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Study the Effect of Different Growing Conditions and Month of Grafting on Graft-Take, Number of Sprouts per Graft and Leaves in Tamarind (*Tamarindus indica* L.)

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A B S T R A C T

An experiment was conducted at University of Agricultural sciences, Bengaluru to investigate the "Study the effect of different growing conditions and month of grafting on Graft-Take, Leaves and Scion diameter. The result revealed that the effect of month of grafting on days taken for first sprouting was observed, significantly lesser number of days taken for first sprouting was recorded in the month of March (20.47 days) followed by in February (22.55 days). The highest days taken for first sprouting was recorded in the month of May (24.31days). Among the three different growing conditions, significantly lesser days for first sprouting was observed in poly house (20.46 days),the higher days for first sprouting was observed in open field condition (24.62days) whereas under shade net condition (22.62 days) taken for first sprouting. Days taken for first sprouting were significantly influenced by the interaction between month and condition (M×C). The interaction of M2C1 that is March month under low cost polyhouse (18.88 days) recorded lesser days taken for first sprouting. The higher days for first sprouting were recorded with the interaction of M4C2 that is during May month grafts kept under open field condition (26.06 days). Higher number of sprouts per graft were recorded in March (12.02 days), followed by February (9.51days) and least in May (6.84 days). Among the three different growing conditions, maximum number of sprouts (11.88) was observed in grafts kept under low cost polyhouse condition followed by (9.97) shadenet condition. However the minimum number of sprouts (5.82) was recorded in open field condition whereas under shadenet condition (9.97) sprouts were observed. Interaction effect between different growing conditions and grafting months showed that significantly highest number of sprouts (16) were noticed in grafts which are done in March month and kept under low cost polyhouse and followed by same month grafted plants kept under shade net condition (12.7). While the less number of sprouts (3.73) were recorded in grafts which are done in May month and kept under open field condition. Significantly higher number of leaves per graft was found in the month of March (25.01 and 42.31) followed by February (22.11 and 31.37) and the least number of leaves per graft was found in the month of May (16.55 and 20.78) at 60 and 90 days after grafting respectively. Number of leaves per graft was observed significantly higher under polyhouse (25.66 and 37.19) followed by shadenet condition (22.8 and 32.16) while significantly lesser number of leaves per graft was found under open field condition (14.63 and 23.18) at 60 and 90 days after grafting respectively. Interaction effect between different growing conditions and grafting months showed significantly maximum number of leaves (30.66) and (51.06)were noticed in grafting which is done in March month under low cost polyhouse and least number of leaves were observed during May month grafts kept under open field condition (10.53) and (16.53) at 60 and 90 days after grafting respectively.

Introduction

Tamarind is a monotypic genus tree, botanically *Tamarindus indica* L. popularly known as "Indian date". Tamarind is one of the important underutilized and indigenous fruit crops which is having major importance as a spice crop. It is largely grown in south Indian states of Karnataka, Kerala, Tamilnadu and Andrapradesh. The major districts cultivating tamarind are in Karnataka are Kolar, Chitradurga, Chikkaballapur and Belagavi. Recently, varieties GKVK- 17 and GKVK- 33 which have been released from university have got more demand.

Tamarind is a highly cross pollinated crop and hence wide variability is common in this species. Selection could improve the quality, yield and earliness of fruiting (Saideswara rao, 1995). Tamarind trees are generally raised from seed. Seedling trees usually show high level of heterogeneity with a long juvenile phase. The method of vegetative propagation came into practice largely out of the desire to perpetuate elite seedling clone and the practice of raising trees from seed has been discontinued. Among the vegetative methods of propagation, air layering and soft wood grafting are most commonly and widely practiced for mass production of identified elite clones. Softwood grafting is gaining popularity among nurserymen and growers. Main advantage of using this method results in fairly high rate of graft success and survival. Commercially, tamarind is propagated by air layering though considered to be most inexpensive method for vegetative propagation, the method did not prove very successful in case of tamarind due to production of poor quality roots and hence, poor field survival (Shashikumar *et al.,* 2012). As a solution to these problems, softwood grafting gives an excellent response by higher graft success and survival percentage of quality grafts with the least possibility of mortality which helps in better and uniform orchard establishment (Ram and Pathak, 2006). Provision of shade during and after grafting was found to have beneficial effect on success of grafting. Light is a essential source for triggering photosynthetic activity and there by better nourishment of grafts. The rate of photosynthetic activity varies with the level of shade (Swamy, 1993). So, keeping these points in mind, the present investigation was carried out to assess "Study the Effect of Different Growing Conditions and Month of Grafting on Graft-take, Number of sprouts per graft and Leaves in Tamarind" (*Tamarindus indica* L.)

Materials and Methods

The experiment was conducted at Division of Horticulture, University of Agricultural Sciences, Bengaluru in a split plot design. One year old healthy and uniform rootstocks of tamarind (*Tamarindus indica* L.) were raised for soft wood grafting. A total of 360 healthy tamarind seedlings were used for this experiment. Soft wood grafting was done by using GKVK-17 variety as scion material at different growing conditions and time of grafting i.e. Low cost polyhouse, Open field, Shade net and February, March, April, May. Observations were recorded on 10 grafts in each replication at 30,60,90 and 120 days after grafting. The data were subjected to statistical analysis as perthe procedure outlined by Panse and Sukhatme (1967) and the treatment means were compared by critical difference values computed at 5% level of significance.

Results and Discussion

Number of days taken for first sprouting

There were significant differences among the different months of grafting, growing conditions and their interactions with respect to number of days taken for first sprouting were presented in (Table 1).

Grafts done during February and March had shown early days for first sprouting 22.55 days and 20.47 days respectively and comparatively more days for first sprouting was seen in May month (24.31 days). It is due to congenial climatic condition prevailing during February and March month, this enhances the early union of two cambium layers of stock and scion. The similar kind of findings were recorded by Joshi *et al.,* (2000) on softwood grafting in custard apple. In wood apple, Giri and Lenka (2008) reported the minimum days taken for sprouting (8days) in May.

Grafts under low cost polyhouse had shown lesser number of days for first sprouting (20.46 days) compared to shade net condition (22.62 days) and open field (24.62 days). It is obtained due to controlled condition prevailing the higher relative humidity and temperature inside the polyhouse when compared with the shade net condition and open field condition. A similar kind of opinion was expressed by Gurjar and Singh (2012) in aonla and (Patel *et al.,* 2010) in khasi mandarin under polyhouse for early sprouting.

Table.1 Effect of months of grafting, growing conditions and their interaction on the days taken for first sprout emergence of tamarind softwood grafts.

Treatments	Days taken for first sprout emergence
Months (M)	
M1-February	**22.55**
M2-March	**20.47**
M3-April	**22.94**
M4-May	**24.31**
F test (p≤0.05)	*
S.Em±	**0.11**
CD at 5%	**0.41**
Conditions (C)	
C1-Low cost polyhouse	**20.46**
C2-Open field	**24.62**
C3-Shade net	**22.62**
F test (p≤0.05)	*
S.Em±	**0.08**
CD at 5%	**0.24**
Interaction (M×C)	
M1C1	**20.23**
M1C2	**25.02**
M1C3	**23.36**
M2C1	**18.88**
M2C2	**22.63**
M2C3	**20.04**
M3C1	**20.26**
M3C2	**24.53**
M3C3	**22.86**
M4C1	**22.6**
M4C2	**26.06**
M4C3	**24.26**
F test (p≤0.05)	*
S.Em±	**0.17**
CD at 5%	**0.57**

*Significant

T1 - M1C1: February + Low cost polyhouse
T2 - M1C2: February + Open field
T3 - M1C3: February + Shadenet
T4 - M2C1: March + Low cost polyhouse
T5 - M2C2: March + Open field
T6 - M2C3: March +Shadenet
T7 - M3C1: April + Low cost Polyhouse
T8 - M3C2: April + Open field
T9 - M3C3: April + Shadenet
T10 - M4C1: May + Low cost Polyhouse
T11 - M4C2: May + Open field
T12 - M4C3: May + Shadenet

Table.2 Effect of months, growing conditions and their interaction on number of sprouts of softwood grafted plants of tamarind

Treatments	Number of sprouts at 30
Months (M)	
M1-February	**9.51**
M2-March	**12.02**
M3-April	**8.53**
M4-May	**6.84**
F test (p≤0.05)	*
S.Em±	**0.15**
CD at 5%	**0.55**
Conditions (C)	
C1-Low cost polyhouse	**11.88**
C2-Open field	**5.82**
C3-Shade net	**9.97**
F test (p≤0.05)	*
S.Em±	**0.22**
CD at 5%	**0.68**
Interaction (M×C)	
M1C1	**12.3**
M1C2	**6.5**
M1C3	**9.66**
M2C1	**16**
M2C2	**7.3**
M2C3	**12.7**
M3C1	**10.26**
M3C2	**5.73**
M3C3	**9.6**
M4C1	**8.93**
M4C2	**3.73**
M4C3	**7.86**
F test (p≤0.05)	*
S.Em±	**0.39**
CD at 5%	**1.23**

*Significant

T1 - M1C1: February + Low cost polyhouse
T2 - M1C2: February + Open field
T3 - M1C3: February + Shadenet
T4 - M2C1: March + Low cost polyhouse
T5 - M2C2: March + Open field
T6 - M2C3: March +Shadenet
T7 - M3C1: April + Low cost Polyhouse
T8 - M3C2: April + Open field
T9 - M3C3: April + Shadenet
T10 - M4C1: May + Low cost Polyhouse
T11 - M4C2: May + Open field
T12 - M4C3: May + Shadenet

Table.3a Effect of months of grafting, growing condition and their interaction on the number of leaves produced in softwood grafted plants of tamarind at 60 days after grafting

Treatments	Number of leaves at 60
Months (M)	
M1-February	**22.11**
M2-March	**25.01**
M3-April	**20.31**
M4-May	**16.55**
F test (p≤0.05)	*
S.Em±	**0.29**
CD at 5%	**1.04**
Conditions (C)	
C1-Low cost polyhouse	**25.66**
C2-Open field	**14.63**
C3-Shade net	**22.68**
F test (p≤0.05)	*
S.Em±	**0.34**
CD at 5%	**1.04**
Interaction (M×C)	
M1C1	**27.66**
M1C2	**14.33**
M1C3	**24.33**
M2C1	**30.66**
M2C2	**17.66**
M2C3	**26.66**
M3C1	**23.93**
M3C2	**16.22**
M3C3	**21.44**
M4C1	**20.43**
M4C2	**10.53**
M4C3	**18.73**
F test (p≤0.05)	*
S.Em±	**0.6**
CD at 5%	**2.0**

*Significant

T1 - M1C1: February + Low cost polyhouse
T2 - M1C2: February + Open field
T3 - M1C3: February + Shadenet
T4 - M2C1: March + Low cost polyhouse
T5 - M2C2: March + Open field
T6 - M2C3: March +Shadenet
T7 - M3C1: April + Low cost Polyhouse
T8 - M3C2: April + Open field
T9 - M3C3: April + Shadenet
T10 - M4C1: May + Low cost Polyhouse
T11 - M4C2: May + Open field
T12 - M4C3: May + Shadenet

Table.3b Effect of months of grafting, growing conditions and their interaction on the number of leaves produced in softwood grafted plants of tamarind at 90 days after grafting

Treatments	Number of leaves at 90 days
Months (M)	
M1-February	**31.37**
M2-March	**42.31**
M3-April	**28.91**
M4-May	**20.78**
F test (p≤0.05)	*
S.Em±	**0.33**
CD at 5%	**1.19**
Conditions (C)	
C1-Low cost polyhouse	**37.19**
C2-Open field	**23.18**
C3-Shade net	**32.16**
F test (p≤0.05)	*
S.Em±	**0.34**
CD at 5%	**1.03**
Interaction (M×C)	
M1C1	**38.4**
M1C2	**23.34**
M1C3	**32.73**
M2C1	**51.06**
M2C2	**32.66**
M2C3	**43.32**
M3C1	**35.53**
M3C2	**20.53**
M3C3	**30.66**
M4C1	**23.7**
M4C2	**16.53**
M4C3	**22.06**
F test (p≤0.05)	*
S.Em±	**0.65**
CD at 5%	**2.06**

*Significant

T1 - M1C1: February + Low cost polyhouse
T2 - M1C2: February + Open field
T3 - M1C3: February + Shadenet
T4 - M2C1: March + Low cost polyhouse
T5 - M2C2: March + Open field
T6 - M2C3: March +Shadenet
T7 - M3C1: April + Low cost Polyhouse
T8 - M3C2: April + Open field
T9 - M3C3: April + Shadenet
T10 - M4C1: May + Low cost Polyhouse
T11 - M4C2: May + Open field
T12 - M4C3: May + Shadenet

Days taken for first sprouting were significantly influenced by the interaction between month and condition (M×C). The interaction of M2C1 that is March month under low cost polyhouse (18.88 days) recorded lesser days taken for first sprouting. The higher days for first sprouting were recorded with the interaction of M4C2 that is during May month grafts kept under open field condition (26.06 days)

Number of sprouts per graft

There were significant differences among the different months of grafting, growing conditions and their interactions with respect to number of sprouts per graft were presented in (Table 2).

Number of sprouts was significantly differed at 30 days. Higher number of sprouts per graft were recorded in March (12.02 days), followed by February (9.51days) and least in May (6.84 days). Significantly maximum number of sprouts was found in the month of March, this might be due to prevailing ideal temperature and relative humidity congenial for plant activity which will increases the accumulation of carbohydrate, which had resulted in increased number of sprouts with more meristematic activity.

Among the three different growing conditions, maximum number of sprouts (11.88) was observed in grafts kept under low cost polyhouse condition followed by (9.97) shadenet condition. However the minimum number of sprouts (5.82) was recorded in open field condition whereas under shadenet condition (9.97) sprouts were observed.

This may be attributed to moderately high temperature coupled with high humidity and which will increases the accumulation of carbohydrates which readily served as a reservoir of food for new growth reflected to higher number of sprouts (Raghavendra *et al.,* 2011) and (Syamal *et al.,* 2013)

Interaction effect between different growing conditions and grafting months showed that significantly highest number of sprouts (16) were noticed in grafts which are done in March month and kept under low cost polyhouse and followed by same month grafted plants kept under shade net condition (12.7). While the less number of sprouts (3.73) were recorded in grafts which are done in May month and kept under open field condition.

Number of leaves per graft at 60 and 90 days after grafting

There were significant differences among the different months of grafting, growing conditions and their interactions with respect to Number of leaves per graft at 60 and 90 days after grafting were presented in (Table 3a & 3b).

The maximum number of leaves was observed in the month of March (25.01 and 42.31), followed by February (22.11 and 31.37) and minimum number of leaves was observed in the month of May (16.55 and 20.78) at 60 and 90days after grafting respectively. This might be due to higher cell activity and early sprouting which are responsible for more number of leaves. The results were supported by the studies of Kulkarni (1990).

Among growing conditions maximum number of leaves (25.66) and (37.19) recorded under low cost poly house at 60 and 90 days respectively. The environmental conditions like optimum temperature with higher relative humidity under polyhouse might have favoured in early sprouting of bud and formation of leaves. The increase in number of leaves might be due to the active growth of stock and scion followed by favourable climatic conditions for the cambial activity and in turn favouring growth of grafts. Similar findings were obtained in other fruit crops by Harshavardhan (2011) in jack fruit.

Author Contributions

G. C. Nanditha: Investigation, formal analysis, writing—original draft. Shwetha Hiremath: Validation, methodology, writing—reviewing. K. G. Thejashwini:—Formal analysis, writing—review and editing.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

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