Standardization of method and time of budding in Jamun (*Syzygium cumini* Skeels)

ABSTRACT

The present investigation was conducted at the Research Farm of Department of Horticulture, SHUATS, Prayagraj, on 1-year old rootstocks of Jamun during the period June 2022 to October 2022 with the objective to find out the suitable time and method of budding in Jamun. The statistical design adopted for the experiment was Factorial completely randomised design (Factorial CRD) with three replications and eighteen treatment combinations. This study comprises of two methods of propagation i.e. T-Budding and Patch budding. The results revealed that among the methods of budding adopted Patch budding during the period 1-15th August was found to be exceptional in terms of highest percent success, number of branches, bud take, length of the new sprout, stem thickness, leaf area, number of leaves per plant, and number of days to bud sprout was best in terms of minimum days. Thus, based on the results obtained from the experiment Patch budding during the month of August was found to be the most effective for Jamun propagation.

Key words*: Patch budding, T-budding, Jamun, Percent success, Bud take, Propagation*

INTRODUCTION

Jamun (*Syzygium cumini* Skeels.), an indigenous and significant minor crop in India, recently attained major importance in arid zones under commercial exploitation **(Baloda *et al.* 2016).** Jamun is widely grown throughout most of India, from the Indo-Gangetic Plains in the North to Tamil Nadu in the South **(Singh and Srivastava, 2000).** India is home to Jamun. It is extensively spread in India, Sri Lanka, Malyasia, Thailand, Australia, the Philippines, Burma, Ceylon, Nepal, Pakistan, and Bangladesh, all of which are tropical or subtropical regions. According to the rankings in terms of world's production and area India ranks second. **(Bodkhe and Rajput 2010)**. In 2017–18, under Tamil Nadu conditions, there were 156 hectares of land and 1014 tonnes of produce per hectare. The majority of the trees components, including the bark, leaves, seeds, and fruits, are used as complementary medicines to treat a variety of ailments, giving the tree significant economic significance. Well-known traditional remedies employ it to help diabetic people manage their blood sugar levels.

The tree is abundant in phytochemicals such as gallic acid, terpenoids, tannins, anthocyanins, glycoside jambolin, and other minerals. According to **Chaudhary and Mukhopadhyay (2012),** these diverse ranges of health-promoting chemicals make them a potential candidate to be employed as a nutraceutical. Jamun is esteemed for its medicinal and therapeutic properties. Abundance of mineral constituents principally Iron (1%), calcium (0.02%), and phosphorus (0.01%), essential oils have also been reported **(Chandra, 1985)** Pinene, camphene, myrcene, and limonene are among the essential oils isolated from newly gathered leaf (which accounts for 82% of the oil), stem, seed, and fruits. Jambolin or antimellin, an alkaloid found in the seeds, prevents the diastatic conversion of sugar to starch. Vitamins A and C, nicotinic acid, riboflavin, folic acid, maleic acid, choline, sugar, amino acid, K, Ca, Na, P, Fe, Mn, Zn are all found in the fruit pulp **(Katiyar *et al.*, 2016).**

There are no specific commercial or improved varieties developed in Jamun cultivation. The most common variety cultivated in north India is "Ram Jamun" or "Raja Jamun". This type of fruit has small seed with good amount of pulp and bigger in size. This fruit is very juicy and sweet. This variety generally ripens before monsoon starts i.e. June - July. There is another type found in Varanasi, U.P. has no seed. There is a late maturing Jamun variety which is small in size with little bigger seed and these types of fruits comes to maturity in the month of August.

CISH J-42- Seedless accession obtained from a land race of Chandauli district of U.P. Fruits are ovoid, seedless with good taste. Average fruit weight is 8.0g, average pulp 97.9%, TSS 14.47▪ Brix. The selected type has a good processing potential into value added products due to absence of seeds.

Despite its considerable potential as a dry land horticulture fruit crop and its several applications, lack of improved varieties, as well as the extended gestation period that plants derived from seeds require for fruiting, are major reasons why this crop is rarely grown commercially in orchards. Propagation can be done both sexually and asexually. Additionally, since jamun is typically propagated through seeds, which cause a great deal of variation in plant type, productivity, fruit size, shape, and quality, and have a long juvenile phase, knowing the right method and timing for budding is also desirable. In contrast, budded plants are true to type and have a shorter juvenile phase. despite its considerable potential as a dry land horticulture fruit crop and its several applications. Because of the medicinal and nutritional benefits of this crop, orchardists are looking for an early bearing and dwarf tree type with great production potential.

In addition asexual approaches are a simple way to retain specific characteristics of variation. For the growth of callus tissue and the formation of a graft union, environmental factors such as moderate temperature and humidity, as well as an appropriate grafting procedure, must be satisfied. The timing of budding is mostly determined by temperature, humidity, and the availability of budding material. Jamun can be propagated by different techniques viz. softwood grafting **(Subash *et al.* 2016),** patch budding **(Sharma *et al.* 2016)** and cuttings **(Abdullah *et al.* 2006).** The time of propagation depends mainly on temperature, humidity and availability of planting material reported that **(Angadi *et al.* 2011)** maximum (100%) graft take was noticed in the months of October. **(Bharad *et al.* 2011)** in jamun at June, **(Mutteppa *et al.* 2017)** in guava at January.

As this crop has gained importance due to its medicinal and nutritive value the orchardists are demanding an early bearing and dwarf tree with high yield potential. Jamun is propagated both sexually and asexually. However, seed propagation is not advisable as it results in late bearing. Asexual techniques are the easy ways to preserve the certain characters of the variety. Jamun can be propagated by different techniques viz. softwood grafting, and budding i.e. patch budding, T-budding. While, choosing a particular technique for propagation of jamun, the time and method of operation should be taken into consideration as the success of each method vary from region to region due to variation in agro-climatic conditions. Any particular method which may be successful at one place may not prove useful at other. Similarly, a particular method successfully adopted will vary from place to place due to environmental factors such as temperature, relative humidity etc. The aim of this research is to find out the best budding technique and effective time of budding in Jamun in Subtropical condition at Prayagraj.

MATERIALS AND METHODS

The present experiment on "Standardization of method and time of budding in Jamun (*Syzygium cumini* Skeels)" was conducted at the Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, for a period lasting from June 2022 to October 2022. Experiment was laid out in factorial completely randomized design (Factorial CRD) with 9 treatments and 3 replications. Two methods of budding i.e. T-budding, Patch budding were performed. Desi rootstock of 0.5 to 1cm with uniform size and vigour were selected for budding. Rootstocks were procured from Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, (M.P.). Rajamun tree and CISH J-42 were selected as the scion material for budding.

On the day of budding and grafting, the scion branches were removed from the mother trees in the early morning (7 to 9 am). After being separated from mother trees, scions were wrapped with wet linen and transported to the experimental site under a polythene cover. Selected were healthy one-year-old pencil-thick shoots. To render the scion material free of pests and pathogens, scion shoots were submerged in a 0.1 percent Bavistin solution. On the day the scion was cut loose from the mother tree, budding and grafting were carried out.

The location of experimental site is situated at an elevation of 98 meters above mean sea level (MSL) at 25.45□ North latitude and 81.84□ East longitudes. The experimental site is located under the subtropical climatic condition which possess three climate seasons viz. summer, rainy and winter. Prevalent in the south-eastern section of the state it has both extremes in temperature, i.e., winter and summer. The summer season occurs from March to June. In the months of May and June, temperatures can approach 115□ degrees Fahrenheit. However, the winter season lasts from December through February, with freezing temperatures. In the winter, temperatures can drop as low as 32□ from December through January. Frosts are widespread in the winter, and blistering breezes are typical in the summer. The average rainfall is roughly 1013.4 mm, with the highest concentration occurring from July to September, with rare showers in the winter.

From June to October 2022, 9 treatments were done at an interval of fifteen days of each month using two budding techniques viz. T-budding and patch budding. To stop the spread of disease and pests, plant protection methods were used. Buddlings received the necessary amount of water each day. Side shoots growing from any part of the rootstock were routinely cut off. Factorial Randomised Block Design was used to conduct the experiment. Data on number of days to bud sprout, leaf area, stem thickness, number of leaves, length of the new sprout, percent success, bud take, number of branches was recorded.

RESULT AND DISCUSSION:

Number of days to bud sprout

The minimum (25.4) number of days to bud sprout were found with Patch budding and the best time to perform budding was performed on 15^{th} August (Table 1). Number of days taken to sprouting of jamun was significantly influenced by the interaction of time and methods of propagation in jamun where minimum (21.7) number of days to sprout was observed in patch budding during 1-15^{th} August. The maximum (31.1) number of days to bud sprouting were number of days to bud sprouting was recorded under T-Budding on 15^{th} June.

Regardless of planting time or propagation technique, the cause for early sprouting may be linked to its improved capacity to respond to the meteorological circumstances present at the time of propagation as well as better physiological conditions and more active buds. The apical dominance and rate of substrate supply, along with the presence of a suitable environment in terms of temperature, moisture, and oxygen, control the emerging sprout. Cell division occurs in the presence of phytohormones, and energy released by the hydrolysis of carbohydrates and polysaccharides occurs through enzymatic pathways is used.

The propagation procedure should be carried out when favourable weather conditions are anticipated, and the cambium tissue is in an active state. A higher temperature promotes the production of calluses that connect the scion buds to the stock. Results are consistent with those found by **Panday and Singh (2001)** in Mango and **Giri and Lenka (2007)** in Jamun.

Number of leaves per budling after 120 days

The results on the number of leaves per bud clearly showed that the number of leaves per bud increased as the development stages progressed in various treatment combinations. At 120 days after budding the maximum (13.4 and 11.8) number of leaves were found when budding was done on 15th August and 30th August, whereas it was found to be minimum (6.0) on 15th October (Table 2).

The treatment combination of propagation time and method substantially raised the number of leaves per budling (14.9) in combination of 15th August with Patch Budding. The number of leaves was lowest (5.5) when budding was performed on 15th October in combined with T-Budding.

The genetic characteristics of a variety as well as activity and better bud healing during these months are other potential explanations for the increased number of leaves. Vegetative growth may also have been enhanced as a result of physiological processes that were activated by stimulating factors in the plant’s metabolism and growth. The findings indicating the most shoots and leaves between August 1 and 15 are consistent with those of **Gurjar and Singh (2012)** in Aonla, who discovered that during the rainy season, well-matured rootstock is promoted by high atmospheric humidity as well as moderately high temperatures. The buds produced the least number of leaves when grafting was done on 15th June and 15th October. **Angadi and Karadi (2012)**.

Leaf area (cm^2)

The maximum (30.4 cm^2) and minimum (24.4 cm^2) leaf area were recorded under Patch budding and T-Budding, respectively (Table 3). As influenced by the effect of time of budding, maximum (37.0) and minimum (14.8) leaf area was found be on 15th August and 15th October, respectively. Therefore, leaf area was recorded highest (41.8) on 15th August in combination with Patch budding.

Stem girth (mm)

The maximum (17.0 mm) and minimum (8.4 mm) stem girth were recorded under Patch budding and T-budding, respectively (Table 4). The interaction of method and time was found to be significant. The best results were observed on 15th August (20.9 mm) followed by 30th August (20.6 mm) in combination with Patch budding.

The growth stimuli might be related to endogenous gibberellin levels, which appear to correspond with enhanced cell division and cell enlargement. This might be due to the stock's rapid development, which ended up resulting in an increase in stem thickness. **Chovatia and Singh (2000)** and **Bharad *et al*. (2006)** showed similar results in jamun.

Length of the new sprout (cm)

Maximum (14.9 cm) sprout length was found to be in Patch budding, whereas it was lower (12.5 cm) in T-Budding (Table 5). The interaction between method and time was found to be non-significant. Therefore, maximum (22.7 cm) sprout length was found to be on 15th August with Patch budding.

Higher bud temperatures stimulated shoot development and advanced the date of bud break. The lowest (7.0 cm) sprout length were found in the case of T-budding. Similar results were proposed by **Baloda *et al.*, 2016.**

Percent success of the sprout

The highest percent success (70.5%) was recorded on 15th August and among various methods of propagation the highest (61.1%) percent success was recorded in patch budding while the minimum per cent success was (22.4%) on October and (36.5%) with T-Budding (Table 6). Interaction of time and methods of propagation also had a significant effect on per cent success of Jamun.

Patch budding has the superiority over other procedures in terms of percent success which may be related to the bigger bark and cambium tissues in the patch budding operation. Highest success in patch budding is in accordance with the findings of **Manohran *et al.*, (2000).**

This might also be as a result of an appropriate humidity and temperature for success. The minimum or below average percentage of successful bud-take was recorded in the budding performed during 15th June and 15th October.

Percent bud take

The highest bud take (60.8%) was recorded on 15th August and among various methods of propagation the highest (67.4%) bud take % was recorded in patch budding while the minimum bud take % was (30.3%) on October and (19.5%) with T-Budding (Table 7). The interaction between method and time resulted to be significant.

Weather played an important role of bud union and sprouting as it is the time when cambium layer is in its active stage which ensures callus interlocking and highest essential callus production, as advocated by **Moran *et al.* (1972).**

The beneficial effect could be attributed to high humidity stretched for longer period in August, which prevents desiccation of the scion. The environmental conditions for mist house buds can be readily controlled, there by permitting greater reliability of budding over long period, when compared to outdoor budding operation, as reported by **Hartmann and Kester (1979).**

Number of branches per bud

The highest (2.15) number of branches were recorded on 15th August and were also higher (1.56) with Patch budding (Table 8). The interaction between time and method was found to be non-significant. Minimum (1.05) number of shots were observed on 15th October and were lower (1.0) with T-budding. Therefore, patch budding when performed on 15th August gave the highest (2.56) number of branches per bud.

The result could be attributed to favourable climatic parameters during the monsoon, which aided in faster growths that acted positively on the rootstock and scion shoot, which might have occurred due to the longer time available for growth in meristematic cells combined with better physiological processes such as photosynthesis and lower respiration. This result is similar with **Rani *et al.* (2015).**

CONCLUSION

Based on the results obtained from the present investigation, it can be concluded that the propagating period for Jamun from 1-15th August was found to be the best and among the methods of budding, Patch budding was found to be the best for jamun propagation in subtropical condition at Prayagraj. At this period days to bud sprouting (25.4), leaf area (41.8 cm^2), shoot diameter (20.9 mm), number of leaves (14.9), bud take % (89.4 %), number of branches (2.56), percent success (92.9 %), length of the new sprout (22.7 cm) were found be best in this duration.

Table 1 Effect of budding time and method on number of days to bud sprout of Jamun (*Syzygium cumuni* Skeels)

	15th June 2022	**30th June 2022**	**15th July 2022**	**30th July 2022**	**15th August 2022**	**30th August 2022**	**15th September 2022**	**30th September 2022**	**15th October 2022**	**Mean**
T-BUDDING	31.167	30.917	30.583	30.583	24.500	25.967	30.333	30.583	30.567	**29.467**
PATCH BUDDING	29.000	28.533	25.800	25.467	20.333	20.933	23.000	26.467	29.067	**25.400**
Mean	**30.083**	**29.725**	**28.192**	**28.025**	**22.417**	**23.450**	**26.667**	**28.525**	**29.817**	
		C.D.	**SE(d)**	**SE(m)**	**F-Test**					
Method		**0.362**	**0.178**	**0.126**	**S**					
Time		**0.768**	**0.377**	**0.267**	**S**					
(Method x Time)		**1.085**	**0.533**	**0.377**	**S**					

Table 2 Effect of budding time and method on number of leaves per budling after 120 days on Jamun (*Syzygium cumini* Skeels)

	15th June 2022	30th June 2022	15th July 2022	30th July 2022	15th August 2022	30th August 2022	15th September 2022	30th September 2022	15th October 2022	Mean

T-BUDDING	6.610	7.500	10.450	11.083	11.833	11.433	10.833	8.277	5.500	**9.280**
PATCH BUDDING	8.133	9.100	9.200	10.020	14.977	12.353	10.467	9.487	6.687	**10.047**
Mean	**7.372**	**8.300**	**9.825**	**10.552**	**13.405**	**11.893**	**10.650**	**8.882**	**6.093**	
		C.D.	**SE(d)**	**SE(m)**	**F-Test**					
Method		**0.517**	**0.254**	**0.180**	**S**					
Time		**1.098**	**0.539**	**0.381**	**S**					
(Method x Time)		**1.552**	**0.762**	**0.539**	**S**					

Table 3 Effect of budding time and method on leaf area (cm2) in Jamun (*Syzygium cumini* Skeels)

	15th	**30th**	**15th**	**30th**	**15th**	**30th**	**15th**	**30th**	**15th**	

	June 2022	**June 2022**	**July 2022**	**July 2022**	**August 2022**	**August 2022**	**September 2022**	**September 2022**	**October 2022**	**Mean**
T-BUDDING	18.933	19.333	25.267	27.267	32.267	29.967	29.267	23.800	14.333	**24.493**
PATCH BUDDING	22.900	26.900	29.167	32.633	41.800	41.300	36.100	28.000	15.267	**30.450**
Mean	**20.917**	**23.117**	**27.217**	**29.950**	**37.033**	**35.633**	**32.683**	**25.900**	**14.800**	
		C.D.	**SE(d)**	**SE(m)**	**F-Test**					
Method		**1.030**	**0.506**	**0.358**	**S**					
Time		**2.185**	**1.073**	**0.759**	**S**					
(Method x Time)		**3.090**	**1.517**	**1.073**	**S**					

Table 4 Effect of budding method and time on stem thickness (mm) in Jamun (*Syzygium cumini* Skeels)

	15th	**30th**	**15th**	**30th**	**15th**	**30th**	**15th**	**30th**	**15th**	

	June 2022	June 2022	July 2022	July 2022	August 2022	August 2022	September 2022	September 2022	October 2022	Mean
T-BUDDING	7.027	7.337	8.273	8.670	10.967	10.570	9.000	7.413	7.007	**8.474**
PATCH BUDDING	15.100	15.603	16.947	17.080	20.927	20.633	18.667	17.193	11.493	**17.071**
Mean	**11.063**	**11.470**	**12.610**	**12.875**	**15.947**	**15.602**	**13.833**	**12.303**	**9.250**	
		C.D.	**SE(d)**	**SE(m)**	**F-Test**					
Method		**0.370**	**0.182**	**0.128**	**S**					
Time		**0.784**	**0.385**	**0.272**	**S**					
(Method x Time)		**1.109**	**0.545**	**0.385**	**S**					

Table 5 Effect of budding method and time on length of the new sprout (cm) in Jamun (*Syzygium cumini* Skeels)

	15th June 2022	30th June 2022	15th July 2022	30th July 2022	15th August 2022	30th August 2022	15th September 2022	30th September 2022	15th October 2022	Mean
T-BUDDING	8.200	10.333	10.833	11.200	20.400	20.267	14.233	10.467	7.033	**12.552**
PATCH BUDDING	11.373	12.353	13.413	14.580	22.793	20.427	14.840	13.313	11.320	**14.935**
Mean	**9.787**	**11.343**	**12.123**	**12.890**	**21.597**	**20.347**	**14.537**	**11.890**	**9.177**	
		C.D.	**SE(d)**	**SE(m)**	**F-Test**					
Method		1.090	0.535	0.378	**S**					
Time		2.312	1.135	0.803	**S**					
(Method x Time)		N/A	1.606	1.135	**NS**					

Table 6 Effect of budding time and method on Percent success of Jamun buddling (*Syzygium cumini* Skeels)

	15th June	30th June	15th July	30th July	15th August	30th August	15th September	30th September	15th October	Mean

	2022	2022	2022	2022	2022	2022	2022	2022	2022	
T-BUDDING	27.193	26.927	40.213	40.833	48.107	47.913	41.017	36.637	19.680	**36.502**
PATCH BUDDING	31.183	48.653	61.440	68.787	92.907	86.080	85.423	50.593	25.150	**61.134**
Mean	**29.188**	**37.790**	**50.827**	**54.810**	**70.507**	**66.997**	**63.220**	**43.615**	**22.415**	
		C.D.	**SE(d)**	**SE(m)**	**F-Test**					
Method		2.885	1.417	1.002	**S**					
Time		6.119	3.005	2.125	**S**					
(Method x Time)		8.654	4.250	3.005	**S**					

Table 7 Effect of budding time and method on Bud take (%) of Jamun (*Syzygium cumini* Skeels)

	15th June	**30th June**	**15th July**	**30th July**	**15th August**	**30th August**	**15th September**	**30th September**	**15th October**	**Mean**

	2022	2022	2022	2022	2022	2022	2022	2022	2022	
T-BUDDING	11.933	15.033	19.233	21.350	32.267	27.387	25.000	13.200	10.343	**19.527**
PATCH BUDDING	52.767	60.533	65.673	71.573	89.407	83.637	78.080	54.967	50.343	**67.442**
Mean	**32.350**	**37.783**	**42.453**	**46.462**	**60.837**	**55.512**	**51.540**	**34.083**	**30.343**	
		C.D.	**SE(d)**	**SE(m)**	**F-Test**					
Method		0.349	0.171	0.121	**S**					
Time		0.740	0.363	0.257	**S**					
(Method x Time)		1.046	0.514	0.363	**S**					

Table 8 Effect of budding time and method on number of branches per bud in Jamun (*Syzygium cumini* Skeels)

	15th June	30th June	15th July	30th July	15th August	30th August	15th September	30th September	15th October	Mean

	2022	2022	2022	2022	2022	2022	2022	2022	2022	
T-BUDDING	1.00	1.23	1.20	1.43	1.73	1.50	1.43	1.10	1.05	**1.30**
PATCH BUDDING	1.10	1.34	1.55	1.66	2.56	1.90	1.80	1.07	1.05	**1.56**
Mean	**1.05**	**1.29**	**1.38**	**1.55**	**2.15**	**1.70**	**1.62**	**1.08**	**1.05**	
		C.D.	**SE(d)**	**SE(m)**	**F-Test**					
Method		**N/A**	**0.710**	**0.502**	**NS**					
Time		**N/A**	**1.506**	**1.065**	**NS**					
(Method x Time)		**N/A**	**2.130**	**1.506**	**NS**					

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