“STUDIES ON THE EFFECT OF PRETREATMENTS, TIME AND METHOD OF PROPAGATION IN MANGO (*Mangifera indica* L.) CV. BANESHAN”

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DECLARATION

I, Ms. S.B. SHAMA, hereby declare that the thesis entitled **"Studies on the effect of pretreatments, time and method of propagation in mango (*Mangifera indica* L.) cv. Baneshan"** submitted to the Dr. Y.S.R. Horticultural University, Venkataramannagudem, for the degree of Master of Science in Horticulture (Fruit Science) is the result of original research work done by me. I declare that no material contained in the thesis has been published earlier in any manner.

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CERTIFICATE

Ms. S.B. SHAMA has satisfactorily prosecuted the course of research and that the thesis entitled **"Studies on the effect of pretreatments, time and method of propagation in mango (*Mangifera indica* L.) cv. Baneshan"** submitted is the result of original research work and is of sufficiently high standard to warrant its presentation to the examination.

I certify that neither the thesis nor its part thereof has been previously submitted by her for a degree of any university.

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ABSTRACT

The present investigation entitled **"Studies on the effect of pretreatments,time and method of propagation in mango (*Mangifera indica* L.) cv. Baneshan"** was carried out from June 2012 to February 2013 at Fruit Research Station, Sangareddy, Medak. Two experiments were carried out in Factorial Randomized Block Design with appropriate replications.

In the first experiment, pretreatments and storage of scion wood was done for sixteen treatments with 3 replications and propagated through different methods.The treatments were T_1 (precured scion + 0 days storage + veneer grafting), T_2 (un precured scion + 0 days storage + veneer grafting), T_3 (precured scion + 3 days storage + veneer grafting), T_4(un precured scion + 3 days storage + veneer grafting),T_5 (precured scion + 5 days storage + veneer grafting), T_6 (un precured scion + 5 days storage + veneer grafting, T_7 (precured scion + 7 days storage + veneer grafting), T_8 (un precured scion + 7 days storage + veneer grafting), T_9 (precured scion + 0 days storage + T-budding), T_{10} (un precured scion + 0 days storage + T-budding), T_{11} (precured scion + 3 days storage + T-budding), T_{12} (un precured scion + 3 days storage + T-budding), T_{13} (precured scion + 5 days storage + T-budding), T_{14} (un precured scion + 5 days storage + T-budding), T_{15} (precured scion+7 days storage + T-budding) and T_{16} (un precured scion + 7 days storage + T-budding).

In the second experiment, effect of season was studied on sixteen treatments with 3 replications. The treatments were T_1 (veneer grafting at 1st fortnight of August), T_2 (veneer grafting at 2nd fortnight of August), T_3 (veneer grafting at 1st fortnight of September), T_4 (veneer grafting at 2nd fortnight of September), T_5 (veneer grafting at 1st fortnight of October), T_6 (veneer grafting at 2nd fortnight of October), T_7 (veneer grafting at 1st fortnight of November), T_8 (veneer grafting at

2nd fortnight of November), T_9 (T-budding at 1st fortnight of August), T_{10} (T-budding at 2nd fortnight of August), T_{11} (T-budding at 1st fortnight of September), T_{12} (T-budding at 2nd fortnight of September), T_{13} (T-budding at 1st fortnight of October), T_{14} (T-budding at 2nd fortnight of October), T_{15} (T-budding at 1st fortnight of November) and T_{16} (T-budding at 2nd fortnight of November).

Data was recorded on bud take (%), days taken for bud break where as data on number of flushes, length of new scion shoot (cm), diameter of new scion shoot (cm), number of new leaves per shoot, internodal length of new shoot (cm), number of new laterals, length of new laterals (cm) was recorded at 15 days interval from 30 days after grafting up to a period of 105 days.

In both experiments, among the propagation methods, only veneer grafting showed success where as complete failure was observed in T-budding under southern Telangana conditions of Andhra Pradesh.

In the first experiment, among the scion wood studied, precured scion wood defoliated for ten days before veneer grafting recorded mean minimum number of days taken for bud break (14.33), mean maximum new scion length (5.45 cm), diameter (0.47 cm), internodal length (2.28 cm), number of flushes (1.50), number of leaves (9.39) and mean maximum number of new laterals (1.31) and length of new laterals (2.46 cm) which was significantly superior to non precured scions. Among different periods of storage of mango scion wood, storage for 3 days recorded mean minimum number of days taken for bud break (14.11), mean maximum new scion length (5.19 cm), diameter (0.44 cm), internodal length (2.20 cm), number of flushes (1.45), number of leaves (9.23) and maximum number of new laterals (1.27) and length of new laterals (2.40 cm) which was significantly superior to 0 days storage, 5 days and 7 days storage.

The interaction between pretreatments and storage intervals of scion wood revealed that precured scion stored for 3 days has recorded minimum number of days taken for bud break (12.13), maximum new scion length (6.13 cm), diameter (0.53 cm), internodal length (2.77 cm), number of flushes (1.71), number of leaves (10.16) and maximum number of laterals (1.47) and length of laterals (2.75 cm) which was significantly superior to 0 days storage, 5 days and 7 days storage.

In the second experiment, regarding season effect, September month followed by August month recorded minimum number of days for bud break (13.23), maximum new scion length (6.20 cm), diameter (0.58 cm), internodal length (3.50 cm), number of flushes (2.23), number of leaves (10.10) and maximum number of new laterals (1.45) and length of new laterals (3.14 cm) which was significantly superior to November and December months.

Among different methods of propagation tried, it is concluded that T- budding is a complete failure in mango and can be successfully propagated through veneer grafting by using defoliated scion which is stored for 3 days and grafted during September followed by August month under Southern Telangana region of Andhra Pradesh.

CHAPTER I

INTRODUCTION

Mango (*Mangifera indica* L.), is one of the most important fruits for all sections of people in India belongs to the family Anacardiaceae and is native of Indo-Burma region (Mukherjee, 1958). There are nearly 50 species in mango but only *Mangifera indica* L. produces edible fruits of superior quality. It occupies a pre-eminent place among the fruit crops grown in India. It is considered as the national fruit of India and is grown extensively throughout the length and breadth of the country. It is available from mid-March to mid-September in one region or the other, the longest duration any fruit is available in fresh form in our country (Chadha, 1989). Mango is most popular among the tropical fruits of the world and is rightly described as 'king of fruits' owing to its delicious taste, captivating flavor and attractive aroma.

Among fruit crops, mango is the richest source of vitamin-A, also it has fair amounts of vitamin- B and C (Anonymous, 1962). They are mainly used for consumption as ripe fruits and for processing in to various products like jam, jelly, squash, syrup, nectar, mango leather, toffee etc. According to Hindu mythology, mango is accepted as a holy tree and its leaves are used in religious functions.

It is extensively grown in states like Andhra Pradesh, Uttar Pradesh, Bihar, Karnataka, Maharashtra, West Bengal and Gujarat. In India total area under cultivation of mango is 2.297 million ha, with a production of 15.188 tonnes and productivity of 6.6 million tonnes/ha. Andhra Pradesh is one of the leading state in mango in India, ranking first in mango production with a share of 22% (3.3634 million tonnes), and occupies an area of 0.391million ha and highest productivity of 8.6 tonnes/ha, (NHB, 2011). In A.P mango is grown in districts of Krishna, Chittoor, VijayaNagaram, Khammam,Warangal, Cuddapa, MahboobNagar.

Inarching or approach grafting is the popular and traditional method of propagation of mango which is an expensive and tedious method. Hence, in order to

accomplish a large scale and commercial method of vegetative propagation of plants, the method should be relatively simple, highly successful and low in cost (Prasanth *et al.*, 2006). In the recent years, veneer grafting has gained importance over inarching because of ease in operation, economy and high rate of success.

The veneer grafting was tried first in Florida in 1941, which has been successfully adopted under Indian conditions (Mukherjee and Majumdar, 1961**).** Hence, such new venture should not only have higher percentage of success but should have good vigour of the grafts also.

Budding, a technique of vegetative propagation widely used for citrus species, is also been adopted in mango, and reported success in North India but the method has not been commercially adopted due to various factors like method and time of budding, wrapping material, cutting treatments and effect of scion and stock influencing on success. Through budding large number of plants can be produced with minimum expenditure and with minimum scion material.

One of the factor like defoliation of scion wood before being cut for graftage can increase the success rate of mango propagation technique**. (**Kashyap *et al*., 1972). These defoliated scions sprout earlier than undefoliated ones, that would help the grafted plants to complete their vegetative growth earlier than later ones and thus allowing earlier availability of grafts for planting. Hence, to improve the efficacy of propagation methods with quick and better success in relation to defoliation there is a need to optimize the storage period of scion wood.

Similarly, another factor like time of graftage is also considered to be the most vital factor which has a bearing on several climatic factors like temperature, rainfall and humidity that has significant influence on the percentage of survival and establishment of the grafts. **(**Singh and Singh, 2006)

Under Southern Telangana region of Andhra Pradesh, propagation of mango through grafting and budding has not been standardized so far with the type of scion and the period to which it is to be stored for a successful graftage along with the

influence of season effect on success percentage of propagation methods.

Keeping in view of the above, it is proposed to study the effect of pretreatments on success of propagation methods in mango cv. Baneshan in different months.

Objectives:

i. To study the effect of precured and freshly detached (unprecured) scion wood on success of grafting and budding.

ii. To study the effect of period of storage of scion wood in sphagnum moss on success of grafting and budding.

iii. To study the impact of seasonal influence on propagation methods of mango under Southern Telangana region

CHAPTER II

REVIEW OF LITERATURE

Mango is one of the most important fruits in India. The area under mango is increasing rapidly owing to great demand for fresh fruits as well as processed products in the international market. Even though the area under mango is increasing, the pace of development is not appreciable. The greatest bottleneck in the expansion of area under fruits is the non-availability of genuine and quality planting material in adequate quantity from reliable nurseries which requires a commercial method of propagation.

In order to accomplish a large scale and commercial method of vegetative propagation of plants, the method should be relatively simple, highly successful and low in cost (Prasanth *et al.*, 2006). In the recent years, veneer grafting has gained importance and with budding method, large number of plants can be produced with minimum expenditure and with minimum scion material.

Along with good success, grafts should also have good vigour which depends on factors like defoliation of scion before being cut for graftage can increase the success rate of mango propagation technique, its storage period and season of propagation has influence on the percentage of survival and establishment of the grafts. (Singh and Singh, 2006)

Pertinent literature with respect to the effect of pretreatments, storage of scion wood and season of propagation is reviewed here under different heads.

2.1 COMPARATIVE EVALUATION OF GRAFTING METHODS

A successful propagation of fruit trees depends on the technologies used in obtaining high quality seedlings. The best method for mango tree propagation is one that provides fast beginning of the production in a nursery with a high success percent and better establishment.

2.1.1 Success rate (%)

In a study conducted by Mishra (1982) on vegetative propagation of persimmon reported a success rate (%) of 80.40 % in veneer grafting, 75.30 % in tongue grafting and 41.40 % in budding.

Kashyap *et al.* (1989) in studies on vegetative propagation of mango reported that whip (or splice) grafting generally gave higher success rate (after 6 weeks) than cleft (or wedge) or veneer grafting.

Abdell –All *et al.* (1993) conducted an experiment to study the effect of grafting methods on the growth of mango (cv. Himdi-Be-Sinnara), grafted on 9-month-old mango rootstocks (0.9-1.1 cm in diameter) in 1987 and 1988 and reported best success of 85.50 % and 82.80 % in modified top grafting in 1987 and 1988 respectively followed by 80.70 % and 81.40 % success in side veneer grafting in 1987 and 1988 respectively.

Kumar and Mitra (1994) in mango cv. Himsagar reported that, grafting success rate was highest (92.00%) in inarching and 82.00%, 82.40% and 42.30% in veneer grafting, side grafting and T-budding respectively.

Roy and Sinha (1996) conducted an experiment in Patna to evaluate methods of propagation in 3 mango cultivars (Amrapali, Dasheri and Langra) and reported that greater success in graft production was observed with approach grafting than with veneer grafting (90.00 and 80.00 % survival, respectively) but no significant differences were found between the cultivars.

Chauvatia and Singh (1999) conducted an experiment to standardize the method and time of propagation in custard apple cv. Sindhan Local under Saurashtra conditions, Gujarat and reported that grafting success (73.53%) was higher on an average than that of budding (69.81%).

Nayak and Sen (2000) in mango cv. Amrapali revealed that veneer grafting was the best, while forket budding was the worst method in terms of final success.

Pereira *et al.* (2004) conducted an experiment to evaluate 3 grafting types (cleft, splice and budding) in 3 commercial mango cultivars (Haden, Tommy Atkins and Palmer) using winter season mango cv. Espada as the rootstock. The splice grafting showed 100.00 % establishment at the formation of seedlings of Haden and Palmer, significantly differing from the other grafting types, of which the maximum establishment was 50.00 %. In Tommy Atkins, the cleft grafting and the splice grafting provided 100.00 % and 90.00 % establishment, respectively whereas the - budding technique was the worst grafting method for three cultivars studied, since it provided a maximum establishment of 60.00 %.

Bharad *et al.* (2006) studied the effect of time and method of vegetative propagation in Jamun under Akola conditions and reported maximum values for bud take percent under softwood grafting over the patch budding method.

Vural *et al.* (2008) conducted an experiment on black mulberry in cold temperate zones and reported that grafting success was highest (40.60 %) in T-budding while it was 34.60 % in patch budding and 21.70 % in crown grafting.

2.1.2 Days taken for bud break

Nayak and Sen (2000) in mango cv. Amrapali reported that veneer grafting was the best, while forket budding was the worst method in terms of bud break.

Bharad *et al.* (2006) conducted an experiment to study the effect of time and method of vegetative propagation in Jamun under Akola conditions and reported that soft wood grafting took minimum number of days for bud sprouting when compared to patch budding.

2.1.3 Number of flushes

Nayak and Sen (2000) reported veneer grafting was the best method when compared to forket budding in terms of leaf emergence in mango cv. Amrapali.

2.1.4 Length of new scion shoot (cm)

Abdell –All *et al.* (1993) in mango cv. Himdi-Be-Sinnara reported that veneer grafted seedlings had highest length when compared to modified top grafted seedlings.

Nayak and Sen (2000) in mango cv. Amrapali reported that veneer grafting was the best method in terms of sprout length when compared to forket budding.

Bharad *et al.* (2006) reported maximum linear scion growth in softwood grafting when compared to patch budding in jamun.

2.1.5 Diameter of new scion shoot (cm)

Abdell –All *et al.* (1993) reported that veneer grafted plants had highest diameter when compared to modified top grafted plants in mango cv. Himdi-Be-Sinnara.

2.1.6 Number of leaves

Abdell –All *et al.* (1993) reported in mango cv. Himdi-Be-Sinnara that veneer grafted plants had highest number of leaves when compared to modified top grafted plants.

Bharad *et al.* (2006) reported maximum number of leaves under softwood grafting over the patch budding in jamun under Akola conditions.

Soft wood-grafted plants had higher number of leaves (18.90) than patch budded plants (17.18) in jamun under semi –arid environment of Gujarat (Singh and Singh, 2006).

2.1.7 Other growth parameters

Veneer grafted plants recorded highest leaf area when compared to modified top grafted plants in mango cv. Himdi-Be-Sinnara **(**Abdell –All *et al.*, 1993).

Roy and Hoda (1996) reported that, approach grafting in mango was the most economical method, giving the highest net income (Rs 4.02/graft) and highest survival rate (86.65 %) after 6 months, whereas stone grafting gave the lowest net income (Rs 2.19/graft) and survival rate (65.80 %).

Bharad *et al.* (2006) studied the effect of time and method of vegetative propagation in Jamun under Akola conditions and reported maximum values for final survival under softwood grafting over the patch budding method.

2.2 EFFECT OF DEFOLIATION ON SUCCESS OF GRAFTING

Precuring of bud wood improved the vigour of the grafts and increased the success percentage (Gunjate, 1989 and Mukherjee and Majumdar, 1961).

2.2.1 Success rate (%)

Grafting scions 10 days after defoliation gave the best results for initial success (95.00 %) in mango cv. Langra under Bihar conditions **(**Dhakal and Hoda, 1986).

Kashyap *et al.* (1989) stated highest success rate with a scion of the past year's growth which was defoliated 10 days prior to grafting.

Prasad *et al.* (1990) studied the effect of defoliation in mango cv. Banganpally and reported precured scions gave higher success (78.96 %) than non-precured scions (52.75 %) where the mean graft survival after potting was 75.39 % with precured scions and 52.28 % with non-precured scions.

Jha and Shyamal (1995) carried out veneer grafting in mango cv. Amrapali and stated highest graft success rate with scions defoliated 10 days before grafting and grafted on 1-year-old rootstocks.

Roy and Hoda (1996) in mango cv. Langra observed scion shoots defoliated 8 days before detachment exhibited best results in terms of initial grafting success under Bhagalpur conditions.

Dod *et al.* (1996) reported greater graft success (90.00%) in mango after 6 months in in-situ soft wood grafting with the scion shoots defoliated 10 days before grafting under Akola conditions.

Best treatment for promoting successful grafting in mango cv. Dashehari was precuring 8 days prior to detachment. This treatment promoted highest success (84.07 %) after 6 months of grafting (Rajesh Kumar and Jain, 1998).

Abhay Mankar *et al*. (1999) reported defoliation of the bud wood 6 days before detachment recorded best results in terms of grafting success both in wedge (63.33 %) and splice grafting (60.44 %) in mango cv. Amrapali under Sabour, Bhagalpur conditions.

Brahmachari *et al.* (1999) reported that scions defoliated 10 days before grafting and grafted on 5-day-old seedling rootstocks achieved maximum success of grafts in gangetic plains of Bihar.

Roy *et al.* (1999) studied the effect of grafting methods (veneer or soft wood) and reported that scions which were defoliated 8 days before harvest promoted better grafting success and survival in mango cv. Langra in Lohianagar, Patna.

Jha and Brahmachari (2002) reported that, defoliation 6 days prior to grafting recorded highest values for graft success of 76.65 % in 2 months old scion and 79.11 % in 4 months old scion in mango cv. Dashehari under Bihar conditions.

Patil *et al*. (2006) reported preconditioning (defoliation) of scion in mango for 4 to 15 days was helpful for more success of in-situ epicotyl grafting.

Maske *et al.* (2009) reported use of precured scion stick recorded cent per cent initial success and final survival percentage of 90.00 % in soft wood grafting of sapota.

Shashi Kumar *et al.* (2012) carried out soft wood grafting in guava cv. Sardar and found that the scions cured for nine days gave better results in terms of graft success (84.00 %) and graft survival (88.09 %) under Bagalkot conditions.

2.2.2 Days taken for bud break

Jha and Shyamal (1995) stated scions defoliated 10 days before grafting required shortest time for sprouting in veneer grafting of mango cv. Amrapali.

Roy and Hoda (1996) stated scion shoots defoliated 8 days before detachment took 7 days time to sprout when compared to 24.13 days in freshly detached defoliated scions in mango cv. Langra under Bhagalpur conditions.

Rajesh Kumar and Jain (1998) reported precuring of scion wood 8 days prior to detachment promoted early sprouting (13.58 days) in mango cv. Dashehari

Abhay Mankar *et al*. (1999) observed defoliation of the bud wood 6 days before detachment required shortest time for sprouting both in wedge (16.45 %) and splice grafting (17.33 %) in mango cv. Amrapali under Sabour, Bhagalpur conditions.

Jha and Brahmachari (2002) stated defoliation 6 days prior to grafting recorded the shortest time for sprouting (15.17 days) in 2 months old scion and 16.04 days in 4 months old scion in mango cv. Dashehari under Bihar conditions.

2.2.3 Length of new scion shoot (cm)

Dhakal and Hoda (1987) reported highest sprout length (20.95 cm) with scion shoots grafted 10 days after defoliation in mango.

Dod *et al.* (1996) in mango reported maximum shoot length (17.95 cm) after 6 months in in-situ soft wood grafting with scion shoots that were defoliated 10 days before grafting under Akola conditions.

Abhay Mankar *et al*. (1999) in mango cv. Amrapali reported defoliation of the bud wood 6 days before detachment gave best results in terms of length of scion shoot both in wedge (17.78 cm) and splice grafting (17.43 cm) under Sabour, Bhagalpur conditions.

In a study conducted on mango cv. Dashehari, it was reported that defoliation 6 days prior to grafting recorded highest value for length of scion 10.88 cm and 11.25 cm after 6 months in 2 months old and 4 months old scion respectively under Bihar conditions (Jha and Brahmachari, 2002).

Shashi Kumar *et al*. (2012) carried out soft wood grafting in guava cv. Sardar and stated that the scions cured for nine days gave better results in terms of growth parameter like graft height (21.96 cm) under Bagalkot conditions.

2.2.4 Diameter of new scion shoot (cm)

Abhay Mankar *et al*. (1999) in mango cv. Amrapali reported that defoliation of the bud wood 6 days before detachment gave the best results in terms of diameter of scion shoot both in wedge (0.66 cm) and splice grafting (0.65 cm) under Sabour, Bhagalpur conditions.

Jha and Brahmachari (2002) in mango cv. Dashehari, reported that defoliation 6 days prior to grafting recorded highest value of scion diameter 0.52 cm and 0.53 cm after 6 months in 2 months old and 4 months old scion respectively under Bihar conditions.

2.2.5 Number of leaves

Dhakal and Hoda (1987) reported highest number of leaves (16.75) with scion shoots grafted 10 days after defoliation in mango.

Dod *et al.* (1996) in mango recorded highest number of leaves per scion shoot (29.75) after 6 months in in-situ soft wood grafting with scion shoots that were defoliated 10 days before grafting under Akola conditions.

Abhay Mankar *et al*. (1999) in mango cv. Amrapali reported that defoliation of the bud wood 6 days before detachment gave the best results in terms of number of leaves both in wedge (10.78) and splice grafting (9.33) under Sabour, Bhagalpur conditions.

Jha and Brahmachari (2002) in a study conducted on mango cv. Dashehari reported that defoliation 6 days prior to grafting recorded highest values of 17.78 and 17.89 of number of leaves per graft after 6 months in 2 months old and 4 months old scions respectively under Bihar conditions .

Scions cured for nine days gave better results in terms of number of leaves (9.60) in soft wood grafting in guava cv. Sardar under Bagalkot conditions (Shashi Kumar *et al*., 2012).

2.2.6 Number of new laterals

Shashi Kumar *et al.* (2012) carried out soft wood grafting in guava cv. Sardar and reported that the scions cured for nine days gave better results in terms of number of sprouts (1.67) under Bagalkot conditions

2.2.7 Other growth parameters

Dhakal and Hoda (1987) reported that, grafting in mango cv. Langra by use of scions 10 days after defoliation gave 75.00 % survival after 6 month under Bihar conditions.

Purbiati *et al*. (1987) reported that, growth rate of grafted mango tree propagated by defoliated bud wood 10 days before grafting, was higher than those of undefoliated bud wood.

Inarching generally gave smaller plants of lower spread in mango cv. Baneshan in comparison with other methods viz. veneer grafting, patch budding and shield budding (Ismail and Rao, 1989).

The mean graft survival after potting in mango cv. Banganpally was 75.39 % with precured scions and 52.28 % with non-precured scions (Prasad *et al.* 1990).

Grafting in mango cv. Dashehari reported highest survival of 81.97 % after 6 months by use of scions precured 8 days prior to detachment (Rajesh Kumar and Jain, 1998).

Abhay Mankar *et al*. (1999) reported that defoliation of the bud wood 6 days before detachment in mango cv. Amrapali gave the best results in terms of graft survival both in wedge(85.56 %) and splice grafting (85.67 %) under Sabour, Bhagalpur conditions.

Brahmachari *et al.* (1999) reported that, scions defoliated 10 days before grafting and grafted on 5-day-old seedling rootstocks achieved maximum survival and vigour of grafts in mango in gangetic plains of Bihar.

Roy *et al*. (1999) studied the effect of grafting methods (veneer and soft wood) in mango cv. Langra and reported that scions defoliated 8 days prior to harvest reduced the time taken to complete graft union compared with the control in Lohianagar, Patna.

Jha and Brahmachari (2002) conducted a study in mango cv. Dashehari and reported that defoliation 6 days prior to grafting recorded highest values for total leaf area of 167.24 and 174.96 cm^2 and graft survival of 66.45 % and 70.00 % in 2 months and 4 months old scion respectively after 6 months under Bihar conditions.

Shashi Kumar *et al.* (2012) found that the scions cured for nine days gave better results in terms of graft survival in guava cv. Sardar under Bagalkot conditions.

2.3 EFFECT OF STORAGE OF SCION WOOD ON SUCCESSS OF GRAFTING

In addition to defoliation of scion wood, the success in a grafting method can be improved by standardizing an appropriate period of storage of scion wood along with obtaining information on storage period of scion wood with its vigour during long distance transportation.

2.3.1 Success rate (%)

Dhakal and Hoda (1987) reported 90.00 % initial success by use of scion shoots taken 5 days after defoliation and stored for 3 days in mango cv. Langra under Bihar conditions.

Lenka *et al*. (1993) studied the effect of scion storage on grafting in cashew cv. Bhubaneswar-1 and reported that dipping the cut ends of the scions in wax

before storage resulted in an average grafting success of 44.95 % after 6 days storage but in unwaxed scions, a comparable grafting success was obtained only with scions stored for up to 3 days. After 12 days storage, grafting success was zero in all treatments.

The best grafting success was observed using bud sticks stored either in plastic bags or in sphagnum moss and the worst grafting success was observed in the control treatment in in situ soft wood grafting in cashew cv. Vengurla-4 (Kadam *et al.,* 1995).

Phuse *et al.* (1995) reported best graft success (78.25 %) in mango cv. Pairi with 5 days defoliated scions whose cut ends were treated with molten wax. Graft success was acceptable after 1 day storage (96 .00 %) and 2 days storage (94.00 %), and declined rapidly to 26.00 % after 8 days storage.

Initial grafting success of 90.00 % was reported in mango cv. Langra with the scion shoots defoliated 8 days before detachment and stored for 3 days when compared to grafting success of 55.00 % in freshly detached and defoliated scions under Bhagalpur conditions (Roy and Hoda, 1996)

Rajesh Kumar and Jain (1998) reported that use of scions defoliated 8 days prior to detachment followed by 3 days storage promoted highest graft success of 84.07 % in mango cv. Dashehari.

Abhay Mankar *et al.* (1999) reported that defoliation of the bud wood 6 days before detachment and its storage for 3 days prior to grafting gave the best results in terms of graft success both in wedge (62.89 %) and splice grafting (59.56 %)) in mango cv. Amrapali under Sabour, Bhagalpur conditions.

Dod *et al.* (1996) reported in mango that highest graft success of 98.75 % after 6 months with the treatment in which scion shoots were removed from the plant 5 days after defoliation, treated with 0.05 % bavistin solution and their cut ends dipped in paraffin wax. Then they were wrapped in sphagnum moss and kept in

perforated polyethylene sheets at room temperature and stored for 3 days under Akola conditions.

Roy *et al*. (1999) and reported in mango cv. Langra that scions defoliated 8 days prior to harvest and stored for 3 days promoted higher grafting success and promoted survival compared with the control in Lohianagar, Patna.

Tandel and Patel (2009) reported maximum success in softwood grafting of sapota cv. Kalipatti with scion sticks stored after wrapping in newspaper and sealing in perforated polythene bag under Gujarat conditions.

2.3.2 Days taken for bud break

The scion shoots in mango cv. Langra defoliated 8 days before detachment and stored for 3 days took 7 days to sprout when compared to 24.13 days in freshly detached and defoliated scions under Bhagalpur conditions (Roy and Hoda, 1996).

Rajesh Kumar and Jain (1998) reported best treatment that promoted early sprouting (13.58 days) in mango cv. Dashehari was defoliation 8 days prior to detachment and storage for 3 days under Bihar conditions.

Abhay Mankar *et al*. (1999) reported in mango cv. Amrapali that defoliation of the bud wood 6 days before detachment and its storage for 3 days prior to grafting required minimum number of days taken for bud break both in wedge (16.00) and splice grafting (17.00) under Sabour, Bhagalpur conditions.

2.3.3 Length of new scion shoot (cm)

Dhakal and Hoda (1986) reported highest increase in length (16.19 cm) of scion shoots stored for 3 days wrapped in moist news paper and then kept in perforated polythene bags at room temperature.

Dod *et al.* (1996) reported maximum length of scion shoot (19.75 cm) in mango after 6 months after grafting. For grafting, scion shoots were removed from the plant 5 days after defoliation, treated with 0.05 % bavistin solution and their cut ends dipped in paraffin wax. Then they were wrapped in sphagnum moss and kept in

perforated polyethylene sheets at room temperature and stored for 3 days under Akola conditions.

Abhay Mankar *et al*. (1999) reported in mango cv. Amrapali that defoliation of the bud wood 6 days before detachment and its storage for 3 days prior to grafting gave best results in terms of length of scion shoot both in wedge (17.69 cm) and splice grafting (17.40 cm) under Sabour , Bhagalpur conditions.

Tandel and Patel (2009) reported maximum height of grafts in softwood grafting of sapota cv. Kalipatti made with scion sticks which were wrapped in newspaper and sealed in perforated polythene bag under Gujarat conditions.

2.3.4 Diameter of new scion shoot (cm)

Abhay Mankar *et al*. (1999) reported in mango cv. Amrapali that defoliation of the bud wood 6 days before detachment and its storage for 3 days prior to grafting gave best results in terms of diameter of scion shoot both in wedge (0.66 cm) and splice grafting (0.64 cm) under Sabour, Bhagalpur conditions.

Tandel and Patel (2009) reported maximum diameter of grafts in softwood grafting of sapota cv. Kalipatti made with scion sticks which were wrapped in newspaper and sealed in perforated polythene bag under Gujarat conditions.

2.3.5 Number of leaves

Dod *et al.* (1996) reported maximum number of leaves (20.50) in mango after 6 months of grafting. For grafting, the scion shoots used were removed from the plant 5 days after defoliation, treated with 0.05 % bavistin solution and their cut ends dipped in paraffin wax. Then they were wrapped in sphagnum moss and kept in perforated polyethylene sheets at room temperature and stored for 5 days under Akola conditions.

Abhay Mankar *et al*. (1999) reported that defoliation of the bud wood 6 days before detachment and its storage for 3 days prior to grafting gave best results in

terms of number of leaves both in wedge (11.00) and splice grafting (9.48) of mango cv. Amrapali under Sabour , Bhagalpur conditions.

Tandel and Patel (2009) reported that maximum growth of grafts in terms of number of leaves in softwood grafting of sapota cv. Kalipatti made with scion sticks which were wrapped in newspaper and sealed in perforated polythene bag under Gujarat conditions.

2.3.6 Other growth parameters

Dhakal and Hoda (1986) reported 80.00% graft survival after 6 months of grafting in mango cv. Langra with the treatment in which scion shoots taken 5 days after defoliation and were stored for 3 days under Bihar conditions.

Phuse *et al.* (1995) reported best survival (67.50 %) and better subsequent growth with 5 days defoliated scions whose cut ends were treated with molten wax. Graft survival were acceptable after 1 day storage (84.00 %) and 2 days storage (72.00 %), and declined rapidly to 22.00 % after 8 days storage in mango cv. Pairi.

Rajesh Kumar and Jain (1998) reported in mango cv. Dashehari that the best treatment that promoted highest survival (81.97 %) after 6 months was defoliation 8 days prior to detachment with 3 days storage under Bihar conditions.

Abhay Mankar *et al.* (1999) stated high graft survival of 85.34 % and 84.48 % in wedge and splice method of grafting with bud wood defoliated 6 days before detachment and stored for 3 days prior to grafting in mango cv. Amrapali under Sabour, Bhagalpur conditions.

Rajesh Kumar *et al.* (1999) reported in mango cv. Dashehari that scions which had been defoliated for 8 days and stored for 3 days before grafting showed best growth and survival (79.00 %).

Roy *et al.* (1999) studied the effect of grafting methods (veneer and soft wood) in mango cv. Langra and reported that scions defoliated 8 days prior to harvest and

stored for 3 days reduced the time taken to complete graft union compared with the control in Lohianagar, Patna.

2.4 EFFECT OF SEASON IN DIFFERENT GRAFTING METHODS

There are number of factors which influence the healing of graft union in which weather conditions, especially the temperature and humidity play a very crucial role in the success of grafting (Hartman and Kester, 1979). Similarly, difference in success with season has also been reported by different workers for different parts of India (Mukherjee and Majumdar, 1962 and1964; Ahmed, 1964; Prasad *et al.*, 1973).

2.4.1 Success rate (%)

Softwood grafting in mango recorded 91.50 per cent success in nursery and 76.00 per cent in field at Anand by wedge grafting technique (Amin, 1974).

Softwood grafting performed in fruits like aonla (*Phyllanthus emblica* L.), guava (*Psidium guajava* L.), sapota *(Manilkara acharas*) and phalsa (*Grewia asiatica*) recorded success of 73.30, 70.70, 91.60 and 100.00 per cent respectively in the month of August at Anand (Amin, 1978b).

Amin (1978c) reported 71.40 per cent success in soft wood grafting of cashew during August month under Anand conditions.

Amin (1979) reported that the period from March to September was very much congenial for softwood grafting in mango the drier parts of Gujarat.

Nagabhushanam *et al.* (1979) observed high graft take (53.00 %) in cashew with cleft grafting in September followed by August (50.00 %) while the success in whip grafting for the same month was 23.00 and 25.00 per cent respectively.

Nagawade *et al*. (1979) in mango reported the success of 34.56 and 29.76 per cent in the month of July and August respectively under extreme conditions of Rahuri.

Harnekar (1980) studied softwood grafting in cashew and obtained 56.00 and 44.00 percent success in May and June month respectively under Dapoli conditions.

Singh and Srivastava (1980) studied on softwood grafting in mango and highest success (84.00 %) was recorded in July.

Hulamani and Nachegowda (1981) reported better success (64.33 %) in green wood wedge grafting in mango during the month of February and March irrespective of varieties under Bangalore condition.

Patel and Amin (1981) reported that softwood grafting on in situ raised seedling done in mango from February to September recorded 70 per cent success and more than 85.00 per cent success between April and August months.

Mishra (1982) in persimmon reported that 80-100 % success rates with veneer or tongue grafting between late June and 3rd week of August.

Better success was recorded in softwood grafting in August (90.00 %) followed by July (64.85 %) (Singh and Srivastava, 1982).

Khalil *et al*. (1983) reported May to September period as the best time for veneer grafting of guava, where the success rate was 92.00 per cent.

Chaudhari (1984) recorded 63.00 to 80.00 per cent success in cashew from January to November under west coast conditions.

Gaur (1984) obtained highest success (80.00 %) by softwood grafting and was economically most profitable.

Singh *et al.* (1984*)* obtained 100.00 per cent success in softwood grafting in mango during June month.

Konhar and Das (1985) found 43.00 to 100.00 per cent success in softwood grafting of cashew under Bhubneshwar conditions throughout the year and highest success of 90.00 and 100.00 per cent was recorded during the month of January and February respectively.

Krishnamurthy *et al.* (1985) reported the success of 39.00 to 75.00 per cent in soft wood grafting in cashew during the period from February to May under Ullal conditions.

Mishra (1985) studied softwood grafting in pecannut (*Carya illinoensis* (Wang) R. Koch), a new introduction in India and recorded a very high success of 90.00 per cent in August followed by 80.70 per cent in July.

Panicker (1986) in mango reported maximum success (82%) in July followed by May (72.00 %) and November (70.00 %) under Dapoli conditions.

Sawke *et al.* (1986) reported that, softwood grafting was most successful in polybags throughout the year except December and January which coincides with cold period. The mean success of consecutive three years ranged between 71.33 and 83.66 per cent during February to November under warm and humid climate of Konkan region. The lowest success of 22.33 per cent was observed in the month of December.

Shailendra and Sinha (1987) studied veneer grafting in mango and obtained a success over 80.00 per cent in June and October and 70 per cent in April, May and November.

Shankara (1987) tried green wood wedge grafting during February and March at fortnight interval in mango and observed highest graft take (44.46 %) during second fortnight of March followed by first fortnight of March (27.33 %) under Dharwad conditions.

Reddy and Melanta (1988) obtained highest success of 90 per cent in softwood grafting in mango after 60 days of grafting.

Softwood grafting in mango gave higher success (70-100 %) during July to September under Akola (Maharashtra) condition (Tayade *et al*., 1988).

Upadhyay and Prasad (1988) obtained higher success rate of 85.00 % in June followed by July, August and September each with 80 per cent success in mango.

Bankar (1989) reported that, vegetative propagation in Annonas gave 84.00 and 86.00 percent success rate in veneer grafting in cultivars like Balanagar and Pond-apple respectively.

Ismail and Rao (1989) studied the effect of method of operation (inarching, veneer grafting, patch budding and shield budding) in mango cv. Baneshan and reported that, inarching gave the highest success rate (31.60 - 91.60 %) throughout

the year where as veneer grafting was equally successful in August and September (monsoon months) but poorer at other times. Patch budding and shield budding gave the lowest success rates throughout the year.

Bhuva *et al*. (1990) studied the influence of environment on success of Sapota propagation and reported highest mean survival percentage (90.00 %) for grafts made in February followed by January (86.55 %).

Kulkarni (1990) tried softwood grafting in custard apple and noted highest success (63.55%) in March on six months old rootstock.

Madalageri *et al.* (1990) reported that, the per cent success was higher in Sapota during the first half of the year till July. Maximum success (82.00 %) was recorded in July followed by May (67.37 %) and the least success (34.00 %) was recorded in September at Dharwad.

Waghamare (1990) reported higher success of 59.00 to 76.00 per cent in Sapota during August to September followed by May (50.00 to 55.00 per cent) with a rapid scion growth under warm and humid climatic conditions at Dapoli.

Thangaraj *et al.* (1991) conducted an experiment to study the effect of season on bud take in mandarin orange in Yercaud, Tamil Nadu and reported that percentage bud take was highest (53.60 %) in the samples received in December from Maharashtra followed by those received in March from France (41.00 %). Samples obtained in January from Australia and those received in November from Nilgiris, Tamil Nadu, showed no budtake.

Singh *et al.* (1992) carried out veneer grafting in mango cv's Langra and Dashehari and reported highest sprouting success (82.50 %) after 6 months with July grafting and least success with April grafting.

Ozkan *et al.* (1993) reported that bud take and subsequent shoot growth occurred in jack fruit only with patch, forkert and I budding and not with shield, T, inverted T ,chip, ring, and flute budding.

Kumar and Mitra (1994) reported highest grafting success rate in mango cv. Himsagar on July 30th with inarching (92.00 %) followed by veneer grafting

(82.00 %), side grafting (82.40 %) and T-budding (42.30 %) respectively. The success rate was better for all techniques between June and August and then declined dramatically.

Basavaraja (1996) reported highest average graft success (50.33 %) in mango cv.'s Alphonso and Pairi with grafts made in the first fortnight of August, followed by those made in the second fortnight of July.

Singh and Suryanarayana (1996) obtained the higher grafting success (87.00 %) on softwood grafting in mango during August.

Brahmachari *et al.* (1997) conducted an experiment to study the seasonal effect on success of veneer grafting in mango cv. Amrapali and reported maximum sprouting (91.13 %) in July under Bhagalpur conditions.

Sulikeri *et al.* (1997) obtained maximum success of 61.33 per cent on softwood grafting in Sapota during May.

Chauvatia and Singh (1999) reported that irrespective of the method (grafting or budding) used, greater success was achieved when performed in March (91.11 %) or April (85.00 %) and success was lowest in July in custard apple cv. Sindhan Local under Saurashtra conditions, Gujarat.

Rajesh kumar *et al.* (1999) carried out wedge grafting with scions of nine mango cultivars in mid august and reported that after 45 days, graft take was 70-90 percent for Pairy, Kesar, Pundur and Panchdharkalsa and 72-85per cent for Neelum, Local-1, Local-2, Totapari and Banganpalli. Similarly in a separate trial, Pairy and Langra were grafted at fortnight intervals between 20th August to 30th September and reported that higher initial graft take was in September grafted trees under Akola conditions.

Chaitanya (2000) observed higher graft success in sapota cv. Kalipatti when grafting is carried out during May and July (90 and 85 %) respectively.

Chandel and Ananda (2000) reported mean percentage of bud take with annular budding (47.39 %) and 30th June (55.92 %), and their interaction (82.54 %). Patch

budding performed on 30th June (73.78 %) and 15th July (70.61 %) also resulted in high bud take success in pecan nut cv. Mahan in Nauni, Solan, Himachal Pradesh.

Chovatia and Singh (2000) reported that, budding method proved superior to grafting when it was performed in June in jamun cv. Paras Local. The success was poor from February to May under Gujarat conditions.

Nayak and Sen (2000) observed high success percentage (78.80 %) when veneer grafting was done in July-August as compared to 75.00 % in January-March respectively in mango cv. Amrapali.

Pampanna and Sulikeri (2000) reported that, the initial and final graft take was highest with May grafting (both 60.00 %) followed by April (both 43.30 %) on use of invigorated rootstocks for softwood grafting of Sapota.

Sharma and Joolka (2003) carried out budding in walnut using two methods (annular and patch budding) from 2nd July to 19th August at 8-day intervals and reported that, annular budding on 2nd July, 26 July and 3rd August and patch budding on 2nd July gave the highest bud take success of 80.00 %.

Singh *et al*. (2004) reported that, jamun seedlings patch budded on 15th June method showed the best performance in terms of bud take (59.10 %) in Uttar Pradesh.

Prasanth *et al.* (2006) carried out veneer grafting in 3 mango cv's Mallika, Khader and Baneshan, at fortnightly intervals from August to December in Raichur, Karnataka and reported that, grafting in September showed maximum sprouting percentage (82.50 %) with poor sprouting in December.

Singh and Singh (2006) conducted experiments under semi – arid conditions of Gujarat to standardize the method and time of propagation in jamun under a semi-arid environment and reported higher percentage of graft success (40.00 %) in patch budded plants in March with 36.00 % success in soft wood-grafted plants in August.

Rezaee *et al.* (2008) reported modified bark grafting in walnut performed in mid-April was the most convenient and reliable grafting method for 2- to 3-year-old walnut seedlings, with 80.00 – 93.00 % grafting success.

Vural *et al.* (2008) conducted an experiment on black mulberry in cold temperate zone and reported that budding made in May was superior for budding success (43.20 %). Although June budding had higher bud take success (53.40 %) but only 31.80 % of successful buddlings grew into shoots whereas August budding had the lowest bud take (16.30 %)

Maske *et al*. (2009) conducted an experiment to study the effect of season on success of softwood grafting in sapota and reported that higher success in grafting was observed in the month of August with very poor success when grafting was performed from 15th November to 15th April.

Chandra *et al.* (2011) in pomegranate cv. Bhagawa reported that maximum graft success (85.00 %) was recorded after 90 days of grafting with wedge grafting done on January 30th under Maharashtra conditions.

Ghojage *et al*. (2011) studied the effect of season on softwood grafting in jamun in Bagalkot and revealed that maximum grafting success was recorded during February (81.66 %), which is on par with October (80.00%). The minimum grafting success was recorded during December (35.00 %).

In a study conducted by Seletsu *et al*. (2011) on the effect of different times of T-budding in four citrus varieties i.e. lime, lemon, Kinnow and grapefruit stated that maximum success (81.67 %) was recorded with lemon budded during first week of November.

Singh *et al.* (2012) carried out an experiment in Sabour, Bihar in mango and reported that, highest graft-take success (96.66 %) and survival (90.00 %) was obtained when veneer grafting was performed on 15th July.

2.4.2 Days taken for bud break

Nayak and Sen (2000) reported that the time taken to bud break in cv. Amrapali was greater when veneer grafting was done in January (55 days) as compared to July-August (26 days).

Singh *et al*. (2004) reported that seedling of jamun patch budded on 15th June showed the best performance in terms of bud sprouting under Uttar Pradesh conditions.

Bharad *et al.* (2006) conducted an experiment to study the effect of time and method of vegetative propagation in Jamun under Akola conditions and reported that March propagation showed the better results with bud-sprouting.

Prasanth *et al.* (2006) carried out veneer grafting in 3 mango cv's Mallika, Khader and Baneshan, at fortnightly intervals from August to December in Raichur, Karnataka and reported that grafting in September (24.50) required minimum number of days for sprouting.

Singh and Singh (2006) conducted experiments under semi – arid conditions of Gujarat to standardize the method and time of propagation in jamun under a semi-arid environment and reported that patch budded (16 days) plants and soft wood-grafted plants (15 days) sprouted earliest in July month.

Chandra *et al.* (2011) reported higher scion sprouting in pomegranate cv. Bhagawa with wedge grafting done in the last week of January after 15 (90.00 %) and 21 (96.67 %) days of grafting under Maharashtra conditions.

Seletsu *et al.* (2011) in his study on the effect of different times of T-budding in four citrus varieties i.e. lime, lemon, Kinnow and grapefruit stated that lemon budded during first week of November required minimum number of days for bud sprouting (13.30 days).

Singh *et al*. (2012) carried out at an experiment in Sabour, Bihar to study the effect of grafting methods (veneer grafting, cleft grafting and tongue grafting) and time of grafting (30th June to 15th September at fortnightly interval) on success and

growth of mango grafts and revealed that that veneer grafting performed on 15th July recorded minimum time (13.00 days) for bud sprouting.

2.4.3 Length of new scion shoot (cm)

Singh *et al.* (1992) carried out veneer grafting in mango cv's Langra and Dashehari and reported highest sprout growth with July grafting after 5 months of grafting.

Ozkan *et al.* (1993) studied the effect of season on the success and growth of bud grafts of jack fruit and reported that Patch budding in February gave significantly greater shoot length.

Brahmachari *et al.* (1997) obtained greatest average sprout length in June for veneer grafting in mango cv. Amrapali under Bhagalpur conditions.

Chovatia and Singh (2000) reported that, budding in May resulted in significantly maximum shoot length in jamun cv. Paras Local under Gujarat conditions.

Singh *et al.* (2004) reported that, seedlings of Jamun patch budded on 15th June showed the best performance in terms of height under Uttar Pradesh conditions.

Singh and Singh (2006) conducted experiment under semi – arid conditions of Gujarat to standardize the method and time of propagation in jamun under a semi-arid environment and reported that patch budded plants showed maximum length of 51.00 cm in month of March whereas soft wood-grafted plants showed maximum length of 49.12 cm in month of April after 90 days of budding.

Vural *et al.* (2008) conducted an experiment on black mulberry in cold temperate zones and reported that shoot length was 100.20 cm for budding made in May and shoot length was very short (20.2 cm) in June budding with no shoots in August budding as the grafts were killed by winter colds.

Chandra *et al.* (2011) reported higher scion length after 6 months in pomegranate cv. Bhagawa when wedge grafting done between 30th December and 30th January under Maharashtra conditions.

Ghojage *et al.* (2011) carried out soft wood grafting in jamun in Bagalkot and reported highest graft height (20.66 cm) in October which was on par with February (18.66 cm) and August (17.66 cm). On the other hand, December recorded the lowest height (12.00 cm).

In a study conducted by Seletsu *et al.* (2011) on the effect of different times of T-budding in four citrus varieties i.e. lime, lemon, Kinnow and grapefruit stated that maximum sprout length (8.87 cm) was recorded with lemon budded during first week of November.

Singh *et al.* (2012) reported that, veneer grafting in mango performed on 15th July produced maximum scion linear growth (26.25 cm) after 180 days of grafting under Bihar conditions.

2.4.4 Diameter of new scion shoot (cm)

Chovatia and Singh (2000) reported that budding in jamun cv. Paras local in May resulted in significantly maximum shoot diameter under Gujarat conditions

Singh *et al.* (2004) reported that Jamun seedlings patch budded on 15th June showed the best performance in terms of diameter under Uttar Pradesh conditions.

Bharad *et al.* (2006) reported that March propagation in Jamun showed the better results with scion diameter under Akola conditions.

Singh and Singh (2006) conducted experiments under semi – arid conditions of Gujarat to standardize the method and time of propagation in jamun under a semi-arid environment and reported that patch budded plants and soft wood-grafted plants showed maximum diameter of 1.14 cm and 1.12 cm respectively in month of March after 150 days of budding.

Ghojage *et al.* (2011) carried out soft wood grafting in jamun in Bagalkot and reported maximum graft girth in September (8.24 mm) which was significantly different from all other months while minimum graft girth was recorded in January (4.08 mm).

Seletsu *et al.* (2011) in four citrus varieties i.e. lime, lemon, Kinnow and grapefruit reported maximum sprout girth (9.09 mm) when lemon was T- budded during first week of November month.

Singh *et al*. (2012) in mango reported that, veneer grafting when performed on 30th June, produced maximum scion radial growth (12.14 mm) after 180 days of grafting under Bihar conditions.

2.4.5 Number of leaves

Singh *et al.* (1992) reported highest leaf number (8.26) with July grafting after 6 months of grafting in mango cv.'s Langra and Dashehari.

Ozkan *et al.* (1993) studied the effect of season on the success and growth of bud grafts of jack fruit and reported that patch budding in February gave significantly more leaves.

Chauvatia and Singh (1999) reported that the number of functional leaves were greater in budded plants (16.13 per shoot at 180 days) than grafted plants (14.44) in custard apple cv. Sindhan Local under Saurashtra conditions, Gujarat.

Chovatia and Singh (2000) reported that budding in May resulted in significantly maximum number of functional leaves in jamun cv. Paras local under Gujarat conditions.

Singh *et al.* (2004) reported that, Jamun seedlings patch budded on 15th June method showed the best performance in terms of leaf number under Uttar Pradesh conditions.

Ghojage *et al.* (2011) carried out soft wood grafting in jamun in Bagalkot and stated maximum number of leaves (9.33) in February which were on par with March and September (9.00) and July (7.33), while the minimum number of leaves were recorded in December (3.00).

Seletsu *et al*. (2011) in his study on the effect of different times of T-budding in four citrus varieties i.e. lime, lemon, Kinnow and grapefruit stated that maximum

number of leaves (16.97) were recorded with lemon budded during first week of November.

Singh *et al.* (2012) in mango reported that veneer grafting performed on 30th July produced maximum number of leaves (24.00) after 180 days of grafting under Bihar conditions.

2.4.6 Number of new laterals

Singh *et al.* (2004) reported that, Jamun seedlings patch budded on 15th June, showed the best performance in terms of number of branches under Uttar Pradesh conditions.

In a study conducted by Seletsu *et al.* (2011) on the effect of different times of T-budding in four citrus varieties i.e. lime, lemon, Kinnow and grapefruit stated that maximum number of branches (2.22) were recorded with lemon budded during first week of November.

2.4.7 Other growth parameters

Panicker (1986) reported 54-82 per cent final survival in mango in a trial carried out for 12 months at Dapoli in mango cv.'s Langra and Dashehari.

Singh *et al.* (1992) reported highest leaf size and highest per cent survival (86.25 %) after 6 months when veneer grafting was done in July month

Brahmachari *et al.* (1997) tried veneer grafting in mango cv. Amrapali and noted highest survival after 180 days for August grafting.

Rajesh kumar *et al.* (1999) carried out wedge grafting with scions of nine mango cultivars in mid august, 1982 and reported that reported that though higher initial graft take was observed in September grafted trees, but survival after 180 days was higher for earlier grafts (August) under Akola conditions.

Bharad *et al.* (2006) conducted an experiment to study the effect of time and method of vegetative propagation in Jamun and reported that March propagation showed the better results with final survival of grafts/ buddlings.

Prasanth *et al.* (2006) carried out veneer grafting in 3 mango cv.'s Mallika, Khader and Baneshan, at fortnightly intervals from August to December in Raichur, Karnataka and reported that, grafting in September reported highest survival percentage with lowest in July grafting.

Chandra *et al.* (2011) reported that, plant height after 6 months of grafting was higher when wedge grafting was done between 30th December and 30th January in pomegranate cv. Bhagawa.

Ghojage *et al.* (2011) studied the effect of season on softwood grafting in jamun in Bagalkot and revealed that, maximum graft survival was recorded during February month (95.97 %) followed by October (95.83 %), September (93.97 %) and June (93.02 %) months which are on par with each other. The lowest survival percentage was recorded during December (61.90 %) month.

Singh *et al.* (2012) reported highest survival (90 per cent) in mango when veneer grafting was performed on 15th July at Sabour, Bihar.

CHAPTER III

MATERIALS AND METHODS

The materials used and methods adopted during the course of the present investigation are briefly described in this chapter.

3.1 GEOGRAPHICAL LOCATION OF THE EXPERIMENTAL SITE

The present investigation entitled **"Studies on the effect of pretreatments, time and method of propagation in mango (*Mangifera indica* Linn.) cv. Baneshan"** was conducted from June 2012 to February 2013 at Fruit Research Station, Sangareddy (Medak district, Andhra Pradesh). The experimental site is situated at an altitude of 360.5 m above mean sea level at 78^{o} 67' East longitude and 17^{o} 12' North latitude.

3.2 WEATHER CONDITIONS

The climate of Sangareddy is tropical, semi-arid and dry climate. The data on weather parameters collected during the period of experimentation at meteorological station attached to Fruit Research Station, Sangareddy are presented in appendix I.

3.3 SALIENT FEATURES OF THE CULTIVAR STUDIED

Baneshan: The fruits are large-sized and the color is very attractive golden-yellow, with a very smooth skin. The shape is obliquely oval. The bearing is moderate and fairly regular (Bose and Mitra, 2001).

3.4 CULTIVATION DETAILS:

3.4.1 Media Preparation

The media was prepared by using red soil, well rotten farmyard manure (FYM) and sand in the proportion of 1:1:1.

3.5 TREATMENT DETAILS FOR EXPERIMENTS ON GRAFTING METHODS

3.5.1 Selection of rootstock for grafting

The rootstock seedlings selected for grafting experiments were healthy, vigorous, and uniform in growth. The rootstocks used for veneer grafting and T-budding were random seedlings of one year old raised in polythene bags having standard potting mixture(1:1:1 FYM, soil and sand).

3.5.2 Selection of scion

The scions used for grafting methods were collected from the mango trees cv. Baneshan which were about 6 to 8 years old growing in Fruit Research Station, Sangareddy, Medak. Healthy 6 months old shoots which were free from pests and diseases were selected as scion material.

3.5.3 Pretreatments

3.5.3.1 Precured scion wood:

Healthy scion shoots, free from pests and diseases were selected. Scion sticks were collected directly from the terminal shoots of mango tree and leaf lamina of shoots were removed leaving the petioles attached to the shoots. The shoots were allowed to remain on the tree for about 10 days till the petioles got dropped. Precured scions of size 15- 18 cm long were taken. The scion shoots having plumpy buds were collected from the mother tree in morning hours and used for both the propagation methods namely grafting and budding.

3.5.3.2 Freshly detached scion wood

Healthy scion shoots, free from pests and diseases were selected. Scion sticks were collected directly from the terminal shoots of mango tree.

3.5.4 Storage of scion wood

The scion wood both precured and freshly detached were wrapped in sphagnum moss in perforated polythene sheet and stored for 0, 3, 5 and 7 days intervals before using in both the propagation methods.

3.5.5 Propagation techniques:

3.5.5.1 Veneer grafting:

Veneer grafting resembles side grafting and is being used on rootstocks of 1-$1^{1/2}$ year having a diameter of 1 .0 to 5.0 cm.

Preparing the stock: Leaves are trimmed off below 15 cm of the root stock and a slanting cut of 2.5 to 4.0 cm long is made in a smooth area about 15 cm above the ground level. At the base of this cut, a second short inward and downward cut is given to intersect the first cut, removing a piece of wood and bark.

Preparing the scion: The scion is prepared by giving a long cut along one side and a very short cut on the opposite side to match the cuts on the stock.

The scion is then placed in to the stock, so that the cambium layers match on the longer side. After the union takes, as indicated by sprouting of the scion buds, the rootstock is cut.

3.5.5.2 T-budding

Preparing the stock: Budding knives usually have a curved tip, making it easier to cut a T-shaped slit. First, insert the point of the knife and use a single motion to cut the top of the T. Then without removing the point of the knife, twist it perpendicularly to the original cut and rock the blade horizontally down the stem to make the vertical slit of the T. If bark is slipping properly, a slight twist of the knife at the end of this cut will pop open the flaps of the cut and make it easier to insert the bud**.**

Removing buds from the bud stick: The bud to be inserted is often just a shield of bark with a bud attached or a very thin layer of wood with both the bark shield and bud attached. Begin the first scion cut about $^{1}/2$ inch below the bud and draw the knife upward just under the bark to a point at least $^{1}/4$ inch above the bud. Grasp the petiole from the detached leaf between the thumb and forefinger of the free hand. Make the second cut by rotating the knife blade straight across the horizontal axis of the bud stick and about 1/4 inch above the desired bud. This cut should be deep enough to remove the bud, its shield of bark and a thin sliver of wood.

Caution: Straight lifting rather than the sideward motion will separate the bud from the bark rather than keeping it intact.

Inserting the bud: Insert the bud shield into the 'T' flaps of the stock and slide it down to ensure that it makes intimate contact with the rootstock.

Securing the bud: Pull the cut together by winding a 4 or 5-inch long budding rubber around the stem to hold the flaps tightly over the bud shield and prevent drying. Do not cover the bud.

3.5.6 After care

The polythene bags containing grafts were watered periodically. Weeds were removed by hand weeding. The side shoots arising from the rootstock portion of the grafts were removed as and when they appeared.

3.5.7 Plant protection

Regular plant protection measures were taken as per the nursery management practices (Reddy and Shukla, 2007)

3.6 EXPERIMENTAL DETAILS

In the present study, two experiments were conducted.

EXPERIMENT-1:

EFFECT OF PRETREATMENTS AND STORAGE OF SCION-WOOD ON GRAFT TAKE AND GROWTH IN DIFFERENT METHODS OF GRAFTING IN MANGO cv. BANESHAN

Design	: Factorial RBD
Replications	: 3
Number of grafts per replication	: 40
Total number of treatments	: 16

TREATMENTS:

Factor-1	Factor-2	Factor-3
Method of grafting	Period of storage	
G_1-Veneergrafting	S_1-0 days	P_1-Precuring
G_2-T-budding	S_2-3 days	P_2-Withoutprecuring
	S_3-5 days	
	S_4-7 days	

TREATMENT COMBINATIONS:

T_1-Precured scion sticks stored for 0 days and veneer grafted

T_2-Un precured scion sticks stored for 0 days and veneer grafted

T_3- Precured scion sticks stored for 3 days and veneer grafted

T_4-Un precured scion sticks stored for 3 days and veneer grafted

T_5- Precured scion sticks stored for 5 days and veneer grafted

T_6-Un precured scion sticks stored for 5 days and veneer grafted

T_7-Precured scion sticks stored for 7 days and veneer grafted

T_8- Un precured scion sticks stored for 7 days and veneer grafted

T_9-Precured scion sticks stored for 0 days and T-Budded

T_{10}-Un precured scion sticks stored for 0 days and T-Budded

T_{11}-Precured scion sticks stored for 3 days and T-Budded

T_{12}-Un precured scion sticks stored for 3 days and T-Budded

T_{13}-Precured scion sticks stored for 5 days T-Budded

T_{14}-Un precured scion sticks stored for 5 days and T-Budded

T_{15}-Precured scion sticks stored for 7 days and T-Budded

T_{16}-Un precured scion sticks stored for 7 days and T-Budded

EXPERIMENT-2:

EFFECT OF SEASON ON GRAFT TAKE AND GROWTH IN MANGO cv. BANESHAN

Design : Factorial RBD

Replications : 3

Number of grafts per replication : 40

Total number of treatments : 16

Best of treatment combination in veneer grafting and T-budding from Experiment-1 were taken for Experiment-2 and tested for their suitable time of propagation in both the methods.

TREATMENT COMBINATIONS:

T_1-Best of Experiment (in veneer grafting) and grafting at 1st fortnight August

T_2- Best of Experiment (in veneer grafting) and grafting at 2nd fortnight August

T_3- Best of Experiment (in veneer grafting) and grafting at 1st fortnight September

T_4-Best of Experiment (in veneer grafting) and grafting at 2nd fortnight September

T_5- Best of Experiment (in veneer grafting) and grafting at 1st fortnight October

T_6- Best of Experiment (in veneer grafting) and grafting at 2nd fortnight October

T_7-Best of Experiment (in veneer grafting) and grafting at 1st fortnight November

T_8-Best of Experiment (in veneer grafting) and grafting at 2nd fortnight November

T_9- Best of Experiment (in T-budding) and budded at 1st fortnight August

T_{10}- Best of Experiment (in T-budding) and budded at 2nd fortnight August

T_{11}- Best of Experiment (in T-budding) and budded at 1st fortnight September

T_{12}- Best of Experiment (in T-budding) and budded at 2nd fortnight September

T_{13}- Best of Experiment (in T-budding) and budded at 1st fortnight October

T_{14}- Best of Experiment (in T-budding) and budded at 2nd fortnight October

T_{15}- Best of Experiment (in T-budding) and budded at 1st fortnight November

T_{16}- Best of Experiment (in T-budding) and budded at 2nd fortnight November

3.7 COLLECTION OF DATA

Sampling procedure

The following observations were recorded on single plant basis on ten randomly selected plants in each replication in each treatment at 15 days interval.

3.8 OBSERVATIONS ON GRAFT TAKE AND GROWTH IN DIFFERENT METHODS OF PROPAGATION IN MANGO cv. BANESHAN

3.8.1 Number of days taken for bud break

The number of days taken for bud burst and appearance of rudimentary leaves was recorded on ten randomly selected grafts and expressed as number of days taken for sprouting of buds on scion.

3.8.2 Percentage of graft/bud take

Those grafts in which the scion had sprouted and remained alive without shriveling at the time of observations were noted and percentage of graft success

was worked out. The graft-take was calculated using the following formula and expressed in per cent.

$$\text{Graft-take (\%)} = \frac{\text{Total number of scions sprouted}}{\text{Total number of scions grafted}} \times 100$$

3.8.3 Number of flushes per scion

Every fresh growth on the scion was considered as a new flush. Whenever the new flush arises, it was noted and the number was added to the earlier one. The number of flushes per scion was recorded on ten randomly selected plants in each replication at 15 days interval from 30 days after grafting up to a period of 105 days.

3.8.4 Length of new scion shoot (cm)

Ten grafts were selected at random for measuring the length of new shoot growth, developed or initiated from the scion stick grafted. It was recorded at 15 days interval from 30 days after grafting up to a period of 105 days.

3.8.5 Diameter of new scion shoot (cm)

Ten grafts were selected at random for measuring scion diameter in each replication. The diameter of fresh growth on scion stick initiated after grafting was recorded at 15 days interval from 30 days after grafting up to a period of 105 days using Vernier callipers.

3.8.6 Number of leaves per shoot

The number of leaves emerged were counted on ten randomly selected grafts in each replication and recorded at 15 days interval from 30 days after grafting up to a period of 105 days in both the propagation methods.

3.8.7 Internodal length (cm)

The length between the two nodes is considered as internodal length. The internodal length was recorded for ten randomly selected grafts and at 15 days

interval from 30 days after grafting up to a period of 105 days and expressed in centimeters.

3.8.8 Number of new laterals

The new shoots arising from the scion shoots were counted on ten randomly selected grafts in each replication at 15 days interval from 30 days after grafting up to a period of 105 days in both the grafting methods.

3.8.9 Length of new laterals (cm)

The length of new shoots arising from the scion shoots were counted on ten randomly selected grafts in each replication at 15 days interval from 30 days after grafting up to a period of 105 days in both the grafting methods.

3.9 STATISTICAL ANALYSIS

The design adopted was randomized block design and with factorial concept and the data were subjected to statistical analysis as per the procedure outlined by Panse and Sukhatme (1985). Critical difference (CD) values were calculated wherever the 'F' test was found to be significant.

The data were processed at Computer Centre, Acharya N. G. Ranga Agricultural University, Rajendranagar, Hyderabad using established statistical methods.

CHAPTER IV

RESULTS AND DISCUSSION

The present investigation on the **"Studies on the effect of pretreatments, time and method of propagation in mango (*Mangifera indica* L.) cv. Baneshan"** was conducted at Fruit Research Station, Sangareddy during June 2012 to February 2013. The data were collected and statistically analyzed and the results obtained are presented in this chapter.

4.1 EFFECT OF PRETREATMENTS AND STORAGE OF SCION-WOOD ON GRAFT TAKE AND GROWTH IN DIFFERENT METHODS OF PROPAGATION IN MANGO cv. BANESHAN

4.1.1 Bud take (%)

The data pertaining to bud take (%) in mango cv. Baneshan are presented in Table 4.1.1 and Fig 4.1.1. The bud take (%) of mango scions has differed significantly due to method of propagation, pretreatments, storage and their interaction effects.

Among the propagation methods veneer grafting recorded significantly mean maximum bud take (69.16) with complete failure in T-budding (0.00).

Precured scion recorded significantly mean maximum bud take (34.60) when compared to non precured scion wood (18.90).

Among the storage periods for scion wood, 3 days storage recorded mean maximum bud take (33.48) followed by 0 days (26.78) and 5 days storage (25.33) with mean minimum bud take in 7 days storage (21.42).

Interaction between method of propagation and pretreatments given to scion wood were significant. Significantly maximum bud take (%) was noticed in

precured scion when veneer grafted (84.16) in relation to non precured scion (54.16). Only veneer grafted plants survived whereas complete failure was observed in T-budded plants.

The interaction effects between method of propagation and storage of scion wood were significant. Significantly maximum bud take was noticed in precured scion with 3 days storage (80.00) followed by 0 days (68.18), 5 days (66.66) and 7 days storage (60.00). Significantly minimum bud take (%) was found in T-budded plants which did not survive.

The interaction effects between pretreatments and storage of scion wood were significant. Significantly maximum bud take was noticed in precured scion with 3 days storage (44.37) followed by 0 days (37.58), 5 days (30.84) and 7 days storage (25.63) respectively where as minimum bud take was recorded in non precured scions with 0 days storage (15.98) followed by 7 days storage (17.22) and 5 days storage(19.82).

Three way interactions between method of propagation, type of scion and storage interval of scion were statistically significant. Significantly highest bud take (96.67) was recorded in precured scion stored for 3 days interval and veneer grafted followed by 0 days storage (90.00) and significantly minimum bud take was noticed in non precured scion wood with 0 days storage (46.37) followed by 7 days storage (50.00) .

The anatomy of bud union in T-budding involves different stages as observed by Soule (1971), which includes the pre-callus stage (i.e., 4 days after the budding) only a periderm was present, at the callus stage(8 days after budding) proliferation from the tissues mainly near the cambium resulted in firm attachment of the components; at cambial stage (12 days after budding) cambial layers from the stock and the scion formed a bridge and vascular tissues were differentiated within 36-48 days (Bose *et al*., 2005). Hence the failure in T-budding in mango might be due to

the incomplete bud union or due to lack of development of vascular connections in between the bud and the stock.

A perusal of the data revealed that, bud take percentage in veneer grafting was higher when pre defoliated scions were used as compared to that of freshly defoliated scions. This is probably because pre defoliated scions suffer less from dessication than those of freshly defoliated scions, which retain their leaf stalks for some time after grafting and cut ends of the leaf stalk accelerate the dessication process. The results are in conformity with Ram and Bist (1982) and Maiti and Biswas (1980). Success with storage of scions was probably because of protection of scions from dehydration. The success due to precuring may be due to swelling of buds resulting in better sprouting in precured scions as explained by Dhandar (1985).

Since there was no bud take (%) in T- budding method, only veneer grafting was considered as the method of propagation for the parameters mentioned below.

4.1.2 Number of days taken for bud break

The data pertaining to number of days taken for bud break in mango cv. Baneshan are presented in Table 4.1.2 and Fig 4.1.2. The number of days taken for bud break of mango scions differed significantly due to pretreatments, storage and their interaction effects.

Among the type of scion wood studied, precured scion wood defoliated for ten days recorded mean minimum number of days for bud break (14.33) which was significantly superior to non precured scions (16.75).

Storage of mango scion wood for 3 days recorded mean minimum number of days for initiation of bud break (14.11) which was significantly superior to 0 days storage (15.51) followed by 5 days (16.11) whereas, the scions stored for 7 days recorded significantly mean maximum number of days (16.41) for initiation of bud break over other treatments studied.

The interaction between pretreatments and storage intervals of scion wood differed significantly with respect to number of days taken for bud break. Among the type of scion wood used, precured scion wood defoliated 10 days before veneer grafting with its storage up to 3 days recorded minimum number of days for bud break (12.13) which was significantly superior to 0 days (13.80), 5 days (15.50) and 7 days (15.90) storage respectively where as minimum number of days taken for bud break were recorded in non precured scions with 0 days storage (17.23) followed by 7 days storage (16.93) and 5 days (16.73) storage.

The observations from table 4.1.2 and fig 4.1.2 confirm that precured scions defoliated 10 days before grafting took minimum number of days for bud break when compared to non precured scion wood. This might be due to the fact that defoliation causes an immediate rise in sucrose content of phloem sap of the shoots (Zimmerman, 1985b), which helped in movement of the solutes towards the apex of the shoot (Munch, 1930) and there by resulting in higher meristematic activity at the bud level. This was in conformity with Jha and Shyamal (1995).

Among the storage periods 3 days storage recorded minimum number of days for bud break where as storage for longer period may have resulted in depletion of stored food material due to respiration. The results were in conformity with Kochar and Krishnamoorthy (1984).

The interaction between pretreatments and storage intervals of scion wood revealed that, precured scion wood defoliated 10 days before grafting and stored for 3 days recorded minimum number of days for bud break. These findings are in conformity with the results obtained by Roy and Hoda (1996) and Kumar and Jain (1997). The reason behind the least time consumed in bud break might be the activation of the shoots due to pretreatment of defoliation and storage.

4.1.3 Number of flushes produced

The data pertaining to number of flushes produced in mango cv. Baneshan are presented in Table 4.1.3 and Fig. 4.1.3. The number of flushes in mango scions differed significantly due to pretreatments, storage and their interaction effects**.**

4.1.3.1 30 Days after grafting (30 DAG)

With regard to pretreatments given to scion wood, precured scion defoliated 10 days before grafting wood recorded mean maximum number of flushes (1.128) which was significantly superior to non precured scion wood (0.793).

Number of flushes produced were found to be significantly influenced by different storage intervals of scion wood. Maximum mean number of flushes were registered during 3 days storage (1.060) followed by 0 days storage (0.955), 5 days storage (0.935) and 7 days storage (0.890) respectively.

The interaction studies between pretreatments and storage of scion wood, revealed that among the type of scion wood used, precured scion with 3 days storage (1.220) recorded maximum number of flushes which were significantly superior to 0 days storage (1.180) followed 5 days (1.080) and 7 days storage (1.030) respectively where as minimum number of flushes produced were recorded in non precured scions with 0 days storage (0.730) followed by 7 days storage (0.750).

4.1.3.2 45 Days after grafting (45 DAG)

Among the pre treatments made for scion wood, precured scion wood defoliated for 10 days before grafting recorded mean maximum number of flushes (1.235) which was significantly superior to non precured scion wood (0.853).

Storage of mango scion wood for 3 days recorded mean maximum number of flushes (1.155) followed by 0 days storage (1.040), 5 days storage (1.015) respectively and 7 days storage recorded significantly mean minimum number of flushes (0.965) over other treatments studied.

The interaction between pre treatments and storage of scion wood differed significantly for number of flushes. Among the type of scion wood used, precured scion wood with 3 days storage (1.350) recorded maximum number of flushes which was found significantly superior to 0 days storage (1.300), 5 days storage (1.170) and 7 days storage (1.120) respectively where as minimum number of flushes produced were recorded in non precured scion wood with 0 days storage (0.780) followed by 7 days storage (0.810) and 5 days storage (0.860).

4.1.3.3 60 Days after grafting (60 DAG)

With regard to pretreatments given to scion wood, precured scion defoliated 10 days before grafting recorded mean maximum number of flushes (1.315) which was significantly superior to non precured scion wood (0.898).

Number of flushes were found significantly influenced by different storage intervals of scion wood. Maximum mean number of flushes were registered during 3 days storage (1.245) followed 0 days storage (1.100), 5 days (1.070) and 7 days storage (1.010) respectively.

The interaction studies between pretreatments and storage of scion wood, revealed that among the type of scion wood used, precured scion with 3 days storage (1.470) recorded maximum number of flushes which were significantly superior to 0 days storage (1.380) followed by 5 days (1.240) and 7 days storage (1.170) respectively where as minimum number of flushes produced were recorded in non precured scion wood with 0 days storage (0.820) followed by 7 days storage (0.850).

4.1.3.4 75 Days after grafting (75 DAG)

Number of flushes produced were significantly influenced by different pretreatments given to scion wood. Precured scion wood defoliated 10 days before grafting recorded mean maximum number of flushes (1.388) with respect to non precured scion wood (0.990).

Significant differences were noticed among treatments regarding storage where scion wood stored for 3 days (1.310) reported mean maximum number of flushes followed by 0 days storage (1.190), 5 days storage (1.155) and 7days storage (1.100) respectively.

The interaction between pretreatments and storage of scion wood differed significantly for number of flushes. Among the type of scion wood used, precured scion wood with 3 days storage recorded maximum number of flushes (1.540) which was found significantly superior to 0 days storage (1.460), 5 days storage (1.310) and 7 days storage (1.240) respectively where as minimum number of flushes

produced were recorded in non precured scion wood with 0 days storage (0.920) followed by 7 days storage (0.960).

4.1.3.5 90 Days after grafting (90 DAG)

Among the pretreatments made for scion wood, precured scion wood defoliated for 10 days recorded mean maximum number of flushes (1.455) which was significantly superior to non precured scion wood (1.043).

Storage of mango scion wood for 3 days recorded mean maximum number of flushes (1.400) followed by 0 days storage (1.270) and 5 days storage (1.200) respectively. Whereas, the scion wood with 7 days storage recorded significantly mean minimum number of flushes (1.140) over other treatments studied.

The interaction between pretreatments and storage of scion wood differed significantly for number of flushes. Among the type of scion wood used, precured scion wood with 3 days storage recorded maximum number of flushes (1.650) which were found significantly superior to 0 days storage (1.580), 5 days storage (1.340) and 7 days storage (1.280) respectively where as minimum number of flushes produced were recorded in non precured scion wood with 0 days storage (0.960) followed by 7 days storage (1.000).

4.1.3.6 105 Days after grafting (105 DAG)

With regard to pretreatments given to scion wood, precured scion wood defoliated 10 days before grafting recorded mean maximum number of flushes (1.505) which was significantly superior to non precured scion wood (1.083).

Number of flushes were found significantly influenced by different storage intervals of scion wood. Maximum mean number of flushes were registered during 3 days storage (1.455) followed by 0 days storage (1.315), 5 days (1.235) and 7 days storage (1.170) respectively.

In the interaction studies, it was observed that, among the type of scion wood used, precured scions stored up to 3 days recorded maximum number of flushes (1.710) which were significantly superior to 0 days storage (1.630) followed by 5 days (1.380) and 7 days storage (1.300) respectively where as minimum number of

flushes produced were recorded in non precured scions with 0 days storage (1.000) followed by 7 days (1.040) and 5 days storage (1.090).

The observations from table 4.1.3 and fig. 4.1.3 confirm that, precured scions defoliated 10 days before grafting with 3 days storage recorded maximum number of flushes, it might be due to the fact that defoliated bud wood used for propagation, may be quite rich in carbohydrates and other stored food substances (Abhay Mankar *et al.,* 1999). Precuring of scions resulted in vigorous growth of the graft (Viswa Prasad *et al.*, 1990) and several other workers (Mukherjee and Majumdar, 1964 and Singh and Srivastava, 1979) emphasized the importance of precuring.

4.1.4. Length of new scion shoot (cm)

The data pertaining to length of new scion shoot of mango cv. Baneshan are presented in Table 4.1.4 and Fig. 4.1.4. The length of new scion differed significantly due to pre treatments, storage of scion wood and their interaction effects.

4.1.4.1 30 Days after grafting (30 DAG)

Among the pretreatments given to scion wood, precured scion wood defoliated 10 days before grafting recorded mean maximum length of new scion shoot (2.013) which was significantly superior to non precured scion wood (1.476).

Storage of mango scion wood for 3 days recorded mean maximum scion shoot length (1.913) followed by 0 days storage (1.742), 5 days storage (1.712) respectively whereas, the scions with 7 days storage recorded significantly mean minimum scion shoot length (1.610) over other treatments studied.

The data regarding the interaction effects revealed that among the type of scion wood used, precured scion wood with 3 days storage (2.210) recorded maximum scion shoot length which was significantly superior to 0 days storage (2.107 cm) followed by 5 days (1.917) and 7 days storage (1.817) respectively where as minimum length of new scion shoot was recorded in the non precured scion wood stored for 0 days (1.377) followed by 7 days storage (1.403).

4.1.4.2 45 Days after grafting (45 DAG)

Among the pretreatments given for scion wood, precured scion wood defoliated for 10 days recorded mean maximum scion shoot length (2.398) which was significantly superior to non precured scion wood (1.808).

Storage of mango scion wood for 3 days recorded mean maximum scion shoot length (2.392) followed by 0 days storage (2.079) and 5 days storage (2.006) respectively. Whereas, the scion wood with 7 days storage recorded significantly minimum scion shoot length (1.925) over other treatments studied.

The results relating to the interaction studies between pretreatments and storage of scion wood showed that, among the type of scion wood used, precured scion with 3 days storage (2.783) recorded maximum scion shoot length which was significantly superior to 0 days storage (2.460) followed by 5 days storage (2.210) and 7 days storage (2.117) respectively where as minimum scion shoot length was recorded in non precured scion wood with 0 days storage (1.698 cm) followed by 7 days storage (1.733) .

4.1.4.3 60 Days after grafting (60 DAG)

Among the pretreatments done for scion wood, defoliated scion wood for 10 days recorded mean maximum scion shoot length (3.193) which was significantly superior to non precured scion wood (2.026).

Storage of mango scion wood for 3 days recorded mean maximum scion shoot length (3.067) followed by 0 days storage (2.644) and 5 days storage (2.530) respectively. Whereas, the scion wood with 7 days storage recorded significantly mean minimum scion shoot length (2.210) over other treatments studied.

The interaction between pretreatments and storage of scion wood differed significantly for scion shoot length. Among the type of scion wood used, precured scion wood with 3 days storage recorded maximum scion shoot length (3.890) which was found significantly superior to 0 days storage (3.490), 5 days storage (2.970) and 7 days storage (2.443) respectively where as minimum scion shoot length was recorded in non precured scion with 0 days storage (1.798) followed by 7 days storage (1.977).

4.1.4.4 75 Days after grafting (75 DAG)

Among the pretreatments made for scion wood, precured scion wood defoliated for 10 days recorded mean maximum scion shoot length (3.709) which was significantly superior to non precured scion wood (2.526).

Storage of mango scion wood for 3 days recorded mean maximum scion shoot length (3.622) followed by 0 days storage (3.080) and 5 days storage (2.952) respectively. Whereas, the scion wood with 7 days storage recorded significantly mean minimum scion shoot length (2.736) over other treatments studied.

The interaction between pretreatments and storage of scion wood differed significantly for scion shoot length. Among the type of scion wood used, precured scion wood with 3 days storage recorded maximum scion shoot length (4.233) which was found significantly superior to 0 days storage (3.917), 5 days storage (3.407) and 7 days storage (3.120) respectively where as minimum scion shoot length was recorded in non precured scion wood with 0 days storage (2.243) followed by 7 days storage (2.353).

4.1.4.5 90 Days after grafting (90 DAG)

Among the pretreatments made for scion wood, precured scion wood defoliated for 10 days recorded mean maximum scion shoot length (4.639) which was significantly superior to non precured scion wood (3.063).

Storage of mango scion wood for 3 days recorded mean maximum scion shoot length (4.545) followed by 0 days storage (3.792) and 5 days storage (3.650) respectively. Whereas, the scion wood with 7 days storage recorded significantly mean minimum scion shoot length (3.417) over other treatments studied.

The results relating to the interaction studies between pretreatments and storage of scion wood showed that among the type of scion wood used, precured scion wood with 3 days storage recorded maximum scion shoot length (5.350) which was found significantly superior to 0 days storage (4.983), 5 days storage (4.203) and 7 days storage (4.020) respectively where as minimum scion shoot length was recorded in non precured scion wood with 0 days storage (2.600) followed by 7 days storage (2.813).

4.1.4.6 105 Days after grafting (105 DAG)

Among the pre treatments made for scion wood, defoliated scion wood for 10 days recorded mean maximum scion shoot length (5.424) which was significantly superior to non precured scion wood (3.700).

Storage of mango scion wood for 3 days recorded mean maximum scion shoot length (5.193) followed by 0 days storage (4.548) and 5 days storage (4.350) respectively. Whereas, the scion wood with 7 days storage (4.157) recorded significantly mean minimum scion shoot length over other treatments studied.

The results relating to the interaction studies between pretreatments and storage of scion wood showed that among the type of scion wood used, precured scion wood with 3 days storage recorded maximum scion shoot length (6.133 cm) which was found significantly superior to 0 days storage (5.803 cm), 5 days storage (5.000 cm) and 7 days storage (4.760 cm) respectively where as minimum scion shoot length was recorded in non precured scion with 0 days storage (3.293 cm) followed by 7 days storage (3.553 cm).

The observations from table 4.1.4 and fig. 4.1.4 confirm that precured scions defoliated 10 days before grafting with 3 days storage recorded maximum scion shoot length. The results were in conformity with Dod *et al*. (1996) and Jha and Brahmachari (2002), Dhakal and Hoda (1986). The good performance of this treatment might have been due to the sufficient accumulation of food materials in the defoliated scion shoots and also due to more number of leaves produced in this treatment that synthesized photosynthates where as minimum scion length observed in 5 and 7 days storage may be due to the fact that longer storage leads to loss of vigour of cambium tissue due to respiration. Such observation was also put forth by Kochar and Krishnamoorthy (1984).

4.1.5 Diameter of new scion shoot (cm)

The data pertaining to diameter of new scion shoot of mango cv. Baneshan are presented in Table 4.1.5 and Fig.4.1.5. There were significant differences in new scion shoot diameter due to pre treatments, storage and their interaction effects.

4.1.5.1 30 Days after grafting (30 DAG)

With regard to pretreatments given to scion wood, precured scion wood defoliated 10 days before grafting wood recorded mean maximum scion shoot diameter (0.174) which was significantly superior to non precured scion wood (0.119).

Diameter of new scion shoot was found significantly influenced by different storage intervals of scion wood. Mean maximum diameter of new scion shoot was registered during 3 days storage (0.177) followed by 0 days storage (0.149), 5 days storage (0.138) and 7 days storage (0.123) respectively.

The interaction studies between pretreatments and storage of scion wood, revealed that among the type of scion wood used, precured scion with 3 days storage recorded maximum scion shoot diameter (0.217) which was significantly superior to 0 days storage (0.192) followed by 5 days (0.155) and 7 days storage (0.123) respectively where as minimum scion shoot diameter was recorded in non precured scion wood with 0 days storage (0.106) followed by 7 days storage (0.113).

4.1.5.2 45 Days after grafting (45 DAG)

Among the pretreatments made for scion wood, defoliated scion wood for 10 days recorded mean maximum scion shoot diameter (0.253) which was significantly superior to non precured scion wood (0.141).

Storage of mango scion wood for 3 days recorded mean maximum scion shoot diameter (0.248) followed by 0 days storage (0.205) and 5 days storage respectively (0.170). Whereas, the scion wood with 7 days storage recorded significantly mean minimum scion shoot diameter (0.161) over other treatments studied.

The interaction between pretreatments and storage of scion wood differed significantly for scion shoot diameter. Among the type of scion wood used, precured scion wood with 3 days storage recorded maximum scion shoot diameter (0.320) which was found significantly superior to 0 days storage (0.293), 5 days storage (0.200) and 7 days storage (0.193) respectively where as minimum scion shoot

diameter was recorded in non precured scion wood with 0 days storage (0.117) followed by 7 days storage (0.130).

4.1.5.3 60 Days after grafting (60 DAG)

With regard to pretreatments given to scion wood, precured scion defoliated 10 days before grafting wood recorded mean maximum scion shoot diameter (0.288) which was significantly superior to non precured scion wood (0.163).

Diameter of new scion was found significantly influenced by different storage intervals of scion wood. Mean maximum scion shoot diameter was registered during 3 days storage (0.280) followed by 0 days storage (0.225), 5 days (0.212) and 7 days storage (0.185) respectively.

The interaction studies between pretreatments and storage of scion wood, revealed that among the type of scion wood used, precured scion with 3 days storage recorded maximum scion shoot diameter (0.357) which was significantly superior to 0 days storage (0.323) followed 5 days (0.247) and 7 days storage (0.227) respectively where as minimum scion shoot diameter was recorded in non precured scion with 0 days storage (0.127) followed by 7 days storage (0.143).

4.1.5.4 75 Days after grafting (75 DAG)

New scion shoot diameter was significantly influenced by different pretreatments given to scion wood. Precured scion defoliated 10 days before grafting recorded mean maximum scion shoot diameter (0.356) with respect to non precured scion wood (0.197)

Significant differences were noticed among the treatments regarding storage where scion wood stored for 3 days (0.338) reported mean maximum scion shoot diameter followed by 0 days storage (0.272), 5 days storage (0.257) and 7 days storage (0.235) respectively.

The interaction between pre treatments and storage of scion wood differed significantly for scion shoot diameter. Among the type of scion wood used, precured scion wood with 3 days storage recorded maximum scion shoot diameter (0.433) which was significantly superior to 0 days storage (0.390), 5 days storage

(0.310) and 7 days storage (0.290) and minimum scion shoot diameter was recorded with 0 days storage (0.153) followed by 7 days storage (0.180).

4.1.5.5 90 Days after grafting (90 DAG)

Among the pretreatments made for scion wood, precured scion wood defoliated for 10 days recorded mean maximum scion shoot diameter (0.398) which was significantly superior to non precured scion wood (0.233).

Storage of mango scion wood for 3 days recorded mean maximum scion shoot diameter (0.387) followed by 0 days storage (0.305) and 5 days storage (0.295) respectively. Whereas, the scion wood with 7 days storage (0.273) recorded significantly mean minimum scion shoot diameter over other treatments studied.

The interaction between pretreatments and storage of scion wood differed significantly for scion shoot diameter. Among the type of scion wood used, precured scion wood with 3 days storage recorded maximum scion shoot diameter (0.470) which was found significantly superior to 0 days storage (0.427), 5 days storage (0.360) and 7 days storage (0.333) respectively where as minimum scion shoot diameter was recorded in non precured scion wood with 0 days storage (0.183) followed by 7 days storage (0.213).

4.1.5.6 105 Days after grafting (105 DAG)

With regard to pretreatments given to scion wood, precured scion defoliated 10 days before grafting wood recorded mean maximum scion shoot diameter (0.471) which was significantly superior to non precured scion wood (0.295).

Diameter of new scion shoot was found significantly influenced by different storage intervals of scion wood. Mean maximum scion shoot diameter were registered during 3 days storage (0.447) followed by 0 days storage (0.378), 5 days storage (0.365) and 7 days storage (0.342) respectively.

The interaction studies between pre treatments and storage of scion wood, revealed that among type of scion wood used, precured scion wood with 3 days storage recorded maximum scion shoot diameter (0.533) which was significantly superior to 0 days storage (0.507) followed 5 days (0.430) and 7 days storage

(0.413) respectively where as minimum scion shoot diameter was reported in non precured scion with 0 days storage (0.250) followed by 7 days storage (0.270).

The observations from table 4.1.5 and fig. 4.1.5 confirm that, precured scions defoliated 10 days before grafting with 3 days storage recorded maximum diameter, it might be due to early sprouting of buds giving quick growth as explained by Patil *et al.,* (1983) and the results are in conformity with Jha and Brahmachari (2002).

4.1.6 Number of leaves per shoot

The data pertaining to number of leaves per shoot of mango cv. Baneshan are presented in Table 4.1.6 and Fig. 4.1.6. There were significant differences in number of leaves per shoot due to pre treatments, storage and their interaction effects.

4.1.6.1 30 Days after grafting (30 DAG)

Among the pretreatments made for scion wood, defoliated scion wood for 10 days recorded mean maximum number of leaves per shoot (6.875) which was significantly superior to non precured scion wood (5.607).

Storage of mango scion wood for 3 days recorded mean maximum number of leaves per shoot (6.748) followed by 0 days storage (6.252) and 5 days storage (6.110) respectively. Whereas, the scion wood with 7 days storage recorded significantly mean minimum number of leaves per shoot (5.853) over other treatments studied.

The results relating to the interaction studies between pretreatments and storage of scion wood differed significantly for number of leaves per shoot. Among the type of scion wood used, precured scion wood with 3 days storage recorded maximum number of leaves per shoot (7.493) which was found significantly superior to 0 days storage (7.300), 5 days storage (6.500) and 7 days storage (6.207) respectively where as minimum number of leaves per shoot was recorded in non precured scion wood with 0 days storage (5.203) followed by 7 days storage (5.500).

4.1.6.2 45 Days after grafting (45 DAG)

Number of leaves were found significantly influenced by different pretreatments given to scion wood. Precured scion defoliated 10 days before grafting

recorded mean maximum number of leaves per shoot (7.438) with respect to non precured scion wood (6.058).

Significant differences were noticed among different storage intervals in mango cv. Baneshan. Mean maximum number of leaves per shoot were observed during 3 days storage (7.300) followed by 0 days storage (6.755) and 5 days storage (6.550) where as mean minimum number of leaves per shoot were recorded in 7 days storage (6.360).

Interaction effects of pretreatments and storage of scion wood exerted significantly prominent effect on number of leaves per shoot. Among the type of scion wood used, precured scion wood with 3 days storage recorded maximum number of leaves per shoot (8.100) which was significantly superior to 0 days storage (7.850), 5 days storage (7.000) and 7 days storage (6.800) respectively where as minimum number of leaves per shoot was recorded in 0 days (5.660) followed by 7 days storage (5.920).

4.1.6.3 60 Days after grafting (60 DAG)

Among the pretreatments made for scion wood, precured scion wood defoliated for 10 days recorded mean maximum number of leaves per shoot (8.119) which was significantly superior to non precured scion wood (6.449).

Storage of mango scion wood for 3 days recorded mean maximum number of leaves per shoot (7.890) followed by 0 days storage (7.305) and 5 days storage (7.177) respectively. Whereas, the scion wood with 7 days storage recorded significantly mean minimum number of leaves per shoot (6.765) over other treatments studied.

The interaction between pretreatments and storage of scion wood differed significantly for number of leaves per shoot. Among the type of scion wood used, precured scion wood with 3 days storage recorded maximum number of leaves per shoot (8.830) which was found significantly superior to 0 days storage (8.560), 5 days storage (7.857) and 7 days storage (7.230) respectively where as minimum

number of leaves per shoot was recorded in non precured scion wood with 0 days storage (6.050) followed by 7 days storage (6.300).

4.1.6.4 75 Days after grafting (75 DAG)

With regard to pretreatments given to scion wood, precured scion wood defoliated 10 days before grafting wood recorded mean maximum number of leaves per shoot (8.578) which was significantly superior to non precured scion wood (6.938).

Number of leaves per shoot were found significantly influenced by different storage intervals of scion wood. Mean maximum number of leaves per shoot were registered during 3 days storage (8.310) followed by 0 days storage (7.800), 5 days storage (7.695) and 7 days storage (7.225) respectively.

The interaction studies between pretreatments and storage of scion wood, revealed that, among type of scion wood used, precured scion with 3 days storage recorded maximum number of leaves per shoot (9.220) which was significantly superior to 0 days storage (9.050) followed 5 days (8.340) and 7 days storage (7.700) respectively where as minimum number of leaves per shoot was recorded in non precured scion wood with 0 days storage (6.550) followed by 7 days storage (6.750).

4.1.6.4 90 Days after grafting (90 DAG)

Number of leaves per shoot were found significantly influenced by different pre treatments given to scion wood. Precured scion defoliated 10 days before grafting recorded mean maximum number of leaves per shoot (8.940) with respect to non precured scion wood (7.423).

Significant differences were noticed among treatments regarding storage where scion wood stored for 3 days reported mean maximum number of leaves per shoot (8.785) followed by 0 days storage (8.140), 5 days storage (8.105) and 7 days storage (7.695) respectively.

The interaction between pretreatments and storage of scion wood differed significantly for number of leaves per shoot. Among the type of scion wood used,

precured scion wood with 3 days storage recorded maximum number of leaves per shoot (9.720) which was found significantly superior to 0 days storage (9.300), 5 days storage (8.680) and 7 days storage (8.060) respectively where as minimum number of leaves was recorded in non precured scion wood with 0 days storage (6.980) followed by 7 days storage (7.330).

4.1.6.6 105 Days after grafting (105 DAG)

Among the pretreatments made for scion wood, defoliated scion wood for 10 days recorded mean maximum number of leaves per shoot (9.393) which was significantly superior to non precured scion wood (7.793).

Storage of mango scion wood for 3 days recorded mean maximum number of leaves per shoot (9.230) followed by 0 days storage (8.625), and 5 days storage (8.470) respectively. Whereas, the scion wood with 7 days storage recorded significantly mean minimum number of leaves per shoot (8.045) over other treatments studied.

The interaction between pretreatments and storage of scion wood differed significantly for number of leaves per shoot. Among the type of scion wood used, precured scion wood with 3 days storage recorded maximum number of leaves per shoot (10.160) which was found significantly superior to 0 days storage (9.850), 5 days storage (9.100) and 7 days storage (8.460) respectively where as minimum number of leaves per shoot was recorded in non precured scion wood with 0 days storage (7.400) followed by 7 days storage (7.630).

The observations from table 4.1.6 and fig. 4.1.6 confirm that precured scions defoliated 10 days before grafting with 3 days storage recorded maximum number of leaves. This variation in different treatments might be due to the effect of defoliation as the grafts produced from these scions were more vigorous and storage of bud sticks had still activated the buds (Zimmerman, 1958). Linear trend of growth as recorded was also marker one for number of leaves on scion shoot (Dod *et al.*, 1996). Shashi kumar *et al.* (2012) in guava also reported that scions cured for nine days gave better results in terms of number of leaves.

4.1.7 Internodal length of new shoot (cm)

The data pertaining to internodal length of mango cv. Baneshan are presented in Table 4.1.7 and Fig 4.1.7. The internodal length has differed significantly due to pretreatments, storage and their interaction effects.

4.1.7.1 30 Days after grafting (30 DAG)

The results with respect to pretreatments of scion wood revealed that, precured scion wood defoliated 10 days before grafting recorded mean maximum internodal length (1.059) which was significantly superior to non precured scion wood (0.622).

Storage of mango scion wood in sphagnum moss wrapped in perforated polythene sheet recorded mean maximum internodal length in 3 days storage (1.038) followed by 0 days storage (0.808) and 5 days storage (0.781) where as 7 days storage (0.733) recorded significantly mean minimum internodal length over other treatments studied.

The interaction studies between pretreatments and storage of scion wood, revealed that among the type of scion wood used, precured scion wood with 3 days storage recorded maximum internodal length (1.303) which was significantly superior to 0 days storage (1.100) followed 5 days (0.942) and 7 days storage (0.887) respectively where as minimum internodal length was reported in non precured scion with 0 days storage (0.517) followed by 7 days storage (0.580 cm).

4.1.7.2 45 Days after grafting (45 DAG)

Among the pretreatments made for scion wood, defoliated scion wood for 10 days recorded mean maximum internodal length (1.211) which was significantly superior to non precured scion wood (0.677).

Storage of mango scion wood for 3 days recorded mean maximum internodal length (1.147) followed by 0 days storage (0.938) and 5 days storage (0.902).Whereas, the scion wood with 7 days storage recorded significantly mean minimum internodal length (0.788 cm) over other treatments studied.

The interaction between pre treatments and storage of scion wood differed significantly for internodal length. Among the type of scion wood used, precured

scion wood with 3 days storage recorded maximum internodal length (1.483) which was found significantly superior to 0 days storage (1.302), 5 days (1.097) and 7 days storage (0.960) respectively where as minimum internodal length was recorded in non precured scion wood with 0 days storage (0.573) followed by 7 days storage (0.617 cm).

4.1.7.3 60 Days after grafting (60 DAG)

Internodal length was significantly influenced by different pretreatments given to scion wood. Precured scion wood defoliated 10 days before grafting recorded mean maximum internodal length (1.393) with respect to non precured scion wood (0.894)

Significant differences were noticed among effects imposed by the treatments regarding storage where scion wood stored for 3 days reported mean maximum internodal length (1.358**)** followed by 0 days storage (1.136), 5 days storage (1.083) and 7 days storage (1.008) respectively.

The interaction studies between pretreatments and storage of scion wood differed significantly for internodal length. Among the type of scion wood used, precured scion wood with 3 days storage recorded maximum internodal length (1.680) which was found significantly superior to 0 days storage (1.490) followed 5 days (1.240) and 7 days storage (1.163) respectively where as minimum intermodal length was recorded in non precured scion with 0 days storage (0.782) followed by 7 days storage (0.853).

4.1.7.4 75 Days after grafting (75 DAG)

With regard to pretreatments given to scion wood, precured scion wood defoliated 10 days before grafting recorded mean maximum intermodal length (1.649 cm) which was significantly superior to non precured scion wood (1.084 cm).

Internodal length was found to be significantly influenced by different storage intervals of scion wood. Mean maximum internodal length registered during 3 days

storage (1.578) followed by 0 days storage (1.373), 5 days (1.322) and 7 days storage (1.193) respectively.

The interaction studies between pretreatments and storage of scion wood, revealed that among the type of scion wood used, precured scion wood with 3 days storage recorded maximum internodal length (1.947) which was significantly superior to 0 days storage (1.783) followed by 5 days (1.527) and 7 days storage (1.340) respectively where as minimum internodal length was reported in non precured with 0 days storage (0.963) followed by 7 days storage (1.047) .

4.1.7.5 90 Days after grafting (90 DAG)

Among the pretreatments made for scion wood, precured scion wood defoliated for 10 days recorded mean maximum internodal length (1.987) which was significantly superior to non precured scion wood (1.282).

Storage of mango scion wood for 3 days recorded mean maximum internodal length with 3 days storage (1.867) followed by 0 days storage (1.638) and 5 days storage (1.602) respectively. Whereas, the scion wood with 7 days storage recorded significantly mean minimum internodal length (1.430) over other treatments studied.

The interaction between pretreatments and storage of scion wood differed significantly for internodal length. Among the type of scion wood used, precured scion wood with 3 days storage recorded maximum internodal length (2.307) which was found significantly superior to 0 days storage (2.153), 5 days storage (1.877) and 7 days storage (1.610) respectively where as minimum internodal length was recorded in non precured scion with 0 days storage (1.123) followed by 7 days storage (1.250).

4.1.7.6 105 Days after grafting (105 DAG)

The results with respect to pretreatments of scion wood revealed that precured scion wood defoliated 10 days before grafting recorded mean maximum internodal length (2.288) which was significantly superior to non precured scion wood (1.453).

Storage of mango scion wood in sphagnum moss wrapped in perforated polythene sheet recorded mean maximum internodal length with 3 days storage

(2.203) followed by 0 days storage (1.842) and 5 days storage (1.813) where as 7 days storage (1.623) recorded significantly mean minimum internodal length over other treatments studied.

The interaction studies between pretreatments and storage of scion wood, revealed that among the type of scion wood used, precured scion wood with 3 days storage recorded maximum internodal length (2.770) which was significantly superior to 0 days storage (2.403), 5 days (2.127) and 7 days storage (1.853) respectively where as minimum internodal length was recorded in non precured scions with 0 days storage (1.280) followed by 7 days storage (1.393).

The observations from table 4.1.7 and fig. 4.1.7 confirm that precured scions defoliated 10 days before grafting with 3 days storage recorded maximum internodal length. This might be due to initiation of cambium activity which might have resulted from defoliation (Hartman *et al.,* 1997) which resulted in better shoot growth and in maximum internodal length. The beneficial effects of precuring in terms of growth of mango grafts has been reported by Reddy and Melanta (1988) and Patil *et al.* (1983). Similarly Shashi Kumar *et al.* (2012) in guava reported that, cured scions for 9 days gave better results in terms of graft height.

4.1.8 Number of new laterals

The data pertaining to number of new laterals of mango cv. Baneshan are presented in Table 4.1.8 and Fig. 4.1.8. The number of new laterals has differed significantly due to pretreatments, storage and their interaction effects.

4.1.8.1 30 Days after grafting (30 DAG)

Among the pretreatments made for scion wood, defoliated scion wood for 10 days recorded mean maximum number of new laterals (0.985) which were significantly superior to non precured scion wood (0.625).

Storage of mango scion wood for 3 days recorded mean maximum number of new laterals (0.940) followed by 0 days storage (0.828) and 5 days (0.762) respectively. Whereas, the scion wood with 7 days storage recorded significantly mean minimum number of new laterals (0.690) over other treatments studied.

The interaction between pretreatments and storage of scion wood differed significantly for number of new laterals. Among the type of scion wood used, precured scion wood with 3 days storage recorded maximum number of new laterals (1.180) which were significantly superior to 0 days storage (1.103), 5 days storage (0.877) and 7 days storage (0.780) respectively where as minimum number of new laterals were recorded in non precured scion with 0 days storage (0.553) followed by 7 days storage (0.600).

4.1.8.2 45 Days after grafting (45 DAG)

Among the pretreatments made for scion wood, precured scion wood defoliated for 10 days recorded mean maximum number of new laterals (1.028) which was significantly superior to non precured scion wood (0.688).

Storage of mango scion wood for 3 days recorded maximum number of new laterals (1.000) followed by 0 days storage (0.870) and 5 days (0.825) respectively. Whereas, the scion wood with 7 days storage recorded significantly mean minimum number of new laterals (0.735) over other treatments studied.

A perusal of data on the interaction between pretreatments and storage of scion wood revealed that, among the type of scion wood used, precured scion wood with 3 days storage recorded maximum number of new laterals (1.200) which were found significantly superior to 0 days storage (1.140), 5 days storage (0.950) and 7 days storage (0.820) respectively where as minimum number of new laterals were recorded in non precured scion with 0 days storage (0.600) followed by 7 days storage (0.650).

4.1.8.3 60 Days after grafting (60 DAG)

With regard to pretreatments given to scion wood, precured scion defoliated 10 days before grafting wood recorded maximum number of new laterals (1.060) which was significantly superior to non precured scion wood (0.733).

Number of new laterals was significantly influenced by different storage intervals of scion wood. Maximum number of new laterals were registered during 3

days storage (1.035) followed by 0 days storage (0.910), 5 days storage (0.860) and 7 days storage (0.780) respectively.

The interaction studies between pretreatments and storage of scion wood, revealed that among the type of scion wood used, precured scion with 3 days storage recorded maximum number of new laterals (1.230) which were significantly superior to 0 days storage (1.170) followed by 5 days (0.980) and 7 days storage (0.860) respectively where as minimum number of new laterals were recorded in non precured with 0 days storage (0.650) followed by 7 days storage (0.700).

4.1.8.4 75 Days after grafting (75 DAG)

Number of new laterals was significantly influenced by different pre treatments given to scion wood. Precured scion wood defoliated 10 days before grafting recorded mean maximum number of new laterals (1.115) with respect to non precured scion wood (0.778).

Significant differences were noticed among effects imposed by the treatments regarding storage where scion wood stored for 3 days reported maximum number of new laterals (1.085) followed by 0 days storage (0.950), 5 days storage (0.925) and 7 days storage (0.825) respectively.

The interaction studies between pretreatments and storage of scion wood, differed significantly for number of new laterals. Among the type of scion wood used, precured scion with 3 days storage recorded maximum number of new laterals (1.280) which were found significantly superior to 0 days storage (1.210) followed 5 days (1.050) and 7 days storage (0.920) respectively where as minimum number of new laterals were recorded in non precured with 0 days storage (0.690) followed by 7 days storage (0.730).

4.1.8.5 90 Days after grafting (90 DAG)

Among the pretreatments made for scion wood, defoliated scion wood for 10 days recorded maximum number of new laterals (1.203) which was significantly superior to non precured scion wood (0.835).

Storage of mango scion wood for 3 days recorded maximum number of new laterals (1.150) followed by 0 days storage (1.010) and 5 days storage (0.985) respectively. Whereas, the scion wood with 7 days storage recorded significantly minimum number of new laterals (0.930) over other treatments studied.

The interaction between pre treatments and storage of scion wood differed significantly for number of new laterals. Among the type of scion used, precured scion wood with 3 days storage recorded maximum number of new laterals (1.340) which were found significantly superior to 0 days storage (1.280), 5 days storage (1.120) and 7 days storage (1.070) respectively where as minimum number of new laterals were recorded in non precured scion wood with 0 days storage (0.740) followed by 7 days storage (0.790).

4.1.8.6 105 Days after grafting (105 DAG)

With regard to pretreatments given to scion wood, precured scion wood defoliated 10 days before grafting wood recorded maximum number of new laterals (1.318) which was significantly superior to non precured scion wood (0.973).

Number of new laterals was significantly influenced by different storage intervals of scion wood. Maximum number of new laterals were registered during 3 days storage (1.275) followed by 0 days storage (1.140), 5 days storage (1.120) and 7 days storage (1.045) respectively.

The interaction studies between pretreatments and storage of scion wood, revealed that among the type of scion used, precured scion with 3 days storage recorded maximum number of new laterals (1.470) which was significantly superior to 0 days storage (1.400) followed by 5 days (1.220) and 7 days storage (1.180) respectively where as minimum number of new laterals were recorded in non precured scion with 0 days storage (0.880) followed by 7 days storage (0.910).

The observations from table 4.1.8 and fig. 4.1.8 confirm that, the precured scions defoliated 10 days before grafting with 3 days storage recorded maximum number of laterals, it may be due to the fact that cured scions showed more vigour in terms of quantum of branches per scion (Jauhari and Singh, 1970). Higher vigour

attributed to growth activity of buds of scion which get activated after defoliation and storage of scion. The results are in conformity with Shashi Kumar *et al.* (2012) who reported better results in terms of quantum of branches for scion cured 9 days before grafting in guava.

4.1.9 Length of new laterals (cm)

The data pertaining to length of new laterals of mango cv. Baneshan are presented in Table 4.1.9 and Fig. 4.1.9. There were significant differences in length of new laterals due to pretreatments, storage and their interaction effects.

4.1.9.1 30 Days after grafting (30 DAG)

Among the pre treatments made for scion wood, precured scion wood defoliated for 10 days recorded mean maximum length of new laterals (1.155) which was significantly superior to non precured scion wood (0.808).

Storage of mango scion wood for 3 days recorded mean maximum length of new laterals (1.155) followed by 0 days storage (0.990), and 5 days storage (0.915) respectively. Whereas, the scion wood with 7 days storage recorded significantly mean minimum length of new laterals (0.865) over other treatments studied.

The interaction between pretreatments and storage of scion wood differed significantly for length of new laterals. Among the type of scion wood used, precured scion wood with 3 days storage recorded maximum length of new laterals (1.400) which was found significantly superior to 0 days storage (1.250), 5 days storage (1.000) and 7 days storage (0.970) respectively where as minimum length of new laterals were recorded in 0 days storage (0.730) followed by 7 days storage (0.760).

4.1.9.2 45 Days after grafting (45 DAG)

Among the pretreatments made for scion wood, precured scion wood defoliated scion wood for 10 days recorded maximum length of new laterals (1.368) which was significantly superior to non precured scion wood (0.900).

Storage of mango scion wood for 3 days recorded mean maximum length of new laterals (1.300) followed by 0 days storage (1.130) and 5 days storage (1.085)

respectively. Whereas, the scion wood with 7 days storage recorded significantly mean minimum length of new laterals (1.020) over other treatments studied.

A perusal of data on the interaction between pretreatments and storage of scion wood revealed that, among the type of scion wood used, precured scion wood with 3 days storage recorded maximum length of new laterals (1.600) which was found significantly superior to 0 days storage (1.450), 5 days storage (1.250) and 7 days storage (1.170) respectively where as minimum length of new laterals were recorded in 0 days storage (0.810) followed by 7 days storage (0.870).

4.1.9.3 60 Days after grafting (60 DAG)

With regard to pretreatments given to scion wood, precured scion wood defoliated 10 days before grafting recorded mean maximum length of new laterals (1.671 cm) which was significantly superior to non precured scion wood (1.086).

Length of new laterals was found to be significantly influenced by different storage intervals of scion wood. Maximum mean length of new laterals were registered during 3 days storage (1.620) followed by 0 days storage (1.423), 5 days storage (1.300) and 7 days storage (1.170) respectively.

The interaction studies between pretreatments and storage of scion wood, revealed that among the type of scion wood used, precured scion with 3 days storage recorded maximum length of new laterals (2.020) which was significantly superior to 0 days storage (1.863) followed by 5 days (1.500) and 7 days storage (1.300) respectively where as minimum length of new laterals were recorded in non precured scion wood with 0 days storage (0.983) followed by 7 days storage (1.040).

4.1.9.4 75 Days after grafting (75 DAG)

Length of new lateral was significantly influenced by different pretreatments given to scion wood. Precured scion wood defoliated 10 days before grafting recorded mean maximum length of new laterals (1.927) with respect to non precured scion wood (1.212).

Significant differences were noticed among treatments regarding storage, where scion wood stored for 3 days reported mean maximum length of new laterals

(1.850) followed by 0 days storage (1.545), 5 days storage (1.512) and 7 days storage (1.370) respectively.

The interaction studies between pretreatments and storage of scion wood, differed significantly for length of new laterals. Among the type of scion wood used, precured scion wood with 3 days storage recorded maximum length of new laterals (2.223) which was significantly superior to 0 days storage (2.057) followed by 5 days (1.787) and 7 days storage (1.640) respectively where as minimum length of new laterals were recorded in non precured scion wood with 0 days storage (1.033) followed by 7 days storage (1.100).

4.1.9.5 90 Days after grafting (90 DAG)

Among the pre treatments made for scion wood, defoliated scion wood for 10 days recorded mean maximum length of new laterals (2.135) which was significantly superior to non precured scion wood (1.433).

Storage of mango scion wood for 3 days recorded mean maximum length of new laterals (2.075) followed by 0 days storage (1.763) and 5 days storage (1.728) respectively. Whereas, the scion wood with 7 days storage recorded significantly mean minimum length of new laterals (1.570) over other treatments studied.

The interaction between pretreatments and storage of scion wood differed significantly for length of new laterals. Among the type of scion wood used, precured scion wood with 3 days storage recorded maximum length of new laterals (2.460) which were found significantly superior to 0 days storage (2.283), 5 days storage (1.997) and 7 days storage (1.800) respectively where as minimum length of new laterals were recorded in non precured scion wood with 0 days storage (1.243) followed by 7 days storage (1.340).

4.1.9.6 105 Days after grafting (105 DAG)

With regard to pretreatments given to scion wood, precured scion wood defoliated 10 days before grafting wood recorded mean maximum length of new laterals (2.460 cm) which was significantly superior to non precured scion wood (1.688 cm).

Length of new laterals were found to be significantly influenced by different storage intervals of scion wood. Maximum mean length of new laterals were registered during 3 days storage (2.400) followed 0 days storage (2.048), 5 days (1.972) and 7 days storage (1.877) respectively.

The data regarding the interaction effects revealed that among the type of scion wood used, precured scion wood with 3 days storage recorded maximum length of new laterals (2.750) which was significantly superior to 0 days storage (2.603) followed by 5 days (2.297) and 7 days storage (2.190) storage respectively where as minimum length of new laterals were reported in non precured scion wood with 0 days storage (1.493) followed by 7 days storage (1.563).

The observations from table 4.1.9 and fig.4.1.9 confirm that precured scions defoliated 10 days before grafting with 3 days storage recorded maximum length of new laterals due to sufficient stored food material in the precured scion resulting in vigorous growth of the grafts, thereby giving spurt in various growth attributes. These results are in conformity with Patil *et al.* (1983) and Jauhari and Singh (1970).

4.2 EFFECT OF SEASON ON GRAFT TAKE & GROWTH IN MANGO cv. BANESHAN

4.2.1 Bud take (%)

The data pertaining to number of days taken for bud break in mango cv. Baneshan after grafting is presented in Table 4.2.1 and Fig 4.2.1.

Among the propagation methods veneer grafting recorded significantly mean maximum bud take (68.74) and complete failure was observed in T-budding (0.00).

Mean maximum bud take (%) was recorded with the grafting season of 2nd fort night of September (48.33) which was significantly superior to 1st fort night of September (46.66) followed by 2nd fort night of August (43.33). Minimum bud take was recorded with plants grafted during 2nd fort night November (26.66) followed by 1st fort night of November (28.33).

The interaction effects between method of propagation and season were significant. Significantly maximum bud take was noticed in plants which were veneer grafted in 2nd fort night of September (96.67) followed by 1st fort night of September (93.33), 2nd fort night of August (86.67) and minimum bud take were recorded with plants veneer grafted in 2nd fort night November (53.33) followed by 1st fort night of November (56.67). Only veneer grafted plants recorded bud take (%) and complete failure was observed in T-budded plants.

The complete failure of T-budding in mango might be due to lack of development of vascular connections in between the bud and the stock and hence the propagation trials should be conducted on regional basis and under a set of definite secondary factors as disagreement in budding time has been advocated by several other workers in other tropical crops (Teotia *et al.*1963).

A perusal of the data revealed that, success obtained in usual veneer grafting was in agreement with the results reported by Ahmed (1960), Mukherjee and Majumdar (1961, 1964) working under west Bengal and Delhi conditions respectively. Singh *et al.* (1979) and Ram and Bist (1982) found almost similar results. Grafing in 2nd fort night of September has recorded maximum success because of favourable temperature particularly mean maximum temperature of 33^0C and mean minimum temperature of 23^0C coupled with good rainfall and relative humidity (71%) with minimum success in the month of November due to low temperature, relative humidity and no precipitation might have lead to dessication of scion and more mortality of grafts (Prasanth *et al*., 2006).

Since there was no bud take (%) in T- budding method, only veneer grafting was considered as the method of propagation for the parameters mentioned below.

4.2.2 Number of days taken for bud break

The data pertaining to number of days taken for bud break in mango cv. Baneshan after grafting is presented in Table 4.2.2 and Fig 4.2.2.

The days taken for bud break significantly differed among different treatments. The number of days taken for bud break was significantly less (13.23) in plants grafted on 2nd fort night of September followed by 1st fort night of September (14.06) and 2nd fort night August (14.46) where as more number of days taken for bud break (21.63) was noticed in 2nd fort night of November grafted plants over rest of the treatments.

A perusal of the data revealed that, September month took minimum number of days for bud break, it can be presumed that early bud break in September month may be due to favourable diurnal temperature particularly mean minimum temperature of 23 ^{0}C and mean maximum temperature of 33 ^{0}C with moderate humidity (71 %) and good precipitation. The results are in agreement with Asante and Barnette (1997) who reported that, favourable temperature coupled with precipitation and optimum relative humidity encouraged graft union where as delay in bud break in the month of November may be due to the prevalence of low temperature and inadequate sap flow.

4.2.3 Number of flushes produced

The data regarding number of flushes produced at 30, 45, 60, 90 and 105 days after grafting (DAG) under the influence of season are presented in Table 4.2.3 and Fig 4.2.3

4.2.3.1 30 Days after grafting (30 DAG)

Maximum number of flushes (1.19) were recorded in plants grafted on 2nd fort night of September which was significantly superior to 1st fort night of September (1.08) followed by 2nd fort night of August (1.00). Minimum number of flushes produced (0.50) were recorded on 2nd fort night of November followed by 1st fort night November (0.60).

4.2.3.2 45 Days after grafting (45 DAG)

During 2nd fort night of September maximum number of flushes (1.34) were recorded followed by those grafted on 1st fort night of September (1.21), 2nd fort

night of August (1.13) and 1st fort night of August (1.04). Whereas grafting in 2nd fort night of November recorded significantly minimum number of flushes (0.63) over other treatments studied.

4.2.3.3 60 Days after grafting (60 DAG)

Maximum number of flushes produced (1.56) were recorded in plants grafted on 2nd fort night of September which was significantly superior to 1st fort night of September (1.46) and 2nd fort night of August (1.40). Minimum number of flushes (0.86) produced were registered in 2nd fort night of November.

4.2.3.4 75 Days after grafting (75 DAG)

Plants grafted during 2nd fort night of September recorded maximum number of flushes (1.72) followed by 1st fort night of September (1.66) and 2nd fort night of August (1.56). Plants grafted during 2nd fort night of November recorded minimum number of flushes (1.02) followed by 1st fort night of November (1.12).

4.2.3.5 90 Days after grafting (90 DAG)

Maximum number of flushes were recorded in plants grafted during 2nd fort night of September (2.00) which was significantly superior to 1st fort night of September (1.90) followed by 2nd fort night of August (1.80). Minimum number of flushes were recorded on 2nd fort night of November (1.16) followed by 1st fort night of November (1.26).

4.2.3.6 105 Days after grafting (105 DAG)

Plants grafted on 2nd fort night of September recorded maximum number of flushes (2.23) followed by 1st fort night of September (2.15), 2nd fort night of August (2.08) and 1st fort night of August (2.00). Whereas grafting on 2nd fort night of November recorded significantly minimum number of flushes (1.38) over other treatments studied**.**

The observations from the table 4.2.3 and fig. 4.2.3 confirm that, September month followed by August month recorded maximum number of flushes, it might be due to the prevalence of favourable temperature and optimum relative humidity

which resulted in obtaining maximum number of flushes with minimum number of flushes in months of November and December. The results were in conformity with Narayana Rao and Srirama Murthy (1979) who stated 3rd week of September as the most congenial time for veneer grafting in mango under Sangareddy conditions. Similar findings were also made by Singh and Srivastava (1979).

4.2.4 Length of new scion shoot (cm)

The data regarding length of new scion shoot was recorded at 30, 45, 60, 75, 90 and 105 days after grafting (DAG) under the influence of season are presented in Table 4.2.4 and Fig. 4.2.4.

4.2.4.1 30 Days after grafting (30 DAG)

Maximum length of new scion shoot was recorded in plants grafted on 2nd fort night of September (2.25) which was significantly superior to 1st fort night of September (2.10) followed by 2nd fort night of August (1.98). Minimum scion shoot length was recorded on 2nd fort night of November (1.18) followed by 1st fort night of November (1.32).

4.2.4.2 45 Days after grafting (45 DAG)

During 2nd fort night of September maximum scion shoot length (2.71) was recorded followed by 1st fort night of September (2.60), 2nd fort night of August (2.48) and 1st fort night of August (2.36). Whereas grafting on 2nd fort night of November recorded significantly minimum scion shoot length (1.50) over other treatments studied.

4.2.4.3 60 Days after grafting (60 DAG)

In the treatment of grafting on 2nd fort night of September highest scion shoot length (3.28) was recorded which was significantly superior to grafting on 1st fort night of September (3.10) and 2nd fort night of August (3.00). Lowest scion shoot length was registered in 2nd fort night of November (2.00).

4.2.4.4 75 Days after grafting (75 DAG)

Plants grafted during 2nd fort night of September recorded maximum scion shoot length (4.00) followed by 1st fort night of September (3.85), 2nd fort night of August (3.72). Plants grafted during 2nd fort night of November (2.64) recorded minimum scion shoot length.

4.2.4.5 90 Days after grafting (90 DAG)

Maximum scion shoot length was recorded with plants grafted during 2nd fort night of September (5.10) which was significantly superior to 1st fort night of September (4.94) followed by 2nd fort night of August (4.80). Minimum scion shoot length was recorded on 2nd fort night of November (3.54) followed by 1st fort night of November (3.66).

4.2.4.6 105 Days after grafting (105 DAG)

Plants grafted during 2nd fort night of September recorded maximum scion shoot length (6.20) followed by 1st fort night of September (6.00), 2nd fort night of August (5.90) and 1st fort night of August (5.73) .Where as grafting on 2nd fort night of November recorded significantly minimum scion shoot length (4.68) over other treatments studied.

A perusal of the data revealed that, maximum scion length was recorded in September month followed by August month, it might be due to the fact that the growth of scion are in accordance with rise in temperature. Such results of vigorous growth during September and August (Dhakal and Hoda, 1986) and poor growth of scion shoot during October to December (Upadhyay and Prasad, 1988) were recorded in mango.

4.2.5 Diameter of new scion shoot (cm)

The data regarding diameter of new scion shoot was recorded at 30, 45, 60, 75, 90 and 105 days after grafting (DAG) under the influence of season are presented in Table 4.2.5 and Fig. 4.2.5.

4.2.5.1 30 Days after grafting (30 DAG

Maximum scion shoot diameter was recorded with the season of grafting during 2nd fort night of September (0.26) which was significantly superior to 1st fort night of September (0.24) followed by 2nd fort night of August (0.21). Minimum scion shoot diameter was recorded in the season of grafting on 2nd fort night of November (0.11) followed by 1st fort night of November (0.12).

4.2.5.2 45 Days after grafting (45 DAG)

Plants grafted during 2nd fort night of September recorded maximum scion shoot diameter (0.33) followed by 1st fort night of September (0.31), 2nd fort night of August (0.28) and 1st fort night of August (0.26). Whereas grafting in 2nd fort night of November recorded significantly minimum scion shoot diameter (0.16) over other treatments studied.

4.2.5.3 60 Days after grafting (60 DAG)

In the treatment of season of grafting during 2nd fort night of September maximum scion shoot diameter (0.39) was recorded which was significantly superior to 1st fort night of September (0.37) and 2nd fort night of August (0.35). Minimum scion shoot diameter was registered in plants grafted on 2nd fort night of November (0.21).

4.2.5.4 75 Days after grafting (75 DAG)

Plants grafted during 2nd fort night of September recorded maximum scion shoot diameter (0.46 cm) followed by 1st fort night of September (0.44 cm), 2nd fort night of August (0.42 cm). Plants grafted during 2nd fort night of November recorded minimum scion shoot diameter (0.25 cm).

4.2.5.5 90 Days after grafting (90 DAG)

Maximum diameter of new scion shoot was recorded with grafting season of 2nd fort night of September (0.53) which was significantly superior to 1st fort night of September (0.50) followed by 2nd fort night of August (0.48). Minimum scion

shoot diameter was recorded on 2nd fort night of November (0.31) followed by 1st fort night of November (0.34).

4.2.5.6 105 Days after grafting (105 DAG)

Maximum diameter (0.58) of scion shoot was recorded during 2nd fort night of September followed by 1st fort night of September (0.55), 2nd fort night of August (0.52) and 1st fort night of August (0.49). Whereas grafting plants in 2nd fort night of November recorded significantly minimum scion shoot diameter (0.32) over other treatments studied.

The observations from the table 4.2.5 and fig. 4.2.5 confirm that, September month followed by August month recorded maximum diameter of new scion shoot, it might be due to the prevalence of favourable temperature and optimum relative humidity in those respective months which resulted in obtaining maximum scion shoot diameter, where as grafting performed during pre winter periods (October and November) produced poor vegetative growth due to low temperatures and dry atmosphere during the growth (Patel and Amin,1981).

4.2.6 Number of leaves per shoot

The data regarding number of leaves per shoot recorded at 30, 45, 60, 75, 90 and 105 days after grafting (DAG) under the influence of season are presented in Table 4.2.6 and Fig. 4.2.6.

4.2.6.1 30 Days after grafting (30 DAG)

Maximum number of leaves per shoot were recorded with the season of grafting of 2nd fort night of September (8.00) which was significantly superior to 1st fort night of September (7.80) followed by 2nd fort night of August (7.66). Minimum number of leaves per shoot were recorded in 2nd fort night of November (5.20) followed by 1st fort night of November (5.90).

4.2.6.2 45 Days after grafting (45 DAG)

Maximum number of leaves per shoot (8.43) were recorded during 2nd fort night of September followed by 1st fort night of September (8.21), 2nd fort night of August (8.05) and 1st fort night of August (7.86). Whereas grafting in 2nd fort night of November recorded significantly minimum number of leaves per shoot (6.28) over other treatments studied.

4.2.6.3 60 Days after grafting (60 DAG)

Maximum number of leaves per shoot (8.75) were recorded during 2nd fort night of September which was significantly superior to 1st fort night of September (8.58) and 2nd fort night of August (8.43). Minimum number of leaves per shoot were registered in 2nd fort night of November (6.68).

4.2.6.4 75 Days after grafting (75 DAG)

Maximum number of leaves per shoot (9.06) were recorded during 2nd fort night of September followed by 1st fort night of September (8.95), 2nd fort night of August (8.83). Plants grafted during 2nd fort night of November recorded minimum number of leaves per shoot (7.28).

4.2.6.5 90 Days after grafting (90 DAG)

Maximum number of leaves per shoot were recorded with the grafting season of 2nd fort night of September (9.53) which was significantly superior to 1st fort night of September (9.36) followed by 2nd fort night of August (9.24). Minimum number of leaves per shoot were recorded in 2nd fort night of November (7.73) followed by 1st fort night of November (7.91).

4.2.6.6 105 Days after grafting (105 DAG)

Maximum number of leaves per shoot (10.10) were recorded with the grafting season of 2nd fort night of September followed by 1st fort night of September (9.81), 2nd fort night of August (9.65) and 1st fort night of August (9.42). Whereas grafting in 2nd fort night of November recorded significantly minimum number of leaves per shoot (8.00) over other treatments studied.

A perusal of the data revealed that, maximum number of leaves were obtained in September month followed by August, which might be due to the development of more sprouts, more meristematic activity and better healing of grafts during these months and also influenced by favorable temperature and humidity which resulted in good vegetative growth. Similar results were obtained by Amin (1979) under Gujarat conditions while carrying out softwood grafting in mango.

4.2.7 Internodal length of new scion shoot (cm)

The data regarding internodal length of new scion recorded at 30, 45, 60, 75, 90, 105 days after grafting (DAG) under the influence of season are presented in Table 4.2.7 and Fig. 4.2.7.

4.2.7.1 30 Days after grafting (30 DAG)

Maximum internodal length of new scion was recorded with the grafting season of 2nd fort night of September (0.94) which was significantly superior to 1st fort night of September (0.83) followed by 2nd fort night of August (0.76). Minimum scion shoot internodal length was recorded in 2nd fort night of November (0.34) followed by 1st fort night of November (0.43)

4.2.7.2 45 Days after grafting (45 DAG)

Maximum scion intermodal length (1.32) was recorded during 2nd fort night of September followed by 1st fort night of September (1.19), 2nd fort night of August (1.07) and 1st fort night of August (1.00). Whereas grafting in 2nd fort night of November recorded significantly minimum scion intermodal length (0.55) over other treatments studied.

4.2.7.3 60 Days after grafting (60 DAG)

Maximum internodal length (1.77) was recorded during 2nd fort night of September which was significantly superior 1st fort night of September (1.58) and 2nd fort night of August (1.43). Minimum scion internodal length was registered during 2nd fort night of November (1.24).

4.2.7.4 75 Days after grafting (75 DAG)

Plants grafted during 2nd fort night of September recorded maximum scion internodal length (1.97 cm) followed by 1st fort night of September (1.81 cm), 2nd fort night of August (1.69 cm). Plants grafted during 2nd fort night of November (0.90 cm) recorded minimum scion internodal length.

4.2.7.5 90 Days after grafting (90 DAG)

Maximum internodal length of new scion was recorded in the grafting season of 2nd fort night of September (2.67 cm) which was significantly superior to 1st fort night of September (2.51 cm) followed by 2nd fort night of August (2.29 cm). Minimum scion internodal length of scion was recorded in 2nd fort night of November (1.48 cm) followed by 1st fort night of November (1.61 cm).

4.2.7.6 105 Days after grafting (105 DAG)

Maximum scion internodal length (3.50 cm) was recorded during 2nd fort night of September followed by 1st fort night of September (3.31 cm), 2nd fort night of August (3.12 cm) and 1st fort night of August (3.03 cm). Whereas grafting in 2nd fort night of November recorded significantly minimum scion internodal length (2.33 cm) over other treatments studied.

A perusal of the results revealed that, September month recorded maximum internodal length followed by August month revealing that in addition to photosynthates contribution towards the growth of the grafts, it may be more in month of September because of optimum temperature prevalence during the respective period resulting in good growth of scion, emphasized by number of workers (Shippy, 1930 and Hartmann and Kester, 1972).

4.2.8 Number of new laterals

The data regarding number of new laterals recorded at 30, 45, 60, 75, 90, and 105 days after grafting (DAG) under the influence of season are presented in Table 4.2.8 and Fig 4.2.8.

4.2.8.1 30 Days after grafting (30 DAG)

Maximum number of new laterals were recorded in the grafting season of 2nd fort night of September (1.18) which was significantly superior to 1st fort night of September (1.10) followed by 2nd fort night of August (1.01). Minimum number of new laterals were recorded in 2nd fort night of November (0.38) followed by 1st fort night of November (0.50).

4.2.8.2 45 Days after grafting (45 DAG)

Maximum number of new laterals (1.23) were recorded during 2nd fort night of September followed by 1st fort night of September (1.14), 2nd fort night August (1.06) and 1st fort night of August (1.00). Whereas grafting in 2nd fort night of November recorded significantly minimum number of new laterals (0.45) over other treatments studied.

4.2.8.3 60 Days after grafting (60 DAG)

Maximum number of new laterals (1.28) were recorded during 2nd fort night of September which were significantly superior to 1st fort night of September (1.20) and 2nd fort night of August (1.14). Minimum number of new laterals were registered in 2nd fort night of November (0.50).

4.2.8.4 75 Days after grafting (75 DAG)

Plants grafted during 2nd fort night of September recorded maximum number of new laterals (1.33) followed by 1st fort night of September (1.26), 2nd fort night of August (1.19). Plants grafted during 2nd fort night of November recorded minimum number of new laterals (0.56).

4.2.8.5 90 Days after grafting (90 DAG)

Maximum number of new laterals were recorded with the grafting season of 2nd fort night of September (1.37) which was significantly superior to 1st fort night of September (1.31) followed by 2nd fort night of August (1.25). Minimum number of new laterals were recorded in 2nd fort night of November (0.60) followed by 1st fort night of November (0.71).

4.2.8.6 105 Days after grafting (105 DAG)

Maximum number of new laterals (1.45) were recorded during 2nd fort night of September followed by 1st fort night of September (1.38), 2nd fort night of August (1.30) and 1st fort night of August (1.19).Where as grafting in 2nd fort night of November recorded significantly minimum number of new laterals (0.65) over other treatments studied.

A perusal of the data revealed that, maximum number of new laterals were obtained during the month of September followed by August month, revealing that the success in veneer grafting is maximum when the maximum temperature during summer is moderately high and the relative humidity is relatively high in mango (Singh *et al*., 1984).

4.2.9 Length of new laterals (cm)

The data regarding length of new lateral at 30, 45, 60, 75, 90 and 105 days after grafting (DAG) under the influence of season are presented in Table 4.2.9 and Fig. 4.2.9.

4.2.9.1 30 Days after grafting (30 DAG)

Maximum length of new laterals were recorded with the plants grafted during 2nd fort night of September (1.22 cm) which was significantly superior to 1st fort night of September (1.13 cm) followed by 2nd fort night of August (1.05 cm). Minimum length of new laterals were recorded in 2nd fort night of November (0.50 cm) followed by 1st fort night of November (0.60 cm).

4.2.9.2 45 Days after grafting (45 DAG)

Maximum length of new laterals (1.42) were recorded during 2nd fort night of September followed by 1st fort night of September (1.30), 2nd fort night of August (1.21) and 1st fort night of August (1.14). Whereas grafting in 2nd fort night of November recorded significantly minimum length of new laterals (0.67) over other treatments studied.

4.2.9.3 60 Days after grafting (60 DAG)

Maximum length of new laterals (1.86) were recorded during 2nd fort night of September which were significantly superior to 1st fort night of September (1.74) and 2nd fort night of August (1.65). Minimum length of new laterals were registered in 2nd fort night of November (0.84).

4.2.9.4 75 Days after grafting (75 DAG)

Plants grafted during 2nd fort night of September recorded maximum length of new laterals (2.33) followed by 1st fort night of September (2.16), 2nd fort night of August (2.08). Plants grafted during 2nd fort night of November recorded minimum length of new laterals (1.05).

4.2.9.5 90 Days after grafting (90 DAG)

Maximum length of new laterals were recorded with the grafting season of 2nd fort night of September (2.89) which was significantly superior to 1st fort night of September (2.64) followed by 2nd fort night of August (2.45). Minimum length of new laterals were recorded in 2nd fort night of November (1.18) followed by 1st fort night of November (1.32).

4.2.9.6 105 Days after grafting (105 DAG)

Maximum length of new laterals (3.14) were recorded with the grafting season of 2nd fort night of September followed by 1st fort night of September (3.03), 2nd fort night of August (2.90) and 1st fort night of August (2.72). Whereas grafting in 2nd fort night of November recorded significantly minimum length of new laterals (1.32) over other treatments studied.

The results revealed that, maximum length of new laterals were obtained in September month followed by August month which might be due to the prevalence of congenial temperature, rainfall and humidity conditions during the respective months resulting in good take and growth of scion in terms of length of laterals, emphasized by number of workers (Shippy, 1930 and Hartmann and Kester, 1972).

Chapter V

SUMMARY AND CONCLUSIONS

The present investigation entitled **"Studies on the effect of pretreatments, time and method of propagation in mango (*Mangifera indica* L.) cv. Baneshan"** was carried out during June, 2012 to February, 2013 at Fruit Research Station (FRS),Sangareddy, Medak district, Dr.Y.S.R.H.U, Andhra Pradesh. The experiment was laid out in randomized block design with factorial concept with 16 treatments in 3 replications. The salient features of findings are summarized and concluded here under.

1. Among the propagation methods, only veneer grafting showed success and resulted in higher bud take (%) where as complete failure was observed in T-budding under southern Telangana conditions of Andhra Pradesh.

2. Among the scion wood studied, precured scion wood defoliated ten days before veneer grafting recorded mean minimum number of days taken for bud break (14.33), mean maximum new scion length (5.454 cm), diameter (0.471 cm), internodal length (2.288 cm), number of flushes (1.505), number of leaves (9.393) and mean maximum number of new laterals (1.318) and length of new laterals (2.460 cm) which was significantly superior to non precured scions.

3. Storage of mango scion wood for 3 days recorded mean minimum number of days taken for bud break (14.11), mean maximum new scion length (5.193 cm), diameter (0.447 cm), intermodal length (2.203 cm), number of flushes (1.455), number of leaves (9.230) and maximum number of new laterals (1.275) and length of new laterals (2.400 cm) which was significantly superior to 0 days storage, 5 days and 7 days storage.

4. The interaction between pretreatments and storage intervals of scion wood revealed that, precured scion stored for 3 days recorded minimum number of days taken for bud break (12.13), maximum new scion length (6.133 cm),

diameter (0.533 cm), intermodal length (2.770 cm), number of flushes (1.710), number of leaves (10.160) and maximum number of new laterals (1.470) and length of new laterals (2.750 cm) which was significantly superior to 0 days storage, 5 days and 7 days storage.

5. Regarding influence of season on grafting, grafting during September followed by August month recorded minimum number of days for bud break (13.23), maximum new scion length (6.20 cm), diameter (0.58 cm), internodal length (3.50 cm), number of flushes (2.23), number of leaves (10.10) and maximum number of new laterals (1.45) and length of new laterals (3.14 cm) which was significantly superior to November and December months.

CONCLUSION:

From the results it can be concluded that, T-budding is a complete failure under agroclimatic conditions of Fruit Research Station, Sangareddy, Medak district, Andhra Pradesh where as in veneer grafting, precuring of scion is more beneficial in terms of better success rate along with better overall graft growth and further the storage of scion had still improved the efficacy of the growth parameters resulting in better graft growth and giving a possibility of maintaining the vigour of the scion during transport for a period of time inspite of immediate grafting soon after scions are detached from mother plant. In terms of season effect, monsoon period found to have a profound effect on better graft growth with high success rate.

From the results, it is very clear that the growth, vigour, success rate in mango for commercial production of mango grafts can be manipulated by taking into consideration factors like defoliation, storage of scion wood and season

FUTURE LINE OF WORK:

1. Studies on the active stage of growth in scion sticks to avoid defoliation period.
2. Studies on storage life of scion sticks with provision of appropriate storage conditions along with either use of anti transpirants and anti dessicants.
3. Studies on anatomy and physiology of bud union in mango under different seasons.

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* Original not seen.

Table 4.1.1 Effect of pretreatments and storage of scion wood on bud take (%) in different methods of propagation in mango cv. Baneshan

Bud take (%)						
	Storage of scion (S)					
Method of propagation (M)	**Type of scion (P)**	**0 days**	**3 days**	**5 days**	**7 days**	**Mean**
Veneer grafting	Precuring	90.00^{b} (71.55)	96.67^{a} (79.48)	80.00^{c} (63.43)	70.00^{d} (56.78)	**84.16^{a} (67.81)**
	Non-precuring	46.37^{d} (41.23)	63.33^{a} (52.73)	53.33^{b} (48.83)	50.00^{c} (45.00)	**54.16^{b} (46.94)**
	Mean	**68.18^{b} (57.32)**	**80.00^{a} (66.10)**	**66.66^{c} (56.13)**	**60.00^{d} (50.89)**	**69.16 (57.61)**
T-buddinng	Precuring	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	**0.00 (4.05)**
	Non-precuring	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	**0.00 (4.05)**
	Mean	**0.00 (4.05)**	**0.00 (4.05)**	**0.00 (4.05)**	**0.00 (4.05)**	**0.00 (4.05)**
	Precuring	37.58^{b} (37.81)	44.37^{a} (41.77)	30.84^{c} (33.74)	25.63^{d} (30.42)	**34.60^{a} (35.93)**
	Non-precuring	15.98^{d} (23.57)	22.60^{a} (28.39)	19.82^{b} (26.44)	17.22^{c} (24.52)	**18.90^{b} (25.73)**
	Mean	**26.78^{b} (30.69)**	**33.48^{a} (35.08)**	**25.33^{c} (30.09)**	**21.42^{d} (27.47)**	**26.75 (30.83)**

	SEm±	**CD(5%)**		**SEm±**	**CD(5%)**
M	0.002	0.007	MXP	0.005	0.015
P	0.003	0.010	MXS	0.003	0.010
S	0.002	0.007	PXS	0.005	0.015
			MXPXS	0.007	0.010

* - Figures in parantheses are arc sin transformed values

Table 4.1.2 Effect of pretreatments and storage of scion wood on number of days taken for bud break of mango grafts cv. Baneshan

Period of scion storage (S)	Type of scion (P)		
	Precured	**Non-precured**	**Mean**
0 days	13.80	17.23	**15.51[b]**
3 days	12.13	16.10	**14.11[a]**
5 days	15.50	16.73	**16.11[c]**
7 days	15.90	16.93	**16.41[d]**
Mean	**14.33[a]**	**16.75[b]**	
	S	**P**	**S×P**
SEm±	0.04	0.03	0.06
CD (5%)	0.14	0.10	0.20

Table 4.1.3 Effect of pretreatments and storage of scion wood on number of flushes produced in mango grafts cv. Baneshan

Period of scion storage(S)	30 DAG			45 DAG			60 DAG		
	Type of scion (P)		Mean	Type of scion (P)		Mean	Type of scion (P)		Mean
	Precured	Non-precured		Precured	Non-precured		Precured	Non-precured	
0 days	1.180	0.730	**0.955^{b}**	1.300	0.780	**1.040^{b}**	1.380	0.820	**1.100^{b}**
3 days	1.220	0.900	**1.060^{a}**	1.350	0.960	**1.155^{a}**	1.470	1.020	**1.245^{a}**
5 days	1.080	0.790	**0.935^{c}**	1.170	0.860	**1.015^{c}**	1.240	0.900	**1.070^{c}**
7 days	1.030	0.750	**0.890^{d}**	1.120	0.810	**0.965^{d}**	1.170	0.850	**1.010^{d}**
Mean	**1.128^{a}**	**0.793^{b}**		**1.235^{a}**	**0.853^{b}**		**1.315^{a}**	**0.898^{b}**	
	S	**P**	**S×P**	**S**	**P**	**S×P**	**S**	**P**	**S×P**
SEm±	0.004	0.003	0.006	0.019	0.013	0.028	0.005	0.003	0.008
CD (5%)	0.014	0.010	0.021	0.012	0.009	0.018	0.016	0.011	0.024

Table 4.1.3 cont.

Period of scion storage(S)	75 DAG			90 DAG			105 DAG		
	Type of scion (P)		Mean	Type of scion (P)		Mean	Type of scion (P)		Mean
	Precured	Non-precured		Precured	Non-precured		Precured	Non-precured	
0 days	1.460	0.920	**1.190**[b]	1.580	0.960	**1.270**[b]	1.630	1.000	**1.315**[b]
3 days	1.540	1.080	**1.310**[a]	1.650	1.150	**1.400**[a]	1.710	1.200	**1.455**[a]
5 days	1.310	1.000	**1.155**[c]	1.340	1.060	**1.200**[c]	1.380	1.090	**1.235**[c]
7 days	1.240	0.960	**1.100**[d]	1.280	1.000	**1.140**[d]	1.300	1.040	**1.170**[d]
Mean	**1.388**[a]	**0.990**[b]		**1.455**[a]	**1.043**[b]		**1.505**[a]	**1.083**[b]	
	S	**P**	**S×P**	**S**	**P**	**S×P**	**S**	**P**	**S×P**
SEm±	0.007	0.005	0.010	0.005	0.001	0.003	0.006	0.004	0.009
CD (5%)	0.022	0.015	0.032	0.016	0.011	0.023	0.019	0.013	0.028

Table 4.1.4 Effect of pretreatments and storage of scion wood on length of new scion shoot (cm) of mango grafts cv. Baneshan.

Period of scion storage(S)	30 DAG			45 DAG			60 DAG		
	Type of scion(P)		Mean	Type of scion (P)		Mean	Type of scion (P)		Mean
	Precured	Non-precured		Precured	Non-precured		Precured	Non-precured	
0 days	2.107	1.377	**1.742**[b]	2.460	1.698	**2.079**[b]	3.490	1.798	**2.644**[b]
3 days	2.210	1.617	**1.913**[a]	2.783	2.000	**2.392**[a]	3.890	2.243	**3.067**[a]
5 days	1.917	1.507	**1.712**[c]	2.210	1.803	**2.006**[c]	2.970	2.090	**2.530**[c]
7 days	1.817	1.403	**1.610**[d]	2.117	1.733	**1.925**[d]	2.443	1.977	**2.210**[d]
Mean	**2.013**[a]	**1.476**[b]		**2.398**[a]	**1.808**[b]		**3.193**[a]	**2.026**[b]	
	S	**P**	**S×P**	**S**	**P**	**S×P**	**S**	**P**	**S×P**
SEm±	0.006	0.004	0.008	0.015	0.010	0.021	0.026	0.018	0.037
CD (5%)	0.018	0.012	0.026	0.046	0.032	0.065	0.080	0.056	0.114

Table 4.1.4 cont.

Period of scion storage (S)	75 DAG			90 DAG			105 DAG		
	Type of scion (P)		Mean	Type of scion (P)		Mean	Type of scion (P)		Mean
	Precured	Non-precured		Precured	Non-precured		Precured	Non-precured	
0 days	3.917	2.243	**3.080**[b]	4.983	2.600	**3.792**[b]	5.803	3.293	**4.548**[b]
3 days	4.233	3.010	**3.622**[a]	5.350	3.740	**4.545**[a]	6.133	4.253	**5.193**[a]
5 days	3.407	2.497	**2.952**[c]	4.203	3.097	**3.650**[c]	5.000	3.700	**4.350**[c]
7 days	3.120	2.353	**2.736**[d]	4.020	2.813	**3.417**[d]	4.760	3.553	**4.157**[d]
Mean	**3.709**[a]	**2.526**[b]		**4.639**[a]	**3.063**[b]		**5.424**[a]	**3.700**[b]	
	S	**P**	**S×P**	**S**	**P**	**S×P**	**S**	**P**	**S×P**
SEm±	0.025	0.018	0.036	0.020	0.014	0.282	0.040	0.028	0.056
CD (5%)	0.078	0.055	0.111	0.060	0.042	0.086	0.121	0.086	0.172

Table 4.1.5 Effect of pretreatments and storage of scion wood on diameter of new scion shoot (cm) of mango grafts cv. Baneshan

Period of scion storage(S)	30 DAG			45 DAG			60 DAG		
	Type of scion(P)		Mean	Type of scion(P)		Mean	Type of scion(P)		
	Precured	Non-precured		Precured	Non-precured		Precured	Non-precured	Mean
0 days	0.192	0.106	**0.149**[b]	0.293	0.117	**0.205**[b]	0.323	0.127	**0.225**[b]
3 days	0.217	0.137	**0.177**[a]	0.320	0.177	**0.248**[a]	0.357	0.203	**0.280**[a]
5 days	0.155	0.121	**0.138**[c]	0.200	0.140	**0.170**[c]	0.247	0.177	**0.212**[c]
7 days	0.123	0.113	**0.123**[d]	0.193	0.130	**0.161**[d]	0.227	0.143	**0.185**[d]
Mean	**0.174**[a]	**0.119**[b]		**0.253**[a]	**0.141**[b]		**0.288**[a]	**0.163**[b]	
	S	**P**	**S×P**	**S**	**P**	**S×P**	**S**	**P**	**S×P**
SEm±	0.002	0.001	0.003	0.004	0.003	0.007	0.002	0.001	0.003
CD (5%)	0.007	0.005	0.010	0.001	0.001	0.002	0.007	0.005	0.010

Table 4.1.5 cont.

Period of scion storage (S)	75 DAG			90 DAG			105 DAG		
	Type of scion (P)		Mean	Type of scion (P)		Mean	Type of scion (P)		Mean
	Precured	Non-precured		Precured	Non-precured		Precured	Non-precured	
0 days	0.390	0.153	**0.272**[b]	0.427	0.183	**0.305**[b]	0.507	0.250	**0.378**[b]
3 days	0.433	0.243	**0.338**[a]	0.470	0.303	**0.387**[a]	0.533	0.360	**0.447**[a]
5 days	0.310	0.205	**0.257**[c]	0.360	0.230	**0.295**[c]	0.430	0.300	**0.365**[c]
7 days	0.290	0.180	**0.235**[d]	0.333	0.213	**0.273**[d]	0.413	0.270	**0.342**[d]
Mean	**0.356**[a]	**0.197**[b]		**0.398**[a]	**0.233**[b]		**0.471**[a]	**0.295**[b]	
	S	**P**	**S×P**	**S**	**P**	**S×P**	**S**	**P**	**S×P**
SEm±	0.002	0.002	0.004	0.001	0.001	0.002	0.001	0.001	0.002
CD (5%)	0.008	0.006	0.013	0.005	0.004	0.008	0.004	0.003	0.006

Table 4.1.6 Effect of pretreatments and storage of scion wood on number of leaves per shoot of mango grafts cv. Baneshan

Period of scion storage (S)	30 DAG			45 DAG			60 DAG		
	Type of scion (P)		Mean	Type of scion (P)		Mean	Type of scion (P)		Mean
	Precured	Non-precured		Precured	Non-precured		Precured	Non-precured	
0 days	7.300	5.203	**6.252**[b]	7.850	5.660	**6.755**[b]	8.560	6.050	**7.305**[b]
3 days	7.493	6.003	**6.748**[a]	8.100	6.500	**7.300**[a]	8.830	6.950	**7.890**[a]
5 days	6.500	5.720	**6.110**[c]	7.000	6.100	**6.550**[c]	7.857	6.497	**7.177**[c]
7 days	6.207	5.500	**5.853**[d]	6.800	5.920	**6.360**[d]	7.230	6.300	**6.765**[d]
Mean	**6.875**[a]	**5.607**[b]		**7.438a**	**6.058b**		**8.119a**	**6.449b**	
	S	**P**	**S×P**	**S**	**P**	**S×P**	**S**	**P**	**S×P**
SEm±	0.007	0.005	0.011	0.044	0.031	0.063	0.012	0.008	0.017
CD (5%)	0.023	0.016	0.034	0.135	0.096	0.192	0.036	0.025	0.052

Table 4.1.6 cont

Period of scion storage (S)	75 DAG			90 DAG			105 DAG		
	Type of scion (P)		Mean	Type of scion (P)		Mean	Type of scion (P)		Mean
	Precured	Non-precured		Precured	Non-precured		Precured	Non-precured	
0 days	9.050	6.550	**7.800**[b]	9.300	6.980	**8.140**[b]	9.850	7.400	**8.625**[b]
3 days	9.220	7.400	**8.310**[a]	9.720	7.850	**8.785**[a]	10.160	8.300	**9.230**[a]
5 days	8.340	7.050	**7.695**[c]	8.680	7.530	**8.105**[c]	9.100	7.840	**8.470**[c]
7 days	7.700	6.750	**7.225**[d]	8.060	7.330	**7.695**[d]	8.460	7.630	**8.045**[d]
Mean	**8.578**[a]	**6.938**[b]		**8.940**[a]	**7.423**[b]		**9.393**[a]	**7.793**[b]	
	S	**P**	**S×P**	**S**	**P**	**S×P**	**S**	**P**	**S×P**
SEm±	0.011	0.007	0.015	0.007	0.005	0.011	0.009	0.006	0.012
CD (5%)	0.033	0.024	0.048	0.023	0.016	0.034	0.027	0.019	0.039

Table 4.1.7 Effect of pretreatments and storage of scion wood internodal length (cm) of new shoot of mango grafts cv. Baneshan

Period of scion storage (S)	30 DAG			45 DAG			60 DAG		
	Type of scion(P)		Mean	Type of scion (P)		Mean	Type of scion (P)		Mean
	Precured	Non-precured		Precured	Non-precured		Precured	Non-precured	
0 days	1.100	0.517	**0.808**[b]	1.302	0.573	**0.938**[b]	1.490	0.782	**1.136**[b]
3 days	1.303	0.773	**1.038**[a]	1.483	0.810	**1.147**[a]	1.680	1.037	**1.358**[a]
5 days	0.942	0.620	**0.781**[c]	1.097	0.707	**0.902**[c]	1.240	0.927	**1.083**[c]
7 days	0.887	0.580	**0.733**[d]	0.960	0.617	**0.788**[d]	1.163	0.853	**1.008**[d]
Mean	**1.059**[a]	**0.622**[b]		**1.211**[a]	**0.677**[b]		**1.393**[a]	**0.894**[b]	
	S	**P**	**S×P**	**S**	**P**	**S×P**	**S**	**P**	**S×P**
SEm±	0.006	0.004	0.008	0.003	0.002	0.004	0.012	0.008	0.017
CD (5%)	0.018	0.013	0.026	0.010	0.007	0.015	0.037	0.026	0.052

Table 4.1.7 cont

Period of scion storage (S)	75 DAG			90 DAG			105 DAG		
	Type of scion (P)			Type of scion (P)			Type of scion (P)		
	Precured	Non-precured	Mean	Precured	Non-precured	Mean	Precured	Non-precured	Mean
0 days	1.783	0.963	**1.373**[b]	2.153	1.123	**1.638**[b]	2.403	1.280	**1.842**[b]
3 days	1.947	1.210	**1.578**[a]	2.307	1.427	**1.867**[a]	2.770	1.637	**2.203**[a]
5 days	1.527	1.117	**1.322**[c]	1.877	1.327	**1.602**[c]	2.127	1.500	**1.813**[c]
7 days	1.340	1.047	**1.193**[d]	1.610	1.250	**1.430**[d]	1.853	1.393	**1.623**[d]
Mean	**1.649**[a]	**1.084**[b]		**1.987**[a]	**1.282**[b]		**2.288**[a]	**1.453**[b]	
	S	**P**	**S×P**	**S**	**P**	**S×P**	**S**	**P**	**S×P**
SEm±	0.003	0.002	0.005	0.005	0.003	0.007	0.005	0.004	0.008
CD (5%)	0.010	0.007	0.015	0.015	0.010	0.022	0.017	0.012	0.025

Table 4.1.8 Effect of pretreatments and storage of scion wood on number of new laterals of mango grafts cv. Baneshan

Period of scion storage (S)	30 DAG			45 DAG			60 DAG		
	Type of scion (P)			Type of scion (P)			Type of scion (P)		
	Precured	Non-precured	Mean	Precured	Non-precured	Mean	Precured	Non-precured	Mean
0 days	1.103	0.553	**0.828**[b]	1.140	0.600	**0.870**[b]	1.170	0.650	**0.910**[b]
3 days	1.180	0.770	**0.940**[a]	1.200	0.800	**1.000**[a]	1.230	0.840	**1.035**[a]
5 days	0.877	0.647	**0.762**[c]	0.950	0.700	**0.825**[c]	0.980	0.740	**0.860**[c]
7 days	0.780	0.600	**0.690**[d]	0.820	0.650	**0.735**[d]	0.860	0.700	**0.780**[d]
Mean	**0.985**[a]	**0.625**[b]		**1.028**[a]	**0.688**[b]		**1.060**[a]	**0.733**[b]	
	S	**P**	**S×P**	**S**	**P**	**S×P**	**S**	**P**	**S×P**
SEm±	0.006	0.004	0.008	0.003	0.002	0.005	0.006	0.004	0.009
CD (5%)	0.018	0.012	0.026	0.011	0.008	0.017	0.020	0.014	0.029

Table 4.1.8 cont.

Period of scion storage (S)	75 DAG			90 DAG			105 DAG		
	Type of scion (P)		Mean	Type of scion (P)		Mean	Type of scion (P)		Mean
	Precured	Non-precured		Precured	Non-precured		Precured	Non-precured	
0 days	1.210	0.690	**0.950**[b]	1.280	0.740	**1.010**[b]	1.400	0.880	**1.140**[b]
3 days	1.280	0.890	**1.085**[a]	1.340	0.960	**1.150**[a]	1.470	1.080	**1.275**[a]
5 days	1.050	0.800	**0.925**[c]	1.120	0.850	**0.985**[c]	1.220	1.020	**1.120**[c]
7 days	0.920	0.730	**0.825** [d]	1.070	0.790	**0.930**[d]	1.180	0.910	**1.045**[d]
Mean	**1.115**[a]	**0.778**[b]		**1.203**[a]	**0.835**[b]		**1.318**[a]	**0.973**[b]	
	S	**P**	**S×P**	**S**	**P**	**S×P**	**S**	**P**	**S×P**
SEm±	0.006	0.004	0.009	0.006	0.004	0.008	0.006	0.004	0.009
CD (5%)	0.020	0.014	0.030	0.019	0.013	0.027	0.020	0.014	0.028

Table 4.1.9 Effect of pretreatments and storage of scion wood on length of new laterals (cm) of mango grafts cv. Baneshan

Period of scion storage (S)	30 DAG			45 DAG			60 DAG		
	Type of scion (P)		Mean	Type of scion (P)		Mean	Type of scion (P)		Mean
	Precured	Non-precured		Precured	Non-precured		Precured	Non-precured	
0 days	1.250	0.730	**0.990**[b]	1.450	0.810	**1.130**[b]	1.863	0.983	**1.423**[b]
3 days	1.400	0.910	**1.155**[a]	1.600	1.000	**1.300**[a]	2.020	1.220	**1.620**[a]
5 days	1.000	0.830	**0.915**[c]	1.250	0.902	**1.085**[c]	1.500	1.100	**1.300**[c]
7 days	0.970	0.760	**0.865**[d]	1.170	0.870	**1.020**[d]	1.300	1.040	**1.170**[d]
Mean	**1.155**[a]	**0.808**[b]		**1.368**[a]	**0.900**[b]		**1.671**[a]	**1.086**[b]	
	S	**P**	**S×P**	**S**	**P**	**S×P**	**S**	**P**	**S×P**
SEm±	0.005	0.003	0.007	0.005	0.003	0.007	0.005	0.003	0.007
CD (5%)	0.015	0.010	0.022	0.015	0.010	0.021	0.016	0.011	0.023

Table 4.1.9 cont.

Period of scion storage (S)	75 DAG			90 DAG			105 DAG		
	Type of scion (P)		Mean	Type of scion (P)		Mean	Type of scion (P)		Mean
	Precured	Non-precured		Precured	Non-precured		Precured	Non-precured	
0 days	2.057	1.033	**1.545**[b]	2.283	1.243	**1.763**[b]	2.603	1.493	**2.048**[b]
3 days	2.223	1.477	**1.850**[a]	2.460	1.690	**2.075**[a]	2.750	2.050	**2.400**[a]
5 days	1.787	1.237	**1.512**[c]	1.997	1.460	**1.728**[c]	2.297	1.647	**1.972**[c]
7 days	1.640	1.100	**1.370**[d]	1.800	1.340	**1.570**[d]	2.190	1.563	**1.877**[d]
Mean	**1.927**[a]	**1.212**[b]		**2.135**[a]	**1.433**[b]		**2.460**[a]	**1.688**[b]	
	S	**P**	**S×P**	**S**	**P**	**S×P**	**S**	**P**	**S×P**
SEm±	0.003	0.002	0.005	0.005	0.003	0.007	0.004	0.003	0.006
CD (5%)	0.010	0.007	0.015	0.016	0.011	0.023	0.013	0.009	0.019

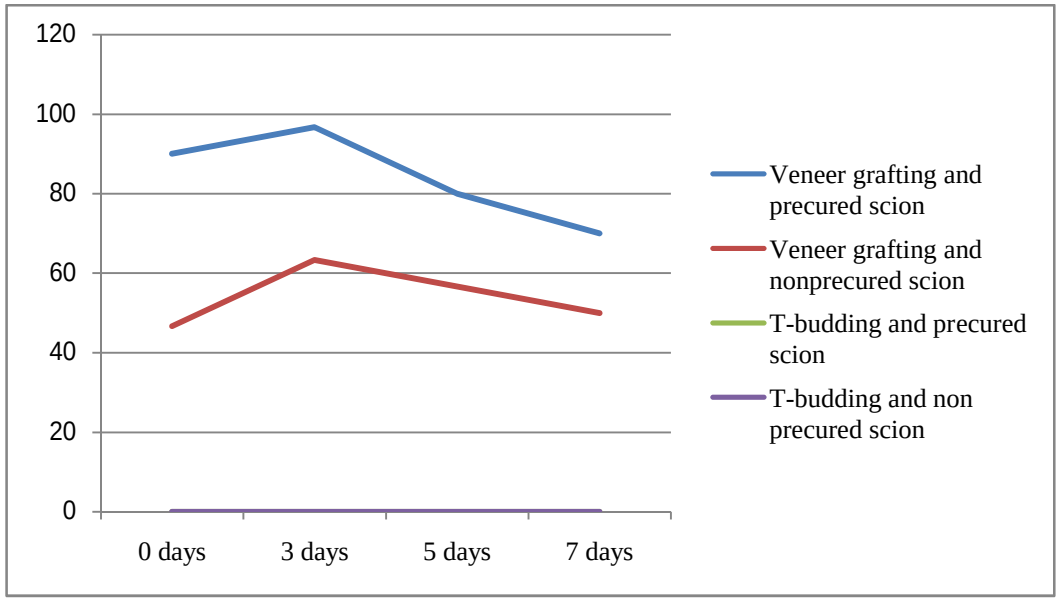

Fig 4.1.1 Effect of pretreatment and storage of scion wood on bud take (%) in different methods of propagation in mango cv. Baneshan

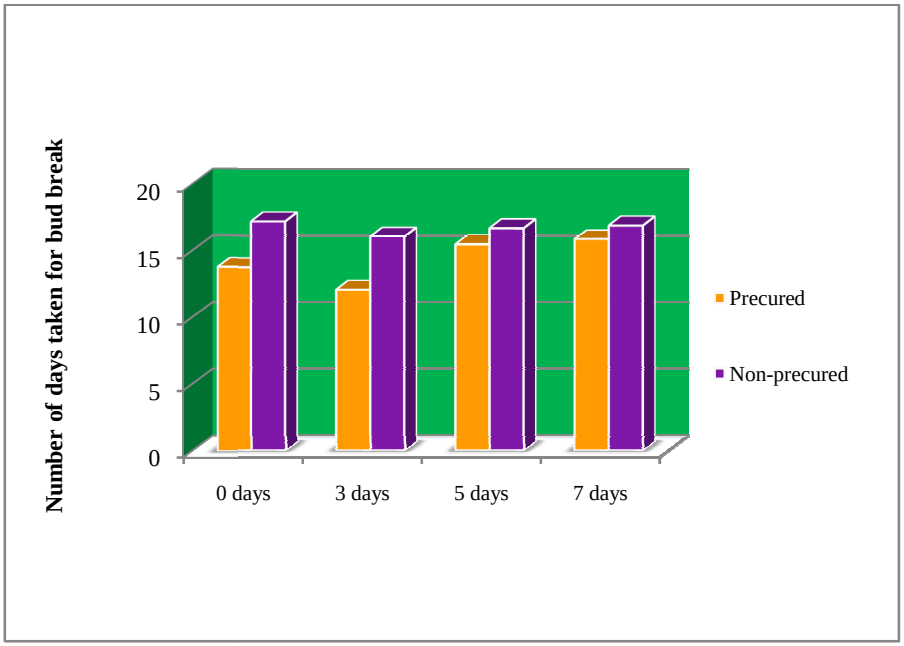

Fig 4.1.2 Effect of pretreatments and storage of scion wood on number of days taken for bud break

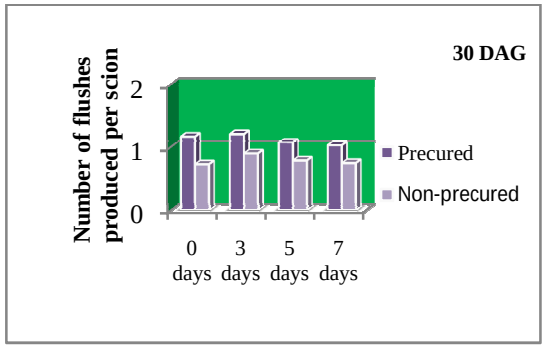

Fig.4.1.3.a Effect of pretreatments and storage of scion wood on number of flushes produced 30 days after grafting (DAG)

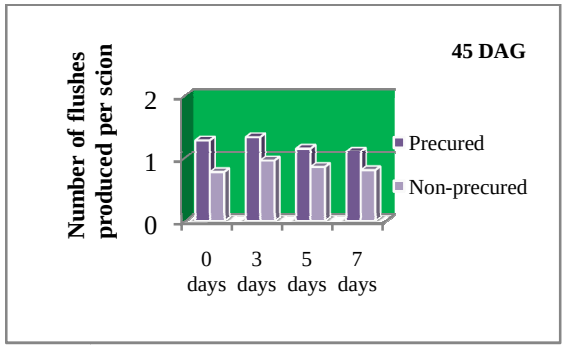

Fig.4.13.b Effect of pretreatments and storage of scion wood on number of flushes produced 45 days after grafting (DAG)

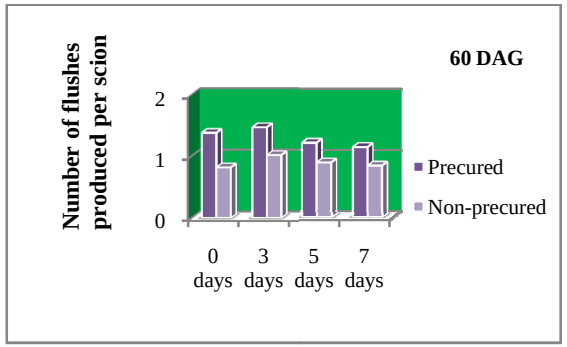

Fig.4.1.3.c Effect of pretreatments and storage of scion wood on number of flushes produced 60 days after grafting (DAG)

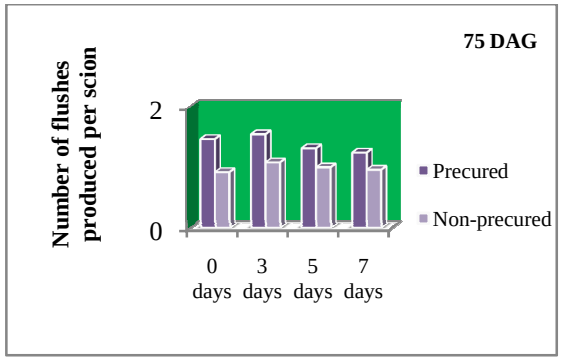

Fig.4.1.3.d Effect of pretreatments and storage of scion wood on number of flushes produced 75 days after grafting (DAG)

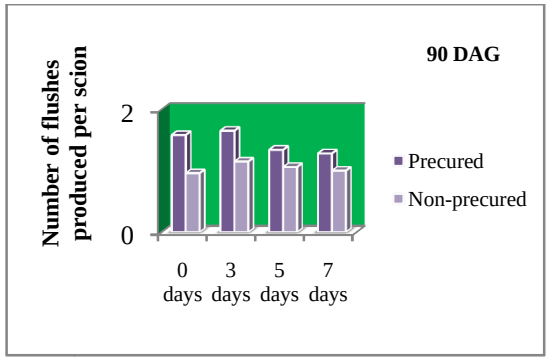

Fig.4.1.3.e Effect of pretreatments and storage of scion wood on number of flushes produced 90 days after grafting (DAG)

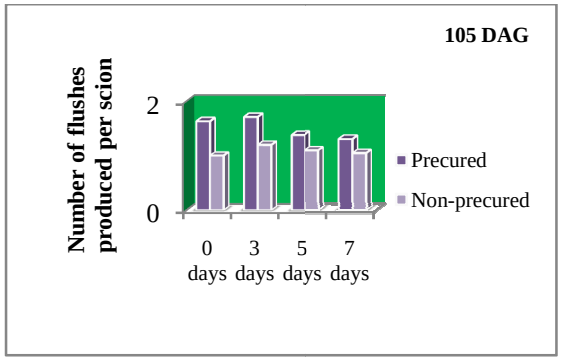

Fig.4.1.3.f Effect of pretreatments and storage of scion wood on number of flushes produced 105 days after grafting (DAG)

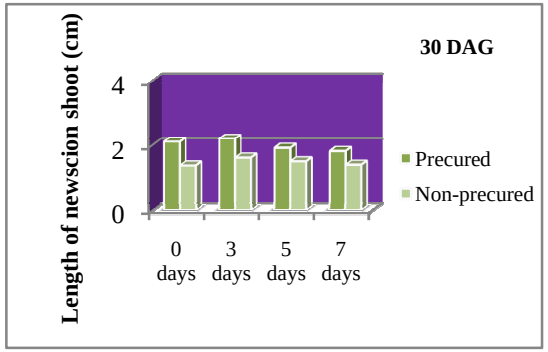

Fig.4.1.4.a Effect of pretreatments and storage of scion wood on length of new scion shoot 30days after grafting (DAG)

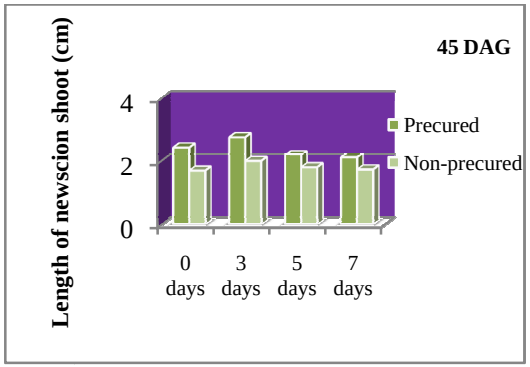

Fig.4.1.4.b Effect of pretreatments and storage of scion wood on length of new scion shoot 45 days after grafting (DAG)

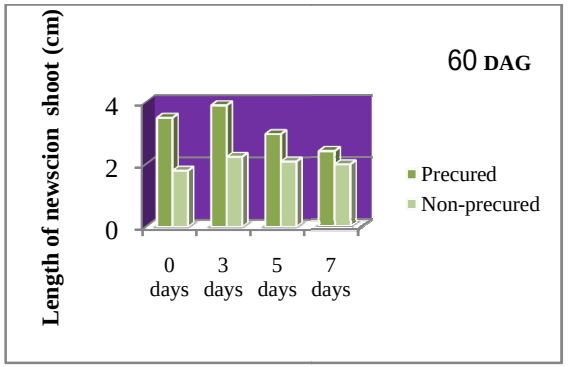

Fig.4.1.4.c Effect of pretreatments and storage of scion wood on length of new scion shoot 60 days after grafting

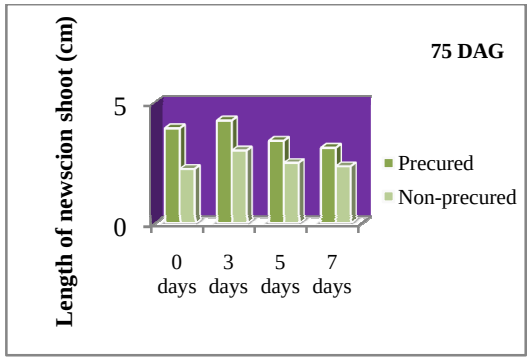

Fig4.1.4.d Effect of pretreatments and storage of scion wood on length of scion shoot 75 days after grafting (DAG)

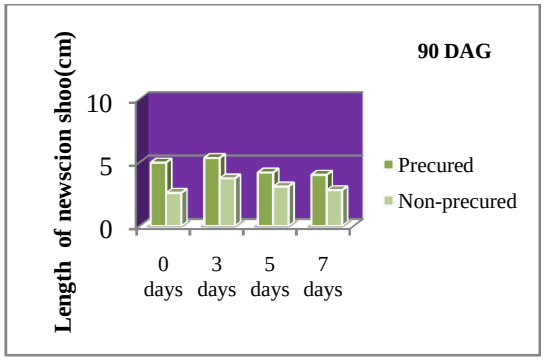

Fig 4.1.4.e Effect of pretreatments and storage of scion wood on length of new scion shoot 90 days after grafting (DAG)

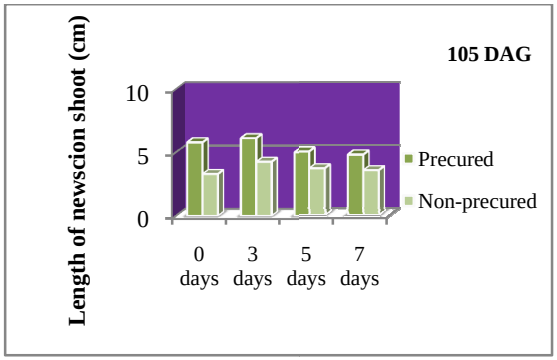

Fig.4.1.4.f Effect of pretreatments and storage of scion wood on length of new scion shoot 105 days after grafting (DAG)

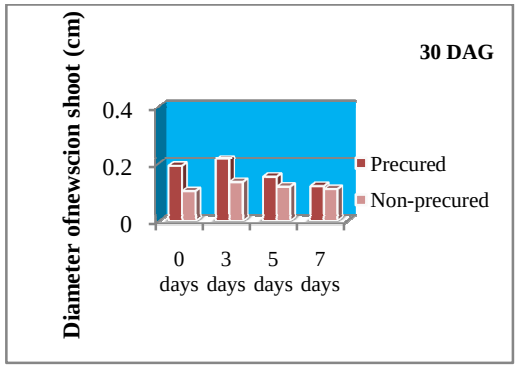

Fig.4.1.5.a Effect of pretreatments and storage of scion wood on diameter of new scion shoot (cm) 30 days after grafting (DAG)

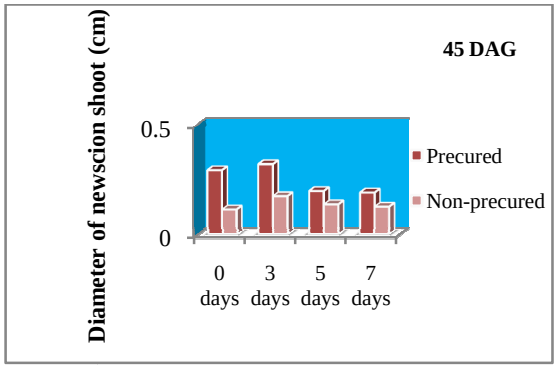

Fig.4.1.5.b Effect of pretreatments and storage of scion wood on diameter of new scion shoot (cm)45 days after grafting (DAG)

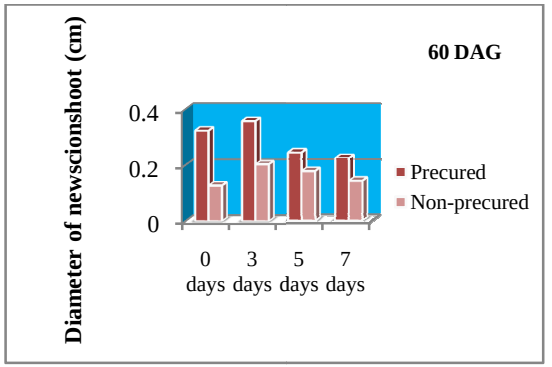

Fig.4.1.5.c Effect of pretreatments and storage of scion wood on diameter of new scion shoot (cm) 60 days after grafting (DAG)

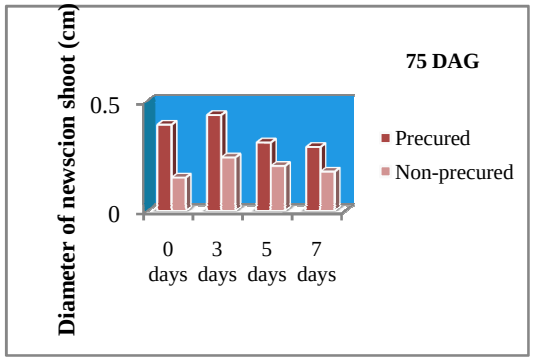

Fig.4.1.5.d Effect of pretreatments and storage of scion wood on diameter of new shoot (cm) 75 days after grafting (DAG)

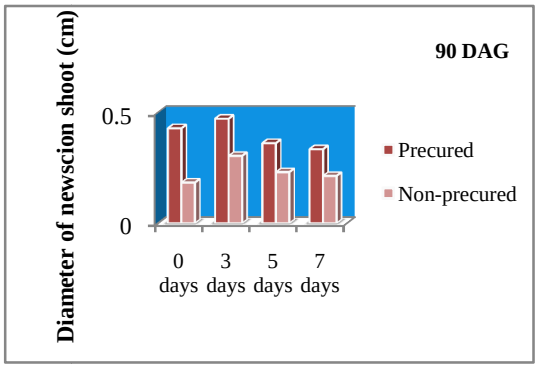

Fig.4.1.5.e Effect of pretreatments and storage of scion wood on diameter of new shoot (cm) 90 days after grafting (DAG)

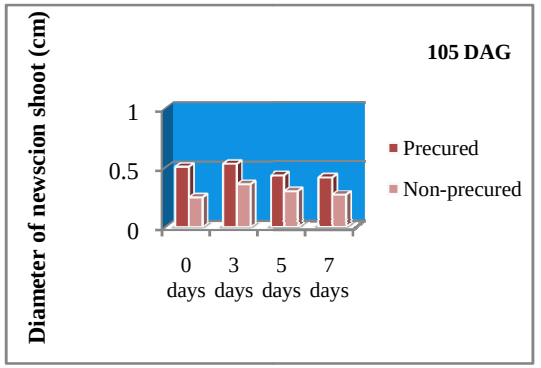

Fig.4.1.5.f Effect of pretreatments and storage of scion wood on diameter of new shoot (cm) 105 days after grafting (DAG)

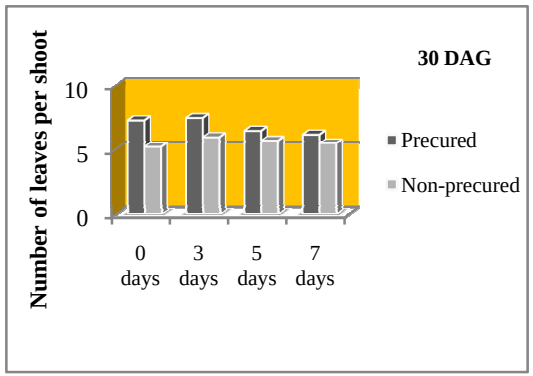

Fig.4.1.6.a Effect of pretreatments and storage of scion wood on number of leaves per shoot 30 days after grafting (DAG)

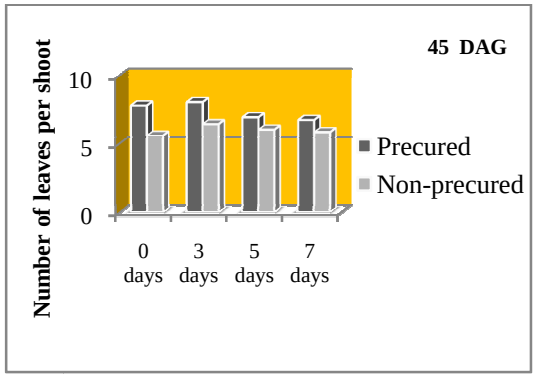

Fig.4.1.6.b Effect of pretreatments and storage of scion wood on number of leaves per shoot 45 days after grafting (DAG)

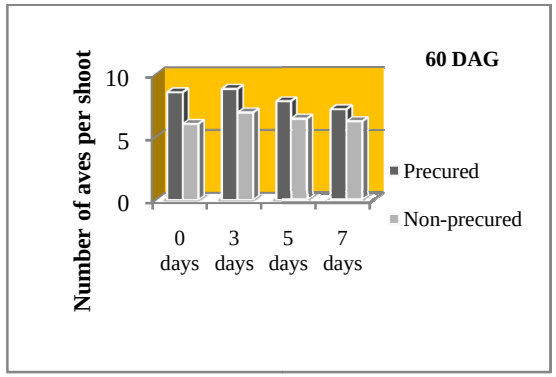

Fig.4.1.6.c Effect of pretreatments and storage of scion wood on number of leaves per shoot 60days after grafting (DAG)

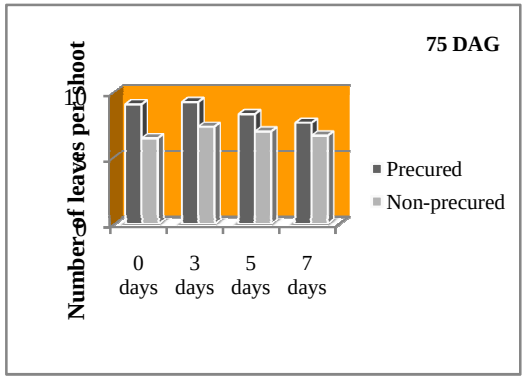

Fig.4.1.6.d Effect of pretreatments and storage of scion wood on number of leaves per shoot 75 days after grafting (DAG)

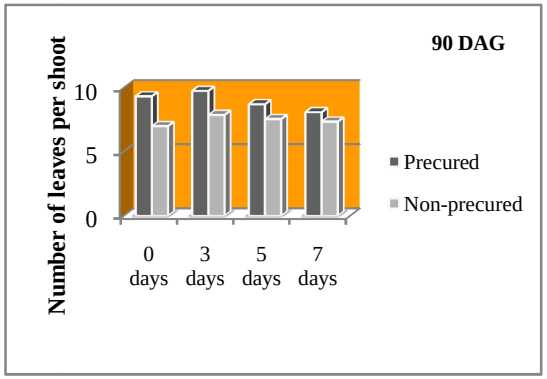

Fig.4.1.6.e Effect of pretreatments and storage of scion wood on number of leaves per shoot 90 days after grafting (DAG)

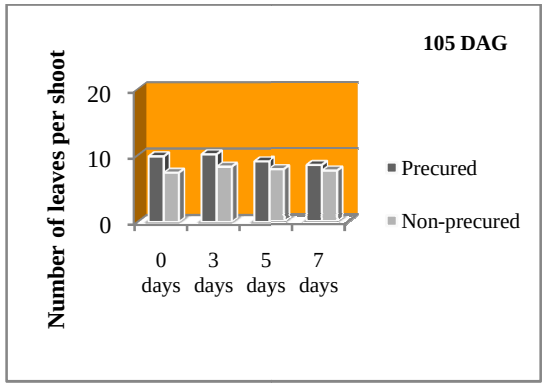

Fig.4.1.6 Effect of pretreatments and storage of scion wood on number of leaves per shoot 105 days after grafting (DAG)

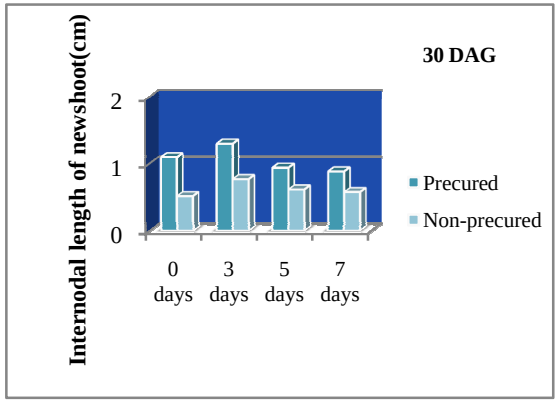

Fig.4.1.7.a Effect of pretreatments and storage of wood on internodal length (cm) days after grafting (DAG)

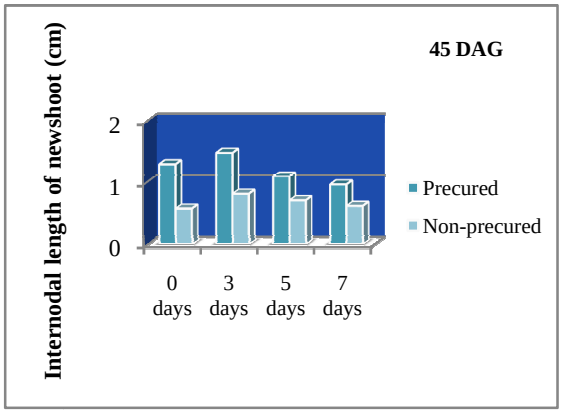

Fig.4.1.7.b Effect of pretreatments and storage of scion wood on internodal length (cm) of new shoot 45 days after grafting (DAG)

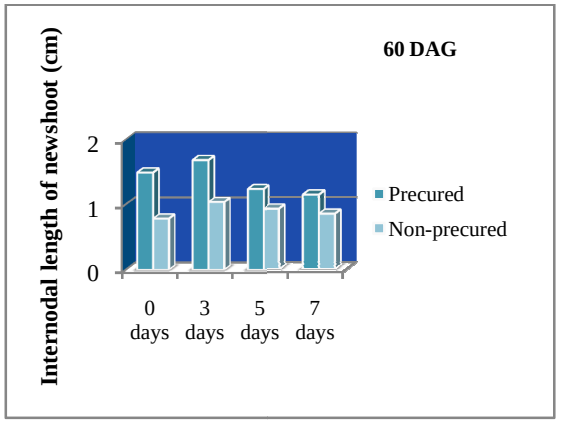

Fig.4.1.7.c Effect of pretreatments and storage of scion of scion wood on internodal length (cm) of of new shoot 30 new shoot 60 days after grafting (DAG)

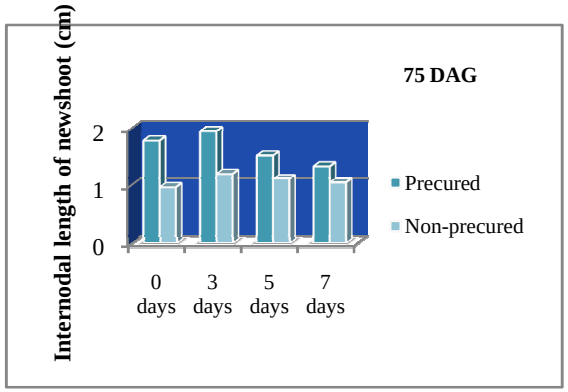

Fig.4.1.7.d Effect of pretreatments and storage of scion wood on internodal length (cm) of new 75 days after grafting (DAG)

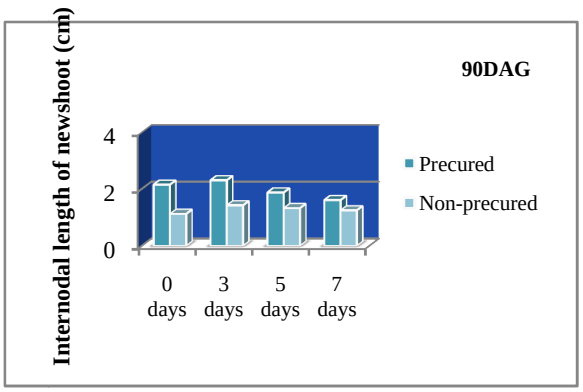

Fig.4.1.7.e Effect of pretreatments and storage of scion wood on internodal length (cm) of new shoot 90 days after grafting (DAG)

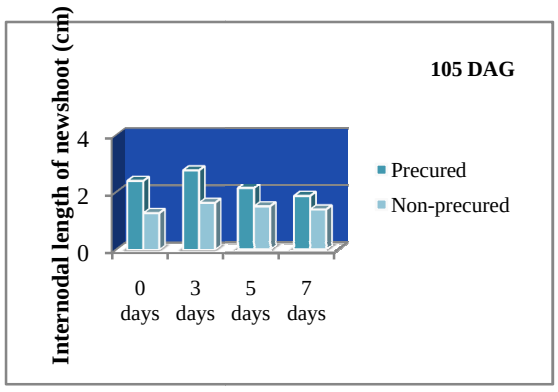

Fig.4.1.7.f Effect of pretreatments and storage of scion wood on internodal length (cm) of new shoot 10 5 days after grafting (DAG)

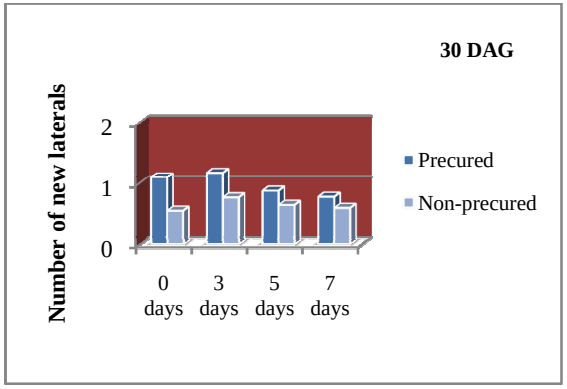

Fig.4.1.8.a Effect of pretreatments and storage of scion wood on number of new laterals 30 days after grafting (DAG)

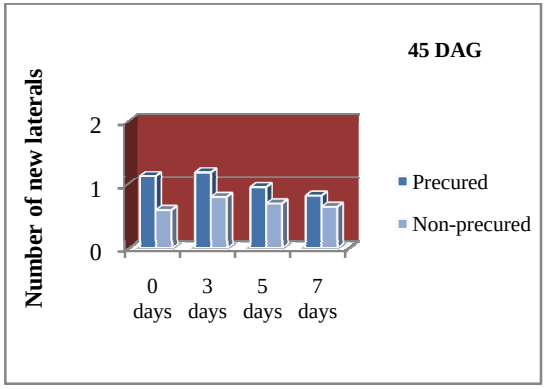

Fig.4.1.8.b Effect of pretreatments and storage of scion wood on number of new laterals 45 days after grafting (DAG)

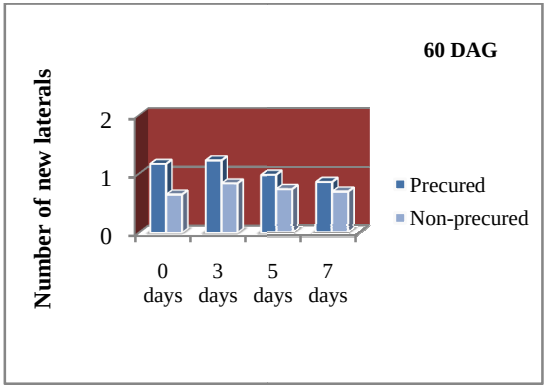

Fig.4.1.8.c Effect of pretreatments and storage of scion wood on number of new laterals 60 days after grafting (DAG)

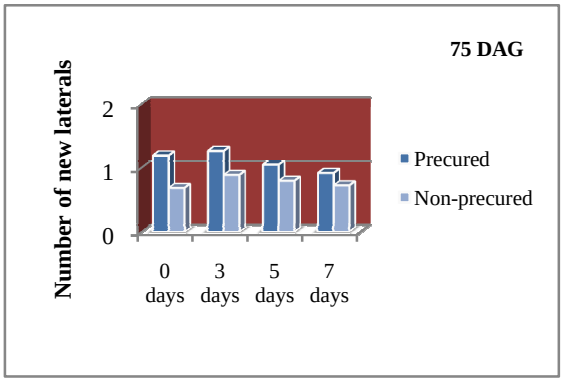

Fig.4.1.8.d Effect of pretreatments and storage of scion wood on number of new laterals 75 days after grafting (DAG)

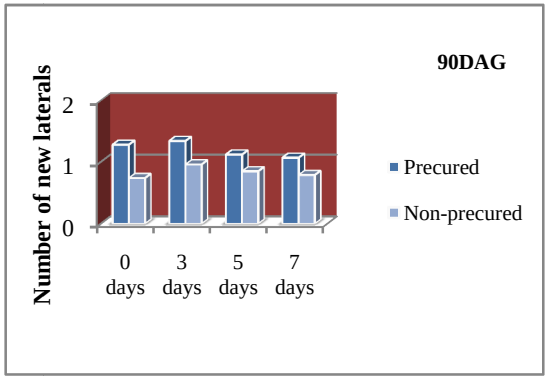

Fig.4.1.8.e Effect of pretreatments and storage of scion wood on number of new laterals 90 days after grafting (DAG)

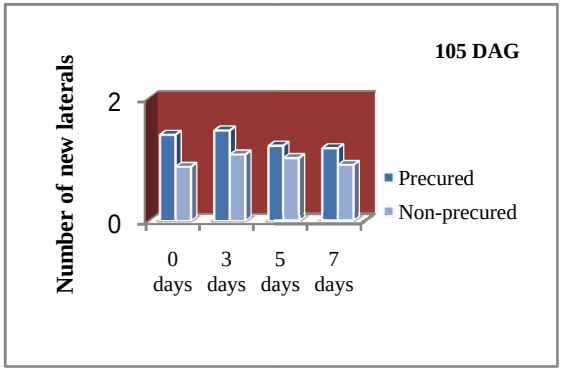

Fig.4.1.8.f Effect of pretreatments and storage of scion wood on number of new laterals 105 days after grafting (DAG)

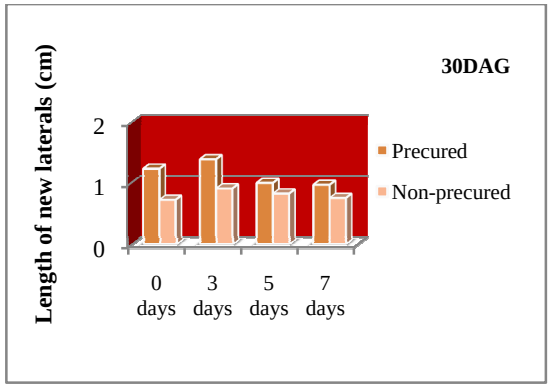

Fig.4.1.9.a Effect of pretreatments and storage of scion wood on length of new laterals 30 days after grafting (DAG)

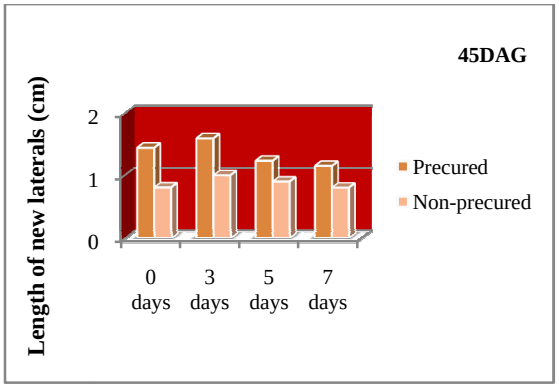

Fig.4.1.9.b Effect of pretreatments and storage scion wood on length of new laterals 45 days after grafting (DAG)

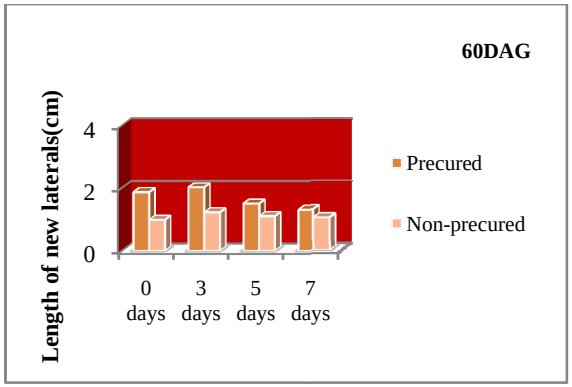

Fig.4.1.9.c Effect of pretreatments and storage of scion wood on length of new laterals 60 days after grafting (DAG)

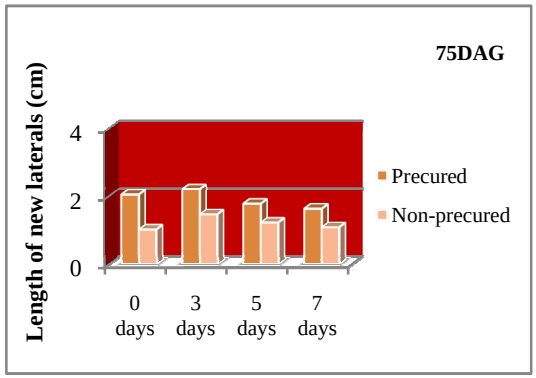

Fig.4.1.9.d Effect of pretreatments and storage of scion wood on length of new laterals 75 days after grafting (DAG)

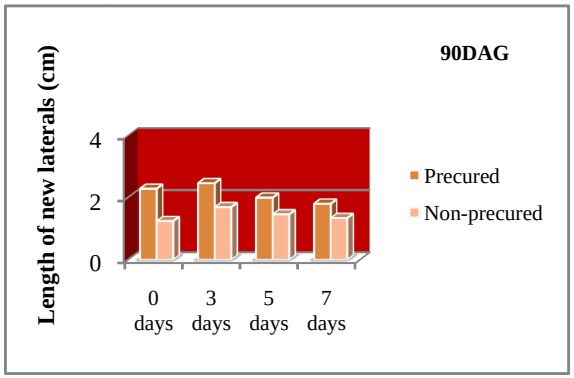

Fig.4.1.9.e Effect of pretreatments and storage of scion wood on length of new laterals 90 days after grafting (DAG)

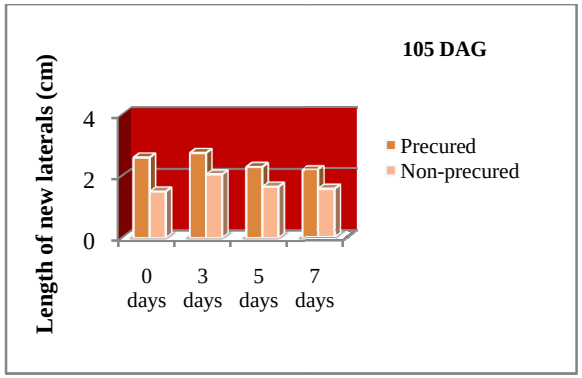

Fig.4.1.9.f Effect of pretreatments and storage of scion wood on length of new laterals 105 days after grafting (DAG)

APPENDIX

Meteorological data during the period of work

Week no.	Period	Temperature (^{0}C)		Relative humidity (%)		Rain fall (mm)	Rainy days	Solar radiation		WNS Km/hr		Chill Hours	Evapo transpiration(m)
		Min.	Max.	FN	AN			FN	AN	Min.	Max.		
1	21- 30 JUNE	23.30	33.50	87.80	43.60	5.95	0.30	667.80	466.70	1.80	14.80	7^0	3.32
	Mean	**23.30**	**33.50**	**87.80**	**43.60**	**5.95**	**0.30**	**667.80**	**466.70**	**1.80**	**14.80**	**7^0**	**3.32**
2	01-08 JULY	23.25	31.25	81.12	57.50	6.375	0.25	640.25	457.12	3	19.37	7^0	3.63
3	09-16	22.50	31.37	86.00	54.37	1.33	0.125	638.25	431.87	1.625	13	7^0	3.75
	Mean	**22.87**	**31.31**	**83.56**	**55.93**	**3.85**	**0.18**	**639.25**	**444.49**	**2.31**	**16.18**	**7^0**	**3.69**
4	17-24	22.37	29.50	94.75	65.50	9.93	0.25	461	314.50	2.5	14.12	7^0	3.66
5	25-31	22.57	30.28	89.85	55.14	5.92	0.28	558.42	426.57	3.42	13.71	7^0	3.76
	Mean	**22.47**	**29.89**	**92.30**	**60.32**	**7.92**	**0.26**	**509.71**	**370.53**	**2.96**	**13.91**	**7^0**	**3.71**

6	01-08 AUGUST	22.50	31.37	93.87	53.25	3.125	0.5	616	331.12	3.75	15.87	7^0	3.62
7	09-16	21.87	32.00	94.37	50.62	1.12	0.25	679.12	366.37	4.25	14.00	7^0	3.98
	Mean	**22.18**	**31.68**	**94.12**	**51.93**	**2.12**	**0.37**	**647.56**	**348.74**	**4.00**	**14.93**	**7^0**	**3.80**
8	17-24	22.50	31.75	94.62	50.37	1.43	0.12	719	457.50	2.25	11.37	7^0	4.14
9	25-31	22.42	31.14	97.28	61.28	7.35	0.57	614.85	392.57	4.28	13.14	7^0	3.13
	Mean	**22.46**	**31.44**	**95.95**	**55.82**	**4.39**	**0.34**	**666.92**	**425.03**	**3.26**	**12.25**	**7^0**	**3.63**
10	01-08 SEPTEMBER	22.50	31.87	95.50	55.62	2.18	0.12	659.25	428.37	3.125	12.50	7^0	3.76
11	09-16	22.57	32.12	94.75	55.50	0.77	0.00	670.75	478.75	2.75	12.50	7^0	3.48
	Mean	**22.53**	**31.99**	**95.12**	**55.56**	**1.47**	**0.06**	**665.00**	**453.56**	**2.93**	**12.50**	**7^0**	**3.62**
12	17-23	22.42	33.00	96.57	49.71	5.65	0.42	602.71	537.71	3.71	27.85	7^0	3.37
13	24-30	23.58	33.00	96.00	45.00	0.28	0.00	788.71	481.85	1.71	10.57	7^0	4.27
	Mean	**23.00**	**33.00**	**96.28**	**47.35**	**2.96**	**0.21**	**695.71**	**509.78**	**2.71**	**19.21**	**7^0**	**3.82**
14	01-08 OCTOBER	21.62	30.75	99.00	56.50	6.68	0.625	733.25	488.25	2.25	11.75	7^0	3.12

15	09-16	16.25	33.00	98.50	26.25	0.00	0.00	708.12	475.87	2.875	12.50	7^0	3.85
	Mean	**18.93**	**31.87**	**98.75**	**41.37**	**3.34**	**0.31**	**720.68**	**482.06**	**2.56**	**12.12**	**7^0**	**3.48**
16	17-24	18.00	32.12	98.25	39.00	0.05	0.00	704.00	450.12	4.125	13.00	7^0	3.07
17	25-31	16.71	33.14	96.00	32.14	0.00	0.00	675.42	433.85	2.42	13.14	7^0	3.27
	Mean	**17.35**	**32.63**	**97.12**	**35.57**	**0.02**	**0.00**	**689.71**	**441.98**	**3.27**	**13.07**	**7^0**	**3.17**
18	01-08 NOVEMBER	19.75	29.87	97.37	52.62	3.55	0.37	513.75	303.62	2.37	9.37	7^0	2.64
20	09-16	14.12	31.87	96.00	28.75	0.02	0.00	668.37	331.00	3.50	13.00	7^0	2.67
	Mean	**16.93**	**30.87**	**96.68**	**40.68**	**1.78**	**0.18**	**591.06**	**317.31**	**2.935**	**11.18**	**7^0**	**2.65**
21	17-23	14.57	32.71	93.42	40.00	0.00	0.00	749.00	309.00	3.00	14.00	7^0	2.79
22	24-30	17.85	33.71	95.85	41.28	0.00	0.00	749.00	309.00	2.85	14.00	7^0	2.79
	Mean	**16.21**	**33.21**	**94.63**	**40.64**	**0.00**	**0.00**	**749.00**	**309.00**	**2.92**	**14.00**	**7^0**	**2.79**
23	01-08 DECEMBER	16.00	33.87	91.62	36.50	0.00	0.00	513.75	303.62	2.37	9.37	7^0	2.64
24	09-16	16.00	34.87	85.25	28.12	0.00	0.00	668.37	331.00	3.50	13.00	7^0	2.67

	Mean	**16.00**	**34.37**	**88.43**	**32.31**	**0.00**	**0.00**	**591.06**	**317.31**	**2.93**	**11.18**	**7^0**	**2.65**
25	17-24	12.37	32.75	92.37	30.12	0.00	0.00	749.00	309.00	3.00	14.00	7^0	2.79
26	25-31	13.00	32.28	90.85	32.71	0.00	0.00	749.00	309.00	3.00	14.00	7^0	2.79
	Mean	**12.68**	**32.51**	**91.61**	**31.41**	**0.00**	**0.00**	**749.00**	**309.00**	**3.00**	**14.00**	**7^0**	**2.79**
27	01-08 JANUARY	18.37	35.00	91.87	35.87	0.00	0.00	509.00	303.62	2.375	9.37	7^0	2.80
28	09-16	11.25	34.00	81.75	21.25	0.00	0.00	501.87	331.00	3.50	13.00	7^0	2.89
	Mean	**14.81**	**34.50**	**86.81**	**28.56**	**0.00**	**0.00**	**505.43**	**317.31**	**2.93**	**11.18**	**7^0**	**2.84**
29	17-24	15.37	33.25	88.25	28.75	0.00	0.00	519.12	309.00	3.00	14.00	7^0	2.76
30	25-31	17.00	33.14	92.57	34.57	0.24	0.28	500.00	309.00	3.00	14.00	7^0	2.68
	Mean	**16.18**	**33.19**	**90.41**	**31.66**	**0.12**	**0.14**	**509.56**	**309.00**	**3.00**	**14.00**	**7^0**	**2.72**
31	01-07 FEBRUARY	16.42	33.14	89.28	32.57	0.00	0.00	508.57	314.85	2.57	9.57	7^0	3.09
32	08-14	18.28	34.14	87.42	29.00	0.00	0.00	441.28	322.14	2.42	12.00	7^0	3.31
	Mean	**17.35**	**33.64**	**88.35**	**30.78**	**0.00**	**0.00**	**474.92**	**318.49**	**2.49**	**10.78**	**7^0**	**3.20**

33	15-21	16.42	33.00	94.57	33.00	0.20	0.28	584.42	309.00	4.00	14.00	7^0	3.59
34	22-28	16.71	35.85	84.71	28.71	0.00	0.00	500.00	309.00	2.85	14.00	7^0	3.81
	Mean	**16.56**	**34.42**	**89.64**	**30.85**	**0.10**	**0.14**	**542.21**	**309.00**	**3.42**	**14.00**	**7^0**	**3.70**

Table 4.2.1 Effect of season on bud take in different methods of propagation in mango cv. Baneshan

Method of propagation	Bud take (%)								
	Season of propagation(M)								
	M_1	M_2	M_3	M_4	M_5	M_6	M_7	M_8	Mean
G_1	83.33 (65.90)	86.67 (68.58)	93.33 (75.03)	96.67 (79.48)	73.33 (58.90)	66.67 (54.73)	56.67 (48.83)	53.33 (46.90)	**68.74[a] (62.29)**
G_2	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	0.00 (4.05)	**0.00[b] (4.05)**
Mean	**41.66[d] (34.97)**	**43.33[c] (36.32)**	**46.66[b] (39.54)**	**48.33[a] (41.77)**	**36.66[e] (31.48)**	**33.33[f] (29.39)**	**28.33[g] (26.44)**	**26.66[h] (25.48)**	

	G	M	GM
SEm±	0.002	0.005	0.007
CD (5%)	0.007	0.015	0.021

* - Figures in parantheses are arc sin transformed values

G_1-Veneer grafting

G_2-T-budding

M_1 -1st fort night of August

M_2 -2nd fortnight of August

M_3 -1st fort night of September

M_4 -2nd fort night of September

M_5 -1st fortnight of October

M_6 -2nd fortnight of October

M_7 .1st fort night of November

M_8 -2nd fortnight of November

Table 4.2.2 Effect of season on number of days taken for bud break of mango grafts cv. Baneshan

Treatment	Days taken for bud break
T_1-1st FN August	15.50 [d]
T_2-2nd FN August	14.46 [c]
T_3-1st FN September	14.06 [b]
T_4-2nd FN September	13.23 [a]
T_5-1st FN October	17.80 [e]
T_6-2nd FN October	18.96 [f]
T_7-1st FN November	20.56 [g]
T_8- 2nd FN November	21.63 [h]
Mean	17.02
SEm±	0.01
CD (5%)	0.03

Table 4.2.3 Effect of season on number of flushes produced in mango grafts cv. Baneshan.

Treatment	Number of flushes produced					
	30 DAG	**45 DAG**	**60 DAG**	**75 DAG**	**90 DAG**	**105 DAG**
T_1-1st FN August	0.91[d]	1.04[d]	1.30[d]	1.50[d]	1.75[d]	2.00[d]
T_2-2nd FN August	1.00[c]	1.13[c]	1.40[c]	1.56[c]	1.80[c]	2.08[c]
T_3-1st FN September	1.08[b]	1.21[b]	1.46[b]	1.66[b]	1.90[b]	2.15[b]
T_4-2ndFN September	1.19[a]	1.34[a]	1.56[a]	1.72[a]	2.00[a]	2.23[a]
T_5-1st FN October	0.80[e]	0.93[e]	1.16[e]	1.34[e]	1.52[e]	1.80[e]
T_6-2nd FN October	0.71[f]	0.84[f]	1.07[f]	1.23[f]	1.46[f]	1.62[f]
T_7-1st FN November	0.60[g]	0.73[g]	0.96[g]	1.12[g]	1.26[g]	1.50[g]
T_8-2nd FN November	0.50[h]	0.63[h]	0.86[h]	1.02[h]	1.16[h]	1.38[h]
Mean	**0.84**	**0.98**	**1.22**	**1.39**	**1.60**	**1.84**
SEm±	0.02	0.03	0.01	0.01	0.01	0.03
CD (5%)	0.07	0.01	0.01	0.03	0.03	0.01

Table 4.2.4 Effect of season on length of new scion shoot (cm) of mango grafts cv. Baneshan

Treatment	Length of new scion shoot(cm)					
	30 DAG	**45 DAG**	**60 DAG**	**75 DAG**	**90 DAG**	**105 DAG**
T_1-1st FN August	1.88[d]	2.36[d]	2.88[d]	3.57[d]	4.57[d]	5.73[d]
T_2-2nd FN August	1.98[c]	2.48[c]	3.00[c]	3.72[c]	4.80[c]	5.90[c]
T_3-1st FN September	2.10[b]	2.60[b]	3.10[b]	3.85[b]	4.94[b]	6.00[b]
T_4-2nd FN September	2.25[a]	2.71[a]	3.28[a]	4.00[a]	5.10[a]	6.20[a]
T_5-1st FN October	1.64[e]	2.10[e]	2.50[e]	3.20[e]	4.24[e]	5.46[e]
T_6-2nd FN October	1.50[f]	1.79[f]	2.30[f]	3.00[f]	3.92[f]	5.00[f]
T_7-1st FN November	1.32[g]	1.62[g]	2.10[g]	2.83[g]	3.66[g]	4.80[g]
T_8-2nd FN November	1.18[h]	1.50[h]	2.00[h]	2.64[h]	3.54[h]	4.68[h]
Mean	**1.73**	**2.14**	**2.64**	**3.35**	**4.34**	**5.47**
SEm±	0.01	0.01	0.01	0.01	0.01	0.01

CD (5%)	0.03	0.03	0.03	0.03	0.03	0.03

Table 4.2.5 Effect of season on diameter of new scion shoot (cm) of mango grafts cv. Baneshan

Treatment	**Diameter of new scion shoot(cm)**					
	30 DAG	**45 DAG**	**60 DAG**	**75 DAG**	**90 DAG**	**105 DAG**
T_1-1st FN August	0.19^{d}	0.26^{d}	0.33^{d}	0.40^{d}	0.46^{d}	0.49^{d}
T_2-2nd FN August	0.21^{c}	0.28^{c}	0.35^{c}	0.42^{c}	0.48^{c}	0.52^{c}
T_3-1st FN September	0.24^{b}	0.31^{b}	0.37^{b}	0.44^{b}	0.50^{b}	0.55^{b}
T_4-2ndFN September	0.26^{a}	0.33^{a}	0.39^{a}	0.46^{a}	0.53^{a}	0.58^{a}
T_5-1st FN October	0.16^{e}	0.25^{e}	0.29^{e}	0.37^{e}	0.46^{e}	0.45^{e}
T_6-2nd FN October	0.14^{f}	0.22^{f}	0.26^{f}	0.33^{f}	0.41^{f}	0.40^{f}
T_7-1st FN November	0.12^{g}	0.20^{g}	0.23^{g}	0.28^{g}	0.34^{g}	0.35^{g}
T_8- 2ndFN November	0.11^{h}	0.16^{h}	0.21^{h}	0.25^{h}	0.31^{h}	0.32^{h}
Mean	**0.17**	**0.25**	**0.30**	**0.36**	**0.43**	**0.45**
SEm±	0.01	0.01	0.01	0.01	0.01	0.01
CD (5%)	0.03	0.03	0.03	0.03	0.03	0.03

Table 4.2.6 Effect of season on number of leaves per shoot of mango grafts cv. Baneshan

Treatment	Number of leaves per shoot					
	30 DAG	**45 DAG**	**60 DAG**	**75 DAG**	**90 DAG**	**105 DAG**
T_1-1st FN August	7.20[d]	7.86[d]	8.18[d]	8.65[d]	9.05[d]	9.42[d]
T_2-2nd FN August	7.66[c]	8.05[c]	8.43[c]	8.83[c]	9.24[c]	9.65[c]
T_3-1st FN September	7.80[b]	8.21[b]	8.58[b]	8.95[b]	9.36[b]	9.81[b]
T_4-2nd FN September	8.00[a]	8.43[a]	8.75[a]	9.06[a]	9.53[a]	10.10[a]
T_5-1st FN October	6.60[e]	7.14[e]	7.56[e]	8.00[e]	8.64[e]	9.03[e]
T_6-2nd FN October	6.18[f]	6.72[f]	7.04[f]	7.68[f]	8.16[f]	8.63[f]
T_7-1st FN November	5.90[g]	6.50[g]	6.82[g]	7.45[g]	7.91[g]	8.25[g]
T_8- 2nd FN November	5.20[h]	6.28[h]	6.68[h]	7.28[h]	7.73[h]	8.00[h]
Mean	**6.81**	**7.39**	**7.75**	**8.23**	**8.70**	**9.11**
SEm±	0.01	0.01	0.01	0.01	0.01	0.01
CD (5%)	0.03	0.03	0.03	0.03	0.03	0.03

Table 4.2.7 Effect of season on internodal length of new shoot (cm) of mango grafts cv. Baneshan

Treatment	Internodal length (cm)					
	30 DAG	**45 DAG**	**60 DAG**	**75 DAG**	**90 DAG**	**105 DAG**
T_1-1st FN August	0.62[d]	1.00[d]	1.24[d]	1.52[d]	2.12[d]	3.03[d]
T_2-2nd FN August	0.76[c]	1.07[c]	1.43[c]	1.69[c]	2.29[c]	3.12[c]
T_3-1st FN September	0.83[b]	1.19[b]	1.58[b]	1.81[b]	2.51[b]	3.31[b]
T_4-2nd FN September	0.94[a]	1.32[a]	1.77[a]	1.97[a]	2.67[a]	3.50[a]
T_5-1st FN October	0.60[e]	0.88[e]	1.06[e]	1.26[e]	1.86[e]	2.69[e]
T_6-2nd FN October	0.50[f]	0.80[f]	0.90[f]	1.11[f]	1.71[f]	2.54[f]
T_7-1st FN November	0.43[g]	0.70[g]	0.78[g]	1.00[g]	1.61[g]	2.43[g]
T_8-2nd FN November	0.34[h]	0.55[h]	0.63[h]	0.90[h]	1.48[h]	2.33[h]
Mean	**0.62**	**0.93**	**1.17**	**1.40**	**2.03**	**2.86**
SEm±	0.02	0.02	0.01	0.01	0.01	0.01
CD (5%)	0.07	0.06	0.03	0.03	0.03	0.04

Table 4.2.8 Effect of season on number of new laterals of mango grafts cv. Baneshan

Treatment	Number of new laterals					
	30 DAG	**45 DAG**	**60 DAG**	**75 DAG**	**90 DAG**	**105 DAG**
T_1-1st FN August	0.91[d]	1.00[d]	1.06[d]	1.10[d]	1.15[d]	1.19[d]
T_2-2nd FN August	1.01[c]	1.06[c]	1.14[c]	1.19[c]	1.25[c]	1.30[c]
T_3-1st FN September	1.10[b]	1.14[b]	1.20[b]	1.26[b]	1.31[b]	1.38[b]
T_4-2nd FN September	1.18[a]	1.23[a]	1.28[a]	1.33[a]	1.37[a]	1.45[a]
T_5-1st FN October	0.82[e]	0.89[e]	0.91[e]	0.95[e]	0.99[e]	1.07[e]
T_6-2nd FN October	0.61[f]	0.65[f]	0.73[f]	0.83[f]	0.88[f]	0.91[f]
T_7-1st FN November	0.50[g]	0.57[g]	0.62[g]	0.67[g]	0.71[g]	0.75[g]
T_8- 2nd FN November	0.38[h]	0.45[h]	0.50[h]	0.56[h]	0.60[h]	0.65[h]
Mean	**0.81**	**0.87**	**0.93**	**0.98**	**1.03**	**1.08**
SEm±	0.02	0.01	0.01	0.01	0.01	0.01
CD (5%)	0.07	0.05	0.04	0.04	0.03	0.03

Table 4.2.9 Effect of season on length of new laterals (cm) of mango grafts cv. Baneshan

Treatment	Length of new laterals(cm)					
	30 DAG	**45 DAG**	**60 DAG**	**75 DAG**	**90 DAG**	**105 DAG**
T_1-1st FN August	0.96^{d}	1.14^{d}	1.52^{d}	1.92^{d}	2.24^{d}	2.72^{d}
T_2-2nd FN August	1.05^{c}	1.21^{c}	1.65^{c}	2.08^{c}	2.45^{c}	2.90^{c}
T_3-1st FN September	1.13^{b}	1.30^{b}	1.74^{b}	2.16^{b}	2.64^{b}	3.03^{b}
T_4-2nd FN September	1.22^{a}	1.42^{a}	1.86^{a}	2.33^{a}	2.89^{a}	3.14^{a}
T_5-1st FN October	0.83^{e}	1.00^{e}	1.21^{e}	1.52^{e}	1.83^{e}	2.24^{e}
T_6-2nd FN October	0.70^{f}	0.88^{f}	1.07^{f}	1.27^{f}	1.56^{f}	1.95^{f}
T_7-1st FN November	0.60^{g}	0.78^{g}	0.96^{g}	1.13^{g}	1.32^{g}	1.62^{g}
T_8- 2nd FNNovember	0.50^{h}	0.67^{h}	0.84^{h}	1.05^{h}	1.18^{h}	1.32^{h}
Mean	**0.87**	**1.05**	**1.32**	**1.68**	**2.01**	**2.36**
SEm±	0.01	0.01	0.01	0.01	0.01	0.01
CD (5%)	0.03	0.03	0.03	0.03	0.04	0.04

G_1-Veneer grafting

G_2-T-budding

M_1 -1st fort night of August

M_2 -2nd fortnight of August

M_3 -1st fort night of September

M_4 -2nd fort night of September

M_5 -1st fortnight of October

M_6 -2nd fortnight of October

M_7 .1st fort night of November

M_8 -2nd fortnight of November

Fig.4.2.1 Effect of season on bud take (%) in different methods of propagation in mango cv. Baneshan

T_1- 1st fortnight August

T_2- 2nd fortnight August

T_3- 1st fortnight September

T_4- 2nd fortnight September

T_5- 1st fortnight October

T_6- 2nd fortnight October

T_7- 1st fortnight November

T_8- 2nd fortnight November

Fig.4.2.2 Effect of season on number of days taken for bud break of mango grafts cv. Baneshan

T_1- 1st fortnight August

T_2- 2nd fortnight August

T_3- 1st fortnight September

T_4- 2nd fortnight September

T_5- 1st fortnight October

T_6- 2nd fortnight October

T_7- 1st fortnight November

T_8- 2ndfortnight November

Fig.4.2.3 Effect of season on number of flushes produced in mango grafts cv. Baneshan.

T_1- 1st fortnight August

T_2- 2nd fortnight August

T_3- 1st fortnight September

T_4- 2nd fortnight September

T_5- 1st fortnight October

T_6- 2nd fortnight October

T_7- 1st fortnight November

T_8- 2ndfortnight November

Fig.4.2.4 Effect of season on length of new scion shoot (cm) of mango grafts cv. Baneshan

T_1- 1st fortnight August

T_2- 2nd fortnight August

T_3- 1st fortnight September

T_4- 2nd fortnight September

T_5- 1st fortnight October

T_6- 2nd fortnight October

T_7- 1st fortnight November

T_8- 2ndfortnight November

Fig.4.2.5 Effect of season on diameter of new scion shoot (cm) of mango grafts cv. Baneshan

T_1- 1st fortnight August

T_2- 2nd fortnight August

T_3- 1st fortnight September

T_4- 2nd fortnight September

T_5- 1st fortnight October

T_6- 2nd fortnight October

T_7- 1st fortnight November

T_8- 2ndfortnight November

Fig.4.2.6 Effect of season on number of leaves per shoot of mango grafts cv. Baneshan

T_1- 1st fortnight August

T_5- 1st fortnight October

T_2- 2nd fortnight August

T_3- 1st fortnight September

T_4- 2nd fortnight September

T_6- 2nd fortnight October

T_7- 1st fortnight November

T_8- 2ndfortnight November

Fig.4.2.7 Effect of season on internodal length (cm) of new shoot of mango grafts cv. Baneshan

T_1- 1st fortnight August

T_2- 2nd fortnight August

T_3- 1st fortnight September

T_4- 2nd fortnight September

T_5- 1st fortnight October

T_6- 2nd fortnight October

T_7- 1st fortnight November

T_8- 2ndfortnight November

Fig.4.2.8 Effect of season on number of new laterals of mango grafts cv. Baneshan

T_1- 1st fortnight August

T_2- 2nd fortnight August

T_3- 1st fortnight September

T_4- 2nd fortnight September

T_5- 1st fortnight October

T_6- 2nd fortnight October

T_7- 1st fortnight November

T_8- 2ndfortnight November

Fig.4.2.9 Effect of season on length of new laterals (cm) of mango grafts cv. Baneshan

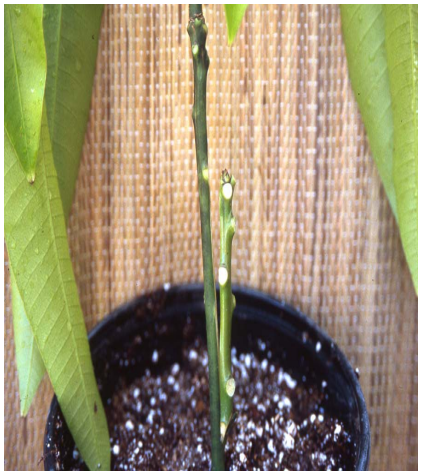

Plate 1a. Veneer grafting technique

Plate 1b. T-budding technique

Plate 1. Propagation techniques

Plate 3a Precured scions

0 days storage

Plate 3b Precured scions

3 days storage

Plate 3c Precured scions

5 days storage

Plate 3d Precured scions

7 days storage

Plate 3. Storage of precured scions in sphagnum moss for different day intervals

Plate 4a Un precured scions

0 days storage

Plate 4b Un precured scions

3 days storage

Plate 4c Unprecured scions

5 days storage

Plate 4d Unprecured scions

7 days storage

Plate 4. Storage of non precured scions in sphagnum moss for different day intervals

Plate 2.View of experimental site 1

Plate 2.View of experimental site 2