

A study of the plants produced by different methods of vegetative propagation in mango (cvs. Amrapali and Gopalbhog)

M.F.A. Bhuiyan, M.A. Rahim and M.S. Alam

Department of Horticulture, BAU, Mymensingh, Bangladesh

Abstract: Experiments 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 February 2003 to January 2004 to investigate the performance of the plants produced by different methods of vegetative propagation in respect to morphological growth, fruiting behavior including fruit weight and quality in mango. Experiment was laid out in Randomized Complete Block Design with three replications. The result revealed that the highest height and girth of rootstock as well as scion and no. of shoots/plant were obtained from modified cleft grafted 'Gopalbhog' plants. Cleft grafted 'Gopalbhog' plants produced the highest number of leaves/plant, girth of the scion and canopy volume than that of Amrapali.

Key words: Mango, vegetative propagation, variety.

Introduction

The farmers of Bangladesh generally use seed for mango propagation. Varietal purity can not be maintained in plants raised from seed. The plants take 8-10 years for fruiting and the canopy of the plant becomes large which covers larger area (Hartmann *et al.*, 1997). On the other hand, grafted mango plants require small area and yield can be obtained earlier compared to the plants raised from seed. In Bangladesh mangoes are grown everywhere, but the commercial and good quality grafted mangoes with known varietal names are mostly grown in the north-western districts and mangoes of unknown varieties (seedling mangoes) are grown in the south-eastern and other parts of the country (Bhuiyan, 1995; Faruque and Fakir, 1973; Reza *et al.*, 1995 and Samad *et al.*, 1975). In most of the areas of Bangladesh, the farmers, the growers or the nurserymen are not aware about the improved methods of propagation (Singh and Sirohi, 1972). There are many methods of mango propagation in mango growing countries like Thailand, the Philippines, among which now-a-days cleft grafting and stone grafting are the most commonly adapted methods. Considering the above facts the experiment was undertaken to find out the best method of vegetative propagation of mango for getting more yield and quality fruits for a long time.

Materials and Methods

The experiments were conducted at the Germplasm Center of the FTIP (Fruit Tree Improvement Project), Department of Horticulture, Bangladesh Agricultural University, Mymensingh. The experiment was conducted to investigate the performance of the plants produced by different methods of vegetative propagation. The plants were produced by different methods as contact grafting, stone grafting, veneer grafting, cleft grafting, modified cleft grafting and air layering. As this experiment is a continuation of a Ph. D work, the plants were planted during October 1999 and the study was continued up to March 2002 for Ph. D program and further study was carried out during the period from April 2002 to March 2003 for a MS program and also then this study was carried out during the period from February 2003 to January 2004. The two-factor experiment was conducted in a Randomized Complete Block Design (RCBD) with 12 types of plants raised by 6 types of grafting methods in two varieties of mango (cv. Amrapali and Gopalbhog). The

experiment consists of (6 x 2) 12 types of plant produced by 6 types of grafting methods in two varieties of mango (cvs. Amrapali and Gopalbhog) planted in 3 blocks. Factor A = Methods of propagation : A₁ = Plant produced by contact grafting , A₂ = Plant produced by Stone grafting (rootstock of unknown variety), A₃ = Plant produced by Veneer grafting, A₄ = Plant produced by Cleft grafting, A₅ = Plant produced by Modified cleft grafting, A₆ = Plant produced by Air Layering and Factor B = Variety: B₁ = Amrapali (Dwarf), B₂ = Gopalbhog (Tall) .Thus the total number of 6 x 2 x 3 x 2 = 72 grafts were planted during October,1999.The selected grafts were planted in a hexagonal system at 3.5 m distance. Drains of about 30 x 30 cm were made between each block for better drainage facilities. 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 observe the growth habit of the plants raised by different grafting methods. The data was recorded in one month interval. Different types of grafts were planted under this investigation. Data were recorded on-increase in height (cm) and girth (cm) of rootstock, height (cm) and girth of scion (cm), number of shoot/plant, leaf area index and leaves/ plant for better understanding of the growth of each group of the plant and canopy volume was measured as a common phenomenon for all the plants. Data was collected from February 2003 and continued up to January 2004.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 growth study have been presented on the height and girth of the rootstock and scion, number of shoots per plant, number of leaves per plant and canopy volume.

Table 1. Combined effect of methods of vegetative propagation and varieties on the increase in the height of rootstock

Variety	Propagation methods	Increase in the height of the rootstock (cm) at different months					
		42nd month	44 th month	46 th month	48 th month	50 th month	52nd month
Amrapali	Contact	18.92	19.33	19.95	20.46	20.80	21.17
	Stone	9.00	9.37	10.03	10.47	10.75	11.09
	Veneer	32.58	33.33	34.33	35.14	35.70	36.20
	Cleft	50.33	50.60	51.27	51.95	52.45	52.87
	M. Cleft	36.17	36.77	37.77	39.80	38.73	38.92
	Air layering	0.00	0.00	0.00	0.00	0.00	0.00
Goplabhog	Contact	15.75	16.17	16.76	17.63	18.05	18.44
	Stone	6.50	7.92	8.39	8.78	9.09	9.38
	Veneer	44.25	43.40	44.30	45.00	45.56	44.78
	Cleft	44.58	45.18	46.18	46.88	47.03	47.48
	M. Cleft	54.17	54.77	55.77	56.37	58.25	58.75
	Air layering	0.00	0.00	0.00	0.00	0.00	0.00
LSD (0.05)		10.01	10.01	10.09	10.05	9.55	9.83

Table 2. Combined effect of methods of vegetative propagation and varieties on the increase in the girth of the rootstock

Variety	Propagation methods	Grith of rootstock (cm)					
		42nd month	44 th month	46 th month	48 th month	50 th month	52nd month
Amrapali	Contact	25.20	25.59	26.07	26.85	26.97	27.05
	Stone	21.50	21.92	22.76	23.49	23.98	24.35
	Veneer	21.70	22.12	23.27	24.11	24.59	25.00
	Cleft	24.67	25.09	25.91	26.75	26.91	27.32
	M. Cleft	27.07	27.51	28.31	28.79	29.18	29.64
	Air layering	0.00	0.00	0.00	0.00	0.00	0.00
Goplabhog	Contact	25.53	25.93	26.40	27.54	28.03	26.80
	Stone	15.23	22.32	23.13	23.92	24.43	24.83
	Veneer	21.97	22.38	22.85	23.65	24.15	24.57
	Cleft	24.93	25.34	26.18	26.99	27.49	27.87
	M. Cleft	27.27	27.67	28.47	29.27	29.77	30.18
	Air layering	0.00	0.00	0.00	0.00	0.00	0.00
LSD (0.05)		3.03	0.546	0.891	0.865	0.987	1.476
(0.01)		4.082	0.742	1.211	1.176	1.342	2.006
Level of significance		**	**	**	**	**	**

Increase in height of rootstock: It was found that the increase in the height of the rootstock was varied among the plants produced by different methods at 42, 44, 46, 48, 50 and 52th month after plantation. The highest increase of rootstock at 41 month after planting was found in the plants produced by cleft grafting (50.18cm) followed by modified cleft grafted plants (48.84cm) and the lowest increase (10.24cm) in the height of the rootstock was recorded in stone grafted plants. The highest increase in the height of the rootstock in cleft grafted plants might be due to excellent stionic relationship that promoted the growth of the rootstock through rapid graft union process. No significant effect on increase in the height of the rootstock was observed between the different varieties of mango in this investigation. However, the highest increase in height of rootstock (29.12cm) was found from Goplabhog plants.

The highest increase in the height of rootstock (58.75cm) was observed in the cv. Goplabhog produced by modified cleft grafting and that of the lowest was (9.38cm) in the

stone grafted Goplabhog plant at 52nd month after planting the grafts in the field (Table 1).

Increase in girth of rootstock; After 52nd month of planting the modified cleft grafted plants gave the highest increase in the girth of the rootstock (29.91cm) followed by cleft grafted plants (27.60 cm). The lowest (24.59 cm) was found in epicotyl grafted plants. The highest increase in the girth of the rootstock in the modified cleft grafted plants might be due to the well growth scion shoot provided food materials produced in its leaves for the rootstock and the rootstock provided the required amount of water and mineral nutrient through their rapid and excellent stionic relationship and ultimately the rootstock had the highest girth in the modified cleft grafted plants. The result is partial agreement with the findings of Radhamony *et. al.* (1989) where, they found that the girth of rootstock significantly varied only during the initial stage of growth but the investigation postulated the highly significant variation of the girth of the rootstock through the total period of investigation.

Different varieties of mango exerted no significant effect on the increase in the girth of the rootstock 42, 46, 48, 50 and 52th months after planting the grafts but 44th month showed significant effect. The highest girth of rootstock observed in Gopalbhog (20.61cm) at 44th month.

The combined effects of the methods of propagation and the varieties were found highly significant in the increase on the girth of the rootstock at 42, 44, 46, 48, 50 and 52th months after planting of the grafts.

It was found that the highest increase in the girth of the rootstock (29.64cm) was recorded in the modified cleft grafted Gopalbhog plants and the lowest (24.35cm) obtained from stone grafted Amrapali plant at 52th month after planting the grafted in the field (Table 2). However,

the result revealed that the increase in the girth of the rootstock had a trend of highly significant growth towards the aging of the plants.

Increase in height of scion: The increase in the length of the scion in different months after planting was highly influenced by the different methods of vegetative propagation in mango. At 52th month after planting the highest (393.00cm) increase of scion was recorded in modified cleft grafted plants followed by cleft grafted plants. The lowest increase in the height of the scion (266.20cm) was recorded in the air layering plants at 41th months after plantation. The highest increase in the modified cleft grafted plants may be due to proper stionic relationship.

Table 3. Combined effect of methods of vegetative propagation and varieties on the increase in the height of the scion

Variety	Propagation methods	Height of scion (cm)					
		42nd month	44 th month	46 th month	48 th month	50 th month	52nd month
Amrapali	Contact	236.00	242.00	261.66	281.00	285.00	290.00
	Stone	246.00	258.30	277.30	294.30	302.30	305.30
	Veneer	240.00	253.00	270.00	289.00	297.00	303.00
	Cleft	260.17	274.00	307.00	328.30	338.30	345.70
	M. Cleft	288.17	305.00	335.30	360.30	369.30	376.30
	Air layering	227.30	233.00	250.00	262.00	298.30	268.00
Gopalbhog	Contact	250.00	256.00	274.30	285.30	292.00	297.00
	Stone	248.00	258.00	288.30	307.30	315.30	325.30
	Veneer	245.00	262.30	281.30	302.70	306.70	308.70
	Cleft	270.00	284.00	301.00	323.00	334.00	343.30
	M. Cleft	308.17	327.00	364.70	390.70	400.70	409.70
	Air layering	224.43	230.30	244.30	256.30	260.30	264.30
LSD (0.05)		8.216	8.286	8.099	7.795	27.910	8.044
(0.01)		11.170	11.260	11.01	10.060	-	10.930
Level of significance		**	**	**	**	*	**

Table 4. Combined effect of variety and methods of vegetative propagation on the increase in the grith of scion

Variety	Propagation methods	Grith of scion (cm)					
		42nd month	44 th month	46 th month	48 th month	50 th month	52nd month
Amrapali	Contact	18.30	18.75	19.35	19.66	19.80	16.54
	Stone	18.50	18.96	19.74	20.24	20.46	20.57
	Veneer	15.00	15.55	16.15	16.54	16.69	16.80
	Cleft	19.90	20.45	21.32	21.95	22.29	22.41
	M. Cleft	18.60	19.35	20.42	21.18	21.50	21.60
	Air layering	16.47	16.97	17.70	18.25	18.46	18.53
Gopalbhog	Contact	20.00	20.50	21.30	21.34	21.56	21.63
	Stone	15.33	15.70	16.23	16.49	14.53	16.78
	Veneer	17.20	17.59	18.43	18.93	19.11	19.19
	Cleft	21.30	21.97	22.82	23.44	23.67	23.78
	M. Cleft	20.07	21.10	22.43	23.01	23.29	23.40
	Air layering	20.07	20.47	21.30	21.80	22.04	22.36
LSD (0.05)		0.987	0.997	1.007	0.984	1.629	5.490
(0.01)		1.342	1.356	1.369	1.338	2.215	7.501
Level of significance		**	**	**	**	**	**

Highly significant differences in varieties of mango on increase in the length of the scion were recorded at 42, 44, 48, 50 and 52th months after planting the grafts in the field except 46th month. The highest increase in the height of

scion was produced by cv. Gopalbhog plants (324.70cm) than cv. Amrapali plants. The highest height of Gopalbhog plants might be due to the tallness characteristics of the cv. Gopalbhog.

The combined effect of the methods of propagation and the varieties had highly significant effect on the increase in the height of scion from 42, 44, 46 48 and 52th months after planting the grafts in the field except 50th month which was significant (Table 3). At 42,44,46 and 52th month it was found that the modified cleft grafted Gopalbhog plants gave the highest increase (409.70 cm) in the height of rootstock. This might be due to the excellent stionic relationship and the nature of the cultivar. The cultivar Gopalbhog is a tall variety by nature which has a tendency for quick growth than of cv. Amrapali.

Girth of the scion: The highest increase in the girth of the scion (23.10cm) was recorded in the plant produced by cleft grafting followed by modified cleft grafted plants

(22.50cm). Though inserted contact grafted plants had considerable increase in the girth of the scion during the study period. The lowest increase (18.00cm) in the girth of the scion was recorded in the plants produced by veneer grafted plants after 52th month of plantation and the increase in the girth of the scion showed a highly significant increasing trend with the increase in the age of the plants.

Highly significant effect of variety under the investigation was observed on the increase in the girth of the scion at 42, 44, 46, 48 and 52th months after planting the grafts in the field and significant effect showed in 50th month. However, the highest increase in the girth of the scion (21.19cm) was obtained from Gopalbhog plant.

Table 5. Combined effect of different methods of vegetative propagation and varieties on the increase in the number of shoots/plant

Treatments		Number of shoots per plant					
Variety	Propagation methods	42nd month	44 th month	46 th month	48 th month	50 th month	52nd month
Amrapali	Contact	98.50	115.66	127.33	137.66	164.00	174.00
	Stone	196.00	226.00	261.00	281.00	303.33	322.67
	Veneer	172.00	201.33	231.50	251.33	284.67	294.67
	Cleft	251.67	282.33	322.67	357.33	417.33	439.00
	M. Cleft	251.67	288.33	348.50	374.33	427.67	468.00
	Air layering	121.00	138.00	158.00	170.67	212.67	0.00
Goplabhog	Contact	117.83	128.00	140.00	149.67	165.67	175.67
	Stone	172.00	196.67	220.83	240.67	266.00	286.67
	Veneer	217.33	257.33	307.33	326.67	366.67	376.67
	Cleft	247.67	277.67	327.67	353.67	425.00	456.00
	M. Cleft	280.00	320.00	360.00	390.00	440.00	480.00
	Air layering	155.33	170.33	190.50	202.00	227.67	247.67
LSD (0.05)		3.448	5.177	4.441	4.325	8.963	7.165
(0.01)		4.686	7.036	6.036	5.878	12.18	9.738
Level of significance		**	**	**	**	**	**

Table 6. Combined effect of variety and methods of vegetative propagation on the number of leaves per plant

Treatments		Number of leaves per plant					
Variety	Propagation methods	42nd month	44 th month	46 th month	48 th month	50 th month	52nd month
Amrapali	Contact	4061.66	4611.66	5311.50	5865.00	6146.66	6632.66
	Stone	2590.00	2840.00	3092.00	3424.33	3514.33	3748.00
	Veneer	4908.33	5628.33	6351.67	7264.67	7455.67	7736.33
	Cleft	6065.00	6915.33	7766.33	8912.33	9382.33	10382.33
	M. Cleft	5230.00	6051.67	6870.00	7920.00	8155.33	8755.33
	Air layering	4181.67	4854.67	5524.33	6194.33	6346.33	6646.33
Goplabhog	Contact	4390.00	4993.33	5793.33	6570.33	6767.00	7146.67
	Stone	3155.00	3640.00	4185.67	4714.33	4914.33	5209.33
	Veneer	4530.00	5240.00	5950.00	6863.00	7013.00	7513.00
	Cleft	6614.33	7424.33	8244.33	9483.33	10062.33	11162.33
	M. Cleft	5552.33	6252.33	6952.33	8052.33	8435.33	9068.67
	Air layering	3786.67	4340.00	4893.33	5747.00	5947.00	6347.00
LSD (0.05)		8.885	23.50	80.38	80.32	55.23	37.52
(0.01)		11.63	31.94	109.20	109.20	75.06	50.99
Level of significance		**	**	**	**	**	**

The combined effect of the methods of vegetative propagation and the varieties under this investigation had highly significant influence on the increase in the girth of the scion from 42th to 52th month after plantation. The highest increase in the girth of the scion was observed in the cleft grafted Gopalbhog (23.78cm) plants after planting the grafts in the field (Table 4).

Number of shoots per plant: The modified cleft grafted plants produced the highest number of shoots (474.00). Contact grafted plants were the most inferior in the production of shoots (174.83) followed by the air layered plants (304.67). Although primarily a considerable number of shoots were produced by air layered plants. Finally, the highest number of shoots was produced by the modified cleft grafted plants followed by the cleft grafted plants and that of the lowest was recorded in the increase contact grafted plants. It also indicated that the overall growth of the modified cleft and cleft grafted plants were significantly increasing and that of air layered and inserted contact grafted plants were slow with the aging of the plants. This result is almost similar to the findings of Ram and Sirohi (1989) where they stated that the number and the time of the production of the primary branches varied with the methods of propagation.

The production of the number of the shoots per plants i.e., the increase in the number of shoots per plants was highly affected by the different varieties of mango under investigation from 42th to 52th months after planting. Gopalbhog produced the highest number of shoots (337.11cm) and Amrapali produced the lowest number (283.06cm) of shoots.

Combined effect of methods of propagation and varieties was highly significant from 42th and 52th month after planting the grafts. The modified cleft grafted Gopalbhog plants produced the highest (480.00) number of shoots/plant (Table 5). This might be due to the interaction of the good stionic relationship and the genetical make-up of the respective mango variety.

Number of leaves per plant: The different methods of vegetative propagation highly influenced the production of number of leaves/ plant from 42th to 52th months after planting of the grafts in the field. Leaves are the most important growth factor of a plant, which was the highest in the cleft grafted plants (10772.33) followed by modified cleft grafted plants (8912.00). The epicotyl grafted plants produced the lowest number of leaves during the study period. The highest number of leaves production by the cleft grafted plants might be due to providing the excellent translocation of the water and mineral nutrient to the leaves of the scion part which manufactured food materials and translocated to the plants providing emergence of new shoots. This result is in agreement with the findings of Sant- Ram (1993). He reported that cleft grafted plants produced a higher number of primary branches than other methods of grafting.

Highly significant different was observed on performance of different varieties from 31 to 41 months after planting the grafts in the field. The highest number of leaves observed in Gopalbhog (7741.17). Highly significant interaction effect of the methods of propagation and

varieties were observed from 42 to 52 months after planting the grafts (Table 6).

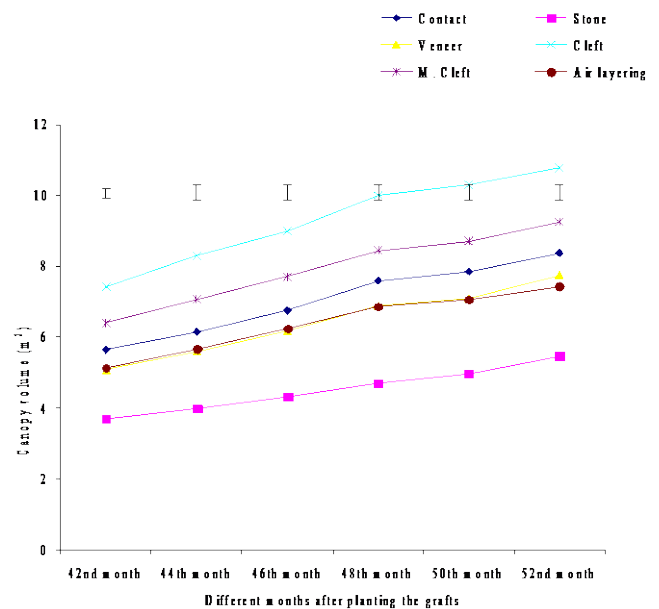


Fig. 1. Canopy volume of the plants produced by different methods of vegetative propagation. Vertical bars represent LSD at 1% level of significance

The highest number of leaves (11162.33) was produced by cleft grafted Gopalbhog plants this might be due to genetical characteristics of the variety that numerous small leaves are produced at each node of the newly developed shoots.

Canopy volume (m³): The canopy volume was highly influenced by the different methods of vegetative propagation at 42 to 52 months after planting the grafts in the field.

The trend in the development of the canopy volume was lowest in the epicotyl grafted planted (5.46m³) followed by Air layering (7.42m³) plants (Figure 1). The trend was highest in the cleft grafted plants (10.77m³) followed by modified cleft grafted plants (9.24m³).

The canopy volume of the plants was highly influenced by the different varieties of mango from 42 to 52 months after planting the grafts in the field. The highest value was observed in Amrapali (8.32m³) and the lowest in Gopalbhog (8.02m³) at 52 month. Highest and lowest different was small.

The methods of vegetative propagation and the varieties of mango exerted highly significant interaction on the growth i.e. the canopy volume (m³) of the plants from 42 to 52th months after planting the grafts in the field. The result revealed that the highest canopy volume was marked in the cleft grafted Gopalbhog plants (11.16m³) but that of the lowest was in the stone grafted Gopalbhog plants (4.56m³) (Table 8). From the result it is postulated that there was increasing growth trend of the plants with the increase in the plants after plantation in the fields. The production of the highest canopy volume in cleft grafted Gopalbhog plant might be due to tallness of the cultivar which supports the work of Sant – Ram (1993). He found that the height of the main stem was higher in the cleft

grafted plants than air layering, veneer grafted and other plants.

Table 7. Main effect of different mango varieties on the increase in the volume per plant

Treatment	Volume of plant					
	42th month	43th month	44 th month	45 th month	46 th month	47 th month
Amrapali	5.62	6.23	6.78	7.52	7.77	8.32
Gopalbhog	5.49	6.01	6.60	7.29	7.53	8.02
LSD (0.05)	0.021	0.030	0.030	0.030	0.030	0.030
(0.01)	0.029	0.042	0.042	0.042	0.042	0.042
Level of significance	**	**	**	**	**	**

Table 8. Combined effect of variety and methods of vegetative propagation on the volume per plant

Treatments		Volume of plants					
Variety	Propagation methods	42nd month	44 th month	46 th month	48 th month	50 th month	52nd month
Amrapali	Contact	5.65	6.18	6.74	7.56	7.79	8.41
	Stone	4.10	4.50	4.86	5.31	5.69	6.37
	Veneer	5.05	5.62	6.16	6.85	7.06	7.91
	Cleft	7.18	8.15	8.87	9.87	10.15	10.38
	M. Cleft	6.86	7.60	8.19	8.97	9.17	9.73
	Air layering	4.85	5.34	5.85	6.55	6.78	7.08
Gopalbhog	Contact	5.60	6.13	6.76	7.60	7.86	8.33
	Stone	3.25	3.45	3.75	4.07	4.24	4.56
	Veneer	5.10	5.57	6.18	6.92	7.12	7.59
	Cleft	7.65	8.43	9.10	10.10	10.45	11.16
	M. Cleft	5.92	6.52	7.19	7.89	8.20	8.75
	Air layering	5.40	5.95	6.61	7.15	7.33	7.75
LSD (0.05)		0.053	0.075	0.075	0.075	0.075	0.075
(0.01)		0.072	0.102	0.102	0.102	0.102	0.102
Level significance		**	**	**	**	**	**

The investigation carried out on the performance of plants raised by different methods of propagation found that there was significant difference on the growth and fruiting of different plants raised by different methods of vegetative propagation but in some of the case no significant effect was found between the varieties. The increase in the height and girth of the rootstock and height of scion was the highest in the modified cleft grafted Gopalbhog plants at 52 month after planting the grafts in the field. The highest increase in the girth of the scion was recorded in the cleft grafted Gopalbhog plants. The investigation showed that the highest number of shoots per plant was produced in the modified cleft grafted plants. The tall variety cv. Gopalbhog raised by modified cleft grafting produced the highest number of shoots per plants where as, the highest number of the leaves were produced by cleft grafted Gopalbhog plants. The result revealed that the shoot production in the modified cleft grafted plants and that of the cleft grafted plants were more or less statistically identical.

References

Bhuyan, M. A. J. 1995. Mango. In: Fruit Production Manual, Horticulture Research and Development Project, DAE-BADC. Pp. 197.

- Faruque, A. H. M. and M. M. A. S. Fakir. 1973. Propagation of mango by different methods of grafting. *Bangladesh Hort.* 1(2): 25-28.
- Hartmann, H. Kester, T. D. E., Davies, J R.F.T. and Geneve, R.L. 1997. *Plant Propagation: Principles and Practices*. Prentice-Hall of India Private Limited, New Delhi-110001.770p.
- Radhamony, P. S., Gopikumar K. and Valsalakumari, P. K. 1989. Varietal response of scion to stone grafting in mango for commercial propagatin. *south Indian Hort.* 3795: 298-299.
- Ram S. and Sirohi, S. C. 1989. Performance of Dasherhari mango trees propagated by different vegetative methods. *Acta Hort.* 231:210-215.
- Reza, M. H., Guha, D. and Shakur, M. A. 1995. Annual Report on Mango Improvement. (1994-95). RHRS, BARI, Nawabgong. 37p.
- Samad, M. A., Faruque, A H. M. and Malek, M. A. 1975. A study on the biochemical characteristics of the fruits of some common mango varieties of Bangladesh. *Bangladesh Hort.*, 3(2): 28-32.
- Singh, A. R. and Sirohi, R. K. 1972. Relative efficiency of different methods of propagation is influencing the growth of mango. *Horticulture Advances*, 9(1): 25-26.