

EFFECT OF SCION LENGTH, DURATION OF DEFOLIATION AND POLY TUBE CAPPING ON SUCCESS OF WEDGE GRAFTING IN MANGO C V. DASHEHARI

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ABSTRACT

Studies were conducted to observe the effect of scion length, duration of defoliation and poly tube capping on success of wedge grafting in mango cv. Dashehari at Horticulture Farm, Department of Horticulture, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) during the year 2011-2012 in *kharif* and *rabi* seasons. The treatments consisted of combinations of three lengths of scion (15, 18, and 21 cm), three durations of defoliation of scion (4, 8 and 14 days) and covering or without covering of grafts with polythene tube just after grafting. Longer scions of 21 cm resulted in significantly higher percentage of successful grafts survival, percentage of graft establishment, percentage of graft sprouting, maximum height of grafted plant and length of sprout than shorter ones whereas it showed significantly minimum number of leaves graft⁻¹, days taken for first sprouting and days taken for last sprouting. Eight days duration of defoliation found to be the best for all growth characters except for days taken first sprouting. The highest numbers of successful grafts were obtained when grafted plants were covered with poly tube. Whereas, significant difference was found due to interaction of three factors, on length of sprout, girth of sprout, number of leaves graft⁻¹ and total height of grafted plant at 180 days after grafting. The treatment combination (21 cm scion length, 8 days defoliation duration with poly tube capping) exhibited maximum sprout length (18.31 cm) while, minimum sprout length (10.45 cm) was recorded in treatment combination of 15 cm scion length, 4 days defoliation duration without poly tube capping. The treatment combination 18 cm scion length, 8 days defoliation duration with poly tube capping recorded maximum sprouts girth (5.06 mm).

However, it was recorded lowest (2.44 mm) girth in treatment combination of 15 cm scion length, 4 days defoliation duration without poly tube capping. The best result (11.88 leaves per graft) obtained in treatment combination of 21 cm scion length, 8 days defoliation duration with poly tube while, minimum number of leaves (5.13) were found in treatment combination of 18 cm scion length, 4 days defoliation duration without poly tube capping. The treatment combination of 21 cm scion length, 8 days defoliation duration with poly tube capping was noted best among all the treatments, as it gave maximum height (59.23 cm), whereas lowest height (45.55 cm) was noted in treatment combination of 15 cm scion length, 4 days defoliation duration without poly tube capping.

(Key words: Mango, scion length, defoliation, poly tube capping, wedge grafting)

INTRODUCTION

The mango (*Mangifera indica* L.) is one of the most important fruit crops having socio-economic significance in many countries. It is the most popular, the choicest fruit and occupies a prominent place among the fruits of the world. Mango is the national fruit of India, Philippines and Pakistan. Three main centres of distribution of mango were suggested *viz.*, the India-Burma-Siam area, the Philippines, and the Malay Peninsula, with emphasis on the Indo-Burma region (Mukherjee, 1967). However, the north-eastern India, the Indo-Myanmar border region and Bangladesh is considered as centre of origin of mango (Candolle, 1904). The mango crop occupies an area of 2500

thousand hectares with the production of 18002 thousand metric tonnes in the country (Anonymous, 2013a) whereas in the Chhattisgarh state its area and production are 60,146 hectares and 2,91,827 metric tonnes respectively (Anonymous, 2013b).

In order to bring new area under improved varieties, healthy planting materials in sufficient quantity is essential. In the traditional method of propagation, the plants take two years from seedling to planting in the field with lower survival rates owing to uprooting of grafted seedlings from the ground. Now various methods of propagation are being adopted with varying degree of success in different regions of India. Further, wedge grafting has a tremendous potential for multiplying mango plants rapidly throughout the year

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either in green house and in open conditions as well. In view of this, the present experiment was carried out to standardize effect of scion length, duration of defoliation and poly tube capping on success of wedge grafting in mango seedlings grown in polythene bags.

MATERIALS AND METHODS

The experiment was carried out at Department of Horticulture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, (C.G.). Raipur which is located in south-eastern part of Chhattisgarh, at 21° 16' N latitude and 81°36' E longitude and at an altitude of 289.56 meters above from mean sea level. Raipur has sub-humid agro-climatic conditions. The average rainfall of this region is 1200-1400 mm, most of which (about 85 per cent) is received during Monsoon season (June to September) and the rest during post monsoon and winter season. The experiment material consisted of 3 lengths of scion of mango i.e. 15 cm, 18 cm, 21 cm and 3 durations of defoliation 4, 8 and 14 days and covering of the grafts with or without poly tube cappings. Thus, the treatment combinations were 18 which were replicated four times under Factorial Complete Randomized Design (FCRD). The seedling rootstocks in polythene bags were selected from the already available rootstocks in the nursery. The seedlings rootstock of uniform height i.e. 25-30 cm, thickness and about one year old which were raised from the locally collected mango stones were used for the study. The scions of Dashehari were selected from about 20 years old mango orchard of the Horticulture Farm.

One to two months old shoots of current year, free from pests and disease were selected. The defoliation of the selected scions was done 4 days, 8 days and 14 days ahead of grafting as per the treatment. The defoliation was done by clipping off the leaf blades with a sharp secateurs and leaving the petioles of one cm length intact. The scions length of 15 cm, 18 cm and 21 cm as per treatments were used for wedge grafting. The scion shoots were severed from the mother tree with a sharp cut in the morning hours on the day of grafting with secateur. The scion shoots were wrapped in a wet cloth immediately after separation and were carried in polythene covers to the grafting site. The rootstocks were cut smoothly with a sharp budding knife. The rootstock was decapitated 20-30 cm above soil level and about 2-3 centimetre deep cut was made at the top of the rootstock to create a "V"-shaped notch in the wood, depending on the diameter of the stock. The scion having 3 to 4 buds was trimmed like a wedge 2.5 to 3 cm at the lower end with outer side slightly broader than the inner side. The prepared scion was inserted into the rootstock cut to match the cambiums on the thick side of the scion, in such a way that the cambium layer of scion is in touch with the cambium layer of the stock. The grafting portion was held by polythene tape wrapping firmly which were 45 cm long, 1.5 cm wide and 200 gauges transparent white polythene strips to seal the union to prevent moisture loss and to stop scion movement. Grafting was done with the help of a sharp knife. The grafting was done on 20th July,

2011 and just after grafting half of the grafts were covered with 25 cm long and 3 cm wide white transparent polythene tube sealed on upper side to ensure high relative humidity and this poly tube capping was removed as the sprouts were seen in the upper portion of the grafted scion.

All the observations in respect of girth of rootstock, girth of scion, length of sprout, girth of sprout, number of leaves graft⁻¹, total height of the grafted plant, percentage of graft sprouting, days taken for first sprouting, days taken for last sprouting, percentage of graft establishment, percentage of graft survival were recorded at 180 days after grafting (DAG) and the average data related to individual effect of length of scion, duration of defoliation and poly tube capping on characters of grafted plants are depicted in table 1.

RESULTS AND DISCUSSION

The results of this experiment are presented and discussed under following headings:

(1) Individual Effect

Girth of rootstock

In case of scion length, duration of defoliation and poly tube capping, significant variation was observed in girth of rootstock. The maximum rootstock girth (5.197 mm) was found in 18 cm and minimum girth (4.971 mm) was found in 15 cm of scion 180 days after grafting. This might be due to optimum nutrient content and hormonal status of longer scions as well as their good callusing capability. The results are also similar to Gurudutta *et al.* (2004), who reported that six months after grafting Mallika recorded the highest rootstock girth compared with the other cultivars *viz.*, Langra, Dashehari, Amrapali. The maximum rootstock girth (5.114 mm) was found in 8 days of defoliation and minimum rootstock girth (4.958 mm) was found in 4 days of defoliation at 180 days after grafting (DAG). The grafts with poly tube capping produced maximum girth (5.118 mm) than grafts without poly tube capping in the month of January. There were no significant differences due to interaction.

Girth of scion

As regards the effect of scion length, highest growth in the girth of scion (5 mm) was recorded in 18 cm in the month of January, while minimum growth in the girth of scion (4.687 mm) was recorded in 15 cm during the month of January. Gurudutta *et al.* (2004) reported that the six months after grafting Mallika recorded the highest scion girth compared with the other cultivars *viz.*, Langra, Dashehari, Amrapali. The maximum girth (5.031mm) of scion was found in 8 days of defoliation in the month of January and minimum (4.687 mm) in 14 days of defoliation. The findings resembles the result reported by Jha and Brahmachari (2002), they reported defoliation at 6 days prior to grafting required the shortest time for sprouting (15.17 days) and the highest diameter of scion after 6 months (0.52 cm). Grafts with poly tube capping significantly produced higher girth of scion

(5 mm) than the grafts without poly tube capping. Significant differences in the girth were observed during all the months due to poly tube capping.

Length of sprout

In case of scion length, maximum length of sprout was recorded in 21 cm and minimum was noted under the treatment 15 cm. The result is in close conformity as reported by Alam *et al.* (2006), as they recorded that Langra performed the best in all categories of scion length whereas BARI Aam-3 succeeded the least. As regarding defoliation duration, the longest sprout (15.94 cm) was obtained from 8 days and minimum (13.968 cm) in 14 days. Poly tube capping significantly produced longest sprout (15.81 cm) than grafts without poly tube capping due to high relative humidity of grafts within poly tube capping.

Girth of sprout

In case of scion length, after 180 days of grafting, the maximum (3.95 mm) shoot girth was observed in 18 cm length while it was recorded minimum (3.53 mm) in 15 cm. In case of duration of defoliation, the significantly maximum shoot girth (4.187 mm) was exhibited in 8 days while, it was found minimum (3.145 mm) for 4 days defoliation. In case of grafts with poly tube capping, maximum sprout girth (4.07 mm) was recorded as compared to grafts without poly tube capping (3.33 mm). The similar results were also reported by Nimbalkar *et al.* (2011), as they reported that the grafts covered with polythene bags sprouted more in numbers than the graft without polythene bag cover.

Number of leaves graft⁻¹

Significant difference was observed on the number of leaves among the grafts of different length of scion, duration of defoliation and use of poly tube. After grafting, the maximum number of leaves graft⁻¹ was noted in 21 cm length of scion while, it was recorded minimum in treatment 18 cm length of scion. Similarly, Jha and Brahmachari (2002) reported that number of leaves graft⁻¹ (17.78) and graft survival (66.45%) in their experiment on stone grafting of mango. In case of duration of defoliation significantly maximum number of leaves graft⁻¹ was observed in 8 days while it was recorded minimum in 4 days. In respect of poly tube capping the significantly maximum number of leaves graft⁻¹ (9.715) was produced with the use of poly tube than without using poly tube.

Total height of grafted plant

In respect effect of length of scion, significant variation was observed in total height of graft after wedge grafting at various stages of growth observations. Maximum length of scion (21 cm) gave maximum height (57.44 cm) while, 15 cm produced minimum height (47.86 cm). It may be due to larger scion length and also more length of sprout produced in larger scions than shorter scions. As regards duration of defoliation, maximum height (53.59 cm) was observed in the grafts of 8 days defoliation, whereas minimum height (51.85 cm) was achieved in the grafts of 4 days defoliation after 180 days of grafting. In case of poly

tube capping, the maximum height (53.70 cm) observed in grafts with poly tube capping than grafts without poly tube capping at 180 days after grafting, because the poly tube cover reduced the rate of transpiration and increased humidity around graft joint, which protected the tissues in grafts joint from desiccation resulting in favourable growth conditions. Similarly, Nimbalkar *et al.* (2011) reported that use of younger scion and polythene bag cover on graft resulted in the early sprouting and maximum height as compared to grafts without polythene bag.

Percentage of grafts sprouted

After grafting, the highest percentage of graft sprouted (73.95%) was recorded from the grafts of 21 cm long scion and minimum (59.37%) was recorded from the grafts of 15 cm scion. In case of defoliation duration, maximum percentage (75%) of graft sprouting was recorded in 8 days, while minimum (61.45%) in 4 days of defoliation. In case of poly tube capping, grafts with poly tube capping gave more percentage (70.13%) of graft sprouting than grafts without poly tube capping (62.5%). Pandey and Singh (2001) observed similar trends and reported the use of polyethylene tube as an anti-transpirant significantly increased the sprouting in mango.

Days taken for first and last sprouting

In case of length of scion, maximum days (15.770) required for sprouting was observed in the grafts with 15 cm of scion. Whereas, earlier sprouting (13.854 days) was observed in 21 cm scion followed by 14.958 days in the scion of 18 cm. However, scion length 15 cm took the longest period (25.125 days) for completion of sprouting and shortest duration (21.250 days) for last sprouting was recorded in the scion of 21 cm. Similarly Dod *et al.* (1997) found that graft take was greater (90-100%) when scions were cut 5 to 10 days after defoliation which is in close conformity to our results. Amongst duration of defoliation, maximum period of sprouting (15.218 days) was required in the grafts of 4 days defoliation, whereas treatment of 8 days defoliation exhibited early sprouting (14.354 days). This result is in close conformity with the findings of Sidahmed (1992) as they observed that 8 days defoliated scion promoted early sprouting (13.58 days). Maximum duration (24.635 days) was required by 4 days defoliation and minimum duration (22.427 days) for last sprouting was recorded in 14 days defoliation. Among the treatment with poly tube capping, the quickest sprouting was found in grafts with poly tube capping that is in 13.847 days whereas grafts without poly tube capping took longest time of 15.875 days for sprouting. Similarly Haldankar *et al.* (1997) also reported quicker sprouting in nutmeg grafts when covered with poly tube. In case of last sprouting maximum duration (24.354 days) was recorded from the grafts without poly tube capping while, shortest duration (21.583 days) was recorded from the grafts with poly tube capping.

Percentage of grafts established

After 180 days of grafting, the highest percentage of graft establishment (63.541%) was recorded from the

grafts of 21 cm long scion and minimum (46.875%) was recorded from the grafts of 15 cm scion. It may be due to lesser reserve food in shorter scion. Longer scions resulted in a significantly higher percentage of establishments of the grafts than shorter ones. In view of this reason Ram and Sirohi (1989) suggested the use of relatively longer scions. In case of defoliation duration, maximum percentage (65.625%) of graft establishment was found in 8 days defoliation, while minimum (51.041%) in 4 days of defoliation. The highest percentage was found in 8 days defoliation. These results are in conformity with Roy and Hoda (1994), who reported higher establishment of the grafts when scion shoots were defoliated 8 days before detachment. In case of poly tube capping, grafts with treatment of poly tube capping gave more percentage (61.805%) of graft establishment than grafts without poly tube capping (52.77%).

Percentage of grafts survived

Scion length of 21 cm was observed significantly superior as compared to other scion lengths and it was recorded highest survival percentage (58.33%) followed by 18 cm with 53.12%. While, lowest graft survival percentage (38.54%) was observed in 15 cm scion length. The scion length on the success of graft 'take' is also well established by Kanwar and Bajwa (1974) in side grafting of mango and Maiti and Biswas (1980) in stone grafting of mango. The result of the present studies indicated that scion length influenced significantly the success of 'graft take'. Among duration of defoliation, the treatment of 8 days was found significantly superior and was recorded maximum (57.29%) success percentage, while it was recorded minimum (43.75%) in 4 days defoliation. This result is also similar to the finding by Kumar *et al.* (1999) as they reported the best growth and survival percentage (79%) of grafted plants in the treatment in which scions had been defoliated for 8 days and stored for 3 days before grafting. In case of poly tube capping, grafts with poly tube capping gave maximum percentage of graft survival (53.47%) than grafts without poly tube capping. This result is in close conformity with Pandey and Singh (2001) as they reported that the use of polythene tube as an anti-transpirant which significantly increased the survival percentage of sprouted plants six months after grafting (59.06 and 62.075%) in mango.

(2) Interaction effect

All the observations in respect of interaction between length of scion x duration of defoliation x poly tube capping on length of sprout, girth of sprout, number of leaves graft⁻¹ and total height of grafted plant were recorded at 180 days after grafting (DAG) and the average data of interactions are depicted in table 2. The results are presented under following headings.

Length of sprout

Significant difference was found due to interaction of length of scions x duration of defoliation x poly tube capping under study on length of sprout after grafting. The

treatment combination (21 cm scion length, 8 days defoliation duration with poly tube capping) exhibited maximum sprout length (18.31 cm). While minimum sprout length (10.45 cm) was recorded in treatment combination of 15 cm scion length, 4 days defoliation duration without poly tube capping after 180 days of grafting. The result is in close conformity to Alam *et al.* (2006) as they reported that Langra cultivar performed best in all categories of scion length whereas BARI Aam-3 succeeded the least.

Girth of sprout

The treatment combination of 18 cm scion length, 8 days defoliation duration with poly tube capping recorded maximum sprouts girth (5.06 mm). However, it was recorded lowest (2.44 mm) in treatment combination of 15 cm scion length, 4 days defoliation duration without poly tube capping. The girth was significantly increased due to interaction effect. Growth enhancements due to endogenous gibberellins levels appear to be attributed for stimulations of more cell division and cell enlargement. This could be attributed to the vigorous growth of stock, which increased the shoot girth. The similar results were also found by Nimbalkar *et al.* (2011) as they reported that the grafts covered with polythene bags sprouted more in numbers than the graft without polythene bag cover.

Number of leaves graft⁻¹

The best result (11.88 leaves graft⁻¹) obtained in treatment combination of 21 cm scion length, 8 days defoliation duration with poly tube after 180 days of grafting followed by treatment combination of 18 cm scion length, 8 days duration of defoliation with poly tube capping. While, minimum number of leaves (5.13) were found in treatment combination of 18 cm scion length, 4 days defoliation duration without poly tube capping followed by treatment combination of 15 cm scion length, 4 days defoliation without poly tube capping. It might be due to more sprouting percentage during the grafting period. Similarly, Pandey and Singh (2001) reported that the sprouting percentage of grafts was positively correlated with number of leaves graft⁻¹. The increase in sprouting percentage also increased the number of leaves graft⁻¹. Similarly, Jha and Brahmachari (2002) reported 17.78 number of leaves graft⁻¹ with 66.45% graft survival.

Total height of grafted plant

It is evident from table 2 that the treatment combination of 21 cm scion length, 8 days defoliation duration with poly tube capping after 180 days of grafting was noted best among all the treatments, as it gave maximum height (59.23 cm), whereas lowest height (45.55 cm) was noted in treatment combination of 15 cm scion length, 4 days defoliation duration without poly tube capping. The effect of interaction was significant and height was significantly increased after the month of August. It may be due to favourable agro-meteorological conditions prevailing during the grafting period. This could be attributed to the vigorous growth of stock, which increased the growth and

Table 1. Individual effect of length of scion, duration of defoliation and poly tube capping on different characters of grafted mango plant at 180 days after Grafting (January Month)

Treatments	Girth of rootstock (mm)	Girth of scion (mm)	Length of sprout (cm)	Girth of sprout (mm)	No. of leaves graft ⁻¹	Total height of grafted plant (cm)	Percentage of graft sprouting	Days taken for first sprouting	Days taken for last sprouting	Percentage of graft establishment	Percentage of graft survival
Length of scion											
S ₁ (15 cm)	4.971	4.687	13.104	3.531	3.531	47.868	59.375	15.770	25.125	46.875	38.541
S ₂ (18 cm)	5.197	5.000	14.473	3.947	3.947	52.100	65.625	14.958	24.031	61.458	53.125
S ₃ (21 cm)	5.187	4.750	16.343	3.635	3.635	57.441	73.958	13.854	21.250	63.541	58.333
SEM±	0.105	0.080	0.161	0.072	0.072	0.152	1.725	0.176	0.594	1.804	1.719
CD at 5%	0.299	0.228	0.457	0.204	0.204	0.433	2.744	0.499	1.685	2.883	2.731
Duration of defoliation											
D ₁ (4 DAP)	4.958	4.718	14.006	3.145	3.145	51.852	61.458	15.218	24.635	51.041	43.750
D ₂ (8 DAP)	5.114	5.031	15.944	4.187	4.187	53.596	75.000	14.354	23.343	65.625	57.291
D ₃ (14 DAP)	5.104	4.687	13.968	3.781	3.781	51.960	62.500	15.010	22.427	55.208	48.958
SEM±	0.105	0.080	0.161	0.072	0.072	0.152	1.725	0.176	0.594	1.804	1.719
CD at 5%	–	0.228	0.457	0.204	0.204	0.433	2.744	0.499	1.685	2.883	2.731
Poly tube capping											
T ₁ (With Capping)	5.118	5.000	15.810	4.076	4.076	53.703	70.138	13.847	21.583	61.805	53.472
T ₂ (Without Capping)	5.000	4.625	13.469	3.333	3.333	51.236	62.500	24.354	24.354	52.777	46.527
SEM±	0.086	0.065	0.131	0.058	0.058	0.124	1.588	0.485	0.485	1.658	1.582
CD at 5%	–	0.186	0.373	0.166	0.166	0.353	2.497	1.376	1.376	2.622	2.486

Table 2. Effect of interaction between length of scion x duration of defoliation x poly tube capping on length of sprout, girth of sprout, number of leaves graft⁻¹ and total height of grafted plant at 180 days after grafting (January month).

Treatments	Length of sprout (cm)	Girth of sprout (mm)	Number of leaves graft ⁻¹	Total height of grafted plant (cm)
S1D1T1	13.49	3.31	6.25	48.66
S1D1T2	10.45	2.44	5.81	45.55
S1D2T1	15.10	4.13	11.63	49.19
S1D2T2	13.72	3.88	8.13	47.76
S1D3T1	14.23	4.25	10.75	49.31
S1D3T2	11.63	3.19	10.13	46.75
S2D1T1	16.25	4.06	7.50	54.23
S2D1T2	10.31	2.94	5.13	46.28
S2D2T1	16.65	5.06	11.81	54.60
S2D2T2	15.91	4.00	10.13	53.88
S2D3T1	15.30	4.44	8.38	53.25
S2D3T2	12.42	3.19	7.13	50.38
S3D1T1	17.22	3.19	7.69	58.19
S3D1T2	16.32	2.94	6.06	58.22
S3D2T1	18.31	4.56	11.88	59.23
S3D2T2	15.98	3.50	6.81	56.93
S3D3T1	15.76	3.69	11.56	56.68
S3D3T2	14.48	3.94	9.88	55.40
SEm±	0.39	0.18	0.44	0.37
CD 5%	1.119	0.50	1.253	1.06

leading to maximum accumulation of stored metabolites at the time of grafting. Nimbalkar *et al.* (2011) reported that use of younger scion and polythene bag cover on graft resulted in the early sprouting and maximum height as compared to without polythene bag graft.

The present data of interaction of scion length, defoliation duration and poly tube capping significantly influenced the length of sprout, girth of sprout, number of leaves graft⁻¹ and total height of grafted plant in various treatments. The data of interaction revealed that treatment combination of 21 cm scion length, 8 days defoliation duration with poly tube capping exhibited maximum sprout length (18.31 cm) along with maximum 11.81 leaves graft⁻¹ and maximum height (59.23 cm) whereas, minimum sprout length (10.45 cm) was recorded in treatment combination of 15 cm scion length, 4 days defoliation duration without poly tube capping along with lowest (2.44 mm) girth and lowest height (45.55 cm).

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