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EFFECTS OF METHODS OF GRAFTING AND AGE OF ROOTSTOCK ON PROPAGATION OF OFF-SEASON GERMPLASMS OF JACKFRUIT

M. A. Mannan*, M. M. Islam and S. A. K. U. Khan
Agrotechnology Discipline, Khulna University, Khulna 9208, Bangladesh

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Abstract: An experiment was conducted to the effect of methods of grafting and age of rootstock in off-season jackfruit propagation. Higher success of grafting was observed in cleft grafting with 7, 10 and 14-day old rootstock (89.24, 89.24 and 63.58%, respectively) and that was lower in splice grafting with 118, 22, 26 and 30-day old rootstock (0.91%). The higher values of success (84.99%) was found with 7 day-old rootstock and the highest time was required to bud break (35 days), to emergence of first leaf (38.78 days), and to first flush (42.83 days) in 14 -day old rootstock, whereas the highest percentage of survivality (99.98%) was recorded in 7 and 14-day old rootstocks in cleft grafting. Taller plant was obtained in cleft grafting with 7-day, 10-day and 14-day old rootstock (25.50, 23.78 and 23.00 cm, respectively) 180 days after grafting (DAG). Almost similar growth of scion was observed with 7-day, 10-day and 14-day old rootstocks (5.67, 5.59 and 5.62 cm, respectively) 180 DAG. Number of leaves, length of leaves and breadth of leaves were also higher in cleft grafting with 7-day, 10-day and 14-day old rootstocks.

Key words: Grafting, rootstock age, propagation, jackfruit

Introduction

Jackfruit (*Artocarpus heterophylus* Lam.) is the national fruit of Bangladesh. It belongs to the family Moraceae and one of the most important and popular fruit crops in Bangladesh (Haque, 1977). The jackfruit serves as a food for millions of poor people in the countryside during the season (May to July) where there remains a scarcity of food in the rural areas of Bangladesh. A large quantity of jackfruit comes to the market at this time. But due to the lack of storage facilities a major portion of this is spoiled. On the other hand, a huge scarcity of fruits occurs during October to March. Jackfruit also grows out of season in Bangladesh (Hossain, 1976). There is a scope to select superior off-season germplasm of jackfruit to mitigate the fruit and nutritional shortage of scarcity period. Jackfruit is a cross- pollinated fruit crop and usually propagated through seed (Samaddar, 1990). As a result a number of heterozygous trees are found in the homestead and orchards in Bangladesh. So, good quality planting materials having uniform characters are the utmost demand of the farmers. For this reasons vegetative propagation is essential to get true-to-type propagules (Purseglove, 1968). Method of grafting and age of rootstock are more important for the production of quality and successful grafts in jackfruit as reported by different authors (Jose and Velsalakumari, 1991; Vijayakumar *et al*. 1991; Dhar, 1998

* Corresponding author. Cell: 01716-703576; e-mail:<mannanku@yahoo.com>
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and Azad, 1999). Considering the above facts, attempts have been taken to investigate the effect of methods of grafting and ages of rootstock on propagation of off-season jackfruit to determine the appropriate age of rootstock for grafting of off-season jackfruit and to identify the suitable and easy method of grafting for off-season germplasm of jackfruit.

Materials and Methods

The study was conducted at Horticulture Centre, Department of Agricultural Extension, Daulatpur, Khulna, during May to December 2004. All possible combinations of two methods of grafting (viz. Cleft and splice) and eight ages of rootstock (viz., 3, 7, 10, 14, 18, 22, 26 and 30 days) were considered as treatments. A two-factor experiment was laid out in Randomized Complete Block Design (CRBD) with three replications.

Data were collected at an interval of 30 days starting from 90 days of bud break until 180 days. Data were recorded on number of successful grafts, days to bud break, days to emergence of first leaf, days to first flush, percentage of survivability, growth of scion (length and diameter in centimeter), growth of plant (cm),number of leaves, length of leaves (cm) and breadth of leaves (cm)

The collected data were statistically analyzed to find out the significance of differences between the treatments and treatment combinations. The means of all the treatments were calculated and the analysis of variances (ANOVA) for all the characters was performed by F-test. The significant differences of the means of treatments were compared by Duncans New Multuple Range Test (DMRT) (Gomez and Gomez, 1984).

Results

Percentage of success: The effect of method of grafting and age of rootstock showed significant variation in regard to success of grafting (Table 1). The highest success (89.24%) of grafting was observed with 7-day and 10-day old rootstock followed by 14-day old rootstock (63.58%) in case of cleft grafting, 7-day old rootstock (56.83%) with splice grafting, and 3-day old rootstock (50.82%) with cleft grafting.

Table 1. Effect of methods of grafting and age of rootstock on grafting of off-season germplasm of jackfruit.

Treatment combination	Success (%)	Bud break (days)	Emergence of first leaf (days)	First flush (days)	Survivability (%)
$M_1 T_1$	50.82 d (60.00)	31.00 b	34.50 ab	37.33 bc	89.25 a (100.00)
$M_1 T_2$	89.24 a (100.00)	18.44 c	21.64 c	25.56 d	89.24 a (100.00)
$M_1 T_3$	89.24 a (100.00)	18.89 c	22.55 c	26.33 d	89.24 a (100.00)
$M_1 T_4$	63.58 b (80.00)	32.66 ab	36.22 ab	40.33 bc	89.24 a (100.00)
$M_1 T_5$	33.22 f (30.00)	35.33 ab	38.33 ab	41.33 bc	35.28 c (33.33)
$M_1 T_6$	33.22 f (30.00)	33.33 ab	36.33 ab	40.00 bc	89.24 a (100.00)
$M_1 T_7$	26.51 g (20.00)	32.67 ab	36.33 a	39.33 bc	89.24 a (100.00)
$M_1 T_8$	18.39 h (10.00)	41.67 a	45.00 ab	52.00 a	89.24 a (100.00)
$M_2 T_1$	0.91 i (0.00)	0.00 d	0.00 d	0.00 e	0.91 d (0.00)
$M_2 T_2$	56.83 c (70.00)	17.83 c	21.83 c	0.00	89.24 a (100.00)
$M_2 T_3$	45.02 e (50.00)	27.50 bc	30.83 bc	25.00	63.58 b (80.00)
$M_2 T_4$	26.46 g (20.00)	37.33 ab	41.33 ab	34.00	89.24 a (100.00)
$M_2 T_5$	0.91 i (0.00)	0.00 d	0.00 d	45.33	0.91 d (0.00)
$M_2 T_6$	0.91 i (0.00)	0.00 d	0.00 d	0.00	0.91 d (0.00)
$M_2 T_7$	0.91 i (0.00)	0.00 d	0.00 d	0.00	0.91 d (0.00)
$M_2 T_8$	0.91 i (0.00)	0.00 d	0.00 d	0.00	0.91 d (0.00)
Level of significance	**	**	**	**	**

Note: The percentage data were transformed in arcsine method. The figures in parenthesis indicate the original values.
M_1 = Cleft grafting; M_2 = Splice grafting; T_1 = 3 days old rootstock; T_2 = 7 days old rootstock; T_3 = 10 days old rootstock; T_4 = 14 days old rootstock; T_5 = 18 days old rootstock; T_6 = 22 days old rootstock; T_8 = 30 days old rootstock.
**Significant at 1% level

Days required to bud break: Days required to bud break significantly varied due to the effect of method of grafting and age of rootstock (Table 1). The minimum time (17.83 days) was required in case of splice grafting with 7 day old rootstock followed by 7day (18.44 days) and 10-day (18.89 days) old rootstocks with cleft grafting, whereas maximum time (41.67days) was required in case of cleft grafting with 30 day old rootstock (Table 1). The average time required to bud break was not uniform throughout the experimental period and this might be due to variation in climatic conditions and unavailability of actively growing scions and rootstocks during the study period. Similar result was also reported by Dhar (1998). He stated that the days required to bud break for cleft method was 41.16, 33.39 and 33.01 with 5, 10, 15and 20 day old rootstocks, respectively.

Days required to emergence of first leaf: The effect of different grafting methods and different ages of rootstock on days required to emergence of first leaf was found statistically significant (Table 1). The maximum time (45 days) required to emergence of first leaf was found in cleft grafting with 30-day old rootstock followed by 14-day old rootstock in case of splice grafting (41.33 days) and the minimum times (21.64 days, 22.55 days) were recorded in cleft grafting with 10-day and14-day old rootstock followed by 7-day old rootstock (21.83 days) in splice grafting (Table 1).

Table 2. Effect of methods of grafting and age of rootstock on growth of scion and growth of plant.

Treatment combination	Length of scion (cm) after different days of grafting				Height of plant (cm) after different days of grafting			
	90	120	150	180	90	120	150	180
$M_1 T_1$	10.00 bc	10.41 def	12.00 ef	15.07cd	12.30 g	12.83 g	15.66 f	19.41h
$M_1 T_2$	11.20 a	12.98 a	15.30 a	18.65 a	19.65 cd	21.05 d	23.10d	25.50 de
$M_1 T_3$	10.75 ab	12.00 ab	14.10 abc	17.35ab	16.00 e	17.30 e	19.60e	23.78 ef
$M_1 T_4$	9.31 cd	11.31bcde	13.25bcde	16.31bc	15.00 ef	16.68 e	19.45e	23.00 fg
$M_1 T_5$	8.00 e	10.50cdef	13.00cdef	16.53bc	13.53efg	16.53ef	20.00 e	23.53egf
$M_1 T_6$	9.16 cde	10.33 def	11.83 f	15.16cd	13.16 fg	14.66fg	16.99 f	21.16 gh
$M_1 T_7$	9.25 cd	10.00 ef	12.00 ef	15.00cd	49.00 a	50.00 a	52.25a	56.00 a
$M_1 T_8$	8.50 de	9.50 f	12.00 ef	15.50cd	27.53 b	28.50 b	31.00b	35.33 b
$M_2 T_1$	0.00 f	0.00 g	0.00 g	0.00 e	0.00 h	0.00 h	0.00 g	0.00 I
$M_2 T_2$	10.00abc	11.85 abc	14.34 ab	15.61cd	19.00 d	21.35 d	25.21d	27.20 d
$M_2 T_3$	10.00abc	11.62abcd	13.37bcd	14.56 d	19.50cd	21.00 d	24.12d	26.30 d
$M_2 T_4$	9.75 bc	11.00bcde	12.75def	14.02 d	22.00 c	24.25 c	27.50c	29.58 c
$M_2 T_5$	0.00 f	0.00 g	0.00 g	0.00 e	0.00 h	0.00 h	0.00 g	0.00 I
$M_2 T_6$	0.00 f	0.00 g	0.00 g	0.00 e	0.00 h	0.00 h	0.00 g	0.00 I
$M_2 T_7$	0.00 f	0.00 g	0.00 g	0.00 e	0.00 h	0.00 h	0.00 g	0.00 I
$M_2 T_8$	0.00 f	0.00 g	0.00 g	0.00 e	0.00 h	0.00 h	0.00 g	0.00 i
Level of significance	**	**	**	**	**	**	**	**

cm= centimeter; M_1 = Cleft grafting; M_2 = Splice grafting; T_1 = 3 days old rootstock; T_2 = 7 days old rootstock; T_3 = 10 days old rootstock; T_4 = 14 days old rootstock; T_5 = 18 days old rootstock; T_6 = 22 days old rootstock; T_8 = 30 days old rootstock. ** Significant at 1% level

Days required to first flush: A significant effect of method of grafting and age of rootstock on days required to first flush was observed (Table 1). In splice grafting more time (45.33 days) was required for first flush with 18-day old rootstock followed by 18-day old (40.33 days) and 22-day old (41.33 days) rootstocks in cleft grafting and the shortest time (25.00 days) in splice grafting with 10-day old rootstock followed by 10-day and 14-day old rootstock (25.56 days and 26.33 days, respectively) in cleft grafting.

Percentage of survivability: There was significant combined effect of method of grafting and different ages of rootstock on the percentage of survivability. Percentage of survivability was counted 180 days after grafting from different treatment combinations (Table 1). The highest survivability (89.25%) was recorded with 3, 7, 10, 14, 22, 26 and 30-day old rootstocks in cleft grafting and also 7 and 14- day old rootstocks in splice grafting. The lowest survivability was

obtained (33.33%) with 18- day old rootstocks in cleft grafting. Jose and Velsalakumari (1991) reported the similar results. They found 21.76% survivability in epicotyl grafting of jackfruit with 5-day old rootstock.

Growth of scion: Length of scion varied significantly due to the effect of methods of grafting and age of rootstock (Table 2). Cleft method produced the longest scion (18.65 cm) 180 DAG with 7-day old rootstock followed by 10-day old (17.35 cm), 14-day old (16.31 cm), and 18-day old (16.53 cm) rootstocks. The shortest scion height (14.02 cm) was recorded in splice method with 14-day old rootstocks followed by 10-day old (14.56 cm) rootstocks. Dhar (1998) reported that seed grafting made onto 15-day old rootstock produced 8.72 cm long scion.

Growth of plant: The effect of methods and different ages of rootstock on the height of plant was found to be statistically significant (Table 2). The tallest plant (56.00 cm) was found with 26-day old rootstocks in cleft grafting and the shortest plant (19.41 cm) was recorded with 3-day old rootstock in splice grafting.

Diameter of scion: The effect of different grafting methods and age of rootstock on diameter of scion was statistically significant. Clef grafting produced the highest diameter of scion (5.97mm) with 26-day old rootstock at 180 DAG. On the other hand, splice grafting produced the lowest diameter (5.27mm) of scion 180 DAG (Table 3).

Number of leaves: Significant variation in the number of leaves was observed in case of effect of methods grafting and age of rootstock. At 180 DAG, the highest number of leaves (4.50) were obtained from clef grafting with 3-day old rootstocks and 7-day old (4.50) rootstocks followed by 7- day old rootstock in splice grafting (4.28) and,10 and 14-day old rootstocks (4.00) in cleft grafting. The 14-day old rootstock in splice grafting also showed only 4.00 leaves (Table 4). The lowest number of leaves (3.00) was produced by the cleft grafting 180 DAG with 18-day old rootstock followed by 30-day old (3.03) rootstock. No leaf was observed in splice grafting with 18, 22, 26 and 30-day old rootstocks.

Table 3. Combined effect of method of grafting and age of rootstock on diameter of scion.

Treatment	Diameter of scion (mm) after different days of grafting			
	90	120	150	180
$M_1 T_1$	3.39 a	3.59 d	4.61 a	5.24 a
$M_1 T_2$	4.19 a	4.48 ab	5.11 a	5.67 a
$M_1 T_3$	3.41 a	4.21 abcd	5.00 a	5.59 a
$M_1 T_4$	3.91 a	4.36 abc	5.09 a	5.62 a
$M_1 T_5$	3.49 a	3.64 cd	4.43 a	5.30 a
$M_1 T_6$	3.50 a	4.37 abc	4.98 a	5.65 a
$M_1 T_7$	4.26 a	4.81a	5.25 a	5.97 a
$M_1 T_8$	3.33 a	3.83 bcd	4.62 a	5.30 a
$M_2 T_1$	0.00 b	0.00 e	0.00 b	0.00 b
$M_2 T_2$	3.92 a	4.36 abc	4.97 a	5.30 a
$M_2 T_3$	3.96 a	4.40ab	5.02 a	5.51 a
$M_2 T_4$	3.81 a	4.36 abc	4.92 a	5.27 a
$M_2 T_5$	0.00 b	0.00 e	0.00 b	0.00 b
$M_2 T_6$	0.00 b	0.00 e	0.00 b	0.00 b
$M_2 T_7$	0.00 b	0.00 e	0.00 b	0.00 b
$M_2 T_8$	0.00 b	0.00 e	0.00 b	0.00 b
Level of significance	**	**	**	**

mm= millimeter; M_1 = Cleft grafting; M_2 = Splice grafting; T_1 = 3 days old rootstock; T_2 = 7 days old rootstock; T_3 = 10 days old rootstock; T_4 = 14 days old rootstock; T_5 = 18 days old rootstock; T_6 = 22 days old rootstock; T_8 = 30 days old rootstock; T_8 = 30 days old rootstock. ** Significant at 1% level

Length of leaves: The effect of methods and age of rootstock was highly significant regarding length of leaves. Cleft grafts produced the longest leaves (8.95 cm) with 7-day old rootstock followed by 10-day old (8.07 cm) and 14-day old (8.12 cm) rootstocks, while the shortest leaves (4.93 cm) was recorded in cleft grafting with 30-day old rootstocks 180 DAG (Table 4).

Breadth of leaves: Breadth of leaves differed significantly by the methods of grafting and age of rootstocks (Table 4). Splice grafting method produced the broadest leaves (3.99 cm) followed by 7-day old (3.89 cm) and 14-day old (3.90 cm) rootstocks 180 DAG, while cleft grafts resulted in the narrowest breadth (2.63 cm) with 30-day old rootstock preceded by 22-day old rootstock (2.90cm) and in splice grafting with 14-day old rootstocks (3.01 cm) 180 DAG.

Table 4. Combined effect of methods of grafting and age of rootstock on number of leaves, length of leaves and breadth of leaves**.**

Treatments	Number of leaves after different days of grafting				Length of leaves (cm) after different days of grafting				Breadth of leaves (cm) after different days of grafting			
	90	120	150	180	90	120	150	180	90	120	150	180
$M_1 T_1$	4.30 a	3.80bc	4.50 a	4.50 a	7.31 a	6.29bcd	6.36bc	7.83abc	3.37 b	2.90 de	2.94 ef	3.35 d
$M_1 T_2$	3.70 b	4.50 c	4.50 a	4.50 a	8.35 a	8.11 a	8.23 a	8.95 a	3.75 a	3.59 a	3.68 b	3.89ab
$M_1 T_3$	3.70 b	3.83 d	4.00 b	4.00 c	6.63bc	7.49 ab	7.30ab	8.07 ab	3.02 c	3.34 b	3.42 c	3.70bc
$M_1 T_4$	3.00 c	3.53 c	3.53cd	4.00 c	6.39cd	7.08abc	7.67 a	8.12 ab	2.91 c	3.21 bc	3.45 c	3.90ab
$M_1 T_5$	1.30 f	3.00 d	2.97 e	3.00 g	5.00 e	5.75cde	6.02cd	6.56c	2.63 d	2.76 ef	3.06de	3.46 d
$M_1 T_6$	2.00 e	2.33 e	3.00 e	3.30 f	3.75 f	4.55e	4.91de	5.12 d	2.01 e	2.46 g	2.56 g	2.90 e
$M_1 T_7$	2.50 d	3.00 d	3.50 d	3.50 e	5.72de	6.20bcd	5.10de	6.70 c	2.60 d	2.93 de	2.95 ef	3.34 d
$M_1 T_8$	1.00 f	2.00 e	3.00 e	3.03 g	2.70 g	6.00 cd	4.33 e	4.93 d	2.00 e	2.22 h	2.02 h	2.63 f
$M_2 T_1$	0.00 g	0.00 f	0.00f	0.00h	0.00 h	0.00 f	0.00f	0.00 e	0.00 f	0.00 I	0.00 I	0.00 g
$M_2 T_2$	3.71b	4.28ab	4.28 a	4.28b	5.94cd	6.77bcd	7.46ab	8.01ab	2.63 d	2.89 de	3.17 d	3.56cd
$M_2 T_3$	3.25bc	3.75 c	3.75 c	3.75 d	6.22cd	6.46bcd	7.18ab	7.52 bc	2.91 c	3.07 cd	3.86 a	3.99 a
$M_2 T_4$	2.50 d	4.02abc	4.00 b	4.00 c	4.96 e	5.46 de	6.48bc	6.92 bc	2.58 d	2.65 fg	2.89 f	3.01 e
$M_2 T_5$	0.00 g	0.00 f	0.00 f	0.00 h	0.00 h	0.00 f	0.00 f	0.00 e	0.00 f	0.00 I	0.00 I	0.00 g
$M_2 T_6$	0.00 g	0.00 f	0.00 f	0.00 h	0.00 h	0.00 f	0.00 f	0.00 e	0.00 f	0.00 I	0.00 I	0.00 g
$M_2 T_7$	0.00 g	0.00 f	0.00 f	0.00 h	0.00 h	0.00 f	0.00 f	0.00 e	0.00 f	0.00 I	0.00 I	0.00 g
$M_2 T_8$	0.00 g	0.00 f	0.00 f	0.00 h	0.00 h	0.00 f	0.00 f	0.00 e	0.00 f	0.00 i	0.00 i	0.00 g
Level of significance	**	**	**	**	**	**	**	**	**	**	**	**

cm= centimeter; M_1 = Cleft grafting; M_2 = Splice grafting; T_1 = 3 days old rootstock; T_2 = 7 days old rootstock; T_3 = 10 days old rootstock; T_4 = 14 days old rootstock; T_5 = 18 days old rootstock; T_6 = 22 days old rootstock; T_8 = 30 days old rootstock. ** Significant at 1% level cm= centimeter; M_1 = Cleft grafting; M_2 = Splice grafting; T_1 = 3 days old rootstock; T_2 = 7 days old rootstock; T_3 = 10 days old rootstock; T_4 = 14 days old rootstock; T_5 = 18 days old rootstock; T_6 = 22 days old rootstock; T_8 = 30 days old rootstock. ** Significant at 1% level

Discussion

It was observed from the results that the methods of grafting and age of rootstock had significant effect on the percentage of success, percentage of survivability, growth and development of the grafts. Grafting operation done by cleft grafting method with 7, 10 and 14 days old rootstock found to be the best combination for the propagation of off-season jackfruit.

Similar results were also reported by Islam (2001) and Kuddus (2001). In a study on epicotyl grafting of jackfruit, Islam (2001) obtained the highest (39.84%) success from 14-day old rootstocks and 21-day old rootstock gave the lowest (28.3%). Kuddus (2001) the highest percentage of success (36%) was in 20-day old rootstock and the lowest success (30%) from 10-day old rootstock. It was also observed that grafting with 3, 18, 22, 26 and 30-day old rootstock in splice grafting were totally unsuccessful. Jose and Velsalakumari (1991) reported 21.76% survivability in epicotyl grafting of jackfruit with 5-day old rootstock.

Conclusion

From the study, it was observed that the methods of grafting and age of rootstock had significant effect on the percentage of success, percentage of survivability, growth and development of the grafts. Grafting operation done by cleft method with 7-, 10- and 14-day old rootstocks were the better combinations for the propagation of off-season germplasm of jackfruit.

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