International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(3): 3618-3621

Received: 04-03-2018
Accepted: 09-04-2018

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Standardization of method and period of grafting in black Jamun (*Syzygium cuminii* (L.) Skeel) cv. Konkan Bahadoli

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Abstract
An experiment was carried out to study the standardization of method and period of grafting in black jamun (*Syzygium cuminii* (L.) Skeel) cv. Konkan Bahadoli during the year 2016-2017. The experiment was laid out in a Completely Randomized design with factorial concept (FCRD) and repeated thrice with eight treatments combination. The experiment involved four grafting month at monthly interval starting from June to September and two grafting methods *viz.* wedge & side, using scion of cultivar 'Konkan Bahadoli' on black jamun rootstocks raised in polythene bags. Results showed that among the different grafting method and different period, wedge grafting and June month grafting were individual as well as intheir combination found to be the most beneficial for like increment total number of leaves, height of grafts, scion girth, scion length and number of shoots per grafts and graft survival percentage.

Keywords: jamun, konkan bahadoli, wedge grafting, side grafting

Introduction
Jamun (*Syzygium cuminii* (L.) Skeel), a member of subfamily of family Myrtaceae, attaining a height of 25-30 m and a stem girth 3-4 m. This long lived tree bearing fruits up to 60-70 years. Jamun is an important indigenous minor fruit of commercial value. It is also known as 'black plum', Indian 'black cherry' and 'Ram jamun' in different parts of India. However, jamun is a hardy fruit and grows well in tropical and subtropical climatic conditions. It prefers dry weather at the time of flowering and fruit setting. Early rains in subtropical areas are considered to be beneficial for proper fruit growth. Young jamun plants are susceptible to frost conditions (Prabhuraj, 2001) [13]. Fruits are used for consumption for fresh fruits, also used for making delicious and nutritious RTS, squash, syrup, jam, jelly, juice and wines etc. Jamun fruit possesses considerable nutritive value. It is a good source of iron, apart from the usual contents like minerals, sugars, proteins, pigments etc. (Singh and Srivastava, 2000) [16].
Due to cross pollination the variation exist in leaves, plant height and spread, bearing, fruit size, color, shape, taste and texture. Therefore, there is urgent need to standardize the technology of vegetative propagation for quick multiplication of elite jamun plants. Environmental conditions like mild temperature and humidity and suitable grafting technique must be met for development of callus tissue and to form a graft union. In this context the significance of vegetative propagation in maintenance of genetic uniformity and preservation of identity of clone/ cultivar is well recognized in jamun. Wedge grafting has a tremendous potential for multiplying rapidly throughout the year either in green house as well as in open conditions. In view of varied climatic conditions of our country planting material are required round the year (Mukhejee and Majumdar, 1964) [12].

Material and Methods
The investigation was carried out at the Regional Horticultural Research Station, ASPEE Collage of Horticulture and Forestry, Navsari Agricultural University, Navsari during 2016-17. The experiment was laid out in a Completely Randomized Design with factorial concept (FCRD) with three repetitions and eight treatment combinations. The experiment involved two grafting methods such as wedge (G_1) and side (G_2) and four different months *i.e.* June (M_1), July (M_2), August (M_3) and September (M_4) month. Ten month old rootstocks raised in polybages and kept under 50 % shade net house conditions for grafting.

Each replication contain 20 graft per treatment. Different observations on growth parameter and survival percentage were recorded.

The observation on growth parameters like increment total number of leaves per graft, height of grafts, scion girth, scion length and number of shoots per graft were recorded 60, 120 and 180 days after grafting and survival percentage were recorded after 120 DAG.

Results and Discussion

Two grafting methods (wedge and side) and four grafting periods (June, July, August and September) were used. The interaction effect between method of grafting and periods of grafting were significant in all the characters observed during experiment and the best results was found in wedge grafting done during June month (G_1M_1).

Total number of leaves per graft

Total number of leaves per grafts was significantly affected by grafting time, methods and their interactions. The observation (Table 1) regarding grafting month were influenced significantly the incremental total number of leaves (11.73, 7.86 and 6.96 at 60, 120 and 180 DAG, respectively) were recorded when grafting done in June (M_1) which was at par with grafting done in August (M_3) at 120 and 180 DAG.

Significantly the maximum incremental total numbers of leaves per graft (10.42, 6.96 and 6.17 leaves at 60, 120 and 180 DAG, respectively) were recorded in wedge grafting (G_1) as compared to side grafting (G_2).

Significantly, the maximum incremental total number of leaves (12.60 and 8.66 per graft at 60 and120 DAG, respectively) were recorded in treatment combination G_1M_1 (wedge grafting done in June). This may be due to favourable climatic conditions prevailed during that period as well as higher food reserve in plants leading to early sprouting of scions that supported growth of the grafts at higher rate during June and resulting in production of higher number of leaves on the grafts. These findings are supported by Islam *et al.* (2004) [7] in mango, Chovatia and Singh (2000) [5], Bharad *et al*. (2006) [2] in jamun.

Table 1: Effect of grafting month and methods on incremental total number of leaves per graft at 60, 120 and 180 DAG in Black jamun cv. Konkan Bahadoli

Method Month	Incremental total number of leaves per graft								
	60 DAG			120 DAG			180 DAG		
	(G_1)	(G_2)	Mean	(G_1)	(G_2)	Mean	(G_1)	(G_2)	Mean
M_1	12.60	10.86	11.73	8.66	7.06	7.86	7.80	6.16	6.96
M_2	6.66	5.20	5.93	4.46	3.66	4.06	4.93	3.13	4.03
M_3	12.06	10.26	11.16	8.56	6.80	7.68	7.53	6.06	6.76
M_4	10.33	10.20	10.26	6.13	6.06	6.10	4.46	3.26	3.86
Mean	10.42	9.13		6.96	5.90		6.17	4.65	
	S.Em±	C.D. at 5 %	C.V. %	S.Em±	C.D. at 5 %	C.V. %	S.Em±	C.D. at 5 %	C.V. %
M	0.17	0.51	4.32	0.11	0.34	4.41	0.10	0.31	4.77
G	0.12	0.37		0.08	0.25		0.07	0.22	
G × M	0.24	0.73		0.16	0.49		0.14	NS	

Height of Graft

Significantly maximum grafting height was recorded (8.66, 6.30 and 5.00 cm at 60, 120 and 180 days after grafting, respectively) when grafting done in June (M_1) which was statistically at par with treatments M_3 (grafting done in August). Whereas, grafting height were significantly influenced by different grafting methods. Jamun plants grafted by wedge grafting (G_1) had recorded significantly the maximum incremental grafting height (7.78, 5.65 and 4.72 cm at 60, 120 and 180 days after grafting, respectively).

Table 2: Effect of grafting month and methods on incremental height of graft (cm) at 60, 120 and 180 DAG in Black jamun cv. Konkan Bahadoli

Method Month	Incremental height of graft (cm)								
	60 DAG			120 DAG			180 DAG		
	(G_1)	(G_2)	Mean	(G_1)	(G_2)	Mean	(G_1)	(G_2)	Mean
M_1	9.80	7.53	8.66	7.13	5.46	6.30	5.40	4.60	5.00
M_2	5.40	5.00	5.20	3.40	3.00	3.20	5.60	3.00	3.30
M_3	9.73	7.06	8.40	6.53	5.80	6.16	5.13	4.40	4.76
M_4	6.20	5.73	5.96	5.53	5.00	5.26	4.73	4.13	4.43
Mean	7.78	6.33		5.65	4.82		4.72	4.03	
	S.Em±	C.D. at 5 %	C.V. %	S.Em±	C.D. at 5 %	C.V. %	S.Em±	C.D. at 5 %	C.V. %
M	0.10	0.30	3.52	0.08	0.25	3.90	0.08	0.24	4.57
G	0.07	0.21		0.06	0.18		0.06	0.17	
G × M	0.14	0.43		0.11	0.35		0.11	NS	

The interaction effects between grafting time and grafting methods on height of grafts was found to be Significantly the maximum incremental height graft (9.80, 7.13 cm at 60 and 120 DAG, respectively) were recorded in treatment combination G_1M_1 (wedge grating done in June) which was statistically at par with G_1M_3 at 60 and 120 DAG. The favourable climatic conditions during June and August definitely increased the rate of photosynthesis and leads to formation of more food materials that supported higher rate of growth in the grafts that might facilitated earlier union formation and subsequent growth during initial periods and lasts during later stages to produce grafts with higher height. Similar results were observed by Islam *et al.* (2004) [7] in mango, Chandra *et al.* (2011) [3] in pomegranate.

Girth of Scion

Increment girth of scion was found to be significantly affected by grafting time and grafting methods at 60, 120 and 180 DAG (Table 3). The maximum scion girth (7.46, 5.60 and 3.81 mm at 60, 120 and 180 DAG, respectively) were observed in grafting done on June month (M_1) which was statistically at par with the treatments M_3 at 60, 120 and 180 DAG. The increment in girth can be correlated with graft height and it is obvious that the grafts with maximum height also have higher girth in a particular mass of plants kept at uniform climatic conditions (Khopade and Jadav, 2013) [10].

Significantly the maximum incremental scion girths (6.76, 4.99 and 3.71 mm at 60, 120 and 180 DAG, respectively) were recorded for wedge grafting (G_1)). This may be due to more cambium contact between the cut portion of stock and scion in wedge grafting that contributed in early callus development leading to quicker repair of broken cells resulting in early union development and thereby, maintained increased rate of growth in terms of girth of scion as compared to the side grafting. Similar results were obtained by Rani Sohnika *et al.* (2015) [14] in guava, Bharad *et al.* (2006) [2] in jamun, Khatun *et al.* (2008) [9] in jackfruit.

Table 3: Effect of grafting month and methods on incremental scion girth (mm) at 60, 120 and 180 DAG in Black jamun cv. Konkan Bahadoli

Method Month	Incremental scion girth (mm)								
	60 DAG			120 DAG			180 DAG		
	(G_1)	(G_2)	Mean	(G_1)	(G_2)	Mean	(G_1)	(G_2)	Mean
M_1	7.62	7.31	7.46	5.64	5.56	5.60	4.06	3.57	3.81
M_2	4.75	4.01	4.38	3.42	3.12	3.27	3.42	3.12	3.27
M_3	7.54	7.08	7.31	5.58	5.13	5.36	3.93	3.45	3.69
M_4	7.12	6.53	6.82	5.32	4.47	4.89	3.42	3.06	3.24
Mean	6.76	6.24		4.99	4.57		3.71	3.30	
	S.Em±	C.D. at 5 %	C.V. %	S.Em±	C.D. at 5 %	C.V. %	S.Em±	C.D. at 5 %	C.V. %
M	0.12	0.38	4.83	0.09	0.27	4.67	0.05	0.16	3.85
G	0.09	0.27		0.06	0.19		0.04	0.12	
G × M	0.18	NS		0.12	NS		0.07	NS	

Number of shoot per grafts

The results in table -4 revealed that the significantly maximum incremental number of shoots (1.86, 1.60 and 1.40 shoot per graft at 60, 120 and 180 DAG, respectively) were observed when grafting done in June (M_1) which was at par with treatment M_3 (grafting done in August). The probable reason might be the plants grafted during June sprouted early due to its higher carbohydrate content stored after harvesting of fruits. Such grafts then produced more number of leaves at different intervals. The photosynthetic food produced by these leaves was in turn utilized to continue the primary growth at a faster rate and resulted as higher graft height, scion length and number of shoot for the grafts prepared in the month of June. The climatic conditions prevailed after grafting in these months also helped in maintaining the growth of grafts at a faster rate. Similar findings here reported by Rani Sohnika *et al.* (2015) [14] in guava.

The maximum incremental number of shoots (1.77, 1.46 and 1.34 shoots per graft at 60, 120 and 180 DAG, respectively) were observed in wedge grafting (G_1) treatment.

The maximum incremental number of shoot (2.13 shoot per graft at 60 DAG) was reported in treatment combination G_1M_1 (wedge grafting done in June) which was at par with treatment combination of G_1M_3 (2.07). The probable reason might be the branches on grafts a result of stages involving sprouting scions, production of leaves and increment in height simultaneously. All these growth parameters are correlated with each other linearly and positively. Similar trend was observed by Islam *et al.* (2004) [7] in mango and Rani Sohnika *et al.* (2015) [14] in guava.

Table 4: Effect of grafting month and methods on incremental number of shoot per graft at 60, 120 and 180 DAG in Black jamun cv. Konkan Bahadoli

Method Month	Incremental number of shoot per graft								
	60 DAG			120 DAG			180 DAG		
	(G_1)	(G_2)	Mean	(G_1)	(G_2)	Mean	(G_1)	(G_2)	Mean
M_1	2.13	1.60	1.86	1.73	1.46	1.60	1.50	1.31	1.40
M_2	1.30	1.13	1.21	1.13	1.00	1.06	1.13	1.06	1.10
M_3	2.07	1.47	1.76	1.60	1.33	1.46	1.40	1.26	1.33
M_4	1.58	1.32	1.45	1.36	1.26	1.31	1.31	1.18	1.25
Mean	1.77	1.38		1.46	1.27		1.34	1.21	
	S.Em±	C.D. at 5 %	C.V. %	S.Em±	C.D. at 5 %	C.V. %	S.Em±	C.D. at 5 %	C.V. %
M	0.03	0.10	5.38	0.03	0.08	5.35	0.02	0.08	5.20
G	0.02	0.07		0.02	0.06		0.02	0.06	
G × M	0.04	0.14		0.04	NS		0.03	NS	

Table 5: Interaction effect of grafting month and methods on graft survival percentage at 180 DAG

G × M	Wedge grafting (G_1)	Side grafting (G_2)
M_1- June	78.33	71.66
M_2- July	48.33	33.33
M_3- August	71.66	73.33
M_4- September	56.66	46.66
S. Em. ±	2.20	
C.D. at 5%	6.61	
C.V. %	6.36	

The data presented in Table 5 revealed that the interaction effects between grafting month and grafting methods were found significant effect on graft survival percentage at 180 DAG. Significantly the maximum graft survival (78.33 %) was recorded in treatment combination G_1M_1 (wedge grafting done in June), which was at par with the treatment combinations of G_1M_3. Significantly the minimum (33.33 %) grafts were survived in the treatment combination of G_2M_2 (side grafting in July) at 180 days after grafting. The higher sap flow condition of the mother plants along with congenial weather conditions prevailed during these time, provided ideal conditions for better union of cambium layer in stock and scion. The grafts prepared during June obtained climatic conditions as well as plant biological benefits naturally that leads to higher graft survival percentage for the grafts (Chovatia and Singh, 2000) [5]. Similar results were observed by Bharad *et al.* (2006) [2] in jamun, Islam *et al.* (2004) [7] in mango, Kumar *et al.* (2014) [11], Chauvatia and Singh (1999) [4], Golap *et al.* (2000) [6] in custard apple, Syamal *et al.* (2012) [18], Beer *et al.* (2013) [1] in guava.

Conclusion

To conclude that grafting done in month of June with wedge grafting method proved to be superior for the various growth parameters like, total number of leaves and height of graft, scion girth, scion length and number of shoot per graft in black jamun cv. Konkan Bahadoli.

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