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Studies on effect of Precuring and time of grafting on success of softwood grafting in tamarind

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Abstract
A study was conducted to evaluate the effect of precuring and time of grafting on success of softwood grafting in Tamarind (*Tamarindus indica* L.) at college of Horticulture, Dr. Y.S.R Horticulture University, Venkataramannagudem, AP in a factorial completely randomized design (FCRD) with two factors at unequal levels and replicated twice. Among the treatment combinations grafting practiced on 15th March with scion sticks precured 10 days prior to grafting (T_9) exhibited profound effect on growth parameters over grafting done on 30th June with unprecured scion sticks (T_{16}). Grafting exercised on 15th March with scion sticks precured 10 days prior to grafting (T_9) showed significant difference with respect to sprouting per cent (97.75), graft take per cent (72.30, 85.85 and 99.85 at 30, 60 and 90 DAG respectively), graft height (66.40, 71.80 and 74.40 cm at 90, 120 and 150 DAG respectively) and sprout length (33.60, 36.85 and 40.80 cm at 90, 120 and 150 DAG respectively) and least was noticed with grafting carried out on 30th June with unprecured scion sticks with respect to sprouting per cent (49.30), graft take per cent (21.00, 32.70 and 45.10 at 30, 60 and 90 DAG respectively), graft height (42.20, 49.10 and 52.15 cm at 90, 120 and 150 DAG respectively) and sprout length (23.60, 25.85 and 27.12 at 90, 120 and 150 DAG respectively).

Keywords: Tamarind, precuring, grafting time, sprouting %, graft take %

Introduction
Tamarind (*Tamarindus indica* L.) is an underutilized fruit and is widely distributed throughout the tropics and sub-tropics as stray plantation or as avenue tree. It belongs to the subfamily Caesalpiniaceae and family Fabaceae. It is a rich source of timber, fruits, seeds, fodder and also rich in medicinal properties. It has wide potential of industrial uses. It is highly heterozygous and cross-pollinated crop. It exhibits a wide range of variations, which aids in selection of superior as well as desirable genotypes.

The cross pollination and predominant practice of seed propagation in tamarind has lead to provide an immense opportunity to locate elite trees with desirable horticultural traits, are needs to be conserved and exploited. Despite of its varied advantages, it can't attract much scientific attention towards its propagation. True-to-type propagules can be multiplied from elite trees that produce high yield with good quality fruits only through asexual methods. Softwood grafting has distinct advantage over other methods of propagation in tamarind.

It is an efficient, economic, rapid method and grafts can be ready within a year. The initial success with least mortality, better and uniform orchard establishment is achieved only through softwood grafting. Success, survivability and grafts growth depends upon many other factors including grafting method, time of grafting, age of scion stick, rootstock and environmental conditions. Precuring of scion and age of the scion shoots play an important role in success of softwood grafting. The scientific literature on precuring and time of grafting in tamarind crop especially under coastal humid tropical ecosystem is very meagre. Hence it is proposed to study the influence of precuring of scion and time of grafting on success of softwood grafting in tamarind grown in Godavari zone of Andhra Pradesh.

Material and Methods
The present investigation was carried out at College of Horticulture, Dr. Y.S.R Horticultural University, Venkataramannagudem, West Godavari District, Andhra Pradesh under 50% shade net structure during the year 2020. Experiment was laid out in the factorial complete randomized design (FCRD) with 2 factors, precuring (2 levels P_1: Precuring on the day of grafting, P_2: Precuring 10 days prior to grafting and grafting time at (8 levels G_1: Grafting on 15th March, G_2: Grafting on 30th March, G_3: Grafting on 15th April, G_4: Grafting on 30th April,

G_5: Grafting on 15th May, G_6: Grafting on 30th May, G_7: Grafting on 15th June, G_8: Grafting on 30th June) with 16 treatment combinations replicated twice.

Treatment combinations comprised of T_1: P_1G_1: Grafting with unprecured scion sticks on 15th March, T_2: P_1G_2: Grafting with unprecured scion sticks on 30th March, T_3: P_1G_3: Grafting with unprecured scion sticks on 15th April, T_4: P_1G_4: Grafting with unprecured scion sticks on 30th April, T_5: P_1G_5: Grafting with unprecured scion sticks on 15th May, T_6: P_1G_6: Grafting with unprecured scion sticks on 30th May, T_7: P_1G_7: Grafting with unprecured scion sticks on 15th June, T_8: P_1G_8: Grafting with unprecured scion sticks on 30th June, T_9: P_2G_1: Grafting with precured scion sticks on 15th March, T_{10}: P_2G_2 Grafting with precured scion sticks on 30th March T_{11}: P_2G_3 Grafting with precured scion sticks on 15th April T_{12}: P_2G_4 Grafting with precured scion sticks on 30th April, T_{13}: P_2G_5 Grafting with precured scion sticks on 15th May, T_{14}: P_2G_6 Grafting with precured scion sticks on 30th May, T_{15}: P_2G_7 Grafting with precured scion sticks on 15th June, T_{16}: P_2G_8 Grafting with precured scion sticks on 30th June.

Raising of rootstocks

The seeds of Thettu Amalika, a local variety were collected from the Horticultural Research Station (HRS), Anantapur. Polybags of 9 x 11 cm size with 200-gauge thickness were used for raising the rootstocks. Staggered sowing was done to get same age and uniform sized rootstocks for softwood grafting during different months. The seeds were sown in polybags filled with a potting mixture (red soil, vermicompost and coco peat in 1:1:1 ratio). The seeds were sown in polybags at a depth of 2 cm from top for quick and better seed germination. Optimum moisture content was maintained in polybags for rapid and uniform germination.

Preparation of scion shoots

Selection of good scion material is very crucial for getting higher percentage of graft success. Scion sticks of 15-20 cm in length and having pencil thickness were collected from non-flowered shoots (3-5 months old) with pointed and dormant apical buds from tamarind mother block maintained at College of Horticulture, Venkataramannagudem. The selected scion shoots were defoliated (precured) 10 days prior to grafting and separated from mother trees on the day of grafting in early morning hours. The unprecured scion shoots were also collected on the day of grafting. The collected scion sticks were protected by wrapping with moist gunny cloth.

Softwood grafting

The healthy, disease free and 8 months old seedlings with good, clean, up right stem having pencil thickness (0.5-1.0 cm) rootstocks were selected for grafting. The top portion of stock was decapitated with the help of sharp grafting knife by leaving about 20 cm from the ground level. The top of the stem was split longitudinally to about 4-5 cm in length forming a 'V' shape by sharp grafting knife. Scion stick about the same thickness as that of the rootstock with a length of about 9-10 cm was selected. The lower end of the scion was cut into gently sloping wedge of about 3 to 4 cm by removing the bark and wood from both the opposite sides. The wedge-shaped scion stick was inserted into the 'V' shaped split of the rootstock and secured firmly with 200-gauge thickness white transparent polythene strip. The scions were covered with transparent polythene caps (15 cm in length and 100-gauge thickness). Polythene cap maintained the humidity and temperature and also prevent the contamination and desiccation of the apical buds present on scion sticks. The sprouts developed below the graft union i.e., on rootstock were removed carefully from time to time without disturbing the new sprout growth. The polythene caps were removed after development of new growth from auxiliary bud of scion.

The observations like graft take % at 30, 60 and 90 DAG respectively. Bud sprouting percentage at 3 months after grafting, graft height and sprout length (cm), were recorded at 90, 120 and 150 days after grafting (DAG) on fifteen randomly selected grafts. The collected data were subjected to statistical analysis to find the significant difference among the treatments.

Results and Discussion

Graft take (%)

The data presented in Table 1 depicts that the maximum graft take (72.30, 85.85 and 99.85) was recorded in grafting on 15th March with scions precured 10 days prior to grafting (P_2G_1) which was on par with (P_2G_2) grafting on 30th March with scions precured 10 days prior to grafting (72.20, 85.75 and 99.80) and the minimum graft take (21.00, 32.70 and 45.10) was observed in (P_1G_8) grafting on 30th June with uncured scions at 30, 60, and 90 DAG respectively.

The graft take percent was significantly increased at 30, 60 and 90 days after grafting in grafts grafted with scion sticks precured 10 days prior to grafting than grafts grafted with unprecured scion sticks. It might be due to storage of food material in precured scion sticks causes rapid formation of callus tissue that allow translocation of vital chemical compounds between rootstock and scion, leading to more chance of maximum graft take. It also influenced the growth parameters attributed to initiation of cambium activity might have resulted in early and strong graft take formation as earlier reported by Nahar *et al*. (2018) [4] in lime.

The highest graft take percentage was recorded in grafts grafted during the March month due to prevailing favourable external and internal conditions like optimum humidity, moderate temperature and biochemical status of scion sticks as earlier reported by Dhutraj *et al*. (2018) [1] in tamarind. The least graft take percent was recorded in grafts grafted during the month of June at 30, 60 and 90 DAG might be attributed to prevailing of unfavourable weather conditions like temperature and relative humidity. The physiological condition of rootstock and decreased sap flow on 30th June might have interfered with the healing of graft union. The similar findings were obtained by Pathak *et al*. (1992) [9] in tamarind; Patel and Amin (1976) [7] in mango and Singh *et al*. (2012) [11] in mango.

Bud sprouting %

The scion sticks precured 10 days prior to grafting and grafting on 15th March (P_2G_1) recorded highest bud sprouting (97.75%), which was on par with (P_2G_2) grafting carried out on 30th March with scion precured 10 days prior to grafting (95.80%). The lowest bud sprouting (49.30%) was noticed with grafting on 30th June (P_1G_8) with unprecured scions (Table 2).

The highest percentage of bud sprouting was noticed with grafting of rootstocks with scion sticks precured 10 days prior to grafting (P_2) than grafting with unprecured scion sticks might be due to the supply of sufficient food material to the meristematic tissue present in the buds. Similar findings have also been reported by Pampana and Sulikeri (2001) [6] in

sapota. Precuring of scion sticks had significant role on percent of bud sprouting. The precuring of scion sticks on this parameter could be attributed to initiation of rapid cambial activity might have resulted in early bud sprouting (Hartmann *et al*., 1997) [2].

The per cent bud sprouting was found significantly high in grafts grafted during March month. This may be attributed to prevailing of moderately high temperature, high relative humidity, adequate supply of moisture and nutrients helps in fast cambial activity as well as accumulation of high carbohydrates in scion shoots results in rapid and early sprouting of buds during March month. The results are in agreement with the findings of Padma and Reddy (1995) [5] in mango grafts.

Height of the graft (cm)

Data exhibited in table 1 revealed that the maximum graft height (66.40 cm, 71.80 cm and 74.40 cm) was recorded in (P_2G_1) followed by (P_2G_2) with graft height of 69.00 cm and 71.00 cm at 120 DAG and 150 DAG respectively and was on par at 90 DAG (64.30) and minimum graft height (42.20 cm, 49.10 cm and 52.15 cm) was recorded in grafts which were prepared on 30th June with un precured scions (P_1G_8) at 90, 120 and 150 DAG respectively.

The maximum graft height was reported in grafts grafted with scion sticks precured 10 days prior to grafting might be due to presence of congenial climatic condition for the development of dormant and swollen terminal buds on scion. This could be also due to vigorous nature of the younger scions results in rapid multiplication of meristematic cells of the juvenile scions. Similar results were obtained in guava (Patel *et al*., 2007) [8].

The height of the graft was found to increase significantly with the grafting time. This can be explained by the fact that, there was high physiological activity and good sap flow in the rootstock during March month along with favourable temperature and relative humidity in the atmosphere. Results were in close conformity with findings of Pathak *et al*. (1992) [9] in tamarind.

Sprout length (cm)

The effect of grafting time and precuring shows significant difference with regard to sprout length (Table 4). The length of sprout recorded in grafting made on 15th March with scion precured 10 days before grafting (P_2G_1) showed a significantly highest value (33.60, 36.85 and 40.80) at 90, 120 and 150 DAG, followed by (P_2G_2) grafting done on 30th March with scion precured 10 days before grafting registered a sprout length of 31.93 cm and 37.95 cm at 90 and 150 DAG respectively and was found on par at 120 DAG (35.75). The minimum sprout length (23.60, 25.85 and 27.12) was observed in grafting on 30th June with un precured scions (P_1G_8) at 90, 120 and 150 DAG respectively.

The maximum sprout length was recorded in grafts grafted with scion sticks precured 10 days prior to grafting. It might be due to precured scion sticks had contain more carbohydrates and other food substances as reported by Thakar and shah, (2013) [12] in mango. The accumulation of more carbohydrates in scion sticks precured 10 days prior to grafting had resulted in rapid cell division and cell elongation in meristematic tissue present in buds promotes early sprouting of first bud (17.59 d), maximum percentage of bud sprout at (81.57%) at 90 DAG as well as maximum sprout length (34.38 cm) as earlier reported by Hartman *et al*. (1997). The present results are in agreement with the findings of. Patil *et al*. (1983) [10] in mango grafts.

Maximum sprout length was recorded in grafts grafted on 15th March due to prevailing of congenial weather conditions during month of March, the sprout length was also influenced by the time available for growth of meristematic cells present in buds had coupled with better physiological processes (photosynthesis and lower respiration). The results are in accordance with the findings of Mandal *et al*. (2011) [3] in mango.

Table 1: Effect of precuring and time of softwood grafting on graft take (%) in tamarind

Grafting time (G)	Graft take %								
	30 DAG			60 DAG			90 DAG		
	P_1	P_2	Mean	P_1	P_2	Mean	P_1	P_2	Mean
G_1	71.50	72.30	71.90	83.50	85.85	84.67	96.80	99.85	98.32
G_2	69.00	72.20	70.60	82.70	85.75	84.22	95.80	99.80	97.80
G_3	65.00	66.00	65.50	78.30	80.90	79.60	92.30	93.90	93.10
G_4	62.00	65.00	63.50	76.70	79.20	77.95	90.10	93.30	91.70
G_5	48.00	52.50	50.25	59.20	66.10	62.65	69.80	77.50	73.65
G_6	40.00	40.50	40.25	51.95	53.85	52.90	65.40	66.30	65.85
G_7	31.50	36.50	34.00	42.20	48.50	45.35	55.60	59.10	57.35
G_8	21.00	28.50	24.75	32.70	40.65	36.67	45.10	50.70	47.90
Mean	51.00	54.18		63.40	67.60		76.38	80.05	
Factor	P	G	PXG	P	G	PXG	P	G	PXG
SE (m) +	0.35	0.69	0.98	0.28	0.56	0.80	0.40	0.81	1.14
CD at 5%	1.04	2.08	2.94	0.84	1.69	2.40	1.21	2.43	3.43

G_1: Grafting on 15th March G_5: Grafting on 15th May P_1: Un precured
G_2: Grafting on 30th March G_6: Grafting on 30th May P_2: Precured 10 days prior to grafting
G_3: Grafting on 15th April G_7: Grafting on 15th June
G_4: Grafting on 30th April G_8: Grafting on 30th June

Table 2: Effect of precuring and time of softwood grafting on bud sprouting (%) at 3 months after grafting in tamarind

Grafting time (G)	Bud sprouting (%)		Mean
	P_1	P_2	
G_1	95.40	97.75	96.57
G_2	91.60	95.80	93.70
G_3	89.95	93.00	91.47
G_4	82.45	90.45	86.45
G_5	70.65	83.45	77.05
G_6	63.00	72.55	67.78
G_7	55.50	63.50	59.50
G_8	49.30	56.10	52.70
Mean	74.73	81.57	
Factor	P	G	PXG
SE (m) +	0.44	0.88	1.25
CD at 5%	1.32	2.65	3.74

G_1: Grafting on 15th March G_5: Grafting on 15th May P_1: Un precured
G_2: Grafting on 30th March G_6: Grafting on 30th May P_2: Precured 10 days prior to grafting
G_3: Grafting on 15th April G_7: Grafting on 15th June
G_4: Grafting on 30th April G_8: Grafting on 30th June

Table 3: Effect of precuring and time of softwood grafting on height of graft (cm) in tamarind

Grafting time (G)	Height of graft (cm)								
	90 DAG			120 DAG			150 DAG		
	P_1	P_2	Mean	P_1	P_2	Mean	P_1	P_2	Mean
G_1	58.20	66.40	62.30	60.90	71.80	66.35	62.40	74.40	68.40
G_2	57.10	64.30	60.70	59.50	69.00	64.25	60.50	71.00	65.75
G_3	55.00	61.40	58.20	57.50	64.70	61.10	58.50	68.00	63.25
G_4	53.90	59.60	56.75	55.90	63.60	59.75	57.20	65.70	61.45
G_5	53.50	57.00	55.25	55.10	59.61	57.35	56.95	61.90	59.42
G_6	51.00	53.60	52.30	53.80	56.30	55.05	55.56	57.95	56.75
G_7	48.50	52.22	50.36	51.10	54.50	52.80	52.80	57.50	55.15
G_8	42.20	50.20	46.20	49.10	53.90	51.50	52.15	57.40	54.77
Mean	52.42	58.09		55.36	61.67		57.00	64.23	
Factor	P	G	PXG	P	G	PXG	P	G	PXG
SE (m) +	0.29	0.58	0.81	0.21	0.42	0.59	0.28	0.56	0.79
CD at 5%	0.86	1.73	2.44	0.63	1.26	1.78	0.84	1.68	2.38

G_1: Grafting on 15th March G_5: Grafting on 15th May P_1: Un precured
G_2: Grafting on 30th March G_6: Grafting on 30th May P_2: Precured 10 days prior to grafting
G_3: Grafting on 15th April G_7: Grafting on 15th June
G_4: Grafting on 30th April G_8: Grafting on 30th June

Table 4: Effect of precuring and time of softwood grafting on sprout length (cm) in tamarind

Grafting time (G)	Sprout length (cm)								
	90 DAG			120 DAG			150 DAG		
	P_1	P_2	Mean	P_1	P_2	Mean	P_1	P_2	Mean
G_1	32.00	33.60	32.80	35.65	36.85	36.25	39.55	40.80	40.17
G_2	30.90	31.93	31.41	34.75	35.75	35.25	37.65	37.95	37.80
G_3	29.50	30.85	30.17	33.10	34.05	33.57	36.00	36.15	36.07
G_4	27.60	29.00	28.30	31.05	32.00	31.52	34.15	34.30	34.22
G_5	27.00	28.30	27.65	29.90	31.00	30.45	33.40	34.05	33.72
G_6	26.00	26.60	26.30	27.00	30.10	28.55	29.95	33.20	31.57
G_7	24.10	26.00	25.05	26.20	28.00	27.10	28.15	30.80	29.47
G_8	23.60	25.05	24.32	25.85	26.52	26.18	27.12	27.85	27.48
Mean	27.58	28.91		30.43	31.78		33.24	34.38	
Factor	P	G	PXG	P	G	PXG	P	G	PXG
SE (m) +	0.14	0.29	0.41	0.18	0.35	0.50	0.19	0.39	0.55
CD at 5%	0.43	0.87	1.30	0.53	1.06	1.49	0.58	1.17	1.65

G_1: Grafting on 15th March G_5: Grafting on 15th May P_1: Un precured
G_2: Grafting on 30th March G_6: Grafting on 30th May P_2: Precured 10 days prior to grafting
G_3: Grafting on 15th April G_7: Grafting on 15th June
G_4: Grafting on 30th April G_8: Grafting on 30th June

Conclusion

Based on the results obtained in the experiment it could be concluded that, among the 16 treatment combinations, grafts prepared on 15th March with scion sticks precured 10 days prior to grafting showed the best results with regard to graft take percent, bud sprouting at 3 months after grafting, height of the graft and sprout length than the grafts grafted on 30th June with unprecured scion sticks.

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