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Effect of storage condition for grafts and capping material on success and survival of softwood grafting in Jamun (*Syzygium cumini* L. Skeels) cv. Konkan Bahadoli

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Abstract
The present investigation carried out during 2022-23 in winter season at Horticulture Nursery, VNMKV, Parbhani. The experiment was laid out in FRBD (Factorial Randomized Block Design) with two factors, factor A consist of 3 storage conditions of graft i.e. S1: Poly house, S2: Shade net and S3: Open field condition and factor B consist of capping material i.e. C1: Pepsi bag, C2: Plastic bag and C3: Without capping with three replications. The experiment was farmed to study the effect of storage conditions and capping material on success and survival of softwood graft in Jamun. Observation on success and survival of individual treatments were recorded. The results of the present investigation revealed that, The effect of storage conditions of graft indicated that the storage at poly house (S1) recorded minimum days required for sprouting (12.10), maximum number of successful grafts (26.00), number of survival of graft (26.88), percent success of graft (86.63%), percent survival graft (89.60%) and recorded minimum percent mortality of graft (10.35%). The effect of capping material indicated that the capping with pepsi bag (C1) recorded minimum number of days require for sprouting (12.43), maximum number of successful graft (24.77), number of survival graft (26.11), percent success of graft (82.57%), percent survival graft (87.00%) and recorded minimum percent mortality of graft (12.94%).The interaction effect of storage condition and capping material indicated that the treatment S1C1 (Poly house + Pepsi bag) recorded minimum number of days require for sprouting (11.43), maximum number of successful graft (27.33), number of survival graft (27.66), percent success of graft (91.10%), percent survival graft (92.20%) and recorded minimum percent mortality of graft (7.73%).

Keywords: Jamun, softwood grafting, Konkan Bahadoli, storage condition, capping material

Introduction
Jamun (*Syzygium cumini* L. Skeels) is a major underutilized indigenous fruit crop of India. It is very common, large, evergreen beautiful tree of Indian sub-continent. It belongs to Myrtaceae family having chromosome number 2n=40. In Jamun there are about 400 to 500 species of which only few are considered edible fruit bearers (Chundawat, 1990) [6]. The other common name of Jamun is Java plum, Black plum, Indian blackberry, Jambolan plum and so forth. It is also known by numerous regional names including Jamun, Jambhul, Jambolanum, Phalani or Phalinda and Kalajam etc. rose apple, Water apple and Malayan rose apple are small commercial crops. It has recently gained prominence in arid regions. It is one of the hardiest fruit crops and could be easily grown in neglected and marshy areas where other fruit plants cannot be grown successfully. It is widely distributed in tropical and subtropical parts of India, Sri Lanka, Malaysia, Thailand, Australia and Philippines.

It is grown in India's tropical and subtropical regions and requires deep loam and well-drained soil for optimal growth and yield. It can also grow well under salinity and water logged conditions. It can be grown at an elevation of around 1500m above mean sea level. Jamun is a hardy fruit tree that grows well in wastelands. It is drought resilient yet being tolerant of water stagnation and marshy wetlands. Its scattered plantation can be seen in parks, along wayside avenues, and as a windbreak.

India ranks second in Jamun production next to Brazil in area and production in the world (Bodkhe and Rajput, 2010) [4]. The Jamun is a large growing, evergreen tree attaining a height of 25-30 meter and a girth of 3-4 meter. This is long lived tree bearing fruits up to 60- 70 years is usually with crocked branches and a tendency to droop smaller branches, on the whole,

forming a beautiful shape tree and is grown for shade and on the boundary Leaves are smooth, shiny, lanceolate, oblong or elliptical or hardy or broadly ovate, gland dotted. The first week of March to the end of April sees the onset of greenish white fragrant blossoms in trichotomous particles. Flowers of Jamun are hermaphrodite which appears in the axils of the leaves.

The fruit of the tree grows in clusters of only a few to 10 to 40 round or rectangular, sometimes curved, long fruits that typically change colour as they ripen from green to light-magenta, then dark purple or nearly black. Jamun fruit is purple colour due to anthocyanin. In Indonesia, a white fruited variety has been noted. The pulp is purple or white, very juicy and normally encloses a single oblong green or brown seed, tightly compressed within a leathery coat and some are seedless. The fruit flavour ranges from acidic to somewhat sweet and sometimes unpalatable. Tannins content in fruits is account for astringency of the fruit.70% of fruits are edible. The Jamun fruit has a lot of nutritional value. The principle sugar content in Jamun are glucose and fructose. Major acid found in Jamun is malic acid (0.59% of the weight of fruit). Jamun is one of India's useful medicinal crops because of its refreshing and curative properties. Fruits are used in Ayurvedic Indian Medicine.

Jamun trees are typically grown from seeds, and the seedlings typically exhibit a high amount of variability and a protracted juvenile phase. If propagation is done by seed, it will take longer time to get bearing and large-scale multiplication is not possible in shorter period and true-to type plants are not obtained, so vegetative methods of propagation is used to overcome this problem.

In situ soft wood grafting in the mango was developed by Amin (1978) [1] at Gujarat Agricultural University, Anand, and obtained good success. This method of grafting should be useful even in Jamun for rootstock raised in polythene bags with suitable media.

In Jamun softwood grafting method is gaining popularity among nurseryman and growers. The procedure involved in soft wood grafting is simple, economical, and less cumbersome. The microclimate conditions of the location have a considerable impact on vegetative propagation tactics. Jamun has an important role to play in satisfying the demand for nutrition, delicately flavoured attractive natural foods of high therapeutic value. Due to its rising demand, it is essential to select plants of excellent quality with high-yielding potential. It is only possible when desirable mother trees are used for propagation.

In Jamun polyembryony condition is found so there are difficulties to identify true to type, hence for obtaining true to type elite planting material the experiment had framed for softwood grafting. The survival of grafts is limited, so different storage conditions of grafts and different capping materials of scion sticks are also used to create humidity and prevent drying and desiccation of the graft union to get maximum success. In view of this, the present investigation ''Effect of Storage Conditions for Grafts and Different Capping Material on Success and Survival of Softwood Grafting in Jamun (*Syzygium cumini* L. Skeels) cv. Konkan Bahadoli'' was carried out with an objective: to study the effect of storage conditions of the grafts on success and survival of grafts of Jamun and to study the effect of capping material on success and survival of grafts of Jamun.

Materials and Methods

A field experiment on Jamun was conducted during winter season at Horticulture Nursery Parbhani, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. Geographically Parbhani is situated between 190 16" North latitude and 960 41" east longitudes and at an altitude of 409 meters above mean sea level (MSL). The experiment was designed in FRBD (Factorial Randomized Block Design). There were nine treatment combinations and each treatment was replicated thrice. There were two factor, factor A consist of 3 storage conditions of graft i.e. S1: Poly house, S2: Shade net and S3: Open field condition and factor B consist of capping material i.e. C1: Pepsi bag, C2: Plastic bag and C3: Without capping.

In order to evaluate the effect of different storage condition and capping material on success and survival of softwood graft of jamun, necessary periodical observations were recorded at 30, 60, 90 and 120 DAG and the recorded data was statistically analysed by ANOVA method given by Panse and Sukhatme 1985 [13].

Results and Discussion

Days required for sprouting

Among storage conditions, storage at (S1) poly house required minimum number of days for sprouting (12.10) represented in table 1. Maximum number of days required for sprouting in (S3) open field condition (13.40). This might be due to presence of controlled condition inside poly house which provide regulated temperature, humidity and light for better sprouting of grafts. These findings are in agreement with finding observed by Makavana *et al.,* (2022) [10] in Jamun, Mithapara and Karetha (2021) [11] in Sapota. Among capping material, minimum number of days was required for sprouting by using (C1) Pepsi bag (12.43) as capping material followed by (C2) plastic bag (12.52). However, maximum days were recorded in (C3) without capping (13.37). These might be due to pepsi bag capping provide humidity around graft joint and reduce rate of transpiration, which protected tissues in graft joint from desiccation. Similar results were reported by Nimbalkar *et al.,* (2011) [12] in Karonda, Dewangan *et al.,* (2016) [7] in Mango and Bhilare *et al.,* (2018) [3] in Lemon.

Among interaction effect, interaction of S1C1 recorded minimum number of days required to sprout (11.43) which was significantly superior over all the interactions. Next best interaction S1C2 recorded (11.73) which is followed by S2C2 (12.40). While maximum days required to sprout was found in S3C3 (13.73). This might be due to best combine effect of storage condition and capping material which provide controlled environment and create micro climate around graft union and less transpiration helping better sprouting. Similar result were reported by Dewangan *et al.,* (2016) [7] in Mango, Kumar *et al.,* (2018) [9] in Guava and Visen *et al.,* (2010) [15] in Guava.

Number of successful graft

Number of successful graft were recorded at 30, 60 and 90 DAG and represented in table 2. Number of successful grafts were significantly influenced by different storage conditions at 30, 60 and 90 DAG. Storage at (S1) poly house (21.11, 23.22 and 26.00) recorded significantly maximum number of successful grafts, while minimum number of successful grafts were observed in (S3) open field condition (16.00, 18.66 and

21.22). This may be due to congenial environmental conditions reveling in the control condition might lead to maximum number of successful grafts. Same research results were found by Makavana *et al*., (2022) [10] in Jamun and Chander *et al*., (2016) [5] in Jamun.

Number of successful grafts were significantly influenced by different capping material at 30, 60 and 90days after grafting. Capping with (C1) pepsi bag (19.44, 22.44 and 24.77) recorded significantly maximum number of successful grafts, while minimum number of successful grafts were observed in (C3) without capping (17.33, 19.00 and 22.33). This might be due to scion had more stored food material which cause rapid formation of callus tissues that allow translocation of vital chemical compound between stock and scion leading to more chance of graft success.

The interaction effect between storage condition (S) and capping material (C) was significantly influenced at 30, 60 and 90 days after grafting. Among interaction effect, number of successful grafts was recorded maximum in interaction effect of S1C1. This might be due to this treatment had maximum number of leaves and exhibited excellent vegetative growth thus higher photosynthesis rate result in luxuriant vegetative growth and causing maximum success of graft. Similar result was obtained by Makavana *et al*., (2022) [10] in Jamun and Chander *et al*., (2016) [5] in Jamun.

Number of survival graft

Number of survival graft recorded at 120 DAG and represented in table 4. Number of survival grafts were significantly influenced by different storage conditions at 120 days after grafting. Storage at (S1) poly house (26.88) recorded significantly maximum number of survival grafts, while minimum number of survival grafts were observed in (S3) open field condition (22.77). This may be due to suitable microclimatic conditions. These findings are in agreement with finding observed by Gotur *et al.,* (2017) [8] in Guava, Dewangan *et al.,* (2016) [7] in Mango.

Number of survival grafts were significantly influenced by different capping material at 120 days after grafting. maximum number of survival grafts was recorded in (C1) pepsi bag (26.11), while minimum number of survival grafts were observed in (C3) without capping (23.66). This might be due to ideal microclimate circumstances. Similar results are reported by Dewangan *et al.,* (2016) [7] in mango and Banyal *et al*., (2022) [2] in Guava.

Among interactions S1C1 recorded maximum number of survival graft (27.66) which was at par with S1C2 (26.66), S1C3 (26.33) and S2C2 (26.00) followed by S2C1 (25.66). The less number of survival grafts (19.66) was found in S3C3. Similar results are reported by Dewangan *et al.,* (2016) [7] in mango, Gotur *et al.,* (2017) [8] in guava and Banyal *et al*., (2022) [2] in Guava.

Percent success of graft

Percent success of graft recorded at 30, 60 and 90 DAG and represented in table 3. Percent success of grafts were significantly influenced by different storage conditions at 30, 60 and 90 days after grafting. Storage at (S1) poly house (70.33, 77.32 and %) recorded significantly maximum Percent success of grafts, while minimum Percent success of grafts were observed in (S3) open field condition (53.29, 62.92 and 70.70%). This may be due to congenial environmental conditions reveling in the control condition might lead to maximum Percent success of grafts. Same research results were found by Makavana *et al*., (2022) [10] in Jamun and Chander *et al*., (2016) [5] in Jamun.

Percent success of grafts were significantly influenced by different capping material at 30, 60 and 90days after grafting. Capping with (C1) pepsi bag (64.79, 74.79 and 82.57%) recorded significantly maximum Percent success of grafts, while minimum Percent success of grafts were observed in (C3) without capping (57.73, 64.79 and 74.07%). This might be due to scion had more stored food material which cause rapid formation of callus tissues that allow translocation of vital chemical compound between stock and scion leading to more chance of graft success.

Among interaction percent success of grafts was recorded maximum in interaction effect of S1C1. This may be due to more activity of meristematic tissue inside the scion with increased height.

Percent survival of graft

Percent survival of graft recorded at 120 DAG and represented in table 4. Among storage condition storage at (S1) poly house (89.60%) recorded significantly maximum percent survival of grafts, while minimum percent survival of grafts were observed in (S3) open field condition (75.90%). This may be due to suitable micro climatic conditions. These findings are in agreement with finding observed by Gotur *et al.,* (2017) [8] in Guava, Dewangan *et al.,* (2016) [7] in Mango, Mithapara and Karetha (2021) [11] in Sapota and Sivudu *et al.,* (2014) [14] in Mango.

Among capping material maximum percent survival of grafts was recorded by using (C1) pepsi bag (87.00%), while minimum percent survival of grafts were observed in (C3) without capping (78.87%). This might be due to ideal micro climatic circumstances. Similar results are reported by Dewangan *et al.,* (2016) [7] in Mango and Banyal *et al*., (2022) [2] in Guava.

Among interaction effects, interaction S1C1 recorded maximum percent survival of grafts (92.20%) which was followed by S1C2 (88.90%), S1C3 (87.73%) and S2C2 (86.63%) followed by S2C1 (85.50%). The minimum percent survival of grafts (65.53%) was found in S3C3. This might be due to this treatment had maximum number of leaves and exhibited excellent vegetative growth thus higher photosynthesis rate result in luxuriant vegetative growth and causing maximum survivability of grafts. Similar results are reported by Dewangan *et al.,* (2016) [7] in Mango, Gotur *et al.,* (2017) [8] in Guava, Mithapara and Karetha (2021) [11] in Sapota and Banyal *et al*., (2022) [2] in Guava.

Percent mortality of graft

Percent mortality of graft recorded at 120 DAG and represented in table 4. Among storage condition, Storage at (S3) open field (24.07%) condition recorded significantly maximum percent mortality of grafts, while minimum percent mortality of grafts were observed in (S1) poly house condition (10.35%). This may be due to that uncongenial conditions results in faster desiccation of scion sticks and drying up before graft- take. Similar results are reported by Mithapara and Karetha (2021) [11] in Sapota and Makavana *et al*., (2022) [10] in Jamun.

Among capping materials maximum percent mortality of grafts was recorded in (C3) without capping (21.10%), while minimum percent mortality of grafts were observed in (C1)

pepsi bag (12.94%). This may be due to uncongenial conditions results in faster desiccation of scion sticks and drying up before graft-take.

Among interaction effects, grafting interaction S3C3 recorded maximum percent mortality of grafts (34.44%) which was followed by S3C2 (21.10%), S3C1 and S2C3 (16.66%).

Table 1: Effect of storage conditions and capping material on Days required for sprouting.

Treatments	Days required for sprouting
Storage condition (S)	
S1	12.10
S2	12.82
S3	13.40
SE	0.12
CD at 5%	0.36
Capping material (C)	
C1	12.43
C2	12.52
C3	13.37
SE	0.12
CD at 5%	0.36
Interaction (S X C)	
S1 C1	11.43
S1 C2	11.73
S1 C3	13.13
S2 C1	12.83
S2 C2	12.40
S2 C3	13.23
S3 C1	13.03
S3 C2	13.43
S3 C3	13.73
SE	0.20
CD at 5%	0.62

Table 2: Effect of storage conditions and capping material on Number of successful grafts

Treatments	Number of successful graft		
	30	60	90
Storage condition (S)			
S1	21.11	23.22	26.00
S2	19.00	21.44	23.77
S3	16.00	18.66	21.22
SE	0.27	0.42	0.30
CD at 5%	0.83	1.27	0.91
Capping material (C)			
C1	19.44	22.44	24.77
C2	19.33	21.88	23.88
C3	17.33	19.00	22.33
SE	0.27	0.42	0.30
CD at 5%	0.83	1.27	0.91
Interaction (S X C)			
S1 C1	21.66	24.33	27.33
S1 C2	21.00	23.00	25.75
S1 C3	20.66	22.33	25.00
S2 C1	19.00	21.66	23.66
S2 C2	20.33	22.33	24.00
S2 C3	17.66	20.33	23.66
S3 C1	17.70	21.33	23.33
S3 C2	16.70	20.33	22.00
S3 C3	13.70	14.33	18.33
SE	0.48	0.73	0.52
CD at 5%	1.45	2.21	1.58

Table 3: Effect of storage conditions and capping material on percent success of graft.

Treatments	Percent success of grafts		
	30	60	90
Storage condition (S)			
S1	70.33 (57.00)*	77.32 (61.56)	86.63 (58.00)
S2	63.30 (52.71)	72.20 (58.18)	78.89 (62.65)
S3	53.29 (46.89)	62.92 (52.49)	70.70 (57.23)
SE	0.92	1.46	0.93
CD at 5%	2.77	4.41	2.83
Capping material (C)			
C1	64.79 (53.60)	74.79 (59.86)	82.57 (65.32)
C2	64.40 (53.37)	72.87 (58.61)	79.59 (63.14)
C3	57.73 (49.45)	64.79 (53.60)	74.07 (59.39)
SE	0.92	1.46	0.93
CD at 5%	2.77	4.41	2.83
Interaction (S X C)			
S1 C1	72.20 (58.18)	81.10 (64.23)	91.10 (72.64)
S1 C2	70.00 (56.79)	76.43 (60.94)	85.50 (67.62)
S1 C3	68.83 (56.04)	74.43 (59.60)	83.30 (65.88)
S2 C1	63.30 (52.71)	72.20 (58.18)	78.90 (62.65)
S2 C2	67.73 (55.37)	74.43 (59.60)	80.00 (63.43)
S2 C3	58.90 (50.13)	70.00 (56.79)	77.83 (61.89)
S3 C1	58.90 (50.13)	71.10 (57.48)	77.73 (61.82)
S3 C2	55.50 (48.16)	67.73 (55.37)	73.30 (58.89)
S3 C3	45.50 (42.42)	50.00 (45.00)	61.10 (51.41)
SE	1.60	2.52	1.62
CD at 5%	4.80	7.64	4.91

*Value presented in parenthesis are Arsenic value

Table 4: Effect of storage conditions and capping material on Number of survival graft, Percent Survival and Percent Mortality of graft

Treatments	Number of survival graft	Percent Survival of graft	Percent Mortality of graft
	120	120	120
Storage condition (S)			
S1	26.88	89.60 (71.19)*	10.35 (18.77)
S2	25.55	85.16 (67.34)	14.81 (22.63)
S3	22.77	75.90 (60.60)	24.07 (29.38)
SE	0.37	1.25	1.26
CD at 5%	1.14	3.80	3.81
Capping material (C)			
C1	26.11	87.00 (68.87)	12.94 (21.08)
C2	25.44	84.79 (67.05)	15.18 (22.93)
C3	23.66	78.87 (62.63)	21.10 (27.35)
SE	0.37	1.25	1.26
CD at 5%	1.14	3.80	3.81
Interaction (S)			
S1 C1	27.66	92.20 (73.78)	7.73 (16.14)
S1 C2	26.66	88.90 (70.54)	11.11 (19.47)
S1 C3	26.33	87.73 (69.47)	12.22 (20.46)
S2 C1	25.66	85.50 (67.62)	14.44 (22.33)
S2 C2	26.00	86.63 (68.53)	13.33 (21.41)
S2 C3	25.00	83.33 (65.88)	16.66 (24.09)
S3 C1	25.00	83.30 (65.88)	16.66 (24.09)
S3 C2	23.66	78.90 (62.65)	21.10 (27.35)
S3 C3	19.66	65.53 (56.79)	34.44 (35.93)
SE	0.65	2.18	2.18
CD at 5%	1.98	6.59	6.60

*Value presented in parenthesis are Arsenic value

The minimum percent mortality of grafts (7.73%) was found in S1C1. This might be due to unfavorable weather conditions results in faster desiccation of scion sticks and drying up before graft-take. Similar results are reported by Mithapara

and Karetha (2021) [11] in Sapota and Makavana *et al*., (2022) [10] in Jamun.

Conclusion

From the present investigation it can be concluded that:

- Among storage conditions, storage at poly house showed minimum number of days required for sprouting, maximum number of successful graft, maximum number of survival graft, percent success of graft, percent survival of graft and minimum percent mortality of graft.
- Among effect of capping material, capping with pepsi bag recorded minimum number of days required for sprouting, maximum number of successful graft, maximum number of survival graft, percent success of graft, percent survival of graft and minimum percent mortality of graft.
- Among interaction effect S1C1 i.e. (poly house + pepsi bag) significantly recorded minimum number of days required for sprouting, maximum number of successful graft, maximum number of survival graft, percent success of graft, percent survival of graft and minimum percent mortality of graft.

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