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Performance of red jackfruit (*Artocarpus heterophyllus* L.) genotypes for softwood graft success

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Abstract
An experiment was carried out to study the response of elite red jackfruit genotypes for softwood grafting at Department of Fruit Science, College of Horticulture, Mysuru during the period of September 2018. The about 15 genotypes were selected for softwood grafting on six month old rootstocks. The results revealed that per cent graft success and survivability percentage varied from 20.04% to 40.67% at 90 days after grafting and 57.08% to 71.67% at 120 days after grafting, respectively. The graft success, graft survival and other growth parameters such as number of sprouts, number of leaves, graft height and graft girth was significantly varied among the different genotypes.

Keywords: Red jackfruit, softwood grafting, rootstock, success and survival

Introduction
The jackfruit (*Artocarpus heterophyllus* Lam.) bears the largest fruit among the edible fruits, which belongs to family Moraceae. It is native to India and popular in several tropical and sub-tropical countries. It is also one of the suitable fruit crop for dry land horticulture. The colour shade between yellowish red, orange shades, saffron, light red to dark red are all characterized as 'red jackfruit'. Red fleshed jackfruit is called as "Chandra halasu" (Kannada) and "Chembaratti Chakka" (in Malayalam). There is wide variation with respect to fruit size, fruit shape, colour of bulbs, quality of fruit, season of bearing, harvesting period and also in flake colour as a result of seed propagation. Jackfruit trees which are raised from seed resulted in wide variation. In addition to that long pre-bearing period, non availability of the grafts from the elite quality of clones is also one of the constraint for jackfruit area expansion and production. Softwood grafting is one of the simple and rapid method of vegetative propagation for these elite red genotypes. This vegetative method of propagation technique brings down the long juvenile period and maintains genetic uniformity. Survey has done in different southern districts and identified elite red genotypes. These were multiplied by softwood grafting and growth parameters were recorded.

Material and methods
An investigation on "Performance of red jackfruit (*Artocarpus heterophyllus* L.) genotypes for softwood graft success" was carried at the Department of Fruit Science, College of Horticulture, Mysuru during the year, 2018-19. Selected healthy seeds were sown in the polybags of 5x8 inches of 300 gauge thickness. These polybag were filled with pot mixture of soil, sand and FYM (1:1:1). The scions were collected from 15 elite red type jackfruit mother trees at different locations through survey in southern districts of Karnataka. Selection was based on its morphological and quality parameters, which were high yield with good quality fruits and free from pest and diseases. One season old shoots of pencil thickness were collected as scion for the experiment. Immediately after separation of the scions from mother trees, they were wrapped in moist cloth and carried to site of grafting. These scion sticks were immersed in water before grafting in order to remove latex. The six month old healthy rootstock were selected and softwood grafting was done during September, 2018. The stock and scion union was wrapped with 200 gauge transparent stretchable polythene strips of 1.5 cm width and 40 cm length. Then the Scions were covered by Polycap to avoid desiccation of scion by creating humidity. The experiment was laid out in completely randomized block design with three replications and 10 plants in each replication. The data regarding per cent of success, per cent survival, number of sprouts, number of leaves, graft height (cm) and graft girth (mm) at30, 60, 90 and 120 days after grafting were recorded.

The per cent of graft success was recorded 90 days after grafting by formula and expressed in percentage.

$$\text{Graft success (\%)} = \frac{\text{Number of successful grafts}}{\text{Total number of grafts}} \times 100$$

Survival of the graft was recorded four months after grafting by the following formula and expressed in percentage.

$$\text{Graft survival (\%)} = \frac{\text{Number of grafts remain alive}}{\text{Total number of successful grafts}} \times 100$$

Results and discussion

Graft success and survivability percentage

In the present experiment, data on the per cent graft success on 90 days after grafting (DAG) and per cent survivability on 120th day after grafting of elite red jackfruit are presented in Table 1. Graft success and survivability percentage was found maximum (40.67% and 71.67%, respectively) in ABS-1 followed by BRH-1 (36.17% and 66.10%, respectively). Whereas, it was minimum (20.00% and 57.08%, respectively) in HSK-7.

Even though same age of rootstock was used in the present experiment variation in the graft success among different genotypes may be due to the genetic constituent which would influence the histological and physiological development within the grafts. Maiti and Biswas 1980 [1] and Sampath *et al.*, 2017 [2] in mango and six month old rootstocks was suggested as best for softwood grafting with respect to graft success and survivability by Swamy (1993) [3].

The age of rootstock influences the regenerating ability of a plant part which is found to be higher in younger rootstocks and this is because of higher activity of meristematic cells causing in faster formation of callus and quick healing of graft union. This fact has been supported by Hartmann and Kester (1979) [4]. Establishment of vascular connection by the formation of new xylem and phloem. Which in turn influences the undifferentiated mass of parenchyma cells when grafting was done Bhaskharan *et al.*, 2008 [5]. This finding is in agreement with the findings of Agasimani *et al.* (2017) [6] and Devi *et al* (2018) [7] in tamarind and jamun, respectively.

Apart from the age of rootstock, congenial environment condition such as high humidity and temperature plays a major role in establishment of graft union which would activated the dormant buds to sprout results in successful grafts. Similar opinion was also expressed by Selvi *et al.* (2008) [8] and Aseef *et al.* (2018) [9]. The abundance of humidity (95.1% -52.4%), good amount of shower (158.8 mm) and optimum temperature (29.5 °C-19.2 °C) prevailed in the atmosphere during present investigation may helped in getting good results.

The maturity of the scion is also another important factor in determining the graft success. The lower success of grafts were also influenced by amount of carbon assimilates present in the scion. Thus, a smaller amount of assimilates in the scions would lead to the lower per cent success Khanthu *et al.*, 2008 [10] and Aseef *et al.*, 2018 [9].

In jackfruit, one of the major interruption for successful establishment of graft is exudation of the latex. Failure of establishment of graft union could be due to lack of intimate contact of cambial region of stock and scion by the latex inference. These may also interfere with auxin synthesis (Hartman and Kester 1979) [4].

Number of sprouts and leaves per graft

Number of sprouts per graft could not show its significant effect at 30th day after grafting (Table 2). The highest number (2.22) of sprouts were recorded in ABS-1 and lowest was observed in KTC-4 (1.00). As number of day increases, number of sprouts increased. At 60th, 90th and 120th days after grafting, highest number of sprouts were observed in ABS-1 (2.44, 3.56 and 3.67, respectively). Whereas lowest number of sprouts were recorded in KTC-4 *i.e.*1.44, 1.56 and 2.00 respectively at 60th, 90th and 120th day after grafting.

Maximum number of leaves were found in ABS-1 at 30, 60, 90 and 120 days after grafting *i.e.*, 4.44, 6.00, 7.44 and 8.56 respectively. Whereas, minimum was found in KTC-4 at 30, 60, 90 and 120 days after grafting *i.e.*, 2.78, 4.22, 5.22 and 6.67, respectively.

More sprouts would be the result of more activity of meristematic tissues which would influenced by successful graft healing. Whereas more number of leaves also depended on genotype character. The present results are in accordance with Nanditha *et al* (2017) [11]. More number of sprouts also contributed for the more number of leaves in favourable conditions. The number of leaves were influenced by season of grafting at all the stages of growth (Mulla *et al.*, 2011) [12]. As the number of leaves increases it indicates that union was successful and active growth was started between stock and scion. It will also influence by the climatic condition which in turns favours cambial activity.

Graft height and girth

At 30, 60, 90 and 120 days after grafting, graft height and girth was found to be significant among genotypes (Table 2). ABS-1 recorded the highest graft height (11.71 cm, 15.72 cm, 17.42 cm and 18.89 cm, respectively) and HSK-7 noted lowest height (8.33 cm, 11.00 cm, 13.05 cm and 14.17 cm, respectively) at 30, 60, 90 and 120 days after grafting, respectively. KTC-5 recorded maximum graft girth (5.16 mm, 6.52 mm, 7.44 mm and 7.97 mm particularly) and minimum in HGP-1(4.10 mm, 5.15 mm, 5.82 mm and 6.26 mm) at 30, 60, 90 and 120 days after grafting, respectively.

The combine effect of climatic condition and also more number of leaves influences the growth. The more number of leaves which increase more leaf area per graft. The photosynthates produced by leaves helped in the cambial activity, which in turn heals the graft union. In the meantime, roots also nourish well and the strong root system might have absorbed more nutrients from the soils which results in the increase of height and girth Karna *et al.*, 2017 [13] and Nalage *et al.*, 2010 [14] in mango.

Table 1: Response of red jackfruit genotypes on grafting success and survivability

Genotypes	Per cent success (90 DAG**)	Per cent survival (120 DAG)
ABS-1	40.67 (39.62)*	71.67(57.86)*
BHB-1	26.66 (31.01)	64.67(53.53)
BKH-2	32.00 (34.45)	66.00(54.38)
BRH-1	36.17 (36.97)	66.10(54.39)
HGP-1	26.00 (30.66)	64.42(53.38)
HSK-5	27.33 (31.52)	65.08(53.78)
HSK-7	20.03 (26.59)	57.08(49.07)
HSK-17	28.85 (32.11)	65.12(53.81)
KTC-2	26.00 (30.66)	64.33(53.42)
KTC-3	25.85 (30.56)	63.77(52.99)
KTC-4	30.00 (33.21)	65.75(54.19)
KTC-5	25.67 (30.44)	63.67(52.94)
MAM-2	24.00 (29.33)	60.67(51.16)
MDS-1	29.00 (32.58)	65.67(54.13)
MHK-1	24.85 (29.89)	62.92(52.51)
S.Em ±	1.00	1.93
C.D. @ 5%	2.89	5.57

* Values in parenthesis are arc sin transformation data
** DAG-Days after Grafting

Table 2: Response of red jackfruit genotypes on growth parameters of graft

Genotypes	Number of sprouts				Number of leaves				Graft height (cm)				Graft girth (mm)			
	30 DAG*	60 DAG	90 DAG	120 DAG	30 DAG	60 DAG	90 DAG	120 DAG	30 DAG	60 DAG	90 DAG	120 DAG	30 DAG	60 DAG	90 DAG	120 DAG
ABS-1	2.22	2.89	3.56	3.67	4.44	6.00	7.44	8.56	11.71	15.72	17.42	18.89	4.49	5.87	6.63	7.17
BHB-1	1.56	2.00	2.56	2.67	3.33	4.56	5.44	7.22	10.33	13.68	14.73	15.97	4.30	5.77	6.61	6.99
BKH-2	1.67	1.89	2.67	2.89	3.44	4.89	6.22	7.44	10.17	13.22	15.00	16.02	4.40	6.02	6.91	7.05
BRH-1	2.00	2.44	3.00	3.22	3.89	5.11	6.56	7.56	10.12	13.17	15.35	16.83	4.38	5.40	6.39	6.74
HGP-1	1.67	2.33	2.67	3.00	3.11	4.67	6.33	7.32	9.01	11.52	13.76	15.17	4.10	5.15	5.82	6.26
HSK-5	1.78	2.11	2.44	2.78	3.56	4.89	6.34	7.33	9.72	14.01	15.39	16.67	4.37	6.26	7.01	7.19
HSK-7	1.78	1.67	2.11	2.44	3.56	5.22	5.89	6.78	8.33	11.00	13.05	14.17	4.37	5.85	7.39	7.06
HSK-17	1.44	2.33	2.67	3.11	3.22	5.44	6.00	7.00	10.19	13.42	14.67	15.80	4.49	6.03	7.56	7.13
KTC-2	1.78	1.89	2.22	2.67	3.33	4.44	5.67	7.22	10.86	13.67	15.62	17.92	4.33	5.56	6.83	6.51
KTC-3	1.89	2.22	2.33	2.78	3.33	5.00	5.78	7.44	10.86	13.08	15.28	16.77	4.74	5.91	6.95	7.20
KTC-4	1.00	1.44	1.56	2.00	2.78	4.22	5.22	6.67	9.77	12.34	13.50	15.78	4.48	5.36	6.52	7.04
KTC-5	1.89	2.44	2.56	2.67	3.00	4.78	5.56	7.00	10.01	12.45	14.68	15.99	5.16	6.52	7.56	7.97
MAM-2	1.89	2.11	2.33	2.56	3.44	4.78	6.11	7.11	10.10	13.36	14.49	15.80	4.46	5.91	7.03	7.09
MDS-1	1.67	2.00	2.78	2.89	3.44	5.00	6.44	7.44	10.16	12.70	13.87	14.12	4.45	5.65	6.65	6.88
MHK-1	1.56	1.56	2.11	2.89	3.22	4.56	5.67	6.89	9.39	14.12	16.17	17.02	4.63	6.36	7.17	7.29
S.Em ±	0.22	0.11	0.14	0.12	0.15	0.21	0.26	0.26	0.44	0.42	0.43	0.48	0.15	0.17	0.23	0.22
C.D. @ 5%	NS	0.33	0.41	0.35	0.45	0.62	0.76	0.75	1.27	1.23	1.24	1.40	0.44	0.50	0.66	0.63

Conclusion

Interpretation of the data indicates that for any successful establishment of graft union it depends on the many factors such as age of the rootstock, scions, method of grafting and period of grafting. A favourable interaction among all these components would results in successful graft union formation and also responsible for longer survivability.

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