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Studies on the Influence Age of Rootstocks and Season on Grafting Success in Manila Tamarind (*Pithecellobium dulce Roxb.*)

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ABSTRACT

Background: Manila tamarind [*Pithecellobium dulce* (Roxb.) Benth] belongs to the family Fabaceae and sub-family Mimosoideae. This tree have multiple uses; fruit, firewood, honey, fodder, soap oil, tannin, hedges and shade. Naturally this plant species can be multiplied by seeds. Apart from genetic variability, the seedling progenies may take long time to first bearing and sometimes irregular bearing also noticed due to its genetic makeup. In order to overcome these drawbacks, vegetative propagation is the only alternate way to get genetically uniform, early bearing and high yielding characters. The age of rootstocks and season of grafting influences the success of the grafts and performance of the grafted plants. With this background, studies on age of rootstocks and season on grafting success in Manila Tamarind was carried out.

Methods: An experiment was conducted to assess the effect of season and age of the rootstocks in Manila tamarind (*Pithecellobium dulce*). The experiment was laid out in factorial randomized block design with 15 treatment combinations and four replications. In this study, three rootstocks of different age *viz*., 6, 9 and 12 months old were grafted during June, July, August, September and October.

Result: The main and interaction effects on age of rootstocks and season of grafting had a significant influence on survival percentage, number of days taken to first sprouting, number of leaves per plant and chlorophyll content of manila tamarind under controlled conditions. The softwood grafting performed on nine month old rootstocks during September recorded the highest survival percentage and it was significantly different from all other treatments. The same treatment *i.e*., nine months old rootstock grafted in September was also recorded the less number of days taken to first sprouting with highest number of leaves per plant and chlorophyll content.

Key words: Age, Chlorophyll, Grafting, Manila tamarind, Rootstock, Survival percentage.

INTRODUCTION

Manila tamarind [*Pithecellobium dulce* (Roxb.) Benth] belongs to the family Fabaceae and sub-family Mimosoideae. This tree has multiple uses; fruit, firewood, honey, fodder, soap oil, tannin, hedges and shade. The genus name means curly pod, that imitates an ape's earring (pithekos ellobium) and the species name "dulce" means sweet pod. This species are widely cultivated for protein rich fodder and fire wood in Asia, South America and African countries (Bangarwa *et al*., 2010). The plant is native to South America and cultivated in many tropical Asian and African countries (Subhadrabandhu, 2001). In India, this species is present throughout the tropical parts of the country except North Eastern parts and Kashmir (Parrotta, 1991).

It is one of the minor fruit trees and highly suitable for alley cropping. The pods can be eaten as fresh fruit in Mexico and India. In India, the seeds are used for curry preparations. The fresh fruits are liked by monkeys and cattle (Tang *et al*., 2005).

This species have several medicinal and nutritional properties The pitheduloside separated from the plants are anti-inflammatory, anti-microbial, anti-tubercular, spermicidal, protease inhibitor, anti venom and abortifacient. The leaves can be used as poultice with alcohol to treat bile and to prevent abortions/miscarriage. The extracts of leaves are used to relieve pain, convulsions, indigestion and diabetes. The fruits are used to prepare refreshing cool drinks. The fruits, seeds, leaves and bark are possess antioxidant properties and capable to cure intestinal problems and cancer.

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It is commonly raised as an ornamental, shade tree planted on paths and roads and hedges in gardens. It is usually pruned to be an avenue tree and rarely used for more making large size topiary. Regular pruning produces a hedge which quickly forms a dense spiny fence and acts as a barrier to livestock. It can withstand severe pruning. The trees are commonly used as a shade or shelterbelt tree and which is tolerant to drought and problematic soils. Coppicing usually increases the presence of spines. This species are having nitrogen fixing ability and commonly planted on problem soils for reclamation. Trees are used as a host for rearing lac insects.

It is a fast growing medium size tree grown up to a height of 10-15 m. This species grows in wide range of soil and climatic conditions. It grows well in semi-arid regions and temperature ranging from 7 to 8°C in January to 40 to 42°C in May and June. It survives in hot climates and annual rainfall ranging from 40 to 165 cm. This species can be grown above 1,500 m MSL in Mexico and East Africa. This species perform well in wide range of soil type *viz*., clay, limestone and sands. Manilla tamarind is tolerant to heat, salinity and moisture stress.

Naturally this plant species can be multiplied by seeds. Usually the plants multiplied through seeds have deep root system and long life span (Guimaraes *et al*., 2016). However, the seeds collected from different mother plants shows variability in terms of yield and quality of fruits. Apart from genetic variability, the seedling progenies may take long time to first bearing and sometimes irregular bearing also noticed due to its genetic makeup. In order to overcome these drawbacks, vegetative propagation is the only alternate way to get genetically uniformed, early bearing and high yielding characters. In this context, the propagation method should provide deep root system and esae in multiplication by the nursery men. The age of rootstocks and season of grafting influences the success of the grafts and performance of the grafted plants. With this background, studies on age of rootstocks and season on grafting success in Manila Tamarind was carried out.

MATERIALS AND METHODS

The experiment was conducted at the Central Farm of Department of Fruit Science, Horticultural College and Research Institute, Periyakulam during 2015 to 2019. Softwood cleft grafting was performed in the experiment. The field experiment was laid out in factorial randomized block design (FRBD) with 14 treatments and two replications as detailed below:

Factor 1-Month of grafting

M_1- June
M_2- July
M_3- August
M_4- September
M_5- October

Factor II-Age of rootstock

A_1- Six months
A_2- Nine months
A_3- Twelve months

Ten randomly selected plants were used as rootstocks to record various observations. The observations *viz*., number of days taken for sprouting, number of leaves per graft, per cent success on graft take and leaf chlorophyll content were recorded at 90 days after grafting. The number of days taken to sprouting was assessed by observing the plants on alternate days from the days of grafting. The number of new leaves per plant and chlorophyll content in the leaves was recorded after 90 days of propagation. The data were subjected to statistical scrutiny by Panse and Sukhatme (1985). The ANOVA and critical difference at five per cent level of significance were calculated.

RESULTS AND DISCUSSION

Survival per cent of grafts

The results indicated that all the treatments exhibited significant difference on survival per cent presented in Table 1. The survival per cent ranged from 53.03 to 90.03. The highest survival per cent (90.03) was registered in Nine months old rootstocks grafted in September followed by 12 months old rootstock grafted in September (85.22). The lowest survival per cent (53.03) was recorded in 12 months old rootstock grafted in June. The various interactions between rootstock age and month of propagation on number of days required for bud sprouting were also found to be significant. The highest graft survival might be due to grafting

Table 1: Effect of rootstock age and month of grafting on survival percentage.

Month of grafting	Age of rootstock (months)			Mean
	6 (A_1)	9 (A_2)	12 (A_3)	
June (M_1)	72.15	73.92	71.40	72.49
July (M_2)	55.91	60.84	53.03	56.59
August (M_3)	66.03	66.61	65.74	66.13
September (M_4)	84.36	90.03	85.22	86.54
October (M_5)	53.85	58.05	56.98	56.29
		Factor (I)	**Factor (II)**	**Factor (I × II)**
	CD (0.05)	0.91	0.70	1.57
	SE (d)	0.44	0.34	0.77

time favoured in the formation of new cambial layer in the cambium bridge at the right time. The interaction between the age of rootstock and time of grafting also showed significant differences which might be due to congenial environmental condition prevailing during post grafting hardening period. These findings are in accordance with the Manga *et al*. (2017) in guava and Mulla *et al*. (2011) in Jamun.

Number of days taken for sprouting of grafts

Effect of rootstock age and month of propagation on number of days taken for sprouting was recorded and presented in Table 2. The observation on number of days taken for sprouting showed significant variations among rootstock age and methods of propagation on days taken for first sprouting. The minimum number of days taken for bud sprouting (7.25) was observed when propagation was performed on nine months old rootstock grafted in September followed by 12 months old rootstock grafted in September (7.53). The maximum time taken for bud sprouting (9.48) was observed in the 12 months old rootstock grafted in October month. The findings of this investigation are in accordance with Usare (2016) and Rivera *et al.* (2002). According to Rymbai and Reddy (2010) in Guava, steady increase in relative humidity with temperature favoring growth and development of plant in the month of August. The various interactions between rootstock age and month of propagation on number of days required for bud sprouting were also found to be significant. But age of rootstock showed non-significant effect on number of days taken for sprouting. These results are in agreement with the findings of Jose and Valsalakumari and Jose (1991); Dhar (1998) and Giri and Lanka (2005).

Number of leaves per plant

Effect of rootstock age and month of propagation on number of leaves per plant are presented in Table 3. The observation on number of leaves per plant showed significant variations among rootstock age and month of grafting. The observation on number of leaves per plant ranged from 113.34 to 162.34. The maximum number of leaves per plant (162.34) was observed when grafting was performed on nine months old rootstock grafted in September followed by 12 months old rootstock grafted in September (157.34). The minimum number of leaves per plant (113.34) was observed in the 12 months old rootstock grafted in June month. The various interactions between rootstock age and month of propagation on number of leaves per plant were also found to be significant. But month of grafting showed non-significant effect on number of leaves per plant. Visen *et al.* (2010) showed that 3-4 buds scattered in all four directions on scion sticks ideal for grafting.

Leaf chlorophyll content

Effect of rootstock age and month of propagation on chlorophyll content of leaves was recorded and presented in Table 4. The observation on chlorophyll content of leaves exhibited significant variations among rootstock age and month of grafting. The observation on chlorophyll content of the leaf ranged from 0.68 to 0.83 mg g^{-1}. The maximum chlorophyll content of leaves mg g^{-1} was observed when propagation was performed on nine months old rootstock

Table 2: Effect of rootstock age and month of grafting on number of days taken to first sprouting.

Month of grafting	Age of rootstock (months)			Mean
	6 (A_1)	9 (A_2)	12 (A_3)	
June (M_1)	8.18	7.96	8.32	8.15
July (M_2)	9.18	8.54	9.32	9.01
August (M_3)	8.42	8.02	8.68	8.37
September (M_4)	7.73	7.25	7.53	7.50
October (M_5)	8.80	9.23	9.48	9.17
		Factor (I)	**Factor (II)**	**Factor (I × II)**
	CD (0.05)	0.33	NS	0.57
	SE (d)	0.16	0.12	0.28

Table 3: Effect of rootstock age and month of grafting on number of leaves per plant.

Month of grafting	Age of rootstock (months)			Mean
	6 (R_1)	9 (R_2)	12 (R_3)	
June (M_1)	150.23	152.45	143.56	148.75
July (M_2)	115.45	120.23	113.34	116.34
August (M_3)	132.34	141.98	136.34	136.89
September (M_4)	155.34	162.34	157.34	158.34
October (M_5)	124.45	126.34	121.23	124.01
		Factor (I)	**Factor (II)**	**Factor (I × II)**
	CD (0.05)	5.41	NS	9.37
	SE (d)	2.67	2.07	4.63

Table 4: Effect of rootstock age and month of grafting on chlorophyll content (mg/g).

Month of grafting	Age of rootstock (months)			Mean
	6 (R_1)	9 (R_2)	12 (R_3)	
June (M_1)	0.74	0.77	0.76	0.76
July (M_2)	0.70	0.72	0.67	0.70
August (M_3)	0.81	0.83	0.82	0.82
September (M_4)	0.78	0.80	0.80	0.79
October (M_5)	0.68	0.71	0.69	0.69
		Factor (I)	**Factor (II)**	**Factor (A × B)**
	CD (0.05)	0.003	0.003	0.006
	SE (d)	0.002	0.001	0.003

grafted in August followed by 12 months old rootstock grafted in August. The minimum chlorophyll content of leaves was observed in the 12 months old rootstock grafted in June month. The significant differences in leaf chlorophyll content might be due to the increase in the photosynthetic efficiency of leaves and the present results are in similarity with the results as reported by Chandan *et al.* (2006).

CONCLUSION

The softwood grafting performed on nine month old rootstocks during September recorded the bmaximum survival percentage and grafted in September was recorded the less number of days taken to first sprouting with maximum number of leaves per plant and chlorophyll content.

Conflict of interest

We wish to confirm that there are no conflict of interest associate with this publication and there has been no significant financial support for this work that could have influenced its outcome.

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