PROPAGATION STUDIES IN ROSE (*ROSA HYBRIDA*)

By

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MASTER OF SCIENCE

IN

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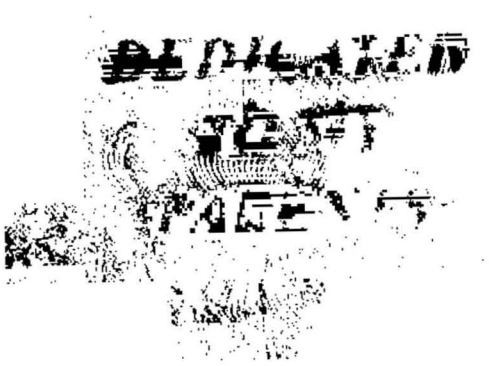

DEDICATED
TO MY
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CERTIFICATE I

This is to certify that this thesis entitled, **"Propagation Studies in Rose (*Rosa hybrida*)"**, submitted to the CCS Haryana Agricultural University, Hisar is a bonafide research work carried out by Mr. Arvind Singh Malik under my supervision and that no part of this has been submitted for any other degree.

The assistance and help received during the course of investigation has been fully acknowledged.

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CERTIFICATE II

This is to certify that this thesis entitled, **"Propagation Studies in Rose (*Rosa hybrida*)"**, submitted by Mr. Arvind Singh Malik to CCS Haryana Agricultural University, Hisar, in partial fulfilment of the requirements for the degree of M.Sc. in the subject of Horticulture has been approved by the Student's Advisory Committee after an oral examination on the same in collaboration with an External Examiner.

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CHAPTER-I

1. INTRODUCTION

Since time immemorial flowers are grown for various purposes such as offering to God, making garlands, bouquets, decoration and preparation of perfumes. Beside this, growing of ornamental plants have prime importance in maintaining ecological balance. From the aesthetic as well as well commercial consideration, flowers are important in India. Flowers and gardens have been very closely associated with the Indian culture from ancient vedic times (Sawrup and Singh, 1984). Owing to beauty, elegance and pleasing fragrance, rose, a member of family Rosaceae is called "Queen of Flowers". No other flower is a better symbol of love, adoration, innocence and other virtues than the rose. It is certainly the best known and most popular of all garden flowers throughout the world and has been growing on the earth for millions of years (Fairbrother, 1965, Gault and Synge, 1971). Rose growing in India developed with the distillation of roses, mentioned in Ayurveda by

Charaka around 100 A.D. The interest of cultivation however, increased considerably mainly during Mughal period and on commercial scale during the last three decades.

The rose, because of its utility, occupies a pre eminent place amongst the flower crops. It's different types having beautiful flower of equisite shape, different sizes, bewitching colour and most delightful fragrance has made it an important flower of its varied uses. Apart from making garland, bouquets, button holes, preserve and their use for worship in temples, rose makes one of the best cut flowers and as such is in great demand in the internal as well as foreign market. Rose oil is an important commercial product obtained from rose petals. Apart from sweet fragrance, it has medicinal property and is used in Ayurveda (Rode and Ogale, 1984). Rose water is another commercial product obtained from rose petals. It is used as perfume and in medicines and confectionary (Narayanswami and Biswas, 1957). Other products made from rose are Gulkand, Pankuri and Gul-Roghan. In Europe, rose are used for making pot-pourri, conserves, rose vinegor and rose petal wine.

Rose is cultivated in India approximately in 3392 hectares but in Haryana, it is being cultivated in 150 hectares (Sindhu, 1990). It is grown on commercial scale in Maharastra, Rajasthan, Karnataka, Tamil Nadu and Uttar Pradesh. Besides, it is grown in Gujrat, Punjab, Madhya Pradesh in limited area. The Netherland is the largest producer and exporter of rose flower

(Swarup, 1989). Federal Republic of Germany has been reported to be biggest consumer and importer of cut flowers (Malik and Dadlani, 1984).

Rose can be propagated by seeds and various vegetative methods like cutting, layering, budding and grafting. Specialist propagators, also use the technique of tissue culture for producing disease free plants in large number. Seed propagation is generally adopted by breeders for developing new cultivars with desirable characters. Propagation of roses by cutting is normally done to raise stocks for grafting or budding. However, this method is also useful and adopted for multiplying vigorous types or cultivars. Climber, Rambler Polyantha and miniature roses respond quite well to this method.

Budding is the most popular and successful method for multiplying roses. It provides larger number of plants than cutting layering or grafting, as a single shoot of the desired scion furnishes a number of buds for budding. Shield or T budding is the method commonly used. On the selected root stocks the buds are inserted into a T shaped incesion and then tied with suitable wrapping material. Raffia, polythene tape, adhesive tape, binding rubber strips are commonly used wrapping material, but strip of plastic film have been found superior to other by several workers (Cornuz, 1955, Volkel, 1964, Kirewa, 1967, Davies *et al.*, 1980). For budding, proper selection of root stock is of imense importance. As root stock are known to import marked effect on the vigour, precosity, productivity, quality of flower, longivity of bushes, disease resistance, adaptability to soil and climatic condition etc. and therefore,

it is necessary to choose the most suitable root stock for budding or grafting roses. The commonly used root stock are Edouard (*R. bruboniana*), *R. multiflora* and *R. indica* var. Odorata. Planting of root stock begins in mid November and is completed in mid December. Budding is done from November to December.

The new method of cuttage buddage is followed to reduce the long period. In this method, cuttings are budded immediately and planted in sand or burnt rice husk for rooting under polythene cover in the month of December or January. It takes about 3-4 weeks for cutting to stike roots and bud to grow. The success of budding depends on the time. Although many workers have suggested different time or season of budding.

Although different budding methods have been tried by various research workers i.e. T. budding, patch budding, chip budding and ring budding but no attempt has been made so far in Haryana to study the response of time and season of budding on bud uptake of rose particularly Hybrid Tea and Floribunda.

Keeping the above aspect in view, the present study was undertaken with the following objective :

To know the optimum time of budding and its effect on bud uptake and effect on growth and flowering.

CHAPTER-II

2. REVIEW OF LITERATURE

In this chapter an attempt has been made to review the work done in India and abroad on effect of root stock, scion variety, time of budding, method of budding on bud success, growth and flowering. Salient features of the work have been discussed in the present chapter.

2.1 Effect of root stock on bud success

Many worker have studied the effect of root stock on bud take. Nanjan *et al.* (1971) obtained 78 per cent bud success on briar cuttings. Rojas (1972) reported 90 per cent bud take on *Rosa multiflora*. Singh (1972-74) found that the bud take was better on *R. bourboniana* and *R. multiflora* than on *R. moschata*, when these were used as root stock for cultivars 'Piccadilly', 'Montezuma' and 'Super Star'.

Sharma (1979) found that bud take percentage was significantly influenced by root stock as well as scion cultivar and reported highest take on *R. indica* which ranged from 70 per cent with cultivar 'Queen Elizabeth' to 100

per cent with 'Montezuma'. The bud take on *R. multiiflora* ranged from 33.3 in 'Himangini' to 75 per cent in 'Veina Charm' and on *R. bourboniana* from 50 per cent in 'Super Star' to 87.5 per cent in 'Delhi Princes'. Nanjan (1979) observed 100 per cent bud take when several rose cultivar were buded on *Rosa multiflora*. Mukhopadhyay *et al.* (1980) obtained a thornless mutant root stock which gave 90 per cent bud take with cv. 'Happiness' as compared with 80 per cent on *R. multiflora* and *R. indica*. Davies and Fann (1983) reported 93 per cent bud take in *R. multiflora*.

2.2 Effect of root stock on growth, flowering and yield

Various workers have observed the effect of root stock on growth and flowering.

Rowley (1955-56) and Lenander (1956) separately reported vigorous growth, early flowering and more number of flowers on *R. multiflora*. McFadden (1956-57) studied the performances of scion of Hybrid Tea cv. Happiness on *R. fortuneana, R. multiflora* and *R. indica* and showed superiority of *R. fortuneana* over the other three root stocks in growth and flowering of scion. Veski (1957) reported that Budding on *R. canina* resulted in higher percentage of bud take than on *R. afzenliana* but the survival was more on later root stock. Van Der Harst (1962) conducted root stock trial and reported *R. multiflora* as the best root stock for plant size and flower production.

Vecera (1967) observed highest yield of roses on root stock *R. coriifolia*

under glass house condition. Swarup and Malik (1974) studied the performance of several rose cultivars on different root stocks and found *R. indica* variety 'Odorata' being superior to other stocks like *R. bourboniana* variety 'Edouard' or *R. bourboniana* variety 'Baramasi' and *R. multiflora* in respect of plant vigour and flower production. Pandey and Sharma (1976) observed *R. multiflora* as superior root stock in respect of bud take, bud sprout, plant vigour and flower production to *R. bourboniana* under North Indian condition.

Singh (1977) studied the performance of 'Charlesmallerin' on four different root stock species and reported *R. marchata* superior in respect of all vegetative characters and flowering. In another study, Singh (1980) studied the effect of root stock on growth and flowering by using three root stock *R. bourboniana,R. moschata* and *R. multiflora* and scion cvs. Piccadilly, Montezuma and Super Star. Maximum girth was obtained on *R. multiflora*. Number of flowers was also influenced root stock. Maximum number of flowers of Piccadilly variety was obtained on *R. moschata* whereas Montezuma budded on *R. multiflora* produced significantly more number of flowers. Flowers on *R. multiflora* were found significantly bigger in size than on *R. bourboniana*.

Thomas (1980) found rose Cv. Rose Pantropica to be successful, compatible root stock for a wide range of Hybrid Tea Cvs. and recorded flowering in 12-24 weeks. Mukhopadhyay (1985) conducted experiments on three root stocks viz., Thornless, *R. multiflora* and *R. indica* and concluded

that maximum number of flowers were obtained on plants budded over thornless followed by plant budded on *R. multiflora*.

2.3 Effect of scion variety on bud take, growth and flowering

Canarache (1966) conducted trial of thirty Hybrid Tea cultivars on *R. canina* rooting for forcing under glass houses and recommended Baccara, Volcano, Monjave and Montezuma as producing the largest number of high quality early blooms. Rupprecht (1968) obtained the best performance of Virgo on *R. canina*. Singh (1972-74) conducted trial on root stock and budding in rose and concluded that bud mortility and bud break were both affected by root stock and scion cultivar and found Piccadilly as superior over Montezuma and Super Star.

Tsvetkov (1973) observed that cultivar Super Orange, Trimph and Fiesta showed best results on *R. canina*. Swarup and Malik (1974) obtained largest number of flowers on Piccadilly which also had biggest size followed by Montezuma.

Meneve and Moerman (1977) reported highest bud take of Floribunda cultivars on *R. dumetorum* but in case of Hybrid Tea cultivars, it was with *R. canina*.

Singh (1980) reported that Piccadilly produced larger flower than Montezuma and Super Star. Sharma (1979) reported 33.3 per cent bud take in Himangini whereas it was 75 per cent in Vienna Charm and Sadabahar when

these cultivar were buded on *R. multiflora*, where bud take was 50 per cent in super star and Dr. Vatois and 87.5 per cent in Delhi Princess when budded on *R. bourboniana*.

Mukhopadhyay (1985) reported that mean length of flower stem and diameter of flower from Happiness significantly better than Queen Elizabeth and Super Star. In an other study, Mukhopadhyay *et al.* (1985) reported that cultivar Happiness, produced largest branches, while Queen Elizabeth produced more number of flower.

Ishtiaq and Khan (1994) studied the performance of different rose cultivars on *R. multiflora* and reported greatest bud take in Smoky (83.33%) followed by Piccadilly (70%). Sprounting after budding was also reported to be greatest in Smoky. Piccadilly plants were tallest (14 cm) followed by Smoky (11.33 cm).

2.4 Effect of method of budding on bud success, growth and flowering

Several budding methods have been found successful in rose. Various workers have successfully tried different methods. Strydon and Van Maanen (1963) obtained 85 per cent saleable rose bushes with in one year by skin budding as compared to about 50 per cent using the well known T-budding.

Nanjan *et al.* (1971) developed a new technique of budding of Hybrid Tea and Floribunda roses, which were budded on *R. multiflora* grown in

polythene bags, 15-20 day after planting of cutting. The mean success in this method was 78 per cent compared with 68 per cent in normal budding method.

Rojas (1972) in a experiment, T-budded cuttings of *R. multiflora* rooted in polythene bag with various rose cultivars the bud success was reported to be more than 90 per cent and first flower appeared with in 8 weeks of budding. Maiti (1974) studied the effect of method of budding on Hybrid Tea and Floribunda roses and reported that chip budding was found more suitable for Hybrid Tea but for Floribunda both methods were found almost equally suitable. Dutt and Bradu (1976) described another new technique to raise budded roses by using rooted root stock suckers.

Ohkawa (1980) studied cutting-grafts as a mean to propagate green house roses using 2-node tonque-grafted on to unrooted root stock cuttings and concluded that cutting-grafts of Sonia on *R. multiflora*, *R. indica* and *R. manetti* produced flowers of same number and quality as when budded on the *R. multiflora* seedling root stock (standard). Kawai (1981) used cold storage budding. Scion buds were stored at 3-5 deg. C. He concluded that all buds gave a good take but those stored for 7 days were easiest to use.

Fann *et al.* (1983) tested the technique of bench chip budding as alternative to T-budding and recorded more than 90 per cent success when Mirandy scions were bench chip budded in rooted Brooks 56 root stocks. In another study Davies and Fann *et al.* (1983) tested the technique of chip budding on to dormant unrooted stock and obtained 93 per cent success.

Nanjan and Kumar (1983) recorded consistently greater success with patch budding than in shield budding in 16 cultivars of rose with mean success of 82.1 per cent in patch budding as compared to 77.8 per cent in shield budding. Singh and Lal (1985) found that treatment of 20 cm long hard wood stem cutting of *R. bourboniana* with 1000 ppm IAA before shield budding resulted in quicker and higher bud break and greater rooting.

2.5 Effect of time of budding on bud success

Robert (1962) observed that early budding results in higher bud take.

Singh (1972-74) reported that bud take was not influenced by the time of budding but bud mortality and bud break both were affected by the time of budding. Budding in April resulted in lower mortality but also less bud break than November budding. Pal (1972) reported that in places of mild climate all the year round, like Banglora, budding can be done almost any time.

Maiti (1974) found that success rate was not influenced by budding date, but plant height and branch number, six month later increased with later budding dates. Bose and Mukherjee (1977) reported that best time of budding is from January to March for Eastern India. Swarup (1980) found December to February as best time for budding in North India.

Nanjan and Kumar (1983) in a 2 year trial found that mean bud take percentage was 80 for the period from January to June, it declined to 52-55.5 per cent in August and September and then rose again.

Lal and Seth (1984) also recorded the influence of budding time of bud success and recorded maximum bud success in plants of May budding on *R. multiflora*. Pandey *et al.* (1991) studied the effect of time of budding using Rose cultivar Show Girl and briar root stock. Budding was done on 5 dates at 15 days interval between the 1st week in January and 1st week in March. Budding success was greatest when budding was carried out in 1st week of January.

CHAPTER-III

3. MATERIAL AND METHODS

The present study entitled, "Propagation Studies in Rose *(Rosa hybrida)*" was carried out at experimental orchard of the Department of Horticulture, CCS Haryana Agricultural University, Hisar, during the year 1995-96. The details of techniques followed and material used are described in this chapter.

3.1 Experimental site

The experimental site as mentioned above is situated in subtropics of 29°10' latitude north and 75°46' longitude east and at an elevation of 215.2 meters above mean sea level. Hisar has a typical semi-arid climate. It enjoys the extreme climate with very hot and dry summer alongwith cold winter and humid warm monsoon season. The mean maximum and minimum temperature, therefore, show a wide degree of fluctuations during summer and winter. The average annual rainfall in the region is about 425 mm which is unevenly distributed throughout the year. So, it clearly indicates that climatic conditions are favourable for rose cultivation. The daily observations were recorded at

meteorological observatory which is situated in close vicinity of the experimental site. The observations are presented in Table 1.

3.2 Field preparation

A patch of land was selected to conduct the experiment which was ploughed and harrowed with the help of a tractor. Beds of 4.5x3.0 m were prepared with the help of spade. Basal dose of farm yard manure at the rate of 200 kg/bed mixed with equal quantity of sand was incorporated in the soil followed by dusting with BHC for precautions against termites.

3.3 Planting

To conduct propagation studies, rooted plants of root stock, *R. bourboniana* and *R. indica* var. odorata were planted in beds at a distance of 60x60 cm in November, 1995 and just after planting beds were irrigated with canal water.

3.4 Budding operation

For purpose of budding of rootstock, scion wood of 4 varieties i.e. Montezuma, Queen Elizabeth, American Heritage and Golden Times were procured from Department of Floriculture and Landscaping, P.A.U., Ludhiana. Budding operation was performed on three different dates i.e. January 10th, January 25th and February 10th. Method used for budding was followed T-budding. Budding knife was used to carry out budding operation. Bud union

Table 1. Weekly meteorological data for the year 1996 (January to June)

Standard week	Maximum	Minimum	Relative humidity %		Rainfall (mm)
			Morning	Evening	
1	21.4	4.3	93.7	42.8	0.0
2	20.8	3.9	94.8	47.8	0.3
3	17.7	5.3	92.8	56.5	0.5
4	20.4	5.4	92.2	43.1	0.0
5	21.7	1.4	93.5	32.1	0.0
6	23.0	7.6	91.0	53.4	2.2
7	23.1	6.0	93.1	49.2	0.0
8	25.0	8.8	90.4	53.4	1.5
9	24.4	8.7	94.4	54.5	1.2
10	27.9	9.2	95.2	51.7	0.0
11	30.1	13.2	91.0	61.2	0.0
12	26.5	10.0	91.5	57.4	4.5
13	31.8	13.1	77.7	35.7	0.0
14	33.7	11.9	71.1	24.8	0.0
15	35.5	11.7	61.1	16.5	0.0
16	38.5	17.7	63.2	26.2	0.0
17	37.4	19.9	65.2	28.5	0.0
18	41.3	22.3	45.2	13.0	0.1
19	41.0	21.2	35.5	10.4	0.0
20	38.5	21.9	38.5	24.2	1.8
21	38.0	23.5	57.4	26.0	0.0
22	42.4	24.0	47.8	18.5	0.0
23	41.6	24.5	55.7	32.4	0.0
24	36.8	23.0	77.7	44.5	2.5
25	34.1	21.9	67.2	57.7	5.7
26	36.1	22.7	79.4	48.4	5.8

was wrapped with polythene tape. After bud sprouting, the portion of the root stock 2 inches above bud union was removed with the help of secateur and cut end was pasted with cuperic fungicide i.e. Bordeux mixture to prevent the cut end with disease.

3.5 Soil analyses

For estimating status of major nutrient, a composite sample upto 30 cm depth was taken from each bed before the application of fertilizers. The analysis reports of the soil sample is given as under :

Table 2. Soil analyses parameters

Sr.No.	Particulars	Content
1.	pH	7.8
2.	EC (m mhos/cm)	0.52
3.	Available N	225 kg/ha
4.	Available P	16.5 kg/ha
5.	Available K	280 kg/ha

3.5.1 Nitrogen

To determine the available nitrogen, alkaline permaganate method (Subbiah and Asija, 1956) was used and expressed in kg/ha using the formula

Mineralizable N (kg/ha) = $R \times 0.02 \times 1/20 \times 0.014 \times 2.24 \times 10^6$

Where

R = Volume of 0.02 normal H_2SO_4 required for titration

3.5.2 Phosphorus

Olsen's method (Olsen *et al.*, 1954) was used to determine the phosphorus status of the soil and available phosphorus present in soil was calculated on hectare basis.

$$\text{Available P (kg/ha)} = R \times \frac{\text{Total volume of extract}}{\text{Volume of aliquot}} \times \frac{1}{\text{Weight of soil taken}} \times \frac{2.24 \times 10^6}{10^6}$$

Where

R = *µg P in the aliquot (to be seen from standard curve)*

3.5.3 Potassium

The term available potassium incorporates both exchangeable and water soluble forms of the nutrients in soil. The readily exchangeable plus water soluble K is determined in neutral normal ammonium acetate extract of soil and reading was taken with the help of flame photometer and calculated as :

$$= \frac{\text{Volume of extract}}{\text{Weight of soil taken}} \times \frac{2.24 \times 10^6}{10^6}$$

Where

R = ppm of K in the extract (obtained from standard curve)

= ppm of K x 11.2

3.5.4 Soil pH

Determined in 1:2 soil water suspension with glass electrode pH meter (Black, 1965).

3.5.5 Electrical conductivity

Determined in 1:2 soil water suspension using conductivity bridge (Black, 1965).

3.6 Application of manure and fertilizers

A basal dose of farm yard manure at the rate of 200 kg/bed, P_2O_5 at the rate of 280 g/bed and K_2O at the rate of 280 g/bed was incorporated and well mixed with soil at the time of planting. Nitrogen at the rate of 560 g/bed was applied in the two split doses, i.e. half at the time of budding and remaining half at the time of floral bud initiation.

3.7 Layout of experiment

The experiment was laid out in Factorial Randomized Block Design with three replications of each treatment. The details of experiment are given

below :

1.	Number of replications	3
2.	Plant unit/replication	4
3.	Planting distance	60x60 cm
4.	Size of beds	4.5x3 m
5.	Total number of beds	4
6.	Root stock	2 *(Rosa bourboniana)* *(Rosa indica* variety Odorata)

3.8 Treatment

Three time of budding and 4 varieties were selected for the experiment.

Time of budding - *January 10th, January 25th, February 10th*

Varieties - Montezuma, Queen Elizabeth, American Heritage, Golden Times

3.9 Observation recorded

To study the effect of treatment the observation given below were taken.

(i) Number of days taken for bud break

Number of days taken for sprouting of buds were counted from date of budding on each plant budded on different dates.

(ii) Per cent bud success

It was calculated on the basis of number of plants budded and on their success on each plant in each replication.

(iii) Number of leaves per plant

To record this observation, number of leaves per sprout were counted after 90 days of budding.

(iv) Stem girth

It was measured below 5 cm of union with the help of verneer calliper after 90 days of budding and expressed in centrimeter.

(v) Scion girth

It was measured above 5 cm of bud union with the help of Verneer calliper after 90 days of budding.

(vi) Number of days taken for appearance of first floral bud

Number of days for appearance of first floral bud were calculated from the date of budding to appearance of first floral bud i.e. when the first floral bud was of peanut size.

(vii) Number of days taken for opening of flower

Number of days taken for opening of flower counted from date of appearance of first floral bud to unfurling of outer most petals.

(viii) Stem length of flowers

The stem length of flowers was measured with the help of measuring rod

from base of union to the base of flower and expressed in centimeter.

(ix) Diameter of flower

Diameter of fully opened terminal flower was measured with the scale in centimeter.

(x) Number of flowers per plant

Number of flowers on each plant were counted upto June i.e. when growth ceased.

3.10 Statistical analyses

The final data was put to appropriate method of analysis i.e. Factorial RBD as given by Cochran and Cox (1959). The conclusions were drawn only after the determination of significance of difference between treatment means at 5 per cent level of probability and C.D. was also calculated as follows

$$CD\ 5\% = \sqrt{\frac{2 \times EMS}{n}} \times t$$

Where

n = Number of observation

EMS = Error mean square

CD = Critical difference

t = tabulated value of t (error d.f.) at 5% level of significance.

CHAPTER-IV

4. EXPERIMENTAL RESULTS

The experimental results emenating from the present studies regarding different parameters of *Rosa hybrida* as affected by different time of budding are presented in this chapter.

4.1 Number of days taken for bud break

Under experimentation to study the response of time of budding on bud sprouting in different varieties on root stock *Rosa bourboniana* and *R. indica* var. Odorata budding was done on three different dates. It is evident from Table 3 that while using root stock *R. bourboniana*, it was observed that the bud break was significantly influenced by time of budding, varieties and their interaction. Among various dates of budding, a significant effect on bud break was observed in i.e. 10th February budding, which took minimum number of days (29.7 days) for bud break followed by 25th January and 10th January.

Similarly, in root stock *R. indica* var. Odorata minimum number of days

for bud break was observed in 10th February (29.5 days), while compairing varietal response in both the root stocks, it was found that period for budbreak ranged from 33.7 to 46.7 days. Variety Montezuma overall, took minimum number of days for budbreak followed by American Heritage, Golden Times and Queen Elizabeth respectively. Whereas in case of root stock *R. indica* var. Odorata, in both the varieties a no significant difference was observed.

While studying the combined effect of time of budding and variety, it was observed that V_2T_3 was found most effective, in which minimum number of days for bud break was recorded using root stock *R. bourboniana* (Table 3).

4.2 Per cent bud break

It is evident from data presented in Table 4 that effect of time of budding on per cent bud break was non significant under both the root stocks. However, per cent bud break was maximum in plants budded on January 25th. The bud success ranged from 62.5 to 74.9 per cent.

While studying the varietal response, the per cent bud break was significantly affected by varieties, when plants were budded on root stock *R. bourboniana*. Among the various varieties maximum bud break was observed in vareity Montezumea (74.9%) followed by Golden Times (71.60%), Queen Elizabeth (69.4%) and American Heritage (44.4%) respectively. Whereas in plants budded on *R. indica* var. Odorata both varieties were found equally effective on per cent bud break.

Table 3. Effect of time of budding in different varieties on number of days taken for bud break

Date of budding	*R. bourboniana*				Mean	*R. india* var. Odorata		Mean
	Montezuma (V_1)	Queen Elizabeth (V_2)	American Heritage (V_3)	Golden Times (V_4)		Montezuma (V_1)	Queen Elizabeth (V_2)	
10th January (T_1)	40.8	57.6	39.0	51.6	47.2	64.0	57.3	60.6
25th January (T_2)	30.3	42.0	51.0	35.6	39.2	46.4	40.8	43.6
10th February (T_3)	30.0	26.3	29.3	33.3	29.7	29.7	29.3	29.5
Mean	33.7	41.9	39.9	40.2		46.7	42.4	

C.D. at 5%		C.D. at 5 %	
Time	4.04	Time	6.9
Variety	4.67	Variety	N.S.
Time x variety	8.09	Time x variety	N.S.

Table 4. Effect of time of budding in different varieties on per cent bud break

Date of budding	*R. bourboniana*				Mean	*R. india* var. Odorata		Mean
	Montezuma (V_1)	Queen Elizabeth (V_2)	American Heritage (V_3)	Golden Times (V_4)		Montezuma (V_1)	Queen Elizabeth (V_2)	
10th January (T_1)	83.3 (65.96)	66.6 (54.76)	41.6 (40.22)	66.6 (54.76)	64.5 (53.49)	66.6 (54.82)	58.3 (49.84)	62.5 (52.30)
25th January (T_2)	83.3 (65.96)	75.0 (60.07)	41.6 (40.22)	65.0 (53.79)	66.2 (54.51)	83.3 (65.96)	66.6 (54.82)	74.9 (63.44)
10th February (T_3)	58.3 (49.84)	66.6 (54.76)	50.0 (45.06)	83.3 (65.96)	64.5 (53.49)	58.3 (49.84)	83.3 (65.96)	70.8 (57.35)
Mean	74.9 (60.07)	69.4 (56.48)	44.4 (41.84)	71.60 (57.86)		69.4 (56.48)	69.4 (56.48)	

C.D. at 5%		C.D. at 5 %	
Time	N.S.	Time	N.S.
Variety	12.5	Variety	N.S.
Time x variety	N.S.	Time x variety	N.S.

PLATE 1 **MONTEZUMA**

4.3 Number of leaves per plant

The perusal of data presented in Table 5 indicate that number of leaves per plant was significantly affected by time of budding under both the root stocks. Among various dates of budding using root stock *R. bourboniana* the plant budded on 2nd date i.e. 25th January produced maximum number of leaves (58.6) followed by those budded on 10th February (41.3) and 10th January respectively. Similar trend of number of leaves per plants was observed in plants budded on *R. indica* var. Odorata.

While studying the effect of variety, among the different varieties Golden Times produced maximum number of leaves per plant (57.8) followed by Montezuma (46.9), Queen Elizabeth (40.2) and American Heritage (35.7) respectively, when these varieties were budded on root stock *R. bourboniana*, whereas on *R. indica* var. Odorata, varieties have no significant effect on the number of leaves per plant, however, variety Montezuma proved little better regarding production of leaves per plant (Table 5).

4.4 Stem girth of stock

The data on stem girth of stock is presented in Table 6. It is clear from the data that the effect of time, variety and their interaction was found non significant in plants budded on root stock *R. bourboniana*, however, maximum stem girth was recorded in plants budded on 2nd date of budding i.e. 25th January (1.02 cm) followed by those budded on 10th February and 10th

Table 5. Effect of time of budding in different varieties on number of leaves produced per plant

Date of budding	*R. bourboniana*				Mean	*R. india* var. Odorata		Mean
	Montezuma (V_1)	Queen Elizabeth (V_2)	American Heritage (V_3)	Golden Times (V_4)		Montezuma (V_1)	Queen Elizabeth (V_2)	
10th January (T_1)	36.0	24.6	36.0	45.6	35.5	39.6	37.3	38.4
25th January (T_2)	69.7	59.0	33.3	72.6	58.6	71.6	71.0	71.3
10th February (T_3)	35.0	37.0	38.0	55.3	41.3	59.6	54.3	56.9
Mean	46.9	40.2	35.7	57.8		56.9	54.2	

C.D. at 5%		C.D. at 5 %	
Time	11.06	Time	8.4
Variety	12.70	Variety	N.S.
Time x variety	N.S.	Time x variety	N.S.

Table 6. Effect of time of budding in different varieties on stem girth of stocks (cm)

Date of budding	*R. bourboniana*				Mean	*R. india* var. Odorata		Mean
	Montezuma (V_1)	Queen Elizabeth (V_2)	American Heritage (V_3)	Golden Times (V_4)		Montezuma (V_1)	Queen Elizabeth (V_2)	
10th January (T_1)	0.89	0.91	0.80	0.96	0.89	0.90	0.75	0.82
25th January (T_2)	1.15	0.93	1.01	1.00	1.02	0.99	0.89	0.94
10th February (T_3)	1.17	0.81	0.78	0.84	0.90	0.84	0.76	0.80
Mean	1.07	0.88	0.86	0.93		0.91	0.80	

C.D. at 5%		C.D. at 5 %	
Time	N.S.	Time	0.08
Variety	N.S.	Variety	0.07
Time x variety	N.S.	Time x variety	N.S.

PLATE 2 QUEEN ELIZABETH

January respectively. Among different varieties maximum stem girth of stock was recorded in variety Montezuma (1.07 cm) followed by Golden Times (0.93 cm), Queen Elizabeth (0.88 cm) and American Heritage (0.86 cm) respectively.

Whereas in plants budded on *R. indica* var. Odorata, a significant effect of time of budding and variety on stem girth of stock was observed. Among different dates of budding, maximum stem girth of stock was recorded in plant budded on 2nd date of budding i.e. 25th Janualry followed by those budded on 10th February and 10th January respectively. While compairing the effect of the two varieties budded on *R. indica* var. Odorata Montezuma produced significantly thicker stem girth (0.91 cm) in comparison to Queen Elizabeth (0.80 cm) (Table 6).

4.5 Stem girth of scion

The data on stem girth of scion is presented in Table 7. The perusal of data presented in table reveals that the effect of time of budding on stem girth of scion was found non-significant in both the root stocks. However, maximum thickness of stem girth of scion was recorded in plants budded on 2nd date of budding i.e. on 25th January (0.48 cm) followed by those budded on 10th January (0.46 cm) and 10th February (0.41 cm) respectively, in case of *R. bourboniana*, whereas in plants budded on *R. indica* var. Odorata maximum stem girth was recorded in 10th February budding.

Table 7. Effect of time of budding in different varieties on stem girth of scion (cm)

Date of budding	*R. bourboniana*				Mean	*R. india* var. Odorata		Mean
	Montezuma (V_1)	Queen Elizabeth (V_2)	American Heritage (V_3)	Golden Times (V_4)		Montezuma (V_1)	Queen Elizabeth (V_2)	
10th January (T_1)	0.40	0.52	0.41	0.51	0.46	0.44	0.30	0.37
25th January (T_2)	0.65	0.52	0.31	0.44	0.48	0.35	0.36	0.35
10th February (T_3)	0.40	0.45	0.42	0.38	0.41	0.44	0.32	0.38
Mean	0.48	0.49	0.38	0.44		0.41	0.32	

C.D. at 5%	
Time	N.S.
Variety	N.S.
Time x variety	N.S.

C.D. at 5 %	
Time	N.S.
Variety	0.07
Time x variety	N.S.

While compairing the effect of varieties, it was found that in case plants on *R. bourboniana*, effect of variety was non significant. However, among the various varieties Queen Elizabeth produced maximum stem girth of scion (0.49 cm) followed by Montezuma (0.48 cm), Golden Times (0.44 cm) and Queen Elizabeth (0.38 cm) respectively, whereas in root stock *R. indica* var. Odorata, a significant effect of varieties on stem girth of scion was observed, while compairing the two varieties, stem girth of Montezuma scions were recorded to have more thickness (0.41 cm) than that of Queen Elizabeth (0.32 cm) (Table 7).

4.6 Number days for appearance of first floral bud

It is evident from the data presented in Table 8 that the time of budding significantly affected the number days taken for appearance of first floral bud on both the root stocks. Among various dates of budding, a significant effect on appearance of first floral bud was observed in last date of budding i.e. 10th February which took minimum number of days for appearance of first floral bud (51.9 days), followed by 25th January and 10th January budding respectively.

Similarly, in root stock *R. indica* var. Odorata first bud appearance was recorded earliest in February 10th budded plants. While compairing the varietal response in both root stocks, it was found that number days taken for first floral bud appearance ranged from 52.1 to 69.3 days. Variety Montezuma

Effect of time of budding in different varieties on number of days taken for appearance of first floral bud

Date of budding	*R. bourboniana*				Mean	*R. india* var. Odorata		Mean
	Montezuma (V_1)	Queen Elizabeth (V_2)	American Heritage (V_3)	Golden Times (V_4)		Montezuma (V_1)	Queen Elizabeth (V_2)	
10th January (T_1)	62.0	86.0	59.3	69.0	69.0	76.6	81.6	79.1
25th January (T_2)	46.3	70.3	62.3	60.0	59.7	57.6	61.3	59.4
10th February (T_3)	48.0	51.6	46.6	59.3	51.4	47.6	47.6	47.6
Mean	52.1	69.3	56.1	62.7		60.6	63.5	

C.D. at 5%	
Time	5.81
Variety	6.71
Time x variety	N.S.

C.D. at 5 %	
Time	4.4
Variety	N.S.
Time x variety	N.S.

PLATE 3 AMERICAN HERITAGE

overall took minimum number of days for appearance of first floral bud followed by American Heritage, Golden Times and Queen Elizabeth respectively, whereas in case of root stocks *R. indica* var. Odorata a non-significant difference was observed between two varieties.

While studying combined effect of time of budding and variety, it was observed that V_1T_3 was found most effective in which minimum number of days for appearance of first floral bud was noticed using root stock *R. bourboniana* (Table 8).

4.7 Number of days taken for flower opening

The period between appearance and opening of flower was considered for taking above data which is present in Table 9.

The perusal of data shows that time of budding has no significant effect on number of days taken for opening of flower under both the root stocks. However, among various dates of budding minimum number of days for flower opening were taken by the plants budded on 2nd date of budding i.e. on 25th January followed by 10th January budding using rootstock *R. bourboniana*, whereas in case of *R. indica* var. Odorata flower opening was earliest in plants budded on 10th Feburary.

While compa-ring varietal response, it was observed that in case of plants budded on rootstock *R. bourboniana*, varieties have significant effect on number of days taken for flower opening. among different varieties, flower

Table 9. Effect of time of budding in different varieties on number of days taken for flower opening

Date of budding	*R. bourboniana*				Mean	*R. india* var. Odorata		Mean
	Montezuma (V_1)	Queen Elizabeth (V_2)	American Heritage (V_3)	Golden Times (V_4)		Montezuma (V_1)	Queen Elizabeth (V_2)	
10th January (T_1)	18.6	14.6	15.6	17.0	16.4	15.0	16.3	15.6
25th January (T_2)	20.6	13.6	15.3	15.0	16.1	17.0	14.6	15.8
10th February (T_3)	19.3	17.0	16.3	15.0	16.9	16.0	14.3	15.1
Mean	19.5	15.1	15.7	15.6		16.0	15.0	

C.D. at 5%	
Time	N.S.
Variety	1.82
Time x variety	N.S.

C.D. at 5 %	
Time	N.S.
Variety	N.S.
Time x variety	N.S.

opening was recorded earliest in variety Queen Elizabeth (15.1 days) followed by Golden Times (15.6 days), American Heritage (15.7 days) and Montezuma (19.5 days) respectively, whereas in case of root stock *R. indica* var. Odorata, difference between the two varieties was non significant (Table 9).

4.8 Stem length of flowers

It is evident from the data presented in Table 10 that time of budding has no significant effect on stem length of flowers, under both the rootstocks. However, among different dates of budding, maximum stem length was produced by plants budded on 2nd date of budding i.e. 25th January on both the root stocks, followed by 10th February and 10th January budding respectively.

While studying the varietal effect on stem length of flowers using root stock *R. bourboniana,* it was observed that there was significant effect of varieties on stem length of flowers. Among various varieties, American Heritage produced maximum stem length of flowers (27 cm) followed by Golden Times (24.7 cm), Queen Elizabeth (22.3 cm) and Montezuma (21.1 cm) respectively.

In case of root stock *R. indica* var. Odorata, although effect of varieties was found non-significant but variety Queen Elizabeth proved better to Montezuma as stem length was recorded 25.05 cm in former as compared 23.5 cm in latter (Table 10).

Table 10. Effect of time of budding in different varieties on stem length of flower (cm)

Date of budding	*R. bourboniana*				Mean	*R. india* var. Odorata		Mean
	Montezuma (V_1)	Queen Elizabeth (V_2)	American Heritage (V_3)	Golden Times (V_4)		Montezuma (V_1)	Queen Elizabeth (V_2)	
10th January (T_1)	23.0	17.0	27.4	26.6	23.5	22.8	24.3	23.5
25th January (T_2)	23.7	24.6	27.6	22.6	24.6	25.3	27.3	26.3
10th February (T_3)	18.5	25.4	26.7	24.9	24.0	22.6	23.6	23.1
Mean	21.7	22.3	27.2	24.7		23.5	25.0	

C.D. at 5%		C.D. at 5 %	
Time	N.S.	Time	N.S.
Variety	3.76	Variety	N.S.
Time x variety	N.S.	Time x variety	N.S.

PLATE 4 GOLDEN TIMES

4.9 Number of flowers per plant

It is evident from data presented in Table 11 that time of budding has no significant effect on number of flowers per plant under both the root stocks. While compa-ring the effect of different dates of budding, it was noted that maximum number of flowers were produced by plants budded on 2nd date of budding i.e. on January 25th in both the root stocks.

While studying the varietal response using root stock *R. bourboniana*, it was found that maximum number of flowers per plant were recorded in variety Golden Times (3.22) followed by Montezuma (2.68), Queen Elizabeth (2.05) and American Heritage (1.00) respectively, whereas in case of root stock *R. indica* var. Odorata both varieties were found equally effective in producing number of flowers per plant (Table 11).

4.10 Diameter of flower

The data on diameter of flower is presented in Table 12, which indicate that time of budding has no significant effect on diameter of flowers produced by different varieties on root stock *R. bourboniana*. However, among different dates of budding, maximum size of flower (8·38cm) was recorded in plants budded on 2nd date of budding i.e. on January 25th , followed by 10th January and 10th February respectively, whereas in case of plants budded on *R. indica* var. Odorata, time of budding significantly effected the diameter of flowers. Among different dates of budding, maximum size of flower (8·50cm) was produced by

Table 11. Effect of time of budding in different varieties on number of flowers produced per plant

Date of budding	*R. bourboniana*				Mean	*R. india* var. Odorata		Mean
	Montezuma (V_1)	Queen Elizabeth (V_2)	American Heritage (V_3)	Golden Times (V_4)		Montezuma (V_1)	Queen Elizabeth (V_2)	
10th January (T_1)	2.82	2.22	1.00	3.10	2.24	3.1	2.6	2.8
25th January (T_2)	2.60	2.06	1.00	3.40	2.26	3.7	3.3	3.5
10th February (T_3)	2.63	1.86	1.00	3.16	2.16	2.9	2.7	2.8
Mean	2.68	2.05	1.00	3.22		3.2	2.8	

C.D. at 5%	
Time	N.S.
Variety	0.416
Time x variety	N.S.

C.D. at 5 %	
Time	N.S.
Variety	N.S.
Time x variety	N.S.

Table 12. Effect of time of budding in different varieties on diameter of flower (cm)

Date of budding	*R. bourboniana*				Mean	*R. india* var. Odorata		Mean
	Montezuma (V_1)	Queen Elizabeth (V_2)	American Heritage (V_3)	Golden Times (V_4)		Montezuma (V_1)	Queen Elizabeth (V_2)	
10th January (T_1)	9.16	7.00	9.40	7.86	8.35	7.50	7.70	7.60
25th January (T_2)	8.53	8.10	9.53	7.36	8.38	8.30	8.80	8.50
10th February (T_3)	7.96	8.33	9.20	7.26	8.18	7.60	7.90	7.70
Mean	8.55	7.81	9.37	7.49		7.80	8.10	

C.D. at 5%	
Time	N.S.
Variety	5.83
Time x variety	N.S.

C.D. at 5 %	
Time	0.59
Variety	N.S.
Time x variety	N.S.

plants budded on January 25th ——— ; followed by 10th January and 10th February respectively.

While compa-ring the size of flowers produced by different varieties using root stock *R. bourboniana*, it was noted that diameter of flowers was significantly affected and among different varieties American Heritage produced flowers having maximum diameter (9.37 cm) followed by Montezuma (8.55 cm), Queen Elizabeth (7.81 cm) and Golden Times (7.49 cm) respectively, whereas rootstock *R. indica* var. Odorata could not show any pronounced difference on size of flower between both varieties (Table 12).

CHAPTER-V

5. DISCUSSION

The results of experiment entitled, ''Propagation studies in Rose''. in the preceding chapter have been discussed here in the light of available information.

5.1 Bud sprouting

To study the effect of time of budding on bud sprouting, buds of different varieties were budded on different dates on root stocks *R. bourboniana* and *R. indica* var. odorata. Among various dates of budding, minimum number of days for bud break was observed in 10th February budding in both the root stocks. Among different varieties, minimum number of days were taken by variety Montizuma followed by American-Heritage, Golden Times and Queen Elizabeth respectively. The reason for minimum number of days taken for bud break may be due to a favourable temperature suitable for bud sprout i.e. during 2nd week of Febryary as compared to budding done during 2nd and last week of January, as due to rise in temperature buds of rose sprout rapidly and

exhaust the food material and auxin present in the stock. The finding are in accordance with findings of Swarup (1980) who also reported budding time from December to February as best for Northern India conditions.

5.2 Per cent bud break

The results on per cent bud break as affected by different time of budding in rootstock *R. bouboniana* and *R. indica* var. odorata indicated that time of budding did not show any significant response but maximum per cent bud break was observed in both the rootstocks in variety montezuma budded on January 25th followed by Golden Times. Queen Elizabeth and American Heritage respectively.

The finding clearly indicated that 25th January budding time was more effective in terms of per cent bud break and there is variation at species level. These results are in confirmity with those of Singh (1972-74), Maite (1974) and Pandey *et al.* (1991).

5.3 Number of leaves

The number of leaves is an important growth parameter affecting over all growth and flower production. The results indicated that time of budding significantly affected number of leaves per plant under both the rootstocks. Among various dates of budding, maximum number of leaves were recorded in plants budded on 25th January.

Among different varieties, Golden Times produced maximum number of leaves per plant followed by Montezuma, Queen Elizabeth and American Heritage, respectively. The possible reason for more number of leaves may be because of presence of favourable environmental conditions during 2nd date of budding i.e. 25th January. There results were confirmed by the findings of Maiti (1974) and Swarup and Malik (1974).

5.4 Stem girth of stock

The present study revealed that time of budding has no significant effect on stem girth of stock when budded on rootstock *R. bourboniana*, where as time of budding has significant effect on stem girth in root stock *R. indica* var. odorata.

Among different dates of budding, maximum thickness of stem girth was recorded in plants budded on 2nd date of budding i.e. January 25th. Among different varieties, maximum stem girth of stock was recorded in variety Montezuna followed by Golden Times.

5.5 Stem girth of scion

The results of stem girth of scion as affected by time of budding shows that time of budding has non-significant effect on stem girth of scion under both the root stocks. Among different dates of budding, maximum thickness of stem girth of scion was recorded in 2nd date of budding i.e. 25th January on root stock *R. bourboniana* whereas on rootstock *R. indica* var. odorata

maximum stem girth of scion was recorded in 3rd date of budding i.e. February 10th.

Among different varieties, Queen Elizabeth produced maximum thickness of stem girth followed by montezuna. The possible reason for more thickness of scion stem on 2nd date of budding may be due to presence of more number of leaves.

5.6 Appearance of floral bud

The results indicated that time of budding affected the number of days taken for appearance of first floral bud on both the root stocks. Among various dates of budding, minimum number of days for appearance of first floral buds were recarded in 10th February budding.

Among various varieties first floral bud appearance was observed earliest in variety montezuma followed by American Heritage, Golden Times and Queen Elizabeth respectively.

The possible reason for early appearance of first floral bud in 3rd date of budding may be presence of favourable environmental conditions suitable for bud initiation. Maite (1974) and Swarup (1980).

5.7 Flower opening

The present study revealed that time of budding has no significant effect on number of days taken for opening of flowers under both the root stocks.

Among various dates of budding, minimum number of days for flower opening was taken by plants budded on 2nd date of budding i.e. on 25th January.

Among different varieties, flower opening was earliest in variety Queen Elizabeth followed by Golden Times and Montezuma respectively. The early flower opening in 2nd date of budding may be due to more number of leaves per plant as compared to plants budded on other dates, as a result photosynthetic activity was more and flower opening hastened. The results are in accordance with the findings of Canarche (1966).

5.8 Stem length of flowers

The stem length is important parameter affecting market value of flower. The results indicated that time of budding has no significant effect on stem length of flowers under both the root stock. Among different dates of budding, maximum stem length was produced by25th January budded plants.

Among the different varieties, maximum stem length of flowers was produced by American Heritage followed by Golden Times, Queen Elizabeth and Montezuma respectively. The possible reason for more stem length may be due to favourable environmental conditions suitable for growth provided on 2nd date of budding. Similar results were obtained by Swarup (1980) and Mukhopadhyay (1985).

5.9 Number of flowers

The present study reveals that time of budding has no significant effect on number of flowers per plant under both the root stocks. Among different dates of budding maximum number of flowers (2·26) per plant were produced by plant budded on 25th January.

Among various varieties, maximum number of flowers per plants were recorded in Golden Times followed by Montezuna, Queen Elizebeth and American Heritage respectively.

The possible reason for more number of flowers in 25th January budded plants may be due to more number of leaves as result there is more photosynthetic activity and increased flower production that is why variety Golden Times having maximum number of leaves produced more number of flowers as compared to other varieties. These results are in confirmity with those of Swarup and Malik (1974) and Singh (1980).

5.10 Diameter of flowers

The results on diameter of flowers as affected by time of budding, reveals that time of budding has no significant effect on diameter of flowers on root stocks *R. bourboniana*, where as in case of *R. indica* var. odorata, time of budding significantly affected diameter of flowers.

Among different dates of budding, maximum size of flowers were

recorded in plants budded on January 25th. Among various varieties, American Heritage produced flowers of maximum size(9·37cm).

The possible reason for maximum diameter in 2nd date of budding may be due to more number of leaves as discussed earlier. These results are supported by Canarche (1966) and Swarup and Malik (1974).

CHAPTER-VI

6. SUMMARY AND CONCLUSION

The present investigation entitled 'Propagation studies in Rose' *Rosa hybrida* was undertaken at experimental orchard of the Department of Horticulture, CCS Haryana Agricultural University Hisar to study the effect of budding on different dates using root stocks, *R. bourbonian* and *R. indica* var. odorata. During experimentation, buds of four varieties namely Montezuma, Queen Elizabeth, American Heritage and Golden Times were procured from Division of Landscape and Floriculture P.A.U. Ludhiana and budded on different dates at 15 days interval. The results of the experiment are briefly summarized in this chapter.

6.1 From the foregoing discussion, it is obvious that minimum number of days taken for bud break were recorded in plants budded on 10th February whereas maximum per cent bud break was observed in plants budded on January 25th. Among various varieties, Montezuma performed well in relation to per cent bud break and days taken for bud break.

6.2 The time of budding also affected, the number of leaves per plant. Maximum number of leaves per plant were recorded in plants budded on 25th January in variety Golden Times using both the root stocks.

6.3 The stem girth of stock and scion were not affected by date of budding.

6.4 The appearance of first floral bud was earliest in variety *montezuma* in plants budded on 10th February. Number of days taken for flower opening from the date of bud appearance was observed minimum in plant budded on 25th January and among different varieties, Queen Elizabeth buds opened earliest in comparison to other varieties.

6.5 Maximum stem length and size of flower was recorded in variety American Heritage budded on 25th January.

6.6 Number of flowers was recorded maximum in variety Golden Times budded on 25th January.

Conclusion

On the basis of results – obtained during experimentation, it may concluded that for maximum bud uptake, number of leaves per plant, stem length of flower, number of flower and size of flowers, the rose plants should be budded on January 25th, under Hisar conditions.

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