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Effect of age old rootstocks on growth pattern of grafted scions in jackfruit (*Artocarpus heterophyllus* Lam)

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Abstract
An attempt to study the effect of age old rootstocks on growth pattern of grafted scions in jackfruit was done by adopting softwood grafting at monthly intervals during July, 2015 to December, 2015 with twelve to seventeen months old rootstocks. The graft success per cent, number of leaves and length of new shoots were significantly higher in 14 months old rootstocks was due to environmental effect, whereas, the least graft success per cent was in 17 months old rootstocks was due to the influence of tree phenology. Interestingly, it is difficult to study the effect of influence of age old rootstock on graft success rate with the interruption of the environmental effect and the tree phenology. Hence, a strategy was suggested to conduct an experiment to study the effect of influence of rootstocks on graft success per cent by eliminating the experimental errors.

Keywords: Jackfruit, grafting, growth pattern

Introduction
Jackfruit (*Artocarpus heterophyllus* Lam.) is a perennial tree and a minor fruit crop which grows well in sub-tropical areas. Being a cross pollinated crop, jackfruit is highly heterozygous and seedling origin. For establishment of commercial orchard, clonal propagation of jackfruit is essential to relish the desirable traits of maternal parent. In clonal propagation, air layering is being followed in jackfruit to certain extent; even though, it requires huge amount to establish a temporary construction around each tree for the platform of rootstocks. Hence, softwood grafting would be an alternative and cost effective method of propagation. In jackfruit, studies had been done for the standardization of rootstock age for grafting. The results showed that higher success percentage of grafting in jackfruit was observed in six (Swamy and Melanta, 1994) [7], seven (Aralikatti *et al*., 2011 and Priyanka *et al*., 2017) [2, 5] and nine (Abd El-Zaher, 2008) [1] months old rootstocks. There has been no study on the effect of age old rootstocks (12 months and above) on grafting in jackfruit. Hence, the present study was taken up with an aim to understand the response of age old rootstocks on grafting, which may open up a new path on grafting research.

Materials and Methods
The experiment was conducted at University Orchard, Department of Fruit Crops, Tamil Nadu Agricultural University, Coimbatore during 2014 to 2016. Softwood grafting in jackfruit was done at monthly intervals during July, 2015 to December, 2015 with twelve to seventeen months old rootstocks. Graft success per cent and the growth parameters like number of leaves and length of new shoots (cm) were measured from the day of grafting to 105 DAG (days after grafting) at fortnight intervals. Completely randomized design (CRD) was followed as a statistical design with three replications of twenty plants per replication. The data in percentage were transformed to Arcsine values for statistical analysis using AGRES software. The illustration art was done using Adobe® Photoshop® CS6 version 13.0.

Preparation of scion
Scions were collected from AH-35; a superior jackfruit genotype from Pudukkottai (Aseef *et al*., 2017). Fifteen days cured scions were used for softwood grafting. The scions were treated with 0.1 per cent carbendazim just before grafting to ensure the quality of scion free from fungal contamination.

Preparation of rootstock

The seeds of forty jackfruit genotypes (AH-1 to AH-40) were sown immediately after harvest during July, 2014. These seedlings were then raised in a polybag with a pot mixture of red earth, FYM and sand with the proportion of 1:1:1 in a mist chamber with the temperature of 30°C and 90% RH. In order to nourish the rootstocks, one per cent of 19:19:19 fertilizer was given in a monthly interval as a foliar spray.

Grafting method

Softwood grafting method was performed and the exudation of latex from both the rootstock and scion were whipped off using a cloth. The grafted plants were then placed in a mist chamber with the temperature of 30°C and 90% RH.

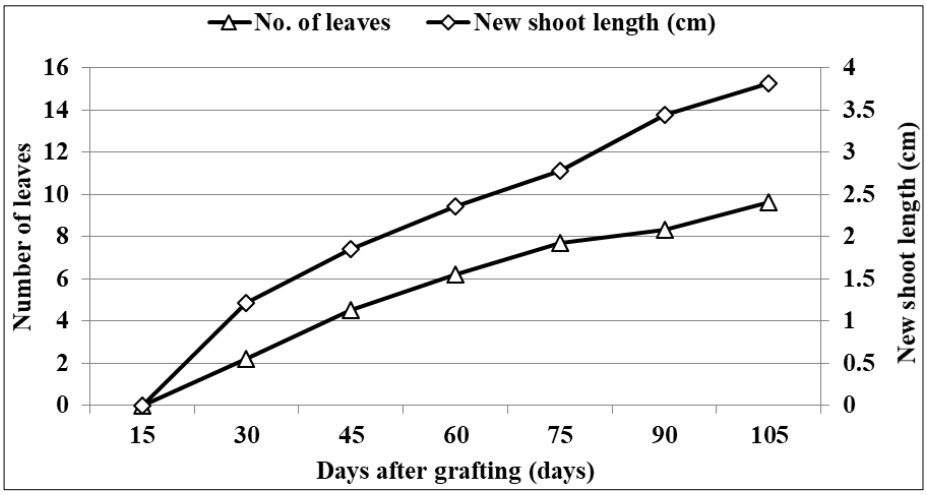
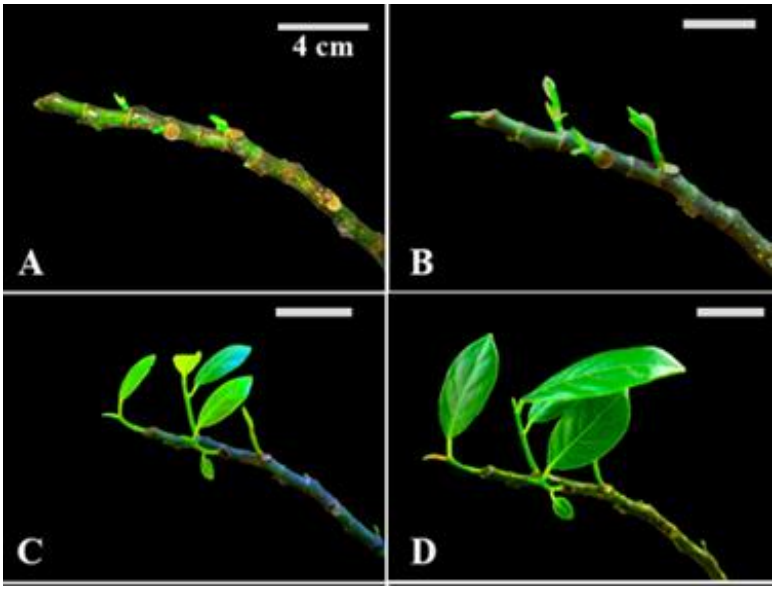


Fig 1: Growth pattern of scion on 14 months old rootstocks

Table 1: Effect of rootstock age on graft success, number of leaves and length of new shoots at 30, 60 and 90 days after grafting (DAG)

Rootstock age (Months)	Month of grafting	Graft success (%)				Number of leaves				Length of new shoot (cm)			
		30 DAG	60 DAG	90 DAG	Mean	30 DAG	60 DAG	90 DAG	Mean	30 DAG	60 DAG	90 DAG	Mean
12	July	41.67 (40.35)	25.00 (29.89)	11.67 (20.41)	26.11 (30.21)	1.37 (6.64)	2.99 (10.05)	4.36 (12.23)	2.91 (9.64)	0.86 (5.41)	1.84 (7.62)	2.78 (9.63)	1.83 (7.55)
13	August	46.67 (43.51)	23.33 (28.91)	8.33 (16.88)	26.11 (29.76)	1.88 (7.90)	3.03 (9.94)	4.52 (12.33)	3.14 (10.05)	0.81 (5.09)	1.82 (7.85)	2.89 (9.80)	1.84 (7.58)
14	September	68.33 (54.94)	43.33 (41.20)	20.00 (26.99)	43.89 (41.04)	3.22 (10.33)	6.15 (14.23)	7.08 (15.50)	5.48 (13.35)	1.21 (6.20)	2.36 (8.78)	3.44 (10.43)	2.34 (8.47)
15	October	53.33 (46.06)	30.00 (33.21)	13.33 (21.18)	32.22 (33.48)	2.88 (9.78)	4.18 (11.56)	6.02 (14.08)	4.36 (11.08)	0.93 (5.50)	2.04 (8.13)	3.12 (10.14)	2.03 (7.92)
16	November	40.00 (38.44)	18.33 (24.95)	6.67 (14.95)	21.67 (26.11)	2.15 (8.43)	3.55 (10.84)	5.06 (13.05)	3.59 (10.77)	0.74 (4.86)	1.76 (7.62)	2.87 (9.90)	1.79 (7.46)
17	December	31.67 (33.46)	16.67 (24.25)	3.33 (10.46)	17.22 (22.72)	1.54 (7.08)	2.74 (9.71)	4.11 (11.88)	2.80 (9.55)	0.52 (4.13)	1.32 (6.52)	2.01 (8.06)	1.28 (6.23)
Mean		46.94 (42.79)	26.11 (30.40)	10.56 (18.47)	-	2.17 (8.36)	3.77 (11.05)	5.19 (13.17)	-	0.845 (5.19)	1.86 (7.75)	2.85 (9.66)	-
SEd		0.66	0.18	0.26		0.06	0.12	0.16		0.07	0.08	0.10	
CD at 5%		1.44	0.39	0.56		0.12	0.25	0.36		0.14	0.17	0.22	



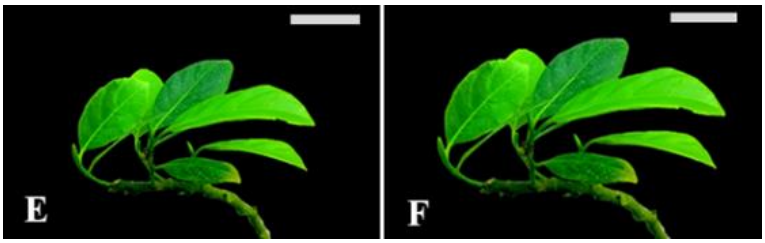


Fig 2: Growth of scion on 14 months old rootstock A) 15 DAG, B) 30 DAG, C) 45 DAG, D) 60 DAG, E) 90 DAG and F) 105 DAG. The bar represents 4 cm

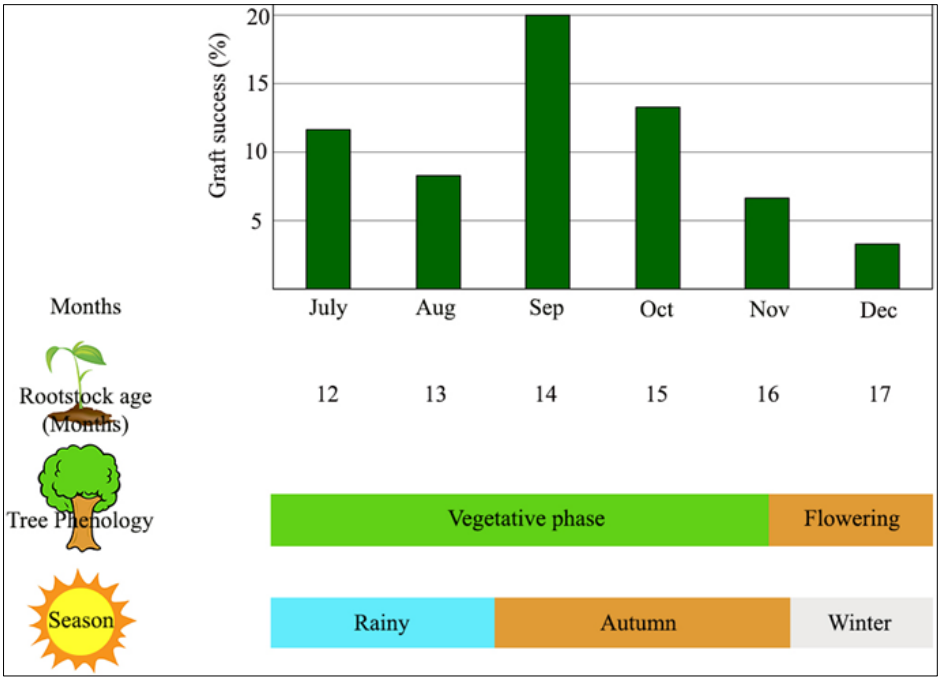


Fig 3: Illustration of the influence of rootstock age, tree phenology and season over the graft success per cent

Results and Discussion

The results showed that the graft success per cent was significantly higher in 14 months old rootstocks in 30, 60 and 90 DAG followed by 15 months old rootstocks (Table 1). This may be due to the environmental factors like high relative humidity and rainfall received by the scions during the month of July and August which eventually activated the dormant buds to sprout. Similar results were found by Selvi *et al*., 2008 [6]. The 12 and 13 months old rootstocks were on par for the graft success per cent may be due to the age old rootstocks which may be incompatible with the scions (Table 1). The significantly lower graft success per cent at 30, 60 and 90 DAG was recorded in 16 and 17 months old rootstocks that were grafted during November and December respectively (Table 1). The decrease in the success per cent may be due to the influence of tree phenology. Since, the scions collected from AH-35; which started to flower during December. The carbon assimilates would have been transported to the sink for floral initiation process and thus less assimilates in the scions would lead to the lower success per cent. The results were in line with Selvi *et al*., 2008 [6]; in which the least graft success per cent was found during the month of December.

Regarding number of leaves, 14 and 15 months old rootstocks showed significantly higher and followed by 16 months old rootstocks at 30, 60 and 90 DAG (Table 1). Regarding length of new shoots (cm), similar pattern was observed with 14 and 15 months old rootstocks as significantly higher followed by 13 months old rootstocks at 30, 60 and 90 DAG (Table 1). The higher the number of leaves and length of new shoots in 14 months old rootstocks was may be due to the presence of matured scion buds with more carbon assimilates that leads to early bud sprout and early graft union establishment. Similar results were found by Khatun *et al*., 2008 [4]; where the study involved the cleft grafting in jackfruit during the months of March to August with the result of higher graft take per cent (39%) and less number of days for sprouting (4.66 days) was noticed during the month of August.

The growth pattern of the grafted scions on 14 months old rootstocks were recorded from 15 to 105 DAG (Fig. 1 and Fig. 2). Upto 15 DAG there was no or poor growth either in number of leaves or length of new shoots, later, a sudden increase in both the parameters was observed. The average number of leaves and length of new shoots attained in grafted plants with 14 months old rootstocks at 105 DAG was 9.6 and 3.81 cm respectively.

Conclusion

It can be concluded that age old rootstocks showed a low graft success per cent with a range of 3-20 per cent at 90 DAG. But comparing with the data of graft success per cent on 30 DAG, 14 months old rootstocks showed high success rate which clearly shows the higher the influence of environment than the age of rootstocks. The lesser the graft success rate shows the strong influence of scion age or tree phenology than the environment and age of rootstock. Hence, it is difficult to study the effect of influence of age old rootstock on graft success rate with the interruption of the environmental effect and the tree phenology (Fig. 3). So, the future works on grafting in jackfruit should be focused on fixing the

environment and rootstock age and the interacted results should be correlated with the tree phenology. For instance, in July month, grafting has to be done with the rootstocks of age ranging from 12 to 17, likewise upto December month. By following this we can understand the real influence of the age of rootstocks on grafting success per cent. But the problem is to get the 12 to 17 months old rootstocks for grafting during the month of July. For this, one has to sow the seeds in a monthly interval from February to July of the previous year. Such planning has to be done to carry out the experiment for eliminating the experimental errors.

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