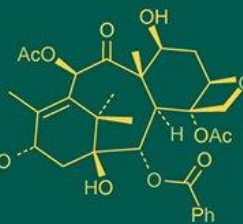
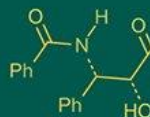


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The assessment of propagation methods as influenced by season in Jamun var. Goma Priyanka

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Abstract

Jamun var. Goma Priyanka is popular among farmers due to its high yield, high pulp content, prolific and regular bearer and small stature, making it ideal for high-density planting. Standardizing the appropriate propagation method and season for specific varieties is essential for successful commercial cultivation under specific agro-climatic conditions. Therefore, the investigation entitled “assessment of propagation methods as influenced by season in Jamun cv. Goma Priyanka” was conducted at Navsari Agricultural University, Navsari, Gujarat. The experiment consisted of two propagation methods, viz., softwood grafting and patch budding, and three propagation months, viz., April, May, and June. The results revealed that softwood grafting significantly outperformed patch budding by recording the highest sprouting percentage (78.38%), the minimum days required for sprouting (21.80) and successful grafting (26.88), the maximum graft length (9.83, 13.21, and 18.87 cm) and the highest number of leaves (11.76, 14.08, and 17.21 at 60, 90, and 120 days after grafting, respectively), the largest leaf area (37.85 cm²), and the maximum number of shoots (1.81). Among the propagation months, June recorded the highest sprouting percentage (48.33%) and superior vegetative growth, with the greatest graft length (9.82, 11.59, and 19.67 cm) and the highest number of leaves (9.12, 11.76, and 15.46 at 60, 90, and 120 days after grafting, respectively), the maximum leaf area (37.85 cm²), and the highest number of shoots (1.76). In contrast, April grafting required the fewest days for sprouting (9.50) and successful grafting (11.35). With respect to graft survival, the interaction effect revealed 100% survival of sprouted grafts in softwood grafting performed during April and in patch budding performed during June. Overall, softwood grafting in April and patch budding in June were identified as the most suitable propagation combinations for jamun cv. Goma Priyanka, providing an effective strategy for the large-scale multiplication of quality planting material.

Keywords: Goma Priyanka, Jamun, month of propagation, patch budding and softwood grafting

1. Introduction

Jamun (*Syzygium cumini* Skeels) is an underutilized indigenous fruit crop of India that is widely cultivated in tropical and subtropical regions of the world. It belongs to the genus *Syzygium* of the family Myrtaceae (Singh and Singh, 2006) [23]. Jamun has gained considerable attention because of its nutraceutical and medicinal properties, particularly its anti-diabetic potential (Ayyanar and Subash 2012) [2]. The seeds contain bioactive compounds such as jambosine, alkaloids, and the glycoside jamboline (antimellin), which inhibit the diastatic conversion of starch into sugar. Jamun cv. Goma Priyanka was released in 2009 by the Central Horticultural Experiment Station (CHES), Godhra, Gujarat, under the Indian Council of Agricultural Research (ICAR), based on its superior flowering, fruiting, and fruit quality characteristics. The cultivar has become increasingly popular among growers owing to its high productivity (50-70 kg tree⁻¹ from the tenth year onwards), high pulp content (85-90%), low seed weight, prolific and regular bearing habit, and comparatively compact tree stature, making it highly suitable for high-density planting. Initially cultivated in Gujarat, the variety has now been successfully adopted in several states, including Rajasthan, Karnataka, Madhya Pradesh, Chhattisgarh, Tamil Nadu, Maharashtra, Haryana, Punjab, Uttar Pradesh, and Andhra Pradesh (Anon, 2026) [1]. The success of vegetative propagation largely depends on the propagation method and the season, which determine graft establishment and subsequent plant growth under specific agro-climatic conditions. Although jamun can be propagated through both seed and vegetative methods, seed propagation is undesirable because the seeds are highly recalcitrant and produce genetically variable progenies.

Therefore, vegetative propagation is preferred as it produces true-to-type plants, reduces the juvenile phase, and enables bearing within 4-5 years after planting. Among the available vegetative propagation techniques, softwood grafting and patch budding are considered the most promising methods for commercial multiplication of jamun. Softwood grafting is simple, economical, and has been reported to achieve up to 80% success during the active growth periods of spring and the rainy season, particularly in March, April, and July. Under semi-arid conditions, softwood grafting and patch budding performed best during March and April, recording success rates of 90.12% and 85.24%, respectively (Singh *et al.*, 2018) ^[24]. Although patch budding is comparatively slower and technically more demanding, it is advantageous for thick-barked rootstocks and plants propagated through this method begin flowering from the third year after planting (Singh *et al.*, 2019) ^[25]. The higher success of patch budding has been attributed to greater bark surface area and improved cambial contact compared with T-budding (Meghwal and Singh, 2010) ^[17]. Furthermore, patch budding has been reported to perform best during June under Gujarat conditions (Chovatia and Singh, 2000) ^[6]. Despite the commercial importance of jamun cv. Goma Priyanka, information on the optimum propagation method and season for its efficient multiplication under South Gujarat conditions remains limited. Therefore, the present investigation was undertaken to comparatively assess the performance of different propagation methods as influenced by season in jamun cv. Goma Priyanka, with the objective of identifying the most suitable propagation technique and season for the large-scale production of quality planting material.

2. Materials and Methods

The experiment on “assessment of Propagation Methods as Influenced by Season in Jamun cv. Goma Priyanka,” was performed Navsari Agricultural University, Navsari, Gujarat during April 2023 to October 2023. The experiment consisted of two propagation methods, viz., softwood grafting and patch budding, and three propagation months, viz., April, May, and June with six treatments combinations viz., P₁M₁, P₁M₂, P₁M₃, P₂M₁, P₂M₂ and P₂M₃. The experiment was laid out in a Factorial Completely Randomized Design (FCRD) with three replications under polyhouse conditions. For softwood grafting, uniform and vigorous local jamun rootstocks, 10-12 months old with a stem diameter of 0.3-0.5 cm, were used. Scion shoots of pencil thickness bearing 4-6 healthy active buds were selected and defoliated 10 days before grafting. Before grafting, the scion sticks were treated with 0.1% carbendazim solution to minimize disease incidence. The uniform and vigorous rootstocks selected for patch budding were more than 12 months old with 0.5-1 cm diameter all treatment during investigation up to and observations were recorded periodically up to 120 days after grafting (DAG).

3. Results and Discussion

3.1 Effect of Propagation Methods

The results indicated that the interaction between propagation methods and months of grafting (PM) had a significant effect on sprouting percentage, days taken for sprouting, days taken for successful grafts/buds, graft length, number of leaves, leaf area, number of shoots, and graft survival percentage in jamun cv. Goma Priyanka. The

maximum (76.64%) sprouting was recorded in softwood grafting (P₁) as compared to the least sprouting percentage (6.66%) in patch budding (P₂). Softwood grafting took minimum 21.83 days taken for sprouting and 26.88 days for successful grafting in Goma Priyanka. The maximum growth parameter recorded in Softwood grafting. The Maximum length of grafting 9.83 cm, 13.21 cm and 18.87 cm recorded in 60, 90 and 120 DAG in softwood grafting compared to patch budding (4.14, 5.06 and 6.69 at 60, 90 and 120 DAG). The number of leaves of grafts 11.76, 14.08 and 17.21 recorded in 60, 90 and 120 DAG than patch budding. Softwood grafting recorded maximum leaf area 37.85 cm². In case of number of shoots 1.81 recorded in softwood grafting.

The higher sprouting percentage observed in softwood grafting may be attributed to the accumulation of adequate reserve food materials in the pre-cured scion sticks compared with patch budding. These findings are in agreement with those of Umadevi *et al.* (2021) ^[27], who reported higher sprouting in softwood grafting using mature current-season scion sticks that had been pre-cured for 10 days before grafting. The minimum number of days required for sprouting and successful graft establishment is closely associated with the physiological principles outlined by Hartmann *et al.* (1997) ^[10], who stated that the development of new wound-healing xylem and the initial formation of bridging xylem at the graft union are largely controlled by the physiological status and activity of the scion rather than that of the rootstock. The accumulation of greater carbohydrate reserves in the scion likely enhanced the physiological activity of the meristematic tissues at the graft union, thereby promoting rapid callus formation, early vascular connection, and successful graft union. Similar findings have also been reported by Mulla *et al.* (2011) ^[18] in jamun, Prasanth *et al.* (2007) ^[21] in mango, and Nithya *et al.* (2022) ^[19] and Kholia *et al.* (2017) ^[14] in guava. Consequently, higher sprouting percentage, minimum days taken for sprouting, and for successful graft establishment in jamun cv. Goma Priyanka resulted in superior vegetative growth, as evidenced by greater graft height, a higher number of leaves, increased leaf area, and a greater number of shoots per graft. This enhanced growth may be attributed to rapid wound healing and the efficient development of secondary cambial tissues, leading to the formation of functional xylem and phloem connections. These vascular connections facilitate the efficient translocation of water, minerals, and photosynthetic between the rootstock and scion, thereby promoting vigorous shoot growth, increased leaf production, enhanced meristematic activity, and improved photosynthetic efficiency. This similar result recorded by Chavda *et al.* (2018) ^[5] and Ghogage *et al.* (2011) ^[7] in Jamun, Khushi *et al.* (2019) ^[15] and Karna *et al.* (2018) ^[12] in Mango, Girase *et al.* (2022) ^[8] in Aonla, Patel *et al.* (2022) ^[20] in Sapota, Hariharan *et al.* (2021) ^[9] in wood apple and Keerthika *et al.* (2020) ^[13] in Manila tamarind.

3.2 Effect of Season

The data pertaining to sprouting percentage, days to sprouting, days to successful graft/bud, graft length, number of leaves, leaf area, number of shoots per graft, and graft survival percentage revealed significant differences among the different months of grafting in jamun cv. Goma Priyanka. Among the different months of grafting, the

highest sprouting percentage (48.33%) was recorded in June (M_3), whereas the lowest sprouting percentage (38.33%) was observed in both April (M_1) and May (M_2) in jamun cv. Goma Priyanka. Grafting performed in April required the minimum number of days for sprouting (9.50 days) and successful graft establishment (11.35 days) which was followed by May month grafting as compared to June which took maximum 25.39 and 30.71 respectively. Meanwhile, June grafting produced superior vegetative growth, recording the maximum graft length of 9.82, 11.59 and 19.67 cm at 60, 90 and 120 days after grafting (DAG), respectively, followed by April grafting (5.55, 8.90 and 11.08 cm at 60, 90 and 120 DAG, respectively). Likewise, the maximum number of leaves per graft (9.12, 11.76 and 15.46 at 60, 90 and 120 DAG, respectively), the highest leaf area (37.85 cm²), and the maximum number of shoots per graft (1.76) were also recorded in June grafting. However, patch budding failed to sprout when performed during April and May.

The maximum sprouting percentage in June might be attributed to June month, precipitation and humidity (96%) which were an ideal to prevent desiccation of buds which had maintain more living cell in meristematic tissue as well as maintain the water potential in grafted plants, leading to the maximum sprouting percentage in softwood grafting sprouting as well as sprouting in patch budding. Similar results were recorded by Ghogage *et al.* (2011)^[7], Bharad *et al.* (2011)^[3] and Chander *et al.* (2016)^[4], Umadevi *et al.* (2021)^[27] and Mayavel *et al.* (2022)^[16] in Tamarind, Hariharan *et al.* (2021)^[9] in Wood apple. However, the favourable meteorological conditions prevailed during April i.e. maximum (36.28 °C), minimum temperature (20.89 °C) and high relative humidity (90.1%) were favourable for accelerating the rapid cell division in meristematic tissue, leading to better callusing between scion and rootstock (Karna *et al.*, 2018)^[12], resulting in early sprouting which was precedes the development of secondary vascular cambium for successful graft union formation from the day

of grafting until successful graft union. These findings results were noticed by Bharad *et al.* (2011)^[3] and Shinde *et al.* (2011)^[22] in Jamun and Sonawane *et al.* (2012)^[26] in Carambola. The growth parameter performance higher in June due to cumulative effect both propagation success during June month grafting. However this growth phenomenon directly influenced by succeeding climatic conditions. The meteorological condition in August was detrimental to the growth of effective grafts. It was explicitly represented in graft height in P_1M_1 at 120 DAG, P_1M_2 at 90 and 120 DAG and P_1M_3 at 90 DAG. These similar results were observed by Ghogage *et al.* (2011)^[7], Chander *et al.* (2016)^[4] in Jamun, Khushi *et al.* (2019)^[15] in Mango and Girase *et al.* (2022)^[8] in Anola.

Furthermore, softwood grafting recorded the highest graft survival percentage (52.62%) compared with patch budding (33.33), demonstrating its superiority for successful propagation of jamun cv. Goma Priyanka. Among the month of propagation, the highest graft success showed in June month grafting (70.48). Though the interaction effect revealed 100% survival of sprouted grafts in softwood grafting performed during April and in patch budding performed during June. softwood grafting in April month on Goma Priyanka showed a maximum survival percentage might be due to the larger contact area of softwood grafting combined with congenial climate conditions were accelerates the strong formation of vascular cambium, which has enhanced the translocation of food material and water between rootstock and scion from the time of grafting (Bharad *et al.* 2011)^[3]. The sprouting of patch budding on Goma Priyanka in June month (P_2M_3) showed 90% graft survival. It might be due to endogenous hormones and phytochemical effect of scion material coupled with rainy days of June month. Similar results recorded by Jalal *et al.* (2018)^[11].

3.3 Principal component analysis (PCA)

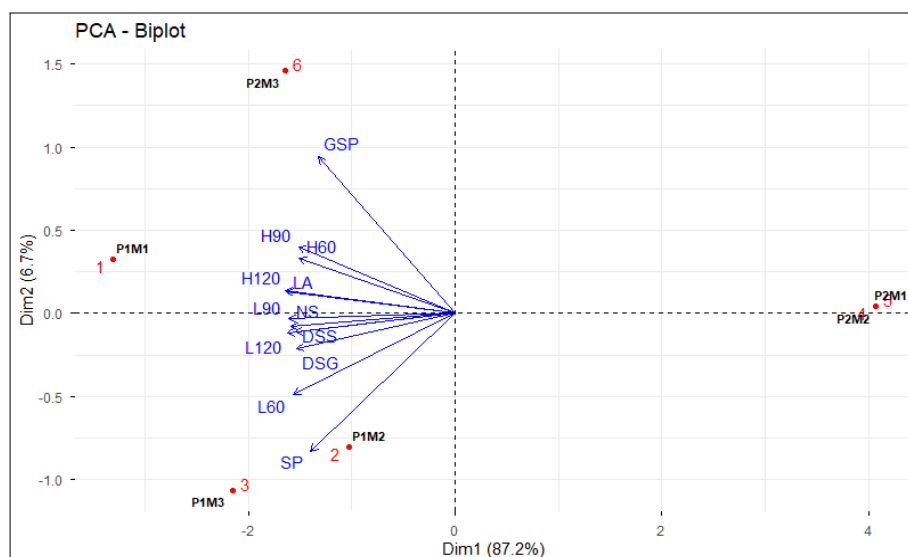


Fig 1: Principal component analysis (PCA) biplot

Principal component analysis revealed that the first two principal components accounted for 93.9 percent of the total variation, with PC1 and PC2 contributing 87.2 and 6.7 percent, respectively. The biplot showed a clear separation of the treatment combinations primarily along PC1,

indicating that the major proportion of variation was associated with differences in sprouting and subsequent vegetative growth attributes. P_1M_1 , P_1M_2 , P_1M_3 and P_2M_3 were positioned on the negative side of PC1 and showed closer associations with several measured attributes,

including days taken for sprouting (DSS), sprouting percentage (SP), days to successful grafting (DSG), number of shoots (NS), graft length at 60, 90 and 120 days (L60, L90 and L120), graft height at 60, 90 and 120 days (H60, H90 and H120), graft survival percentage (GSP) and leaf area (LA). In contrast, P_2M_1 and P_2M_2 were distinctly positioned on the positive side of PC1 and opposite to the majority of the variable vectors, indicating a relatively weaker association with the measured growth and sprouting parameters. Along PC2, which explained 6.7 percent of the total variation, P_2M_3 was showed a relatively stronger association with graft survival percentage (GSP), whereas

P_1M_1 was more closely associated with H90 and H120. P_1M_2 and P_1M_3 were positioned toward the negative side of PC2 and showed closer associations with SP, L60, L90, L120, DSG and other variables directed towards the lower-left quadrant. DSS, SP, DSG and NS contributed to the separation of treatments based on sprouting and grafting performance. Overall, the PCA effectively discriminated the treatment combinations based on their multivariate response for sprouting, graft growth, leaf development and survival attributes, with PC1 serving as the principal dimension of treatment differentiation.

Table 1: The effect of propagation methods as influenced by season on sprouting percentage, number of days taken for sprouting and successful grafts/buds in Jamun var. Goma Priyanka

	Sprouting (%)			No. of days taken for sprouting			No. of days taken for successful graft/bud		
	P ₁	P ₂	Mean	P ₁	P ₂	Mean	P ₁	P ₂	Mean
M ₁	76.6	-	38.3	19	-	9.5	22.71	-	11.35
M ₂	76.66	-	38.33	19.56	-	9.78	23.83	-	11.91
M ₃	76.66	20	48.33	26.95	23.83	25.39	34.10	27.33	30.71
Mean	76.64	6.66		21.83	7.94		26.88	9.11	
	S.Em±	C.D. at 5%		S.Em±	C.D. at 5%		S.Em±	C.D. at 5%	
P	1.925	5.93 ***		0.242	0.745 ***		0.703	2.16 ***	
M	2.35	7.263 **		0.296	0.913 ***		0.861	2.65 ***	
PM	3.33	10.27 *		0.419	1.291 ***		1.217	3.75 ***	

Table 2: The effect of propagation methods as influenced by season on length of sprouting at 60, 90, 120 DAG/DAB in Jamun var. Goma Priyanka

	Length (cm)								
	60 DAG			90 DAG			120 DAG		
	P ₁	P ₂	Mean	P ₁	P ₂	Mean	P ₁	P ₂	Mean
M ₁	11.1	-	5.55	17.98	-	8.90	22.17	-	11.08
M ₂	11.2	-	5.6	13.67	-	6.83	15.17	-	7.58
M ₃	7.2	12.44	9.82	8	15.18	11.59	19.27	20.07	19.67
Mean	9.83	4.14		13.21	5.06		18.87	6.69	
	S.Em±	C.D. at 5%		S.Em±	C.D. at 5%		S.Em±	C.D. at 5%	
P	0.14	0.43 ***		0.12	0.39 ***		0.12	0.39 ***	
M	0.17	0.53 ***		0.15	0.48 ***		0.15	0.488 ***	
PM	0.24	0.76 ***		0.22	0.68 ***		0.22	0.69 ***	

Table 3: The effect of propagation methods as influenced by season on number of leaves at 60, 90, 120 DAG/DAB in Jamun var. Goma Priyanka

	Number of leaves								
	60 DAG			90 DAG			120 DAG		
	P ₁	P ₂	Mean	P ₁	P ₂	Mean	P ₁	P ₂	Mean
M ₁	12.60	-	6.3	19	-	9.5	21.87	-	10.93
M ₂	11	-	5.5	10.83	-	5.41	11.67	-	5.83
M ₃	11.70	6.55	9.12	12.42	10.39	11.4	18.10	12.83	15.46
Mean	11.76	2.18		14.08	3.46		17.21	4.27	
	S.Em±	C.D. at 5%		S.Em±	C.D. at 5%		S.Em±	C.D. at 5%	
P	0.14	0.43 ***		0.22	0.69 ***		0.24	0.74 ***	
M	0.17	0.53 ***		0.27	0.84 ***		0.29	0.91 ***	
PM	0.24	0.75 ***		0.39	1.20 ***		0.42	1.295 ***	

Table 4: The effect of propagation methods as influenced by season on number of shoots, leaf area and graft survival percentage at 60, 90, 120 DAG/DAB in Jamun var. Goma Priyanka

	Number of shoots per grafts			Leaf area (cm ²)			Graft survival percentage		
	P ₁	P ₂	Mean	P ₁	P ₂	Mean	P ₁	P ₂	Mean
M ₁	2.33	0	1.165	48.1	0	24.05	100	0	50
M ₂	1	0	0.5	25.3	0	12.65	16.90	0	8.45
M ₃	2.11	1.42	1.76	40.16	25.3		40.96	100	70.48
Mean	1.81	0.47		37.85			52.62	33.33	
	S.Em±	C.D. at 5%		S.Em±	C.D. at 5%		S.Em±	C.D. at 5%	
P	0.022	0.068 ***		0.204	0.629 ***		3.53	10.88 **	
M	0.027	0.084 ***		0.25	0.77 ***		4.32	13.33 ***	
PM	0.038	0.119 ***		0.353	1.089 ***		6.12	18.86 **	

4. Conclusion

The study concluded that softwood grafting was the most effective propagation method, exhibiting superior growth attributes and the highest survival percentage. Among the seasons, June proved to be the most favourable for graft growth and survival. Furthermore, the interaction effect indicated that softwood grafting in April and patch budding in June produced the best results in jamun cv. Goma Priyanka. These findings can be utilized to standardize propagation practices for the efficient and large-scale production of quality planting material.

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