

Study on the growth of plants produced by epicotyl (stone) grafting with different rootstock-scion combinations in mango

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Abstract: An experiment were carried out in the field of the BAU-Germplasm Center, Fruit Tree Improvement Project (FTIP) as well as in the laboratory of FTIP, Department of Horticulture, Bangladesh Agricultural University, Mymensingh during March 2007 to January 2008 to investigate the performance of mango plants raised by epicotyl grafting with different rootstock –scion combination in respect of growth in mango. Experiment was laid out in Randomized Complete Block Design. The differences among different treatment were separated by LSD test. The result revealed that the combinations of the scion of the same cultivar grafted onto the rootstock of the same cultivar performed better in respect of morphological growth compared to other combinations.

Key words: Epicotyl (stone) grafting, rootstock-scion combination, mango

Introduction

Stionic relationship is an important factor for successful graft production, which is reported by many workers (Hodgson, 1943; Gowder and Irulappan, 1970; Kusumo *et al.*, 1971; Swamy *et al.*, 1972). If the scion is from the dwarf plant and the rootstock is from a tall plant or vice versa, the graft union may occur but the growth of both the scion and stock may not be uniform. The non-uniform growth may affect in the growth and development of the future plants, flowering, fruiting and ultimately on the total production. Not only that, the grafted plants produced by different methods of propagation may differ in their growth and development, flowering and fruiting. Yet, the work on the performance of the different methods of vegetative preparation and rootstock and scion combination are still very limited under Bangladesh conditions. Considering the above facts the experiment was undertaken with the following objectives i) to find out the suitable rootstock and scion combination for balance growth of the plants.

Materials and Methods

The experiment was carried out to study the performance of the plants produced by epicotyl (stone) grafting with different rootstock-scion combinations in mango (cvs. Amrapali and Gopalbhog). The plants were planted during October 1999 and the study was continued up to March 2002 as Ph. D program and the further study for this experiment was carried out from April 2002 to March 2003 for Ms program and. also then this study was carried out during the period from February 2003 to January 2004. A single-factor experiment was conducted in a Randomized Complete Block Design (RCBD) with 6 types of plants raised by 6 rootstock-scion combinations in two varieties of mango (cv. Amrapali and Gopalbhog), planted in 3 blocks having 2 grafts per replications. Types of plants were :A₁ = Plants raised by Amrapali_{rootstock} + Amrapali_{scion} = (A_r + A^s) combination, A₂ = Plants raised by Amrapali_{rootstock} + Gopalbhog_{scion} = (A_r + G^s) combination, A₃ = Plants raised by Gopalbhog_{rootstock} + Amrapali_{scion} = (G_r + A^s) combination, A₄ = Plants raised by Gopalbhog_{rootstock} + Gopalbhog_{scion} = (G_r + G^s) combination, A₅ = Plants raised by Unknown_{rootstock} + Amrapali_{scion} = (U_r + A^s) combination, and A₆ = Plants raised by Unknown_{rootstock} + Gopalbhog_{scion} = (U_r + G^s) combination. Thus, the total numbers of 6 x 2 x 3 = 36 grafts were planted during October 1999. The selected grafts were planted in a hexagonal system at 3.5 meter

distance. Drains of about 30 x 30 cm were made between each block for better drainage facilities. The data were recorded on increase in the height of rootstock ,increase in the girth of rootstock ,increase in the height of scion, increase in the girth of scion, increase in the number of shoots/plant, increase in the canopy volume, leaf area index. Necessary measures were taken to make the plot weed and pest free and create a favorable environment to ensure proper growth and development of the plant. In August 31, 2003 Urea 28 kg, TSP 55 kg and MP 60 kg fertilizer applied in total field after ploughing followed by spading and also 10 kg cowdung/plant and 250 g oil cake were applied in the ring method. Every fertilizer application was followed by subsequent irrigation as and when necessary. Irrigation was done by flood basin method. No training or pruning was done in this experiment to observed the growth habit of the plants raised by different grafting methods. The recorded data on different parameters were statistically analyzed by using MSTAT-C software to find out the significance of variation resulting from the experimental treatments. The difference between the treatment means was judged by Least Significant Difference Test (LSD).

Results and Discussion

The results of the performance of the plants produced by epicotyl (stone) grafting with different rootstock –scion combinations have been presented in this section. The results of the growth of the plants height and girth of the rootstock and scion, number of panicle bearing branch at 42, 44, 46, 48, 50 and 52 months after planting the grafts in the field including the canopy volume have been discussed.

Height of the rootstock: The height of the rootstock was highly influenced by the different combinations of the rootstock and scion at 42, 44, 46, 48, 50 and 52 months after planting the grafts in the field. The highest height of the rootstock was recorded (36.50cm) in the plant produced by grafting the scion of cv. Amrapali onto the Amrapali rootstock (A_r + A^s). The lowest height of the rootstock was recorded (19.32cm) in the plants produced by the Gopalbhog scion onto the rootstock of Amrapali (A_r+G^s) at 41 months after the grafting operation (Table23). The result showed the superiority of the plants produced by grafting of the scion of the same cultivar onto the same rootstock. The combination of rootstock and scion other than the scion and rootstock of the same

variety was found inferior in relation to the height of the rootstock. The highest height of the rootstock of the combination of scion Amrapali onto the rootstock of

Amrapali possibly due to the compatibility of the rootstock and scion which enhanced rapid graft union process resulting highest growth of the plant.

Table 1. Main effect of different method of propagation on the increase in the height of rootstock (cm)

Treatments	Height of rootstock (cm)					
	42nd month	44 th month	46 th month	48 th month	50 th month	52 nd month
A _r +A ^s	32.50	33.30	34.70	35.50	36.20	36.50
A _r +G ^s	17.50	17.93	21.57	18.98	19.25	19.32
G _r +A ^s	21.50	22.00	22.63	23.43	23.80	27.23
G _r +G ^s	27.50	28.10	29.20	30.20	30.80	30.93
U _r +A ^s	23.00	23.90	24.80	25.40	25.60	25.70
U _r +G ^s	22.00	22.70	23.50	23.90	24.33	24.43
LSD at 0.01% level	1.620	1.630	6.775	1.966	1.940	5.599

Table 2. Main effect of different method of propagation on the grith of rootstock (cm)

Treatments	Grith of rootstock (cm)					
	42nd month	44 th month	46 th month	48 th month	50 th month	52 nd month
A _r +A ^s	32.40	32.80	33.54	34.33	35.03	35.33
A _r +G ^s	17.50	21.13	21.73	18.80	19.13	19.30
G _r +A ^s	21.30	21.65	22.25	22.62	22.90	23.07
G _r +G ^s	27.03	27.43	28.53	29.53	30.13	30.23
U _r +A ^s	22.77	23.32	24.32	25.03	25.37	25.47
U _r +G ^s	24.17	24.45	25.15	25.42	25.73	25.83
LSD at 0.01% level	0.838	6.173	6.075	1.073	1.032	1.029

Girth of rootstock: Different combinations of the rootstock and scion highly affected the girth of the rootstock at different months after planting the grafts in the field showing the superiority of the plant produced by the grafting of the same scion onto the same rootstock. The plants produced by grafting of the scion of the cv. Amrapali and Gopalbhog onto the rootstock of the unknown mango variety had more or less same trend in the growth of girth of rootstock (Table 24). On the other hand, the plants produced by the grafting of the grafting of the scion of the cv. Amrapali grafted onto the rootstock of cv. Gopalbhog and vice versa had the lowest girth development from 42 to 52 months after planting the grafts in the field. However, the highest girth (35.33cm) was recorded in the plants produced by the grafting of the scion of cv. Amrapali scion onto the plants produced Amrapali (A_r+A^s) followed by the plants produced by the grafting of the scion of cv. Gopalbhog onto the rootstock of cv. Gopalbhog (30.23cm).

Length of scion: The length of the scion was affected by the different combinations of the rootstock and scion in the stone grafting of mango from 42 to 52 months after planting in the grafts in the field. The highest scion length was (280.00cm) recorded in the plants produced by grafting of 'Gopalbhog' scion onto the unknown mango variety the lowest (178.00cm) was recorded in the plants produced by grafting the scion of cv. 'Gopalbhog' onto the rootstock of cv. 'Amrapali' (A_r+G^s) at 52 months after planting the grafts (Fig. 1).

Girth of the scion: The girth was highly influenced by the different combinations of rootstock and scion from 42 to 52 months after planting the grafts in the field. The highest girth (24.65cm) of the scion was recorded in the plants produced by grafting of the Amrapali scion onto the Amrapali rootstock (A_r+A^s) followed by the plants produced by grafting of the Gopalbhog scion onto the Gopalbhog (G_r+G^s) rootstock (21.07cm) from 42 to 52 month after planting in the field (Table 3). However, the result revealed the superiority of the plants produced by the grafting of the same scion onto the rootstock of the same variety of mango.

Number of shoots per plant: Production of the shoots per plant was seriously affected by the rootstock scion combinations in the epicotyl grafted mango plants at 42, 44, 46, 48, 50 and 52 month after planting the grafts in the field. The highest number of shoots/plant was found to be produced by the plants raised by grafting the scion of Gopalbhog onto rootstock of Amrapali (326.33cm) at 52 month after planting the grafts followed by the plants produced by grafting the scion of Gopalbhog onto the rootstock of Gopalbhog (G_r+G^s) (309.00). This plants raised by the combination of scion Amrapali onto the rootstock of Gopalbhog showed the lowest number of shoots/plant (Table 4).

Number of leaves: The number of leaves production /plant was seriously affected by the different combinations of the rootstock and scion at different months after planting the grafts in the field. The highest number of

Table 3. Main effect of different method of propagation on the increase in the grith of scion (cm)

Treatments	Grith of scion (cm)					
	42nd month	44 th month	46 th month	48 th month	50 th month	52 nd month
A _r +A ^s	21.67	22.07	23.09	23.69	24.29	24.65
A _r +G ^s	18.02	18.42	19.12	19.62	20.12	20.37
G _r +A ^s	15.02	15.32	15.85	16.35	16.85	17.12
G _r +G ^s	18.67	19.07	19.88	20.48	20.98	21.07
U _r +A ^s	18.40	18.80	19.55	20.05	20.55	20.73
U _r +G ^s	13.63	13.93	14.45	14.70	15.10	15.17
LSD at 0.01% level	0.231	0.231	0.216	0.216	0.216	0.216

Table 4. Main effect of different method of propagation on the increase in the number of shoots per plant

Treatments	Number of shoots per plant					
	42 nd month	44 th month	46 th month	48 th month	50 th month	52 nd month
A _r +A ^s	200.00	223.00	246.00	275.33	284.67	294.67
A _r +G ^s	230.00	254.00	277.00	306.33	316.33	326.33
G _r +A ^s	163.00	179.33	202.67	224.33	300.00	243.33
G _r +G ^s	213.00	238.00	263.33	291.33	302.00	309.00
U _r +A ^s	197.67	222.67	247.67	262.67	272.67	316.00
U _r +G ^s	164.33	189.33	214.33	229.33	239.33	245.67
LSD at 0.01% level	7.087	14.73	14.02	14.70	56.01	62.36

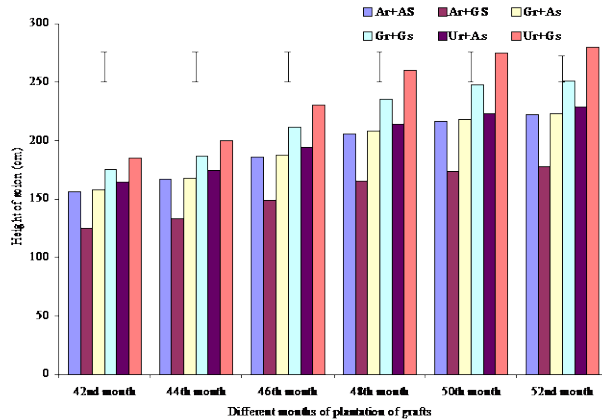


Fig. 1. Growth of scion in height at different months after plantation. Vertical bars represent LSD at 1% level of significance.

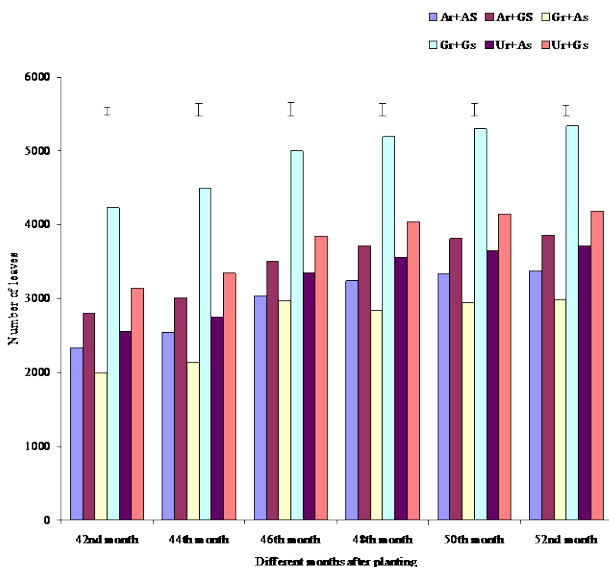


Fig. 2. Number of leaves of the plants raised by different rootstock-scion combination. Vertical bars represent LSD at 1% level of significance

leaves/plants (5340.00) was found to be produced by the plants raised by grafting of Gopalbhog scion onto the Gopalbhog rootstock (G_r+G^s) from 42 to 52 month after planting followed the plants produced by grafting of the Gopalbhog scion onto the rootstock of the unknown (U_r+G^s) mango variety (4191.00). The lowest number of leaves (2993.67) was produced by the plants grafted by the scion of Amrapali onto the rootstock of Gopalbhog (G_r+A^s) at 52 month after planting the grafts in the field (Fig. 2). The production of highest number in leaves of the combination of scion of Gopalbhog onto the rootstock of Gopalbhog might be due to the young twigs of the cv. Gopalbhog emergence with the numerous numbers of new shoots arranged with shortly interval internodes having numerous small leaves at its node, enhancing more number of shoots and leaves than any other variety of mango.

Canopy volume: Plants produced by epicotyl grafting through different rootstock- scion combination affected the overall growth and development, i.e. the canopy volume (m³) of the plants from 42 to 52 months after planting the grafts in the field. The highest canopy volume (7.85m³) were developed in the plants produced by grafting of Amrapali scion onto the rootstock of the Amrapali (A_r+A^s) and Gopalbhog scion onto the Gopalbhog rootstock (7.04m³). The lowest canopy volume was recorded in the plants produced by grafting of the scion of Amrapali onto the rootstock of Gopalbhog (5.14) at 52 month after planting the grafts in the field (Figure 3). The highest canopy volume of the G_r+G^s combination might be due to production of more number of shoots and leaves by the cv. Gopalbhog plants than other mango variety. From the result it is found that tree size vary with different rootstock and scion combination which is similar with the findings of Hartman *et. al.*(1997). They found that rootstock selection in apple has produced a complete

range of tree size from dwarfing to vary vigorous by grafting the same scion cultivar to different rootstocks.

The performance of stone grafted plants raised by different rootstock-scion combination has been studied and the results of the growth of the plants (height and girth of the rootstock and scion, number of shoots and leaves per plant, canopy volume and leaf area index) time of panicle initiation, number of fruit set/plant, weight of fruit/plant and quality of fruits (TSS) is given here. From the findings it was found that the highest height and girth of the rootstock and scion was recorded in the plants produced by grafting of Amrapali scion onto the Amrapali rootstock (Ar +As) but the highest height of the scion was produced in the plants raised by Gopalbhog scion grafted onto the unknown rootstock (Ur+Gs). The highest number of shoots was produced by the plants of Gopalbhog scion grafted on Amrapali rootstock and the highest number of leaves produced by the combination of the Gopalbhog scion grafted onto the rootstock of Gopalbhog. The highest leaf area index was found in the plants produced by the combination of the scion of Gopalbhog onto the rootstock of Gopalbhog. The highest canopy volume was produced by Amrapali scion grafted onto the Amrapali rootstock followed by the plants of Gopalbhog scion onto Gopalbhog rootstock combination plant. From the result it can be postulated that grafting of the scion onto the

rootstock of the same cultivar showed the superiority in the growth.

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