STUDIES ON 'IN SITU' SOFT WOOD GRAFTING OF SOME DRYLAND FRUIT CROPS VIZ., CUSTARD APPLE (Annona squamosa L.), JAMUN (Syzygium cuminni S.) AND TAMARIND (Tamarindus indica L.)

BY

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B. Sc. (Horti.)

DISSERTATION

Submitted to the Marathwada Agricultural University, In Partial Fulfilment of the Requirement for the Degree of

MASTER OF SCIENCE

(Agriculture)

IN

HORTICULTURE

Department of Horticulture

Marathwada Agricultural University

Parbhani, (M. S.), India.

1993

TO,

MY GRANDMOTHER

AND

LATE GRANDFATHER

CANDIDATE'S DECLARATION

I hereby declare that the dissertation or part thereof has not been previously submitted by me for a degree of any University.

Parbhani

Dated : 30 th June, 1993

(M.D.Gojamgunde)

C E R T I F I C A T E - I

This is to certify that Shri. Gojamgunde Mohan Dnyanoba has satisfactorily prosecuted his course of research for a period of not less than one year and that the dissertation entitled "STUDIES ON 'IN SITU' SOFT WOOD GRAFTING IN SOME DRYLAND FRUIT CROPS VIZ., CUSTARD APPLE (Annona squamosa L.) , JAMUN (Syzygium cuminii S.) AND TAMARIND (Tamarindus indica L.)" submitted by him is the result of original research work and is of sufficiently high standard to warrant its presentation to the examination.

I also certify that the dissertation or part thereof has not been previously submitted by him for a degree of any university.

PLACE : PARBHANI

Dated : 30th June,1993

Dr. V.R.CHAKRAWAR
GUIDE

C E R T I F I C A T E - I I

This is to certify that the dissertation entitled "STUDIES ON 'IN SITU' SOFT WOOD GRAFTING IN SOME DRYLAND FRUIT CROPS VIZ., CUSTARD APPLE (Annona squamosa L.) , JAMUN (Syzygium cuminii S.) AND TAMARIND (Tamarindus indica L.)" submitted by Shri. Gojamgunde Mohan Dnyanoba to the Marathwada Agricultural University, Parbhani in partial fulfilment of the requirement of the degree of MASTER OF SCIENCE (Agriculture) in the subject of Horticulture has been approved by the student's advisory committee after oral examination in collaboration with the external member.

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ACKNOWLEDGEMENT

I avail this oportunity to record my deep sense of gratitude to Dr. V.R.Chakrawar, M.Sc.(Agri),Ph.D. (IARI), Head, Deopartment of Horticulture, Marathwada Agriculture university, Parbhani and chairman of my advisory committee for his keen interest, excellent guidance and constructive criticism throughout the course of this ivestigation and in the preparation of this manuscript. I owe to him for his meticulus care and intelligent approach with which he scrutinised the manuscript which enabled me to submit this dessertation in the present form.

With profound respect I acknowledge the indebtedness to Dr.B.A. Kadam, Dr.V.S. Hudge and Prof.P.R.Waghmare, the members of my advisory committee for their valuable suggestions and guidance, during the course of investigation.

I am thankful to Dr.B.N. Shinde, officer-in-charge, Central Nursery, Marathwada Agricultural University, Parbhani for giving the facilities during the course of investigation.

My cardial thanks to Dr.K.W.Anserwadekar, Dr.G.S.Shinde, Dr.S.G.Rajput, Dr.Acharya, and Prof.R.M.Kulkarni, Prof.C.G.Puri, Prof.S.P.Jinturkar, Prof.S.N.Gunjkar, Prof. S.D. Chavan, Prof.U.G.Deshmukh, Prof. Kale (Principal,

Agril.School,) and all the staff members of college of Horticulture, College of Agriculture, Parbhani for their study.

I record my gratitude for the financial assistance rendered by Indian Council of Agricultural Research, New Delhi in the form of Junior Fellowship.

I am thankful to Raner, Ajaj, Amir, Suryawanshi, Trimbak, Shravan for their help during the course of investigation.

I am thankful to Prof.M.V.Deshpande and Shri. P.K.Sanghai for typing the manuscript.

It is great pleasure to acknowledge S/Shri. R.V.Kawade, A.R.Nawale, D.K.Shinde, S.R.Sabade,H.V.Argunde, A.V.Bastapure,D.S.Hausare, S.K.Balsurkar, S.S.Mane, V.S.Jagtap,V.R.Shelke, R.Chakor, M.A.Patil, K.K.Talukdar, Miss.Nalini Nayar, Sandip Pal, B.B.Nagarsale for their continuous co-operation during the course of investigation.

I whole heartly appreciate the moral support, inspiration from Late Grandfather Shri.Sopanrao, Grandmother Smt.Muktabai, Father Shri.Dnyanoba, Mother Sow.Annapurna, uncle Shri.T.S.Gojamgunde and P.N.Gojamgunde, Aunti Sow.Anusaya and Sow.Prabhavati, Mama Shri Maruti Malwade, Aatya Sow.Sushila Malwade,elder brother

Ashok, Sister Sunita,Sangita, Surekha, Dr.Jyoti, Sister in law Savita, Brother in law Narayan, Shriram, Ramakant, Grandfather Shri.T.Chalwad,Mama Dnyanoba Nivrati, Pandurang, Namdev, Ramkrishna for their blessing, providing opportunities and financial assistance throughout studies in building up my educational carrier.

PLACE : PARBHANI

DATE : 30th JUNE, 1993.

M.D.GOJAMGUNDE

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INTRODUCTION

I. INTRODUCTION

India is vast country with different Agro-climatic regions. About 70 per cent of the 144 million hectares of arable land of India depends entirely on rainfall for crop production (Patil, 1990) and the practice of agriculture here is best described as dryland farming. In Maharashtra state at present about 13.1 per cent land is under irrigation (Anon., 1986). Even after exploitation of all resources, the maximum area that can be brought under irrigation may go only to 25 per cent. This means 75 per cent of the total cropped area will still remain as rainfed agriculture indicating the importance and impact of dryland agriculture in the state.

The dryland fruits are the important component of arid horticulture in the state. These crops not only grow well in arid and semi-arid regions but also give a good profit to the farmers with proper care.

Custard apple is very delicious fruit. The important features of custard apple is its wide adaptability to soil and climatic conditions and freedom from pests and diseases. Pulp of the fruits may be mixed with the milk to form a drink or made into icecream. Excellent jam and fruit butter can be prepared from the pulp. The leaves

have medicinal and insecticidal properties as reported by Marippan and Saxena (1984). Area under custard apple in Maharshtra is 2800 hectares and production is about 22400 tonnes (Patil et al., 1990).

Jamun is another important dryland fruit crop of the state. In India, it is cultivated throughout tropical and sub-tropical regions. It requires deep loam and well drained soil for its optimum growth and good yields. Fruits contain 75 per cent edible portion and is used for making alcoholic and non-alcoholic beverages, jelly, jam, squash, vinegar and pickle. Jamun fruits and seeds are valued for medicinal properties.

Tamarind is yet another , one of the most important dryland fruit crop of the state. It is cultivated throughout tropics and subtropics. The tree is not exacting as regards the soil. It generally prefers warm climate and can withstand drought but it sensitive to frost. It is highly tolerant to pest and diseases. It also acts as a wind break and check the soil erosion and therefore, can be planted to utilize the waste and problematic lands. Tamarind can be included as an important plant in social forestry programmes for the afforestation. The fruit contains a sweetish,

acidic pulp which is the tamarind of commerce widely used for souring curries, sauces, Chuntneys and beverages. The fruit pulp can be utilized chemically for the extraction of tartaric acid and fermentation of sugar for getting ethanol, lactic acid and citric acid. The seed testa contain 38.40 per cent of water solubles of which 80 per cent is mixtures of tannins and colouring agent. A fatty oil from the kernel resembles peanut oil and is useful in preparation of paints and varnishes and for burning in lamps (Anon., 1984).

Government of Maharashtra has launched an ambitious horticultural programme of converting the state into horticultural state by bringing about 10 lakh hectares area under horticulture crops by the end of 2000 A.D.. The salient features of the scheme are as under.

1. Every year it is proposed to plant 1.2 lakh ha area with 3500 - 4500 hectares target in each district.
2. Government has decided to spend Rs. 100 crores per year with total target expenditure of Rs. 1724 crores.
3. The scheme provides 100 per cent subsidies to backward classes and small farmers and 75 per cent subsidy to other farmers about 0.2 to 4 ha area limits is fixed for giving benefit.

4. Mango, ber, custard apple, tamrind, jamun, aonla etc. are included in the scheme.

Generally the dryland fruit crops are propagated by seed. In this region, attempts were made by various workers to locate superior types through the survey in custard apple, jamun, tamarind and other dryland fruit crops. superior local elite types have been identified in custard apple (Daulatabad, Dharur, Gangakhed etc.), Jamun (Ambajogai, Aurangabad, Dharur, seedless etc.), Tamrind (No. 263, Pratishthan and Yogeshwari), Mango (Hur, Mishri, Pevandi, Vakilya, Parbhani hapoos, Nakadya, Marutya etc.) and woodapple (Ellora) (Anon. 1984).

In the recent year soft wood grafting has become popular because of its added advantages over other methods. This has been successfully tried in mango, cashewnut, sapota, aonla and guava (Amin, 1978). Kulkarni (1990) reported that in jamun first fortnight of october was found to be better period for softwood grafting in polythene bags and for custard apple the most congenial period for soft wood grafting at Parbhani was February to First week of March with maximum success (63.35 %) in polybags. Gayake (1992) reported that in jamun 25th March was found to be better period for soft wood grafting for polybags

and for tamarind 15th february gave maximum final success in polybags. In custard apple, Jamun and tamarind suitable method of vegetative propogation under 'in situ ' are not standardised so far. Hence, it was thought necessary to undertake the present investigation with following objectives.

1. To see the possibility and extent of soft wood grafting in custard apple, jamun and tamarind under 'in situ' conditions
2. To find out proper season/period for soft wood grafting in these crops.

REVIEW OF LITERATURE

II. REVIEW OF LITERARURE

The research pertaining to the seed and vegetative propagataion in some dryland fruit crops in general and custard apple, jamun and tamarind in particular alongwith some irrigated fruit crops is reviewed in this chapter under appropriate heads.

In fruit trees, the vegetative methods of propagation play an important role in three ways.

1. The uniform and true to type plant population can be obtained.
2. Earlier bearing of fruits can be achieved.
3. Size and shape of the tree can be controlled.

2.1 Custard apple :

2.1.1 Seed propagation :

Ahmed (1936) reported that fresh seeds showed 45 per cent germination but after being chilled by being left out at night for a week the germination improved to 90 per cent.The germination of the seed can be improved by the seed treatment with plant growth regulators.

2.1.2 Vegetative propagation:

a) Cutting :

Custard apple is difficulti to root and therefore rooting does not occur easily. Attempts

were made to propagate custard apple by stem cuttings. Venkataratnam (1965) reported that root cutting of custard apple gave 2-5 per cent success where as 5 per cent rooting was obtained in case of branch cutting.

b) Layering :

Rathore (1976) reported that 93.8 per cent shoots rooted in stooling when they were treated with IBA at 20 ppm concentration.

c) Budding :

Fougue (1972) recommended budding in custard apple on one year old matured wood and by using a dormant bud. Venkatartanam and Satyanarayana Swamy (1956) obtained 75.0 per cent success in the month of June to September in shield budding of custard apple.

d) Grafting :

Singh (1959) successfully inarch grafted custard apple varieties under U.P. conditions. He reported that inarch grafting gave better success but it is time consuming and labourious.

Bankar (1989) reported that 1. Shield budding on Annona squamosa rootstock with 4 scion cultivars. 2. Veneer grafting in custard apple with 5 scion cultivars and 3. rooting cutting of Annona squamosa L.. Local varieties with budding the best results were obtained with the scion cultivars Balanagar and round apple which gave 78 and 72 per

cent success respectively.However with grafting these same 2 cultivars gave 84 and 86 per cent success, respectively. Rooting of cuttings was best (26%) following treatment with IBA at 2500-3000 ppm, the untreated control gave only 4 per cent rooting. Kulkarni (1990) reported that the most congenial period for soft wood grafting of custard apple at Parbhani was February to first week of March with maximum success (63.35%).

2.2 Jamun :

2.2.1 Seed propagation :

The jamun and mango seeds are to be sown immediately after extraction. Shanmugavelu (1967) noticed that jamun seeds loose their viability rapidly. Mowry et al. (1941) reported that jamun seeds sown fresh usually show a higher percentage of germination within two to three weeks.

The phenomenon of polyembryony is important for obtaining uniform plant materials. The advantage of this phenomenon is largely taken in citrus, mango. Singh and Thakur (1977) reported that the percentage of polyembryonic seeds varied from 20-50 in jamun.

2.2.2 Vegetative propagation :

a) Cutting :

In case of jamun rooting of cutting is rather difficult. However, better rooting of

cutting was obtained with the growth regulator treatments (Bose and Sadhu,1974).

b) Layering :

Shanmugavelu (1967) could get only 0.1 per cent rooting in air layering of jamun even after the treatment of IBA + NAA.

Biswas and Roy (1983) reported good success in air layring of jamun with growth regulator treatment.

c) Budding :

Singh et al. (1967) obtained a good success when the budding was carried in the month of July-August. They found that forkert method was better than 'T' budding or shield budding.

d) Grafting :

Singh and Singhort (1984) obtained a good success in soft wood grafting in mid June. They found that soft wood grafting method is a better method among all the methods tried except veneer grafting with immediate top removal. First forthnight of October was found to be better period for soft wood grafting operation (Kulkarni, 1990). Grafting on 5th and 15th October gave maximum final success to the extent of 43.5 per cent and 36.83 per cent respectively at Parbhani. Gayake (1992) reported thatthe most congenial period for soft wood grafting of jamun at Parbhani was 15th March to 25th March, with maxium success (26.19%).

2.3 Tamarind :

2.3.1 Seed propagation :

Chattopadhyay and Mohata (1988) used different media for seed propagation viz., sand (T1), soil (Loam-T2) , cowdung manure (T3), sand + soil (T4), sand + cow dung(T5), soil + cowdung (T6), sand +soil+cow dung (T7) . The results showed that sand (T1), well cowdung manure (T3) and their combination gave good percentage compared to other treatments. The same treatments also showed better growth and vigour of the seedlings.

2.3.2 Vegetative propagation :

a) Layering :

Bhore (1986) reported that tamarind can be propagated successfully by air layering using 4000 ppm IBA under Pune conditions. Lokhande (1987) reported that in tamarind, air layering with application of growth harmones like NAA + IBA 10,000/- ppm produced maximum percentage of air layered plants.

b) Budding :

Ramirez et al. (1986) found that scions when budded and grafted on the Criollo rootstock with diameter of 0.50-0.65 cm., 0.66-0.75 cm or 0.70-0.90 cm, recorded 9.3 per cent success with shield budding and percentage take was highest with splice grafting, whip and tongue grafting (65.3 and

61.3 % respectively). Percentage take was best in case of rootstocks with a diameter at the grafting union of 0.66-0.75 cm.

c) Grafting :

Bhore (1986) found that inarch grafting is possible to propagate promising tamarind trees vegetatively to secure uniform growth and yield.

Purushotham and Narsimharao (1990) took studies on propagation of tamarind by soft wood grafting and veneer grafting. The results indicated that the percentage graft take in soft wood grafting was better (68%) than in veneer grafting (49%).

Gayake (1992) found that grafting on 15 th February gave maximum success (33.05%) followed by 15th (28.23%) and 25th March (20.46%).

Other dryland fruit crops :

2.4 Mango :

a) Soft wood grafting :

Amin (1974) recommended defoliation of scion wood 1-2 weeks before operation and all the leaves from the stem of the stock after the operation of wedge grafting. This has given 91.5 percent success in nursery grown seedlings and 76 per cent success in the cultivators field without irrigation.

Amin (1978) obtained 67.65 per cent success in grafted plants where grafting was

followed by immediate removal of leaves on the stock. While 100 per cent survival was found where grafting was followed by immediate removal of leaves from the lower half of the stock and retaining all the leaves on the stock. Scions preconditioned for ten days, gave maximum success of grafts, followed by scions of five days (Reddy, 1987).

b) Stone grafting :

Bhan et al. (1969) for the first time in India reported stone grafting in mango. They used the sprouting stones as root stock and semimature terminal shoot as scion with cleft or whip method and found 70-80 per cent success.

Ratan et al . (1987) found that when mature 3 to 4 months old, ten days precured scion of 8 cm length was graftd on 5 to ten days old rootstock at 6 to 8 cm height, gave maximum percentage of sprouting and survival during July-August.

Nagawekar et al. (1984) obtained 11 to 12 per cent more success in case of 'in situ'grafting than usual grafting on the seedling raised in the polythene bags by utilising terminal and subterminal scion of mango.

Srivastava et al . (1989) reported that the whip method of grafting proved very successful,

giving the maximum percentage of sprouting of bud sticks. Thirty days old seedling gave better results than 15 or 45 days old seedlings. Lifting the seedlings from the nursery beds before grafting gave better results than grafting '*in situ*'. Grafting succes was highest in Dasheri (86%) followed by Langra(72%), Fazali(52%) and Taimuria (12%).

Tayade *et al*. (1988) reported that high mortality of young stone grafts demonstrated the unsuitability of this technique under Akola condition.

Though stone grafting or epicotyl grafting is very successful and cheap method, still it has some limitations. It can not be easily adopted in custard apple, Jamun or tamarind as the diameter of stem of young seedling is too thin to operate.

c) Veneer grafting :

Upadhyay and Prasad (1988) observed 85 per cent success in veneer grafting in June, followed by July, August and September each with 80 per cent and October with 70 per cent success. The results were insignificant between November to February(18.25%).

d) Period of grafting :

Subbarao (1968) studied the propagation of mango by veneer grafting under Anand conditions.

The results have shown that July to August and January to February were the more suitable months. He showed that average temperature range 29.7 to 31.9_0c was favourable for grafting success.

Kanwar and Bajwa (1974) reported from fruit Research station, Gurudaspur, Punjab that under the climatic conditions of that place side grafting could be performed from last week of February to November when the success varied from 22 to 90 per cent. It was low in May (66.67%) and November (22.22%) . But it was quite satisfactory (79.31%) in February.

Gunjate et al. (1976) found that mango grafts prepared during March to April by veneer method attend good size (about 45 cm including height of stock) within three months. The effect of temperature and atmospheric humidity on the process of graft union have been emphasized by Hartmann and kestar (1986) . According to Patel and Amin (1976) the best period for grafting on young seedlings of mango was found to be second week of July to the end of August.

Upadhyaya and Gupta (1979) standardized the method and time of propagation in mango and reported 90 and 95 per cent of bud take and 80 and 85 per cent success during July and August respectively. Studies carried out by Singh and Srivastava (1980) obtained 84 percent success in

July in soft wood grafting utilizing cv. Bappakai as interstock between the seedling rootstock and Dasheri as scion.

Patel and Amin (1981) reported the best period for soft wood grafting of mango '*in situ*', for this experiment they used scions of cultivar Rajapuri and grafted from February to next January at 15 days interval. They observed that grafting between third week of May to third week of August gave 95 to 100 percent success and February to May gave 85 to 97 per cent success but after week of September it decreased considerably. Highest success with soft wood grafting was obtained on first July and when mango grafts were kept in glass house (Desai and Patil, 1981).

Singh and Srivastava (1982) while standardizing the technique of soft wood grafting in mango found that maximum success (80%) was obtained when grafting was carried out in august by using premature scion shoots and antiranspirants.

Sant Ram and Bist (1982) studied the success of veneer grafting using defoliated and freshly defoliated mango scion in Punjab and obtained 85 per cent success in March when predefoliated scions budsticks were used. However, they also reported better success (50%) in the month of February to March with the use of even freshly defoliated scions.

Gaur (1984) obtained good success in mango by soft wood grafting in mid June and found that soft wood grafting is better method among all the methods.

Reddy and Melanta (1988) obtained highest (95, 95, 90) per cent success after 30th, 40th and 60th days after grafting, when grafting was done in January on 7 months old seedling by "in situ" soft wood graft and lowest success reported in November 85 on 5 months old seedling when grafting was done from September 85 to March, 86.

Randive (1988) stated that soft wood grafting can also be possible with 90 to 98 per cent success during February to March under Aurangabad condition.

Tayade et al. (1988) studied the "in situ" grafting of mango by different methods under Akola conditions and found that the graft prepared by soft wood technique during the period from July to September registered more success and ultimate survival and also produced maximum scion growth.

Bangar (1992) reported that initial and final success was maximum from 5th December to 5th January grafting, which ranged from 23.33 to 100 per cent.

Joshi (1992) reported that initial and final success was significantly more in 7th

February treatment. As the operation was delayed there was gradual decrease in the success.

2.5 Cashew and Jackfruit :

a) Grafting :

Amin (1978) successfully tried the soft wood grafting in cashewnut and jackfruit with 71.4 per cent and 33.3 per cent sucess respectively.

Gunjate et al. (1982) reported 50 to 90 per cent success in jackfruit and 45 per cent success by epicotyl grafting in cashew by Wadge method during April-May.

b) Period of grafting :

Sawake et al. (1985) studied soft wood grafting in cashew cv. Vengurla-1 at monthly intervals and reported highest success in August (83.6%) and in April (83.0 %), the lowest being in December (22.23 %). August, September and January months were suitable months of grafting in cashew. Success and growth of grafts was better with precured scions than freshly defoliated ones (Sarada et al., 1991).

2.6 Aonla, Guava and Phalsa :

Amin (1978) successfully tried the soft wood grafting in aonla, guava and phalsa with 73.3, 70.1 and 100 per cent success, respectively.

2.7 Sapota :

Amin (1978) obtained 91.6 per cent success in sapota by softwood grafting.

Kulwal *et al.* (1985) reported that in soft wood grafts of sapota, some success was obtained in January, February grafting but mortality of young grafts was high in May-June.

MATERIALS AND METHODS

III. MATERIALS AND METHODS

The present investigation entitled "Studies on '*in situ*' soft wood grafting in some dry-land fruit crops viz., custard apple, jamun and tamarind " was carried out in the Department of Horticulture, Marathwada Agricultural University, Parbhani during the year 1992-93.

3.1 Location, Soil and Climate :

Parbhani is situated 19^{0} 16' North Latitude, 76^{0} 47' East Longitude and 408.5 m above mean sea level. The district as a whole belongs to the Godavari peninsular basin situated on the northen side of Marathwada region. Being a part of Deccan pleateau, the land in the distrcit has a general elevation of about 457.60 m above the mean sea level. The climate is generaly dry for eight months of the year and wet during the Sout-West monsoon season. The maximum temperature in the hottest month goes upto 44^{0} C (May), the cold weather commences from the middle of November and minimum temperature goes down to 8.6^{0} C (December). The soil of Parbhani district is medium to heavy vertisol. The normal rainfall of the district is 826.6 mm per year received between June to Septeber.

3.2 Meteorological data :

The meteorological data during the period of experimentation in a respect of maximum and minimum temperature (^{o}C), relative humidity (%) and rainfall (mm) as recorded weekly at the Agricultural Meteorological Observatory, Marathwada Agricultural University, Parbhani are given in the Appendix-I.

3.3 Plan of Experiment :

Three separate experiments were carried out on custard apple, jamun and tamarind with following details.

I) Custard apple

Design : Randomised block design

Treatments : 6

Replications : 5

Unit of experiment : 4 seedlings

Method of grafting : Soft-wood grafting

Table 1 : Details of treatments in custard apple

Sr. No.	Symbol	Dates of soft-wood grafting
1.	C_1	19th January, 1993
2.	C_2	29th January, 1993
3.	C_3	8th February, 1993
4.	C_4	18th February, 1993
5.	C_5	28th February, 1993
6.	C_6	10th March, 1993

II) Jamun

Design : Randomised block design

Treatments : 6

Replications : 5

Unit of experiment : 4 seedlings

Method of grafting : Soft-wood grafting

Table 2 : Details of treatments in Jamun

Sr. No.	Symbol	Dates of soft-wood grafting
1.	J_1	19th January, 1993
2.	J_2	29th January, 1993
3.	J_3	8th February, 1993
4.	J_4	18th February, 1993
5.	J_5	28th February, 1993
6.	J_6	10th March, 1993

III) Tamarind

Design : Randomised block design

Treatments : 6

Replications : 5

Unit of experiment : 4 seedlings

Method of grafting : Soft-wood grafting

Table 3 : Details of treatments in tamarind

Sr. No.	Symbol	Dates of soft-wood grafting
1.	T_1	19th January, 1993
2.	T_2	29th January, 1993
3.	T_3	8th February, 1993
4.	T_4	18th February, 1993
5.	T_5	28th February, 1993
6.	T_6	10th March, 1993

3.4 Raising of rootstock :

The pits of size 0.75 m X 0.75 m X 0.75 m were prepared at the distance of 1.5 m. The pits were filled with 5 kg FYM + 40 gm single Super phosphate + 50 gm 10 % BHC powder at the time of seed sowing. Healthy fresh, sound 4 to 6 seeds soaked in water and treated with Bavistin were sown in June. After seed germination (2 to 3 weeks), the new seedlings were protected with insecticides, fungicides and watering for survival.

Custard apple seedlings were about seven months old, 40 to 50 cm in height and 0.45 tp 0.60 cm in diameter at 15 cm above ground level, jamun seedlings were about seven months old, 40 to 50 cm in height and 0.50 to 0.60 cm in diameter at 15 cm above ground level and tamarind seedlings were about seven months old 35 to 50 cm in height and

0.35 to 0.55 cm in diameter at 15 cm above ground level at the time of grafting operation (January, 1993).

3.5 Selection of scion wood :

In custard apple, the scion mother tree of local selection planted at Department of Horticulture, Marathwada Agricultural University, Parbhani was selected for bud sticks. The scion tree (mother plant) was healthy, vigorous and high yielding. The scion budsticks of current seasons growth of about 4 to 6 months 15 to 25 cm in length with 8 to 10 buds with brownish-black in colour was used. The scion budstick was defoliated 8 days prior to grafting operation. While defoliating, the leaf petioles were retained as such. The detatched scion budsticks were wrapped in moist sphagnum moss covered with polythene sheet to avoid dessication. Scion budsticks with plumpy buds were only used for the grafting operation as per the treatments.

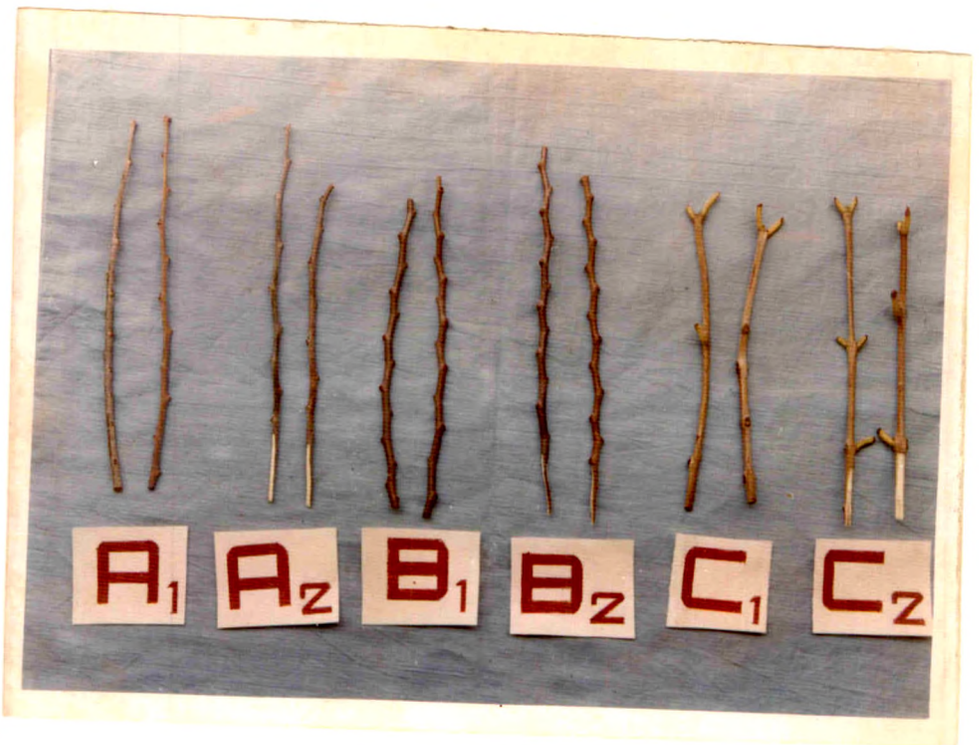
In jamun budsticks were taken from a local selection planted at Central Nursurey, Marathwada Agricultural University, Parbhani. The scion budsticks of current seasons age viz. 4 to 6 months growth were defoliated 8 days prior to grafting, about 15 to 25 cm length with 8 to 10 buds and greenish brown sticks were used as scion material. The scion sticks with plumpy buds were

detatched and wrapped in moist sphagnum moss covered with polythene sheet for keeping them fresh and were used on same day.

In tamarind, the scion mother tree of Pratishthan planted at Central Nursery, Marathwada Agricultural University, Parbhani, was slected for budsticks. The scion budsticks of current seasons growth of about one year old and 15 to 25 cm in length with 8 to 10 buds, greenish with grey tinge were used. The scion budsticks were defoliated 15 days prior to grafting operation. While defoliating, the leaf petioles were retained as such. The scion budsticks were wrapped in moist sphagnum moss covered with polythene sheet for keeping them fresh and were used on the same day. The scion budsticks with plumpy buds were only used for the grafting operation.

3.6 Method of grafting :

Soft-wood grafting in custard apple, jamun and tamarind was done by wedge method as reported in mango by Amin (1974). The root stock seedling was deheaded 25 to 45 cm above the ground level. A split was given from the top to a length of about 3 to 3.5 cm with a sharp knife. The scion of similar thickness as that of split was selected (Plate 1). The lower end of scion twing was mended to 2.5 to 3.0 cm as wedge by removing the bark and little wood from two opposite side



LIST OF PLATES

Plate 1. Budsticks used for grafting.

B_1 – Custard apple budsticks taken

B_2 – Custard apple budsticks operated for grafting

C_1 – Jamun budsticks taken

C_2 – Jamun budsticks operated for grafting

A_1 – Tamarind budsticks taken

A_2 – Tamarind budsticks operated for grafting

taking care to retain some bark on the remaining two sides. The wedge of scion so prepared was inserted into the 'V' shaped split of the stock and secured firmly with 1 to 2 cm wide and 45 cm long 200 gauge white transparent polythene strip as recommended by Jauhari and Singh (1970). One mali completed the grafting operation in all the three crops.

3.7 After care of the grafts :

After grafting, immediately protective irrigation was given to the grafted plants after their 8 to 10 days interval regular watering was given to the field. Timely weeding etc. were done to remove the weeds. The side shoots on the root stocks were nipped off whenever required.

3.8 Record of observations :

The observation of two grafts in each replication (10 grafts in each treatments) for three crops were recorded at 30, 60 and 90 days interval after grafting operation.

3.8.1 Initial success :

The initial success of the grafting was recorded after one month of operation after sprouting of the scion bud and formation of first leaf. The count was taken in each replication.

3.8.2 Final success :

The final success of soft-wood grafts in

custard apple, jamun and tamarind recorded after three months of operation. The count of the healthy, survived grafts was taken as final success and percentage of survival was worked out separately. The per cent success in each replication was noted and their mean was taken as final success was worked out in custard apple, jamun and tamarind, separately.

3.8.3 Height of the graft :

The height of the graft in cm was measured 90 days after grafting operation. It was measured by scale from the ground level to the terminal end of the grafted plant.

3.8.4 Diameter of the graft :

Diameter of the graft in cm at 15 cm above ground level after 90 days of grafting operation was measured by Vernier calliper.

3.8.5 Length of sprouted scion shoot :

The linear growth of the sprouted scion shoot was measured in cm at 90 days after grafting operation.

3.8.6 Diameter of sprouted scion shoot :

The diameter of the sprouted scion shoot was recorded 3 months after the grafting operation i.e. at the time of final success. The diameter was recorded at 10 cm above the stock scion union in cm with the help of vernier calliper.

3.8.7 Number of scion buds sprouted per graft :

The number of scion buds sprouted per grafts on the scion were recorded at 90 days of grafting operation i.e. at the time of final success.

3.8.8 Number of leaves per graft :

The number of leaves produces on the scion shoot per graft was recorded at 90 days after the grafting operation. The final observation was taken 3 months after the date of grafting operation.

3.8.9 Leaf area per graft :

Leaf area of custard apple, jamun and tamarind was estimated by taking the product of length and breadth and multiplying it with respective factors. The factor was derived by taking actual leaf area with the help of graph paper and dividing it with area determined of the same leaf by length X breadth.

$$\text{Factor} = \frac{\text{Actual leaf area (cm)}^2}{\text{Length (cm) X breadth of leaf (cm)}}$$

Total leaf area per graft in cm^2 was worked out by multiplying unit area per leaf with number of leaves produced by the plants.

3.9 Statistical analysis of data :

The statistical analysis of the experimental data was done by following the standard procedures described by Panse and Sukhatme (1967). Whenever necessary the values of percentages were angularly transformed prior to analysis.

RESULTS

IV. RESULTS

The results obtained in the present investigation are presented in this chapter under different heads.

4.1 Effect of different dates of soft wood grafting on initial and final success of grafts : Custard apple.

A. Initial Success:

The results presented in Table 4 revealed that there was significant effect of grafting on the initial success. Maximum success (100%) was obtained when grafting was carried out on 19th, 29th January and 8th February. This was followed by 18th (95%) and 28th February (90%) . Significantly least initial success was noticed when grafting was done on 10th March (85%) (Fig.1).

B. Final Success:

It is evident from the data presented in Table 4 that the final success of grafting significantly differed with dates of operation and is depicted in plates 2 and 3. Maximum success (100%) was obtained when grafting operation was performed on 19th and 29th January followed by 8th February (95%) . Significantly least final success was noticed in case of 10th March grafting (Fig.1).

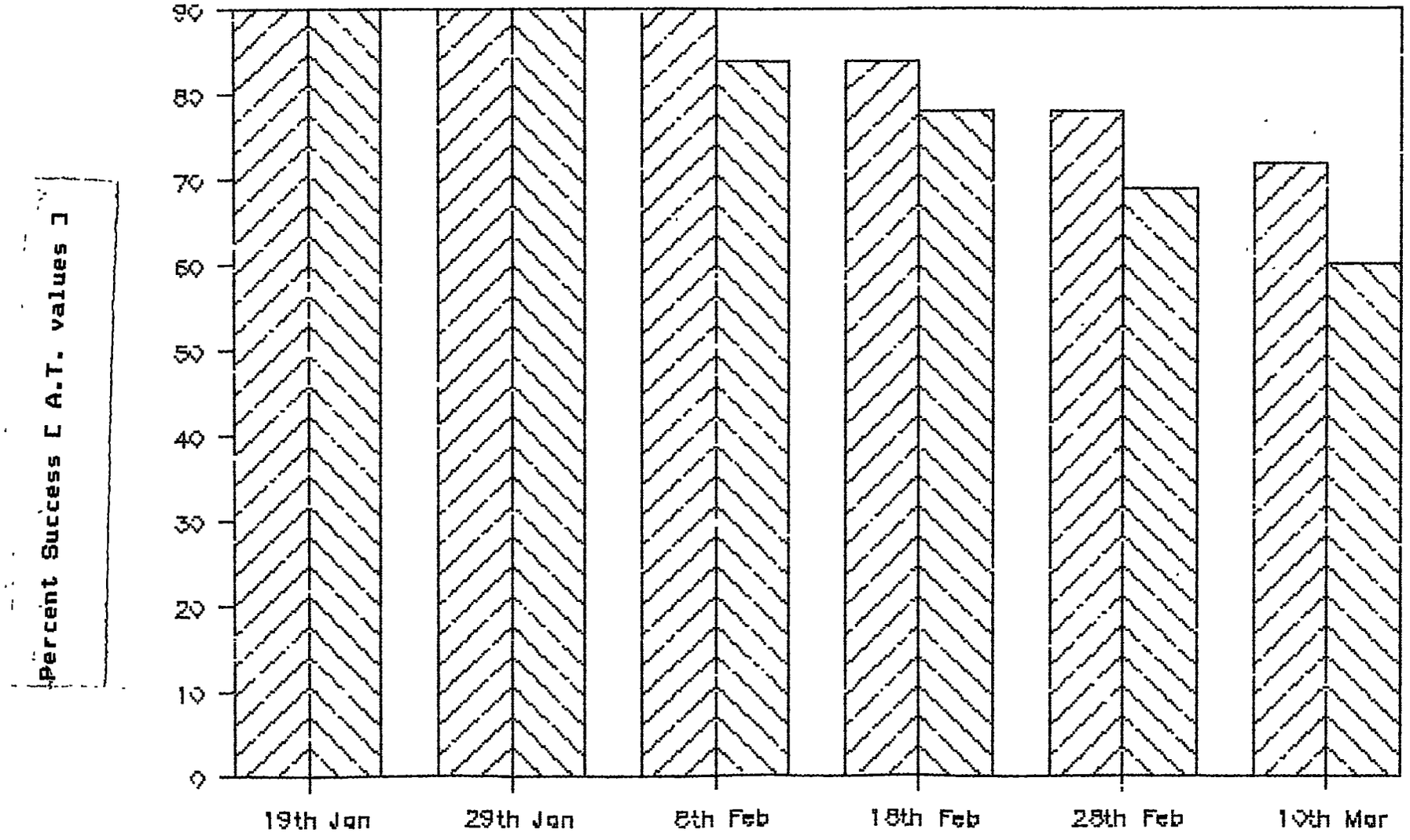


Fig.1 Initial and Final success of grafting in Custard apple

2. Successful graft of custard apple.

3. Failed graft of custard apple.

Jamun:

A. Initial success:

The data presented in Table 4 revealed that the treatments of date of grafting significantoly influenced the initial success in Jamun. Maximum initial succes (60%) was obtained when grafting was carried out on 19th January followed by 29th January (50%). Significantly least success was obtained when grafting was carried out on 10th March (25%) and 28th February (25%) followed by 18th (30%) and 8th February (35%) (Fig.2).

B. Final success :

It is found from the results presented in Table 4 and depicted in plates 4 and 5 that the final success of grafting in jamun was significantly influenced by the dates of operation. The dates 19th January (60%) recorded highest success followed by 29th January (50%) and 8th February (35%). Lowest success recorded when grafting was carried out on 10th of March (20%) and 28th February (20%), followed by 18th February (25%) was significantly least.

Tamarind

A. Initial success:

The findings presented in Table 4 showed that significantly highest initial success was obtained on 8th Feb. (100%), followed by 19th and 29th Jan. (85%). Significantly lowest initial

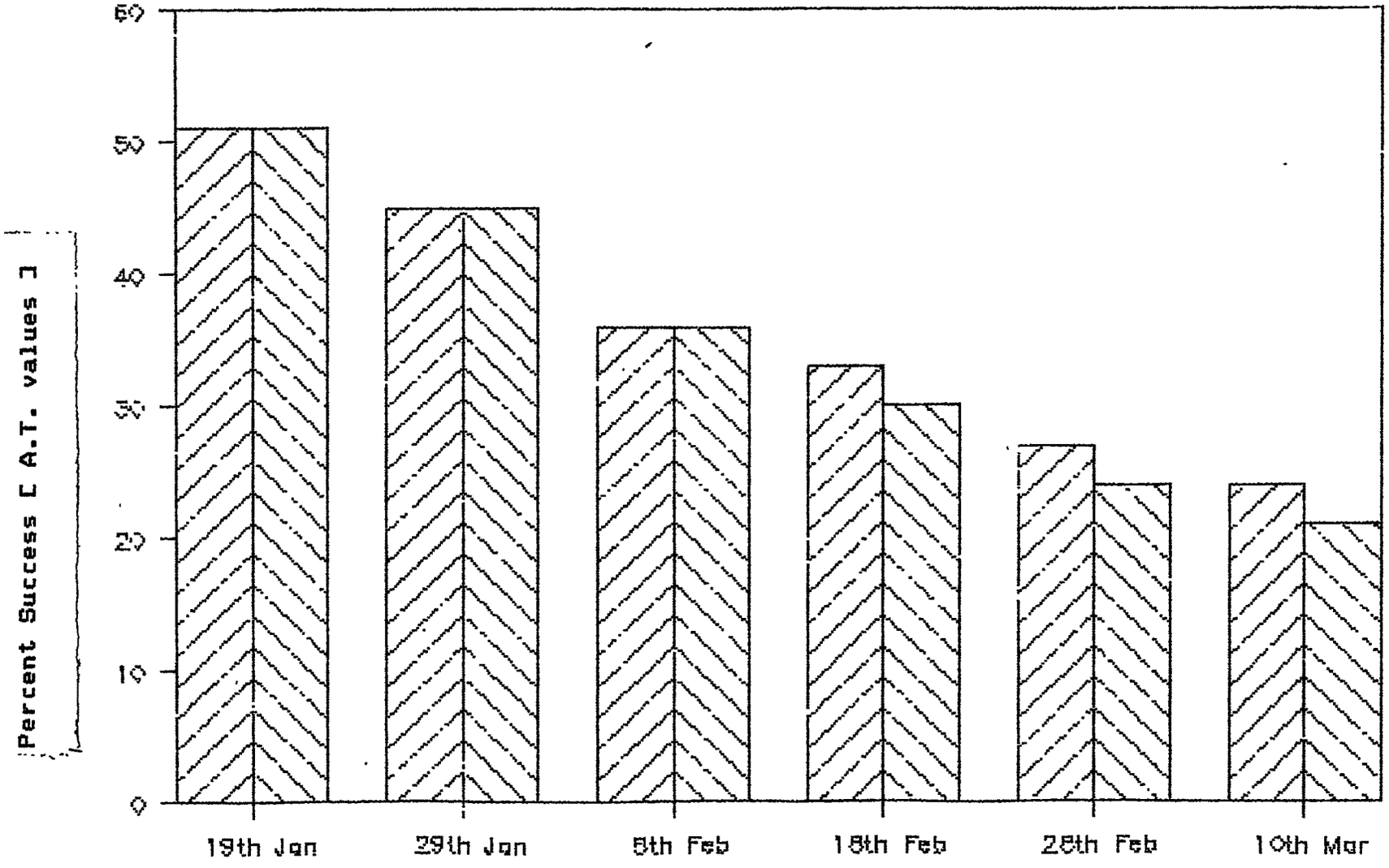


Fig.2 Initial and Final success of grafting in Jamun

4. Successful graft of jamun.

5. Failed graft of jamun.

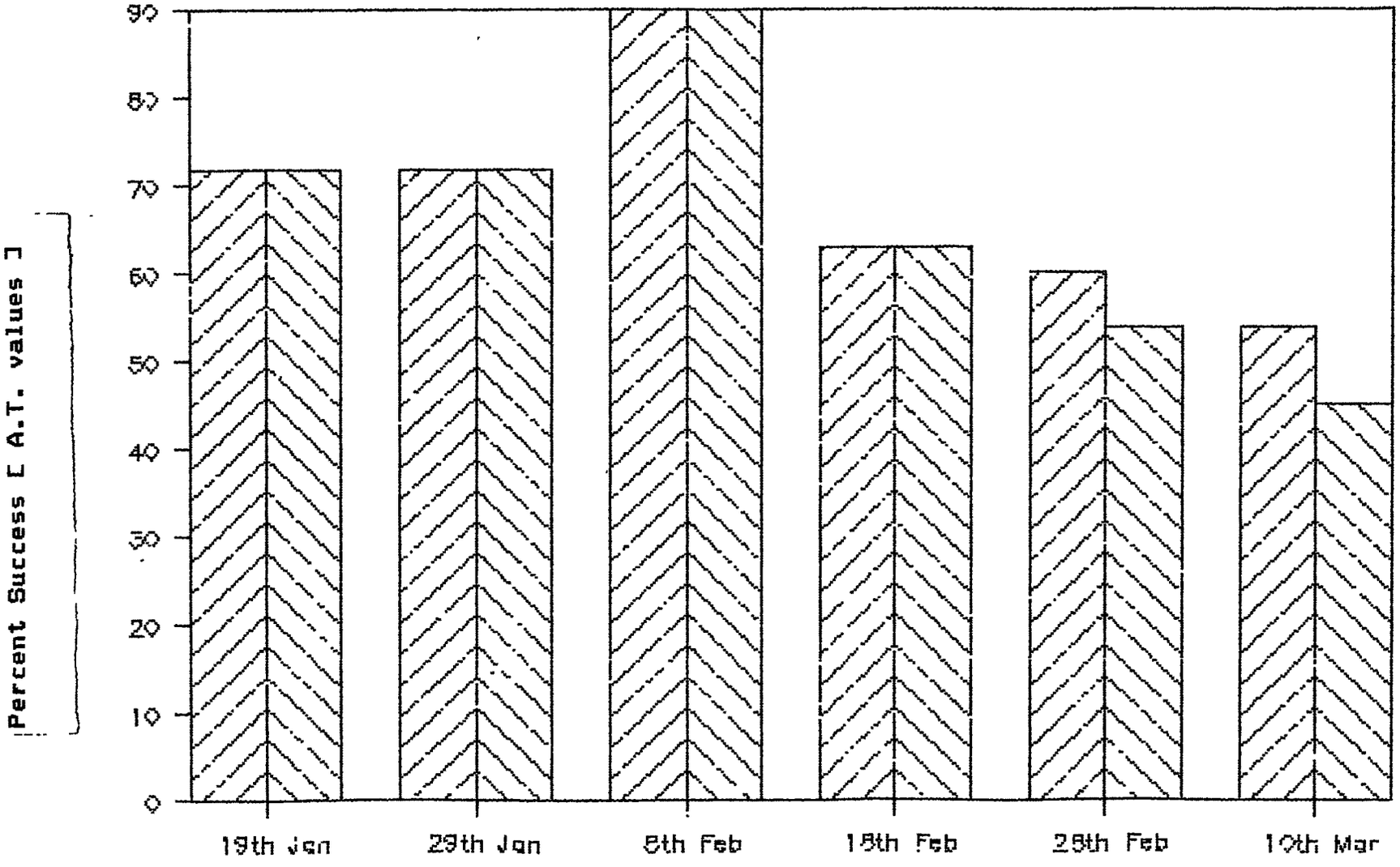


Fig.3 Initial and Final success of grafting in Tamarind

Table 4 : Initial and final success after 30 and 90 days of grafting

Dates of grafting	Custard apple		Jamun		Tamarind	
	Initial success (%)	Final success (%)	Initial success (%)	Final success (%)	Initial success (%)	Final success (%)
19th Jan 93	100 (90)	100 (90)	60 (51)	60 (51)	85 (72)	85 (72)
29th Jan 93	100 (90)	100 (90)	50 (45)	50 (45)	85 (72)	85 (72)
8th Feb 93	100 (90)	95 (84)	35 (36)	35 (36)	100 (90)	100 (90)
18th Feb 93	95 (84)	90 (78)	30 (33)	25 (30)	75 (63)	75 (63)
28th Feb 93	90 (78)	80 (69)	25 (27)	20 (24)	70 (60)	60 (54)
10th Mar 93	85 (72)	70 (60)	25 (24)	20 (21)	60 (54)	50 (45)
SE	4.31	5.19	4.89	4.66	4.83	5.66
CD at 5%	12.72	15.32	14.45	13.75	14.27	14.94

Figures in the parenthesis denote arcsin transformed values.

6. Successful graft of tamarind.

7. Failed graft of tamarind

success was exhibited on 10th March (60%), followed by 28th (70%) and 18th February (75%) (Fig.3).

B. Final success:

The data presented in Table 4 and depicted in plates 6 and 7 reveal significant differences for dates of grafting on final success of graft. Grafting carried out on 8th Feb. (100%) recorded significantly highest success, followed by 29th Jan., 19th Jan. (85%) and 18th Feb. (75). Significantly least final success was obtained on 10th March (50%) follwed by 28th February (60%) (Fig.3).

4.2 Effect of different dates of soft-wood grafting on the height of the graft.

Custard apple:

The results in respect of height of grafts presented in Table 5 expressed statistically significant differences indicating that height was influenced by the dates of grafting. Significantly more height of the grafts was produced in case of grafts prepared on 19 th Jan. over 18th, 28th Feb. and 10th March.

Jamun:

The results in respect of height of grafts presented in Table 5 showed that height of the graft obtained was significantly superior on 19th Jan. followed by 8th Feb., 29th Jan. and 18th February.

Table 5 : Height of the graft, after 90 days of grafting (cm)

Dates of grafting	Custard apple	Jamun	Tamarind
19th Jan 93	72.60	72.36	63.74
29th Jan 93	64.98	69.90	74.98
8th Feb 93	64.98	70.78	56.90
18th Feb 93	62.02	63.96	54.60
28th Feb 93	62.84	49.70	54.16
10th Mar 93	60.20	35.78	53.78
SE	2.74	7.95	3.44
CD at 5%	8.09	23.46	10.17

Tamarind:

The findings pertaining to height of grafts are presented in Table 5. It indicates significant effect of different dates grafting. Grafting on 29th Jan. showed significantly more height over all other dates of grafting.

4.3 Effect of different dates of soft wood grafting on diameter of graft :

Custard apple:

The date given in Table 6 clearly indicated that the diameter of graft was significantly influenced by the different dates of grafting . Grafting carried out on 19th Jan. was significantly superior over all other dates of grafting. Except 19th Jan. all treatments were at par in respect of diameter of graft.

Jamun:

The findings presented in Table 6 showed that diameter of the graft was statistically Significant within different treatments of grafting. Significantly highest diameter of graft was recorded in case of grafts prepared on 19th Jan. followed by 8th Feb., 29th Jan., and 18th February.

Tamarind:

The results given in Table 6 showed that diameter of the graft was stastically influenced by the different dates of grafting. Grafting on 29th

Jan. recorded significantly more diameter of graft over all other treatments. The remaining treatments were statistically at par.

4.4 Effect of different dates of grafting on diameter of sprouted scion shoot :

Custard apple:

The data given in Table 6 showed that there were significant differences of dates of grafting on diameter of sprouted scion shoot. Grafting on 19th Jan. and 8th Feb. was significantly superior than all other treatments in respect of diameter of sprouted scion shoot. The remaining treatments were statistically at par with each other.

Jamun :

The information presented in Table 6 revealed that different dates of grafting significantly influenced the diameter of sprouted scion shoot. Grafting on 19th Jan. recorded significantly highest diameter of scion shoot, followed by 8th Feb., 29th Jan. and 18th February.

Tamarind :

The results projected in Table 6 indicated significant effect on diameter of sprouted scion shoot due to different dates of grafting. Grafting on 29th Jan. recorded highest diameter, followed by 19th Jan. than the remaining

Table 6 : Daimeter of graft and diameter of sprouted scion after 90 days of grafting (cm)

Dates of grafting	Custard apple		Jamun		Tamarind	
	Diameter of graft	Diameter of sprouted scion shoot	Diameter of graft	Diameter of sprouted scion shoot	Diameter of graft	Diameter of sprouted scion shoot
19th Jan 93	0.68	0.54	0.76	0.52	0.56	0.39
29th Jan 93	0.64	0.47	0.70	0.46	0.69	0.49
8th Feb 93	0.66	0.54	0.72	0.51	0.54	0.37
18th Feb 93	0.61	0.47	0.68	0.46	0.53	0.37
28th Feb 93	0.63	0.47	0.53	0.34	0.52	0.36
10th Mar 93	0.61	0.45	0.39	0.27	0.50	0.33
SE	0.02	0.02	0.08	0.05	0.03	0.02
CD at 5%	0.07	0.07	0.25	0.15	0.09	0.06

treatments which were statistically at par with each other.

4.5 Effect of different dates of grafting on number of scion buds sprouted per graft.

Custard apple:

The data presented in Table 7 were found statistically significant implying that there is significant effect of dates of grafting on number of scion buds sprouted. Grafting on 19th Jan. showed significantly more number of scion buds sprouted over grafting carried out on 18th February. The remaining treatments were found statistically similar.

Jamun:

The results given in Table 7 revealed that number of scion buds sprouted were found non significant. Numerically more number of scion buds sprouted when grafting was done on 19th January.

Tamarind :

The findings given in Table 7 indicated significant effect of different dates of grafting on number of scion buds sprouted. Number of scion buds sprouted in 19th and 29th Jan. treatments were significantly more than that of 18th february treatment.

Table 7 : Number of scion buds sprouted per graft and length of sprouted scion shoot after 90 days of grafting (cm)

Dates of grafting	Custard apple		Jamun		Tamarind	
	Number of scion buds sprouted	Length of sprouted scion shoot	Number of scion buds sprouted	Length of sprouted scion shoot	Number of scion buds sprouted	Length of sprouted scion shoot
19th Jan 93	8.00	9.54	5.00	21.06	7.20	8.50
29th Jan 93	6.20	10.16	3.40	22.60	5.80	15.92
8th Feb 93	6.40	9.16	3.20	20.50	5.00	13.48
18th Feb 93	4.20	9.18	3.20	22.10	4.00	14.10
28th Feb 93	6.40	9.50	3.00	13.30	4.80	10.14
10th Mar 93	5.80	9.08	3.40	11.06	4.60	9.22
SE	1.15	1.40	0.95	3.16	0.60	1.88
CD at 5%	3.39	N.S.	N.S.	9.39	1.76	5.55

4.6 Effect of different dates of soft wood grafting on length of sprouted scion shoot :

Custard apple :

The information regarding length of scion shoot presented in Table 7 indicated that length of shoot per graft was statistically non significant among different treatments. Numerically the treatment of 29th Jan. recorded more length of shoot per graft than the remaining dates.

Jamun :

The results presented in Table 7 showed that there was significant effect of different dates of grafting on length of sprouted scion shoot. Grafting on 29th Jan., 18th Feb., 19th Jan. and 8th February produced significantly more length of shoot over 28th Feb. and 10th March treatments.

Tamarind :

The data given in Table 7 revealed that length of sprouted scion shoot of 29th Jan. and 18th Feb. graftings recorded significantly more length of shoot than the remaining treatments.

4.7 Effect of different dates of grafting on number of leaves :

Custard apple :

The data presented in Table 8 showed

Table 8 : Number of leaves and leaf area per graft after 90 days of grafting

Dates of grafting	Custard apple		Jamun		Tamarind	
	Number of leaves	Leaf area (cm^2)	Number of leaves	Leaf area (cm^2)	Number of leaves	Leaf area (cm^2)
19th Jan 93	86.60	1201.93	58.20	3012.21	77.60	1137.00
29th Jan 93	73.60	1093.46	48.20	2576.51	91.60	1372.68
8th Feb 93	77.40	1126.02	51.60	2664.68	71.60	1074.68
18th Feb 93	47.40	692.13	47.40	2575.12	62.40	942.98
28th Feb 93	66.80	989.13	39.00	2011.42	57.40	854.82
10th Mar 93	59.60	887.80	33.00	1707.26	49.60	771.67
SE	8.03	118.21	10.03	529.75	10.36	147.24
CD at 5%	23.70	348.71	N.S.	N.S.	30.56	434.37

that number of leaves per graft of 19th Jan., 8th Feb. and 29th Jan. treatment were significantly superior over other treatments.

Jamun :

The findings pertaining to number of leaves given in Table 8 indicated that the results were non significant. Numerically 19th Jan. treatment recorded highest number of leaves per graft, followed by 8th Feb. treatment.

Tamarind:

The results presented in Table 8 showed that number of leaves per graft of 29th Jan. treatment were significantly superior to remaining treatments.

4.8 Leaf area per graft:

Custard apple:

The leaf area per graft on 19th Jan., 8th Feb. and 29th Jan. treatment was significantly more over remaining dates of grafting (Table 8).

Jamun :

The findings given in Table 8 showed that the results were non significant due to various treatments. The leaf area per graft of 19th Jan. treatment was the highest.

Tamarind :

The data presented in Table 8 clearly indicates that there was significant effect of dates of grafting on leaf area per graft. Leaf area of 29th Jan. treatment was found significantly higher over remaining dates of grafting.

DISCUSSION

V. DISCUSSION

The propagation of plants is a fundamental occupation of mankind. It requires a knowledge of mechanical manipulation and technical skill, knowledge of plant growth, its structure and methods of plant propagaton.

The success of grafting operation is influenced by several factors. viz., physiological condition of stock and scion (eq. dormacy period, period of new flush emergence, Blossom bud differenciation, sap flowing condition of the stock and scion), maturity of scion, the nutritional condition of the stock and scion, age of scion shoot, harmonal balance of mother plant and prevailing climatic conditions of the locality during the period of graft union. Usually, temperatures from 12.8^{o}C to 32^{o}C depending upon the species, are conductive to rapid growth (cell activity). Out- door grafting operation should thus take place at a time of year when such favourable temperatures can be expected and when such favourable temperatures can be expected and when the plant tissues, especially the cambium, are in a naturally active state. These conditions generally occur during the spring months.

In the stadardization of method of soft- wood grafting in custard apple, jamun and tamarind

the results on the various characters studied in respect of success and grwoth are presented in previous chapter and discussed here under appropriate heads.

5.1 Initial success:

In custard apple the maximum initial success (100%) was obtained when grafting was carried out on 19th, 29th Jan. and 8th Feb. followed by 18th Feb. (95%) and 28th Feb. (90%). Comparatively low but very good percentage of initial success was observed on 10th March (85%), second fortnight of Jan. to first fortnight of Feb. was found to be the most suitable period with 100 per cent succes followed by second fortnight of Feb. to first fortnight of March with success ranging from 85 to 95 per cent.

During the period from 19th Jan. to 8th Feb. the climatic conditions were rather congenial for success of grafting. The maximum temperatures ranged from 31^{o}C to 31.8^{o}C where as the minimum temperatures ranged from 8.6^{o}C to 10.9^{o}C. Usually temperature from 12.8^{o}C to 32^{o}C are conducive to rapid cell growth (Hartmann and Kestar, 1986).

The extremities of temperature range as stated by Hartmann and Kestar (1986) are quite similar to the extremeties of temeprature range during the most suitable period of grafting i.e.

19th Jan. to 8th February. This temperature range was accompanied by the relative humidity ranging from 63 to 73 per cent maximum and minimum humidity ranged from 15 to 24 per cent (Appendix-I). After 8th Feb. the relative humidity ranged from 48 to 71 per cent. The initial success of grafting was reduced after this period ranging from 85 to 95 % as compared to the earlier success percentage. Similar results were obtained by Subbarao (1968) in mango under Anand condition by veneer grafting. These results indicated that July to August and Jan. to Feb. were the more suitable months. Soft-wood grafting can also be possible with 90 to 98 per cent success during Feb.and March under Aurangabad condition (Randive, 1988). While Patel and Amin (1981) obtained 97 per cent success in 3rd week of Feb. Reddy and Melanta (1988) obtained highest 90 per cent success after 60 th days after grafting in Jan.on 7 months old seedling by '*in situ*' soft wood grafting and lowest in Nov. 85 per cent on 5 month old seedlings. Kanwar and Bajwa (1974) found that last week of Feb. to Nov. produced success from 22 to 90 per cent. Amin (1978) in mango obtained 33, 30.5, 66.5 and 69% success in soft wood grafting during Oct., Jan., Feb. and March respectively under Anand conditions. Joshi (1992) also reported initial and final success significantly more in 7th Feb.

treatment (76.66%). As operation was delayed upto 26th March there was gradual decrease in success. However, Bangar (1992) obtained maximum initial and final success between 5th Dec. to 5th Jan. which ranged from 83.33 to 100 per cent, follwed by 20th Jan. to 20th February (50 to 66.67%). Sant Ram and Bist (1982) obtained 85 per cent success in March. However, they also reported better success (50%) in the month of Feb. with the use of freshly defoliated scions.

In jamun maximum initial success was obtained on 19th Jan. (60%) followed by 29th Jan. (50%) as compared to 8th, 18th, 28th Feb. and 10th March (35, 30, 25 and 25 per cent success, respectively).

Less success in grafting during second fortnight of Jan. and first fortnight of Feb. might be due to emergence of new flushes in jamun under Parbhani conditions; subterminal portions of scion used might have contributed to the lower success in jamun. Joshi (1992) in mango observed significantly more initial and final success with terminal part of scion wood as compared to subterminal portion. Thus supporting the results of the present investigation.

In tamarind, maximum initial success (100 %) was obtained on 8th Feb. followed by 19th

and 29th Jan. (85%) similar results were reported in veneer grafting of moango by Subbarao (1968). Reddy and Melanta (1988) in Jan. and Joshi (1992) on 7th Feb. in mango.

During the period from 19th Jan. to 8th Feb. the maximum and minimum temperatures ranged from 31°C to 31.8°C and 8.6°C to 10.9°C respectively. These temperature conditions are favourable for rapid cell growth i.e. 12.8°C to 32°C temperature as stated by Hartmann and Kestar (1986). This temperature range was accompanied by the relative humidity 63 to 73 per cent maximum and 15 to 24 per cent minimum humidity (Appendix-I).

These temperatures and humidity conditions might have positively influenced the intial success of tamarind during second fortnight of Jan. and first forthnight of February.

Comparatively lower but better initial success was recorded on 18th Feb. (75%) and 28th Feb. (70%) while least initial success was recorded on 10th March grafting. Beyond 8th Feb. the maximum relative humidity ranged from 48 to 71per cent and minimum from 9 to 23 per cent and maximum and minimum temperatures from 31.9°C to 34.6°C to 8.7° to 16.3°C, respectively. The increase in temperature and decrease in humidity might have caused lower initial success.

5.2 Final Success :

In custard apple, the maximum final success (100%) was obtained on 19th Jan. and 29th Jan. followed by 8th Feb. (95%) and 18th Feb. (90%). Comparatively low but good percentage of final success was also recorded on 28th Feb. (80%) and 10th March (70%) graftings. Similar results were obtained by Reddy and Melanta (1988). However, Bangar (1992) reported initial and final maximum success from 5th Dec. to 5th Jan. followed by 20th Jan. to 20th February.

In jamun, better final success was obtained in case of grafting carried out on 19th Jan. and 29th January. Bangar (1992) reported 50 per cent success in soft wood grafting of mango. Reddy and Melanta (1988) obtained 90 per cent final success in Jan. on 7 months old seedling by '*in situ*' soft wood grafting. Subbarao (1968) reported Jan. and Feb. as suitable months for veneer grafting under Anand conditions. Kulwal *et al.* (1985) reported suitable period of soft wood grafting in Sapota in Jan. and Feb. under Akola conditons.

In tamarind, maximum final success was recorded on 8th Feb. (100%) followed by 19th and 29th January (85%). Joshi (1992) recorded highest final success on 7th Feb. (59.99%) in mango. Gayake (1992) found that grafting on 15th Feb.

gabve maximum success (33.5) followed by 15th (28.23%) and 25th March (20.46%).

Comparatively lower but good success was noted in 18th Feb. (75%), 28th Feb. (60%) and 10th March (50%). Subbarao (1968) reported Jan-Feb as more suitable months for veneer grafting of mango under Anand conditions. Ramirez et al. (1986) grafted tamarind on criollo root stocks. Percentage take was highest with splice grafting and whip and tongue grafting (65.3 and 61.3% respectively). Percentage take was best with a diameter of graft union at 0.66 to 0.75 cm.

5.3 Height, diameter of graft, diameter of sprouted scion shoot, number of leaves and leaf area per graft.

Custard apple:

The maximum height, diameter of graft, diameter of sprouted scion shoot, number of leaves and leaf area per graft was produced in 19th Jan. grafting followed by 8th Feb. and 29th January.

The reason for maximum height, diameter of graft, diameter of sprouted scion shoot, number of leaves and leaf area per graft during 19th Jan. to 8th Feb. treatments might be due to favourable temperatueres, humidity and available soil moisture during season of spring.

Jamun :

The maximum height, diameter of graft, diameter of sprouted scion shoot, numbers of leaves and leaf area per graft was produced in 19th Jan. followed by 8th Feb., 29th Jan. and 18th February. However, Gayake (1992) obtained more height of the graft, diameter of graft and diameter of sprouted scion shoot in case of grafts prepared on 15th March and more number of leaves and leaf area on 25th March treatment.

The reason for maximum height, diameter of graft, diameter of sprouted scion shoot, number of leaves and leaf area per graft of 19th Jan., follwed by 8th Feb. 29th Jan. and 18th Feb. treatments might be due to favourable temperatures, humidity and available moisture during spring season.

These favourable conditions of growth during earlier treatments of grafting accompanied by the period of new flush emergence (January-February) in jamun under Parbhani conditions contributed significantly for growth of grafts.

Tamarind :

The maximum height, diameter of graft, diameter of sprouted scion shoot, number of leaves, leaf area per graft was significantly more in case of grafts prepared on 29th Jan. treatment, followed by 19th Jan., 8th Feb. and rest of the treatments.

Gayake (1992) obtained more height of the graft prepared on 16th March grafting and diameter of graft, diameter of sprouted scion shoot on 25th March and number of leaves and leaf area per graft of 15th Feb. when grafts were prepared in polybags.

These differences might be due to method of raising and change in location. Similar trend of results was obtained by Bangar (1992) under Parbhani conditions thus agreeing with the results of the present investigation.

5.4 Number of scion bud sprouted :

In custard apple the maximum number of scion bud sprouted per graft was produced on 19th Jan., followed by 8th, 28th Feb. and 29th January.

In jamun the number of scion buds sprouted per graft showed non significant results. Though numerically maximum number of scion buds were produced by the grafts prepared on 19th Jan. treatment.

In tamarind the maximum number of scion buds sprouted per graft were produced by the graft prepared on 19th Jan., followed by 29th Jan., 8th and 28th Feb. treatments.

5.5 Length of sprouted scion shoot

In custard apple, the length of sprouted scion shoot per graft showed non-significant results. However, numerically maximum

length of scion was produced by the grafts of 29th Jan. treatment.

In jamun, the maximum length of sprouted scion shoot was produced by the 29th Jan., followed by 18th Feb. and 19th Jan. treatments.

In Tamarind, the length of sprouted scion shoot was maximum on the grafts of 29th Jan., folowed by 18th, 8th and 28th Feb. treatments.

In all the three crops, under '*in situ*' condition the period between second fortnight of Jan. to first fortnight of Feb. months proved better for performing soft wood grafting.

SUMMARY

VI. SUMMARY AND CONCLUSION.

The present investigation entitled "Studies on '*in situ*' soft-wood grafting in some dryland fruit crops viz. custard apple (*Annona squamosa* L.)jamun(*Syzygium cuminii* S.) and tamarind (*Tamarindus indica* L.)" was undertaken in the Department of Horticulture, Marathwada Agricultural University, Parbhani during the year 1992-93. Soft wood grafting on 7 month old '*in situ*' seedlings was tried on different datesat 10 days interval commencing from 19th January to 10th March, 93 in these three crops. The three separate experiments were carried out in Randomised Block Design with six dates of grafting treatments replicated five times. The unit of experiment was four seedlings. In all the three crops, observations on initial success, final success, height of the graft, diameter of graft, diameter of sprouted scion shoot, number of scion buds sprouted, length of scion shoot sprouted, number of leaves and leaf area per graft were recorded. The results obtained are briefly summarised and concluded herewith.

6.1 Initial success:

1. In custard apple, maximum intial success (100%) was recorded in case of 19th Jan.,29th

Jan. and 8th Feb. followed by 18th Feb. (95%), 28th Feb. (90%) and 10th March (85%), treatments.

2. In jamun, maximum intial success was obtained in case of 19th Jan. (60%), followed by 29th Jan. (50%) grafting.

3. In tamarind, maximum intial success was obtained in case of grafting carried out on 8th Feb. (100%), followed by 19th and 29th January. Better initial success was also obtained on 18th (75%), followed by 28th Feb. (70%) and 10th March (60%) treatments.

6.2 Final success :

1. In custard apple, final suuccess (100%) recorded was maximum in case of 19th and 29th Jan. followed by 8th Feb. (95%), 18th Feb.(90%), 28th Feb. (80%) and 10th March (70%) treatments.

2. In jamun, the treatment of 19th Jan. (60%) and 29th Jan. (50%) gave maximum final success.

3. In tamarind, the grafting done on 8th Feb. (100%), followed by 19th and 29th Jan. produced maximum successful grafts. Good percentage of final success was also obtained on 18th Feb. (75%), 28 Feb.(60%) and 10th March (50%) treatments.

6.3 Height of the graft:

1. In custard apple, grafting on 19th Jan. was signigicantly superior over all other

treatments in respect of height of graft (72.60 cm).

2. In jamum, grafting on 19th Jan. was significantly superior to 28th Feb. and 10th March, (72.36 cm) treatments in respect of height, followed by 8th Feb. (70.78 cm), 29th Jan.(69.90 cm) and 18th February (63.96 cm).
3. In tamarind grafting on 29th Jan. produced significanlty more height over all other treatments (74.98 cm).

6.4 Diameter of graft:

1. In custard apple, 19th Jan. grafting gave significantly more diameter of graft (0.68 cm)than other treatments .
2. In jamun, 19th Jan. treatment produced significantly more diameter of graft (0.76 cm) followed 8th Feb., 29th Jan. and 18th February.
3. In tamarind, grafting on 29th Jan. was significantly superior to all other tretments in respect of diameter of the graft (0.69cm).

6.5 Diameter of sprouted scion shoot:

1. In custard apple, difference in diamter of sprouted scion shoot was statistically significant. Grafting on 19th Jan. and 8th Feb. (0.54 cm) were superior to other

treatments.The remaining treatments were statistically at par with each other .

2. In jamun, grafting on 19th Feb. was significantly superior for production of more diameter of scion shoot (0.52 cm), followed by 8th Feb., 29th Jan and 18th Feb. treatments.

3. In tamarind, grafting on 8th Feb. was statistically superior over other treatments in respect of diameter of sprouted scion shoot.

6.6 Number of scion buds sprouted pert graft :

1. In custard apple, grafting on 19th (8.0) Jan. was statistically superior to other treatments.

2. In jamun, number of scion buds sprouted per graft showed non-significant results, more buds were produced in case of 19th January.

3. In tamarind, 19th Jan. gave statistically more number of buds per graft (7.2), followed by 29th January.

6.7 Length of sprouted scion shoot per graft:

1. In custard apple, length of sprouted scion shoot per graft showed non-significant results. Numerically more length of sprouted scion shoot per graft was obtained in case of 29th January (10.16 cm).

2. In jamun, grafting on 29th Jan. was statistically significant in respect of length of sprouted scion shoot per graft (22. 60 cm).

3. In tamarind, grafting on 29th Jan. was statistically significant in respect of length of sprouted scion shoot per graft (15.92), followed by 18th February grafting.

6.8 Number of leaves per graft:

1. In custard apple, grafting on 19th Jan. was statistically significant in respect of number of leaves per graft (86.60) followed by 29th Jan. and 8th February.

2. In jamun, number of leaves produced per graft showed non significant results. Numerically more No. of leaves were produced in case of 19th January (58.20) treatment.

3. In tamarind, grafting on 29th Jan. (91.60) was significantly superior to all other treatments.

6.9 Leaf area per graft:

1. In custard apple, grafting on 19th Jan. was statistically significant in respect of leaf area per graft (1201.93), followed by 8th Feb. and 29th January.

2. In jamun leaf area per graft showed non significant results. Numerically more leaf area per graft (3012.21) was produced in case of 19th Jan. treatment.

3. In tamarind, grafting on 29th Jan. was statistically significant in respect of leaf area per graft (1372.68) over all other treatments.

CONCLUSION

It can be concluded from the present investigation that 'in situ' soft wood grafting is successful in custard apple, jamun and tamarind fruit crops. Out of the period tried, the most congenial period for custard apple was from second fortnight of January to first fortnight of February. In jamun second fortnight of January was found better period for grafting operation. For tamarind second fortnight of January to first fortnight of February was the most congenial period of soft-wood grafting with maximum success. Further investigations with regard to monsoon season, age of the stock and scion shoot, use of plant growth regulators like IAA, GA. Micronutrients like Zn and Boron spray alone and also in combination with growth regulator and urea may be useful.

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* Originals not seen.

Appendix - I

Mean Meteorological data

Meteorological Week		Temperature(oC) Max.	Min.	Relative humidity A.M.	P.M.	Rainfall (mm)
Jan.	1 - 7	31.3	9.3	78	23	00
	8 - 14	32.2	10.9	72	21	00
	15 - 21	32.0	10.9	71	24	00
	22 - 28	31.2	9.0	73	16	00
	29 - 04	31.2	9.5	65	20	00
Feb.	5 - 11	31.8	8.6	63	15	00
	12 - 18	34.6	13.3	53	13	00
	19 - 25	31.9	8.7	48	09	00
	26 - 04	33.0	16.3	69	29	3.4
Mar.	5 - 11	34.4	16.0	71	23	9.0
	12 - 18	36.1	16.0	48	13	00
	19 - 25	38.3	15.9	37	12	00
	26 - 01	36.7	18.0	37	14	00
Apr.	2 - 8	39.0	19.7	30	16	00
	9 - 15	39.2	19.7	42	21	00
	16 - 22	41.3	22.8	31	11	00
	23 - 29	42.1	21.4	34	15	00
	30 - 06	43.1	21.4	29	14	00
May	7 - 13	43.1	24.0	34	18	00
	14 - 23	42.2	23.3	41	22	00
	21 - 27	41.6	25.8	41	22	00
	28 - 3	41.5	24.5	52	23	8.4
June	4 - 10	42.2	26.1	49	30	00