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Effect of stages of rootstocks and methods of operation on the success and survivability of stone grafting of mango

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Abstract
An experiment was carried out at the Germplasm Centre of Fruit Tree Improvement Project (FTIP), Department of Horticulture, Bangladesh Agricultural University, Mymensingh during the period from June, 2019 to March, 2020 to evaluate the success and survivability as influenced by the stages of rootstock and methods in stone grafting of mango cv. Amrapali. The experiment consisted of five stages of rootstock viz; rootstock containing red and curled leaves (8-10 day old), rootstock containing red and flat leaves (13-15 day old), rootstock containing turn to green leaves (18-20 day old), rootstock containing light green leaves (23-25 day old) at first flush and rootstock containing red and flat leaves at second flush (33-35 day old); two methods viz., splice and cleft grafting. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. The observations on the bud break, leaf emergence, leaf number, success, stock length, scion length, height and survival were found significant. The highest success (85.00%), survivability (81.67%), increased scion length (8.00 cm) and stoic height (9.83 cm) and minimum time required to bud break (15.02 days) leaf emergence (20.06 days) were recorded with the rootstock containing red and flat leaves at second flush (33-35 day old).In case of methods of grafting the highest success (83.54%), survivability (48.67%), leaf number (5.67), minimum time required to bud break (18.04 days) and leaf emergence (26.29 days) were observed in splice method of grafting. In combined effects of stages of rootstock and methods of grafting showed significant differences on all the parameters. The treatment combination of 33-35-day old rootstock with the splice method of grafting produced the highest success (86.67%) and survivability (83.33%) whereas the rootstock of same stage with the cleft method of grafting required minimum time required to bud break (14.25 days) and leaf emergence (19.00 days) and best growth of grafts but produced the second highest success (83.33%) and survivability (80.00%). Therefore, 33-35 day old rootstock with the splice method of grafting was the best followed by the cleft method with same stage of root stock for the propagation of Amrapali mango through stone grafting.

Keywords: Stage, Rootstock, Stone, Grafting and Mango

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I. Introduction

Mango (*Mangifera indica* L.) is acknowledged as the king of fruits. It belongs to the family Anacardiaceae. It is one of the most popular and important fruits in Bangladesh. Amrapali was developed from crossing between Dashehari and Neelum by Indian Agricultural Research Institute (IARI), New Delhi. Moreover, it starts bearing just after two years of planting grafts. It can also be grown very successfully in the limited area of home garden and even in the roof garden of the urban people. The methods of vegetative propagation used in mango are not easy and efficient (Hossain *et al.,* 1991). Various methods of grafting such as contact, veneer, cleft, saddle, splice, tongue etc. have been developed and some of them like veneer and cleft grafting's are mainly practiced in Bangladesh. Contact grafting being a traditional method is expensive, laborious and time consuming but the percentage of success is the highest. The success of veneer grafting is higher than cleft and splice grafting but not so easy to perform. Cleft and splice grafting being the modern methods are reported to be successfully practiced. It is a general practice that one-year-old seedlings as rootstocks are used for grafting. But in stone (epicotyl) grafting there is no need to wait for one year, for the development of rootstocks. Few week old very young seedlings can be used as rootstock for stone grafting. Epicotyl grafting has been successfully using as an efficient, economic and rapid method for the propagation of mango (Bhan *et al.,* 1969). The advantages of this technique of grafting are that the germinating seedlings are in

juvenile condition and the cells have the potentiality of quick differentiation and thus play a vital role in the success or graft union. The stages of rootstock and the methods of grafting have been found to be important factors for the higher percentage of success, survivability and growth in case of epicotyl grafting in mango as reported by different authors (Anon., 1990; Jose and Velsalkumari, 1991). Epicotyl grafting in mango was standardized at the Horticultural Research Station, Krishnanagar by Bhan *et al*. (1969) and they claimed 75 to 80 % success by using germinating seed as a rootstock and semi-mature terminal shoot as a scion. At present epicotyl grafting of mango in Bangladesh is not found in commercial practice. Very few research works on epicotyl grafting in mango is found in Bangladesh. Considering above facts the present piece of work was undertaken with a view to achieve the following objectives: i) To determine the appropriate stage of rootstock for the highest success, survivability and subsequent growth in case of different grafting methods of mango graft cv. Amrapali, and ii) To find out the better method of grafting for the highest success and survivability.

II. Materials And Methods

The experiment was conducted at the Germplasm Centre (GP) of the Fruit Tree Improvement Project (FTIP), Bangladesh Agricultural University (BAU), Mymensingh, during June, 2019 to March, 2020 on effect of stages of rootstocks and methods of operation on the success and survivability of stone grafting of mango to determine the appropriate stage of rootstock for the highest success, survivability and subsequent growth in case of different grafting methods of mango graft. The experiment consisted of two factors, viz. Factor A: Stages of rootstocks, S_1 = Rootstock containing red and curled leaves (8-10 days) ;S_2 = Rootstock containing red and flat leaves (13-15 days); S_3 = Rootstock containing turn to green leaves (18-20 days) ;S_4 = Rootstock containing light green leaves (23-25 days) and S_5 = Rootstock containing red and flat leaves at second flush (33 - 35 days) Factor B: Methods of grafting, M_1= Cleft grafting and M_2 = Splice grafting The experiment was conducted in a Randomized Complete Block Design (RCBD) with 10 treatment combinations in 3 replications having 10 grafts per replication. The experimental area was under a subtropical climate, which is characterized by heavy rainfall during the month of June to October and scanty rainfall during the rest period of the year. Rainfall starts in May and continues up to September and 95% of the annual rainfall occurs in the monsoon. The average maximum temperature during the period of experiment was 32.23 °C and average minimum was 12.18 °C. The maximum humidity as observed in September was around 88.13% and the minimum was in February (72.93). For cleft grafting method, about 4-5 cm long two smooth slanting cuts were made at the proximal end of the scion piece on both sides opposite to each other to each other in such a way that the end portion became very thin just like a chisel. It was done with the help of a sharp knife. The rootstock was at first deheaded by giving horizontal cut at proper height above the ground level and then a vertical split cut or cleft was made by a thin and sharp bladed grafting knife at the center of the horizontal cut surface of the stock having a depth of approximately 5 cm. When both the stock and scion were prepared, then the scion was inserted into the cleft of the stock through slight opening the splits. The both components were brought into close contact particularly cambium in face to face and tied firmly with nylon strip and then the scion along with the union portion was covered with a polythene cap to protect the scion from loss of water through transpiration. The operation was done on the 13 August, 2019 and for splice grafting method, the stock plant was cut-off at right angle at proper height above the ground level and then a long slanting upward smooth cut of about 5 cm on one side was given keeping very thin bark at the end point. After preparation of the stock a similar cut of same length and slope was given at proximal end of the scion. The two cut surfaces of the stock and scion were then placed together face to face and tied firmly with a nylon strip and then the grafted portion along with the scion was covered with a polythene bag to minimize transpiration loss of water from scion. Necessary measures were taken to make the plot free from weed and to create a favorable environment to ensure proper growth and development of seedling rootstock and grafted plants. Intercultural operation was done as and when necessary. Water, carbon dioxide and heat accumulated in polythene cap through transpiration and respiration were removed by opening the polythene cap for a few second at few days' intervals up to the date of observance of new flush coming up from the terminal dud of the scion. The data on different parameters were recorded at one-month interval except the times required budding break and leafing emergence which were recorded at 5 days' interval starting from days after grafting operation. The recorded data were statistically analyzed using MSTAT computer package program to find out the significance of variations resulting from the experimental treatments. The means of all the treatments were calculated and the Analyses of Variance (ANOVA) for all the characters were performed by F-test. The differences between the treatment means were compared by Least Significant Difference (LSD) test (Gomez and Gomez, 1993).

III. Results And Discussion

Bud breaking is the primary indication of grafting success. Time required for bud breaking in scion was significantly influenced by the stages of rootstock and methods of grafting.

Effect of stages of rootstock

The earliest bud breaking (15.02 days), the minimum time required for leaf emergence (20.03 days), the highest number of leaves (7.38), percentage of graft success (84.00) and graft survival (78.94%) were found when scion was grafted with the rootstock containing red and flat leaves at second flush (33-35 day old), whereas the lowest values were found on all the mentioned parameters containing red and flat leaves at first flush (13-15 day old) (Table 1). Grafting with the rootstock containing red and flat leaves at first flush (13-15 day old) required to bud breaking considerably more than double time (33.32 days). The Rootstock red and flat leaves at second flush (33-35 days old) was physiologically mature, the leaves supplied more food materials and juvenility having the capacity of rapid cell elongation and cell division, which are essential for rapid wound healing process. So, it possibly attributed to rapid callus formation and union of the graft that led to earlier bud break and scion growth. Dhakal and Hoda (1987) stated that sprouting of scion buds started from second week and completed within six weeks of grafting. Srivastava *et al.* (1989); Singh *et al.*(1992)and Kashyap *et al.* (1989) separately reported that 30 day old seedlings gave better results than 15 or 45 days old seedlings. Brahmachari *et al.* (1999) indicated that the success rate in grafting reduced the stage or root stocks increased.

Effect of methods of grafting

The minimum time required for bud breaking (18.14 days), less time (26.99 days) required for leaf emergence, the highest mean number of leaves (5.60) per graft, the higher percentage of graft success (83.69) and graft survival (48.36) were noticed in splice method of grafting, whereas the maximum time (19.68 days) for bud break and leaf emergence as well as lowest success, survivability and new leaves were found in the method of cleft grafting (Table 1). Earlier sprouting in splice method of grafting might be due to better cambial contact between stock and scion. Maximum days required for bud breaking in cleft grafting was possibly due to delay in callus formation in the grafted portion. Islam *et al.* (1994) noted that days required to bud breaking for the cleft, modified cleft and whip (splice) grafting methods were 36, 17 and 14 days respectively. Mirdah (2002) also found that 16.59 and 19.06 days were required to bud break in case of veneer and cleft grafting respectively. The higher percentage of graft success and survivability were found in splice grafting. This result is in partial agreement with the findings of Bhambota *et al.* (1971) who concluded that splice grafting was slightly superior to cleft grafting. Gupta *et al.* (1988) found that the success with splice (57.00%) grafting was better than the cleft (27.00 %) grafting. Kashyap *et at* (1989) showed that whip (or splice) grafting gave higher success rate (after 6 weeks) than cleft (or wedges) grafting.

Tabel 1. Effect of stages of rootstock and methods of grafting on the days required to bud break and leaf emergence in scion, percentage of graft success, percentage of graft survival and no. of leaves/graft

Treatments	Days required to bud break	Days required to leaf emergence	Percentage of graft success	Percentage of graft survival	No. of new leaves/graft
S_1	16.32	26.26	80.25	50.32	5.98
S_2	33.32	33.00	79.24	45.54	6.84
S_3	18.19	29.55	75.36	38.25	3.97
S_4	24.78	30.55	72.72	32.12	5.32
S_5	15.02	20.03	84.00	78.94	7.38
Lsd $_{0.01}$	3.21	2.87	4.25	3.95	3.11
Level of Sig.	**	**	**	**	**
Splice	18.14	26.99	83.69	48.36	5.60
Cleft	19.68	27.87	78.12	46.57	4.88
Lsd $_{0.01}$	2.11	2.17	3.11	4.32	1.95
Level of Sig.	**	**	**	**	**

S_1 = Rootstock containing red and curled leaves (8-10 days), S_2 =13-15 days, S_3 = 18-20 days, S_4 = 23-25 days and S_5= 33 - 35 days ** = Significant at 1% level of probability

Combined effect of stages of rootstock and methods of grafting

The combined effects of stages of rootstock and methods of grafting on the days required to bud break, leaf emergence in scion, percentage of graft success, percentage of graft survival and no. of leaves/graft were found to be statistically significant (Table 2). The lowest time (14.01 days), the minimum time (19.13 days) required to leaf emergence, the highest number of leaves (7.78) per graft, the highest percentage of graft success (86.67) and percentage of survival (83.33) were found when grafting was done onto the 33-35 days old rootstock with spice method. The highest time (26.00 day) required to bud break was found when grafting was made onto the 13-15 days old rootstock by splice method. The lowest percentage of graft success (60.67) and survivability were found when grafting was done onto the rootstock containing light green leaves (23-25 day

old) by cleft method. The maximum time (35.30 days) required to emergence of new leaf and the lowest number of leaves (3.17) per graft were produced in the grafts when scion was grafted onto 18-20 days old rootstock with splice method. These variations in the stages of rootstock and methods of grafting for the bud breaking might be due to the differences in the translocation of food reserves and changes in cambial activity due to different treatments. Dhakal and Hoda (1987) stated that sprouting of scion buds started from second weeks and completed within six weeks of grafting. The mean number of days required for sprouting varied from minimum of 14.25 days to maximum of 22.88 days.

Table 2. Combined effect of stages of rootstock and methods of grafting on the days required to bud break and leaf emergence in scion, percentage of graft success, percentage of graft survival and no. of leaves/graft

	Treatments	Days required to bud break	Days required to leaf emergence	Percentage of graft success	Percentage of graft survival	No. of new leaves/graft at 90 DAG
Splice	S_1	15.33	23.20	86.67	53.33	5.68
	S_2	25.00	35.30	80.00	46.67	5.64
	S_3	17.29	28.33	86.67	33.33	3.57
	S_4	16.78	23.50	77.67	26.67	5.02
	S_5	15.78	21.13	86.67	83.33	7.78
Cleft	S_1	16.33	25.00	76.67	50.00	5.01
	S_2	24.00	32.33	80.00	40.00	5.14
	S_3	16.40	26.00	76.67	33.00	3.17
	S_4	24.71	33.00	73.67	26.67	5.52
	S_5	14.25	19.00	83.33	80.00	7.18
$Lsd_{0.01}$		3.71	2.97	6.63	5.90	4.12
Level of Significance		**	**	**	**	**

S_1 = Rootstock containing red and curled leaves (8-10 days), S_2 =13-15 days, S_3 = 18-20 days, S_4 = 23-25 days and S_5= 33 - 35 days; ** = Significant at 1% level of probability; DAG= Days after grafting

Effect of stages of rootstock and methods of grafting on the increased stock and scion length

The increase in length of rootstock due to the treatments were measured periodically during the entire period of investigation starting from the date of grafting operation upto 150 DAG at 30 days interval. The increase in length of rootstock was significantly influence by the stages of rootstock and methods or grafting at every date of taking data.

Effect of stages of rootstock

The increase in length of rootstock and scion varied significantly by epicotyl grafting of mango (cv. Amrapaly) when data were taken at 150 days after grafting operation. The highest increase in rootstock length (1.14 cm) and scion length (9.00 cm) were marked in the grafted plants when grafts was done onto the rootstock containing red and flat leaves at second flush (33-35 days old). The lowest increase in rootstock length (0.52 cm) and scion length (3.56 cm) were noticed when grafting operation was done with the rootstock containing red and curled leaves (8-10 days old) (Table 3). However, the results revealed that the 33-35 days old rootstock was the most effective than other stages under investigation. The highest increase in rootstock length after grafting operation might be due to getting maximum time by the stock for manufacturing of more food through its leaves and excellent physiological condition. Slow growth rate of the rootstock might be due to less amount of reserved food that caused physiological activity of the growing rootstocks.

Table 3. Effect of Stages of rootstock and methods of grafting on the increased stock and scion length

Treatments	Increased stock length (cm) at					Increased scion length (cm) at				
	30 DAG	60 DAG	90 DAG	120 DAG	150 DAG	30 DAG	60 DAG	90 DAG	120 DAG	150 DAG
S_1	0.10	0.20	0.31	0.33	0.52	1.85	1.95	2.11	2.65	3.56
S_2	0.11	0.21	0.35	0.40	0.60	2.78	3.12	3.87	4.12	4.78
S_3	0.12	0.31	0.44	0.42	0.67	3.21	4.01	4.75	5.42	5.62
S_4	0.15	0.35	0.45	0.55	0.59	1.25	1.85	2.01	2.11	2.54
S_5	0.21	0.39	0.62	0.82	1.14	2.12	5.12	6.12	7.56	9.00
$Lsd_{0.01}$	0.03	0.05	0.12	0.09	0.14	0.09	0.09	0.15	1.29	2.10
Level of Sig.	**	**	**	**	**	**	**	**	**	**
Splice	0.25	0.35	0.42	0.51	0.66	2.01	2.14	2.45	2.74	3.12
Cleft	0.31	0.41	0.51	0.66	0.79	2.10	2.42	3.01	3.21	3.59
$Lsd_{0.01}$	0.04	0.09	0.14	0.16	0.19	1.04	1.29	1.14	1.96	2.19
Level of Sig.	**	**	**	**	**	**	**	**	**	**

S_1 = Rootstock containing red and curled leaves (8-10 days), S_2 =13-15 days, S_3 = 18-20 days, S_4 = 23-25 days and S_5= 33 - 35 days; ** = Significant at 1% level of probability; DAG= Days after grafting

Effect of methods of grafting

Methods of grafting also significantly influenced on the increased stock and scion length which was recorded periodically. The higher result in increase in length of rootstock (0.79 cm) and scion length (3.59 cm) were noticed in the plants produced by cleft grafting than splice grafting at 150 days after grafting (Table 3). The variation in new scion growth between cleft and splice method were gradually reduce with the advancement of time from 60 to 150 DAG. BARI (1994) found the maximum shoot lengths as well as numbers of flushes were obtained from splice grafting followed by cleft grafting.

Combined effect of Stages of rootstock and methods of grafting and their interaction

The different stages of rootstock and methods of grafting had significant combined effect on the increase in length of rootstock at 150 days after the grafting**.** However, the periodical data should that there was more increase in length of rootstocks recorded upto the 60 DAG but a declining trend in increase in the length was observed in the grafts from 90 DAG to 150 DAG. The highest increase in length of rootstock (1.21 cm) and scion (6.64 cm) were recorded in the graft made onto the rootstock containing red and flat leaves at second flush (33-35 days old) along with cleft method at 150 DAG. The lowest increase of stock length (0.45 cm) and scion length (2.22 cm) were recorded when the grafts were made onto the rootstock containing light green leaves (18-20 days old) along with splice method followed by the 8-10 days old rootstock in cleft method (0.52 cm) (Table 4). The highest result might be due to the active growth at 33-35 days old rootstock because the rootstock got the maximum time for manufacturing of food materials through leaves after second flush. From the above results, it was found that the rate of increase in stock length follow the sequential pattern among the interaction onto the stages of rootstock and methods of grafting under investigation.

Table 4. Combined effect of Stages of rootstock and methods of grafting on the increased stock and scion length

Treatments		Increased stock length (cm) at					Increased scion length (cm) at				
		30 DAG	60 DAG	90 DAG	120 DAG	150 DAG	30 DAG	60 DAG	90 DAG	120 DAG	150 DAG
Splice	S_1	0.14	0.28	0.41	0.51	0.51	0.25	2.41	3.15	4.63	5.10
	S_2	0.13	0.29	0.35	0.40	0.45	0.25	1.23	1.66	2.92	2.22
	S_3	0.17	0.40	0.54	0.67	0.67	0.38	1.52	1.75	2.88	2.88
	S_4	0.12	0.25	0.37	0.45	0.45	0.26	0.59	0.89	2.09	2.26
	S_5	0.23	0.47	0.70	0.90	1.07	3.07	3.27	4.86	5.39	6.64
Cleft	S_1	0.12	0.30	0.41	0.52	0.52	0.28	0.77	1.37	2.42	2.67
	S_2	0.22	0.40	0.59	0.71	0.71	0.19	1.04	1.35	2.56	2.70
	S_3	0.27	0.61	0.81	0.87	0.87	0.27	1.22	1.99	3.11	3.23
	S_4	0.20	0.49	0.67	0.67	0.67	0.19	0.55	0.89	1.99	1.99
	S_5	0.26	0.59	0.80	1.01	1.21	3.15	6.67	9.48	10.13	11.36
$Lsd_{0.01}$		0.02	0.07	0.15	0.11	0.13	0.05	0.58	0.66	0.79	1.38
Level of Sig.		**	**	**	**	**	**	**	**	**	**

S_1 = Rootstock containing red and curled leaves (8-10 days), S_2 =13-15 days, S_3 = 18-20 days, S_4 = 23-25 days and S_5= 33 - 35 days; ** = Significant at 1% level of probability; DAG= Days after grafting

Effect of stages of rootstock and methods of grafting on the increased stionic height

Grafting onto the rootstock at different stages had significant effect on the increased stionic height. The data on increase in stionic heights due to the effects of different stages of stock and methods were recorded periodically during the entire period of study.

Effect of stages of rootstock

The increased stionic height was significantly influenced by different stages of rootstock. The highest increase in stionic height (9.89 cm) was noticed in the grafts produced by rootstock containing red and flat leaves at second flush (33-35 days old) followed (3.95 cm) by the rootstock containing red and curled leaves (8-10 days old) at 150 days after grafting operation. The lowest increased in stionic height (1.68 cm) was noticed onto the rootstock containing light green leaves (23-25 days old) (Table 5). The highest in increase in stionic height might be due to the maximum storage of prepared food by stock of 33-35 days old. Slow growth of the graft at 150 days after grafting operation might be due to slow physiological activity of the growing rootstock.

Table 5. Effect of Stages of rootstock and methods of grafting on the increased Stionic Height

Treatments	Increased Stionic height (cm) at				
	30 DAG	60 DAG	90 DAG	120 DAG	1500 DAG
S_1	1.80	2.05	2.31	2.65	3.96
S_2	2.70	3.22	3.82	4.22	4.78
S_3	3.32	4.11	4.71	5.32	5.72
S_4	1.55	2.85	2.21	2.31	2.74
S_5	3.82	5.52	6.44	7.58	9.89
$Lsd_{0.01}$	0.49	0.69	0.65	2.29	3.10
Level of Sig.	**	**	**	**	**
Splice	2.01	2.14	2.45	2.74	3.12
Cleft	2.10	2.42	3.01	3.21	3.59
$Lsd_{0.01}$	2.04	1.69	1.54	2.96	2.39
Level of Sig.	**	**	**	**	**

S_1 = Rootstock containing red and curled leaves (8-10 days), S_2 =13-15 days, S_3 = 18-20 days, S_4 = 23-25 days and S_5= 33 - 35 days; ** = Significant at 1% level of probability; DAG= Days after grafting

Effect of methods of grafting

The increase stionic in height at 150 days after grafting operation was influenced significantly by the different methods of grafting. After 150 days of grafting operation, the maximum increased stionic height (3.59 cm) was recorded in cleft method than splice method (3.12cm) (Table 5). The cleft method demonstrated the superior effect on most of date of taking data compared to splice method hut there is no significant at 60 DAG and 150 DAG. Variation in these results might be due to differences in the mobilization of food materials and cambial activities between the methods. Thus, continuous sap flow remained between the stock and scion which encouraged cambial activity and subsequent successful graft union, earlier callus proliferation differentiation of vascular tissue and close contacts between tissues of the stock and scion (Hoque and Hossain, 1974).

Combined effect of stages of rootstock and methods of grafting and their interaction

A highly significant difference was observed due to the combined effect of stages of rootstocks and methods of grafting on the increased in the stionic height at 150 days after grafting operation (Table 6). The highest increase in stionic height (12.06 cm) was observed in the 33-35 days old rootstock by cleft grafting followed by the same stage in splice grafting (9.60 cm). The lowest increase in stionic height (2.65cm) was found when scion was grafted onto 23-25 days old rootstock by cleft method followed by the same stage in splice method (2.35cm). In all treatment combinations the increase in stionic height was continued linearly. The highest increase might be due to maximum stage of rootstock. The rootstock got maximum time for manufacturing the food materials through its 5-7 leaves after second flush within 33-35 days after germination. As a result, it was strong enough to withstand the grafting shock with an excellent sap flow that enhanced the graft union process resulting maximum increased stionic height.

Table 6. Combined effect of stages of rootstock and methods of grafting on the increased stionic height

Treatments		**Increased stock length (cm) at**				
		30 DAG	**60 DAG**	**90 DAG**	**120 DAG**	**1500 DAG**
Splice	S_1	0.39	3.70	4.55	5.15	5.62
	S_2	1.33	2.51	2.36	3.52	3.82
	S_3	1.48	2.02	2.75	3.55	3.55
	S_4	1.34	1.84	2.24	2.54	2.35
	S_5	3.58	5.21	7.66	8.43	9.60
Cleft	S_1	1.41	3.16	3.63	4.03	4.28
	S_2	1.40	2.62	3.07	3.45	3.58
	S_3	1.50	2.83	3.75	3.97	4.10
	S_4	1.35	2.01	2.54	2.45	2.65
	S_5	3.58	5.76	9.92	10.61	12.06
$Lsd_{0.01}$		0.34	1.78	1.98	2.71	3.39
Level of Sig.		**	**	**	**	**

S_1 = Rootstock containing red and curled leaves (8-10 days), S_2 =13-15 days, S_3 = 18-20 days, S_4 = 23-25 days and S_5= 33 - 35 days; ** = Significant at 1% level of probability; DAG= Days after grafting

Stages of rootstock had significant influence on all the mentioned parameters. Due to the different stages of rootstock minimum days were required to bud break and leaf emergence and the highest percentage of graft success and survival were noted onto the rootstock containing red and flat leaves at second flush (33-35 day old) whereas, the maximum days required to bud break and leaf emergence) were noticed when grafted onto

the rootstock containing red and flat leaves (13-15 days old).The lowest percentage of graft success and survival were achieved with grafting of the rootstock containing light green leaves day old. The maximum number of leaves was recorded in the rootstock containing light green leaves (23-25-day old) while the minimum number was noted onto the rootstock containing turn to green leaves (18-20 day old). The results revealed that after 150 days of grafting operation the highest increase in stock length, scion length and stionic height were observed in the rootstock containing red and flat leaves at second flush (33-35 day old). On the other hand, the lowest increase in stock length was found in the rootstock containing red and curled leaves (8-10 day old). The lowest increase in each of scion length and stionic height was found in the rootstock containing light green leave (3- 5 day old).

IV. Conclusion

The rootstock containing red and flat leaves at second flush (33-35 day old) is the best for higher percentage of success and survivability. in respect of success and survivability of the graft, the splice method of grafting in Amrapali is superior to cleft method. Finally, the splice grafting onto the rootstock containing red and flat leaves at second flush (33-35 days old) is superior in respect of percentage of success and survivability. Therefore, the rootstock containing red and flat leaves at second flush and splice method of grafting may be recommended followed by cleft method with same stage of rootstock for the large scale propagation of mango (cv. Amrapali).

References

[1]. Anonymous. 1990. Study on stone grafting of jackfruit. Annual Report (1990-91), BARI, Joydebpur. p. 306.
[2]. BARI. 1994. Annual Report 1993-94. Bangladesh Agricultural Research Institute, Joydebpur, Gazipur. p. 376.
[3]. Bhambota, J.R., M.S. Rajput and K.S. Sanhdu. 1971. Veneer grafting a successful method of mango propagation. Punjab Hort. J., 11(1-2): 40-43.
[4]. Bhan, K.C., H.N. Samaddar and P.C. Yaday. 1996. Chip-budding and Stone grafting of mangoes in India. Tropi.Agric. (Trinidad), 46: 247-253.
[5]. Brahmachari, V.S., M.P. Singh and R.C. Bishwas. 1999. Effect of period of defoliation of scion and age of rootstock on success of epicotyl grafting in mango (Mangifera indica L.) cv. Amrapali. Orissa J. Hort., 27(2): 1-4.
[6]. Dhakal, B.R. and M.N. Hoda. 1987. Vigour of mango veneer grafts in relation to defoliation period and storage of scion shoots. South India Hort., 34(3): 184-186.
[7]. Gomez, K.A. and A.A. Gomez. 1993. Statistical procedure for agricultural research (2nd ed.). John Willy and Sons. New York. pp. 272-279.
[8]. Gupta, 0.P., J.S. Jawanda and K.C. Sharma. 1988. Stone grafting in mango .
[9]. Hoque M.E. and A. Hussain. 1974. Graft union studies in mango, Bangladesh Hort., 2(2): 1-3.
[10]. Hossain, MA., M.M. Ahasan, A.K.M.A. Prodhan, M.S.A. Fakir and M.M. Rahman. 1991. Studies on the improvement of propagation techniques of mango (tiangifera indica L.). Proc. BAU Res. Prog., 5: 148-155.
[11]. Islam, M.N., A.K. Azad, D. Kam al and A. Ahmed. 1994. Studies on grafting in mango. Bangladesh Hort., 22 (1-2): 133-135.
[12]. Jose, M. and P. K. Velsalkurnari. 1991. Standardization of epicotyl and softwood grafting in jackfruit. South Indian Hort., 39(5): 264-267.
[13]. Kashyap, R., S.S. Shrivastava and A.B. Sharma. 1989. Studies on the vegetative propagation of mango. Acta Hort., 231: 263-265.
[14]. Mirdah, M.H. 2002. Effect of time of operation, methods and defoliation period on the success and subsequent growth of mango grafts. M.S. Thesis. Department of Horticulture, BAU, Mymensingh. pp. 35-86.
[15]. Singh, A.R., S.P. Pandey. R.K. Singh ancLM.D. Singh. 1992. Influence cultivars andperiod of operation on the success of veneer grafting mango. Advanced in Horticulture and Forestry, 2: 17-23.
[16]. Sritastava, S.S., A.B. Sharma and P. Kumar. 1989. Studies on the factors contributing to the successor grafting in mango. Agricl. Sci. J., 9(1): 7-10.

Md. Rafiqul Islam, et. al. "Effect of stages of rootstocks and methods of operation on the success and survivability of stone grafting of mango." *IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)*, 15(01), 2022, pp. 57-63.