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Effect of age of root stock, grafting time and varieties on the success of soft wood grafting in mango

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Abstract : In order to standardize the effect of grafting time and age of root stock of mango varieties for soft wood grafting to improve its success rate, the experiment was carried out at the Horticultural garden of Bihar Agricultural College, Sabour, Bihar during 2008- 2009. Among the different cultivar tested, Zardalu and one month old root stock grafted in the middle of July '08 took only 13.54 and 12.36 days, respectively for sprout initiation. However, the maximum success per cent of 59.79 and 79.83 were registered in Dudhia Maldah after 30 days of grafting time and two month old root stock grafting in the middle of Aug '08'. Similarly, maximum survival per cent of 56.04 in Doodhia Maldah after 60 days and 73.50 in two month old root stock, grafted in middle of Aug '08' were recorded. Apart from this maximum linear and radial growth after 90 days were noticed in Mallika and Mahmood Bahar, respectively. Two month old root stock when grafted in middle of Aug '08' and one month old root stock performed in middle July '08' attained maximum linear and radial growth. While variety Chousa and two month old root stock grafted in middle Aug '08' obtained maximum number of leaves 10.06 and 10.93, respectively.

Key words : Mango, Cultivars, Root stocks, Grafting

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Mango is the third largest cultivated fruit in the world in terms of both area and production and it also occupies a prominent place amongst the fruit crops grown in India. The agro-climatic condition of Bihar is very congenial for mango orcharding and there is tremendous scope for increase the area under mango cultivation. One of the major requirements for achieving the increased production of mango crops would be the rapid multiplication and distribution of superior clones. In recent times, many detached methods of grafting has been successfully used as an efficient economic and rapid method of propagation of mango (Choudhry, 1984; Bhan *et al.*, 1969; Gaur, 1984; Roy and Hoda, 1996). However, the success of grafting depends on different factors such as influence of environmental parameters, age of root stock, grafting time and method of grafting (Hartman and Kertar, 1972). Hence, it is highly essential to standardize the effect of grafting time and age of root stock of important mango varieties for soft wood grafting process

in order to improve its success rate.

RESEARCH METHODS

The present investigation was carried out at the Horticultural garden of Bihar Agricultural College, Sabour during the year 2008-2009 in order to study the effect of different age and grafting time on success of soft wood grafting in ten important cultivars of mango. The experiment was laid in split plot design with three replications. There were 20 grafts in each replication. Stones were sown in the field at the distance of 40cm x 50cm on 18th June 2008 and the seedling was ready for grafting on particular date as per programme from 18th July to 18th Feb. 2009 for the performance of the different age. The scion shoots for grafting were selected from the current season and six month old terminal shoots of different mango varieties *viz.*, Amrapali, Prabhaskar, Gulabkhas, Mahmood Bahar, Dudhia Maldah, Zardalu, Chousa, Bombai and Krishnabhog. Grafting was done in

shade using cleft method of grafting, scion shoots of ten varieties of mango were grafted on the same day with the idea that graft would get the same environmental conditions for union. The grafting work was performed in the mid July 08, mid Aug. 08, mid Sept. 08, mid Oct. 08, mid Nov. 08 mid Dec. 08, mid Jan. 09 and mid Feb. 09 on one month to eight month regularly from date of stone sowing in open field. The root stock seedlings were grafted with scion of selected mango varieties. The observation on grafted plants were recorded *viz.*, sprouting initiation days in that month, success of the grafted plants after 30 days, survival of the grafted plants after 60 days and radial growth of grafted plants of individual and number of leaves per grafted plant.

RESEARCH FINDINGS AND DISCUSSION

A perusal of the two way mean table (Table 1) showed that treatment differences between different age of root stock non-significantly influenced by different cultivars of mango and months. Similarly, interaction effect of cultivars and month were also non- significant. The time taken for sprout initiations in different cultivars of mango was minimum 13.54 days in cultivar of Zardalu. The minimum sprout initiation days were 12.36 performed on one month old root stock grafting in the middle of July 2008. Whereas interaction effect of cultivars and month were minimum for sprout initiation of different cultivars of mango 11.52 in cultivars of Amrapali and performed on one month old root stock. High rainfall in the month of July, August, September and October 08, the climatic

conditions were favourable. The plant tissue especially cambium are in naturally active stage. Therefore, they were responsible for lesser time taken for bud sprout (Chakrabarty and Sadhu, 1989). Whereas the minimum number of days on 30 days old rot stock due to the proliferation of callus tissues by both the graft component and vascular continuity does not get established during this period studied by Haque and Hussain (1974).

The success per cent of bud was significantly influenced by varying age of root stock and different cultivars (Table 2). The maximum success per cent was observed 59.79 in Dudhia Maldah after 30 days of grafting time and maximum success per cent was 79.83 which performed on two months old root stock, grafting in the middle of Aug ‘08’ whereas interaction effect of cultivars and months, the maximum per cent success was 83.33 in Mallika performed on two month old root stock, grafted in middle of Aug ‘08’. Similarly maximum survival per cent after 60 days was 56.04 in Dudhia Maldah and it was 73.50 performed two month old root stock, grafted in middle of Aug ‘08’. While interaction effect of cultivars and months, the maximum 76.67 per cent was reported in Dudhia Maldah and Mallika performed on two month old root stock, grafted in the middle of Aug ‘08’ (Table 3). Reason for high success percentage is due to presence of enough carbohydrate and other food material in the scion and root stock and the accumulated food material is mobilized for new growth which in turn high meristematic activity in the scion. Moreover, highest survival of grafted mango plants on the age of two months

Table 1 : Effect of age of root stock, grafting time on time taken (days) for sprout initiation in different cultivars of mango

Root stock age	1 month	2 month	3 month	4 month	5 month	6 month	7 month	8 month	
Month	Mid July'08	Mid Aug.'08	Mid Sept'08	Mid Oct.'08	Mid Nov.'08	Mid Dec.'08	Mid Jan'09	Mid Feb'09	
Cultivars									Mean
Amrapali	11.52	11.93	12.31	14.61	14.65	16.32	15.61	12.94	13.74
Prabhashankar	12.05	12.58	12.31	14.24	14.82	15.85	16.17	12.88	13.86
Gulabkhas	12.44	11.86	12.22	14.45	14.26	15.97	15.92	12.37	13.69
Mahmood Bahar	12.69	12.83	12.25	13.60	14.84	16.06	15.65	11.76	13.71
Dudhia Maldah	11.91	12.61	12.32	13.56	14.63	16.02	15.70	12.48	13.65
Zardalu	12.03	11.89	12.24	12.91	14.72	15.75	15.77	13.02	13.54
Mallika	12.72	12.24	11.97	12.84	14.79	15.56	15.59	12.67	13.55
Chousa	12.99	13.17	12.61	14.25	14.80	15.47	15.78	12.85	13.99
Bombai	12.26	12.42	12.94	13.41	14.56	15.70	16.06	12.55	13.74
Krishnabhog	12.98	13.15	12.57	14.01	14.95	15.46	15.84	12.98	13.99
Mean	12.36	12.47	12.37	13.79	14.70	15.82	15.81	12.65	
CD. (P=0.05)	0.05								
V =	0.3019								
M =	0.3164								
M at same V	N.S.								
V at same M	N.S.								

NS=Non-significant

old root stock due to closer cambium contact, early callus formation and most favourable climatic condition prevailing during the period under observation. These findings are also in the line with Pereira *et al.* (2004) and Kumar *et al.* (2006) in different mango cultivars and Giri and Lenka (2008) in wood apple.

So far, linear and radial growth after 90 days was concern (Table 4 and 5), it was 9.69 cm in Mallika and 1.47 cm in Mahmood Bahar and Chousa, respectively. Furthermore, the maximum linear growth was 10.23cm performed on two month old root stock, grafted in middle of Aug '08' and maximum radial growth performed 1.54 cm on one month old root stock grafted in middle of July '08'. The interaction of cultivar and different age of root stock revealed that Krishnabhog attained maximum linear growth of 10.62cm when performed on four month old root stock, grafted in the middle of October '08' where as maximum radial growth of 1.65 cm was attained in Amrapali when performed on two months old root stock,

grafted in the middle of Aug '08'. The favourable temperature and humidity during monsoon period helped in faster growth (linear and radial growth) which act positively on root stock and scion shoot, which might had happened due to the longer time available for growth in meristimatic cells coupled with better physiological processes like photosynthesis and lower respiration.

The data recorded for mean number of leaves per graft after 90 days showed (Table 6) that maximum number of leaves 10.93 was observed in the Chousa cultivars and the maximum leaves were performed on two month old root stock grafted in middle Aug '08' Moreover, interaction effect is concern, same table revealed number of pertinent trend in number of leaves in all the cultivars and it was more when grafting was performed after 2 months old root stock, grafted in middle Aug '08'. The maximum number of leaves recorded when grafting was performed on two months old root stock might be due to longer period for growth and favourable

Table 2 : Effect of age of root stock, grafting time success per cent in different cultivars of mango

Root stock age	1 month	2 month	3 month	4 month	5 month	6 month	7 month	8 month	Mean
Month Cultivars	Mid July'08	Mid Aug.'08	Mid Sept'08	Mid Oct.'08	Mid Nov.'08	Mid Dec.'08	Mid Jan.'09	Mid Feb'09	
Amrapali	45.00 (42.12)	78.33 (62.48)	75.00 (60.07)	61.67 (51.76)	55.00 (47.88)	41.67 (40.20)	48.33 (44.04)	58.33 (49.80)	57.92 (49.79)
Prabhashankar	51.67 (45.97)	80.00 (63.55)	80.00 (63.55)	68.33 (55.77)	51.67 (45.96)	38.33 (38.24)	43.33 (41.16)	46.67 (43.09)	57.50 (49.66)
Gulabkhas	45.00 (42.09)	78.33 (62.48)	78.33 (62.48)	65.00 (53.76)	50.00 (45.00)	40.00 (39.21)	46.67 (43.09)	43.33 (41.16)	55.83 (48.66)
Mahmood Bahar	46.67 (43.06)	80.00 (63.55)	80.00 (63.55)	65.00 (53.76)	50.00 (45.00)	41.67 (40.18)	45.00 (42.12)	58.33 (49.80)	58.33 (50.13)
Dudhia Maldah	53.33 (46.92)	80.00 (63.55)	75.00 (60.07)	68.33 (55.77)	58.33 (49.80)	46.67 (43.09)	45.00 (42.13)	51.67 (45.96)	59.79 (50.91)
Zardalu	51.67 (45.96)	81.67 (64.69)	76.67 (61.33)	61.67 (51.76)	55.00 (47.88)	41.67 (40.20)	41.67 (40.20)	50.00 (45.00)	57.50 (49.63)
Mallika	60.00 (50.79)	83.33 (65.95)	78.33 (62.40)	68.33 (55.85)	53.33 (46.91)	43.33 (41.16)	43.33 (41.16)	46.67 (43.09)	59.58 (50.92)
Chousa	30.00 (33.04)	78.33 (62.29)	70.00 (56.84)	56.67 (48.84)	50.00 (45.00)	40.00 (39.21)	36.67 (37.26)	53.33 (46.91)	51.88 (46.17)
Bombai	63.33 (52.80)	81.67 (64.69)	70.00 (56.84)	61.67 (51.76)	58.33 (49.80)	43.33 (41.16)	43.33 (41.16)	48.33 (44.04)	58.75 (50.28)
Krishnabhog	61.67 (51.91)	74.67 (61.33)	78.33 (62.99)	61.67 (51.76)	46.67 (43.08)	38.33 (38.24)	46.67 (43.09)	48.33 (44.04)	57.29 (49.47)
Mean	50.83 (45.46)	79.83 (63.46)	76.17 (60.94)	63.83 (53.08)	52.83 (46.63)	41.50 (40.09)	44.00 (41.54)	50.50 (45.29)	
C.D. (P=0.05)	0.05								
V	1.52								
M	1.63								
M at same V	5.17								
V at same M	5.05								

Table 3 : Effect of age of root stock, grafting time on survival per cent after 60 days of grafting in different cultivars of mango

Root stock age	1 month	2 month	3 month	4 month	5 month	6 month	7 month	8 month	Mean
Month	Mid	Mid	Mid	Mid	Mid	Mid	Mid	Mid	
Cultivars	July'08	Aug.'08	Sept'08	Oct.'08	Nov.'08	Dec.'08	Jan.'09	Feb'09	
Amrapali	36.67 (37.20)	71.67 (57.91)	68.33 (55.82)	58.33 (49.80)	46.67 (43.09)	43.33 (41.12)	41.67 (40.20)	53.33 (46.91)	52.50 (46.91)
Prabhashankar	43.33 (41.15)	73.33 (59.05)	70.00 (56.84)	60.00 (50.79)	45.00 (42.12)	36.67 (37.26)	41.67 (40.20)	46.67 (43.09)	52.08 (46.31)
Gulabkhas	38.33 (38.22)	71.67 (57.91)	71.67 (57.91)	56.67 (48.84)	46.67 (43.09)	36.67 (37.26)	46.67 (43.09)	43.33 (41.16)	51.46 (45.93)
Mahmood Bahar	36.67 (37.20)	71.67 (57.86)	75.00 (60.07)	60.00 (50.79)	46.67 (43.09)	38.33 (38.24)	45.00 (42.12)	53.33 (46.91)	53.33 (47.04)
Dudhia Maldah	46.67 (43.08)	76.67 (61.14)	70.00 (56.84)	65.00 (53.73)	50.00 (45.00)	46.67 (43.09)	45.00 (42.13)	48.33 (44.04)	56.04 (48.63)
Zardalu	43.33 (41.13)	73.33 (58.93)	71.67 (57.86)	58.33 (49.82)	45.00 (42.12)	36.67 (37.26)	41.67 (40.20)	46.67 (43.09)	52.08 (46.30)
Mallika	51.67 (45.96)	76.67 (61.14)	70.00 (56.84)	61.67 (51.81)	48.33 (44.04)	38.33 (38.24)	41.67 (40.18)	49.67 (43.09)	54.38 (47.66)
Chousa	25.00 (29.74)	73.33 (58.93)	68.33 (55.77)	53.33 (46.91)	43.33 (41.16)	36.67 (37.26)	36.67 (37.26)	48.33 (44.04)	48.13 (43.18)
Bombai	51.67 (45.97)	75.00 (60.07)	68.33 (55.77)	56.67 (48.84)	51.67 (45.96)	36.67 (37.26)	43.33 (41.16)	46.67 (43.09)	53.75 (47.26)
Krishnabhog	45.00 (42.12)	71.67 (57.86)	68.33 (55.77)	56.67 (48.84)	43.33 (41.160)	36.67 (37.26)	45.00 (42.13)	46.67 (43.09)	51.67 (46.03)
Mean	41.83 (4018)	73.50 (59.08)	70.17 (56.95)	58.67 (50.02)	46.67 (43.08)	38.67 (38.42)	42.83 (43.85)	48.00 (43.85)	
C.D.. (P=0.05)	0.05								
V	1.77								
M	1.34								
M at same V	4.25								
V at same M	4.32								

Table 4 : Effect of age of root stock, grafting time on linear growth (cm) after 90 days of grafting in different cultivars of mango

Root stock age	1 month	2 month	3 month	4 month	5 month	6 month	7 month	8 month	Mean
Month	Mid	Mid	Mid	Mid	Mid	Mid	Mid	Mid	
Cultivars	July'08	Aug.'08	Sept'08	Oct.'08	Nov.'08	Dec'08	Jan'09	Feb'09	
Amrapali	8.57	9.34	9.21	9.28	9.67	8.59	9.45	9.58	9.21
Prabhashankar	8.30	10.38	9.72	10.35	10.53	8.85	9.57	9.68	9.67
Gulabkhas	8.81	10.44	9.65	9.57	9.73	7.59	9.83	9.54	9.39
Mahmood Bahar	9.16	9.94	9.85	9.81	9.59	8.28	9.67	9.16	9.43
Dudhia Maldah	10.45	1.31	9.40	9.39	9.37	8.20	9.66	9.47	9.53
Zardalu	9.33	10.18	10.60	9.41	9.37	8.62	9.74	9.60	9.61
Mallika	9.46	10.53	10.23	9.70	9.53	8.25	9.91	9.87	9.69
Chousa	8.44	10.27	10.42	9.75	10.26	7.66	9.44	9.67	9.49
Bombai	8.53	10.42	9.72	10.47	9.49	7.67	9.37	9.74	9.43
Krishnabhog	10.28	10.52	9.52	10.62	8.90	7.71	9.52	9.86	9.61
Mean	9.13	10.23	9.83	9.84	9.64	8.14	9.62	9.62	
CD. (P=0.05)	0.05								
V	0.2597								
M	0.2459								
M at same V	0.7807								
V at same M	0.7704								

Table 5 : Effect of age of root stock, grafting time on radial growth (cm) after 90 days of grafting in different cultivars of mango

Root stock age	1 month	2 month	3 month	4 month	5 month	6 month	7 month	8 month	Mean
Month	Mid	Mid	Mid	Mid	Mid	Mid	Mid	Mid	
Cultivars	July'08	Aug.'08	Sept'08	Oct.'08	Nov.'08	Dec.'08	Jan.'09	Feb'09	
Amrapali	1.58	1.65	1.38	1.13	1.42	1.31	1.37	1.47	1.42
Prabhashankar	1.53	1.58	1.45	1.26	1.26	1.45	1.30	1.41	1.41
Gulabkhas	1.43	1.48	1.49	1.47	1.34	1.39	1.44	1.37	1.43
Mahmood Bahar	1.47	1.50	1.49	1.50	1.42	1.31	1.43	1.61	1.47
Dudhia Maldah	1.47	1.49	1.46	1.14	1.40	1.39	1.43	1.52	1.44
Zardalu	1.57	1.56	1.46	1.50	1.32	1.34	1.44	1.48	1.46
Mallika	1.56	1.49	1.48	1.45	1.45	1.36	1.37	1.35	1.44
Chousa	1.60	1.56	1.49	1.46	1.45	1.42	1.43	1.36	1.47
Bombai	1.54	1.47	1.49	1.44	1.41	1.42	1.40	1.43	1.45
Krishnabhog	1.62	1.49	1.42	1.52	1.50	1.33	1.46	1.43	1.47
Mean	1.54	1.53	1.46	1.41	1.40	1.37	1.41	1.44	
C.D. (P=0.05)	0.05								
V	0.0434								
M	0.0407								
M at same V	0.1294								
V at same M	0.1278								

Table 6 : Effect of age of root stock, grafting time on number of leaves per graft after 90 days of grafting in different cultivars of mango

Root stock age	1 month	2 month	3 month	4 month	5 month	6 month	7 month	8 month	Mean
Month	Mid	Mid	Mid	Mid	Mid	Mid	Mid	Mid	
Cultivars	July'08	Aug'08	Sept'08	Oct.'08	Nov.'08	Dec.'08	Jan.'09	Feb'09	
Amrapali	9.21	9.88	10.02	9.44	11.44	9.73	9.43	9.68	9.85
Prabhashankar	9.50	9.85	10.19	11.29	10.67	7.30	9.79	9.72	9.79
Gulabkhas	8.62	10.35	9.67	10.58	9.56	7.50	10.17	9.76	9.53
Mahmood Bahar	9.80	10.81	9.88	10.63	10.48	8.80	9.64	9.49	9.94
Dudhia Maldah	9.46	10.82	10.41	9.57	10.24	8.43	9.62	9.64	9.77
Zardalu	9.32	11.65	11.37	10.41	10.35	8.32	9.35	9.53	10.04
Mallika	9.41	11.65	10.52	10.56	9.87	8.05	9.48	9.67	9.90
Chousa	9.03	11.45	1.17	10.26	11.54	8.35	9.86	9.83	10.06
Bombai	10.37	11.33	10.35	10.51	9.61	8.51	9.45	9.60	9.97
Krishnabhog	9.47	11.53	9.73	10.66	9.62	8.67	9.70	9.57	9.87
Mean	9.42	10.93	10.23	10.39	10.34	8.37	9.65	9.65	
C.D. (P=0.05)	0.05								
V =	0.2915								
M =	0.2572								
M at same V	0.8167								
V at same M =	0.8120								

climatic condition available during growth of new sprouts. This is in agreement with the findings of Roy (1981) and Synman and Fraser (1988) in Mango and Passion fruit, respectively.

Conclusion

Softwood grafting in different cultivars of mango performed during mid August on two methods old root stock proved to be the most suitable technique for maximum success, survival and growth of the grafted

plants. Among all the mango cultivars Dudhia Maldah exhibited better results in terms of success and survival of grafted plants. Mallika produced maximum linear growth while Mahmood Bahar and Chousa recorded highest radial growth and number of leaves per graft.

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