cultivar is vigorous (IARI, 1975).

Radha Rani : Bud of this cultivar is tapering which opens into very large flowers. Flower colour is carmine pink (B. S. Bhattacharjee, 1956).

Raja Ram Mohan Roy : This cultivar of rose is having extremely attractive flowers. Growth of this cultivar vigorous and plant is tall. The flower colour is golden apricot. Flowers have strong Tea fragrance (A. M. Bhattacharjee, 1959).

Raja Surendra Singh of Nalagarh : It is a hybrid seedling of 'Scarlet Red' X "Montezuma'. Flowers are large in size and have good high centre. Shape of blooms are

classic. Colour of the bloom is dazzling orange salmon pink. Bud of this cultivar is extremely beautiful. The large size flowers are fully double with imbricate petals. Blooms are having long lasting quality (Dr. B. P. Pal, 1977).

Rajaji : Blooms of this cultivar are very large. Flower colour is brilliant red. Flowers are long lasting and very fragrant (A. M. Bhattacharjee, 1967).

Rajani : This cultivar of rose is having flowers of pink with distinctive lilac shading. Blooms are well formed, shapely and possesses plenty of petals excluding fragrance (M. S. Viraraghavan, 1981).

Rajhans : This cultivar of rose is having white flowers with very strong fragrance. Buds are long and open into very large flower. Blooms have many petals and some times it may go upto one hundred. Petal is beautifully arranged on a flower and gives an impressive and attractive look. Blooms appear on a vigorous plant (Dr. B. P. Pal, 1983).

Rajendra Prasad : Buds of this cultivar are pointed which open freely into wide blooms. Flowers are of large size. Plant growth is vigorous. Bloom colour is velvety, dark crimson. Flowers are very sweetly scented (A. M. Bhattacharjee, 1956).

Raj Kumari : It is a hybrid seedling of 'Charles Mallerin' X 'Delhi Princess'. Buds are long and slender open into large and well-formed flower. Flower colour is deep pink. Plant growth is compact and bush is vigorous (IARI, 1957).

Raktabeej : Bloom of this cultivar are massive and compact in nature. Flower colour is fading red. Blooms are very fragrant (B. S. Bhattacharjee, 1960).

Raktagandha : It is a hybrid seedling of 'Christian Dior' X seedling of 'Carrousel'. Blooms are shinning red. Buds are large and pointed open to large and high centred flowers. The cultivar tolerates winter injury. Blooms are slightly fragrant (IARI, 1975).

Raktima : It is a hybrid seedling of 'Pink Parfait X 'Sugandha'. Flowers are shining red in colour with high centre. Flowers are borne on single, strong and straight stems. Blooms have sweet fragrance. This cultivar is having recurrent blooming habit and tendency to produce quality flowers even in off season. Plant is very tall and upright growing bushes (IARI, 1991).

Ram Krishna Dev : Blooms are lovely and high centred. Colour of the bud is orange scarlet (B. S. Bhattacharjee, 1941).

Rampa Pal : This cultivar is having large bud and flowers. Shape is classic. Flower is having blend of pink, white and yellow, which is very difficult to describe. The outer petals are pink with white base while the central inner core in early stage of growth seems to be dipped in orange scarlet which gives very attractive look to the flowers (Dr. B. P. Pal, 1975).

Rana Pratap : This cultivar is having large flowers. Petals are wide. Bloom colour is glowing crimson (A. M. Bhattacharjee, 1960).

Rangshala : This cultivar is seedling of 'Margaret Spaul'. Buds are beautiful and light Saturn-red in colour, which opens to flower of attractive shades of peach, apricot and amber yellow colour. Flowers are of medium sized and perfectly formed. Blooms appear in plant in great profusion. Bush is compact. Blooming is recurrent. Bush is of

medium size and well balanced which is ideal for half standard and for bedding (IARI, 1969).

Rani Jhanshi : This cultivar of rose is very fragrant. Flowers are large. Flower colour is pink (A. M. Bhattacharjee, 1959).

Ranjana : This cultivar of rose is ideal for exhibition. Buds are urn shaped and large in size. Flowers are large, shapely and double. Blooms are of exhibition quality. Flowers have nice fragrance (Dr. B. P. Pal, 1975).

Ratan : This cultivar of rose is having appealing lemon yellow flowers. Shapely lasting buds and blooms are borne on long canes (S. P. Bulsara, 1990).

Ratnaar : This cultivar of rose is having vigorous growing bush with very free flowering nature. It is ideal for bedding and exhibition. Blooms are large, high centred and pink in colour. Shape of the flower is very attractive due to presence of reflex petals (Dr. B. P. Pal, 1985).

Red Recker : This cultivar of rose is having deep non- fading crimson coloured flowers. Blooms are high centred and lasting on long cane. It is good for cutting and exhibition purpose (G. Kasturi Rangan (KSG Son), 1986).

Rosy Evening : This cultivar of rose is excellent, developed through hybridization between rose cultivar 'Invitation' and 'Anvil Sparks'. Blooms are very attractive and coppery pink to flame orange pink in colour. Buds have high centred form, open into well shape, large full flower. Blooms open freely on long stem. This cultivar is ideal for bedding and can be used for exhibition (Dr. B. P. Pal, 1985).

Rose Anil : This culrivar of rose is having elegant buds of garnet purple. Blooms are of eye catching quality. Flowers have richest shades of purple, lilac and magenta (M. S. Viraraghavan, 1998).

Rose Bansal : It is a bud sport of rose cultivar "Anvil Sparks'. Flower colour is having blend of yellow and copper. It is very pretty. Thick cultivars produce very good effect in bed. The plant is always loaded with flowers (Friends Rosery, 1974).

Rose City of Nasik : It is a bud sport of rose cultivar 'Christian Dior'. This cultivar is also known as "Gulab Nagri Nasik". Flower colour is deep pink. This cultivar is good for exhibition and cutting (S. P. Bulsara, 1990).

Rose "KSG Centinary" : This hybrid rose ('Penelope' X 'Frohsini') is the most beautiful blended rose. Petals margin have deep rich yellow blending with salmon turning to deep scarlet. Buds are shapely and blooms are perfect. Petals are broad. This cultivar is free flowering and very showy (Kasturi and Sriram (KSG) Son, 1995).

Rukhsaar : Buds are greenish in colour, which opens into centred blooms. Flower colour is cream. The centre of the flower is shell pink (R. S. Singh, 1969).

S. Percy Lancaster : Flowers of this cultivar are produced freely. Bloom colour is deep velvety crimson (B. S. Bhattacharjee, 1956).

Sadaranga : It is a hybrid seedling of 'Kronenbourg' X 'Peace'. Blooms are large. Flower colour is deep pink. Blooms appear one or more on a long and strong stem. This cultivar is an abundant bloomer. Plant growth is vigorous and upright. This cultivar

of rose is disease resistant. Foliage is normal and green with glossy surface (Hardikar, 1971).

Sahasradhara : It is a bud sport of 'Century Two'. Flower colour is deep pink. Blooms have deep pink, broad petals with pure white streaks and splashes. Buds are regal urn shaped which open into large flower with delicious sweet fragrance. Blooms appear on long single stem. Vase life of cut flower is long. Plant growth is extremely vigorous. Bush is covered with large foliage and its growth is better than medium height cultivars (Arpi Thakur, (Doon Valley Roses), 1981).

Samrat Ashok : This cultivar of rose is having large flowers. Bloom colour is luminous pink. Flowers are flushed with silver shade (A. M. Bhattachajee, 1960).

Sandeepini : This cultivar is vigorous growing and possesses healthy foliage. Raised from open-pollinated seed of "Sabine". It blooms freely. Flower colour is glowing pink, which turns almost into red in cool weather. Buds are of classic shape, which opens into large flower. Blooms are very fragrant (Dr. B. P. Pal, 1983).

Santa Claus : This cultivar of rose is a hybrid of 'Wind Sound' X 'Ace of Hearts'. Bicolour rose is having luminous carmine with white base flowers. Reverse side of the petal is changing to glistening red with age. Blooms are large and full compact. Flowers open slowly from shapely buds (Mr. and Mrs. S. Ghosh, 1998).

Sarojini Naidu : This cultivar of rose is having large flowers. Flower colour is bright magenta with red blend. Flowers are very fragrant (A. M. Bhattacharjee, 1964).

Satvika : This cultivar of rose is a bud sport of 'The Lady'. Beauty of this cultivar is that no two flowers are alike. Some flowers have streaks and splashes of white and others have patches and stripes of off white to cream on petal surface. It is a profuse bloomer and its shapely flowers are lasting (B. K. Patil, Icospin, 1994).

Savkar : This cultivar of rose is a bud sport of 'Yeshwant'. Blooms are huge and crimson colour. Flowers are lasting long and of exhibition standard (B. K. Patil, Icospin, 1988).

Scented Bowl : This cultivar of rose is seedling of 'General Arthur'. Flower colour is glowing red. Blooms have many petals. Flowers have strong fragrance and very attractive look (Dr. B. P. Pal, 1965).

Shakuntala : This cultivar of rose is very attractive. Buds are cent red in colour. It opens into large flowers. Bloom colour is made up of lovely shades of coppery orange pink (S. M. Bhattacharjee, 1962).

Shalimar : This free flowering cultivar of rose is a hybrid raised from cross of 'White Masterpiece' X 'Madras'. Colour of the blooms is light pink with cream base and reverse. Flowers are classically formed of high centred. Blooms are large and open very slowly. Shapely bud appears on tall neck and long lasting (Mr. and Mrs. S. Ghosh, 1998).

Shanker Jaikishan : This hybrid cultivar of rose is very floriferous and evolved from cross between 'Capt. Harry Stebbings' X 'Christian Dior'. Name of this cultivar was coined as Shanker Jaikishan to honour famous music directors of the country. This cultivar produces shapely, massive blooms of high quality. Flower colour is rich bright red with lighter reverse (Dr. N. V. Shastri, 1998).

Shanti : Blooms of this cultivar is large. Flower colour is pure yellow with pink mauve edges. Flowers are fragrant (A. M. Bhattacharjee, 1964).

Shanti : This cultivar is a bud sport of 'Peace'. All the characters of this cultivar are exactly same as 'Peace' but it is more vigorous. Colour of the bloom is deeper yellow and sometimes splashed with saffron petal edge making it more attractive (Friends Rosery, 1980).

Shanti Pal : This cultivar of rose is raised from cross between 'Sonia' and 'Kathleen 'o' Rourkee'. Plant growth is vigorous. Flowers are double, large and high centred. Blooms have beautiful shade of salmon pink and sometimes it has a touch of coral. Buds open slowly into large perfectly shaped flowers. Blooms are borne on long stem freely and possess scent (Dr. B. P. Pal, 1989).

Sharmili : This cultivar of rose is developed from the seedling of the famous French rose 'Rose Goujard'. Buds are beautiful, long and high centred with pointed tip. Colour of the bud is milky white flushed with pink. Blooms are present on long stem. Petal edges have deeper colour. Flowers are very attractive, moderately fragrant and long lasting in nature. Plant growth is vigorous and upright Plant attains medium height (Dr. B. P. Pal, 1986).

Shantaraj : This cultivar of rose originated as a hybrid seedling and evolved as a result of cross between 'My Love' X 'American Pride'. Buds are lovely, elegant and opens in to large shapely flowers. It is a free flowering cultivar. In full bloom stage flowers exhibit red colour with yellow shades at the base of the broad petals. Quality of the blooms is good and they possess strong Tea fragrance (G. Kasturi Rangan and Sriram, 1998).

Sheer Grace : This cultivar of rose is a striped bud sport of 'Sheer Bliss'. Flower colour is dark pink and petals have striking white stripes and streaks on its broad surface. Blooms have spicy fragrance. Flowers of immaculate shape are of exhibition type (B. K. Patil, Icospin 1995).

Shoba : This cultivar of rose is a striped bud sport of 'Otohime'. Flowers are large, well formed and double in nature. Blooms have beautiful broad chequered lines of white and salmon orange. This cultivar of rose is also known as 'Beauty Show' (Friends Rosery, 1988).

Shimoga : It is a hybrid seedling of 'Marylene' X 'South Sea'. Petals are paler shell pink inside with pink outside (G. Kasturi Rangan, 1976).

Shreyasi : It is a hybrid seedling of 'Pink Parfait' X 'Christian Dior'. Flower colour is very attractive due to its bicolour nature. Blooms are of Tyrian purple with mimosa yellow base and spinal red on reverse. Flowers are of medium size and very good for floral arrangement. Bush is upright growing and bears pleasing fragrance. Blooms stand well even in severe cold climate (IARI, 1991).

Shree Dayanand : It is a hybrid seedling of 'Scarlet Knight' X 'Festival Beauty'. Flower colour is deep pink. Blooms are fragrant. Flowers are large and borne on strong stem. This cultivar is free flowering. Blooming is continuous. Bush is vigorous and spreading. It is a disease resistance cultivar. Foliage is normal and small (Hardikar, 1971).

Shri Swamy Samarath : This cultivar is a bud sport of 'Gladiator'. All the morphological characters of the bud sport are similar to its parent except the flower colour. Bloom colour is pink. Plants are vigorous and sturdy. Blooms are huge and enormous (B. K. Patil, 1992).

Sir C. V. Raman : It is a hybrid seedling of 'Scarlet Knight' X 'First Prize'. Plant is characterized with vigorous growth and healthy foliage. Upright growth blended with vigour makes it outstanding cultivar of rose. Blooms are large, double and brilliant orange scarlet in colour. In extreme cold climate outer side of the petal turns dark shades of red colour. Flowers are long lasting and freely produced in nature during hot weather and possesses fragrance (Dr. B. P. Pal, 1989).

Shyama Prasad : This cultivar is having tapering buds. Open into huge flower. Bloom colour is flame orange (A. M. Bhattacharjee, 1967).

Shyamla : This cultivar is a seedling of 'Sencca Queen ' X 'unknown'. Bloom colour is pale pink. Buds and flowers are perfect (G. Kasturi Rangan, 1972).

Siddartha : This cultivar is a bud sport of 'Christian Dior'. Buds are shapely and elegant. Flower is having stripes on petals. Splashes of white and green appear on the red petals (G. Kasturi Rangan, 1973).

Silky Petal : This cultivar of rose is a hybrid evolved as a result of cross between 'Peter Frankenfeld' X 'Century Two'. Buds are long and elegant and its colour is deep pink. Buds open slowly to perfect flower. Bloom colour is deep pink. Petals are bright, smooth and their surface have silky texture. Flowers appear on strong stem and they are very long lasting (Mr. and Mrs. S. Ghosh, 1998).

Sir Ashutosh : Buds of this cultivar is tapering with high centre. Cultivar is free flowering. Blooms are coppery orange- salmon in colour. Blooms are fragrant (S. M. Bhattacharjee, 1966).

Soma : It is a hybrid seedling of 'Chandrama' X 'Surekha'. Blooms are large and well formed. Flowers are borne freely on a vigorous growing bush. Flower colour is blend of different shades of solferino purple (IARI, 1980).

Somasila : This cultivar of rose is having pointed buds. Colour of bud is soft pink with blended garnet shadings. Buds open into large flowers. Flowers have intoxicating fragranc (M. S. Viraraghavan, 1984).

Speckled Delight : This free flowering cultivar of a rose is a bud sport of 'Black Delight'. Flowers are shapely. Unique rose cultivar is having splashes and stripes of cream and pink colour on velvety deep dark red, broad petals (B. K. Patil, 1998).

Sir Aurobindo : This cultivar is having fragrant flowers. Blooms are large. Flowers have unfading red colour with deeper shading (S. M. Bhattacharjee, 1960).

Sri Babu : Flowers of this cultivar is very fragrant. Bloom size is large. Flower colour is pearly pink and is flushed with amber (A. M. Bhattacharjee, 1959).

Sri Ma : Flower of this rose cultivar is very fragrant. Flower size is large which opens into flat shape. Bloom colour is brilliant red with velvety sheen (A. M. Bhattacharjee, 1959).

Srinivasa : This is a large flower cultivar. It is an outstanding bicolour rose. Petal colour is deep rose red and its reverse side is white. In very cool weather white colour disappears. Flower form is perfect. This cultivar is having quite fragrant flowers. The plant growth is vigorous and foliage is healthy (G. Kasturi Rangan, 1969).

Sthal Kamal : It is a very fragrant rose cultivar. Bloom colour is satin pink to silvery pink. Blooms are globular (A. M. Bhattacharjee, 1959).

Subarna Rekha : Flower of this cultivar is bicolour. Flower colour is golden yellow. Reverse side of the petal is having chrome colour. Flower possesses delicate perfume (S. M. Bhattacharjee, 1966).

Sugandha : Buds of this cultivar is long. Colour of the flower ranges from red to scarlet. Buds open into large loose flower. Blooms are gloriously scented (S. M. Bhattacharjee, 1966).

Sugandha : It is a hybrid seedling of 'Aroma' X 'Red Ensign'. Bud of this cultivar is long and pointed which opens into deep pink flowers. Flowers are sweetly scented. Blooms are of exhibition quality (S. Banerjee).

Sugandhini : It is a seedling of ' Margaret Spaull'. Flowers are exquisitely formed. Bloom colour is rhodamine pink. Cultivar is a profuse bloomer with well-filled blooms on branches. Bush is medium, compact and has vigorous growth. Flowers have fragrance. Cultivar is good for standard and bedding (IARI, 1969).

Sugandha Raj : This free flowering cultivar of rose is having superb crimson red flowers. Blooms are having good petallage with captivating perfume. Flowers well formed, shapely and non-fading in nature (Brahm Datt, 1992).

Sujata : It is a seedling of 'Sabine'. Flowers are well formed. Bloom colour is crimson red. Flowers are large and high centred. Large blooms are borne freely on stem which is having medium shoots. Bush growth is vigorous. Foliage is dark green and its texture is leathery (IARI, 1971).

Sukanya : It is a seedling of 'Effile Tower' X 'Unknown'. Buds are sleek and tender. Blooms are shapely large and high centred. Flowers have glorious fragrance. The colour of the flower is double tone pink which gives bicolour effect to flower. Bloom colour is lighter salmon pink and reverse side of the petal is having deep colour. This is a very beautiful and attractive cultivar (G. Kasturi Rangan, 1979).

Suman : This cultivar is a hybrid and evolved as a result of cross between 'White Masterpiece' and 'Mrinalini'. Suman is having well balance bush with attractive foliage. Blooms shape and form is excellent and they have broad petals. . Flowers have fragrance and their colour is soft pink (Mr. and Mrs. S. Ghosh, 1998).

Sunanda : This free flowering cultivar is a hybrid and evolved as a result of cross between ('Chablis' and 'Madras'). Flower colour is deep pink. Purple shade is also present on petals. Base of the petals have cream and their reverse side is comparatively lighter. High pointed buds open into large flower, which are perfect and borne on strong stem. Strong bush is having plenty of flowers which have strong Tea fragrance (Mr. and Mrs. S. Ghosh, 1998).

Sun God : It is a bud sport of rose cultivar 'Apollo'. This cultivar can with-stand very hot weather. Plant growth is healthy and upright. Buds are elegant and open into large shapely exhibition blooms. Flowers have 40-50 petals. Blooms borne on 15-29 cm long stem which is erect. Blooms have very sweet fragrance (Dey, S. C., 1978).

Supravat : This free flowering cultivar is a hybrid and evolved as a result of cross between 'Peter Frankenfeld' and 'Ace of Heart'. Flower colour is pink. Bloom size is medium and its shape is artistic. The strong bush is full of flowers. Good for cut flower (Mr. and Mrs. Ghosh, 1998).

Supriya : This cultivar is a bud sport of 'Princess Margaret of England'. The mutant is very attractive and beautiful just like its parent. Blooms are pure pink in colour and have very distinctive cream and white splashes and stripes on petals. The elegant flowers are perfectly shaped and resembles with its parent. Blooms have good fragrance (Dr. N. C. Sen, 1982).

Suerya Shikha : This rose cultivar evolved as a striped bud sport of 'Grand Opera'. Blooms are very attractive, large, double and shapely. Petals are broad and having splashes and distinct pink and yellow stripes on it. It is free flowering cultivar (Diby's, 1992).

Surabhi : It is a hybrid seedling of 'Oklahoma' X 'Delhi Princess'. Flower colour is phlox pink. Buds are long and tapering. Flowers open slowely. Blooms are large and having attractive shape. Flowers are long lasting. Blooms have nice fragrance (IARI, 1975).

Surekha : It is a seedling of 'Queen Elizabeth'. Buds are continuously produced on long lasting flowers. Bloom colour is coral red. Flowers have many petals and they are perfect. Plant growth is very healthy. It is a tall growing vigorous bush (IARI, 1969).

Surkhab : It is a bicolour rose cultivar. Flowers are borne on strong and vigorous stem. Blooms are large and are of good shape. Flower colour is red and white. Flowers are freely produced and slightly fragrant (Dr. B. P. Pal, 1976).

Susama : It is a hybrid seedling of 'Aroma' X 'Red Ensign'. Blooms are light pink in colour. Flowers are sweetly scented (S. Banerjee).

Suvra : It is a pure white cultivar of rose. Flowers are fragrant in nature (A. M. Bhattacharjee, 1963).

Suvarna Rekha : This cultivar is a bud sport of 'Soraya', which is a spectacular rose. Flowers have stripes and splashes of golden yellow colour, which is very prominent on petal surface. Outer petals are very attractive. Colour is more contrast on reverse side of the petal. Edges of petals are frilled which provides additional beauty to the flower (Karnad, 1984).

Swagatham : This rose cultivar is a bud sport of 'Surkhab'. Buds are globular and flowers are cup shaped. Blooms are fragrant, large and double. Flower colour is light pink with apricot (G. Kastui Rangan (KSG Son) 1988).

Swami : It is a hybrid seedling of 'Scarlet Knight' x 'Festival Beauty'. Flower colour is pink. Blooms are borne single on long stem. Flower is having very good staying property. Blooms have more than 100 petals. Flowers are large and fragrant. Blooming is moderate. It is a disease resistant cultivar. Blooms are very good as cut flower (Hardikar, 1971).

Swami Vivekanand : This is a medium sized flower cultivar of rose. Bloom colour is milky white, which lemon coloured at the centre (A. M. Bhattacharjee, 1963).

Sweet India : This free flowering cultivar of rose evolved as a bud sport of 'Sweet Surrender'. Blooms are very large and full of petals. Flower colour is creamy white to white. It has all the positive characters of its parent. Flowers are highly fragrant (Tejganga Roses, 1996).

Sweet Innocense : This cultivar of rose gives adequate number of flower through out the season. Buds are large, long and shapely open into very high centred double flowers. Blooms are shapely and pure white in colour. Flowers have delicious fragrance (Dr. B. P. Pal, 1980).

Tambrabarani : This cultivar of rose is very attractive. Blooms are perfect in shape. Flower is having shades of amber orange. Reverse side of the petal is having yellow and coppery overtones (M. S. Viraraghavan, 1988).

Tamishra : This cultivar of rose is maroon red in colour. Flowers have scanty petals. Bloom possesses fragrance (A. M. Bhattacharjee, 1960).

Tamralipta : This cultivar of rose is having medium sized bloom. Flower colour is coppery orange carmine. Blooms have intense fragrance (B. S. Bhattacharjee, 1960).

Tansen : This cultivar of rose is having very large flowers. Blooms are double in nature. Colour of the flower is sulphur yellow to chrome yellow. It is a free flowering cultivar. Flowers have fragrance (A. M. Bhattacharjee, 1967).

Tapan : It is a free flowering cultivar of rose. Buds are high centred, tapering and open into shapely flowers. Colour of the bloom is golden yellow to chrome yellow. Flowers have fragrance (A. M. Bhattacharjee, 1967).

Tapti : It is a bud sport of rose cultivar 'Camelot'. Flower colour is pastel rose pink. Blooms are high centred which later on changes into cup shape. Blooms are large in size and long lasting in nature. Flowers are produced freely. Blooms have spicy fragrance. Plant growth is vigorous (G. Kasturi Rangan, 1978).

Tata Centinary : It is a bud sport of rose cultivar's 'Pigalle'. Flower colour is deep purple mauve splashed with pale yellow stripes on inside of the petals. Reverse side of the petalis light yellow. Flowers are large in size and produced freely. Blooms have nice fragrance (Telco Nursary, 1979).

Tenth Rose Convention : It is a bud sport of rose cultivar 'Brandy'. Flowers are having striking deep ochre yellow colour. Blooms are shapely and well formed with broad petals. It is a free flowering cultivar (B. K. Patil, Icospin, 1990).

Thungabhadra : This cultivar of rose is having coppery orange with carmine flowers. Buds are shapely and well formed (G. Kasturi Rangan (KSG Son), 1985).

Tippu's Flame : This cultivar of rose is free flowering and has lasting flowers. This bi-colour, medium size cultivar of rose is having red and white flowers with good petallage (M. S. Viraraghavan, 1990).

Tilottama : This cultivar of rose is having attractive flowers. Blooms are having apricot gold and chrome blend in petals. Flowers have fragrance (A. M. Bhattacharjee, 1962).

Tulsidas : This cultivar of rose is having very large flower. The blooms give bicolour effect. Petals have coppery-salmon colour on their surface and their reverse side is matted. Blooms are very fragrant (A. M. Bhattacharjee, 1966).

Tushar : This is a large flower cultivar of rose, which are produced freely on a strong bush. Flower colour is white. During rainy season flower develops pink flush. It is a dependable variety (A. M. Bhattacharjee, 1964).

Uday Bhanu : It is a hybrid seedling of 'Sugandha' x 'Red Ensign'. Buds are well shaped and open into light red flowers. Blooms have sweet scent (S. Banerjee).

Uma Rao : This cultivar of rose is having medium growing bush. It is very floriferous in nature. Buds are long pointed and opens into large, double flowers. Blooms are delicately pastel pink in colour. Flowers are borne freely on long stems (Dr. B. P. Pal, 1989).

Uttam : It is a seedling of rose cultivar 'Elite'. Buds are delicately pastel-pink in colour and very attractive. Blooms are well formed and of medium size which are borne freely on long stem. Plant is floriferous, vigorous and has abundant foliage (IARI, 1969).

Vaishnavi : It is a seedling of rose cultivar 'San Antonio' X 'Columbus Queen'. Flowers are light red in colour with a crepe finish. Flowers are large and double. Blooms are borne on a long and strong stem. Flowers are scented (G. Kasturi Rangan, 1975).

Vanamali : It is a hybrid seedling of "Lady X" x ("Gruss an Teplitz" X unknown) X 'Lake Como') X 'Angle Face') bred with the tropical climate in mind. Bud of this cultivar is well-shaped and pure dark mauve in colour. Buds open into large high-centred flowers. Bloom colour is orchid lavender. This cultivar is very good for exhibition as colour and form hold verygood under refrigeration (M. S. Viraraghavan, 1979).

Vasant : It is a hybrid seedling of 'Sweet Afton' X 'Delhi Princess'. The plants grows to an average height of 100 cm. Bush is healthy and vigorous. This cultivars is ideal for bedding. Flower colour is yellow. Petal edge is having large tinge of neyron rose colour. The flowering is continuous and it blooms through out the year. Blooms are produced singly in winters and and in small clusters in spring flush. Flower appears very freely on straight stem in large number (IARI, 1980).

Vasavi : It is a hybrid seedling of 'Piligrim' X 'Proud Land '. Flowers are non-fading and blackish red in colour. Blooms have immaculate shape and form. Flowers have high pointed centre (G. Kasturi Rangan, 1976).

Viola : It is a hybrid developed from the cross between 'Paradise' X 'Vino Delicado'. This cultivars is having deep purple mauve flowers. Petals tip and edge develops reddish purple colour. Blooms are large and cup shaped. Flowers developed on strong stem and have whorls of petal (Mr. and Mrs. S. Ghosh, 1998).

Venu-Vaishali : It is a bud sport of rose cultivar 'Astree'. Flower colour is pink with white stripes and yellow base on petals. This cultivar is very floriferous (R. K. Desh Pandey, 1970).

Vidyapati : Buds of this cultivar is globular. Flowers are compact. Bloom colour is scarlet vermillion (B. S. Bhattacharjee, 1962).

Week End : This cultivars of rose is a hybrid evolved as a result of cross between 'White Masterpiece' and 'Mrinalini'. It is a sweetly scented cultivar with beautifully shaped flowers. Buds are large and pointed. Flower colour is apricot blended light pink with darker reverse. Base of the petals are pale yellow in colour. Blooms have prominent vein on petal surface (Mr. and Mrs. S. Ghosh, 1998).

White Nun : It is a seedling of rose cultivar 'Virgo'. Buds are pure white and open to glistering flowers. Blooms have large petals. Petals are moderate in number. In warm weather flowers are produced in clusters. Plant is having upright growth (Dr. B. P. Pal, 1968).

Yaaden : It is a bud sport of rose cultivar 'La Passionate'. Flower colour is rose pink. It is a very attractive cultivar and its colour becomes more tempting due to presence of cream colour at the base of petals, which are broad. Blooms are strongly fragrant. Flowers are of excellent shape and appear on stout stem very freely. This cultivar is vigorous grower with dark green and glossy leaves (S. K. Singh, 1982).

Yamini Krishnamurthi : This cultivar of rose is having shapely blooms. Flower colour is liliac mauve (R. S. Singh, 1969).

Yeswant : This cultivars of rose is a striped bud sport of 'Suspense'. Flowers are high centred with stripe and splash of white and yellow on petal surface (B. K. Patil, Icospin, 1985).

Zakir Hussain : This cultivar of rose is free bloomer. Flower colour is brilliant carmine rose which is illuminated with yellow flush. Bush is vigorous in growth (A. M. Bhattacharjee, 1959).

FLORIBUNDAS

This group of roses originated as a result of crosses between Polyanthas and Hybrid tea. The main characteristic of this group is the flowers, which are mostly without scent. Roses of this group blooms for months. Many cultivars of this group produce flowers in clusters. In some of the cultivars these clusters are quite large.

Afrat : Flowers of this cultivar are semidouble in nature. Blooms appear on stem in large clusters. Flower colour is salmon orange, which changes into red and finally pinkish white (A. M. Bhattacharjee, 1959).

Agni Veena : This cultivar of rose is having double blooms. Flower colour is chrome yellow to sulphur yellow which changes into salmon and finally to pink and white (A. M. Bhattacharjee, 1959).

Ahalya : This cultivar of rose is a bud sport of 'Summer Snow'. Blooms appear on stem in clusters. Flower colour is pale pink. Flower produced in abundance (G. Kasturi Rangan, (KSG Son), 1969).

Akash Deep : This cultivar of rose is a hybrid, evolved as a result of cross between 'Ahalya' and 'Oklahoma'. It. It is a clustered flowered Floribunda rose which has spreading habit. Blooms are semidouble and appear in huge clusters. Colour of flower is pomegranate red (C. R. Chiplunkar, 1992).

Akash Nartaki : This attractive cultivar of rose originated from 'Sterling Silver'. The

plant is having the habit of low growing. Blooms are double in nature and freely produced in clusters. Petal colour is silvery lilac. Flowers are large and having big petals which are distinctly wavy and slightly frilled. Colour of the petal is retained for a long period and even unchanged at the time of drop off (Dr. B. P. Pal, 1983).

Amrapali : It is a hybrid seedling of ('Amber Light' X 'Traumland') X 'Honey Favourite' X ('Gruss en Teplitz' x Unknown). This cultivar is supposed to be advancement in pink Floribunda rose. Buds are ovoid in shape which opens into fully double flower. Colour of the bud is rose pink, which opens into salmon pink flower. Centre of the flower is having amber colour. Petal edge is lightly touched with liliac especially in cool weather. Flowers have fragrance. Plant is having unusual vigour. This variety is disease resistant (M. S. Viraraghavan, 1979).

Anand Rao : It is a bud sport of rose cultivar 'Pink Frill'. The flower of this cultivar is having many small petals (J. P. Agarwal, 1967).

Apsara : It is a cross between "Sonia" and "Sabina". This cultivar is having very vigorous plant growth with handsome foliage, which are reddish bronze in colour at juvenile stage. This variety is supposed to have extinct. Buds are excellent and very charming. In cool weather salmon pink shade flower appears singly and in hot weather flowers appears in bunches (Dr. B. P. Pal, 1969).

Arkavati : This cultivar is a hybrid seedling of 'Letkis' X 'Unknown'. Plant grows in the form of compact bush. Flower colour is light red. Blooms appear on stem as large clusters (G. Kasturi Rangan, 1971).

Arunima : This cultivar of rose is a seedling of 'Frolic'. Plants appear on stem in small bunches. Bloom colour is deep pink. Flowers have long lasting property. Bush growth is very compact. Cultivar is idealistically suitable for floral arrangement (IARI, 1976).

Ashawaree : Buds appear on long bushes. Colour of bud is soft coral, which open into white flowers. Petals have pink borders. Blooms are fragrant (S. M. Bhattacharjee, 1967).

Azeez : This cultivar is having exquisitely shaped buds. Buds have a shade of salmon or coral pink with alight colour on reverse side at certain season. Flowers are very attractive at full bloom stage. The plant is reasonably resistant to both cold and heat (Dr. B. P. Pal, 1965).

Bahar : This cultivar possesses yellow buds. Bloom colour is carmine pink, which changes finally into cherry- red (A. M. Bhattacharjee, 1967).

Bahurupee : Flower of this cultivar appears in massive bunches on stem. Blooms are very beautiful and changes colour due to ageing phenomenon. Bloom colour changes from light yellow to coppery carmine and then to crimson and finally to white. Flowers are fragrant (S. M. Bhattacharjee, 1966).

Balaka : Buds appear on stem in bunches. Buds have soft pink colour, which opens into purple and finally pure white flowers. Bloom appears on stem singly (S. M. Bhattacharjee, 1966).

Banjaran : This cultivar of rose is very attractive. Plant growth is very vigorous. Flowers are semi double. Blooms appear on stem in well spaced clusters. Flower colour is blend of gold and flame red, which turns in to red softens to flame pink in later stages. Flower is very colourful and resembles with multicolour dress of a gypsy women, hence the name Banjaran has been coined (Dr. B. P. Pal, 1969).

Belle of Punjab : It is a hybrid seedling of 'Montezuma' X 'Flamenco'. Buds are having beautiful shade, which opens into medium size flowers. Disbudding is recommended for getting exhibition size flower. Blooms have beautiful shade of warm pink. During winters, flowers are produced in single or small clusters and during warm weather it produces large clusters. This cultivar is remarkably floriferous. The plant growth is upright and vigorous with healthy foliage. Blooms have slight fragrance (Dr. B. P. Pal, 1965).

Bhagmati : It is a hybrid seedling of 'Charieston' X ('Roman Holiday' X ('Flamenco' X Golden Gleam'). Buds are having shade of anthurium scarlet. Reverse side of the bud is ivory white. Blooms are bicolour. Flower colour is claret red and its centre is golden. The texture of the petal is very good. Foliage is green in colour and very healthy. Blooming freely even in summer (M. S. Viraraghavan, 1977).

Bijoy Krishna : This cultivar of rose is seedling of 'Independence' X 'Vogue'. Cultivar is free flowering and long lasting in nature. Colour of the flower is blackish deep-red. Petal texture is thick. Cultivar is having mild scent (S. Banerjee)

Bright Garbs : The cultivar developed from open pollinated hip on 'Orangeade'. Flower appears in clusters of five or more, blooms open slowly with orange colour and gradually changing into crimson. Flowers stayed long on plants. Blooming is continuous and profuse. Plant is having vigorous growth and dwarf in nature. It is a disease resistant cultivar. Foliage is normal green. Flowers are large and have fragrance (Hardikar, 1967).

Celestial Star : This cultivar of rose is having medium size growth. Flowers appear on stem in clusters. Flowers are of exquisite shape. Blooms are 5 cm across. Flower colour is most attractive and like famous cultivar "Super Star" but its shade is little bit deeper. It is a free bloomer cultivar (Dr. B. P. Pal, 1965).

Chamba Princess : The cultivar is having single to semi-double blooms. Flowers have most beautiful shape. Bloom colour is clear pink. Flowers have large petals with golden anthers. The cultivar can be used as a beautiful spreading variety (Dr. B. P. Pal, 1967).

Chandrama : It is a hybrid seedling of 'White Bouquet X 'Virgo'. Buds are dawn pink, which opens into large, moon light white flowers. Blooms are borne in clusters of four to six flowers on strudy shoots. Approximately forty four flowers are produced on a bush in the winter flush. Plant attain height upto 100 cm. The growth is healthy and well balanced. This cultivar is good for garden display and equally suitable for exhibition purpose (IARI, 1980).

Chingari : This cultivar of rose is a seedling of 'Charleston'. Blooms are very attractive due to presence of blend of yellow and deep velvety red colour. Yellow colour is very prominent in early stage of growth but later the red colour deepens and spread over the petal surface. Yellow streaks are occasionally present. Blooms are produced profusely (Dr. B. P. Pal, 1976).

Chitchor : This cultivar of rose is a seedling of 'Pink Parfait'. Flowers are double in nature. Bloom colour is white. Petals are lightly suffused with pink edges. Centre of the flower sometime illuminated due to presence of golden glow colour. Plant growth is very vigorous and the cultivar is highly floriferous (Dr. B. P. Pal, 1972).

City of Lucknow : This cultivar of rose is a bud sport of 'City of Leeds'. Leaves are long and highly decorative and most outstanding among the rose cultivars. Flower colour is rich vermilion salmon. Flower size is large. Blooms appear in clusters. Plant growth is average with medium height. Cultivar looks very vigorous. Blooms are very attractive. It is a free flowering cultivar (J. P. Agarwal, 1970).

Deepak : This cultivar of rose is having medium size flowers. Bloom colour is dazzling orange and flame red. Flowers appear in large clusters. Plant attains medium height and its growth is very vigorous. This attractive cultivar of rose is free flowering (Dr. B. P. Pal, 1977).

Deepika : This cultivar of rose is a seedling of 'Shepherd's Delight'. Buds are pointed and small. Buds open to very showy flowers. Blooms colour is mandarine red. Reverse side of the petal is having lighter colour. Base of the petals have yellow colour. Flowers are borne in small bunches (IARI, 1975).

Deep Shikha : It is a hybrid seedling of 'Sea Pearl' X 'Shola'. Flower colour is Dutch vermilion. Blooms are double in nature. Flowers are borne in small and big two types of clusters. In the months of summer good flowers are produced and it continued upto rainy season (IARI, 1975).

Delhi Brightness : This cultivar of rose is having semi-double flowers. Buds have brilliant geranium lake colour. Buds open into attractive orange pink colour. Plant growth is vigorous. Foliage in early stage of growth is deep bronze in colour (Dr. B. P. Pal, 1963).

Delhi Daintiness : This cultivar is having semi double flowers, which appear in clusters. Petals are flaring most attractively shaped and wavy. Petal colour is light pink and its reverse side is deep pink. Attractive freckles developed as the petal growing old. Plant is a vigorous bush of medium height. Foliage is healthy. Blooms are suitable for cuttings and good for floral arrangements (Dr. B. P. Pal, 1963).

Delhi Maid : This cultivar of rose is having single flower. Colour of the bloom is flame orange with gold towards base. Flowers are produced both singly and in clusters. Blooms are extremely attractive especially in cool weather. Petals are having wavy nature. Plant growth is medium tall and vigorous with dark green leaves (Dr. B. P. Pal, 1963).

Delhi Pink Powderpuff : This cultivar is having flower with soft pink colour. Flowers have large numbers of petals. Petals are borne on a flower in large number. Petals have 3 or 4 segments in a manner that is most pleasing. Plant growth is upright and vigorous. Foliage is handsome and healthy (Dr. B. P. Pal, 1965).

Delhi Princess : Buds of this cultivar is cerise red which opens to sparkling deep warm pink colour. Bloom appears in clusters in abundance. Flowers are well formed. Foliage is bronze red in colour in juvenile stage in young shoots. It is having ability to stand both in cold nights and warm days. Blooms are having lightly tea-scent. Plant

growth is very vigorous. It is very good for bedding and half standards display (Dr. B. P. Pal, 1963).

Delhi Rosette : This cultivar is having small pretty flowers of brilliant orange scarlet colour. Plant growth is vigorous, upright and compact. Plant is having abundant dark green, glossy foliage (Dr. B. P. Pal, 1965).

Delhi Sherbet : It is a seedling of 'Gruss an Teplitz'. Flower colour is deep rose pink. Blooms are produced in great profusion. Bloom appears both singly and in small clusters. Flowers are highly fragrant. Plant growth is very vigorous. This cultivar is very useful for making fragrant hedge (Dr. B. P. Pal, 1963).

Devdasi : This cultivar is having double flowers. Colour of the bloom is darkest velvety- blackish crimson. Blooms are produced in clusters. Flower shape is just like carnation. Petal edges are serrated. This cultivar is specially suited for for warmer region (G. Kasturi Rangan (KSG Son),1967).

Deccan Delight : This cultivars of rose is a bud sport of 'Anita'. Flower colour is yellow to apricot. Petals colour is orange, changing orange and white which gives bicolour appearance (C. R. Chiplunkar,1985).

Devi Gayatri : This cultivars of rose is a seedling of 'Ice Berg'. It is a lovely bushy plant having plenty of flowers in clusters. Plant is vigorous in growth and bears healthy foliage. Produced by famous rosarian of Asansol, West Bengal (Dr. N. C. Sen, 1992).

Dillagi : Flower of this cultivar is large and semi-double in nature. Bloom colour is cream. Petal edges are lovely pink. Flower appears throughout the season. Plant growth is very healthy and vigorous (Raja Surendra Singh, 1971).

Dr. S. S. Bhatnagar : This cultivar of rose is a hybrid seedling raised from cross between 'Oklahoma' and 'White Christmas'. Plant is bushy in nature and its growth is vigorous and upright. Flowers of this cultivar are bright and velvety red in colour. Blooms are double and their size is medium. Flowers are having long lasting quality. Flowers are produced in 4 to 6 in number in great profusion and continue to blooms through out the season. Blooms are slightly fragrance. Cultivar is good for bedding (IARI, 1994).

First Offering : This cultivar of rose is a seedling of 'unknown pink Tea Rose' X 'Samba'. From the Tea parents it has inherited tolerance to warm climate and freedom of flowering. Growth habit of this cultivar is dwarf. Texture of the petal is excellent. Flower colour is bright dark red. This is one of the few modern roses, raised from direct cross with Tea Rose (M. S. Veraraghavan, 1973).

Fugitive : This cultivar of rose is a seedling of 'Mrs Oakley Fisher'. The flower of this cultivar possesses only five petals. Bloom appears in large clusters. Buds are beautiful and its colour is flame, which turns lighter on opening and ultimately shades of buff and pale yellow chases each other (Dr. B. P. Pal, 1965).

Golden Rays : This cultivar of rose is strudy and splendid. Flower of this cultivar is perfectly shaped. Bloom colour is dazzling golden yellow. Outer side of the petal is having suggestion of red. Flowers borne on stem in clusters. The blooms are highly scented (Mrs. P. L. Airun, 1978).

Gopika : Flowers of this cultivar are borne on stem in small clustuers. Flower colour is very charming i. e. salmon pink. Blooms have very prominent red anthers. Flowers are produced freely (R. S. Singh, 1969).

Gulwadan : This cultivar is having double flowers. Colour of the bloom is silvery pink. Colour of the reverse side of petal is carmine (A. M. Bhattacharjee, 1963).

Gurudev Tagore : The flowers of this cultivar are carmine red colour. Petals have bright gold colour on its reverse side (A. M. Bhattacharjee, 1963).

Hemavathi : This is a hybrid seedling of rose cultivar 'Stanza' X 'Pandit Nehru'. Flower colour is salmon orange with a spread of brown shade. The colour of the blooms deepens in cool weather (G. Kasturi Rangan, (KSG Son) 1975).

Himangini : This cultivar is a seedling of 'Saratoga'. Flower colour is ivory white. Blooms are of medium size. Flowers are produced in huge tresses. Bloom appears on stem in profusion and plant gets completely covered with a mass of white flowers. Blooms are of very long lasting type and quality. At the opening time flowers have a light buff centre to uniform ivory white, which fades to greenish white. Plant is vigorous and blooming is recurrent. This cultivar is recommended for bedding and borders. It is a very good cut flower variety due to its long lasting vase life (IARI,1968).

ICO : This cultivars of rose is a bud sport of 'Deep Purple' H. T. type rose. Bloom colour is pale lilac. Flowers are well formed and slightly fragrant (B. K. Patil, Icospin, 1985).

ICO Pearl : This cultivars of rose is a bud sport of 'Dearest'. Blooms appear in clusters. Flower colour is pink and shaded apricot colour is very prominent on petals (B. K. Patil, Icospin, 1990).

ICO Talk : This cultivar of rose is a striped bud sport of 'Double Talk'. Petals are having pronounced light pink stripes on both surface giving bicolour effects. Buds are of H. T. type and flowers freely borne in clusters (B. K. Patil, 1993).

Indramani : This cultivars of rose is having non-fading bright fire orange flowers. Blooms are H. T. type and are of medium size. Flowers are well shaped (C. R. Chiplunkar, Decospin, 1990).

Jai Hind : Flowers of this cultivar are very large in size. Blooms are double. Colour of the flower is scarlet red. Flowers are very fragrant (A. M. Bhattacharjee, 1964).

Jambun : This is a hybrid seedling of rose cultivar 'American Home' X 'News'. Flower colour is pale plum purple red with crimson shading (G. Kasturi Rangan, (KSG Son), 1978).

Janki : This cultivar of rose is a bud sport of 'Scherzo'. Blooms of Janaki are scarlet red colour and shade of salmon colour is also present. Flowers are borne singly and in clusters. Bloom appears on long stem. Bush growth is vigorous and plant attains height of medium size plant (Dr. B.P. Pal)

Jantar Mantar : This is a hybrid seedling of rose cultivar 'Mirandy' x 'Goudvlinder'. Flowers have 25 to 30 petals. Blooms are excellent and borne on a cluster of 4-6 blooms on long stem. Bush growth is vigorous and plants have bronze green healthy foliage. Plant is floriferous (Dr. B. P. Pal, 1982).

Jayant Tilak : This cultivar of rose is a bud sport of 'Cleopatra'. Flower colour is salmon pink and light yellow. This bicolour rose cultivar is free flowering. Plant growth is vigorous (B. D. Soman, 1970).

Jharna : This cultivar of rose is having semi double flowers. Flower colour is brilliant carmine. During cool weather carmine colour is accompanied with mauve-violet flush (A. M. Bhattacharjee, 1960).

Jwala : This is a hybrid seedling of rose cultivar 'First Crust' X 'Garden Freude'. Flowers are well shaped with scarlet vermilion colour. Blooms are double and appear on evenly spaced tresses (G. Kasturi Rangan, 1973).

Jyoti : It is a seedling of rose cultivar 'Independence' X 'Vogue'. Flowers are produced freely. Bloom colour is deep red. Flowers are highly scented (S. Banerji,).

Kadambari : This is a hybrid seedling of rose cultivar 'Little Darling' X Gruss an Teplitz' X ('Honey Favourite' X 'Unknown'). Flowers have unusal colour of pastel orange and edge of petal is lilac red in the centre. Reverse side of the petal is ivory. Colour of the flower gradually darkens and at the end it remain bright (M. S. Viraraghavan, 1976).

Kamini : This is a hybrid seedling of rose cultivar 'Vagabond' X 'Unknown'. Flowers are of medium size. Blooms are produced and repeat flowering occurs. The colour is very attractive and have blend of light vermilion and gold overcast salmon (G. Kasturi Rangan, 1968).

Kanak : This cultivars of rose is a bud sport of ' Charisma'. Flower colour of Kanak is yellow. Petal colour is pale yellow and their edges are blended with pale pink colour (Sunil Jolly, 1988).

Kavita : This cultivar is a seedling of 'Margret Spaull'. Flowers have attractive colour. Petals have orient pink colour with light yellow. Bush is vigorous growing (IARI, 1972).

Kazi Nazrul : Flowers are intense yellow and have reddish flush. Blooms appear in large clusters (A. M. Bhattacharjee, 1964).

Kessi : Blooms appears on stem in large clusters. This is a free flowering cultivar of rose (R. S. Singh, 1969).

Kolar Princess : This cultivar of rose is having single to semi-double flowers. Flower colour is camellia rose. Petal shape is just like spoon (G. Kasturi Rangan, 1967).

Kumkum : It is a seedling of white 'Junior Miss'. The cultivar is having all the habits of its parent. Buds are very lovely and flowers are produced in shaped tresses. Flower last very well. Plant growth is very vigorous. This cultivar is resistant to disease (G. Kasturi Rangan, 1982).

Kumkum : Flowers borne freely on a vigorous bush and bear large clusters of single or semi-double blooms of a dazzling orange scarlet colour (Dr. B. P. Pal, 1972).

Kushal : It is a hybrid seedling of white 'Plentiful' X 'Orgeade'. Flower colour is luminous vivid vermilion. Flower appears in small clusters. Flowers are well shaped in tresses (G. Kasturi Rangan, 1974).

Kusum : This cultivar is a bud sport of 'Fusilier'. Flower appears in clusters of pale pink colour. Blooms are long lasting. Bud is vigorous and flowers are produced in

amazing frequency and in large quantities. Plant is always full with flowers (V. S. Padhey, 1978).

Kasum Pur : This cultivar of rose is having double flower. Blooms are light pink in colour. Petal colour on reverse side is scarlet pink (A. M. Bhattacharjee, 1960).

Lahar : It is a hybrid seedling of rose cultivar 'Pink Parfait' X 'Ganga'. Flower colour is mimosa yellow with a tinge of spinal pink. It looks very attractive as it gives multicolour effect. Blooming habit is just like HT roses. Flowering is recurrent and blooms are borne in big bunches in great profusion on bushes. Plant growth is upright and vigorous and cultivar is tolerant to diseases. Flowering is excellent and flowers stand very well even to low temperature in winters (IARI, 1991).

Lakshmi : This cultivar of rose produces flowers in profusion. Blooms resemble with Hybrid Tea type rose. Flower colour is extremely light pink (S. M. Bhattacharjee, 1966).

Lalit : Flower of this cultivar is well shaped. Bloom colour is pink carmine and red. Reverse side of petal turns into white colour in later stage of growth. Tresses are well shaped (S. M. Bhattacharjee, 1967).

Loree : It is a seedling of 'Frolic'. Flowers are double. Flower colour is extremely pale pink. Flowers are borne on a plant of medium height. Blooms appear in cluster. In very cool weather the colour of the flower deepens slightly. During warm weather flower becomes almost white. (Dr. B. P. Pal, 1968).

Madhura : It is a hybrid seedling of 'Kiss of Fire' X 'Goudvilinder'. Buds shape of this cultivar is HT type. Flower colour is lovely blend of light yellow and pink. Plant growth is vigorous. Blooms are freely produced in single and small clusters on stem. Blooms are having good honey fragrance (Dr. B. P. Pal, 1979).

Mahadev : This cultivar of rose is a hybrid seedling of 'Gruss an Teplitz' X 'Unknown'. Flowers have bright vermilion orange in colour. Plant growth is bushy. Plant is disease resistant. During mansoon period the plant produces the brightest coloured blooms (G. Kasturi Rangan, 1975).

Mahak : This cultivar of rose is a real rich-pink apricot beauty. Buds are reddish apricot and ivory in colour, which is one of the most important characteristic of this cultivar. Blending of flower colour, goes on and changing dramatically till the flower opens into golden coral. Blooms are of large size. Flowers are borne singly on straight erect stem, which is less thorny. Plant is vigorous in growth and of medium size and nicely covered with green, glossy and healthy foliage. Cultivar is resistant to diseases (Mrs. Airun, P. L., 1982).

Manasi : It is a seedling of rose cultivar 'Frolic'. Blooms appear freely in very big bunches which covers almost the whole plant with flowers. Blooms are light pink in colour and having shades of cream and lilac colour. Bush is medium growing. It is a very floriferous cultivar (IARI, 1991).

Manjula : This cultivar of rose is having large flowers, which are compact and borne in clusters on stem. Bloom colour is pearly pink that turns into silver pink (S. M. Bhattacharjee, 1966).

Manmatha : This cultivar of rose is a hybrid seedling of 'Sonia' X 'Princess Margaret of England'. It is a HT type of Floribunda rose, which blooms profusely. Plant growth is vigorous and foliage is very healthy. Petal colour is smoky pink and or silvery mauve. Buds open into flower, the edges of petals become flushed with red (Dr. B. P. Pal, 1989).

Meenakshi : Flower of this cultivar is double in shape. Bloom colour is coral orange to salmon pink. Flower appears on stem in massive bunches (A. M. Bhattacharjee, 1967).

Menaka : This cultivar of rose is having perfectly shaped pointed buds which are clean yellow in colour with pink flush. Reverse side of the petal is scarlet red and have reflexed edge. Full bloom stage exhibited carmine red colour with yellow centre. Cultivar is very healthy and free flowering (A. M. Bhattacharjee).

Mohini : It is a hybrid seedling of 'Sea Pearl' X 'Shola '. Flower colour is unusual chocolate brown with yellow tinge at the base of petals, mostly during low temperature. At high temperature it turns into dazzling orange. Plants have dark green and very glossy foliage. Bush is having medium growth. This cultivar is a floriferous in nature (IARI, 1970).

Narmada : It is a hybrid seedling of 'Pink Puff' x 'Unknown'. It is a low growing Floribunda rose. Blooms are pink and very charming. Edges of the petal have darker colour. Flowers last long due to presence of thick petals. This cultivar is a generous bloomer (G. Kasturi Rangan, (KSG Son), 1977).

Nav Sadabahar : This cultivar is a bud sport of 'Sadabahar'. This rose is very attractive and blooms profusely and considered as one of the most beautiful Floribunda cultivar. All the characters are just like the parent cultivar except the flower colour. Petals have white streaks on the original deep pink background (IARI, 1980).

Navneet : This cultivar is a hybrid seedling of 'Prelude' x 'African Star'. The cultivar is having semi-double beautiful flower. Bloom colour is creamy white. Blooms are produced in small and big bunches on long and strong stem. Navneet blooms profusely. Bush growth is vigorous and it spreads with large and green foliage. The cultivar is good for bedding (IARI, 1971).

Nayantara : This cultivar is a Hybrid Tea type Floribunda rose. Buds are ovoid shaped. Flower colour is rose red with white variations. Blooms open spirally with high centre. Blooms are very attractive due to presence of shades of water melon pink and rendered even more due to presence of patina of silver markings. Its name is included in the hand painted series. Bush is healthy and have branches which held flower for a long time even at the fully open stage when the flower have yellow centre which adds additional colour contrast (M. S. Viraraghavan, 1982).

Neelambari : This cultivar is a hybrid seedling of 'Blue Moon' X 'African Star'. Buds are pointed, beautiful and opened in to full bloom. Flower colour is magenta rose. Blooms borne freely in single as well as in small and big bunches. During winter flowers appears singles but in spring and summer they come in clusters and bunches. This variety is very attractive due to presence of bluish colour. Flowers have long lasting quality (IARI, 1975).

Neel Kanti : This cultivar is a hybrid seedling of 'Ahalya' X 'Neelambari'. Flower colour is deep purple mauve. Blooms are rosette shaped with plenty of petals. Blooms

borne singly or in clusters. Colour of flowers turn darker with age (C. R. Chiplunkar, Decospin, 1993).

Netravathi : This cultivar is a hybrid seedling of 'Kamini' X 'Desert'. Flower colour is soft pink, which deepen with age. It is considered as one of the best Floribunda. This free bloomer cultivar of rose has compact tresses (G. Kasturi Rangan, (KSG Son), 1975).

Niharika : Blooms of this cultivar appear on strong stem. Flower colour is white and it has greenish glow. Flowers have compact form and it possesses sweet scent (S. M. Bhattacharjee, 1966).

Nutkhut : This cultivar is a hybrid seedling of 'Rumba' X 'Cocorico'. Flower shape is pompon type. Flower colour is coral red. Bloom appears on very large tresses. Foliage of this cultivar is very attractive (Dr. B. P. Pal, 1969).

Orange Cup : This cultivar is a hybrid seedling of 'Cocorico'. The plants have very large tresses of most brilliant orange scarlet flower. Plant growth is tall and upright. It is a free flowering cultivar and makes a beautiful hedge (Dr. B. P. Pal, 1965).

Orange Vichitra : This cultivar is a seedling of rose cultivar' Vichtra'. Flowers are semi-double. Colour of the bloom is geranium orange. Bloom appears in compact tresses. (A. M. Bhattacharjee, 1966).

Paharan : This cultivar is a hybrid seedling of 'Anna Wheat Croft'. Buds appear in large clusters and open in to small flower. Flowers are fully double and have pleasing shade of colour. Range of bloom colour is pearly white to pink. Plant growth is medium. The complexion of flower resembles very much with hill maid, hence paharan name was coined for reminiscent of the complexion (Dr. B. P. Pal, 1971).

Panchu : Blooms of this cultivars are semi double in nature. Flowers are freely produced and have brilliant sheen. Foliage is attractive and handsome. Plant growth is upright and vigorous. Plant attains height up to 120 cm and above after the proper pruning. The cultivar is good for making hedge or as a individual planting as a shrub (Dr. B. P. Pal, 1966).

Pandit Nehru : The cultivar produces dazzling vermilion to scarlet red coloured flower. Buds are pointed and freely produced. In mild weather the blooms are very attractive. Cultivar 'Pandit Nehru' is porne to mildew disease (A. M. Bhattacharjee, 1964).

Parwana : This cultivar of rose produces flowers in single and in small clusters. Buds are very beautiful. Flowers have charming colour i. e. combination of light and medium yellow. Petal possesses red colour in their edges (Dr. B. P. Pal, 1974).

Patasha : This cultivar of rose resembles very much with the cultivar ' Gopika'. Flowers are very beautiful and attractive. Bloom colour is snow white (R. S. Singh, 1970).

Patiala Durbar' : This cultivar of rose produces Hybrid Tea type of blooms, which appears on stem in clusters. Plant growth is very vigorous and upright. Flowers are slim, shapely and high centred. Bloom colour is bright orange. Flowers are slightly fragrant (R. S. Singh, 1970).

Peet Manjari : Flowers of this cultivar are produced in great profusion. Bloom colour is intense yellow with chrome gold (S. M. Bhattacharjee, 1966).

Prakash : It is a seedling of 'Vasuv' X 'Unknown'. The plant growth is low. Bush looks very beautiful due to studded attractive flowers. The glittering blooms have vermilion-scarlet colour in their petals. Buds are tight. Flowers are long lasting (G. Kasturi Rangan, 1970).

Prema : This cultivar is a hybrid seedling of 'Sea Pearl' X 'Shola'. Flower colour is soft pink. Petal edges are deep pink. Shapely flowers are borne in big bunches. It blooms profusely and flowers have long lasting quality. In blooming period entire bush looks like a flower bouquet on medium compact growing bush. Cultivar is resistant to most diseases and pest (IARI, 1970).

Priya : Blooms of this cultivar is like Hybrid Tea rose type. Flowers are multi-coloured and full of petals. Blooming continues throughout the year. Flower appears on stem with well shape tresses. Bloom colour is creamy white. Petal edge colour is orange and creamish which gives beautiful sparkling effect to the flower colour of the blooms. Colour of the flower changes deeper with the aging (G. Kasturi Rangan, 1972).

Ragini : It is a seedling of rose cultivar 'Quen Elizabeth'. Flowers are very delightful. Bloom colour is clean rose pink. Flower appears in well-shaped clusters (Dr. B. P. Pal, 1972).

Rajbala : Blooms of this cultivar are produced in bunches. Blooms are beautiful and very attractive. Petal colour is light cerise pink. Plant growth is very vigorous. Bush is covered with large, light green foliage, which are produced in abundance (Dr. B. P. Pal, 1975).

Rangoli : It is a seedling of rose cultivar 'Golden Slippeni'. Flowers are bicolour. Bud is petite urn shaped open to approximately 25 petal led blooms, which is 8-9 cm across. Flowers have deep coral pink on inner surface of the petals. Reverse side of the petal is smooth cream. Blooms are mildly fragrant. Plant growth is quite vigorous. The dwarf cultivar is having branching habit (Doon Valley Roses, 1978).

Rare Edition : This cultivar is a bud sport of 'Kusum'. Flowers are very attractive due to the presence of luminous scarlet colour with splashes and striped on petal surface. Blooms are borne in clusters in well-shaped tresses. Flowering is recurrent (G. Kasturi Rangan, 1982).

Rose Sherbet : It is a seedling of rose cultivar 'Gruss an Teplitz'. This cultivar is a free flowering. Bloom appears in large number in small clusters on tall plant. Bloom colour is glowing deep pink to light red. Flowers are beautifully scented. They are having the ability to withstand in cold winter night. Cultivar is good for mass planting and it can also be used for making hedge (Dr. B. P. Pal, 1962).

Rupali : It is a hybrid seedling of rose cultivar 'Sweet Afton' X 'Delhi Princes'. Large blooms appears in bunches of amazing size on strong and very long shoots. Flower colour is deep madder. Flowers are beautifully formed. Bush is tall and vigorous growing and have clean foliage. Flowers are slightly fragrant (IARI,1971).

Sadabahar : This cultivar is a seedling of 'Frolic'. Buds are deep pink in colour and open to flower of medium size. Blooms are produced in clusters, in great number and covered the whole plant with mass of flowers throughout the season. Cultivar is very

ideal for bedding and border planting. It makes very beautiful half Standards. Plant growth is very vigorous. Flowers stand very well during the winter. Cultivar is resistant to most of the diseases (IARI, 1969).

Sailoz Mookherjea : This cultivar of rose is having Hybrid Tea type flowers. Flower colour is pure cadmium orange. Buds open into long lasting flowers. Petals are firm. Flowers are dazzling in full bloom stage. Flower clusters are very large. Plant is having vigorous growth and healthy foliage (Dr. B. P. Pal, 1974).

Salmon Splash : This cultivars of rose is a striped bud sport of 'Orange Splash'. Blooms are very attractive and appears in huge sprays. Flower colour is salmon to pale salmon with bold white stripes and splashes (Kasturi and Sriram, 1997).

Sandhya Bela : This cultivar is a seedling of 'Zambra'. Flowers are of medium size. Blooms are double and have striking new shade of orange colour. The plant attains medium height and its growth rate is moderate (Dr. B. P. Pal,1971).

Saroor : This cultivar is very attractive and good looking with orange-scarlet blooms that appear on stem in large clusters (R. S. Singh, 1969).

Saroja : This enchanting rose cultivar originated from 'Rose Gaujard'. Blooms are bi-coloured. Petals are deep cherry pink with a silvery base and reverse. Buds are beautiful and flowers are elegant. Blooms borne singly or in tresses. Flowers are very lasting and blooming repeat quickly (Dr. B. P. Pal,1984).

Shabnam : This cultivar is a seedling of 'Baby Sylvia'. Flowers are compact. Bloom colour is white. Flower size is small and they are produced in enormous clusters. Colour of the bloom changes into icy-white in the spring flush. Plant growth is vigorous and upright. Bush is healthy (IARI, 1975).

Sharbari : This cultivar of rose is having medium size flower in tresses. Bloom colour is bluish crimson with black scraching appears on petal surface in cool weather (A. M. Bhattacharjee, 1962).

Shatdhara : This cultivars of rose havs flat flowers and their colour is rose pink. Stamens are beautiful and yellow coloured. It looks like its parent 'Ahalya'. It is good for borders and beds (C. R. Chiplunkar, 1991).

Shola : This cultivar is a seedling of 'Anna Wheat Croft'. Buds are of Dutch vermilion in colour and open to sheds of sparkling orient red. Blooms are of medium size. Flowers are long lasting, borne in clusters in amazing abundance. Bush is low and spreading (IARI,1969).

Sharvathi : It is a hybrid seedling of 'Percy Pitcher ' X 'Organde' Flower is luminous vermilion. Clusters are very well evenly arranged and spread. Clusters have 4 to 5 flowers, which are lasting long (G. Kasturi Rangan, 1977).

Shringar : This cultivar is a seedling of 'Eiffel Tower' X 'Surodaya'. Bloom colour is deep camellia rose with lighter base. Reverse side of the petal is comparatively lighter. Flowers are beautiful and semi-double in nature. Blooms are fully and freely formed. Flower appears both, singly and in clusters. A bloom looks remarkably well on plant. Cultivar is having good lasting qualities of flower (IARI, 1972).

Shimantak : Blooms appears on plant in compact tresses. Flower colour is vivid scarlet vermilion (B. S. Bhattacharjee, 1960).

Sindoor : This cultivar is a hybrid seedling of 'Sea Pearl' X 'Suryodaya'. Buds are long pointed in shape and opens into well formed flowers. Blooms are double, large and borne on long shoot in single and small clusters during winter flush and big clusters in spring flush. Flower colour is geranium lake. In spring flush big clusters of 15 flowers in great abundance can be seen. Bush is tall and vigorous growing. Foliage is clear and attractive (IARI, 1980).

Sir Jagadish Bose : Blooms of this cultivar is large and Hybrid Tea type. Flower colour is deep red. Petal possesses vermilion glow. Flower appears in huge clusters (A. M. Bhattacharjee, 1964).

Soor Das : The cultivar produces small flowers, which resembles very much with Hybrid Tea roses. Flower colour is velvety blackish-crimson with scarlet glow on petals. Flowers borne on stem in bunch (A. M. Bhattacharjee, 1959).

Stanza : This cultivar of rose produces single to semi-double flowers. Bloom appears in numerous clusters. Stanza is very free flowering cultivar of rose. Bloom colour is pink, which becomes distinctly lighter toward the centre of the flower (Dr. B. P. Pal, 1967).

Suchitra : This cultivar is a hybrid seedling of 'Lady Frost' X 'Swati'. Flowers have rhodamine pink colour with mimosa yellow base. Reverse side of the petal is silvery white. Blooms are double and very beautiful and produced in single and large tresses. This cultivar is very good for bedding. Its floriferous nature and continuous blooming habit make it an ideal rose cultivar and prized garden bush (IARI, 1972).

Sudha Rani : Bush growth is compact. Flower appears on strong stem. Bloom colour is flame orange vermilion. This cultivar is very attractive (S. M. Bhattacharjee, 1966).

Suhashini : This cultivar is a seedling of 'Queen Elizabeth', which possesses abundant blooms. Flower colour is transluscent coral pink. Shape of the blooms is perfect. Petal edge is pointed. Blooms are borne in clusters of 4 or 5 on still strong stems. Plants are of medium height and vigour (Dr. B. P. Pal, 1972).

Sundaram : This cultivar of rose is very free flowering. Bloom colour is vermilion salmon pink on silvery pink background. Flower appears in large bunches on neat growth of the bush. Colour of the flower is intensifies with age. Flowers are perfect like small Hybrid Tea rose (Bhattacharjee).

Suryakiran : This cultivar is a Hybrid Tea type Floribunda, which evolved after crossing of 'Flamenco' X 'Orangeade'. Flowers are large and well shaped. Bloom colour is dazziling orange, which changes into salmon orange with ageing. Flower appears in large clusters on upright stem. Plant growth is very vigorous and it attains height of 95 cm (Dr. B. P. Pal, 1979).

Suryodaya : This cultivar is a seedling of 'Orangeade'. Flower colour is luminous orange. Blooms are well shaped and double. Flowers are borne in single and in clusters of 4-6 flowers. It is a free flowering cultivar. Bush is tall and strong growing (IARI, 1968).

Sushma : This cultivar is a hybrid seedling of 'Lilac Dawn' X 'Unknown'. Flower

colour is charmingly frilled lilac and lavender pink. Bloom appears on huge tresses. Flowers are fragrant (G. Kasturi Rangan, (KSG Son), 1973).

Swapna : This cultivar of rose possesses lovely creamy white buds, which opens into pure white flowers. Inside of the petals gradually changing into pink with specks and splashes of deeper pink and finally turning to deep carmine red. Reverse side of the petals remains white. Flowers are long lasting and have elegant shape (G. Kasturi Rangan, (KSG Son), 1968).

Tarang : This cutivar of rose is a seedling of 'Queen Elizabeth'. This new cultivar is having vigour and freedom of flower just like its parent. Foliage is very attractive, bronzy and glossy. Flowers are of medium size and appear in clusters. Blooms are attractive and have light yellow colour, which set off by a salmon pink flush. Plant is slightly above medium height (Dr. B. P. Pal, 1989).

Temple Flame : This cultivar is a seedling of 'Orangeade'. Bloom colour is brilliant orange. During cold weather petals are flushed with red colour. In parent, flowers are comparatively larger and more double. The cultivar is floriferous and more vigorous. Blooms are produced singly in clusters (Dr. B. P. Pal, 1965).

Thornless Beauty : This cultivars of rose is a bud sport of 'City of Lucknow'. Plant is completely thornless. Blooms are large and semi-double. Flower colour is salmon pink (B. K. Patil, Icospin, 1990).

Timir : Blooms of these cultivars are glistening. Colour of the bloom is velvety. Cultivar looks very attractive during warm climate when colour changes into blackish crimson (A. M. Bhattacharjee, 1962).

Toohin : This cultivar looks like Hybrid Tea rose. Bloom colour is snow white with lemon flush at the centre. Flowers have strong perfumes (S. M. Bhattacharjee, 1962).

Ulka : This cultivar of the rose is very attractive. Blooms have various combinations of colours and looks like a meteorite. Flowers are striped. Petals have deep red background with shower of cream stripe on it (Bhowmick).

Urvashi : This cultivar possesses cherry-red to orange scarlet colour flowers. Reverse side of the petal is having deep yellow colour (A. M. Bhattacharjee, 1962).

Usha : This cultivar is a seedling of 'Orangeade'. Size of the flowers is small. Bloom colour is deep camellia rose with lighter reverse. Flowers are produced in very large clusters. Flowers have long lasting quality (IARI, 1975).

Varsha : This cultivar of rose is a progeny of Floribunda rose 'Nicole'. Buds are elegant and sleek and their colour is white. Buds open into shapely flowers of pure white margined rose pink. Flowers are borne in great profusion and lasting long (Kasturi and Sriram, 1992).

Veena : This cultivar is a hybrid seedling of 'Dearest' X 'Unknown'. Bloom colour is deep coral pink (G. Kasturi Rangan, 1972).

Vichitra : This cultivar is having lovely blooms. Flower colour is coral pink to deep salmon. Blooms are borne in large clusters. (A. M. Bhattacharjee, 1960).

POLYANTHAS

Beauty of the polyanthas rose is its ability to flowering period, which extends to several months. It is also known as "Pompon Roses " some times. Many of the rose cultivar in this class produces enormous clusters of small beautiful flowers.

Anjani : This cultivar of rose is having flower with prominent white-eyes. Blooms are produced in huge sprays (G. Kasturi Rangan (KSG Son), 1970).

Bharani : This cultivar is a polyalthia / miniature rose which produces deep amethyst blue to mauve flowers. Petals have white eyes, which makes this cultivar attractive. Blooms are scented (G. Kasturi Rangan, (KSG Son), 1973).

Nartaki : This cultivar of rose is a seedling of 'Henrich Krosch' X 'Unknown'. Colour of the flower is deep lavender with yellow stamen (G. Kasturi Rangan (KSG Son), 1974).

Pink Showers : This cultivar of rose is a profuse bloomer. Huge clusters of of pink flowers are produced on plants, which looks very attractive (M. R. Muniswamy, 1968).

Pink Spray : Blooms appear in clusters. Flower colour is bright pink and it blooms continuously produced in spray (G. Kasturi Rangan (KSG Son), 1980).

Priti : This cultivar originated as a bud sport of rose cultivar 'Morgo Coster'. Blooms are lovely and ball like. "Morgo Coster" is a prolific bloomer. Flower colour is soft pink. Blooms are borne on huge clusters (G. Kasturi Rangan, (KSG), 1971).

Rashmi : This cultivar of rose is a hybrid seedling of 'Priti' x. 'Muttertag'. Flowers are globular in shape. Bloom colour is blackish crimson with a velvety sheen. Plant growth is low and compact (G. Kasturi Rangan, (KSG Son),1977).

Rishi Bankim : This cultivar of rose is having globular shape blooms. Flower colour is bright pink. Blooms are produced in huge bunch. It is a free flowering cultivar. Flowers are fragrant (B. S. Bhattacharjee, 1959).

Swati : This cultivar originated as a seedling of 'Winifred Coulter'. Bud colour is deep carmine-pink. Buds are dainty well shaped with silver reverse. Blooms are semi double, small and their colour is white. Edge of the petal is deep pink. Flowers are borne in clusters. This cultivar is excellent for making hedge. It can also be grown in pots and beds (IARI, 1968).

Tarapunja : Blooms of this cultivar is beautiful during cold climate. Flower colour is pink. During summer season flower colour changes into white. This cultivar is an abundant bloomer. Tarapunja is highly decorative cultivar of rose which can be grown either in pots or for borders (Bhattacharjee).

MINIATURE ROSES

Miniature rose looks very attractive and beautiful due to their mini shape and size with the exactly same morphology of rose. Mini roses are ideal for pot growing. These baby roses have small leaves and flowers. They are hardy and are multiplied by cuttings and propagated on rootstocks. Plant attains height of 20-30 cm and some times even little more. Beauty of miniature rose enhances due to presence of cute little foliage and perfect double flowers.

Chandrika : This cultivar is originated as a hybrid seedling of 'Katharina' x 'Cindrella'. Flower colour is grayish white to white. Bloom appears in clusters. Flowers have 50 to 60 petals which looks like a cut diamond and attracts the attention (G. Kasturi Rangan, (KSG Son), 1978).

Dark Beauty : This cultivar of rose is having deepest red blooms. Flower shape is fully double. It is a profuse bloomer. Plant growth is compact and abundant of healthy foliage are present on stem (Mrs P. L. Airun, 1980).

Dazzler : This cultivar of rose is having beautiful cineraria like clusters. Flowers are tiny and produced on low bushes. Flower colour is pink with predominant white centre. Stamen colour is yellow. It is a very attractive cultivar (G. Kasturi Rangan, (KSG Son), 1982).

Dazzling Flame : This cultivar originated as a bud sport of rose cultivar 'Darling Flame'. Bloom colour is just like flame, hence, the name was coined. It is a beautiful rose cultivar (G. Kasturi Rangan (KSG Son), 1976).

Delhi Starlet : This cultivar originated as a seedling of rose 'Goudvlinder'. It produces large numbers of small flowers, which resembles very much with its parent. Buds are deep yellow in colour, which opens into light yellow or cream colour flower. Bush is dwarf and compact with handsome new leaves (Dr. B. P. Pal,1963).

Jimmy : This cultivar of rose is a bud sport of 'Don Don'. This is free flowering cultivars of rose. Buds are compact. Blooms borne singly and in clusters. Flower is lovely and has good number of lustrous petals. Flower colour is amber orange. Petal base is white (Chandrakant More, 1993).

Pushkala : This cultivar of miniature rose is a free flowering in nature. Pure white cluster of tiny flowers appears on stem (G. Kasturi Rangan (KSG Son), 1973).

Rosy : This cultivar of rose is a miniature bud sport of 'Don Don'. Flower colour is non-fading pink. Flowers are fully double and are of rosette shape. Blooms have innumerable number of petals. Flowers are long lasting (Chandrakant More, 1993).

Twinkler : This cultivar of miniature rose is very cute. Flower colour is carmine and reverse side of the petal is yellow in colour. It is free flowering cultivars (Brahm Dutt, 1989).

CLIMBERS

Climbing Dr. Homi Bhabha : A climbing bud sport of "Dr. Homi Bhabha", beautifully shaped white flower (Dr. B.P. Pal, 1975).

Climbing Kanyakumari : This cultivar of rose is very attractive. Flower size is huge and its colour is salmon pink. Blooms are strongly scented (M. S. Viraraghavan, 1979).

Climbing Kronenburg : This cultivar of rose is a climbing bud sport of the famous Hybrid Tea rose 'Kronenburg'. It is a free flowering cultivar and constant bloomer (G. Kasturi Rangan (KSG Son), 1973).

Climbing Matangi : This cultivar of rose is a climbing bud sport of the famous Floribunda rose 'Matangi' (C. R. Chiplunkar, Decospin,1985).

Climbing Ole : This cultivars of rose is a free flowering climbing bud sport of the famous rose 'Ole'. Flower colour is scarlet crimson (Tejganga Roses, 1996).

Climbing Pussata : This cultivar of rose is a climbing bud sport of Floribunda famous rose 'Pussata'. It is a free flowering and long lasting cultivar of rose. Flower colour is dark red (B. K. Patil, Icospin 1987).

Climbing Sadabahar : This cultivars of rose is a climbing bud sport of Floribunda 'Sadabahar'. Enormous bunches of flowers appear on stem. Flower colour is self-pink (IARI, 1991).

Climbing Show Biz : This cultivar of rose is a climbing bud sport of Floribunda 'Show Biz'. Huge clusters of flowers appear on stem. Flower colour is bright scarlet red (Tejganga Roses, 1995).

Climbing Tata Centinary : This cultivar of rose is a climbing bud sport of Hybrid Tea ' Tata Centinary'. Plant is hardy. Plenty of flowers appear on stem (Kasturi and Sriram (KSG son), 1995).

Delhi Pink Pearl : This cultivar of rose is a bud sport of Polyantha rose 'Echo'. Plant is thornless and has good foliage. Plant growth is vigorous. Flower colour is pearly pink. Bloom appears in clusters during spring. In warm weather flower colour changes from pink to white (Dr. B. P. Pal,1962).

Delhi White Pearl : This cultivar of rose is a seedling of 'Prosperity'. Plant growth is vigorous and better than its parent. This glorious climber is having small glossy green leaves. Flowers are produced enormously in clusters. Blooming occur several times in a year. Flower colour is pearly white. Blooms are full and have faint musky fragrance (Dr. B P. Pal, 1962).

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