

Effect of wrapping system and time of grafting on the success, survivability and growth performance of mango cv. Amropali

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Abstract: The present experiment was conducted at the Fruit Tree Improvement Program (FTIP), Bangladesh Agricultural University, Mymensingh during the period from March 2013 to August 2014 to investigate the effect of time of grafting and scion wrapping system on the success, survivability and growth performance of mango (Amropali). The experiment consisted of two factors, such as (1) three scion wrapping system viz. (i) fully wrapping the scion by polythene strip, (ii) wrapping the scion with polythene strip except tip and (iii) wrapping scion with polycap and (2) ten time of grafting operations viz. 19 and 29 March, each 08, 18 and 28 of April and May and 07 and 17 June. Wide variations were found among the grafts with respect to different parameters such as days required to bud break, first leaf flush, first leaf opening, percent graft success, leaf number, scion length, graft height, rootstock and scion diameters, length and breadth of the longest leaf, canopy volume and final survivability due to the influence of the treatments. Almost all the treatments showed significant effect on different parameters. In case of wrapping system, scion wrapping except tip required lower time to number of leaves (18.71), scion length (35.99 cm), canopy volume (142.00 cm³), graft success (82.02%) and survivability (77.67%). In case of time of grafting operation the lowest time needed to number of leaves (21.61), scion length (37.90 cm), canopy volume (171.67 cm³), graft success (88.17%) and survivability (83.57%) when grafting operation was done on 28 April but the highest time needed to number of leaves (14.86), scion length (32.02 cm), canopy volume (100.28 cm³), graft success (68.67 %) and survivability (64.64 %) were required on 28 May grafting. The combined effect of the above two factors had also significant influence on all the parameters studied. The lowest time to number of leaves (22.43), scion length (39.56 cm), canopy volume (179.26cm³), graft success (90.32 %) and survivability (85.36 %) were required by the grafts on 28 April under scion wrapping except tip. On the other hand the highest time to number of leaves (14.20), scion length (18.37 cm), canopy volume (95.23 cm³), graft success (66.63 %) and survivability (62.14 %) were needed by the graft in fully wrapping the scion by polythene strip when those were grafted on 28 May. Therefore, the results of the present investigation suggest that grafting operation done on 28 April and wrapping scion except tip with Amropali can be performed with higher percentages of success, survivability and the growth of grafts.

Key words: Wrapping system, grafting time, graft success; survivability, growth performance, mango.

Introduction

Mango (*Mangifera indica* L.) belonging to the family Anacardiaceae is one of the most important and popular fruits of Bangladesh. It has been cultivated this sub-continent from 4000 years ago. Mango is the most popular and important fruit crop among all fruits grown in Bangladesh covering the largest area and the total production being in the 3rd position after banana and jackfruit (FAO, 2013). In Bangladesh the area and production of mango during the year 2010-2011 were 1, 70,800 hac and 1,04,7850 metric tons, respectively (FAO, 2011). There is a great decline in production during the last three decades in Bangladesh. There exists a great scope to grow grafted elite varieties in the homestead areas as well as in orchard to increase the production. Although mango can be propagated by both sexual (seed) & asexual (vegetative) methods, the asexual methods of propagation are desirable for ensuring true-to-type variety. Sometimes seeded plants are planted which is attributed to low fruit qualities due to high genetic variations. In vegetative propagation, however, no genetic change takes place since no genetic union with recombination of genes occurs. The vegetative propagation through cleft grafting is the easiest method (Rahim, 2009). Cleft grafting has been successfully using as an efficient, economic and rapid method for the propagation of mango (Bhan *et al.*, 1969., Amin, 1978; Rahim, 2009). Various factors influence the success and survivability of mango grafts viz. varieties, time of grafting operation, grafting method, growing conditions of grafts, defoliation period of scion, age of the scion, leaf and node retention on rootstock etc. Time of grafting operation has a great influence on the success of grafting in mango (Ahmad, 1974). Optimum time of grafting operation depends mainly on environmental conditions and age of scion and rootstock (Hartman *et al.*, 1997). It is a common practice that grafting operation is

done in Bangladesh during the period from May-August with higher success. For a graft union to be successful, it is necessary that temperature conditions during the periods of cellular activity, callus formation as well as during healing should be favorable. The favorable temperature for cellular activity, in general, varies from 12 to 35°C. The grafting operation should therefore be carried out when the temperatures are favorable for cambial activity and there is the high humidity in the vicinity of the cambial region of the graft union. As grafting involves callus formation, the operation should be performed under temperature conditions favorable for callus formation. The differentiation of callus into xylem and phloem also decreases under reduced water potentials. The presence of a film of water around the callusing surface is therefore a prerequisite for successful graft union. The failure of union in grafting during winter months in Bangladesh is due to low temperature and low humidity in the atmosphere. Information regarding the effect of time of grafting and the different scion wrapping system on the success, survivability and growth performance of Amropali mango variety is inconclusive. Considering the above facts the present piece of research work was undertaken to study the effect of time of grafting and the different scion wrapping system on the success, survivability and growth performance of cleft grafting of Amropali mango variety.

Materials and Methods

The present experiment was conducted at the Fruit Tree Improvement Program (FTIP), Bangladesh Agricultural University, Mymensingh during the period from: March 2013 to August 2014. The rootstocks used in the experiment were three or four month's nursery bed growing rootstocks of unknown variety. The scion shoots used, were collected from the good bearing, well established Amropali mango trees grown in the

Germplasm Centre of the fruit Tree Improvement Program (FTIP), Bangladesh Agricultural University, Mymensingh-2202. The two-factor experiment consisting of 90 treatment combinations was laid out in Randomized Complete Block Design (RCBD) with three replications. For each treatment combination grafting operations were performed on unknown rootstocks of each block. Thus in total 1800 grafts (3×10×3×20) were made. The treatment combinations were randomly assigned to each unit, so as to allot one treatment combination once only in each block. The experiment consisted of two factors. Factor A: Scion wrapping system viz., S₁= Polycap, S₂=Wrapping the scion with polythene strip except tip, S₃ = Full wrapping the scion with polythene strip and Factor B: Time of grafting viz., T₁ = 19 March, 2013, T₂ = 29 March, 2013, T₃ = 08 April, 2013, T₄ = 18 April, 2013, T₅ = 28 April, 2013, T₆ = 08 May, 2013, T₇ = 18 May, 2013, T₈ = 28 May, 2013, T₉ = 07 June, 2013 and T₁₀ = 17 June, 2013. The collected data on the different parameters of study were statistically analyzed to find out the significance of differences between the treatments and treatment combinations. The means of all the treatments were calculated and the analyses of variances (ANOVA) for all the characters were performed by 'F' variance test. The significance of differences between treatment means was compared by Least Significant Difference (LSD) test (Gomez and Gomez, 1993).

Results and Discussion

Effect of wrapping system and time of grafting operation on the leaf number

Main effect of scion wrapping system: The data showed that the scion wrapping system had significant effect on the number of new leaves which were recorded at 15 to 90 DAG. However, the highest number (18.71) of leaves was produced in the wrapping scion except tip and the lowest (17.21) was in fully wrapping the scion with polythene strip (Table 1).

Table 1. Main effect of scion wrapping system on the number of new leaves per graft at different days after grafting

Wrapping system	Number of new leaves at DAG					
	15 DAG	30 DAG	45 DAG	60 DAG	75 DAG	90 DAG
S ₁	11.34	11.83	12.73	16.19	18.08	18.11
S ₂	11.80	12.46	13.14	16.93	18.71	18.71
S ₃	10.65	11.29	11.79	15.59	17.06	17.21
LSD _{0.01}	0.128	0.097	0.043	0.239	0.128	0.095
Level of sign.	**	**	**	**	**	**

S₁ = Polycap, S₂ = Wrapping except tip, S₃ = Full wrapping DAG= Days after grafting, ** = Significant at 1% level of probability

Table 2. Main effect of time of grafting operation on the number of new leaves at different days after grafting

Time of grafting	Leaf number					
	15 DAG	30 DAG	45 DAG	60 DAG	75 DAG	90 DAG
T ₁ -19 th March	11.09	11.30	11.91	15.43	16.69	16.69
T ₂ -29 th March	11.13	11.38	12.40	15.82	17.42	17.42
T ₃ -08 th April	11.88	13.06	13.47	17.67	20.31	20.31
T ₄ -18 th April	12.44	13.42	13.86	18.30	20.71	20.71
T ₅ -28 th April	12.91	13.92	14.72	19.07	21.69	21.69
T ₆ -08 th May	11.44	12.50	13.27	17.08	18.87	18.87
T ₇ -18 th May	11.36	12.11	12.77	16.29	17.93	17.93
T ₈ -28 th May	9.61	9.72	10.61	13.82	14.61	14.86
T ₉ -07 th June	10.76	10.91	11.35	14.63	15.79	15.94
T ₁₀ -17 th June	10.02	10.26	11.14	14.25	15.48	15.70
LSD _{0.01}	0.234	0.177	0.079	0.436	0.234	0.173
Level of sign.	**	**	**	**	**	**

Main effect of time of grafting operation: The number of leaves of new growth was found to be statistically significant at every date of data recording due to the effect of time of grafting operation. After 90 days of

grafting, the highest number of leaves (21.69) was recorded in case of grafting on 28th April, 2013 while the lowest number of leaves (14.86) was found in grafting on 28th May, 2013 (Table 2). The second highest number of leaves (20.71) was found in grafting on 18th April, 2013. This might be due to favorable environmental conditions which accelerated early bud break and thus secondarily affected on maximum leaf emergence of new growth.

Combined effect of scion wrapping system and time of grafting operation: There was significant variation in the number of leaves due to the combined effect of the factors employed in the experiment. The highest number of leaves (22.43) was found when the grafts received the treatment combination of grafting on 28th April, 2013 in wrapping except tip (S₂T₅) while it was the lowest (14.20) for the treatment combination of grafting on 28th May, 2013 and fully wrapping the scion with polythene strip (S₃T₈) (Table 3). This result envisaged that the number of leaves per graft was depended on the cumulative effect of the two factors. The combined effect of the two factors employed in the experiment showed a significant variation in the production of leaf number of new growth. This might be due to the cumulative effect of wrapping system and time of grafting operation that influenced to generate the variation in average leaf number of new growth.

Table 3. Combined effect of scion wrapping system and time of grafting operation on number of new leaves at different days after grafting

Treatment combination	Number of new leaves at					
	15 DAG	30 DAG	45 DAG	60 DAG	75 DAG	90 DAG
S ₁ T ₁	11.17	11.27	11.63	15.83	16.57	16.57
S ₁ T ₂	11.20	11.30	12.93	16.03	17.67	17.67
S ₁ T ₃	12.07	12.90	13.83	17.67	20.20	20.20
S ₁ T ₄	12.83	13.07	14.37	17.97	21.33	21.33
S ₁ T ₅	12.90	13.93	14.40	18.13	21.87	21.87
S ₁ T ₆	11.30	12.43	13.77	17.30	18.93	18.93
S ₁ T ₇	11.30	11.87	13.00	16.23	17.93	17.93
S ₁ T ₈	9.70	9.70	10.67	13.90	14.23	14.53
S ₁ T ₉	10.77	11.10	11.43	14.57	16.10	16.10
S ₁ T ₁₀	10.20	10.77	11.23	14.23	15.97	15.97
S ₂ T ₁	11.20	11.43	12.90	15.97	17.67	17.67
S ₂ T ₂	11.27	11.63	13.07	16.57	17.80	17.80
S ₂ T ₃	12.23	13.97	14.23	17.80	21.83	21.83
S ₂ T ₄	12.87	14.37	14.37	19.27	21.83	21.83
S ₂ T ₅	13.92	14.40	15.83	21.33	22.43	22.43
S ₂ T ₆	11.80	13.00	13.97	17.40	19.27	19.27
S ₂ T ₇	11.60	12.93	13.43	16.80	18.13	18.13
S ₂ T ₈	10.93	10.67	10.77	14.50	15.83	15.83
S ₂ T ₉	11.10	11.23	11.53	14.97	16.23	16.23
S ₂ T ₁₀	11.07	10.93	11.27	14.73	16.10	16.10
S ₃ T ₁	10.90	11.20	11.20	14.50	15.83	15.83
S ₃ T ₂	10.93	11.20	11.20	14.87	16.80	16.80
S ₃ T ₃	11.33	12.32	12.33	17.53	18.90	18.90
S ₃ T ₄	11.63	12.83	12.83	17.67	18.97	18.97
S ₃ T ₅	11.90	13.43	13.93	17.73	20.77	20.77
S ₃ T ₆	11.23	12.07	12.07	16.53	18.40	18.40
S ₃ T ₇	11.17	11.53	11.87	15.83	17.73	17.73
S ₃ T ₈	8.20	8.80	10.40	13.07	13.77	14.20
S ₃ T ₉	10.40	10.40	11.10	14.37	15.03	15.50
S ₃ T ₁₀	8.80	9.07	10.93	13.77	14.37	15.03
LSD _{0.01}	0.406	0.307	0.137	0.755	0.406	0.299
Level of sig.	**	**	**	**	**	**

T₁= 19th March, T₂= 29th March, T₃= 08th April, T₄= 18th April, T₅= 28th April, T₆= 08th May, T₇= 18th May, T₈= 28th May, T₉= 07th June, T₁₀= 17th June and S₁= Polycap, S₂= Wrapping except tip, S₃= Full wrapping.

Effect of scion wrapping system and time of grafting operation on the scion length (cm)

Main effect of scion wrapping system: Scion length was significantly influenced by the different scion wrapping system. The results due to the effect of scion wrapping system on scion length have been presented in Fig. 1. The highest (35.99 cm) increased length of scion was observed under wrapping the scion with polythene strip except tip and the lowest (34.97cm) was in fully wrapping the scion with polythene strip at 90 DAG.

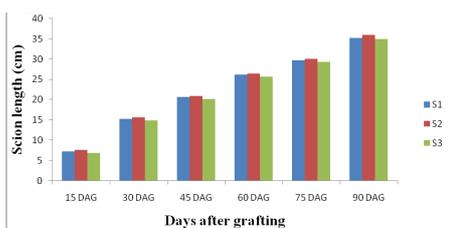


Fig. 1. Main effect of scion wrapping system on the scion length. Vertical bars represents LSD at 0.01 level of probability

Table 4. Main effect of time of grafting operation on the scion length (cm)

Time of grafting	Scion length (cm)					
	15 DAG	30DAG	45DAG	60DAG	75DAG	90DAG
T ₁ -19 th March	6.56	14.97	20.23	25.52	29.66	35.06
T ₂ -29 th March	7.51	15.20	20.56	26.06	29.98	35.34
T ₃ -08 th April	8.31	16.60	21.96	27.35	30.79	36.53
T ₄ -18 th April	8.94	17.17	22.49	27.76	31.25	37.31
T ₅ -28 th April	9.38	17.41	22.75	28.33	31.89	37.90
T ₆ -08 th May	7.78	15.87	21.10	26.65	30.43	36.33
T ₇ -18 th May	7.61	15.53	20.85	26.24	30.20	36.06
T ₈ -28 th May	5.23	12.88	18.19	23.61	26.88	32.02
T ₉ -07 th June	6.11	14.25	19.62	25.06	28.48	34.17
T ₁₀ -17 th June	5.52	13.15	18.56	24.21	27.78	33.14
LSD _{0.01}	0.089	0.148	0.210	0.105	0.254	0.221
Level of sig.	**	**	**	**	**	**

Table 5. Combined effect of scion wrapping system and time of grafting operation on the length of scion (cm)

Scion system x Time of grafting	Scion length (cm) at DAG					
	15	30	45	60	75	90
S ₁ T ₁	6.41	15.22	20.40	25.35	29.48	34.99
S ₁ T ₂	7.45	15.30	20.75	26.30	30.08	35.09
S ₁ T ₃	8.44	16.47	22.05	27.38	30.86	36.66
S ₁ T ₄	8.90	17.18	22.48	27.82	31.40	37.07
S ₁ T ₅	9.30	17.39	22.67	28.42	31.75	37.12
S ₁ T ₆	7.88	15.95	21.20	26.73	30.55	36.26
S ₁ T ₇	7.52	15.87	21.17	26.44	30.27	36.13
S ₁ T ₈	5.33	12.89	18.16	23.64	26.91	31.92
S ₁ T ₉	6.07	13.90	19.45	24.99	28.48	33.94
S ₁ T ₁₀	5.45	13.20	18.50	24.40	27.79	32.85
S ₂ T ₁	7.31	15.51	20.81	25.93	30.11	35.64
S ₂ T ₂	8.16	15.70	20.87	26.44	30.23	35.89
S ₂ T ₃	8.49	17.06	22.29	27.51	30.93	36.80
S ₂ T ₄	9.13	17.36	22.68	27.97	31.43	38.13
S ₂ T ₅	9.59	17.75	23.28	29.02	32.97	39.56
S ₂ T ₆	8.34	16.02	21.27	26.83	30.56	36.66
S ₂ T ₇	8.27	15.91	21.27	26.66	30.38	36.18
S ₂ T ₈	5.38	13.04	18.27	24.02	27.21	32.31
S ₂ T ₉	6.38	15.01	20.13	25.33	28.65	34.74
S ₂ T ₁₀	5.72	13.25	18.73	24.54	28.39	33.98
S ₃ T ₁	5.96	14.18	19.48	25.28	29.39	34.54
S ₃ T ₂	6.93	14.60	20.07	25.43	29.64	35.05
S ₃ T ₃	8.00	16.26	21.53	27.17	30.57	36.13
S ₃ T ₄	8.81	16.98	22.30	27.49	30.92	36.73
S ₃ T ₅	9.24	17.09	22.31	27.55	30.95	37.02
S ₃ T ₆	7.13	15.63	20.82	26.39	30.18	36.08
S ₃ T ₇	7.04	14.80	20.12	25.63	29.96	35.87
S ₃ T ₈	4.99	12.70	18.14	23.16	26.53	31.84
S ₃ T ₉	5.88	13.83	19.29	24.87	28.30	33.84
S ₃ T ₁₀	5.38	13.01	18.44	23.69	27.16	32.60
LSD _{0.01}	0.154	0.257	0.363	0.182	0.440	0.382
Level of sign.	**	**	**	**	**	**

Table 6. Main effect of scion wrapping system of grafting operation on the canopy volume (cm³)

Scion system	Canopy volume (cm ³) at DAG					
	15	30	45	60	75	90
S ₁	51.14	64.94	77.27	93.14	113.43	136.82
S ₂	56.17	71.43	84.18	97.68	118.88	142.00
S ₃	44.85	58.17	70.87	88.04	107.56	131.40
LSD _{0.01}	0.134	0.215	0.25	0.26	0.40	0.27
Level of sign.	**	**	**	**	**	**

Table 7. Main effect of time of grafting operation on the canopy volume (cm³)

Time of grafting	Canopy volume (cm ³) at DAG					
	15	30	45	60	75	90
T ₁ -19 th March	36.99	51.86	67.05	85.90	105.50	128.92
T ₂ -29 th March	40.86	54.70	71.35	88.22	108.50	132.28
T ₃ -08 th April	65.09	81.09	91.15	106.65	128.13	152.92
T ₄ -18 th April	83.97	97.09	104.89	117.96	137.84	162.47
T ₅ -28 th April	98.11	114.32	119.93	130.94	149.19	171.67
T ₆ -08 th May	58.92	71.81	83.92	102.25	121.68	145.07
T ₇ -18 th May	51.48	67.59	77.95	94.72	113.89	136.43
T ₈ -28 th May	19.28	33.16	46.93	51.94	77.26	100.28
T ₉ -07 th June	31.39	42.13	59.11	77.93	98.58	121.23
T ₁₀ -17 th June	21.09	34.70	52.10	73.02	92.34	116.13
LSD _{0.01}	0.244	0.392	0.46	0.48	0.73	0.50
Level of significant	**	**	**	**	**	**

Main effect of time of grafting operation: The periodically recorded data on the increment in scion length envisaged that there was significant influence of different

time of grafting operations on scion length. The means of increased length of scion shoot obtained from every date of data collection have been presented in (Table 4). After 90 days of grafting operation, the highest scion length (37.90 cm) was found on 28th April, 2013 while the lowest (32.02 cm) was recorded in case of 28th May, 2013 grafted plants. The variation in this result might be due to the variation in environmental conditions. However, the growth rate of the scion was seen in accordance with the rising in temperature and increased humidity. A linear growth of new scion shoot was found with the advancement of time. The month of April grafting operation showed the maximum growth. This might be due to prevailing congenial climatic condition along with availability of dormant and swollen terminal buds of scion in bulging condition, which encouraged earlier sprouting and their continual growth.

Combined effect of scion wrapping system and time of grafting operation: There was significant variation in scion length due to the combined effect of scion wrapping system and time grafting operation at 15 to 90 DAG. The highest (39.56 cm) scion length was noted in grafting on 28th April 2013 under wrapping the scion with polythene strip except tip (S₂T₅) and the lowest (18.37 cm) was noted in grafting on 28th May, 2013 and fully wrapping the scion with polythene strip (S₃T₈) (Table 5).

Effect of scion wrapping system and time of grafting operation on the canopy volume (cm³)

Main effect of scion wrapping system: Different scion wrapping system had significant effect on the canopy volume of the mango graft at 15 to 90 days after grafting. The highest (142.00 cm³) and the lowest (131.40 cm³) canopy volumes were obtained at 90 DAG under wrapping the scion with polythene strip except tip and fully wrapping the scion with polythene strip respectively (Table 6). The variation in this result might be due to the number of leaves, size of leaves and number of shoots per graft as influenced by growing conditions.

Main effect of time of grafting operation: The analysis of the collected data on canopy volume also showed a significant variation due to the effect of different time of grafting operation. The results on canopy volume as influenced by time of grafting operation have been presented in Table 7. The highest canopy volume (171.67 cm³) was found in grafting on 28th April, 2013. On the contrary, the lowest canopy volume (100.28 cm³) was recorded in grafting on 28th May, 2013. The highest canopy volume in 28th April grafted plants might be due to favorable environmental condition during the entire period of data collection that might have enhanced the rapid growth of the grafts.

Combined effect of scion wrapping system and time of grafting operation: The canopy volume was significantly effected by combined effect of two factors at 15 DAG to 90 DAG. The highest canopy volume (179.26 cm³) was observed in grafting on 28th April and wrapping the scion with polythene strip except tip (S₂T₅). The lowest canopy volume (95.23 cm³) was in grafting on 28th May under fully wrapping the scion with polythene strip (S₃T₈) (Table 8). This variation may be due to combined effect of favorable environmental condition and adequate supply of

photosynthates during the early stage of graft establishment which enhanced growth of plants. Thus the highest canopy volume was obtained.

Table 8. Combined effect of scion wrapping system and time of grafting operation on the canopy volume (cm³)

Scion system x Time of grafting	Canopy volume (cm ³) at DAG					
	15	30	45	60	75	90
S ₁ T ₁	38.48	51.01	69.18	84.75	104.12	127.20
S ₁ T ₂	40.05	57.72	70.83	86.47	109.21	132.18
S ₁ T ₃	69.17	82.39	92.69	106.78	129.81	157.31
S ₁ T ₄	82.59	95.68	104.20	118.29	138.10	161.77
S ₁ T ₅	96.64	109.38	117.33	129.89	149.26	171.63
S ₁ T ₆	63.04	76.46	85.59	98.75	117.65	140.38
S ₁ T ₇	47.86	66.71	78.04	98.34	116.21	137.51
S ₁ T ₈	19.42	33.35	42.91	53.14	74.58	98.10
S ₁ T ₉	33.24	42.29	59.21	80.71	101.42	123.89
S ₁ T ₁₀	20.87	34.37	52.68	74.29	93.95	118.23
S ₂ T ₁	38.90	58.10	70.36	88.53	108.55	133.23
S ₂ T ₂	48.61	58.85	73.93	93.01	112.18	134.46
S ₂ T ₃	72.14	89.22	97.84	111.98	135.69	157.96
S ₂ T ₄	87.73	100.75	106.99	118.91	139.37	165.37
S ₂ T ₅	104.87	126.65	130.47	139.13	156.70	179.26
S ₂ T ₆	64.99	77.86	94.89	110.94	132.25	156.66
S ₂ T ₇	61.72	77.61	86.29	100.42	118.50	140.19
S ₂ T ₈	22.55	36.93	55.89	54.70	85.62	107.49
S ₂ T ₉	35.49	49.38	69.15	82.92	103.63	125.59
S ₂ T ₁₀	24.66	38.92	55.96	76.22	96.30	119.83
S ₃ T ₁	33.61	46.49	61.61	84.41	103.84	126.34
S ₃ T ₂	33.91	47.54	69.29	85.18	104.11	130.21
S ₃ T ₃	53.97	71.67	82.93	101.18	118.89	143.49
S ₃ T ₄	81.58	94.84	103.49	116.68	136.05	160.27
S ₃ T ₅	92.81	106.93	112.00	123.80	141.61	164.10
S ₃ T ₆	48.74	61.10	71.26	97.08	115.14	138.18
S ₃ T ₇	44.86	58.46	69.52	85.39	106.95	131.60
S ₃ T ₈	15.88	29.19	41.98	47.97	71.58	95.23
S ₃ T ₉	25.42	34.72	48.98	70.16	90.69	114.22
S ₃ T ₁₀	17.72	30.80	47.65	68.54	86.77	110.32
LSD _{0.01}	0.423	0.680	0.79	0.83	1.27	0.87
Level of significant	**	**	**	**	**	**

Table 9. Combined effect of scion wrapping system and time of grafting operation on the percentage of graft success and survivability

Scion system x Time of grafting	% success	% Survivability
S ₁ T ₁	77.67	73.52
S ₁ T ₂	78.96	74.99
S ₁ T ₃	85.18	80.25
S ₁ T ₄	86.96	82.36
S ₁ T ₅	88.12	83.47
S ₁ T ₆	83.44	79.44
S ₁ T ₇	82.25	77.85
S ₁ T ₈	69.20	65.11
S ₁ T ₉	74.95	70.89
S ₁ T ₁₀	72.54	68.60
S ₂ T ₁	80.43	76.34
S ₂ T ₂	81.95	77.66
S ₂ T ₃	86.62	82.36
S ₂ T ₄	88.41	84.60
S ₂ T ₅	90.32	85.36
S ₂ T ₆	85.14	80.49
S ₂ T ₇	84.59	79.36
S ₂ T ₈	70.17	66.67
S ₂ T ₉	77.70	73.49
S ₂ T ₁₀	74.89	70.36
S ₃ T ₁	77.20	72.44
S ₃ T ₂	76.70	72.85
S ₃ T ₃	82.50	78.22
S ₃ T ₄	83.72	79.35
S ₃ T ₅	86.06	81.87
S ₃ T ₆	80.89	76.25
S ₃ T ₇	79.77	75.15
S ₃ T ₈	66.63	62.14
S ₃ T ₉	71.66	67.69
S ₃ T ₁₀	68.20	64.36
LSD _{0.01}	0.423	0.832
Level of significant	**	**

Effect of scion wrapping system time of grafting operation on the percentage of graft success

Main effect of scion wrapping system:

The percentage of graft success was significantly influenced by different growing conditions of mango grafts. The highest graft success (82.02 %) was achieved under wrapping scion except tip and the lowest (77.33 %) was in fully wrapping the scion with polythene strip.

Main effect of time of grafting operation: The percentage of graft success was significantly influenced by the different time of grafting operations. The highest success (88.17 %) was recorded in grafting on 28th April.

The lowest success (68.67 %) was observed in grafting on 28th May. This difference in success might be due to the prevalence of varied wrapping system at the time of grafting operation. The highest success in grafting on was also probably due to availability of dormant scion with swollen bud in bulging condition at that time and favorable temperature and humidity in the atmosphere.

Effect of scion wrapping system and time of grafting operation on the percentage of graft survival

Main effect of scion wrapping system

There was significant variation due to the effect the scion wrapping system in respect of graft survival The highest (77.67 %) and lowest graft (73.03%) survival were noticed wrapping the scion with polythene strip except tip and fully wrapping the scion with polythene strip respectively (Table 9).

Main effect of time of grafting operation: The final survival of grafts responded significantly due to the effects of time of grafting operation .The maximum percentage of graft survival (83.57%) was obtained from the grafting on 28th April while grafting on 28th May gave the lowest (64.64%) survival rate (Table 9). The optimum temperature and atmospheric humidity during 28th April grafting might be the main reason which helped in rapid establishment of vascular connection.

Combined effect of scion wrapping system and time of grafting operation:

The combined as well as interaction effects of scion wrapping system and time of grafting operation on the percent survival of grafts were found to be significant at 90 DAG. The grafting operation conducted on 28th April under wrapping the scion with polythene strip except tip (S₂T₅) was observed to have the highest survival rate (85.36%). The lowest survival rate (62.14%) was noticed in the treatment combination of grafting on 28th May under fully wrapping the scion with polythene strip (S₃T₈) (Table 9). The result of the survivability envisaged that graft survivability was influenced by the cumulative effect of the factors employed in the experiment very much.

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