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Effect of height of rootstock on success of epicotyl grafting in mango (*Mangifera indica* L.) cv. KESAR

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ABSTRACT

The investigation was carried out with twelve treatments comprising four heights (4, 6, 8 and 10 cm) of rootstocks The maximum number of sprouted grafts, maximum sprouting percentage, minimum days for leaf emergence, maximum number of leaves per graft, girth (above the union), minimum mortality (%) and maximum survival (%) of grafts were recorded when grafts were made on 6 cm height of rootstock. Consequently, the maximum growth in terms of height and girth (below the union) and were recorded in grafts made on 10 cm height of rootstock of mango cv. KESAR.

Key words : Epicotyl grafting, mango, height of rootstock

INTRODUCTION

Mango (*Mangifera indica* L.) is considered as the King of fruits. It is the national fruit of our country and seems to be under cultivation well over 4000 years (De Candolle, 1984). Different methods of vegetative propagation used by local commercial nurserymen; which depends upon the grower's preference of the region. In western India, particularly in Gujarat, Maharashtra, Karnataka, inarching or simple approach grafting is very common. However, this method is time consuming, laborious with long process.

In couple of years, epicotyl method has been found the easiest, cheapest and less time consuming method for mango grafting. Epicotyl grafting has a good promise as it is easy to operate and very cheap (Bhan *et al.*, 1969). One of the striking advantages of this method is that the scion shoot of desired varieties can be collected from distant places, because it can be stored up to 4 days with good result up to some days by providing favorable conditions. The cost of production of seedling rootstock is minimized upto a great extent. It is a scion detached method, very easy, simple and rapid (Majumder and Rathore, 1970). The research work carried out during the last few years have clearly shown that this technique can be adopted for large-scale multiplication of mango in Western India. Epicotyl grafting method is being employed for massive production of mango grafts in the Kokan region of Maharashtra (Gunjate, 1989).

MATERIALS AND METHODS

Raising of seedlings for rootstock :

Seed stones of mango cv. KESAR were collected from processing factory. They were sown in line on the flat beds in flat position at 10 x 2.5 cm distance and were covered with 5 cm thick layer of farmyard manure and soil in the ratio of 1:1. Sowing was done on 28th June 2006. Germinating stones from which the epicotyl was just emerged and straightened out were selected as rootstocks. The healthy vigorous seedlings with straight and stout epicotyl were uprooted along with seed stones without causing much injury to the roots.

Rootstocks :

The healthy uniform mango seedlings free from pest and diseases were selected and sorted as per different heights *i.e.* H_1-4cm, H_2-6cm, H_3-8cm and H_4-10cm from the base of stock for propagation purpose.

Operation of epicotyl grafting :

The epicotyl grafting was done by wedge technique of grafting, as described by Bhan *et al.* (1969). In this method, vertical cut of 3 cm length was given onto deheaded epicotyl of germinated seed so as to fit the wedge shape scion. Then the scion of comparative thickness was made like wedge by giving slanting cut of 3 cm length on opposite sides. The wedge shaped scion was inserted into the slit of the epicotyl of the stock. The joint was tied with polythene stripe of 200 gauges. The grafts were observed for initial success (sprouting) at 45, 60, 75 and 90 days of age of grafts. The observations on survival percentage were recorded at after 90 days of grafting. The height, girth (above and below the union) and total number of leaves were recorded one month interval.

RESULTS AND DISCUSSION

There was significant difference in number of sprouted grafts when they were made on different height of rootstocks and periodically observed at 45, 60, 75 and

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90 days of grafts (Table.1). The higher number of sprouted grafts were recorded as 14.83, 12.83, 11.67 and 11.00 at 45, 60, 75 and 90 days of grafting, respectively, when grafts made on 6 cm height of rootstock (H_2). While lower number of sprouted grafts were recorded as 12.00, 10.08, 8.92 and 7.92 when grafts made on 4 cm height of rootstock (H_1) at 45, 60, 75 and 90 days of grafting, respectively.

Early callus formation occurred mainly from the rootstock with cells produced in definite rows, often in fan-like array. The establishment of the cambial bridge between the stock and scion was followed by the formation of a protective layer, the periderm across the callus edges (Asante and Barnett, 1997). Success in grafting depends upon good cambial bridge between stock and scion may result into better callus formation and union. Hence, maximum numbers of sprouted grafts were recorded in mango cv. KESAR, have been recorded in this study. The results obtained by Kanwar and Bajwa (1974), Patel and Amin (1976), Chakrabarti and Sadhu (1984), Patil *et al*. (1984), and Reddy and Kohli (1989) found the same trend while working on mango as well as other fruit crops. The results are in conformity with the present findings.

The data presented in Table 1 clearly revealed that the sprouting percentage of epicotyl grafts were significantly influenced by 6 cm height of rootstocks at 45, 60, 75 and 90 days age of grafts recording 74.17, 64.17, 58.33 and 55.00 per cent, respectively. The other treatments also produced the significant effect on sprouting percentage of grafts. Further, it was also noted that there was gradual decline in the sprouting percentage by the passage of time in all the treatments. Success in grafting depends upon various parameters. Proper development of cambium layer in rootstock having more length i.e height of rootstock and good cambial bridge between stock and scion may result into better callus formation and union. This has resulted into higher percentage of sprouting in epicotyl grafts of mango cv. Kesar. The findings of present studies are in consonance with those Patel and Amin (1976), Chakrabarti and Sadhu (1984), Patil *et al*. (1984), Ratan *et al*. (1987) and Reddy and Kohli (1989). Similar results were also noted in different fruit crops.

The data presented in Table 2 revealed that there were significant differences in days required for leaf emergence in grafts due to different height of rootstock. When the grafts made on 6 cm height of rootstocks (H_2), they took significantly the minimum days (15.65) for leaf emergence which was at par with the height (15.86) epicotyl grafts made on 8 cm height of rootstock (H_3). While the maximum days (16.43) for leaf emergence were recorded in grafts made on 4 cm height of rootstock (H_1).

Callus formation is pre-requisite for successful formation of graft union. New parenchymatous callus proliferates in one to seven days from both the rootstock and scion. However, the stocks produced most of the callus. This perhaps may due to absorption of water and nutrient by rootstock initiating, involvement in rapid cell division of parenchymatous cells. These parenchyma cells comprising the spongy callus tissue, penetrates the thin necrotic layer within two to three days and fill the space between the two components of the grafts (scion and stock), becoming initially interlocked and providing some mechanical support as well as allows for limited passage of water and nutrient between the stock and scion (Hartman and Kester, 2002) due to which early sprouting may have taken place in epicotyl grafting. Patel and Amin (1976) and Patil *et al*. (1984) found the similar results while working on epicotyl grafting in mango, which support the present findings.

The data presented in Table 2 showed that height of rootstock did not exert any significant effect on leaf area.

The data pertaining to effect of height of rootstock on survival percentage of grafts were statistically analyzed and presented in Table 2. It is revealed from the data that the maximum percentage of survival (55.00) after 90 days of grafting, was recorded on the grafts were made on 6 cm height of rootstocks (H_2), while minimum

Table : 1 Effect of height of scion stick on number of sprouted grafts and sprouting percentage of grafts at 45, 60, 75 and 90 days

Treatments	Number of sprouted grafts and sprouting percentage per treatment at 15 days interval							
	45 days		60 days		75 days		90 days	
H_1	12.00	60.00 (50.75)	10.08	50.42 (45.22)	8.92	44.58 (41.87)	7.92	39.58 (38.97)
H_2	14.83	74.17 (59.43)	12.83	64.17 (53.21)	11.67	58.33 (49.77)	11.00	55.00 (47.85)
H_3	14.08	70.42 (57.03)	12.25	61.25 (51.48)	11.00	55.00 (47.85)	10.17	50.83 (45.46)
H_4	13.17	65.83 (54.20)	11.00	55.00 (47.85)	9.83	49.17 (44.05)	9.17	45.83 (42.59)
S.E.+	0.26	0.41	0.28	0.41	0.29	0.41	0.24	0.41
C.D. (P=0.05)	0.75	1.18	0.79	1.18	0.82	1.18	0.70	1.18
C.V %	6.72	6.63	8.33	7.22	9.62	7.66	8.82	7.99

Table 2 : Effect of length of scion stick on days required for leaf emergence, leaf area, survival and mortality percentage of grafts (after 90 days of grafting)

Treatments	Days required for leaf emergence	Leaf area (cm^2)	Survival percentage of grafts	Mortality percentage of grafts
H_1	16.43	254.16	39.58 (38.94)	20.42 (26.85)
H_2	15.65	261.50	55.00 (47.85)	19.17 (25.95)
H_3	15.86	267.93	50.83 (45.46)	19.58 (26.25)
H_4	16.22	275.16	45.83 (42.59)	20.00 (26.55(
S.E.+	0.09	5.37	0.41	0.41
C.D. (P=0.05)	0.25	N.S.	1.18	1.18
C.V %	1.89	7.03	7.99	12.45

N.S. – Non significance

percentage of survival (39.58) was recorded when grafts were made on 4 cm height of rootstocks (H_1). It is perusal from the Table 2 that the minimum mortality (19.17 %) after 90 days of grafting was recorded when the grafts were made on rootstock of 6 cm height (H_2) which was at par with H_3 and H_4 treatments. The maximum mortality (20.42 %) of grafts were recorded when grafts were made on 4 cm height of rootstocks (H_1). There were significant differences in mortality and survival percentage of grafts made by using different height of rootstocks. The minimum mortality and maximum survival percentage of grafts were recorded when epicotyl grafts were made on 6 cm height of rootstock, while the maximum mortality and minimum survival percentage of grafts were recorded when grafts made on 4 cm height of rootstock. The present findings are consonance with Ratan *et.al.* (1987) and Radha and Aravindakshan (1998).

Epicotyl grafting is generally done by uprooting seedlings and after grafting, grafted seedling is again planted in polythene bags. The well established root system get disturbed at the time of uprooting and transplanting, such uprooted seedlings required more time for establishment, such type of injury or damage to root system might be responsible for lower survival percentage. While in grafted plant at 6 cm height of rootstock helped to minimize the shock and ensure better survival and minimum mortality of the epicotyl grafts.

Grafting at 4 cm height of rootstock resulted into good initial sprouting, but later on failed to survive inspite of necessary cares taken at nursery level. Higher humidity during the monsoon months of heavy rain in this south Gujarat agro-climatic condition might have initiated the incidence of infection either at union or collar level because of delicate tissues.

Data presented in Table 3 clearly revealed that total numbers of leaves per graft were significantly influenced

Table 3 : Effect of hength of scion stick on height (cm) and total number of leaves of grafts

Treatments	Height (cm) and total number of leaves of grafts at one month interval							
	1 month		2 month		3 month		4 month	
H_1	20.25	8.93	22.25	14.79	24.43	21.00	27.72	25.24
H_2	21.82	10.88	23.63	17.02	25.93	24.45	29.37	28.94
H_3	23.53	9.97	25.62	16.09	27.77	23.10	31.18	27.53
H_4	25.65	9.52	27.68	15.67	29.73	22.05	33.00	26.35
S.E.±	0.17	0.08	0.20	0.14	0.17	0.12	0.15	0.17
C.D. (P=0.05)	0.49	0.23	0.56	0.41	0.48	0.35	0.42	0.48
C.V %	2.60	2.95	2.72	3.11	2.17	1.87	1.69	2.15

Table : 4 Effect of hength of scion stick on above and below girth (cm) of grafts

Treatments	Above and below girth (cm) of grafts at one month interval							
	1 month		2 month		3 month		4 month	
H_1	2.48	1.54	2.50	1.56	2.56	1.62	2.60	1.67
H_2	2.63	1.58	2.65	1.61	2.71	1.66	2.76	1.71
H_3	2.58	1.62	2.61	1.64	2.66	1.71	2.72	1.78
H_4	2.55	1.66	2.58	1.69	2.63	1.76	2.70	1.82
S.E.±	0.02	0.01	0.02	0.01	0.02	0.01	0.01	0.01
C.D. (P=0.05)	0.05	0.03	0.05	0.03	0.04	0.03	0.04	0.02
C.V %	2.44	2.38	2.28	2.03	2.04	1.99	1.82	1.73

by various heights of rootstocks at periodical interval of growth stages of grafts. Mango grafts made on 6 cm height of rootstock (H_2) had the maximum number of leaves per graft consistently with 10.88, 17.02, 24.45 and 28.94 at 1, 2, 3 and 4 months interval, respectively.

There were significant differences in total number of leaves produced on grafts by using different height of rootstocks. The significantly maximum number of leaves per grafts were recorded when grafts made on 6cm height of rootstock, while the minimum number of leaves of grafts were recorded when grafts made on 4 cm height of rootstock. The rapid division of parenchymatous cells of cambium of rootstock within 2-3 days of grafting, which later on interlocked with parenchyma cells of scion and partly produced the limited passage within short period for translocation of water and nutrients, which might have resulted into production of new leaves. Further, the total number of leaves increased periodically indicated good functional activity of xylem and phloem. Patil *et al*. (1984) and Patil *et al*. (1994) also found the similar findings in mango and jackfruit which are in agreement of the results of present study.

The data pertaining to the height of epicotyl graft as influenced by the use of different height of rootstocks presented in Table 4. Significantly more height and girth (below the union) of grafts were recorded when grafts were made on 10 cm height of rootstock. The minimum height and girth (above and below the union) was recorded when grafts were made on 4 cm height of rootstock. The data clearly revealed that the height of graft was significantly influenced when grafts were made on 10 cm height of rootstocks (H_4) at all the age of grafts *i.e.* 1, 2, 3 and 4 months recording 25.65, 27.68, 29.73 and 33.00 cm, respectively. On the other hand, minimum height of graft was recorded as 20.25, 22.25, 24.43 and 27.72 cm at one month interval, respectively, when grafts were made on 4 cm height of rootstocks (H_1). The data of present research work are similar to those of Chakrabarti and Sadhu (1984) and Patil *et al*. (1984), while working on mango.

The temperature and humidity during July-August were seemed to be congenial for growth and also sap flow condition might be higher during these periods which led faster growth of scion shoots. The temperature and humidity during later part were low due to which, minimum growth might have taken by grafts. The gradual increase in girth periodically *i.e*. at one month interval because of the increase in leaf number and leaf area resulting into synthesis of photosynthates, which translocates towords the union. However, poor translocation may have occurred because of the narrow passage in newly differentiated vascular tissues at union portion. This might have resulted into increase in girth above the union than that of below the union.

Summary and conclusion :

Based on the present investigation on, "Effect of height of rootstock on success of epicotyl grafting in mango (*Mangifera indica* L.) cv. KESAR", it can be concluded that epicotyl grafts can be made successfully on 6 cm height of rootstock. The maximum number of sprouted grafts, maximum sprouting percentage, minimum days taken for leaf emergence, maximum number of leaves per graft, girth (above the union of grafts), minimum mortality and maximum survival (55 % after 90 days of grafting). Whereas, height and girth (below the union) of grafts were recorded when grafts were made on 10 cm height of rootstock in epicotyl grafts of mango cv. KESAR.

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