

**MORPHOLOGICAL EVALUATION OF  
SOME ROSE CULTIVARS**

**SUDEEP VYAPARI**

**DIVISION OF HORTICULTURE  
UNIVERSITY OF AGRICULTURAL SCIENCES  
BANGALORE**

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**MORPHOLOGICAL EVALUATION OF  
SOME ROSE CULTIVARS**

**SUDEEP VYAPARI**

Thesis submitted to the  
**University of Agricultural Sciences, Bangalore**  
in partial fulfilment of the requirements  
for the award of the degree of

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in

**HORTICULTURE**

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*Affectionately Dedicated to*

**Mrs. & Mr. Manohar Rao Jagirdar**

Division of Horticulture,  
UNIVERSITY OF AGRICULTURAL SCIENCES,  
Bangalore

CERTIFICATE

This is to certify that the thesis entitled  
"MORPHOLOGICAL EVALUATION OF SOME ROSE CULTIVARS" submitted  
by Mr. SUDEEP VIAPARI for the degree of MASTER OF SCIENCE  
(AGRICULTURE) in HORTICULTURE to the University of Agri-  
cultural Sciences is a record of research work carried out  
by him under guidance and supervision and that no part of  
the thesis has been submitted for the award of any other  
degree, diploma, associateship, fellowship or other similar  
titles.

Bangalore,  
March 14, 1985.

*R. N. Bhat*  
14/3/85  
(R. N. BHAT)  
Scientist S-3,  
I. I. H. R., Bangalore.

APPROVED BY:

Chairman

*R. N. Bhat*  
10/5/85  
\_\_\_\_\_  
(R. N. Bhat)

Members:

1

*U. V. Sulladmath*  
\_\_\_\_\_  
(U. V. Sulladmath)

2

*M. P. Alexander*  
\_\_\_\_\_  
(M. P. Alexander)

3

*B. G. Muthappa Rai*  
\_\_\_\_\_  
(B. G. Muthappa Rai)

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SUDER V. YAPAT

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## **INTRODUCTION**

## I. INTRODUCTION

The genus Rosa belonging to the family Rosaceae, comprises of nearly 120 species (Pal, 1972) and 20,000 cultivars (Bailey and Bailey, 1977). However, Lancaster et al. (1977) stated that about 300 species of roses have been listed by Dr. W.H. Lawrence of Cornell University and the number of true species according to Dr. Rehder is probably not more than 180. Long before the dawn of written history, primitive man is believed to have known and appreciated the rose. This exquisite flower has been closely associated with the earliest civilizations of the Northern Hemisphere and this association has continued throughout the centuries to the present day (Wright et al., 1966). The rose was found growing wild and indigenously in almost every part of the Northern Hemisphere, even to Iceland and Lapland but never to the South of equator.

The majority of our present day garden roses are hybrids and have been derived from wild species, all of which were natives of various countries in the Northern Hemisphere. Through the ages, a great deal of natural and artificial hybridization has occurred that no other group of plant has such a mixed and complicated ancestry. The ancestral species had single five petalled blossoms, but even previous to about 300 B.C. double roses had made their appearance (Wright et al., 1966). The modern garden

roses, developed mostly in Europe and other countries have a wide range of bewitching colours, exquisite shape of buds and flowers, long lasting quality and are thus unrivalled in beauty and utility.

Ever since the cultivation of roses in India, it has been grown for various purposes like garden displays, cut flower for decoration as garlands, bouquets, button holes, hair adornments by women; for preparation of various products from petals such as rose oil or otto of roses, rose water, gulband and gul-roshan.

Rose breeding is now a world wide activity, largely in temperate countries. Thousands of seedlings are being raised every year by nurserymen in France, Germany, the Netherlands, the United Kingdom, the United States, Canada, Australia and several other countries. In India, rose breeding has been taken up only in recent years. The pioneer rose breeder of any consequence appears to have been B. K. Bhattacharji in India (Pal, 1972). Large number of germplasm collection of roses are being added by various institutions and leading nurserymen every year from different countries. However, many of the standard books and journals do not give detailed information on their growth habit, stem colour, density of thorns, leaf shape, size and area, flower bud colour, shape and size of petals, stalk length, pollen fertility status and disease tolerance. This poses a problem for proper

identification of the cultivars and to utilize them in systematic breeding programmes. Further, most of the garden roses are introduced from temperate countries and exhibit considerable variations when grown under tropical and subtropical conditions. According to Pal (1972), the rose has received little attention at the hands of geneticists. Possibilities of rose improvement are by no means exhausted. The range of variability which is of potential value in the development of new cultivars possessing characters not commonly found is very great and most of it remain unexploited.

A systematic study of the various morphological characters including vegetative and floral characters, pollen fertility status and tolerance to diseases would further facilitate the breeders to select suitable parents for planned breeding programmes. Therefore, in the present investigation, 50 modern hybrid tea rose cultivars were studied with the following objectives:

1. To compare the extent of morphological variations in different rose cultivars under study for both vegetative and floral characteristics.
2. To estimate the pollen fertility status in different rose cultivars using nuclear stains.

3. To screen the rose cultivars for their tolerance to major diseases like black spot (Diplocarpon roseae) and powdery mildew (Sphaerotheca pannosa).
4. To select the rose cultivars suited for different purposes like garden display, exhibition and cut flowers.

## **REVIEW OF LITERATURE**

## II. REVIEW OF LITERATURE

Rose is one of the most important commercial flowers cultivated throughout the world for their cut flowers and garden decoration. Rose breeding is extensively undertaken in France, U.S.A., Canada, Australia, Germany, New Zealand and several other countries. Large number of hybrid and open pollinated seedlings are being raised every year by nurserymen, various institutions and amateurs for selecting the desirable ones from them for commercial release. An attempt is, therefore, made here to present detailed informations available on various morphological aspects involving both vegetative and floral characters of different cultivars of rose, along with their pollen fertility status and disease tolerance. The literature review is done under the following headings:

1. Origin and distribution
2. Morphology
3. Pollen fertility
4. Diseases

### 2.1. Origin and distribution

The origin of the rose is quite prehistoric. Geologists tell us about its existence more than 35 million years ago and it has been found indigenous to almost every part of the Northern Hemisphere, even to Iceland and Lapland

but never to the south of equator (Thomas, 1970). The earliest known representation of the rose is a fresco painting of the Minoan civilization which existed on the Isle of Crete from about 3000 B.C. to 2000 B.C. (Wright *et al.* 1966). Rose has always figured in the myths and legends, in the poetry and music of many ancient people. It has been used in rituals, as a motif in architectural decoration, in beautiful designs in jewelry, in pottery and in embroidery (Pal, 1972).

The Rosa species are extensively distributed in the north temperate and subtropical parts of both the hemispheres, extending from New Mexico to the Arctic Circle in North America; they occur in Abyssinia in north-east Africa, and are found in the great Himalayan belt of mountains and in the mountains of China and Japan (Pal, 1972). Over the area, species have arisen which differ widely from one another, for they have adapted themselves to the prevailing conditions of temperature and environment in which they are found. From dwarf types, a few centimetres high, to giant climbers upto 12 metres (40 ft), they present a wide variety of foliage, flower, fruit, thorn and growth. Because of this wide variation, differing opinions have been expressed as to the number of species to be found (Le Grice, 1976). There is no firm agreement as to how many species survive today -- the figure is

usually put around 120 but may be as high as 150. So, it is not surprising that nobody can even guess as how many there may have been in the past which, for one reason or another died and became extinct (Gibson and Nyall, 1980). Pal (1972) mentions that according to generally accepted classification of Rehder there are about 120 species of roses. Lancaster *et al.* (1977) stated that about 300 species of roses had been listed by Dr. W.H. Lawrence of Cornell University and the number of true species according to Dr. Rehder is probably not more than 180.

## 2.2. Morphology

Studies on the varietal trials of roses have been conducted by many workers. Lundstad (1960) described 125 shrub rose species and cultivars which were under trial during the period 1952-58. The characteristics described in detail were height of the plant, size and number of blossoms and time of blossoming. The botanical species and cultivars were compared in groups according to height, and the different cultivars were classified in cross groups. Of the 125 rose species and cultivars, 22 were finally selected as being of outstanding value.

Lundstad (1962a) reported experimental findings of varietal trials with 31 floribunda roses during the period 1954-60. They were evaluated for different characteristics

like height of the plant, colour and size of the flower and their fragrance. Based on the evaluation results two cultivars 'Border King' and 'Schweizer Gruss' were recommended for cultivation. Lundstad (1962b) reported the results of varietal trials of 25 species and cultivars of shrub roses under trial during the period 1955-1961. Data on the plant vigour, flowering period, number of flowers produced and the weight and size of rose hips have been given. The cultivars evaluated have been described individually and are classified in hybrid groups. Finally the different species and cultivars were discussed on the basis of measurements and observations of the experiment and 7 cultivars were recommended as being of outstanding value. The cultivars were 'Maigold', 'Loje Hammarberg', 'Nevada', Rosa holomas, Rosa pomifera, 'Schneezwerg' and 'Splendens'.

Lundstad (1964) reported results of varietal trials of 93 floribunda roses carried out during the period 1955-1960. This report covered three series of tests. The varieties included in the first test series were planted in the spring of 1955, the second in the spring of 1956 and the third in the spring of 1957. Observations were mainly recorded on plant vigour, number and size of the flowers and colour and fragrance of the flower. The varieties were discussed on the basis of measurements and

data gathered during the test years and the varieties 'Ann', 'Korona', 'Lady Mayle Robinson', 'Moulin Rouge', 'Pink Garnetto', 'Queen Elizabeth' and 'The Fairy' were found to be best for cultivation. Lundstad (1969) carried out varietal trials on 51 hybrid tea roses during the period 1965-68 and reported the findings. Data were recorded mainly on plant growth, behaviour, number and size of the flowers, flowering period and colour and fragrance of flowers. Based on the results of evaluation the cultivars 'Coronado', 'Kna Harkness', 'Hanne', 'Intermezzo', 'McRedy's Sunset' and 'Super Star' were recommended for cultivation.

Lundstad (1975) evaluated 45 new cultivars of floribunda and polyantha roses which were under cultivar testing during the period 1968-1972. Following were some of the characters evaluated, height of the plant which was found to be maximum in the cultivar 'Scarlet Queen Elizabeth' (84 cm) and minimum in 'Goldschats' (30 cm). The cultivars 'Goldrausch' and 'Tip Top' had maximum (9.5 cm) flower diameter and 'Gartnerfreude' and 'Marimba' had minimum (5.5 cm). The number of petals were found to be maximum in the cultivar 'Goldtopas' (48) and minimum in 'Lampion' (5). The colour of the flower was recorded with the help of Horticultural colour chart and the fragrance was also recorded in all the

cultivars. Based on the results of evaluation the cultivars 'Jan Spek', 'Fernille Poulsen' and 'Tip Top' were recommended as best ones.

Lundstad (1979a) tabulated data for 66 hybrid tea roses which were under trial during the period 1969-1972. The characteristics evaluated were height of the plant which was found to be maximum in the cultivar 'Red Queen' (85 cm) and minimum in 'Kleopatra' (31 cm). The maximum and minimum number of petals were found in the cultivars 'Freiheitsglocke' (77) and 'Buccanar' (23) respectively. The cultivars 'Capistrano' and 'Kleopatra' had maximum (13.5 cm) and minimum (8.5 cm) diameter of the flower, respectively. The cultivars 'Arlene Francis', 'Baden Baden', 'Ernest H. Morse', 'Krotika', 'Friedrich Schwarz', 'Grande Amore', 'Konrad Adenauer Rose', 'Liebesauber', 'Mainzer Fastnacht', 'Mister Lincoln' and 'Royal Canadian' were found to be highly fragrant. The colour of the flower was also recorded in all the cultivars. Individual cultivar has been described based on the results of the evaluation, the cultivars 'Konigin der Rosen', 'Pascali' and 'Peer Gynt' were finally selected as being of outstanding value. Lundstad (1979b) reported the results of evaluation of 38 new floribunda and repeat flowering shrub rose cultivars, which were under trial during the period 1972-1976. It was observed that the plant height ranged

between 24 cm ('Ruth ofarin') and 122 cm ('Hansaat'). Maximum number of petals were in the cultivar 'Tiara' (79) and minimum in 'Hansaat' (5). The flower diameter ranged between 3.5 cm ('Maywonder') and 10.0 cm ('Mogido'). Flower colour was recorded in all the cultivars, and the cultivars 'Pariser Charme' and 'Spanish Sun' were found to be highly fragrant. On the basis of evaluation the cvs 'Picasso' and 'Westerland' were recommended as best ones for cultivation.

Bosman and Verloot (1968) investigated leaf and thorn morphology in two floribunda roses and Rupprecht (1970) gave detailed descriptions of flower and vegetative (mainly leaf and thorn) characteristics of three rose cultivars namely, 'Baccara', 'Queen of Bermuda' and 'Roter Stern'. Palocsay and Wagner (1966) studied leaf type, disease resistance, flower production, bud shape and colour and scent in 201 rose varieties grown in the field at Cluj. Brander (1971, 1974, 1978) conducted varietal trials on 345 rose cultivars belonging to different classes. All the cultivars were assessed for vegetative characteristics like flower colour, size and number, time and duration of flowering, fragrance, production and quality and disease tolerance. Similarly, Wieniewska-Grzeszkiewicz (1978) evaluated morphological characters of 29 miniature roses cultivated in Poland. The cultivars were assessed

for plant height and width, number of flowers produced, flower colour and diameter and the number of petals per flower. Studies on the variability (Topalov, 1962), morphological characters (Nazarenko, 1979) and growth and development (Nazarenko, 1977) characteristics of the essential oil bearing roses were conducted and data were recorded on the number of flowering shoots, number of flowers per plant, flower weight, number of petals per flower and colour of the flower. Topalov (1962) reported that the number of petals per flower ranged from 6 to 76 and classified the varieties according to their flower colour into three groups.

Haenchen (1981a) in his series of investigations on rose varieties grown in the German Democratic Republic presented results on the average plant height and diameter of 53 hybrid tea and 74 floribunda roses. At the first flowering in June, the height of the hybrid tea rose ranged from 42 cm ('Duisberg' and 'Marcollo Gret') to 98 cm ('Rakete') and of floribunda rose from 32 cm ('Ladl') to 89 cm ('Queen Elisabeth'). Increase in height between first and second flowering peaks varied from 5 cm to 48 cm for hybrid teas and 5 cm to 53 cm for floribundas, averaging 19.20 cm and 13.40 cm, respectively. At the second flowering peak the height of the plant ranged from 51 cm to 146 cm in the hybrid teas and from 40 cm to 141 cm in the floribundas. The plant diameter ranged between

30 cm and 63 cm, and 29 cm and 94 cm for each group respectively. The height: diameter (ratio) ranges between 1:0.5 to 1:1.1 in hybrid tea cultivars and 1:0.6 to 1:1.2 in floribunda roses. Maschen (1981b) reported his findings of the assessment of the productivity of 54 rose cultivars grown outdoor for cut flowers. The highest average number of cut stems per plant was with 'Hpartan', 'Crimson Glory' and 'Sutter's Gold', being 20.3, 19.3 and 19.1 stems per plant, respectively. The longest average stem length was with 'Bonjour' and 'Rakete', 46.7 cm and 49.0 cm, respectively and the shortest with 'Duisberg' and 'Marcelle Gret', 18.1 cm and 19.0 cm, respectively.

Swarup et al. (1970) described six new varieties of roses evolved at the I.A.R.I., New Delhi, produced by hybridization. The height of the plant was found to be minimum (70 cm) in the cvs 'Rangashala', and 'Shola' and maximum (130 cm) in the cv 'Surekha'. The cvs 'Surekha' and 'Uttam' were found to have maximum (80) number of petals and 'Sarbajhar' had minimum (20). The maximum and minimum average flower diameter is reported in the cvs 'Uttam' (10.0 cm) and 'Shola' (7.0 cm), respectively. The cv 'Sugandhini' is reported to be highly fragrant. The cultivars were also assigned to their respective classes and parentage is given in case of each cultivar.

The colour of the bud and flower has also been described. Swarup et al. (1971a) described four more new cultivars of roses evolved at I.A.R.I., New Delhi. The cv 'Ganga' had the maximum (100 cm) plant height, whereas the cvs 'Bhim' and 'Hans' had minimum (80 cm) height. The foliage colour was dark green and light green in 'Ganga' and 'Hans', respectively. Colour of the bud and flower, and shape of the flower has been described. The average size of the flower varies between 8.0 cm ('Prama') and 11.5 cm ('Hans'), and the number of petals were found to be maximum in 'Bhim' (80) and minimum in 'Hans' (18).

Swarup et al. (1973b, 1974, 1978) have described 21 new rose cultivars evolved at the I.A.R.I., New Delhi. Of these, 10 were hybrid teas and 11 were floribundas. The cvs 'Aridula' and 'Chitralekha' were found to have maximum (150 cm) and minimum (65 cm) plant height, respectively. The foliage was light green in 'Chitwan' and 'Raj Kumari', whereas it was dark green in 'Deepika', 'Aridula', 'Noelambari', 'Suchitra' and 'Gujata'. The colour of the flower varied from creamy white in 'Navnet', phlox pink in 'Surabhi' to deep ruby red in 'Chitralekha'. The cvs 'Shabnam' and 'Deepika' had maximum (85) and minimum (15) number of petals, respectively. The maximum and minimum average diameter was found in 'Charugandha' and 'Gujata' (12 cm) and 'Usha' (4 cm), respectively. The cvs 'Charugandha' and 'Surabhi' were highly fragrant.

A discussion of the Parkland series of Rosa arkansana hybrids with descriptions of 5 cultivars has been given by Marshall (1977). The cultivars were evaluated for morphological characters like height of the plant, colour and shape of the flower and type (single/double/semidouble) of flowers. The parentage of these cultivars has also been mentioned.

Kuppuswamy and Sampath (1956 and 1957) have described 77 rose varieties in the Sim's Park collection at Coonoor, Tamil Nadu. The following characteristics like habit, colour of the stem, colour, size and shape of the thorns, colour, shape, margin and texture of leaves, number of leaflets per leaf, colour of the tender leaves and shoots, colour, size and shape of the flower and fragrance were studied. Descriptions of four shrub rose cultivars have been given by Svejda (1978) under Ottawa conditions. The cultivars were evaluated for the following characters like, height of the plant, shape of thorns, number of thorns per 10 cm stem section, colour of the young and matured foliage, size, texture and number of leaflets, colour of the flower, number and size of petals, diameter of the flower and intensity of fragrance. Similarly, Semoniuk (1979) also described three new everblooming floribunda cultivars, namely, 'Spotless Gold', 'Spotless Yellow' and 'Spotless Pink'. The characteristics described were shape of the thorns,

number of thorns per 10 cm stem section, colour, size and number of leaflets, bud shape, colour and diameter of the flower and number of petals and fragrance.

Studies on the evaluation of morphological characters after the effect of ionizing radiations have been conducted by many workers. Gupta (1966) irradiated budwood of six cultivars of hybrid tea roses with gamma rays and studied its effect on the length of the shoot after five months of budding, total number of flowers per plant, number of normal and abnormal flowers, size, shape and colour of the abnormal flowers and other abnormalities such as petaloid sepals, sepaloid petals, sepals leaf like and anthers fused with petals. In another experiment Gupta and Shukla (1970) subjected rose budwood of cvs 'Montezuma' and 'Super Star' to the different treatments of gamma rays and recorded the data on the height of the plant, total number of flowers per plant, percentage of flowers with morphological abnormalities and colour and shape of the mutated flowers. In a similar kind of experiment, Kalcker and Swarup (1972) recorded data on colour, shape and number of leaflets, colour of the flower, number of petals, and shape and number of flowers per plant in 3 rose cvs 'Christian Dior', 'Kiss of Fire' and 'Queen Elizabeth'. Kalcker and Swarup (1978) reported that the mutant obtained by treating the budwood of rose cv 'Gulzar' had blue stripes on the deep parents rose colour of

the flower. The number of petals per flower and the number of flowers per bush were also recorded.

Morphological data on hybrids between control and mutants of cv 'Montezuma' have been reported by Lata (1975). The data were recorded on stem diameter, length of internodes, length of leaf and terminal leaflet, length of pedicel, diameter of flower, number of sepals and petals, and length and breadth of petals. Lata (1980) studied the effect of ionizing radiations on various morphological characters of 7 rose cultivars. The data were recorded on number and height of the shoots, survival percentage, flowering period, number, size, shape and colour of the flowers, number of petals and size of the petals.

Balasubramanian (1963) while describing 'Madame Mason' as a good cut flower variety, has classified the variety to the 'Hybrid Perpetual' class. He reported that the flower possessed delicate scent and the outer whorl of the petals were fuchsia purple and the inner ones had deep carmine petals. The stalk length was found to be 9 inches or almost 23 cm. Gowda *et al.* (1979) evaluated 8 hybrid tea roses for cut flowers. The characters evaluated were, shoot length which was found to be maximum in 'Maine Superior' (36.00 cm) and minimum in 'Red Devil' (18.58 cm). The cv 'Christian Dior' had maximum (47.09 cm) stem length and 'Red Devil' had the minimum (28.5) cm. The

length and breadth of randomly selected petals from the second whorl of flower gave the size of the petals which were found to be maximum in the cvv 'Pink Parfait' (5.60 cm) and 'Oklahoma' (5.35 cm) and minimum in 'Black Ruby' (4.13 cm) and (3.73cm), respectively. The total number of well developed petals were found to be maximum in 'Red Devil' and minimum in 'Pink Parfait'. The density of thorniness per 2.5 cm of stem length was observed to be maximum in 'Mainauperle' (6.25) and minimum in 'Pink Parfait' (2.25).

Pandey and Sharma (1976) studied the percentage of bud take, length and diameter of buds, number of leaves, number of branches and flowers in rose cultivars 'Montezuma', 'Careless Love' and 'Charles Millerin' on 3 different rootstocks. Swarup et al. (1973a) studied various morphological characters in a total of 184 cross combinations in 12,385 crosses attempted for the hybridization experiment carried out at I.A.R.I., New Delhi. The characters included for the study were height of the plant, colour and form of the flower, size of the flower, number of petals and intensity of fragrance.

Brief descriptions of rose cultivars have been given by many a workers and authors. Bailey (1966) has given taxonomical description of the genus Rosa and key for the identification and morphological description of 38 Rosa spp.

Pal (1969) has described 32 cultivars released between 1962-68. Mandanova (1970) described taxonomic characters of 31 known Turkish series of rose, together with a diagnostic key. Crockett et al. (1971) summarized the morphological descriptions of species and varieties of different classes of roses. Morphological characteristics of 344 rose varieties have been compiled and tabulated by them. Klasteraky (1976) in a monograph on Rosa arvensis covered different aspects like cytology, morphology, distribution, ecology and synonyms. Several spontaneous hybrids of Rosa arvensis were also described.

Swarup et al. (1971b) and Malik et al. (1974) gave brief descriptions of 64 and 28 rose cultivars, respectively, which were registered with the National Registration Centre for roses in India. The descriptions of the cultivars include name of the breeder/institution, year of release, parentage and class, colour and texture of the foliage, shape and size of the buds, diameter and colour of the flower, number of petals and record of fragrance. Khokher and Gupta (1977) have described flower characteristics of 22 hybrid tea, 7 floribunda, 1 polyantha pompon, 2 miniature and 3 climber and rambler roses.

Pal (1972) has listed 242 rose cultivars evolved in India with their brief descriptions, along with a select list of internationally popular varieties of roses belonging

to different classes. The chief characteristics described are colour, form and size of the flower and intensity of fragrance. A list of popular varieties along with their description has been given by many authors (Thomas, 1970; Pizzatti and Cocker, 1975; Le Grice, 1976; Seymour, 1978; Hessayon, 1981; Pal, 1982; Beckett, 1984).

### 2.3. Pollen fertility

Saharo and Shastri (1963) collected data on the pollen sterility in 96 varieties of garden roses. Of these, 67 varieties were of hybrid tea class in which the cultivar 'Kaiserin Auguste Victoria' had highest pollen sterility percentage (98), whereas the cultivars 'Ena Harkness' and 'General McArthur' had the lowest (10) pollen sterility percentage. It was also observed that 3 varieties each of triploid and aneuploid hybrid tea had very high pollen sterility. Lata (1971) carried out a preliminary survey on the pollen sterility status of 6 strongly scented hybrid teas for further facilitation in the breeding programme. Observations on pollen stainability and meiosis were made with the help of acetocarmine stain and shrivelled, unstained, empty pollen grains were considered as sterile. The average pollen fertility in the varieties varied from 19% ('Gruss an Coburg') to 36% ('Crimson Glory') during the winter season. Lata and Gupta (1975) while studying the effect of ionizing radiation on roses, determined pollen fertility after staining the pollen grains for two hours with aceto-

orange flowered mutants. Unstained and shrivelled grains were treated as sterile. The pollen fertility decreased in pink flowered mutant as compared with control, whereas an increase was recorded in reddish flowered mutant. Again, Lata (1980) while studying the effect of ionizing radiations on 7 rose cultivars determined pollen fertility status in all the cultivars on the basis of acetocarmine stainability test. It was observed that irradiation brought about a loss in pollen fertility.

Gowda *et al.* (1977) conducted studies on pollen fertility and stainability in 8 hybrid tea roses. The pollen fertility was determined by acetocarmine stainability test. The percentage of pollen fertility varied from 12.29 ('Super Star') to 56.76 ('White Christmas'). It was also shown that the percentage of pollen fertility in controlled pollinations and pollen stainability percentage by acetocarmine tests were almost the same. Swarup *et al.* (1973a) determined pollen fertility in different cultivars in a total of 184 cross combinations studied, while attempting hybridization between hybrid teas and floribundas or among themselves.

Jicinska *et al.* (1976) evaluated the percentage of morphologically normal pollen grains and compared with the viability and actual *in vitro* germinability of the pollen from 18 shrubs of wild Czechoslovak roses. They found that

E. canina and E. furdzillii had smallest percentage of morphologically normal pollen grains. Semenluk (1979) found out good pollen fertility percentage in 3 new cultivars, namely, 'Spotless Gold', 'Spotless Yellow' and 'Spotless Pink', which were selections from an  $F_3$  population.

#### 2.4. Diseases

##### 2.4.1. Black spot (Diplocarpon roseae)

Thomas (1970) described black spot, a fungal disease caused by Diplocarpon roseae. The disease is apparent only on mature leaves and stems. Black or brown spots appear on the foliage, then the remainder of each leaflet turns yellow, and it soon drops. The black spot infestations reach their maximum in mid or late summer and are much worse in some years than in others.

Lundstad (1960) while carrying out varietal trials of 125 shrub roses grown during the period 1952-1958, reported that there was little damage due to plant diseases, but comparatively the black spot incidence was more than other diseases. Palmer and Semenluk (1960) assessed relative susceptibilities of 16 rose cultivars to black spot and reported that the floribunda cvs 'Goldilocks' and 'Chic' were very resistant and were followed in decreasing order of resistance by the hybrid tea 'George Ardens', the hybrid perpetual 'Black Prince' and the hybrid teas 'Peace' and 'Red Radiance'.

Swarup et al. (1971b) while giving brief descriptions of 64 new Indian roses registered, reported the hybrid tea cvs 'Neer' and 'Yamini Krishnamurthy' and the floribunda cvs 'Kesari' and 'Samer' to be resistant to black spot. The floribunda cv 'Mohini' is found to be tolerant to black spot. Semenluk (1979) for the first time reported the evidence of black spot resistance in roses. The new cultivars were selected from an  $F_3$  population derived from crosses between a tetraploid form of black spot resistant R. rugosa and the commercial cvs 'Goldilock' and 'Chic'. These new cultivars were 'Spotless Gold', 'Spotless Yellow' and 'Spotless Pink'.

Lundsted (1979a) reported that the black spot disease caused greatest damage among the plant diseases affecting the 66 hybrid tea rose cultivars which were under trial during the period 1969-72. Similar observations were reported by Lundsted (1979b) among the 38 new floribunda cultivars which were under trial during the period 1972-76. Haenchen (1980) in a study of over five years evaluated 153 rose cultivars from different sources for their resistance to black spot and reported that out of the 53 hybrid tea rose cultivars tested 'Apollo' and 'Desert' were most resistant and of the 71 bedding roses (floribunda) tested 'Masquerade' and 'Present' were found more resistant.

#### 2.4.2. Powdery mildew (Sphaerotheca pannosa)

Powdery mildew, caused by the fungus Sphaerotheca

powdery mildew, is a very common rose disease, mostly seen on young growth. White mealy powder is found on young leaves of current year of growth and curling of leaves occur. The fungus appears whenever the days are warm and the nights are cool. Dry conditions favour these variations in temperature, so the powdery mildew is seen most commonly in dry weather (Thomas, 1970; Khokher and Gupta, 1977).

Lundstad (1960, 1962a, 1962b, 1964, 1969) while carrying out varietal trials with different classes of roses observed that powdery mildew caused little damage.

Deshpande (1979) noticed a severe outbreak of powdery mildew at Karathwad Agricultural University, Parbhani, in December 1976. In order to assess the degree of susceptibility or resistance in the introduced hybrid tea rose varieties, observations were taken on disease severity in terms of percentage area affected by selecting randomly 3-4 leaves from basal, middle and top portion of a plant thus totalling ten leaves per plant. Out of 54 varieties 40 showed resistance, 4 were categorised as moderately resistant, 3 as moderately susceptible and remaining four as highly susceptible. The cvs 'Aquarius', 'Careless Love' and 'Ladora' were found to be resistant.

Swarup et al. (1971b) reported that the hybrid tea cvs 'Hera' and 'Yamini Krishnamurthy' and the floribunda cvs 'Kesar', 'Whini' and 'Saroor' were mildew resistant.

Haenchen (1980) evaluated 153 rose varieties belonging to different classes for resistance to powdery mildew and reported that the hybrid tea cvs 'Ballet' and 'Ovation' and the floribunda cvs 'Juliska' and 'Roko-Rose Altenburg' were resistant to powdery mildew. 'Schwarzer Saft' and 'Le Reve', and 'Frühlings Gold' and 'Frühlings Morgen' belonging to the class of climbing roses and shrub roses, respectively were also found to be resistant to powdery mildew. Lundstad (1979a, 1979b) reported the incidence of powdery mildew among many cultivars of 66 hybrid tea and 38 floribunda roses under trial during the period 1969-1972 and 1972-1976, respectively.

Combined resistance to both the diseases i.e., black spot and powdery mildew was studied by Flomicher (1972) and also for the rust by Kallio (1972), Vergnaud (1974) and Sieber (1976).

## **MATERIAL AND METHODS**

### III. MATERIAL AND METHODS

The present investigation has been undertaken to evaluate certain morphological characters, pollen fertility status and disease incidence in 50 rose cultivars maintained in the germplasm collection block at the Indian Institute of Horticultural Research, Hebbalghatta, Bangalore. The Institute is located at 26 km north of Bangalore. It is situated approximately between the north latitudes of  $13^{\circ}7'40'' - 13^{\circ}8'$  and east longitudes of  $77^{\circ}29' - 77^{\circ}29'30''$ , respectively. The altitude of the place is 863 meters above the mean sea level. Meteorological data indicating the average rainfall received, temperature and the relative humidity are presented in Annexure.

For the present investigation, the following 50 rose cultivars were selected. 'Adolf Horstmann', 'Akebono', 'Ambassador', 'Ambika', 'Angelus', 'Anne Burda', 'Aquarius', 'Arizona', 'Aswini', 'Bull's Red', 'Canary', 'Caramia', 'Careless Love', 'Chitrangini', 'Deep Secret', 'Doris Tysenmann', 'Ferry Porsche', 'First Prize', 'Flammenpiel', 'Folklore', 'Fragrant Hour', 'Ghazal', 'Gulzar', 'Ilona', 'Interflora', 'Ivory Tower', 'John Waterer', 'Jouveneselle', 'Kalpana', 'Kaiva', 'Kentucky Derby', 'Lancome', 'Landora', 'Leoney Jubilee', 'Lolita', 'Miss Harp', 'Norma', 'Panorama Holiday', 'Paradies', 'Precious Platinum', 'Rebel', 'Red Masterpiece', 'Red Planet', 'Silva', 'Sophocle', 'Summer Days', 'Tapti', 'Vasavi', 'Vicky' and 'Yankee Doodle'.

All the cultivars were planted in the field in December 1980 except the cv 'Illona' which was planted in October 1983. Further, two plants of each were available for recording the observations and these plants were pruned twice a year.

Following are the characteristics evaluated in detail to understand the extent of variability in these 50 rose cultivars.

### 3.1. Classification

Each cultivar has been assigned according to its classification.

### 3.2. Year of release

The year of release or introduction, along with the name of breeder/institution has been indicated in all the cultivars.

### 3.3. Morphological characteristics

To study detailed morphological characteristics of 50 rose cultivars, following important attributes were selected.

#### 3.3.1. Study of the vegetative characters

##### 3.3.1.1. Plant habit

The growth habit of each cultivar like very vigorous, vigorous and moderate nature has been mentioned after

### 3.3.1.2. Plant height

The length of the plant was measured from the bottom to the top of the vegetative growth point before pruning and the average height is given.

### 3.3.1.3. Stem

The colour of the young and matured stem was recorded on the basis of visual observation.

### 3.3.1.4. Thorn

The density of thorniness on the stem after full maturity was observed. For recording this observation, five cuttings of 15 cm length from the basal portion in case of each cultivar were taken and the average number of thorns per centimeter has been presented.

### 3.3.1.5. Leaf

a) Colour of the young and matured leaves was recorded on the basis of visual observation.

b) In rose cultivars there will be usually 3 to 7 leaflets of different sizes. Therefore, it was decided to record the average leaf area (in sq. cm) by using Leaf Area Meter. Five representative random samples of leaves were taken for determining the average leaf area.

c) Observations of matured leaflet with regard to its shape, margin, tip, base and texture were recorded.

### 3.3.2. Study of the floral characters

#### 3.3.2.1. Bud

Observations on the colour of the flower buds, their size (small, medium or large) and shape (bold or pointed) were recorded in each cultivar.

#### 3.3.2.2. Flower colour

The colour of the flower bud and opened flowers was recorded with the help of Horticultural Colour Charts published by the Royal Horticultural Society, England.

#### 3.3.2.3. Flower diameter

The range in flower diameter was recorded from one end of the petal to the other end across the fully opened flowers.

#### 3.3.2.4. Number of petals

The range in number of petals in each rose cultivar was recorded including the small ones.

#### 3.3.2.5. Petal size

The average length and breadth of the outer whorl of petals were taken for measuring the size.

#### 3.3.2.6. Petal shape

Shape of the petals were recorded from a fully opened flower.

### 3.3.2.7. Fragrance

The fragrance of the flower was recorded by smelling the fresh flower in each cultivar.

### 3.3.2.8. Stalk length

Stalk length in each cultivar was measured from the base of the stalk to the tip of the flower bud and the average has been presented.

## 3.4. Pollen fertility

The pollen fertility status of the rose cultivars has been estimated by using two different nuclear stains.

### 3.4.1. Pollen fertility estimation by using acetocarmine stain

The pollen fertility has been estimated by using 0.5 per cent acetocarmine. Pollen grains from freshly dehisced flowers were put on a slide with a drop of acetocarmine and coverslip was then mounted on it and kept for one hour for proper staining. For estimating the sterile and fertile pollen grains, the pollen grains which were shrivelled, deformed and failed to take the stain were recorded as sterile and the ones which were round with proper outline and reddish in colour were recorded as fertile. The average pollen fertility has been estimated in terms of percentage.

### 3.4.2. Pollen fertility estimation by using a versatile stain

Pollen fertility has also been estimated by using a versatile stain suggested by Alexander (1980). The stain

is prepared as follows: Ethyl alcohol (95%) - 20 ml;  
malachite green - 20 mg (2 ml of 1% solution in 95% alcohol);  
distilled water - 50 ml; glycerol - 40 ml; acid fuchsin -  
100 mg (10 ml of 1% aqueous solution); phenol - 5 g and  
lactic acid - 3 ml.

Freshly dehisced pollen grains were taken on a slide with one drop of this stain. The slide was warmed slightly over a flame 3 to 4 times, covered with a cover slip and was then kept for about 5 to 6 minutes for proper staining. For estimating the sterile and fertile pollen grains, the pollen grains which were shrivelled and stained green were recorded as sterile, and the ones which were round and stained crimson red were recorded as fertile. The average pollen fertility has been estimated in terms of percentage.

### 3.5. Evaluation for disease tolerance

All the 50 rose cultivars have been evaluated for the tolerance of major diseases, namely, black spot (Diplocarpon roseae) and powdery mildew (Oidium rosae). The evaluation for the diseases was made during August-November season of 1983 and January-April season of 1984. For the evaluation, leaf samples from three positions of the plant i.e., bottom, central and top, were considered. The cultivars have been categorised as highly susceptible, moderately susceptible, susceptible and tolerant.

## **RESULTS**

## IV. RESULTS

The genus Rosa, belonging to the family Rosaceae comprises of shrubs and climbers. According to generally accepted classification of Rehder there are 120 species of roses. The rose family is very widely distributed throughout the Northern Hemisphere. Over the ages, species have arisen which differ widely from one another. These species adapted themselves to the prevailing conditions of temperature and environment in which they are found. The modern garden roses present a wide range of variability from a few centimeter high miniatures to giant climbers upto 12 metres. To a large extent the variation is also observed in foliage, flower, fruit, thorn and growth characters. The pollen fertility status differs from cultivar to cultivar. Similarly, the disease tolerance in the cultivars differs to a large extent. However, detailed information in many of the cultivars is lacking which poses a problem for planned breeding programme.

In the present investigation, 50 cultivars of roses were selected for their detailed morphological studies. The pollen fertility and disease tolerance in each cultivar has been studied. The results of the findings are described below and the morphological characteristics of all the cultivars are summarized in Tables 7 and 8.

1. ADOLF HORSTMANN

Class: Hybrid Tea

Year of release: 1971

Released by: Kordes

Habit: The plant is erect with moderate growth habit.

Height: The plant grows to a height of 82.00 cm.

Stem: The colour of the young stem is light green with reddish brown tinge, whereas matured stem is greyish green.

Thorns: This cultivar is moderately thorny, with 4.03 thorns per cm which vary in size from big, medium to small.

Leaf: Young leaves are dark reddish brown and on maturity turn to dark green. The leaf area is 49.71 sq. cm. Leaflets are narrowly elliptical, double serrate, acute with obtuse base, and lenthery.

Bud: The flower bud is medium and bold. The bud colour is Chinese Yellow (16A) with reddish tinge towards the tip.

Flower: The flowers are shapely and almost split centred with Chinese Yellow (16A) petals having Canary Yellow (9A) base. The peripheral petals are flushed with Shell Pink (370) towards the edges and the backside of the petals Lemon Yellow (13A) and on fading, turn light yellow. The flower diameter varies from 9.0 cm to 10.5 cm and the number of petals vary from 46 to 50. The petals are obovate and acute, with a length and breadth of 3.96 cm and 3.46 cm, respectively. The flower lacks fragrance.

Stalk length: The stalk length observed is moderate measuring 54.20 cm.

Pollen fertility: The percentage of pollen fertility in this cultivar is very low, being 7.66.

Diseases: The cultivar is moderately susceptible to black spot and tolerant to powdery mildew.

## 2. AKERONO

Class: Hybrid Tea

Year of release: 1975

Released by: Kawai

Habit: The plant is erect and has moderate growth with few branches.

Height: The cultivar grows to a height of 75.25 cm.

Stem: The young stem is light reddish brown with green tinge and turn to dark green on maturity.

Thorns: This cultivar is less thorny with 0.61 thorns per cm and are big in size.

Leaf: The younger leaves are light reddish brown, whereas the matured ones are dark green. The leaf area is 58.94 sq. cm. Leaflets are broadly elliptical, serrate, acute with obtuse to truncate base and leathery (Plate C, 1).

Bud: The flower bud is medium, pointed and Dresden Yellow (5C) with reddish tinge towards the tip.

**Flower:** The full bloomed flowers are shapely, bicoloured and high centred (Plate R, 3). The flower has Canary Yellow (9D) petals flushed with Apricot Red (63B) towards edges and Canary Yellow (9B) base. On fading, turns almost white with Lilac Purple (70A) edges. The flower diameter ranges from 10.0 cm to 13.0 cm, whereas the number of petals ranges from 84 to 92. The petals are obovate and reflexed. The length and breadth of petals is 6.88 cm and 6.18 cm, respectively. The flower has moderate fragrance. Good for exhibition purpose.

**Stalk length:** It has a moderate stalk length of 64.67 cm.

**Pollen fertility:** The pollen fertility percentage estimated was moderately low, being 16.54.

**Diseases:** The cultivar is highly susceptible to black spot and tolerant to powdery mildew.

### 3. AMBASADOR

**Class:** Hybrid Tea

**Year of release:** 1978

**Released by:** Meiland

**Habit:** The cultivar is vigorous and bushy with long, upright branches.

**Height:** The height of the plant is 116.17 cm.

**Stem:** Young stem is dark brownish red and matured stem green.

**Thorns:** This cultivar has comparatively less thorns which are big in size. Number of thorns per cm is 0.92 (Plate B, 9).

Leaf: Young leaves are light reddish brown and on maturity turn green. The leaf area is 33.23 sq. cm and leaflets are thin, elliptical, serrulate, acute with obtuse base.

Bud: The flower bud is large, pointed and Musturtium Red (32B) with reddish tip and Canary Yellow (9D) base.

Flower: The flowers are shapely and almost high centred (Plate F, 16). The colour is a blend of Delft Rose (47C) and Mandarin Red (41 D) with Canary Yellow (9B) base. The Mandarin Red (41 D) is seen on the upper half towards the edges. Backside has Orient Pink (36A) with Canary Yellow (9C) base. On fading, turns Dawn Pink (49A) and at the backside to Venetian Pink (49C). The flower diameter ranges from 12.5 cm to 13.5 cm. The number of petals vary from 25 to 27 and these are obovate and slightly acute with a length of 6.54 cm and breadth of 6.18 cm. The flower has slight fragrance.

Stalk length: The stalk length is good and measures 85.67 cm.

Pollen fertility: The pollen fertility percentage estimated was moderately low, being 25.91.

Disease: The cultivar is moderately susceptible to black spot and tolerant to powdery mildew.

#### 4. AMBIKA

Class: Hybrid Tea

Year of release: 1976

Released by: G. Kasturi Rangan

Habit: The plant is bushy and has moderate growth habit.

Height: The height of the plant measures 88.20 cm.

Stem: Young stem is light green with reddish brown tinge, whereas the matured stem is green.

Thorns: This cultivar is much thorny in nature with 9.11 thorns per cm and are big in size (Plate A, 2).

Leaf: The younger leaves are light reddish brown which turn dark green on maturity. The leaf area is 53.50 sq. cm. Leaflets are ovate to obovate, double serrate, acute with obtuse base, smooth and glossy (Plate C, 2).

Bud: The flower bud is small, bold and Vermilion (41B) with deep vermilion tip.

Flower: Full bloomed flowers are split centred and have blend of Vermilion (41A) and Claret Rose (50A) with Claret Rose (50B) backside. On fading turns to Neyron Rose (55B) with Neyron Rose (55A) towards edges. The flower diameter ranges from 9.5 cm to 10.0 cm and the number of petals vary from 35 to 40. The petals are obovate to oval with length and breadth of 5.14 cm and 5.32 cm, respectively. The flowers are slightly fragrant.

Stalk length: The stalk length measures 56.50 cm.

Pollen fertility: The pollen fertility percentage estimated was moderately high, being 47.03.

Disease: The cultivar is highly susceptible to black spot and tolerant to powdery mildew.

### 5. ANGELUS

Class: Hybrid Tea

Year of release: 1976

Released by: Gaujard

Habit: The cultivar is bushy with moderate growth habit.

Height: The plant grows to a height of 95.55 cm.

Stem: Young stem is dark brownish red and on maturity turns green.

Thorns: The cultivar is moderately thorny. The number of thorns per cm recorded is 2.36 and these vary in size from big to medium.

Leaf: Younger leaves are dark reddish brown and matured ones are green. The leaf area is 58.95 sq. cm. Leaflets are ovate to elliptical, serrate, acute with obtuse to truncate base, smooth and glossy.

Bud: The flower bud is medium and bold. The bud colour is Turkey Red (46C) with deep turkey red towards the edges.

Flower: The flowers are shapely and almost split centred (Plate F, 19). The flower has Scarlet (43C) petals flushed with Turkey Red (46C) on the upper half and Scarlet (43D) backside. On fading turns Claret Rose (50B). The diameter of the flower ranges from 11.0 cm to 12.0 cm (Plate I, 4).

and the number of petals varies from 41 to 50. The petals are obovate and slightly acute with a length and breadth of 5.66 cm and 6.06 cm, respectively. The flowers have moderate fragrance.

Stalk length: This cultivar has good stalk length of 70.50 cm.

Pollen fertility: The estimated pollen fertility percentage was 85.18.

Disease: The cultivar is moderately susceptible to black spot and tolerant to powdery mildew.

#### 6. ANNE BURDA

Class: Hybrid Tea

Year of release: 1973

Released by: Kertes

Habit: The plant is erect, much branched and has vigorous growth habit.

Height: The cultivar has a height of 103.25 cm.

Stem: Young stem is light reddish brown with green tinge and matured stem is green.

Thorns: This cultivar is moderately thorny with 4.53 thorns per cm which vary in size from big to medium.

Leaf: Young leaves are light reddish brown and matured ones are green. The leaf area is 54.13 sq. cm and leaflets are elliptical, serrulate, acute with obtuse base, and thin with coarse texture.

Buds: The flower bud is medium, bold and dark ruby red or almost black with Indian Lake (59B) base.

Flowers: The flowers are almost split centred and shapely. The petals are Currant Red (46A) withuchsia Purple (67A) base and backside. On fading, turns Tyrian Purple (57A) with Rose Bengal (57C) backside. The flower diameter ranges from 9.5 cm to 12.5 cm and the number of petals from 30 to 42. The petals are obovate and acute. The length and breadth of the petals measures 5.54 cm and 5.94 cm, respectively. The flower has no characteristic fragrance.

Stalk length: The stalk length in this cultivar observed is 40.40 cm.

Pollen fertility: The pollen fertility percentage estimated in this cultivar was moderate, being 40.96 (Plate L).

Diseases: The cultivar is moderately susceptible to black spot and tolerant to powdery mildew.

## 7. AQUARIUS

Class: Hybrid Tea

Year of release: 1970

Released by: Armstrong

Habit: The cultivar is erect and has moderate growth habit with few branches.

Height: The plant grows to a height of 86.00 cm.

Stem: Young stem is light green with reddish brown tinge, whereas matured stem is light green.

Thorns: The cultivar is moderately thorny with 3.29 thorns per cm which are big to small in size.

Leaf: The young leaves are light reddish brown which on maturity turn light green. The leaf area recorded is 34.08 sq. cm and leaflets are narrowly elliptical, serrate, acuminate with obtuse base, smooth and glossy.

Bud: The flower bud is shapely, medium, long and pointed having Spinel Red (54B) colour.

Flower: The flowers are very shapely and high centred (Plate F, 13). The flower has Spiraes Red (63C) petals flushed with deep tyrian purple towards the edges. On fading, turns Solferino Purple (65B) with Puschia Purple (67A) edges. The flower diameter ranges from 8.0 cm to 11.5 cm and the number of petals from 32 to 54. The petals are obovate, slightly acute and reflexed with length of 6.24 cm and breadth of 5.36 cm. The flower lacks fragrance. Good for exhibition purpose.

Stalk length: The stalk length in the cultivar observed was 49.00 cm.

Pollen fertility: The pollen fertility percentage estimated

was low, being 13.14.

Diseases: The cultivar is moderately susceptible to black spot and tolerant to powdery mildew.

#### 8. ARIZONA

Class: Hybrid Tea

Year of release: 1975

Released by: Weeks

Habit: The cultivar is bushy, much branched and has moderate growth habit.

Height: The plant grows to a height of 89.14 cm.

Stem: Young stem is light reddish brown with green tinge and on maturity becomes green.

Thorns: This cultivar is moderately thorny with 2.20 thorns per cm and these are big to medium in size.

Leaf: The young leaves are light reddish brown and on maturity turn to dark green. The leaf area is 77.06 sq. cm and the leaflets are narrowly elliptical, double serrate, acuminate with truncate to obtuse base, thin and very glossy (Plate D, 10).

Bud: The flower bud is medium, pointed and Mandarin Red (40C) with Canary Yellow (9B) base.

Flower: The flowers are high centred and very shapely. The petals are Marigold Orange (28C) with Canary Yellow ((9B) base. The peripheral petals are flushed with Jasper Red (39A) towards the edges. On fading, turns light neon rose with Canary Yellow (9C) base. The flower diameter ranges

from 10.5 cm to 11.5 cm and the number of petals from 32 to 40. The petals are obovate, acute and slightly reflexed. The length and breadth of the petals are 4.58 cm and 4.52 cm, respectively. The flower is moderately fragrant and ideal for cut flower purpose.

Stalk length: This cultivar has moderate stalk length measuring 56.67 cm.

Pollen fertility: The pollen fertility percentage estimated was moderate, being 32.45.

Disease: The cultivar is highly susceptible to black spot and tolerant to powdery mildew.

### 9. ASHMI

Class: Hybrid Tea

Year of release: Not mentioned. Released by: G. Kasturi Nangan

Habit: The plant is erect and has moderate growth habit.

Height: The cultivar has a height of 86.12 cm.

Stem: Young stem is light green and matured one is green.

Thorns: The cultivar is comparatively less thorny with 1.03 thorns per cm and these are fairly big in size (Plate B, 6).

Leaf: The young leaves are light reddish brown which on maturity turn light green. The leaf area recorded is 97.24 sq. cm. Leaflets are thin, elliptical, serrate, acute

with obtuse base (Plate D, 16).

Buds: The flower bud is medium, bold and deep cardinal red.

Flowers: The flowers are split centred and have Tyrian Purple (61C) petals with Cardinal Red (53B) towards the edges. The inner whorl of petals are Cardinal Red (53B) and the backside of petals has Rose Bengal (57C). On fading, turns Roseine Purple (68A) with Tyrian Purple (57A) edges. The flower diameter ranges from 10.0 cm to 10.5 cm and the number of petals from 122 to 153. The petals are obovate to oval, slightly acute and reflexed. The petal length is 4.46 cm and petal breadth is 4.84 cm. The flower lacks characteristic fragrance.

Stalk length: The stalk length observed in the cultivar is 61.00 cm.

Pollen fertility: The percentage of pollen fertility estimated was moderately high, being 51.33.

Diseases: The cultivar is highly susceptible to black spot and susceptible to powdery mildew.

#### 10. BULL'S RED

Class: Hybrid Tea

Year of release: 1977

Released by: McGredy

Habit: The cultivar has vigorous growth and is bushy, dense and much branched.

Height: The plants grows to a height of 123.00 cm.

Stem: Young stem is light green with reddish brown tinge, whereas matured stem is green.

Thorns: The cultivar is moderately less thorny with 1.01 thorns per cm and these are big in size.

Leaf: The young leaves are light green with reddish brown tinge and matured ones dark green. The leaf area is 42.66 sq. cm. Leaflets are elliptical, serrate, acute with obtuse base, thin with shiny texture (Plate C, 6).

Buds: The flower bud is medium, bold and almost black with Indian Lake (59C) base (Plate H, 7).

Flower: The full bloomed flowers are very shapely and almost split centred (Plate H, 7). The cultivar flowers very freely. The flower has Cardinal Red (53B) petals with Cardinal Red (53A) edges and Cardinal Red (53C) backside. On fading, turns Tyrian Purple (57A) with Cardinal Red (53A) edges and Rose Bengal (57B) backside. The flower diameter ranges from 8.0 cm to 8.5 cm (Plate I, 5) and the number of petals from 25 to 28. The petals are obovate and slightly acute with length and breadth of 4.60 cm and 5.38 cm, respectively. The flower has slight fragrance. Good for cut flower purpose.

Stalk length: The cultivar has very good stalk length measuring upto 79.50 cm.

Pollen fertility: The pollen fertility percentage estimated in the cultivar was 48.96.

Disenes: The cultivar is moderately susceptible to black spot and tolerant to powdery mildew.

### 11. CANARY

Class: Hybrid Tea

Year of release: 1976

Released by: Tantau

Habit: The plant is erect, much branched, dense and has vigorous growth habit.

Height: The height of the plant observed is 104.78 cm.

Stem: Young stem is light green with reddish brown tinge and matured stem greyish green.

Thorn: The cultivar is less thorny with 0.85 thorns per cm. The thorns are fairly big in size.

Leaf: The young leaves are light reddish brown and on maturity turn dark bluish green. The leaf area is 56.15 sq. cm and leaflets are elliptical, serrate, acute with obtuse base, and thin texture (Plate C, 5).

Bud: The flower bud is medium, bold and Aureolin (12A) with Scarlet (43B) tip and edges.

Flower: The flowers are shapely and almost split corolla. The cultivar is free flowering. The flowers are bicoloured having Chrome Yellow (15C) initially, turning to Canary Yellow (9C) with Canary

Yellow (9B) base and almost Yellow (8C) backside. The peripheral petal edges are flushed with Venetian Pink (49C) and on fading colour turns Empire Yellow (11D) flushed with Crimson (52A) on the upper half and Canary Yellow (9C) base. The flower diameter ranges from 11.0 cm to 12.0 cm and the number of petals from 42 to 48. The petals are obovate to oval, slightly acute with length and breadth of 5.32 cm and 5.20 cm, respectively. The flowers are moderately fragrant. Good for garden display.

Stalk length: The stalk length measures 47.38 cm.

Pollen fertility: The pollen fertility percentage estimated was moderate, being 30.31.

Disease: The cultivar is highly susceptible to black spot and tolerant to powdery mildew.

## 12. SARAJIA

Class: Hybrid Tea

Year of release: 1975

Released by: Armstrong

Habit: The plant is bushy, much branched and has very vigorous growth.

Height: The height of the cultivar observed is 133.50 cm.

Stem: The young stem is light green with reddish brown tinge and the matured stem is light green.

Thorns: The cultivar is moderately thorny with 3.00 thorns per cm and these are medium in size.

Leaf: Young leaves are light reddish brown, whereas matured ones are green. The leaf area is 56.31 sq. cm and leaflets are elliptical, serrate, acuminate with obtuse base and leathery texture.

Bud: The flower bud is small, bold and deep ruby red or almost black.

Flower: The flowers are almost blown shaped having Current Red (46A) petals with Fuchsia Purple (67A) base and backside. On fading, colour turns Trian Purple (57A) with Rose Benzal (57C) at the base and backside. The flower diameter ranges from 8.5 cm to 13.5 cm and the number of petals from 29 to 38. The petals are obovate and acute with length and breadth of 6.18 cm and 6.00 cm, respectively. Flowers lack characteristic fragrance.

Stalk length: The stalk length observed is moderately less, being 48.50 cm.

Pollen fertility: The percentage of pollen fertility was moderately high, being 49.43.

Disease: The cultivar is moderately susceptible to black spot and tolerant to powdery mildew.

### 13. CARELESS LOVE

Class: Hybrid Tea

Year of release: 1955

Released by: Conklin

Habit: The cultivar has vigorous and spreading growth habit with many lateral branches.

Height: The plant grows to a height of 98.60 cm.

Stem: The young stem is dark brownish red and on maturity becomes greyish green.

Thorns: The cultivar is very less thorny with 0.64 thorns per cm which are big to medium in size (Plate B, 7).

Leaf: The young leaves are light reddish brown and the matured ones are dark bluish green. The leaf area is 41.10 sq. cm and the leaflets are narrowly elliptical, serrulate, acuminate with obtuse base and thin with smooth texture (Plate D, 9).

Bud: The flower bud is small, pointed having Fuchsia Purple (67B) colour with prominent white stripes.

Flower: The flowers are Camellia shaped and have Cyclamen Purple (74A) petals with prominent white streaks and blotches and Magenta Rose (64D) on the backside. On fading, colour turns Magenta Rose (64D). The flower diameter ranges from 8.0 cm to 10.5 cm (Plate J, 9) and the number of petals from 8 to 18. The petals are obovate and incurved. The length and breadth of the petals are 5.18 cm and 4.80 cm, respectively. The flowers have mild fragrance.

Stalk length: The stalk length observed is 52.67 cm.

Pollen fertility: The percentage of pollen fertility in the cultivar was 33.79 (Plate 14).

Disease: The cultivar is moderately susceptible to black spot and tolerant to powdery mildew.

14. CHITRANGINI

Class: Hybrid Tea

Year of release: 1971

Released by: G. Kasturi Rangan

Habit: The cultivar is erect and has moderate growth habit with very few branches.

Height: The plant height measures 78.75 cm.

Stem: Young stem is dark brownish red which on maturity turns to light green.

Thorns: The cultivar is comparatively less thorny with 1.36 thorns per cm. These thorns are of big and medium size with small ones inbetween.

Leaf: The young leaves are dark brownish red and the matured ones are dark bluish green. The leaf area is 33.82 sq. cm. The leaflets are elliptical, double serrate, acuminate with obtuse to truncate base, and leathery.

Bud: The flower bud is medium, bold and Canary Yellow (9B) with reddish tinge at the edges and tip.

Flowers: The flowers are bicoloured and almost blown shaped (Plate F, 6) having Canary Yellow (9C) petals with Spiraea Red (63B) towards the edges. Later colour turns completely Spiraea Red (63B) with Canary Yellow (9C) base and almost white backside. On fading, the colour turns Cardinal Red (53B) with Neyron rose (55A) at the backside. The flower diameter ranges from 10.0 cm to 11.0 cm and the number

of petals vary from 39 to 44. The petals are obovate, acute and reflexed. The length and breadth of the petals are 4.94 cm and 4.34 cm, respectively. The flower has mild fragrance.

Stalk length: The stalk length in this cultivar measures 47.60 cm.

Pollen fertility: The percentage of pollen fertility estimated was comparatively low, being 17.84.

Diseases: The cultivar is susceptible to black spot and tolerant to powdery mildew.

#### 15. DREP SECRET

Class: Hybrid Tea

Year of release: 1978

Released by: Tantau

Habit: The plant is erect, dense and has moderate growth habit.

Height: The height of the cultivar observed is 72.50 cm.

Stem: Young stem is light green with reddish brown tinge and matured stem is green.

Thorns: The cultivar is comparatively more thorny with 5.00 thorns per cm and these are of medium size.

Leaf: The young leaves are dark reddish brown and the matured ones dark bluish green. The leaf area recorded is 45.83 sq. cm

and leaflets are narrowly elliptical, serrulate, acuminate with obtuse base, leathery and shiny.

Buds: The flower bud is medium, bold and almost black with Ruby Red (59A) base (Plate G, 4).

Flowers: The flowers are very showy and split centred having deep cardinal red petals with deep tyrian purple backside. On fading, colour turns deep tyrian purple with Rose Bengal (57B) at the backside. The flower diameter ranges from 10.0 cm to 11.0 cm and the number of petals from 39 to 57. The petals are obovate to oval, acute and slightly reflexed with length and breadth of 5.26 cm and 4.64 cm, respectively. The flower has no characteristic fragrance.

Stalk length: The stalk length in this cultivar measures 49.40 cm.

Pollen fertility: The estimated pollen fertility percentage was moderate, being 36.90.

Diseases: The cultivar is highly susceptible to black spot and susceptible to powdery mildew.

#### 16. DOOR TYSERMAN

Class: Hybrid Tea

Year of release: 1975

Released by: Wisbech

Habit: The plant is erect and has moderate growth habit.

Height: This cultivar grows to a height of 94.20 cm.

Stem: The young stem is light green with reddish brown tinge and matured stem is green.

Thorns: The cultivar is moderately less thorny with 1.11 thorns per cm and these are big in size.

Leaf: The young leaves are light reddish brown which on maturity turn green. The leaf area is 57.94 sq. cm and leaflets are elliptical, double serrate, acuminate with obtuse base and leathery texture.

Bud: The flower bud is medium, bold and Fire Red (33B) with Canary Yellow (9C) base and Capsicum Red (33A) edges.

Flowers: The flowers are shapely and almost split centred. The flower has Carrot Red (29A) petals with dark carrot red towards the edges and Canary Yellow (9B) base. On fading, the colour turns Peach (29D) with Canary Yellow (9C) base and Orient Pink (36C) at the backside. The flower diameter ranges from 9.0 cm to 10.5 cm (Plate J, 12). The number of petals ranges from 23 to 25 and these are obovate with length and breadth of 3.38 cm and 3.62 cm, respectively. The flower is slightly fragrant.

Stalk length: The stalk length measures 56.00 cm.

Pollen fertility: The pollen fertility percentage in this cultivar estimated was low, being 14.42.

Diseases: This cultivar is moderately susceptible to black spot and tolerant to powdery mildew.

17. FERRY FORSCHE

Class: Hybrid Tea

Year of release: 1971

Released by: Kordes

Habit: The cultivar is erect, dense, much branched and has moderate growth habit.

Height: The plant height measures 97.78 cm.

Stem: The young stem is light reddish brown with green tinge, whereas the matured stem is greyish green.

Thorn: This cultivar is comparatively less thorny with 1.65 thorns per cm and these are medium in size.

Leaf: The young leaves are dark reddish brown and the matured ones are green. The leaf area is 52.19 sq. cm. The leaflets are narrowly elliptical, serrulate, acuminate with obtuse to truncate base, and thin with coarse texture.

Bud: The flower bud is shapely, medium and bold. The bud is Cardinal Red (53A) with blackish red edges.

Flower: The flowers are almost open cupped. It has Cardinal Red (53C) petals with Cardinal Red (53B) towards the edges and Rose Bengal (57B) at the backside. On fading, the colour turn Tyrian Purple (57A) with Rose Bengal (57C) backside. The flower diameter ranges from 9.0 cm to 13.0 cm. The number of petals varies from 35 to 43. The petals are obovate, slightly acute and slightly reflexed with length of 5.84 cm and breadth of 6.82 cm. The flowers lack fragrance. Ideal for cut flower purpose.

Stalk length: The stalk length observed in the cultivar is moderate measuring 61.17 cm.

Pollen fertility: The estimated pollen fertility percentage was very high, being 82.49 (Plate K).

Disease: The cultivar is moderately susceptible to black spot and tolerant to powdery mildew.

#### 18. FIRST PRIZE

Cultivar: Hybrid Tea

Year of release: 1970

Released by: Boerner

Habit: The cultivar is erect and has moderate growth habit with few branches.

Height: The plant grows to a height of 63.67 cm.

Stem: The young stem is lightly green with reddish brown tinge and the matured stem is green.

Thorns: The cultivar is moderately thorny having fairly big sized thorns with smaller ones inbetween. The number of thorns per cm is 3.84.

Leaf: The young leaves are light green with reddish brown tinge and the matured ones are dark bluish green. The leaf area is 53.18 sq. cm and the leaflets are narrowly elliptical, serrate, acuminate with obtuse base, thin with coarse texture (Plate D, 11).

Bud: The flower bud is shapely, large, pointed and Ruby Red (57A).

Flower: The flowers are very rhapody, open slowly and high centred (Plate F, 20). The petals are Phlox Pink (62B) with Rhodamine Pink (62A) backside. On fading, the colour turns light pink. The flower diameter ranges from 14.0 cm to 14.5 cm and the number of petals from 20 to 30. The petals are obovate and reflexed with length of 6.92 cm and breadth of 7.37 cm. The flowers lack fragrance. Good for exhibition purpose.

Stalk length: The stalk length observed in this cultivar is very less, being 42.00 cm.

Pollen fertility: The estimated pollen fertility percentage was high, being 66.47.

Disease: The cultivar is highly susceptible to black spot and tolerant to powdery mildew.

#### 19. FLA1 KMSPIEL

Class: Hybrid Tea

Year of release: 1978                      Released by: Korden

Habit: The cultivar is erect and has very vigorous growth habit with straight branches.

Height: The plant has good height measuring 158.20 cm.

Stem: The young stem is light reddish brown with green tinge, whereas the matured stem is dark green.

Thorn: This cultivar is very thorny with 8.88 thorns per cm

and these vary in size from big to medium to small (Plate A, 3).

Leaf: The young leaves are dark reddish brown and the matured ones are dark green. The leaf area is 88.25 sq. cm and leaflets are broadly elliptical, serrate, acuminate with obtuse to truncate base, leathery with glossy texture (Plate D, 14).

Bud: The flower bud is large and pointed. The bud colour is Cardinal Red (53C) with Tangerine Orange (24C) base (Plate H, 8).

Flower: The flowers are almost split centred and obapely. The flower colour is blend of Carrot Red (29A) and Carmine Rose (52D) with Canary Yellow (9A) base and Cadmium Orange (23D) backside. On fading, turns Carmine Rose (52C) flushed with Carmine (50B) towards the edges and Canary Yellow (9C) base. The flower diameter ranges from 10.5 cm to 11.5 cm and the number of petals from 58 to 59. The petals are obovate with length and breadth of 5.86 cm and 6.92 cm, respectively. The flowers are slightly fragrant.

Stalk length: The stalk length observed in this cultivar is 25.17 cm.

Pollen fertility: The pollen fertility percentage estimated in the cultivar was moderate, being 43.7%.

Diseases: The cultivar is highly susceptible to black spot and susceptible to powdery mildew.

## 20. POLKLORE

Class: Hybrid Tea

Year of release: 1978

Released by: Korden

Habit: The cultivar is dense, erect, much branched and has very vigorous growth habit.

Height: The plant grows to a height of 139.44 cm.

Stem: Young stem is light green with reddish brown tinge and matured stem is green.

Thorns: This cultivar is moderately thorny having big sized thorns. The number of thorns per cm is 4.41.

Leaf: The young leaves are light green with reddish brown tinge, whereas the matured ones are dark bluish green. The leaf area is 84.66 sq. cm and leaflets are elliptical, double serrate, acute with obtuse base and leathery with shiny texture.

Buds: The flower bud is medium and pointed. The bud colour is blend of Nusturtium Red (32B) and Mandarin Red (40C) with Canary Yellow (9C) base (Plate G, 3).

Flowers: The flowers are very shapely and split centred (Plate F, 14) having blend of Azalea Pink (41C) and Shrimp Red (33C) with Canary Yellow (9C) base and Claret Rose (50B) backside. On fading, the colour turns Azalea Pink

The flower diameter ranges from 11.0 cm to 12.5 cm. The number of petals varies from 33 to 40 and these are obovate with length and breadth of 6.40 cm and 6.78 cm, respectively. The flowers are slightly fragrant.

Stalk length: The stalk length observed in the cultivar is 66.00 cm.

Pollen fertility: Pollen fertility percentage estimated in the cultivar was 35.64.

Disease: The cultivar is moderately susceptible to black spot and susceptible to powdery mildew.

## 21. FRAGRANT HOUR

Class: Hybrid Tea

Year of release: 1973      Released by: McGrody

Habit: The cultivar is bushy, erect and has moderate growth habit.

Height: The plant height measures 80.00 cm.

Stem: The young stem is light green with reddish brown tinge, whereas the matured one is light green.

Thorn: This cultivar is moderately thorny having big to medium sized thorns. The number of thorns per cm is 2.24.

Leaf: The young leaves are light reddish brown and on maturity turn dark bluish green. The leaf area is 71.98

sq. cm. The leaflets are broadly elliptical, serrulate, acute with obtuse base and leathery texture.

Buds: The flower bud is large, pointed and crimson (52A) (Plate G, 2).

Flowers: The flowers are very shapely and split centred (Plate K, 2). This cultivar is free flowering. The flower colour is blond of Saffron Yellow (19B) and Solferino Purple (65B) flushed with Rhodamine Pink (62A) towards the edges and Roseline Purple (68C) backside. On fading, turns Rose Purple (75D). The flower diameter ranges from 12.0 cm to 13.5 cm. The number of petals varies from 34 to 48. The petals are obovate with length of 6.00 cm and breadth of 5.70 cm. The characteristic feature of the flower is its high fragrance.

Stalk length: The stalk length observed in the cultivar is 49.67 cm.

Pollen fertility: The estimated percentage of pollen fertility was moderate, being 40.30.

Diseases: The cultivar is susceptible to black spot and tolerant to powdery mildew.

## 22. GHAZAL

Class: Hybrid Tea

Year of release: 1970

Released by: Singh

Habit: The plant is bushy, much branched and has moderate growth habit.

Height: The height of the cultivar observed is 68.00 cm.

Stem: Young stem is dark brownish red and matured stem is green.

Thorns: This cultivar is moderately thorny. The thorns are small and the number of thorns per cm is 3.95.

Leaf: The young leaves are dark reddish brown and the matured ones are dark green. The leaf area is 29.11 sq. cm and leaflets are narrowly elliptical, double serrate, acute with obtuse base and smooth with shiny texture.

Bud: The flower bud is small, pointed and Cardinal Red (53C).

Flower: This cultivar is very free flowering. The flowers are flat and have Rhodamine Pink (62A) petals with Primrose Yellow (4C) base and Palox Pink (62B) backside. On fading, turns light pink. The flower diameter ranges from 8.0 cm to 8.5 cm and the number of petals from 12 to 17. The petals are obovate and slightly acute. The length and breadth of petals are 4.86 cm and 4.24 cm, respectively. The flower lacks fragrance.

Stalk length: The stalk length observed is 34.00 cm.

Pollen fertility: The percentage of pollen fertility estimated

in the cultivar way 37.15.

Disease: The cultivar is highly susceptible to black spot and moderately susceptible to powdery mildew.

### 23. GULLAR

Class: Hybrid Tea

Year of release: 1977

Released by: I.A.R.I., New Delhi

Habit: The plant is erect and has moderate growth habit.

Height: The height of this cultivar measures 90.67 cm.

Stem: The young stem is light green and the matured stem is dark green.

Thorn: This cultivar is comparatively less thorny. The thorns are big, prominent and the number of thorns per cm is 1.39 (Plate A, 5).

Leaf: The young leaves are light green with reddish brown tinge, whereas the matured ones are light green. The leaf area is 44.12 sq. cm and leaflets are thin, elliptical, double serrate, acuminate with obtuse base (Plate C, 7).

Bud: The flower bud is medium, bold and has Indian Lake (59B) colour with deep ruby red or almost black edges and tip.

Flower: The flowers are shapely and high centred. The flower has Ruby Red (61A) petals and on fading the colour turns

Magenta Rose (648). The flower diameter ranges from 7.9 to 9.5 cm and the number of petals from 57 to 63. The petals are obovate, slightly acute and reflexed. The length and breadth of the petals are 4.36 cm and 4.26 cm, respectively. The flowers are slightly fragrant.

Stalk length: The stalk length observed in this cultivar is 56.50 cm.

Pollen fertility: The pollen fertility percentage estimated in this cultivar was high, being 63.63.

Disease: The cultivar is moderately susceptible to black spot and highly susceptible to powdery mildew.

#### 24. ILONA

Class: Hybrid Tea

Year of release: 1977

Released by: Verbeek

Habit: The cultivar is erect and has vigorous growth habit.

Height: The plant grows to a height of 90.83 cm.

Stem: The young stem is light reddish brown with green tinge and the matured stem is green.

Thorn: This cultivar is comparatively less thorny. The thorns are big to medium in size and the number of thorns per cm is 1.07.

Leaf: The young leaves are dark brownish red and the matured ones are green. The leaf area recorded is

42.12 sq. cm and leaflets are ovate to elliptical, serrulate, acute with obtuse base and thin texture.

Bud: The flower bud is medium, bold and deep cardinal red.

Flowers: The flowers are very shapely and split centred. The flower colour is Vermilion (41B) with light vermilion at the backside. On fading, the colour turns Delft Rose (46D). The flower diameter ranges from 9.5 cm to 11.0 cm (Plate J, 10), and the number of petals from 30 to 52. The petals are obovate and slightly reflexed. The average length and breadth of the petals are 4.38 cm and 5.06 cm, respectively. The flower lacks fragrance. Ideal for cut flower purpose.

Stalk length: The stalk length in this cultivar measures 46.00 cm.

Pollen fertility: The estimated pollen fertility percentage was 30.17.

Disease: The cultivar is high<sup>ly</sup> susceptible to black spot and moderately susceptible to powdery mildew.

## 25. RITZERLORA

Class: Hybrid Tea

Year of release: 1970

Released by: Holland

Habit: The plant is tall and has moderate growth with upright branches.

Height: The height of this cultivar measures 96.80 cm.

Stem: The young stem is dark brownish red and on maturity turn green.

Thorns: This cultivar is moderately thorny having big to medium thorns. The number of thorns per cm is 3.84.

Leaf: The young leaves are dark reddish brown and on maturity turn to dark green. The leaf area is 33.84 sq. cm and leaflets are elliptical, serrulate, acuminate with obtuse base and leathery with shiny texture (Plate D, 15).

Bud: The flower bud is obovate, medium, pointed and has Brick Red (358) colour.

Flower: The flowers are very obovate and almost high centred (Plate F, 12). The petals are Vermilion (41B) with Azalea Pink (41C) backside. The flower diameter is 10.5 cm and the number of petals varies from 65 to 78. The petals are obovate, slightly acute and reflexed. The length and breadth of the petals are 4.88 cm and 4.34 cm, respectively. The flowers have moderate fragrance. Good for cut flower purpose.

Stalk length: The stalk length in this cultivar is very good and measures 77.17 cm.

Pollen fertility: The estimated percentage of pollen fertility was 22.39.

Disease: The cultivar is moderately susceptible to black spot and tolerant to powdery mildew.

26. IVORY TOWER

Class: Hybrid Tea

Year of release: 1978

Released by: Kordes  
(Int. Armstrong)

Habit: The cultivar is erect and has moderate growth habit. The branches are few and grow tall.

Height: The plant grows to a height of 87.71 cm.

Stem: The young stem is light reddish brown with green tinge, whereas the matured stem is green.

Thorns: The cultivar is comparatively less thorny having big sized thorns. The number of thorns per cm is 1.37.

Leaf: The young leaves are light reddish brown and the matured ones are dark green. The leaf area is 33.76 sq. cm and leaflets are elliptical, serrulate, acuminate with obtuse base, and leathery.

Bud: The flower bud is large, shapely and pointed. The bud colour is Chartreuse Green (1D) flushed with Shell Pink (37C) towards the edges.

Flower: The flowers are very shapely and high centred and have Empire Rose (48D) petals with light canary yellow base and almost white backside. On fading, turns almost white. The flower diameter ranges from 12.0 cm to 14.5 cm and the number of petals varies from 34 to 46. The petals are obovate, acute and reflexed. The petal

length is 7.26 cm and petal breadth is 7.12 cm. The flowers are moderately fragrant.

Stalk length: The stalk length observed in this cultivar is 45.00 cm.

Pollen fertility: The pollen fertility percentage estimated was very low, being 8.96.

Diseases: The cultivar is moderately susceptible to black spot and tolerant to powdery mildew.

#### 27. JOHN WATERER

Class: Hybrid Tea

Year of release: 1970

Released by: Sam McGredy

Habit: The plant is erect with straight stem and moderate growth habit.

Height: The height of the plant measures 87.50 cm.

Stem: The young stem is dark brownish red and the matured stem is dark green.

Thorns: This cultivar is moderately thorny. The thorns vary in size from big to medium to small and the number of thorns per cm is 4.72.

Leaf: The young leaves are dark reddish brown, whereas the matured ones are light green. The leaf area is 42.08 sq. cm. The leaflets are narrowly elliptical, serrulate, acuminate with obtuse base and thin texture.

Buds: The flower bud is medium, pointed and deep cardinal red or almost black (Plate H, 6).

Flowers: The flowers are split centred and have Cardinal Red (53A) petals with Rose Bengal (57B) at the backside. On fading, the colour turns deep cardinal red with black edges and Magenta Rose (64B) at the backside. The flower diameter ranges from 9.0 cm to 10.0 cm and the number of petals varies from 59 to 64. The petals are obovate, acute and slightly reflexed with length of 5.70 cm and breadth of 3.06 cm. The flower has moderate fragrance.

Stalk length: The stalk length measures 58.67 cm.

Pollen fertility: The estimated pollen fertility percentage was 30.02.

Diseases: The cultivar is highly susceptible to black spot and moderately susceptible to powdery mildew.

## 28. NOUVEAUCLER

Class: Hybrid Tea

Year of release: 1970

Released by: Gaujard

Habit: The cultivar is bushy, much branched and has moderate growth habit.

Height: The plant grows to a height of 59.22 cm.

Stem: The young stem is light reddish brown with green tinge and the matured one is dark green.

**Thorns:** This cultivar is comparatively less thorny with 1.29 thorns per cm and these are of medium size.

**Leaf:** The young leaves are dark brownish red, whereas the matured ones are dark bluish green. The leaf area recorded is 38.38 sq. cm. The leaflets are broadly elliptical to ovate, serrate, acute with obtuse to truncate base, leathery and glossy.

**Bud:** The flower bud is medium, pointed and Indian Lake (59B) in colour.

**Flower:** The cultivar is very free flowering and the flowers are very shapely and high centred (Plate E, 8). The flower has Rosine Purple (68A) petals with almost white base and backside. On fading, the colour turns Solferino Purple (65B). The petals generally do not open completely and the flower opens slowly. The flower diameter ranges from 9.5 cm to 11.0 cm (Plate I, 3) and the number of petals varies from 29 to 32. The petals are obovate with length and breadth of 4.86 cm and 5.36 cm, respectively. The flower has no fragrance. Good for exhibition and garden display purpose.

**Stalk length:** The stalk length measures 65.00 cm.

**Pollen fertility:** The percentage of pollen fertility estimated was moderate, being 42.76.

**Diseases:** The cultivar is highly susceptible to black spot and powdery mildew.

29. KALPANA

Class: Hybrid Tea

Year of release: 1978

Released by: G. Kasturi Rangan

Habit: This cultivar is bushy, dense, much branched and has vigorous growth habit.

Height: The height of the plant measures 106.25 cm.

Stem: The young stem is light green with reddish brown tinge, whereas the matured stem is dark green.

Thorns: This cultivar is moderately thorny with 3.89 thorns per cm and these are of big to medium size.

Leaf: The young leaves are dark reddish brown and the matured ones are dark green. The leaf area is 64.28 sq. cm and leaflets are elliptical, serrate, acute with obtuse base, smooth and shiny.

Bud: The flower bud is medium, bold and Blood Red (45D) with Currant Red (46A) edges.

Flower: The flowers are shapely and almost quartered shaped. The flower colour is Rhodanite Red (51A) flushed with Currant Red (53D) backside. On fading, the colour turns light rhodanite red. The flower diameter ranges from 10.0 cm to 11.0 cm (Plate J, 11), and the number of petals varies from 95 to 102. The petals are obovate to oval and acute with length and breadth of 3.94 cm and 2.84 cm, respectively. The flowers are moderately fragrant.

Stalk length: The stalk length recorded in the cultivar is 52.33 cm.

Pollen fertility: The pollen fertility percentage estimated was quite high, being 56.03.

Diseases: The cultivar is moderately susceptible to black spot and tolerant to powdery mildew.

### 30 KANYA

Class: Hybrid Tea

Year of release: 1974

Released by: G. Kasturi Rangan

Habit: The plant is erect and has moderate growth habit.

Height: The height of the cultivar measures 81.80 cm.

Stem: The young stem is dark brownish red and the matured stem is green.

Thorns: This cultivar is moderately thorny. The thorns are medium sized and the number of thorns per cm is 2.40.

Leaf: The young leaves are dark brownish red and on maturity become dark green. The leaf area is 35.92 sq. cm and leaflets are thin, narrowly elliptical, serrate and acute with obtuse base.

Bud: The flower bud is small, bold and has Geranium Lake (47C) colour with Spinel Red (54A) edges.

Flower: The flowers are shapely and almost split centred.

The flower has numerous small petals which are Neyron Rose (550) with light neyron rose edges and Roseline Purple (680) backside. On fading, turns light neyron rose. The flower diameter ranges from 7.0 cm to 11.0 cm and the number of petals from 99 to 116. The petals are obovate to oval and acute with an average length and breadth of 4.34 cm and 4.52 cm, respectively. The flower lacks fragrance.

Stalk length: The stalk length observed is 37.20 cm.

Pollen fertility: The pollen fertility percentage estimated in the cultivar was moderately high, being 48.63.

Disease: The cultivar is highly susceptible to black spot and tolerant to powdery mildew.

### 31. KENTUCKY DERRY

Class: Hybrid Tea

Year of release: 1972

Released by: Armstrong

Habit: The plant is erect and has vigorous growth habit.

Height: The height of the cultivar observed is 104.50 cm.

Stem: The young stem is light green with reddish brown tinge and matured stem is green.

Thorn: This cultivar is moderately thorny having big to medium sized thorns. The number of thorns per cm is 3.95.

Leaf: The young leaves are light reddish brown which on

maturity turn to green. The leaf area is 51.43 sq. cm and leaflets are thin, narrowly elliptical, serrulate and acuminate with obtuse base.

Bud: The flower bud is medium, pointed and dark ruby red or almost black with Indian Lake (59B) edges.

Flowers: The flowers are very shapely and split centred, and have Rhodanite Red (51A) petals with Tyrian Purple (57A) base and Tyrian Purple (61C) at the backside. On fading, turns Tyrian Purple (57A) with Rose Bengal (57B) at backside. The flower diameter ranges from 10.0 cm to 12.0 cm (Plate 1, 6), and the number of petals varies from 50 to 52. The petals are obovate, slightly acute and slightly reflexed. The petal length is 5.28 cm and petal breadth is 5.24 cm. The flowers are moderately fragrant.

Stalk length: The Stalk length recorded measure 41.00 cm.

Pollen fertility: Pollen fertility percentage estimated was moderately low, being 25.73.

Diseases: The cultivar is highly susceptible to black spot and susceptible to powdery mildew.

## 32. LANCOSH

Class: Hybrid Tea

Year of release: 1975

Released by: Delbard

Habit: The cultivar is erect and has moderate growth habit.

Height: The height of the cultivar observed is 76.86 cm.

Stems: The young stem is light green with reddish brown tinge and on maturity turns greyish green.

Thorns: The cultivar is moderately thorny and the thorns are of medium size. The number of thorns per cm is 2.05.

Leaves: The young leaves are light green with reddish brown tinge and the matured ones are dark green. The leaf area recorded is 33.87 sq. cm and leaflets are elliptical, double serrate, acuminate with obtuse to truncate base, thin with glossy texture.

Buds: The flower/<sup>bud</sup>is medium and bold having purple colour.

Flowers: The flowers are shapely and almost split centred (Plate F, 17) with Fuchsia Purple (67B) petals. On fading turns Solferino Purple (65B). The flower diameter ranges from 10.0 cm to 12.0 cm and the number of petals varies from 27 to 30. The petals are obovate to oval and slightly acute. The length and breadth of the petals are 5.78 cm and 5.12 cm, respectively. The flowers have no fragrance.

Stalk length: The stalk length recorded is 44.80 cm.

Pollen fertility: The percentage of pollen fertility was 28.44.

Diseases: The cultivar is highly susceptible to black spot and tolerant to powdery mildew.

### 33. LANDORA

Class: Hybrid Tea

Year of release: 1970

Released by: Tantau

Habit: The plant is erect and has moderate growth habit.

Height: The height observed is 64.40 cm.

Stems: The young stem is light green with reddish brown tinge and the matured stem is greyish green.

Thorns: The cultivar is moderately thorny and the thorns are fairly big. The number of thorns per cm is 2.27.

Leaf: The young leaves are light reddish brown and on maturity turns green. The leaf area is 46.80 sq. cm and leaflets are elliptical, double serrate, acuminate with obtuse base and thin texture (Plate D, 13).

Bud: The flower bud is large, pointed and Lemon Yellow (13A).

Flower: The flowers are almost blown shaped. The flowers have Mimosa Yellow (8C) petals with Canary Yellow (9A) base and Canary Yellow (9C) backside. On fading, colour turns light mimosa yellow, sometimes flushed towards the edges with Coral Pink (38D) spots. The flower diameter ranges from 12.5 cm to 15.5 cm and the number of petals from 28 to 31. The petals are obovate and reflexed with length and breadth of 6.32 cm and 5.86 cm, respectively. The flowers are slightly fragrant.

Stalk length: The stalk length recorded is 55.17 cm.

Pollen fertility: The pollen fertility percentage estimated was low, being 14.52.

Diseases: The cultivar is highly susceptible to black spot and tolerant to powdery mildew.

#### 34. LEGACY JUBILEE

Class: Hybrid Tea

Year of release: 1979

Released by: Dawson

Habit: The plant is erect, tall and has very vigorous growth.

Height: The height of the cultivar observed is 150.71 cm.

Stem: The young stem is light green with reddish brown tinge and on maturity turns dark green.

Thorns: The cultivar is comparatively less thorny and the thorns are medium sized. The number of thorns per cm is 1.28.

Leaf: The young leaves are dark reddish brown and on maturity turns dark green. The leaf area is 43.28 sq. cm and leaflets are elliptical, serrate, acuminate with obtuse base, smooth and glossy (Plate C, 8).

Bud: The flower bud is large and bold, and bud colour is blend of Spanish Orange (26B) and Sulphur Yellow (6C) with Currant Red (47A) at edges and tip.

Flowers: The flowers are shapely and almost high centred (Plate E, 9). The colour is blend of Aureolin (12B)

and Canary Yellow (9A) with Orange Buff (22 C) edges. On fading, turns to a blend of Azalea Pink (38 B) and Mimosa Yellow (8B) with Salmon (27B) backside. The flower diameter ranges from 11.0 cm to 11.5 cm and the number of petals from 24 to 26. The petals are obovate and reflexed. The length and breadth of petals are 6.34 cm and 5.58cm, respectively. The flowers are slightly fragrant.

Stalk length: The stalk length observed in the cultivar is 67.33 cm.

Pollen fertility: The percentage of pollen fertility estimated was moderately high, being 48.71.

Diseases: The cultivar is moderately susceptible to black spot and tolerant to powdery mildew.

### 35. LOLITA

Class: Hybrid Tea

Year of release: 1972

Released by: Kordes

Habit: The plant is erect and has moderate growth habit with few branches.

Height: The plant grows to a height of 62.60 cm.

Stem: The young stem is light reddish brown with green tinge and the matured stem is light green.

Thorns: The cultivar is moderately less thorny. The thorns

vary in size from medium to small and the number of thorns per cm is 1.71.

**Leaf:** The young leaves are light green with reddish brown tinge, whereas the matured ones are green. The leaf area is 37.88 sq. cm and leaflets are elliptical, serrulate, acute with obtuse base, leathery and coarse.

**Bud:** The flower bud is large, bold and has blend of Shrimp Red (33D), Mandarin Red (41D) and Canary Yellow (9C) colours (Plate W, 5).

**Flowers:** The flowers are chapeley and almost split centred. The colour is blend of Shrimp Red (33D), Mandarin Red (41D) and Canary Yellow (9C) with Canary Yellow (9B) base. On fading, turns Canary Yellow (9C) flushed with Spinel Red (54B) towards the edges. The flower diameter ranges from 12.0 cm to 13.0 cm and the number of petals varies from 30 to 38. The petals are thick textured, oval to obovate and slightly acute with length and breadth of 6.40 cm and 6.52 cm, respectively. The flowers have moderate fragrance.

**Stalk length:** The stalk length in this cultivar measures 39.00 cm.

**Pollen fertility:** The pollen fertility percentage estimated in the cultivar was 14.19.

**Diseases:** The cultivar is moderately susceptible to black spot and tolerant to powdery mildew.

36. MISS HARE

Class: Hybrid Tea

Year of release: 1973

Released by: Tantau

Habit: The plant is erect and has moderate growth.

Height: The height of the cultivar recorded is 76.00 cm.

Stem: The young stem is light reddish brown with green tinge, whereas the matured stem is green.

Thorn: This cultivar is moderately thorny having big sized thorns. The number of thorns per cm is 2.33.

Leaf: The colour of young leaves is light reddish brown which on maturity turns to dark green. The leaf area recorded is 41.41 sq. cm and leaflets are narrowly elliptical, double serrate, acuminate with obtuse to truncate base and thin texture.

Bud: The flower bud is large and pointed. The bud colour is Lemon Yellow (13A) with Burnt Orange (31B) at the tips.

Flower: The flowers are almost blown shaped. The colour is Lemon Yellow (13B) and on fading, turns almost Yellow (80) with almost Yellow (8A) base. The flower diameter ranges from 11.5 cm to 12.5 cm (Plate J, 8) and the number of petals varies from 28 to 35. The petals are obovate, slightly reflexed and slightly acute. The length and breadth of the petals are 7.28 cm and 5.86 cm, respectively. The flowers have no fragrance.

Stalk length: The stalk length observed is 58.80 cm.

Pollen fertility: The pollen fertility percentage estimated in this cultivar was 14.72.

Diseases: The cultivar is highly susceptible to black spot and tolerant to powdery mildew.

### 37. NORMA

Class: Hybrid Tea

Year of release: 1974

Released by: Gaujard

Habit: The plant is bushy, much branched and has moderate growth habit.

Height: The height of the cultivar recorded is 93.43 cm.

Stem: The young stem is light reddish brown with green tinge and on maturity turns light green.

Thorns: This cultivar is quite thorny with 7.01 thorns per cm. The thorns vary in size from medium to small (Plate B, 10).

Leaf: The young leaves are light reddish brown and on maturity turns dark green. The leaf area is 48.76 sq. cm and leaflets are narrowly elliptical, serrate, acuminate with obtuse base, leathery and very glossy (Plate D, 12).

Buds: The flower bud is large and bold, and the colour is dark ruby red or almost black with deep cardinal red base (Plate G, 1).

Flower: The flowers are shapely and split centred. It has Rose Bengal (57B) petals with Cardinal Red (53A) edges and Magenta Rose (64C) backside. On fading, the colour turns Rose Bengal (57C) with Cardinal Red (53B) edges and Magenta Rose (64D) backside. The flower diameter ranges from 10.5 cm to 12.5 cm (Plate 1, 1) and the number of petals from 40 to 71. The petals are obovate and slightly acute with length of 6.14 cm and breadth of 6.46 cm. The flowers have no fragrance.

Stalk length: The stalk length recorded is 55.33 cm.

Pollen fertility: The percentage of pollen fertility was 29.26.

Disease: The cultivar is highly susceptible to black spot and tolerant to powdery mildew.

### 38. PANGRAJA HOLIDAY

Class: Hybrid Tea

Year of release: 1973

Released by: Gregory

Habit: The plant is erect and has moderate growth habit with few branches.

Height: The height of the cultivar observed is 74.33 cm.

Stem: The young stem is dark brownish red and the matured stem is dark green.

Thorn: The cultivar is moderately less thorny having both

**big and small sized thorns.** The number of thorns per cm is 1.17.

**Leaf:** The young leaves are lighter reddish brown and the matured ones are dark bluish green. The leaf area is 44.42 sq. cm. The leaflets are narrowly elliptical, double serrate, acuminate with obtuse base, and leathery.

**Bud:** The flower bud is medium, pointed and Azalea Pink (388) with Scarlet (430) edges.

**Flower:** The flowers are shapely and split centred. The flower has Empire Rose (480) petals with light pink or almost white backside. On fading, the colour turns Venetian Pink (498). The flower diameter ranges from 9.0 cm to 10.5 cm and the number of petals varies from 32 to 41. The petals are obovate to oval, acute and reflexed with length and breadth of 5.38 cm and 5.30 cm, respectively. The flowers are moderately fragrant.

**Stalk length:** It has a stalk length measuring 46.75 cm.

**Pollen fertility:** The pollen fertility percentage estimated in the cultivar was 37.71.

**Disease:** The cultivar is highly susceptible to black spot and susceptible to powdery mildew.

### 39. PARADISE

**Class:** Hybrid Tea

**Year of release:** 1979

**Released by:** weeks

**Habit:** The cultivar is erect, dense and has moderate growth habit.

**Height:** The height of the plant measures 88.50 cm.

**Stem:** The young stem is light reddish brown with green tinge and the matured stem is green.

**Thorn:** This cultivar is moderately less thorny and the thorns vary in size from big to medium. The number of thorns per cm is 1.07.

**Leaf:** The young leaves are dark brownish red and the matured leaves are green. The leaf area is 39.03 sq. cm and leaflets are narrowly elliptical, serrate, acuminate with obtuse to truncate base, thin and glossy.

**Bud:** The flower bud is medium and pointed. The bud colour is Phlox Purple (75B) with Spiraea Red (65B) at the edges and tip.

**Flower:** The cultivar is free flowering with very shapely, split centred, bicoloured flowers (Plate P, 11). The colour is Phlox Purple (75C) flushed with Spiraea Red (63A) towards the edges and tip and Magnolia Purple (70D) at backside. On fading, the colour turns light purple. The flower diameter ranges from 11.0 cm to 12.5 cm. The number of petals varies from 24 to 34 and these are obovate and slightly reflexed with length and breadth of 4.84 cm and 5.12 cm, respectively. The flowers have no fragrance. Ideal for exhibition and garden display purpose.

Stalk length: The stalk length measures 60.80 cm.

Pollen fertility: The pollen fertility percentage estimated in the cultivar was moderately high, being 48.5%.

Diseases: The cultivar is highly susceptible to black spot and moderately susceptible to powdery mildew.

#### 40. PREGIOUS PLATINUM

Class: Hybrid Tea

Year of release: 1974

Released by: Dickson

Habit: The plant is erect and has moderate growth habit.

Height: The height of the plant is 92.33 cm.

Stems: The young stem is light green with reddish brown tinge which on maturity turns dark green.

Thorns: This cultivar is comparatively less thorny and the thorns are medium sized. The number of thorns per cm is 1.77.

Leaf: The young leaves are light green with reddish brown tinge, whereas the matured leaves are dark bluish green. The leaf area is 47.34 sq. cm. The leaflets are ovate to elliptical, double serrate, acute with obtuse to truncate base and leathery with coarse texture.

Bud: The flower bud is medium, bold and has Indian Lake (59B) colour with Ruby Red (59A) edges.

Flowers: The flowers are shapely and almost split centred.

It has Rose Bengal (57C) petals with Rose Bengal (57D) backside. On fading, the colour turns Rose Bengal (57D). The flower diameter ranges from 9.0 cm to 12.0 cm. The number of petals varies from 46 to 60 and these are obovate, slightly acute and reflexed with length and breadth of 5.08 cm and 4.14 cm, respectively. The flowers lack fragrance.

Stalk length: The stalk length of the plant measures 57.83 cm.

Pollen fertility: The pollen fertility percentage estimated in the cultivar was 40.22.

Disease: This cultivar is moderately susceptible to black spot and susceptible to powdery mildew.

#### 41. RRBHL

Class: Hybrid Tea

Year of release: 1971                      Released by: Kordas

Habit: The plant is erect and has moderate growth habit with few branches.

Height: The plant grows to a height of 94.00 cm.

Stem: The young stem is light reddish brown with green tinge and the matured stem is dark green.

Thorn: This cultivar is very much thorny and these thorns are medium sized with numerous smaller ones in between. The number of thorns per cm is 18.41 (Plate A, 1).

Leaf: The young leaves are dark brownish red and the matured leaves are dark green. The leaf area is 54.43 sq. cm and leaflets are elliptical, serrulate, acuminate with obtuse to truncate base, thin and shiny.

Bud: The flower bud is medium, pointed and deep cardinal red with deep ruby red towards the edges.

Flower: The flowers are chapeley and high contred (Plate K, 4), having Turkey Red (46C) petals with Canary Yellow (9B) base and Cardinal Red (53B) backside. On fading, the colour turns Carmine (52B) with Rose Bengal (57D) at the backside. The flower diameter ranges from 11.5 cm to 13.0 cm. The number of petals varies from 35 to 38 and these are obovate, slightly acute and reflexed. The length and breadth of the petals are 5.48 and 6.20 cm, respectively. The flower lacks fragrance.

Stalk length: The stalk length in this cultivar measures 45.40 cm.

Pollen fertility: The pollen fertility percentage estimated was 23.63.

Diseases: The cultivar is highly susceptible to black spot and moderately susceptible to powdery mildew.

#### 42. RED MASTERPINCH

Class: Hybrid Tea

Year of release: 1974                      Released by: Warriner (J & P)

Habit: The plant is erect with moderate growth habit.

Height: The height of the plant observed is 79.17 cm.

Stem: The young stem is dark brownish red and the matured stem light green.

Thorns: This cultivar is moderately thorny. The thorns are of medium to small size and the number of thorns per cm is 2.11.

Leaf: The young leaves are dark reddish brown and matured ones are green. The leaf area recorded is 43.16 sq. cm and leaflets are elliptical, serrate, acute with obtuse base, thin with coarse texture.

Bud: The flower bud is medium, bold and deep cardinal red with black edges and tip.

Flower: The flowers are shapely and almost split centred (Plate K, 1). It has Cardinal Red (53A) petals with Tyrian Purple (57A) backside. On fading, the colour turns Tyrian Purple (57A) with Rose Bengal (57C) on backside. The flower diameter ranges from 12.0 cm to 14.0 cm (Plate J, 7) and the number of petals varies from 63 to 64. The petals are obovate and slightly acute. The length and breadth of petals are 5.60 cm and 3.56 cm, respectively. The flowers are moderately fragrant.

Stalk length: The stalk length in this cultivar recorded is 74.00 cm.

Pollen fertility: The pollen fertility percentage estimated was 42.09.

Diseases: The cultivar is highly susceptible to black spot and tolerant to powdery mildew.

### 43. RUBY PLANET

Class: Hybrid Tea

Year of release: 1970

Released by: Dickson

Habit: The cultivar is erect and has moderate growth habit.

Height: The plant grows to a height of 58.80 cm.

Stems: The young stem is light green with reddish brown tinge and matured stem is green.

Thorns: This cultivar is moderately less thorny and these thorns vary in size from big to medium. The number of thorns per cm is 1.13.

Leaf: The young leaves are light reddish brown which on maturity turn dark green. The leaf area is 45.10 sq. cm and leaflets are narrowly elliptical, double serrate, acuminate with obtuse base, thin and coarse.

Bud: The flower bud is medium and bold having Indian Lake (59B) colour with Ruby Red (59A) edges.

Flowers: The flowers are almost split centred. The flower colour is Cardinal Red (53B) with Cardinal Red (53A) edges

and Cardinal Red (53C) backside. On fading the colour turns deep tyrian purple with deep rose bengal at the backside. The flower diameter ranges from 9.5 cm to 11.0 cm. The number of petals ranges from 22 to 35 and these are obovate, slightly acute and reflexed. The petal length and breadth are 4.80 cm and 5.08 cm, respectively. The flower lacks fragrance.

Stalk length: The stalk length observed is 48.50 cm.

Pollen fertility: The pollen fertility percentage estimated was moderately low, being 18.95.

Disease: The cultivar is susceptible to black spot and tolerant to powdery mildew.

#### 44. SILVA

Class: Hybrid Tea

Year of release: 1964

Released by: Meiland

Habit: The plant is bushy and has moderate growth habit.

Height: The height of the plant measures 67.75 cm.

Stem: The young stem is light green and the matured stem is greyish green.

Thorns: The number of thorns per cm is moderately low, being 0.91 and these are of big size (Plate B, 8).

Leaf: The young leaves are light green with reddish brown tinge and the matured ones are dark green. The leaf area

is 41.69 sq. cm and leaflets are ovate to elliptical, serrulate, acute with obtuse base, smooth and glossy.

Buds: The flower bud is large and bold. The bud colour is light pink with Brick Red (35C) towards the edges.

Flowers: The flowers are blown shaped and have blend of light neyron rose and Orient Pink (36A) colours with Canary Yellow (9B) base and Neyron Rose (55B) towards edges. On fading, the colour turns light neyron rose. The flower diameter ranges from 11.5 cm to 13.0 cm and the number of petals from 21 to 52. The petals are obovate with length and breadth of 6.34 cm and 3.50 cm, respectively. The flowers are moderately fragrant.

Stalk length: The stalk length observed in this cultivar is 54.17 cm.

Pollen fertility: The pollen fertility percentage estimated was 22.85.

Diseases: The cultivar is moderately susceptible to black spot and tolerant to powdery mildew.

#### 45. SOPHOCLE

Class: Hybrid Tea

Year of release: 1974

Released by: Gaujard

Habit: The plant is bushy, much branched and has moderate growth habit.

Height: The height of the plant recorded is 96.60 cm.

Stem: The young stem is light reddish brown with green tinge and the matured stem is green.

Thorns: This cultivar is moderately thorny. The thorns are medium to small sized and the number of thorns per cm is 2.97.

Leaf: The young leaves are light green with reddish brown tinge and matured leaves are dark green. The leaf area is 69.82 sq. cm and leaflets are narrowly elliptical, serrulate, acute with obtuse base, smooth and glossy.

Bud: The flower bud is large and pointed and the colour is dark ruby red.

Flower: The flowers are shapely and split centred. It has Cardinal Red (53A) petals with Tyrian Purple (61C) at the backside. On fading, turns Cardinal Red (53B) with Rose Bonçal (57B) at the backside. The flower diameter ranges from 9.0 cm to 12.5 cm and the number of petals from 44 to 57. These are obovate and slightly acute. The petal length and breadth are 4.74 cm and 4.64 cm, respectively. The flower lacks fragrance.

Stalk length: The stalk length observed in the cultivar is 47.50 cm.

Pollen fertility: The pollen fertility percentage estimated was 25.28.

**Disease:** The cultivar is highly susceptible to black spot and moderately susceptible to powdery mildew.

#### 46. SULLER DAYS

**Class:** Hybrid Tea

**Year of release:** 1977

**Released by:** Bess

**Habit:** The plant is erect and has moderate growth habit.

**Height:** The height of the plant measures 88.28 cm.

**Stems:** The young stem is light reddish brown with green tinge and the matured one is light green.

**Thorns:** This cultivar is comparatively less thorny with 1.37 thorns per cm. The thorns are big in size.

**Leaf:** The young leaves are dark brownish red and matured ones are dark green. The leaf area recorded is 35.67 sq. cm and leaflets are narrowly elliptical, double, serrate, acuminate with obtuse base, leathery and glossy.

**Bud:** The flower bud is large, pointed and has Chartreuse Green (1D) colour with Dresden Yellow (5B) base.

**Flower:** The flowers are very shapely and high centred (Plate K, 10). The flower has Primrose Yellow (4B) petals with Primrose Yellow (4D) backside. On fading, the colour turns Primrose Yellow (4D). The flower diameter ranges from 10.0 cm to 12.0 cm. The number of petals varies from 39 to 48 and these are obovate with length

and breadth of 4.42 cm and 4.22 cm, respectively. It has flowers with moderate fragrance.

Stalk length: The stalk length measures 49.20 cm.

Pollen fertility: The pollen fertility percentage estimated in the cultivar was 28.42 (Plate N).

Diseases: The cultivar is highly susceptible to black spot and tolerant to powdery mildew.

#### 47. TAPTI

Class: Hybrid Tea

Year of release: 1978

Released by: G. Kauturi Rangan

Habit: The cultivar is erect and has moderate growth habit.

Height: The plant grows to a height of 76.25 cm.

Stem: The young stem is light green with reddish brown tinge and matured stem is green.

Thorns: This cultivar is moderately less thorny with 1.49 thorns per cm and these are big in size.

Leaf: The young leaves are light green with reddish brown tinge and matured ones are green. The leaf area is 54.16 sq. cm and leaflets are ovate to obovate, serrate, acute with obtuse base and thin (Plate C, 3).

Bud: The flower bud is medium, bold and Venotian Pink (49B).

Flower: The flowers are Camellia shaped (Plate F, 18) and the colour is Orient Pink (360) with almost white on the

backside. On fading, the colour turns almost white. The flower diameter ranges from 11.0 cm to 13.0 cm and number of petals from 46 to 52. The petals are obovate to oval, slightly acute and incurved. The length and breadth of petals are 5.96 cm and 5.24 cm, respectively. The flowers are slightly fragrant.

Stalk length: The stalk length observed in the cultivar is 44.00 cm.

Pollen fertility: The pollen fertility percentage estimated was 22.82.

Diseases: The cultivar is moderately susceptible to black spot and tolerant to powdery mildew.

#### 48. YASAVI

Class: Hybrid Tea

Year of release: 1976

Released by: G. Kasturi Rangan

Habit: The plant is bushy and has moderate growth habit.

Height: The height of the cultivar measures 69.28 cm.

Stem: The young stem is light green and on maturity turns greyish green.

Thorn: This cultivar is moderately thorny with 2.36 thorns per cm and these are big to small in size (Plate A, 4).

Leaf: The young leaves are light green with reddish brown tinge and the matured ones are dark green. The leaf area

recorded is 41.31 sq. cm and leaflets are thin, elliptical, serrate and acute with obtuse base.

Habit: The flower bud is medium, bold and Ruby Red (59A) with Indian Lake (59B) base.

Flowers: The flowers are almost split centred (Plate F, 15) having Tyrian Purple (57A) petals with Rose Bengal (57 C) at edges and backside. On fading, the colour turns Fuchsia Purple (67B). The flower diameter ranges from 9.5 cm to 12.0 cm and the number of petals varies from 46 to 64. The petals are obovate and slightly acute with length and breadth of 4.50 cm and 4.56 cm, respectively. The flower is slightly fragrant.

Stalk length: The stalk length recorded in this cultivar is 53.25 cm.

Pollen fertility: The pollen fertility percentage estimated was 37.66.

Diseases: The cultivar is highly susceptible to black spot and moderately susceptible to powdery mildew.

#### 49. VICKY

Class: Hybrid Tea

Year of release: 1973

Released by: Gaujard

Habit: The plant is erect and has moderate growth habit.

Height: The height of the plant measures 71.00 cm.

Stem: Young stem is light green with reddish brown tinge and matured stem is green.

Thorns: The cultivar is very thorny with 9.17 thorns per cm and these vary in size from medium to small.

Leaf: The young leaves are dark reddish brown and the matured ones are green. The leaf area recorded is 33.18 sq. cm. The leaflets are ovate to elliptical, serrate, acute with obtuse to truncate base and thin with smooth texture.

Bud: The flower bud is small, pointed and Cardinal Red (53A).

Flower: The flowers are split centred and have Turkey Red (46C) petals. On fading, turns Rose Bengal (57C). The flower diameter ranges from 9.5 cm to 11.5 cm (Plate 1, 2) and the number of petals varies from 36 to 51. The petals are obovate to oval and slightly acute with length of 4.88 cm and breadth of 5.34 cm. The flowers are slightly fragrant.

Stalk length: The stalk length measures 36.20 cm.

Pollen fertility: The percentage of pollen fertility estimated was moderately high, being 50.80.

Disease: The cultivar is highly susceptible to black spot and tolerant to powdery mildew.

50. YANKMIE DOODLEClass: Hybrid TeaYear of release: 1974Released by: KordeasHabit: The plant is upright, dense and has vigorous growth habit.Height: The plant grows to a height of 106.87 cm.Spine: This cultivar is comparatively less thorny with 1.79 thorns per cm and these are fairly big in size.Leaf: The young leaves are dark reddish brown, whereas matured ones are green. The leaf area is 55.17 sq. cm and leaflets are elliptical, double serrate, acuminate with truncate to obtuse base, leathery and glossy (Plate C. 4).Bud: The flower bud is medium and bold. The bud colour is Lemon Yellow (14 C) with Chartreuse Green (10) base.Flower: The flowers are almost open cupped and have blend of Poppy Red (38C) and Salmon (27A) colours with Canary Yellow (9B) base and Mimosa Yellow (8C) at the backside. On fading, the colour turns blend of Asalea Pink (38A) and Salmon (27A) flushed with Crimson (52A) towards the edges and Canary Yellow (9B) base. The flower diameter ranges from 10.0 cm to 12.5 cm. The number of petals varies from 65 to 80 and these are obovate to oval, slightly acute and incurved. The petal length is 6.30 cm and breadth is 5.98 cm. The flowers are moderately fragrant.

Stalk length: The stalk length in this cultivar is very good measuring 81.33 cm.

Pollen fertility: The pollen fertility percentage estimated was very low, being 6.39.

Diseases: The cultivar is highly susceptible to black spot and tolerant to powdery mildew.

Table 1: Name, classification and year of release of rose cultivars

Sl. No.	Name of the cultivar	Released by	Year of release
1.	Adolf Horstmann (H.T.)	Kordes	1971
2.	Akebono (H.T.)	Kawai	1975
3.	Ambassador (H.T.)	Mollard	1978
4.	Ambika (H.T.)	G. Kasturi Rangan	1976
5.	Angelus (H.T.)	Gaujard	1976
6.	Anne Burda (H.T.)	Kordes	1973
7.	Aquarius (H.T.)	Armstrong	1970
8.	Arizona (H.T.)	weeks	1975
9.	Awini (H.T.)	G. Kasturi Rangan	Not mentioned
10.	Bull's Red (H.T.)	McGredy	1977
11.	Canary (H.T.)	Tantau	1976
12.	Carania (H.T.)	Armstrong	1975
13.	Careless Love (H.T.)	Conklin	1955
14.	Chitrangini (H.T.)	G. Kasturi Rangan	1971
15.	Deep Secret (H.T.)	Tantau	1978
16.	Doris Tystermann (H.T.)	Wisbech	1975
17.	Ferry Porsche (H.T.)	Kordes	1971
18.	First Prize (H.T.)	Roemer	1970
19.	Flammenpiel (H.T.)	Kordes	1978
20.	Folklore (H.T.)	Kordes	1978
21.	Fragrant Hour (H.T.)	McGredy	1973
22.	Ghasal (H.T.)	Singh	1970
23.	Gulsar	I. A. R. I.	1971

Table 1 (contd.)

24. Tlona (H.T.)	Verbeek	1977
25. Interflora (H.T.)	Holland	1970
26. Ivory Tower (H.T.)	Kordes (Int. Armstrong)	1978
27. John Waterer (H.T.)	Sam Mouldy	1970
28. Jouvencelle (H.T.)	Gaujard	1970
29. Kalpana (H.T.)	G. Kasturi Rangan	1978
30. Kanva (H.T.)	G. Kasturi Rangan	1974
31. Kentucky Derby (H.T.)	Armstrong	1972
32. Lancome (H.T.)	Delbard	1975
33. Landora (H.T.)	Tantau	1970
34. Legacy Jubilee (H.T.)	Dawson	1979
35. Lolita (H.T.)	Kordes	1972
36. Miss Harp (H.T.)	Tantau	1973
37. Norma (H.T.)	Gaujard	1974
38. Panorama Holiday (H.T.)	Gregory	1973
39. Paradise (H.T.)	Weeks	1979
40. Precious Platinum (H.T.)	Dickson	1974
41. Rebel (H.T.)	Kordes	1971
42. Red Masterpiece (H.T.)	Warriner (J & P)	1974
43. Red Planet (H.T.)	Dickson	1970
44. Silva (H.T.)	Holland	1964
45. Sophocle (H.T.)	Gaujard	1974
46. Summer Days (H.T.)	Bees	1977
47. Tapti (H.T.)	G. Kasturi Rangan	1978
48. Vasavi (H.T.)	G. Kasturi Rangan	1976
49. Vicky (H.T.)	Gaujard	1973
50. Yankee Doodle (H.T.)	Kordes	1974

Table 2: Rose cultivars showing height of the plant, thorniness and leaf area

Sl. No.	Name of the cultivar	Height of the plant (cm)	No. of thorns (per cm)	Leaf area (sq. cm)
1.	Adolf Horstmann (H.T.)	82.00	4.03	49.71
2.	Akebono (H.T.)	75.25	0.61	58.94
3.	Ambassador (H.T.)	116.17	0.92	33.23
4.	Ambika (H.T.)	88.20	9.11	53.50
5.	Angelus (H.T.)	96.55	2.36	58.95
6.	Anne Burda (H.T.)	103.25	4.53	54.13
7.	Aquarius (H.T.)	86.00	3.29	54.08
8.	Arizona (H.T.)	89.14	2.20	77.06
9.	Auwini (H.T.)	86.12	1.03	39.24
10.	Bull's Red (H.T.)	123.00	1.01	42.66
11.	Canary (H.T.)	104.78	0.85	56.15
12.	Caramia (H.T.)	133.50	3.00	56.31
13.	Careless Love (H.T.)	98.60	0.64	41.10
14.	Chitrangini (H.T.)	78.75	1.36	33.82
15.	Deep Secret (H.T.)	72.50	5.00	45.83
16.	Doris Tystormann (H.T.)	94.20	1.11	57.94
17.	Ferry Porsche (H.T.)	97.78	1.65	52.19
18.	First Prize (H.T.)	63.67	3.84	53.18
19.	Flammenspiel (H.T.)	158.20	8.88	88.25
20.	Folklore (H.T.)	139.44	4.41	84.66
21.	Fragrant Hour (H.T.)	80.00	2.24	71.98
22.	Ghazal (H.T.)	68.00	3.95	29.11
23.	Gulzar (H.T.)	90.67	1.39	44.12

Table 2 (contd.)

24. Ilona (H.T.)	90.83	1.07	42.12
25. Interflora (H.T.)	96.80	3.84	33.84
26. Ivory Tower (H.T.)	87.71	1.37	33.76
27. John Waterer (H.T.)	87.50	4.72	42.08
28. Jouvencelle (H.T.)	59.22	1.29	38.38
29. Kalpana (H.T.)	106.25	3.89	64.28
30. Kanva (H.T.)	81.80	2.40	35.92
31. Kentucky Derby (H.T.)	104.50	3.95	51.43
32. Lancone (H.T.)	76.86	2.05	33.87
33. Landora (H.T.)	64.40	2.27	46.80
34. Lezay Jubilee (H.T.)	150.71	1.28	43.28
35. Lolita (H.T.)	62.60	1.71	37.88
36. Miss Harp (H.T.)	76.00	2.33	41.41
37. Norma (H.T.)	93.43	7.01	48.76
38. Panorama Holiday (H.T.)	74.33	1.17	44.42
39. Paradise (H.T.)	88.50	1.07	39.03
40. Precious Platinum (H.T.)	92.33	1.77	47.34
41. Rebel (H.T.)	94.00	18.41	54.43
42. Red Masterpiece (H.T.)	79.17	2.11	43.16
43. Red Planet (H.T.)	58.80	1.13	45.10
44. Silva (H.T.)	67.75	0.91	41.69
45. Sophocle (H.T.)	96.60	2.97	69.82
46. Summer Days (H.T.)	88.28	1.37	35.67
47. Tapti (H.T.)	76.25	1.49	54.16
48. Vasavi (H.T.)	69.28	2.36	41.31
49. Vicky (H.T.)	71.00	9.17	33.18
50. Yankee Doodle (H.T.)	106.87	1.79	55.17

Table 3: Rose cultivars showing flower diameter, stalk length and intensity of fragrance

Sl. No.	Name of the cultivar	Range of flower diameter (cm)	Stalk length (cm)	Intensity of fragrance
1.	Adolf Horstmann (H.T.)	9.0-10.5	54.20	Nil
2.	Akebono (H.T.)	10.0-13.0	64.67	Moderate
3.	Ambassador (H.T.)	12.5-13.5	85.67	Slight
4.	Ambika (H.T.)	9.5-10.0	56.50	Slight
5.	Angelus (H.T.)	11.0-12.0	70.60	Moderate
6.	Anne Burda (H.T.)	9.5-12.5	49.40	Nil
7.	Aquarius (H.T.)	8.0-11.5	49.00	Nil
8.	Arizona (H.T.)	10.5-11.5	65.67	Moderate
9.	Arwini	10.0-10.5	61.00	Nil
10.	Bull's Red (H.T.)	8.0-8.5	79.50	Slight
11.	Canary (H.T.)	11.0-12.0	47.38	Moderate
12.	Carania (H.T.)	8.5-13.5	48.50	Nil
13.	Careless Love (H.T.)	8.0-10.5	52.67	Slight
14.	Chitragini (H.T.)	10.0-11.0	47.60	Slight
15.	Deep Secret (H.T.)	10.0-11.0	49.40	Nil
16.	Dorin Tyntormann (H.T.)	9.0-10.5	56.00	Slight
17.	Ferry Porsche (H.T.)	9.0-13.0	61.17	Nil
18.	First Prize (H.T.)	14.0-14.5	42.00	Nil
19.	Flammenspiel (H.T.)	10.5-11.5	75.17	Slight
20.	Folklore (H.T.)	11.0-12.5	66.00	Slight
21.	Fragrant Hour (H.T.)	12.0-13.5	49.67	High
22.	Ghazal (H.T.)	8.0-8.5	34.00	Nil
23.	Gulsar (H.T.)	7.9-9.5	56.50	Slight

Table 3 (contd.)

24. Milona (H.T.)	9.5-11.0	46.00	Nil
25. Interflora (H.T.)	10.5	77.17	Moderate
26. Ivory Tower (H.T.)	12.0-14.5	45.00	Moderate
27. John Waterer (H.T.)	9.0-10.0	58.67	Moderate
28. Jouvencelle (H.T.)	9.5-11.0	65.00	Nil
29. Kalpana (H.T.)	10.0-11.0	52.33	Moderate
30. Kanva (H.T.)	7.0-11.0	37.20	Nil
31. Kentucky Derby (H.T.)	10.0-12.0	41.00	Moderate
32. Lancome (H.T.)	10.0-12.0	44.80	Nil
33. Landora (H.T.)	12.5-15.5	55.17	Slight
34. Legacy Jubilee (H.T.)	11.0-11.5	67.33	Slight
35. Lolita (H.T.)	12.0-13.0	39.00	Moderate
36. Miss Harp (H.T.)	11.5-12.5	58.80	Nil
37. Norma (H.T.)	10.5-12.5	55.33	Nil
38. Panorama Holiday (H.T.)	9.0-10.5	46.75	Moderate
39. Paradise (H.T.)	11.0-12.5	60.80	Nil
40. Precious Platinum (H.T.)	9.0-12.0	57.83	Nil
41. Rebel (H.T.)	11.5-13.0	45.40	Nil
42. Red Masterpiece (H.T.)	12.0-14.0	74.00	Moderate
43. Red Planet (H.T.)	9.5-11.0	48.50	Nil
44. Silva (H.T.)	11.5-13.0	54.17	Moderate
45. Saphire (H.T.)	9.0-12.5	47.50	Nil
46. Summer Days (H.T.)	10.0-12.0	49.20	Moderate
47. Tapti (H.T.)	11.0-13.0	44.00	Slight
48. Yasavi (H.T.)	9.5-12.0	53.25	Slight
49. Vicki (H.T.)	9.5-11.5	36.20	Slight
50. Yankee Doodle (H.T.)	10.0-12.5	81.33	Moderate

Table 4: Some cultivars showing number, size and shape of petals

Sl. No.	Name of the cultivar	Range in number of petals	Size of petals		Shape of petals
			Length (cm)	Breadth (cm)	
1.	Adolf Hoffmann (H.T.)	46-54	3.96	3.46	Obovate, acute
2.	Alabono (V.T.)	84-92	6.88	6.18	Obovate, reflexed
3.	Arbassador (H.T.)	25-27	6.54	6.18	Obovate, slightly acute
4.	Artika (H.T.)	35-40	5.14	5.32	Obovate-oval
5.	Angelus (H.T.)	41-50	5.66	6.06	Obovate, slightly acute
6.	Anna Bardia (H.T.)	30-42	5.54	5.94	Obovate, acute
7.	Aquarius (H.T.)	32-54	6.24	5.56	Obovate, slightly acute, reflexed
8.	Arizona (H.T.)	32-40	4.58	4.52	Obovate, acute, slightly reflexed
9.	Aswini (H.T.)	122-153	4.46	4.84	Obovate-oval, slightly acute, reflexed
10.	Bull's Red (V.T.)	25-28	4.60	5.38	Obovate, slightly acute
11.	Canary (H.T.)	42-48	5.32	5.20	Obovate-oval, slightly acute
12.	Cerata (H.T.)	29-38	6.18	6.00	Obovate, acute

continued..

Table 4 (cont'd.)

13. Caroline Love (H.T.)	8-18	5-18	4.80	Obovate, incurved
14. Chitranjali (H.T.)	39-44	4.94	4.34	Obovate, acute, reflexed
15. Deep Secret (H.T.)	39-57	5.26	4.64	Obovate-oval, acute, slightly reflexed
16. Doris Tytormann (H.T.)	23-25	3.38	3.62	Obovate
17. Ferry Porsche (H.T.)	35-43	5.84	6.82	Obovate, slightly acute, slightly reflexed
18. First Prize (H.T.)	20-30	6.92	7.37	Obovate, reflexed
19. Flammenpiel (H.T.)	58-59	5.86	6.92	Obovate
20. Folklore (H.T.)	33-40	6.40	6.78	Obovate
21. Fragrant Hour (H.T.)	34-48	6.00	5.70	Obovate
22. Ghazal (H.T.)	12-17	4.80	4.24	Obovate, slightly acute
23. Gulzar (H.T.)	57-63	4.36	4.26	Obovate, slightly acute, reflexed
24. Illona (H.T.)	30-52	4.38	5.06	Obovate, slightly reflexed
25. Interflora (H.T.)	65-78	4.88	4.34	Obovate, slightly acute, reflexed
26. Ivory Tower (H.T.)	34-46	7.26	7.12	Obovate, acute, reflexed
27. John Waterer (H.T.)	59-64	5.70	5.06	Obovate, slightly reflexed, acute

continued..

Table 4 (contd.)

28. Jouvencelle (H.T.)	27-32	4.86	5.36	Obovate
29. Kalpana (H.T.)	95-102	3.94	2.84	Obovate-oval, acute
30. Kanva (H.T.)	99-116	4.34	4.52	Obovate-oval, acute
31. Kentucky Derby (H.T.)	50-52	5.28	5.24	Obovate, slightly acute, slightly reflexed
32. Lacombe (H.T.)	27-30	5.78	5.12	Obovate-oval, slightly acute
33. Lantora (H.T.)	28-31	6.32	5.86	Obovate, reflexed
34. Lemoy Jubilee (H.T.)	24-26	6.34	5.58	Obovate, reflexed
35. Lolita (H.T.)	30-38	6.40	6.52	Obovate-oval, slightly acute
36. Miss Harp (H.T.)	28-35	7.28	5.86	Obovate, slightly acute, slightly reflexed
37. Norma (H.T.)	40-71	6.14	6.46	Obovate, slightly acute
38. Panrara Holiday (H.T.)	32-41	5.38	5.30	Obovate-oval, acute, reflexed
39. Paradise (H.T.)	24-34	4.84	5.12	Obovate, slightly reflexed
40. Precious Platinum (H.T.)	46-60	5.08	4.14	Obovate, slightly acute, reflexed
41. Rebel (H.T.)	35-38	5.48	6.20	Obovate, slightly acute, reflexed

continued..

Table 4 (contd.)

42. Red Mantorpiece (H.T.)	63-64	5.60	5.56	Obovate, slightly acute
43. Red Planet (H.T.)	22-35	4.80	5.08	Obovate, slightly acute, reflexed
44. Silva (H.T.)	21-52	6.34	5.50	Obovate
45. Sophocle (H.T.)	44-57	4.74	4.64	Obovate, slightly acute
46. Turner Days (H.T.)	39-48	4.42	4.22	Obovate
47. Tapti (H.T.)	46-52	5.96	5.24	Obovate, slightly acute, incurved
48. Varavi (H.T.)	46-64	4.50	4.58	Obovate, slightly acute
49. Vicky (H.T.)	36-51	4.88	5.34	Obovate-oval, slightly acute
50. Yankee Doodle (H.T.)	65-80	6.30	5.98	Obovate-oval, slightly acute

Table 5: Pollen fertility status of rose cultivars

Sl. No.	Name of the cultivar	Acetocarmine stain		Vorstille stain	
		Fertility (%)	Sterility (%)	Fertility (%)	Sterility (%)
1.	Adolf Horstmann (H.T.)	5.28	94.72	7.66	92.34
2.	Akebono (H.T.)	16.25	83.75	16.54	83.46
3.	Ambassador (H.T.)	17.69	82.31	25.91	74.09
4.	Amika (H.T.)	46.38	53.62	47.03	52.97
5.	Anselus (H.T.)	29.76	70.24	45.18	54.82
6.	Anne Burda (H.T.)	38.60	61.40	40.56	59.04
7.	Aquarius (H.T.)	8.73	91.27	13.14	86.86
8.	Arizona (H.T.)	28.37	71.63	32.45	67.55
9.	Aswini (H.T.)	43.76	56.24	51.33	48.67
10.	Bull's Red (H.T.)	40.88	59.12	48.96	51.04
11.	Canary (H.T.)	10.77	89.23	30.31	69.69
12.	Carmia (H.T.)	45.84	54.16	49.43	50.57
13.	Carolina Love (H.T.)	29.45	70.55	33.79	66.21
14.	Chitragini (H.T.)	17.63	82.37	17.84	82.16
15.	Deep Secret (H.T.)	35.67	64.33	36.90	63.10
16.	Doris Tystermann (H.T.)	19.48	80.52	14.42	85.58
17.	Ferry Porsche (H.T.)	82.98	17.02	82.49	17.51
18.	First Prize (H.T.)	8.03	91.97	66.47	33.53
19.	Flammenspiel (H.T.)	30.11	69.89	43.73	56.27
20.	Polkore (H.T.)	27.36	72.64	35.64	64.36
21.	Fraser's Hour (H.T.)	40.27	59.73	40.30	59.70
22.	Ghazal (H.T.)	36.17	63.83	37.15	62.85
23.	Gulsar (H.T.)	59.69	40.31	63.63	36.37

Table 5 (contd.)

24. Ilona (H.T.)	26.26	73.74	30.17	69.33
25. Interflora (H.T.)	21.38	78.62	22.39	77.61
26. Ivory Tower (H.T.)	9.65	90.35	8.96	91.04
27. John Waterer (H.T.)	28.35	71.65	30.02	69.86
28. Jouvencelle (H.T.)	40.40	59.60	42.76	57.24
29. Kalpana (H.T.)	50.78	49.22	56.03	43.97
30. Kanva (H.T.)	28.54	71.46	48.63	51.37
31. Kentucky Derby (H.T.)	23.57	76.43	25.73	74.27
32. Lancone (H.T.)	26.51	73.49	28.44	71.56
33. Landora (H.T.)	14.57	85.43	14.52	85.48
34. Lemay Jubilee (H.T.)	17.58	82.42	48.71	51.29
35. Lolita (H.T.)	9.73	90.27	14.19	85.81
36. Miss Harp (H.T.)	22.04	77.96	14.72	85.28
37. Norma (H.T.)	21.73	78.27	29.26	70.74
38. Panorama Holiday (H.T.)	7.50	92.50	37.71	69.29
39. Paradise (H.T.)	49.88	50.12	48.54	51.46
40. Precious Platinum (H.T.)	26.79	73.21	40.22	59.78
41. Rebel (H.T.)	7.85	92.15	23.63	76.37
42. Red Masterpiece (H.T.)	38.75	61.25	42.09	57.91
43. Red Planet (H.T.)	16.62	83.38	18.95	81.05
44. Silva (H.T.)	19.75	80.25	22.85	77.15
45. Sophocle (H.T.)	26.82	73.18	25.28	74.72
46. Summer Days (H.T.)	24.32	75.68	28.42	71.58
47. Tapti (H.T.)	18.48	81.52	22.82	77.18
48. Vanavi (H.T.)	37.76	62.24	37.66	62.34
49. Vicky (H.T.)	46.95	53.05	50.80	49.20
50. Yankee Doodle (H.T.)	5.32	94.68	6.39	93.61

Table 6. Rose cultivars showing disease tolerance

No.	Name of the cultivar	Black spot	Powdery mildew
1.	Adolf Horstmann (H.T.)	Moderately susceptible	Tolerant
2.	Akebono (H.T.)	Highly susceptible	Tolerant
3.	Ambassador (H.T.)	Moderately susceptible	Tolerant
4.	Ambika (H.T.)	Highly susceptible	Tolerant
5.	Angelus (H.T.)	Moderately susceptible	Tolerant
6.	Anne Burda (H.T.)	Moderately susceptible	Tolerant
7.	Aquarius (H.T.)	Moderately susceptible	Tolerant
8.	Arizona (H.T.)	Highly susceptible	Tolerant
9.	Azimi (H.T.)	Highly susceptible	Susceptible
10.	Bull's Red (H.T.)	Moderately susceptible	Tolerant
11.	Canary (H.T.)	Highly susceptible	Tolerant
12.	Carmia (H.T.)	Moderately susceptible	Tolerant
13.	Careless Love (H.T.)	Moderately susceptible	Tolerant
14.	Chitranjali (H.T.)	Susceptible	Tolerant
15.	Deep Secret (H.T.)	Highly susceptible	Susceptible
16.	Doris Tystermann (H.T.)	Moderately susceptible	Tolerant
17.	Ferry Porsche (H.T.)	Moderately susceptible	Tolerant
18.	First Prize (H.T.)	Highly susceptible	Tolerant
19.	Flammenspiel (H.T.)	Highly susceptible	Susceptible
20.	Folklore (H.T.)	Moderately susceptible	Susceptible
21.	Fragrant Hour (H.T.)	Susceptible	Tolerant
22.	Ghazal (H.T.)	Highly susceptible	Moderately susceptible
23.	Gulzar (H.T.)	Moderately susceptible	Highly susceptible

Table 6 (contd.)

24. Illona (H.T.)	Highly susceptible	Moderately susceptible
25. Interflora (H.T.)	Moderately susceptible	Tolerant
26. Ivory Tower (H.T.)	Moderately susceptible	Tolerant
27. John Waterer (H.T.)	Highly susceptible	Moderately susceptible
28. Jouvencelle (H.T.)	Highly susceptible	Highly susceptible
29. Kalpana (H.T.)	Moderately susceptible	Tolerant
30. Kanva (H.T.)	Highly susceptible	Tolerant
31. Kentucky Derby (H.T.)	Highly susceptible	Susceptible
32. Lancom (H.T.)	Highly susceptible	Tolerant
33. Landora (H.T.)	Highly susceptible	Tolerant
34. Legacy Jubilee (H.T.)	Moderately susceptible	Tolerant
35. Lolita (H.T.)	Moderately susceptible	Tolerant
36. Miss Harp (H.T.)	Highly susceptible	Tolerant
37. Norma (H.T.)	Highly susceptible	Tolerant
38. Panorama Holiday (H.T.)	Highly susceptible	Susceptible
39. Paradise (H.T.)	Highly susceptible	Moderately susceptible
40. Precious Platinum (H.T.)	Moderately susceptible	Susceptible
41. Rebel (H.T.)	Highly susceptible	Moderately susceptible
42. Red Masterpiece (H.T.)	Highly susceptible	Tolerant
43. Red Planet (H.T.)	Susceptible	Tolerant
44. Silva (H.T.)	Moderately susceptible	Tolerant
45. Sophocle (H.T.)	Highly susceptible	Moderately susceptible

Table 6 (contd.)

46. Summer Days (H.T.)	Highly susceptible	Tolerant
47. Tapti (H.T.)	Moderately susceptible	Tolerant
48. Vavani (H.T.)	Highly susceptible	Moderately susceptible
49. Vicky (H.T.)	Highly susceptible	Tolerant
50. Yankee Doodle (H.T.)	Highly susceptible	Tolerant

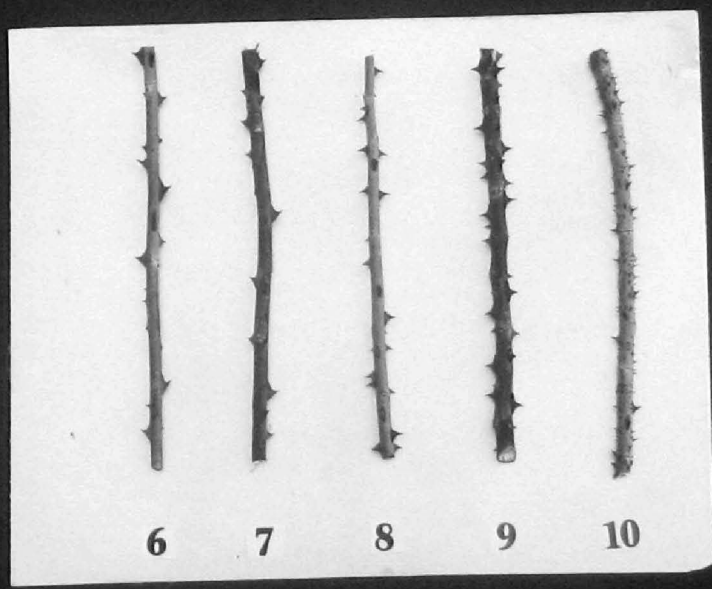
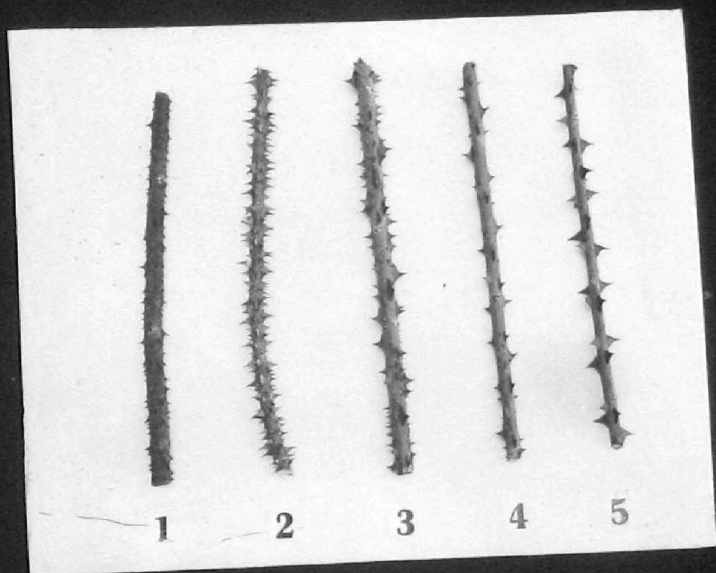
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**Plate A: Density of thorniness in the rose cultivars:**

1. NEERL
2. AMBKA
3. PLASONSPIKL
4. VASAVI
5. GULZAR

**Plate B: Density of thorniness in the rose cultivars:**

6. ASANI
7. CAROLINE LOVE
8. SILVA
9. AMBASSADOR
10. NORMA



**Plate C: Leaf shape and size of the rose cultivars:**

1. AKRONO
2. A. BIKA
3. TAPPI
4. YANKEE DOODLE
5. CANARY
6. BULL'S RED
7. GULZAR
8. LEGACY JUBILEE

**Plate D: Leaf shape and size of the rose cultivars:**

9. CARELESS LOVE
10. ARIZONA
11. FIRST PRIZE
12. NORMA
13. LANDORA
14. FLA MENSPIEL
15. INTERFLORA
16. ASTINI



1



2



3



4



5



6



7



8



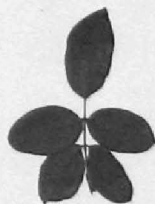
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10



11



12



13



14



15



16

**Plate B: Rose cultivars showing flower colour**

1. RED MASTERPIECE
2. FRAGRANT HOUR
3. AKEBONO
4. REBEL
5. ANNE BURDA
6. CHI TRANGINI
7. BULL'S RED
8. JOUVENCKLER
9. LEGACY JUBILER
10. SUMMER DAYS

**Plate F: Rose cultivars showing flower colour**

11. PARADISE
12. INTERFLORA
13. AQUARIUS
14. FOLKLORE
15. VASAVI
16. A' BASSADOR
17. LANCOME
18. TAPTI
19. ANGELUS
20. FIRST PRIZE

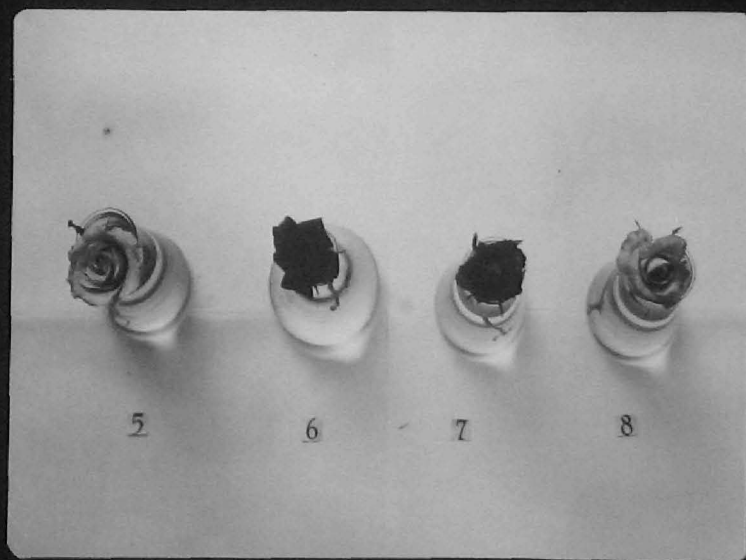
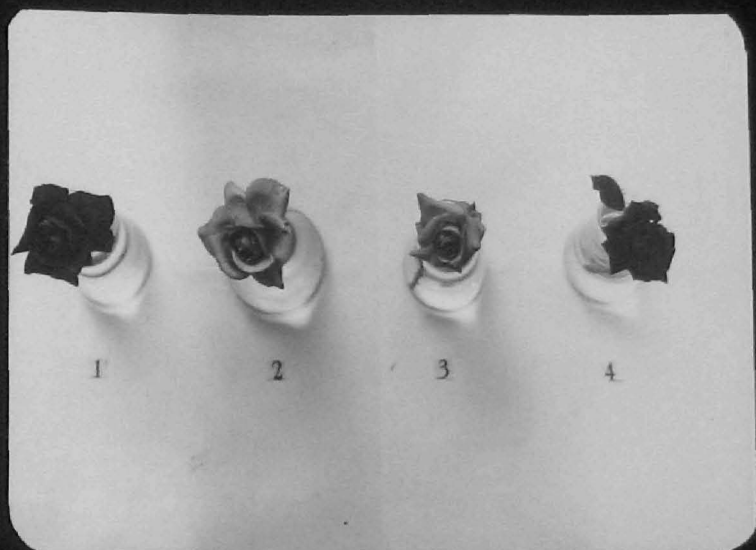


**Plate G: Flower bud shape and size in the rose cultivars:**

1. **NOR 4A**
2. **FRAGRANT HOUR**
3. **FOLKLORE**
4. **DEEP SECRET**

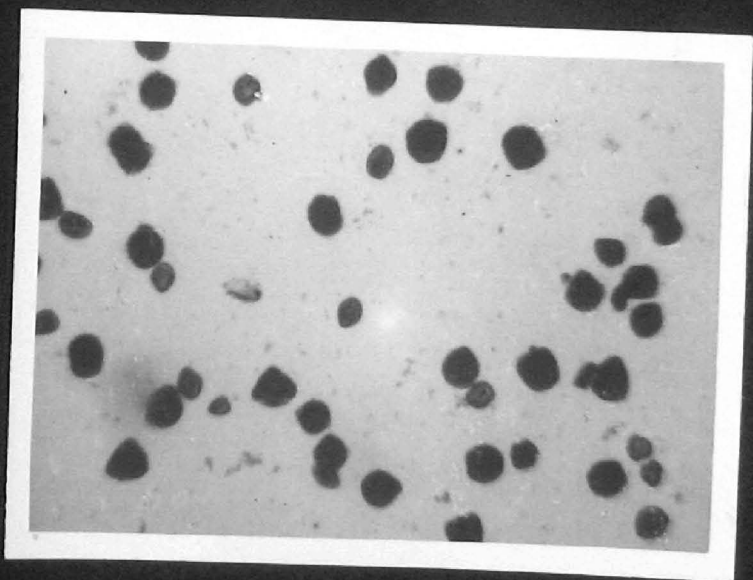
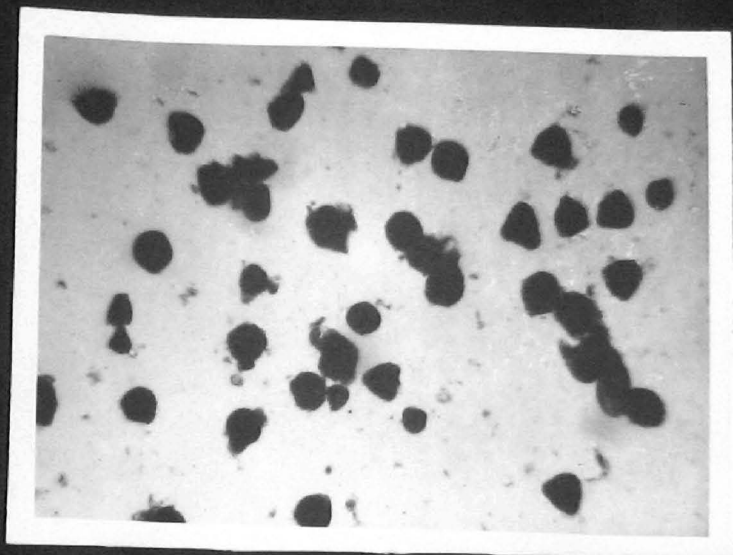
**Plate H: Flower bud shape and size in the rose cultivars:**

5. **LOLITA**
6. **JOHN WATERER**
7. **BULL'S RED**
8. **FLAMENSPIEL**



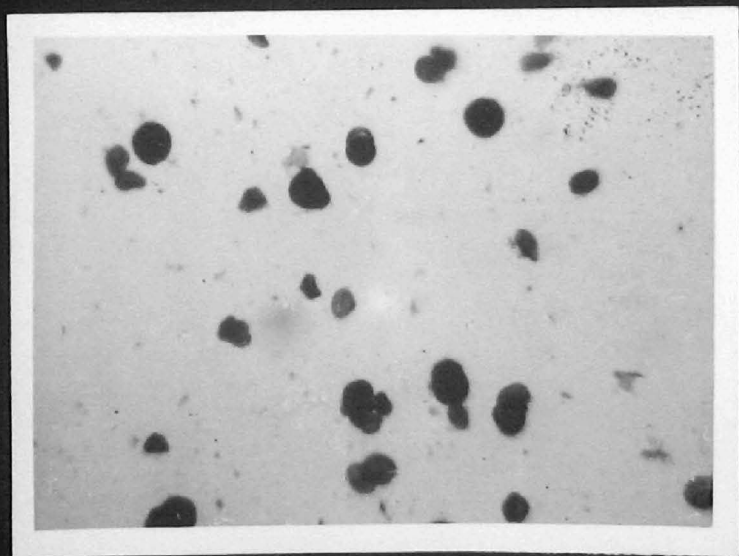
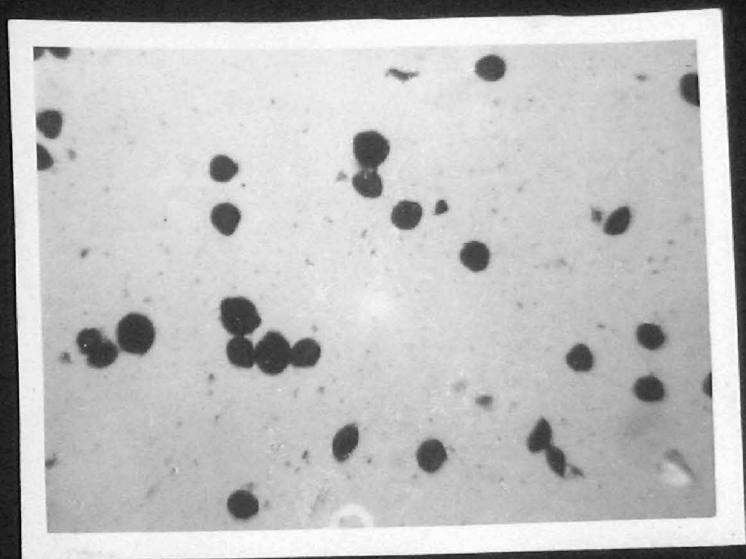
**Plate K: Rose cv 'Ferry Porsche' showing very  
high pollen fertility status**

**Plate L: Rose cv 'Anne Burda' showing moderately high  
pollen fertility status**



**Plate #** Rose cv 'Careless Love' showing moderate  
pollen fertility status

**Plate N:** Rose cv 'Summer Days' showing moderately low  
pollen fertility status



## **DISCUSSION**

## V. DISCUSSION

As far as the present day garden roses of the world are concerned, only eight species have played an important ancestral role, though seven or eight more have also been concerned in a very minor way. An outstanding event in the rose world was the origin of the Hybrid Tea roses. In these, attempts were made to combine the virtues of the Teas and the Hybrid Perpetuals. The first Hybrid Tea rose is considered to be 'La France', raised by the French rose breeder Guillot, and introduced in 1867. Later, the Hybrid Teas were crossed among themselves and also with some other types such as Fernetians with the result that the present day Hybrid Teas are quite a complex group (Pal, 1972). The 50 cultivars under the present investigation were grouped under the Hybrid Tea Class. Majority of the cultivars under investigation were of recent origin, released during the year 1970-1979 except cvs 'Careless Love' (1955) and 'Silva' (1964) (Table 1). Most of the cultivars were of exotic origin except 9 cultivars namely, 'Ambika', 'Aswini', 'Chitrangini', 'Kalpana', 'Kanva', 'Tapti', 'Vasavi', 'Ghasal' and 'Gulzar' which are of Indian origin. The detailed morphological aspects are discussed along with the available literature in the following pages.

### 5.1. Morphological studies

#### 5.1.1. Growth habit

The study of growth habit of different rose cultivars

revealed that except 'Careless Love', others had erect habit. It was also observed that cvs 'Ambassador', 'Bull's Red', 'Canary', 'Carmine', 'Flammenspiel', 'Folklore', 'Kalpana', 'Kentucky Derby', 'Legacy Jubilee' and 'Yankee Doodle' were more vigorous and bushy than the other cultivars. Swarup *et al.* (1973b) described 'Gulzar' as vigorous compact and bushy cultivar. However, in the present investigation it was found to have moderate growth habit. Similarly, Messayon (1981) reported that the cvs 'Doris Tystermann', 'John Waterer', 'Lolita', 'Miss Karp' and 'Precious Platinum' were vigorous and 'Adolf Horatmann' had very vigorous growth under England conditions. These cultivars were found to have moderate growth in our conditions. Pal (1972) mentioned that the conditions under which roses are cultivated in temperate countries differ very much from those prevailing in greater part of India and it is perhaps only in the hill stations and high valleys that the experience gained abroad can be directly utilized. This variation in the growth habit perhaps seems to be due to environmental conditions, varietal character and age of the plant.

With regards to the average plant height, it was observed that the extent of variation was very significant. The cultivars 'Red Planet' and 'Jouvencelle' had minimum plant height measuring 58.80 cm and 59.22 cm, respectively,

whereas the cvs 'Flamenspiel' and 'Lexacy Jubilee' had maximum height of 158.20 cm and 150.71 cm, respectively. This variation in the plant height almost supports the observations made by Beckett (1984) that the plant height of hybrid tea bushes range from about 60.0 cm to 150.0 cm. Although, most of the cultivars had moderate height ranging between 60.00 cm and 100.00 cm (Table 2), it was observed that the cvs 'Ambassador', 'Anne Burda', 'Bull's Red', 'Canary', 'Tilona', 'Kalpana', 'Kentucky Derby' and 'Yankee Doodle' were tall, and 'Caracasia' and 'Folkloro' were very tall. Lundstad (1979a) had observed variation in the plant height of hybrid tea roses wherein the cultivar 'Kleopatra' and 'Red Queen' had minimum (31 cm) and maximum (85 cm) heights, respectively. Haenchen (1981a) working on 53 hybrid teas observed that the plant height ranged from 42.0 cm to 98.0 cm at the first peak flowering and from 51.0 cm to 146.0 cm at the second peak flowering indicating that the plant height also varied from season to season.

#### 5.1.2. Stem and thorn

Variation in the colour of the stem in different rose cultivars was not considerable. It was observed that in most of the cultivars the colour of the young stem was either light green with reddish brown tinge or light reddish brown with green tinge. However, in cvs 'Ambassador',

'Angelus', 'Careless Love', 'Chitrangini', 'Ghazal', 'Interflora', 'John Waterer', 'Kanva', 'Panorama Holiday' and 'Red Masterpiece', the young stem was dark brownish red (Table 7). Interestingly it was observed that in cv 'Ambassador' the dark brownish red colour persisted even in the matured stem. Kuppaswamy and Sampath (1956, 1957) also found slight variation in the colour of tender shoots and matured stem among the 77 rose cultivars studied at Coonoor.

Most of the cultivars were moderately thorny and the number of thorns ranged between 1.00 and 5.00 per cm length of the stem (Table 2). However, the cv 'Akebono' had the lowest (0.61) number of thorns per cm and on the contrary the cv 'Rebel' was very much thorny with as many as 18.41 thorns per cm. The cvs 'Ambassador', 'Careless Love' and 'Silva' had very less number of thorns, whereas 'Ambika', 'Flammenspiel', 'Norma' and 'Vicky' were highly thorny. Svejda (1978) and Hemenluk (1979) also observed variation in the cultivars with regards to the density of thorniness. Gowda et al. (1979) while evaluating eight hybrid tea rose cultivars for out flower purpose, observed variation in the density of thorniness wherein the cvs 'Mainauperie' and 'Pink Parfait' had maximum (6.25) and minimum (2.25) number of thorns per 2.5 cm stem length, respectively. With regards to the size of the thorns, it was observed that

31 cultivars had big sized, 14 with medium sized, 1 with small sized and 4 had all different sizes of thorns. From outside appearance 'Ambika' looks more thorny (Plate A, 2) because of the prominent big sized thorns. But cvs 'Rebel', 'Norma' and 'Vicky' had medium sized thorns with numerous small ones intermingled with each other. Interestingly, the cvs 'Adolf Horstmann', 'Chitrangini', 'Flammenspiel' and 'John Waterer' had all the three sized thorns and 'Ghasal' was quite prominent with only small sized thorns. Kuppaswamy and Sampath (1956, 1957) also noticed variation in the size of thorns. This variation in the density and size of the thorns seems to be due to the varietal character.

### 5.1.3. Leaf

Hessayon (1981) stated that a typical rose leaf has a smooth surface and is made up of three or five or seven leaflets. In the present study, it was observed that there was clear cut variation in the foliage characteristics. The colour of the young foliage was ranging from dark brownish red to light green with reddish brown tinge (Table 7). Hessayon (1981) observed that young foliage in some rose cultivars was distinctly purplish or crimson and in Rosa rubrifolia and 'Buff Beauty' this red colouration also persisted in mature leaves. The colour of the matured leaves in the present investigation revealed that 21 of the 50 cultivars had dark green, 15 with green, 10 with dark

bluish green and 4 with light green leaves (Table 7). Goldstein and Rowler (1975) observed that the colour of the matured foliage was dark green in 'Adolf Horstmann', 'Bull's Red', 'Flammenspiel' and 'Yankee Doodle'. However, Hessayon (1981) observed that the colour of the matured leaves was medium green in 'Adolf Horstmann'. Further, he reported that the matured leaves were medium green in 'Precious Platinum', bronze tinted in 'Doris Tystemann' and dark green in 'John Waterer', 'Lolita' and 'Miss Harp'. Hessayon (1981) stated that nearly all mature rose leaves are green, varying from insipid pale green of 'Fred Loads' to the very dark green of 'Cornelia'. Sometimes, the varieties have green foliage which is bronze tinted giving the leaves a coppery sheen and the leaves of the Alba group were grey-green with a bluish tinge. The colour of the young and matured foliage has been described by Kuppuswamy and Sampath (1956, 1957) in 77 rose cultivars growing at Coonoor, and they observed variation in the colours. Similarly, Svejda (1978) observed variation in the colour of young and matured leaves in 4 cultivars of roses which were grown in Canada.

The leaf area was determined by using leaf area meter. The rose cultivars have generally 3 to 7 leaflets of varying sizes, therefore, to get total area of the leaf in individual cultivars this procedure was adopted so that there will be minimum error. It was observed that there was

considerable variation with regard to leaf area in different roses. The minimum leaf area was recorded in 'Ghasal' (29.11 sq. cm) and the maximum was recorded in the cvs 'Flammenspiel' (88.25 sq. cm) and 'Folklore' (84.66 sq. cm). In the remaining cultivars it was ranging from 33.10sq. cm to 77.06 sq. cm (Table 2). Semeniuk (1979) while studying the disease resistance breeding, recorded the leaflet size in three cvs 'Spotless Gold', 'Spotless Yellow' and 'Spotless Pink' and observed that there was not much variation in the leaflet size. However, Svejda (1978) noticed slight variation in the leaflet size of the four shrub roses. 'Bonavista' had minimum sized leaflets with maximum sized leaflets measuring 5.00 cm to 6.00 cm long.

There was noticeable variation in the leaf shape of different rose cultivars under the present investigation. The leaf shape was elliptical in 22 cultivars and narrowly elliptical in 17 cultivars (Table 7). However, 'Akobono', 'Flammenspiel' and 'Pratrant Hour' varied from other cultivars by their broadly elliptical leaves. In 'Ambika' and 'Tapti' the shape was distinctly ovate to slightly obovate, whereas in 'Angelus', 'Ilona', 'Precious Platinum', 'Uliva' and 'Vicky', it was ovate to elliptical and 'Jouvencelle' was quite distinct with broadly elliptical to ovate leaves.

It was observed that there was not much variation in the margin of the leaves. The leaf margin was either

serrate, double serrate or serrulate in all the cultivars. The leaf tip was found to be acute in 25 cultivars and acuminate in other 25 cultivars and the leaf base was obtuse in 36 cultivars and obtuse to truncate in 14 cultivars (Table 7). The leaf texture slightly varied in these cultivars. Although 27 of the 50 cultivars had thin and smooth textured leaves, in 18 cultivars the leaves were leathery in texture and in 5 cultivars the texture was thin but coarse. The cultivars which had distinctly glossy and shiny leaves were 'Angelus', 'Arizona', 'Interflora', 'Kalpana', 'Legacy Jubilee', 'Silva', 'Summer Days' and 'Yankee Doodle' (Table 7). Messayon (1981) also stated that a typical rose leaf had a smooth surface, but the shininess of the surface varied greatly. Some were highly polished as if they had been recently treated with oil -- others were distinctly dull. Many varieties had leaves between these two extremes. Further, he mentioned that the surface of the foliage was not always smooth. The Rumex group of shrubs had leaves which were deeply ribbed (rumex) giving them a characteristically wrinkled effect. He described the surface quality of the leaves in the rose 'Miss Warr' and 'Precious Platinum' as glossy, in 'John Waterer' and 'Lolita' as matt and of 'Adolf Horstmann' as semiglossy.

#### 5.1.4. Floral studies

##### 5.1.4.1. Flower bud

In the present study of the 50 rose cultivars with

regard to flower characters, it was invariably observed that these had shown remarkable variations.

The size of the flower bud in the different rose cultivars varied from large, medium to small. There was also variation in the flower bud shape which ranged from bold to pointed. The colour of the bud in the cultivars differed to a wide extent. Most of the cultivars belonged to the red colour group, though there was slight variation among these in the intensity of colour. The cvs 'Anne Burda', 'Bull's Red', 'Caramia', 'Deep Secret', 'Ferry Porsche', 'Gulzar', 'John Waterer', 'Kalpana', 'Kentucky Derby', 'Precious Platinum', 'Red masterpiece', 'Red Planet' and 'Vagavi' had dark red flower bud colour. In the cvs 'Aquarius', 'Fragrant Hour', 'Kanva' and 'Lancome', the colour ranged from geranium lake to purple. The flower buds in 'Angelus' and 'Interflora' differed from other red coloured buds by their turkey red and brick red colours, respectively. Similarly, the bud colour was very distinct in 'Careless Love' with fuchsia purple and prominent white streaks and in 'Paradise' with phlox purple and spiraea red tip and edges. Significant among the yellow flower buds were cvs 'Adolf Horstmann', 'Akebono', 'Canary', 'Chitranjali', 'Ladora', 'Miss Harp' and 'Yankee Doodle'. The cvs 'Ivory Tower' and 'Summer Days' were the only with chartreuse green buds (Table 8). The flower bud size generally depends on the number of buds present on the shoots. To get large

specimen blooms for exhibition, garden display or indoor flower arrangement, disbudding is a common practice. Disbudding process involves nipping of side buds, allowing the stronger terminal bud to develop to its maximum size. However, in the present study, the disbudding process was not adopted in any of the cultivars. All these cultivars were grown in similar conditions. Therefore, the variation in size of the flower bud is attributed to the individual varietal characters.

#### 5.1.4.2. Flower

The present investigation showed that there was very wide range of variability in the flower characters. According to Pal (1972), the form of the flower denotes the shape of the bloom or the outer contour of the flower. Hossain (1981) mentioned that a typical hybrid tea bush has a long, pointed bud which opens to reveal many velvety or satin like petals, neatly reflexed and regularly arranged to form a high central cone. In the present study, it was observed that the flower shape was split-centred in 27 cultivars and high centred in 12 cultivars. Interestingly, the flowers were blown shaped in 'Carmelia', 'Chitrangini', 'Landra', 'Miss Harp' and 'Silva', cannella shaped in 'Careless Love' and 'Tapti', open cupped shaped in 'Ferry Porsche' and 'Yankee Doodle', flat shaped in 'Ghazal' and quartered shaped in 'Kalpana'. Pal (1972) also observed that the flower shape was high centred in 'Akebono', 'First

'Prize' and 'Jouvencelle' and Camellia shaped in 'Careless Love'. However, this variation in the flower shape may be due to the number of petals in the flower. According to Pal (1972) the flower at its most perfect phase of beauty will be generally from one-half to three-fourths open, but in certain varieties with fewer petals, this phase may be between the one-third open and the one-half open stages. The best specimen blooms will usually have a sufficient number of petals which are arranged symmetrically in an attractive outline tending towards a high centre. Another notable feature in the cvs 'First Prize', 'Jouvencelle', 'Interflora' and 'Ivory Tower' was that the flower opening was rather slow. The process of slow opening of flowers is generally common with the hybrid tea cultivars grown outside India. Pal (1972) in this context mentioned that the cultivars bred in the cooler regions may not be quite suitable for the hotter regions of the country where roses are exposed to strong sunshine and high temperatures, with the result the flower open quickly. Though roses with a moderate number of petals may be successful in the colder regions, in the warmer regions they are likely to show their centres much too quickly.

Vries et al. (1974) reported that before 1824 rose colours comprised a continuous range from white through

pink to red only. Subsequently pale yellow was introduced by the Stud China variety, 'Parka Yellow Tea scented China'. In 1900, a true break in yellow was realised by Permet-Ducher's introduction of 'Soleil d' Or' an  $F_2$  hybrid between 'Antoine Ducher' and 'Persian Yellow' (*R. foetida* Herma.). Practically all modern yellow roses trace back to 'Soleil d' Or'. Not only species but also mutations contributed to the extension of the colour range. Presently, the rose colours vary in practically every shade from white to yellow, orange and red to mauve, only true blue and black colours are lacking. The present study also revealed that there was wide variation in the flower colours. Most of the cultivars belonged to the red coloured group, although variation in the intensity of colour was noticed. The colour of the flower in 'Anne Burda', 'Asvini', 'Bull's Red', 'Caramia', 'Deep Secret', 'Ferry Porsche', 'Gulsar', 'John Waterer', 'Kalpana', 'Kentucky Derby', 'Norma', 'Precious Platinum', 'Red Masterpiece', 'Red Planet', 'Sophocle' and 'Vauavi' ranged from currant red to deep cardinal red. However, in 'Aquarius', 'First Prize', 'Ghazal', 'Jouvencelle', 'Kanva' and 'Lancom' the colour ranged from neyron rose to rosein purple. The ones 'Panorama Holiday' and 'Tapti' varied to a considerable extent and 'Careless Love' was quite prominent among all the cultivars because of the white streaks and blotches on cyclamen purple coloured petals.

'Angelus', 'Ilona' and 'Interflora' exhibited little variation in colour from other cultivars with their vermilion to scarlet colour range, and 'Rebel' and 'Vicky' varied slightly from others due to their turkey red colours. The cvs 'Arizona' and 'Doris Tysterman' were distinct by their marigold orange and carrot red petals, respectively. The cvs 'Akebono', 'Canary', 'Chitrangini' and 'Paradise' had bicoloured flowers.

Among the cultivars which belonged to the yellow colour group, 'Landora' and 'Miss Harp' differed very slightly from each other. The cultivar 'Adolf Horstmann' and 'Summer Days' were quite distinct from others, for their Shiness yellow and primrose yellow flowers, respectively. The cvs 'Ambassador', 'Anbika', 'Flammenspiel', 'Folklore', 'Fragrant Hour', 'Legacy Jubilee', 'Lolita', 'Silva' and 'Yankee Doodle' had blend of different colours (Table 8). Pal (1972) observed that in the more tropical parts of India some varieties, especially many of those with shades of orange and yellow fail to develop their full colour. Further he stated that success of a variety over a wide range of conditions in the United States did not permit us to predict similar performance in India. The flowering conditions for roses in India are, with the exception of those in some of the hill stations and mountain valleys, extremely different from those in Europe

and America. Differences in temperature and the length of the day are probably responsible for the fact that varieties which provide sheaths of colour over a long period in Europe and America do not seem to perform well in India. However, under Bangalore conditions, their performance is better. The colour of the flower also varies from season to season as reported by Pal (1972) in the cv 'Hehle Meiland' in which the soft pink colour of the flower changed to apricot-orange in another season. Vries *et al.* (1974) mentioned that the basis for the infinite range of colours and shades are mainly the two anthocyanidins (Cyanidin and Pelargonidin), the two flavonols (Quercetin and Kaempferol) and a number of carotenoids. Peonidin is rarely found in garden roses. Glycosides of the anthocyanidins and flavonols and the co-pigmentation of the former with flavonols and several other substances are responsible for innumerable variations in the red colour.

The flower diameter within and between the cultivars varied to some extent. The minimum flower diameter was found to be in cv 'Ghazal' (8.0-8.5 cm) and maximum in the cv 'First Prize' (14.0-14.5 cm). It was observed that 18 of the 50 cultivars had large-sized, 16 with medium to large, 10 with large to very large, 3 with medium and 2 with medium to very large sized flowers (Table 3). Hensayon

(1981) also described the flower size in 'Adolf Herbstmann', 'John Waterer' and 'Jouvencelle' to be large and in 'Doris Tysterman' and 'Precious Platinum' to be medium. However, he reported that the flower size was medium in 'Lolita' and 'Miss Hagg'. These cultivars were found to have comparatively large sized flowers in our conditions. Swarup *et al.* (1973b) observed that flower size was large in 'Gulsar', although under our conditions it was found to have medium size.

The number of petals per flower also varied to a great extent in these cultivars. Hessayon (1981) on the basis of number of petals formed five categories of flower types, namely, single (less than 8 petals), semi-double (8-20), moderately fully double (21-29), fully double (30-39) and very fully double (40 and above). On the similar pattern the flower types were categorised in the present evaluation taking into consideration the upper and lower limits in each cultivar. None of the cultivars were observed to have single flowers. However, 'Careless Love' and 'Ghazal' had minimum 8-18 and 12-17 number of petals, respectively. In 4 cultivars, the flowers were moderately fully double with 23 to 28 petals, fully double in 'Rebel' with 35-38 petals, very fully double in 16 cultivars with 40-92 petals, moderately fully double to fully double in 9 cultivars with 24 to 40 petals, fully double to very fully double in 13 cultivars with 30 to 40 or above petals.

semidouble to fully double in 'First Prize' and moderately fully double to fully double in 'Silva'. The cv 'Aswini' was distinct with maximum number of petals ranging between 122-153. The range in number of petals was found quite large in 'Kalpana' and 'Kanva'. 'Aswini', 'Norma' and 'Silva' exhibited a wide range of variability within the cultivars, whereas 'Flammenspiel' and 'Red Masterpiece' showed minimum variation (Table 4). Hessayon (1981) observed that the cv 'John Waterer' had very fully double and 'Lolita' had fully double flowers, however, the flowers in 'Adolf Horstmann' were moderately fully double, in 'Doris Tystermann' and 'Precious Platinum' fully double and in 'Miss Harp' very fully double. This variation in the number of petals seems to be due to varietal character.

The variation observed in the petal shape was very slight. All the cultivars were observed to have obovate petals, however in 12 cultivars the shape was obovate to oval. Further in 24 cultivars the petals were slightly acute, in 15 cultivars they were plain and in 11 acute. The petals were reflexed in 14 cultivars, slightly reflexed in 8 cultivars and incurved in 3 cultivars, namely, 'Careless Love', 'Tapti' and 'Yankee Doodle' (Table 4). Pal (1972) observed that the petals were incurved in 'Careless Love'. Hessayon (1981) mentioned that the petals of many roses are plain, but those of hybrid tea and some

floribundas are generally reflexed. A feature of few roses is a wavy or ruffled edge to the petals as in 'Just Joey' and in the 'Grantendorst' varieties the petals have a carnation like frilled edges.

The petal size varied from cultivar to cultivar. The cvs 'Doris Tystermann' and 'Miss Harp' had minimum (3.38 cm) and maximum (7.28 cm) average length, respectively, whereas 'Kalpana' and 'First Prize' had minimum (2.84 cm) and maximum (7.37 cm) average breadth, respectively. The petal size was small in 'Kalpana' (3.94 cm x 2.84 cm) 'Doris Tystermann' (3.38 cm x 3.62 cm) and 'Adolf Horstmann' (3.96 cm x 3.46 cm), whereas it was very large in 'Ivory Tower' (7.26 cm x 7.12 cm), 'First Prize' (6.92 cm x 7.37 cm) and 'Miss Harp' (7.28 cm x 5.86 cm). In rest of the cultivars the petal size was moderate to moderately large with petal length ranging between 4.34 cm to 6.88 cm and petal breadth ranging between 4.14 cm to 6.92 cm (Table 4). Gowda *et al.* (1979) observed highly significant differences in respect of petal length and breadth. Highest petal length was recorded in 'Pink Parafault' (5.6 cm) and lowest in 'Black Ruby' (4.13 cm). 'Oklahoma' had the maximum petal breadth (5.35 cm) and 'Black Ruby' had minimum (3.73 cm).

The fragrance of the rose flowers in the present study varied to a considerable extent. Of the 50 cultivars, 15 cultivars were found to have slightly fragrant flowers, 14 cultivars were with moderately fragrant flowers and

the cv 'Fragrant Hour' was most outstanding with highly fragrant flowers. In all other cultivars the flowers lacked fragrance (Table 3). Messayon (1981) reported that the flowers were slightly fragrant in 'Doris Tystermann' and 'John Waterer' and fragrant in 'Lolita'. However, he noticed that the cvs 'Adolf Horstmann', 'Miss Harp' and 'Precious Platinum' had fragrant flowers. In the present study it was observed that the flowers in these 3 cultivars lacked fragrance. Messayon (1981) opined that the variation in the fragrance of the flowers seems mainly due to stage of growth of plant and weather conditions, as he observed that some roses are most fragrant in early flower and others when fully open. Similarly the warmth and high air humidity enhance fragrance.

#### 5.1.4.3. Stalk length

The average stalk length measured in the 50 rose cultivars had shown considerable variations. The maximum stalk length was recorded in 'Ambassador' (85.67 cm) and the minimum was in 'Ohasal' (36.00 cm). In the cvs 'Yankee Doodle' (81.33 cm), 'Bull's Red' (79.50 cm) and 'Interflora' (77.17 cm) the stalk length was very good, however, in 'Vicky' (36.20 cm), 'Kanva' (37.20 cm) and 'Lolita' (39.00 cm) it was very poor. The stalk length was found to be moderate in 21 cultivars, ranging between 50.00 cm to 70.00 cm, moderately less in 14 cultivars ranging between 45 cm to 50 cm and poor in 4 cultivars

ranging between 40.00 cm to 45.00 cm. In 'Angelus', 'Flammenapfel' and 'Red Masterpiece' it was good ranging between 70.00 cm to 75.00 cm (Table 3). Kaanehan (1981b) while assessing 54 rose cultivars grown outdoor for cut flowers, observed that the longest average stem length was with 'Bonjour' and 'Rakete', 46.7 cm and 49.0 cm, respectively and the shortest with 'Dulsberg' and 'Marcelle Gret', 18.1 cm and 19.0 cm, respectively. This variation in the stalk length seems to be due to level of pruning as Mesnayan (1981) observed that hard pruning of hybrid tea newly planted roses and moderate pruning in the established roses stimulates the sturdy fresh shoots from close to the base of the bush. Pal (1972) stated that pruning facilitates in regulating the size and shape of the plant and stimulates the plant to produce new vigorous growth capable of giving better status and flowers.

### 5.2. Pollen fertility

The percentage of pollen fertility estimated by using versatile stain suggested by Alexander (1980) differs very widely from cultivar to cultivar. The average pollen fertility was highest in 'Ferry Porsche' (82.49%) and was very low in 'Yankee Doodle' (6.39%), 'Adolf Horstmann' (7.66%) and 'Ivory Tower' (8.96%). It was observed that in 16 cultivars pollen fertility percentage was moderate, ranging between 30.0 and 45.00, in 13 moderately low ranging between 15.0 to 30.0, in 5 low

ranging between 10.0 to 15.0 and in 10 it was moderately high ranging between 45.0 to 60.0. The cultivars 'Gulsar' and 'First Prize' had quite high percentage of pollen fertility (Table 5).

Another interesting observation made was, the fertility percentage when estimated by Acetocarmine stain, varied to a considerable extent when compared to versatile stain. Although the fertility percentage estimated by both the stain differed slightly within 24 cultivars, there was moderate variation within 8 cultivars and large variation within 6 cultivars studied (Table 5). Though the variation within other 6 cultivars in the pollen fertility percentage was slight and moderate in 'Miss Harp', there was decrease in the pollen fertility percentage when estimated by both the stains. The cvs 'Akebono', 'Chitrangini', 'Fragrant Hour' and 'Vasavi' had shown least difference and on the contrary 'First Prize' had shown maximum variation (Table 5). Alexander (1980) opined that the acetocarmine stain has certain limitations since it stains only nonaborted pollen, while the aborted pollen is identified by the unstained and empty pollen walls. The dry acetocarmine is not effective for the pollen of most of the plants belonging to families, which have thick and impervious nature of their pollen walls. Oberlo and Watson (1953) opined that the procedure involved in vital staining is time consuming, complicated and not always reliable. The versatile stain suggested by Alexander (1980)

overcomes all these problems and gives a clear differentiation between nonaborted and aborted pollen grains. The non-aborted pollen grains take orinason red stain and the aborted ones take green stain. Gowda *et al.* (1977) observed that the pollen fertility percentage was as high as 56.76 in 'White Christmas' and as low as 12.29 in 'Super Star'. Swarup *et al.* (1973) mentioned that roses are complex hybrids involving interspecific hybridisation, polyploidy (triploid, tetraploid and aneuploid) with high female and male sterility. Sahare and Shastry (1963) opined that high pollen sterility exists in most of the garden roses and observed that the pollen sterility percentage in the hybrid tea roses varied from 10 ('Kna Harkness' and 'General Arthur') to 98 ('Kaiserin Auguste Victoria').

### 5.3. Disease

Roses are attacked by several diseases, some of them can be very destructive. Except for a few cases where the causal agent may be a virus, bacteria or nematode. Most of the diseases in roses are incited by fungi. In India, about 26 fungi have been listed by Pal (1972). Of these diseases, two namely, black spot and powdery mildew were found to be of common occurrence on a large scale in Bangalore conditions. Therefore, in the present investigation, 50 rose cultivars were evaluated for their tolerance to these two diseases.

### 5.3.1. Black Spot (Diplocarpon rosae)

Thomas (1970) described black spot, a fungal disease caused by Diplocarpon rosae. The disease is apparent only on mature leaves and stems. Black or brown spots appear on the foliage. Then the remainder of each leaflet turns yellow, and it soon drops. The black spot infestation reach their maximum in mid or late summer and are much worse in some years than in others. Hocwayon (1981) observed that these black spots have yellow fringed margins and the heavy infestations spread to leaf buds and later to stems which die back. It is encouraged by potash shortage and warm wet weather in summer. Pal (1972) mentioned that this is a widely distributed disease in India also. The spots are sometimes as big as a centimeter in diameter and the fungus is said to produce ethylene gas, which causes premature defoliation. In the present study, it was observed that 27 cultivars were highly susceptible, 20 moderately susceptible and 3 susceptible to black spot (Table 6). Resistance to black spot was not observed in any of the cultivars. Pal (1972) stated that there are hardly any varieties which are known to be completely resistant to black spot and had given a list of fairly resistant varieties. Gemeniuk (1979) for the first time reported on evidence of black spot resistance in roses. The new cultivars were selected from an  $F_2$  population derived from crosses between a tetraploid form of the black spot resistant R. rugosa and the commercial cultivars 'Goldilocks' and 'Ohio'. These

new cultivars were 'Spotless Gold', 'Spotless Yellow' and 'Spotless Pink'. Haenchen (1980) reported that of the 53 hybrid tea roses studied only 2 ('Apollo' and 'Desert') were resistant to black spot.

### 5.3.2. Powdery mildew (*Sphaerotheca pannosa*)

Powdery mildew, caused by the fungus *Sphaerotheca pannosa*, is a very common rose disease, mostly seen on young growth. White mealy powder is found on young leaves of current year of growth and curling of leaves occur. The fungus appears whenever the days are warm and the nights are cool. Dry conditions favour these variations in temperature, so the powdery mildew is seen most commonly in dry weather (Thomas, 1970; Khokher and Gupta, 1977). This disease can be severe during years of scanty rainfall. Young growing tips got completely covered by the mildew and quite frequently infected buds do not open. The petals may become discoloured, dwarfed and finally die.

The present study revealed that 34 of the 50 cultivars were tolerant, 7 were susceptible, 7 were moderately susceptible and 2 were highly susceptible to the powdery mildew (Table 6). Deshpande (1979) noticed a severe outbreak of powdery mildew at Parbhani, Maharashtra and observed that out of 54 varieties, 40 showed resistance, 4 were moderately resistant, 3 moderately susceptible and 4 highly susceptible. The cultivars 'Aquarius', 'Careless Love' and 'Landra' were found to be resistant.

These cultivars were found to be tolerant under Bangalore conditions also. Haerchen (1980) reported that out of 153 rose varieties studied belonging to different classes the hybrid tea cultivars 'Ballet' and 'Ovation' were resistant to powdery mildew. The variation in the disease tolerance capacity seems mainly due to environmental and varietal factors. Pal (1972) mentioned that a variety deemed to be resistant in one place may be found susceptible in another.

The rose is widely used for different purposes like garden display, exhibition and cut flowers. On the basis of the evaluation of the 50 rose cultivars, some of them are found to be suitable for different purposes.

#### For garden display

Ambassador (Welland, 1978): Free flowering with big pointed nectarium red buds opening into almost high centred, large double flowers which have blend of soft rose and mandarin red. The flowers are slightly fragrant and stay for a longer time on the plant. Vigorous, bushy with long upright stems and less thorny. Good disease tolerance.

Angelus (Gaujard, 1976): Very free flowering with shapely scarlet flushed with turkey red flowers borne in trusses and moderately fragrant. The flower colour is unfading and the foliage is very attractive and shiny. Good disease tolerance.

Canary (Tantau, 1976): One of the most beautiful bicoloured cultivar, free flowering. The large canary yellow flowers are flushed with venetian pink and are moderately fragrant. Vigorous, dense and less thorny. Good disease tolerance.

Careless Love (Conklin, 1955): One of the most striking and unusual roses, predominantly pink with white streaks and blotches producing number of cecilia like flowers which have mild fragrance. Good disease tolerance.

Deep Secret (Tantau, 1978): One of the most free flowering hybrid teas producing beautifully shaped deepest cardinal red flowers which appear almost black and have satiny petals. The foliage is shiny and attractive.

Fragrant Hour (Gredy, 1973): Free flowering with large pointed crimson buds opening into large to very large enchanting selfering purple flowers which are highly fragrant. Good disease tolerance.

Jouvencelle (Gaujard, 1970): Large, magnificent, very shapely blooms of fully double size which are high centred and have rose pink colour. The flowers stay for a longer time. Less thorny and very free flowering.

Paradise (Weeks, 1979): One of the most beautiful bicoloured hybrid teas. It has very shapely flower buds and flowers. Very free flowering having phlox purple

petals with spiraea red towards the edges. Long lasting flowers with glossy, attractive foliage.

Summer Day (Bees, 1977): Free flowering.

Outstanding yellow, very shapely and high centred flowers which are moderately fragrant. Foliage is dark green and glossy.

For exhibition purpose

Akebono (Kawai, 1975): Large, high centred beautifully shaped bicoloured flowers are canary yellow flushed with spiraea red edges with moderate fragrance.

Aquarius (Armstrong, 1977): Long shapely spiral red buds open into very beautifully shaped spiraea red flowers flushed with tyrian purple edges.

First Prize (Noorner, 1970): One of the most beautiful classic hybrid teas. Although has certain limitations under Bangalore conditions, has extra large perfect blooms which open very slowly. Good disease tolerance.

Jouvencelle (Gaujard, 1970): Large, magnificent, very shapely blooms of fully double size which are high centred and have rose pink colour. The flowers stay for a longer time. Less thorny and very free flowering.

Paradise (Weeks, 1979): One of the most beautiful bicoloured hybrid teas. It has very shapely flower buds and

flowers. Very free flowering having phlox purple petals with spiraea red towards the edges. Long lasting flowers with glossy, attractive foliage.

Red Masterpiece (Warriner, J & P, 1974): Large cardinal red perfectly formed flowers are moderately fragrant and last for a longer time.

Yankee Doodle (Kordes, 1974): Beautiful blooms, outstanding with blend of poppy red and salmon has thick, shiny petals. The flower is moderately fragrant and stays for a longer time.

For cut flower purpose

Ambassador (Weiland, 1978): Free flowering with big pointed nasturtium red buds opening into almost high centred, large double flowers which have blend of delft rose and mandarin red. The flowers are slightly fragrant and stay for a longer time on the plant. Vigorous, bushy with long upright stems and less thorny. Good disease tolerance.

Arizona (Weeks, 1975): Very shapely, high centred, marigold orange flowers flushed with jasper red at edges. Large, double blooms have moderate fragrance. Foliage dark green and very glossy.

Bull's Red (McGrady, 1977): A superb cut flower variety, which lasts for very long time. Dark red petals

are velvety, very free flowering with medium, shapely and slightly fragrant flowers. The stalk length is very good.

Perry Porridge (Kordes, 1971): Large, open cupped, double, cardinal red flowers last for very long time.

Illona (Verbeek, 1977): Internationally popular for cut flowers. Deep cardinal red buds open into vermilion, very shapely, medium and double flowers.

Interflora (Welland, 1970): Pointed, shapely, brick red buds slowly open to reveal vermilion flowers which has pink tinted edges. The flowers are moderately fragrant and have very good stalk length.

Yasawi (Kasturi Rangan, 1976): Brilliant tyrian purple medium flowers which are long lasting and very shapely.

## **SUMMARY**

## VI. SUMMARY

The present investigation was carried out to study and compare the extent of variability in morphological characteristics involving both vegetative and floral characters, pollen fertility status and disease tolerance in 50 rose cultivars. Majority of the cultivars under investigation were of recent origin, released during the year 1970 to 1979 except 'Careless Love' and 'Silva'. Most of the cultivars were of exotic origin and only nine were of Indian origin.

The study of growth habit of different rose cultivars revealed that all the cultivars except 'Careless Love' had erect habit. It was observed that there was variation in the growth habit among the cultivars. Ten cultivars were found to be more vigorous and bushy as compared to the other cultivars. This variation in the growth habit seemed to be due to environmental conditions, varietal characters and age of the plant. Variation in the average plant height was observed to be significant. The cvs 'Red Planet' (58.80 cm) and 'Jouvenelle' (59.22 cm) had minimum plant height and 'Flammenspiel' (158.20 cm) and 'Lacey Jubilee' (150.71 cm) had maximum plant height.

The variation in the colour of the stem was not considerable, however, in the cultivar 'Ambassador' the dark brownish red colour of the young stem was found to persist in the matured stem. Highly significant variation

was observed in the density of thorns in these cultivars. The cv 'Akebono' had lowest (0.61) number of thorns per cm and on the contrary 'Rebel' had as many as 18.41 thorns per cm and 'Ambika', 'Norma' and 'Vicky' were highly thorny. Interestingly, cvs 'Adolf Morstaann', 'Chitrangini', 'Flammenspiel' and 'John Waterer' had all three sized thorns and 'Ghazal' had only small sized thorns.

It was observed that there was clear out variation in the foliage characteristics of these cultivars. The colour of the young foliage ranged from dark brownish red to light green and that of matured foliage ranged from dark bluish green to light green. Considerable variation existed in the average leaf area determined in different rose cultivars. The leaf area was found to be maximum in 'Flammenspiel' (88.25 sq. cm) and 'Folklore' (84.66 sq. cm), and minimum in 'Ghazal' (29.11 sq. cm). There was noticeable variation in the leaf shape of the rose cultivars. The leaf shape was found to be broadly elliptical in cvs 'Akebono', 'Flammenspiel' and 'Farrant Hour' distinctly ovate to slightly obovate in 'Ambika' and 'Tapti' and broadly elliptical to ovate in 'Jouvencelle'. The texture of the leaf exhibited slight variations, and 12 cultivars had distinctly glossy and shiny leaves.

The study of the 50 rose cultivars with regards to the flower characteristics in the present investigation invariably exhibited a wide range of variations. The

flower bud size in different rose cultivars varied from large, medium to small and the flower bud shape ranged from bold to pointed. The flower bud colour in these cultivars exhibited a wide variation. Flower bud colour was red in most of the cultivars. The cvs 'Careless Love', 'Ivory Tower', 'Paradise' and 'Summer Days' were quite distinct by their flower bud colour. The flower shape was observed to range from split centred to high centred in many cultivars. Interestingly, the flower shape was blown in five cultivars, Camellia like in two, open cupped in two and quartered in one. In the cvs 'First Prize', 'Jouvencelle', 'Interflora' and 'Ivory tower' the flower opening was rather slow.

The present study also revealed that the variation in the flower colour was to a large extent. The flower colour in these 50 rose cultivars ranged from yellow to pink and orange to deep red. Most of the cultivars had red coloured flowers, however, in six the flower colour was pink, vermillion in three, yellow in four and blond of colours in nine cultivars. The cvs 'Arizona', 'Careless Love', 'Doris Tjotermann', 'Ivory Tower', 'Panorama Holiday' and 'Tapti' were quite distinct and cvs 'Akebono', 'Canary', 'Chitrangini' and 'Paradise' had bicoloured flowers. The flower diameter within and between the cultivars varied to some extent. The minimum flower diameter was recorded in 'Ghazal' (8.0 cm to 8.5 cm) and maximum in 'First Prize'

(14.0 cm to 14.5 cm). The number of petals also varied to a great extent. The cvs 'Careless Love' and 'Ghasal' had minimum number of petals and the cv 'Aswini' had maximum number of petals. 'Aswini', 'Norma' and 'Silva' exhibited a wide range of variability within the cultivars with regards to the petal number and 'Flammenspiel' and 'Red Masterpiece' showed very slight variation. The petals were incurved in 'Careless Love', 'Tapti' and 'Yankee Doodle'. The size of the petals varied in different roses. The cvs 'Doris Tystermann' and 'Miss Harp' had minimum (3.38 cm) and maximum (7.28 cm), average petal length, respectively, whereas 'Kalpana' and 'First Prize' had minimum (2.84 cm) and maximum (7.37 cm) average petal breadth, respectively. The petal size was small in 'Kalpana', 'Doris Tystermann' and 'Adolf Horstmann' whereas very large in 'Ivory Tower', 'First Prize' and 'Miss Harp'. Of the 50 rose cultivars, 14 were moderately fragrant and the cv 'Fragrant Hour' had highly fragrant flowers. The stalk length too varied widely in these 50 rose cultivars. The cvs 'Ambassador' had maximum (84.67 cm) and 'Ghasal' had minimum (34.00 cm) stalk length.

The percentage of pollen fertility estimated in these cultivars by using versatile stain was found to vary widely. The cv 'erry Porsche' (82.49%) had maximum pollen fertility percentage and cvs 'Yankee Doodle' (6.39%).

'Adolf Horstmann' (7.66%) and 'Ivory Tower' (8.96%) had minimum. An interesting observation made was that the pollen fertility percentage when estimated by acetocarmine stain varied to a considerable extent in many cultivars when compared to the versatile stain. The cvs 'Akebono', 'Chitragini', 'Fragrant Hour' and 'Vanavi' showed least difference and the cv 'First Prize' had shown largest difference between the fertility percentage when estimated by both the stains.

Of the many diseases on roses, black spot and powdery mildew were found to be very common in Bangalore conditions. It was observed that most (27) cultivars were highly susceptible to black spot and 3 were susceptible, whereas most of the cultivars were found to be tolerant to the powdery mildew and a few cultivars were found to be highly susceptible to powdery mildew.

On the basis of results and discussion of the 50 rose cultivars, some of them were described as suitable for different purposes.

#### For garden display

'Ambassador', 'Angelus', 'Canary', 'Careless Love', 'Deep Secret', 'Fragrant Hour', 'Jouvencelle', 'Paradise' and 'Summer days'.

**For exhibition**

'Akebono', 'Aquarius', 'First Prize', 'Jouvencelle',  
'Paradise', 'Red Masterpiece' and 'Yankee Doodle'.

**For cut flower**

'Ambassador', 'Arizona', 'Bull's Red', 'Ferry  
Porsche', 'Illona', 'Interflora' and 'Vasavi'.

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\*Original not seen

## **ANNEXURE**

ANNEXURE

Meteorological data recorded during the experimental period

Month & year	Monthly rainfall (mm)	No. of rainy days in a month	Temperature (°C)		Relative humidity (%)
			Maximum	Minimum	
January 1983	0.0	0	28.3	12.7	57
February 1983	0.0	0	32.7	17.0	49
March 1983	0.0	0	34.6	20.0	47
April 1983	7.0	2	35.2	22.3	59
May 1983	102.6	6	34.5	21.8	61
June 1983	151.0	10	30.7	20.0	67
July 1983	77.0	11	29.8	19.8	68
August 1983	162.9	22	27.8	19.4	75
September 1983	161.1	22	27.3	19.4	79
October 1983	69.6	7	28.3	18.4	76
November 1983	0.0	0	27.8	15.6	65
December 1983	32.4	6	25.7	16.5	71
January 1984	0.0	0	27.0	15.9	63
February 1984	47.7	2	27.7	16.8	62
March 1984	70.1	4	31.2	17.5	51
April 1984	12.3	2	33.0	20.5	57
May 1984	14.2	4	34.5	21.3	55
<b>Total</b>	<b>937.9</b>	<b>98</b>			
<b>Mean</b>	<b>55.17</b>	<b>5.75</b>	<b>30.36</b>	<b>18.52</b>	<b>62.47</b>

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