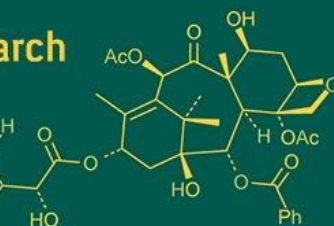


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Enhancing germination and seedling growth of jamun (*Syzygium cumini* L.) through pre-sowing growth regulator treatments

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Abstract

An experiment was conducted to evaluate the performance of jamun seeds using different pre-sowing treatments at Karunya Institute of Technology and Sciences (Coimbatore) during 2025-2026. Healthy, mature fruits were harvested from medium-aged trees during the peak season (June-July) in Tamil Nadu. Seeds were separated from the pulp and subjected to a floatation test in distilled water only the viable sinking seeds were selected for experiment. The treatments included a control (T₁), hydropriming (T₂), scarification (T₃), hot-water treatment (T₄), gibberellic acid GA₃, 250 mg L⁻¹ (T₅), potassium nitrate KNO₃, 0.5% (T₆), thiourea 500 mg L⁻¹ (T₇), and combinations of scarification/GA₃ (T₈), KNO₃/GA₃ (T₉), and thiourea/GA₃ (T₁₀), each treatment was replicated three times in a complete randomized block design. Treated seeds were sown in polybags filled with a potting mixture vermicompost: soil: sand: cocopeat (2:1:1:1). Among all the treatments, GA₃ 250 mg L⁻¹ + KNO₃ 0.5% (T₉) showed the earliest germination (11.9 days), highest germination percentage (92.32%), highest number of seeds germinated (27.69), seedling height (38.73 cm), root length (41.16 cm), number of leaves (23.81), shoot fresh weight and dry weight (12.75 g) (0.692 g) and root fresh weight and dry weight (1.98 g) (0.189 g) at 30,45 and 60 days after sowing. It can be concluded from the above investigation that the seeds treated with GA₃ 250 ppm + KNO₃ 0.5% were found superior in breaking dormancy and enhancing germination and overall seedling growth in jamun.

Keywords: Seed germination, breaking dormancy, pre-sowing treatments

1. Introduction

Jamun or *Syzygium cumini* (L.) Skeels from the Myrtaceae family. It is also known as *Syzygium jambolanum* and *Eugenia cumini*. Other common names are Black plum, Indian Black berry, Jambul, Javaplum, Jamblang etc. It is originated from the Indian subcontinent and Southeast Asia, with its native range including (Indonesia, Bangladesh, Nepal, Pakistan). Jamun thrives in tropical and subtropical climates, including semi-arid regions with minimum 350-500 mm annual rainfall. It prefers deep, loamy, moisture-retentive soils for best growth and yield. It is a fast-growing evergreen tree that has been valued over years for its sweet-sour and tart jamun fruits, which are excellent sources of iron, calcium, phosphorus, sodium, potassium, vitamin C, and carotene and have been reported by Sharma *et al.* (2019) [6] to have health benefits, especially for diabetes and digestion. Its seeds powder regulates blood sugar with compounds like glycoside jambolin, which helps in treating diarrhea, dysentery and inflammation whereas the leaves help with nausea, vomiting, bleeding disorders, boosting immunity and alleviate heart and liver ailments. Around 5,000 acres of Jamun plantations have been established in the last decade, mainly in the southern and western regions of India. Maharashtra is the lead producer of Jamun in India followed by Uttar Pradesh, Tamil Nadu, Gujarat, Assam, Rajasthan and Chhattisgarh.

Jamun seeds are known to be recalcitrant, chlorotic, multicotyledonous, multiple embryos, tetraploid nature and nucellar embryony can be observed in this crop although there have been very few studies examining their seed anatomy or directed towards improving seed germination and vigor Sivasubramaniam *et al.* (2012) [8]. Jamun is commercially propagated by seeds for taking the advantage of nucellar embryony Patil *et al.* (2018) [5]. Seed moisture content and storage conditions are important factors in seed survivability.

Dormancy releasing factors only control whether seeds can germinate in the specific climacteric conditions. Seeds quickly lose its viability hence it should be sown immediately after the harvesting of fruits 2-3 weeks when stored at 25-30 °C Uttamrao *et al.* (2022) [3]. Singh *et al.* (2019) [7] reported that jamun seeds are recalcitrant in nature. The hard seed coat imposes physical dormancy which delays germination under optimal condition 24-61 days. Even though Many researchers have made significant attempts to improve Jamun seed germination Bareke *et al.* (2018) [1]. Whereas pre-sowing of different treatments using different combinations which are not existing by using different combinations with dormancy breaking seed germination process can be accelerated. This study aims to determine the best dormancy breaking method simultaneously maintaining viability. It also helps in healthy seedlings production intern leads to a year-round supply of quality planting material to local farmers as well as researchers.

2. Materials and Methods

This research was carried out in the Shade Net facility, North Farm, under the Division of Horticulture at Karunya Institute of Technology and Sciences' School of Agricultural Sciences in Coimbatore during 2025-2026. Seeds required for this experiment were collected in and around Karunya Nagar from the healthy tress. The Seeds were collected from healthy Jamun (*Syzygium cumini*) trees at medium aged trees (20-40 years old) and fruits were harvested during peak season (typically June-July in Tamil Nadu), ensuring optimal seed maturity followed by a floatation test in distilled water where sinking seeds (viable) were selected and floating seeds (non-viable) were discarded. Freshly extracted seeds were then subjected to different treatments and three replication with complete randomized block design viz., T₁-control (distilled water); T₂-hydropriming (12 h); T₃-scarification (sandpaper); T₄-hot water (100 °C, 5 s); T₅-GA₃ (250 mg L⁻¹, 10 min); T₆-KNO₃ (0.5%, 10 min); T₇-thiourea (500 mg L⁻¹, 10 min); T₈-scarification + GA₃ (250 mg L⁻¹); T₉-KNO₃ (0.5%) + GA₃ (250 mg L⁻¹); T₁₀-thiourea (500 mg L⁻¹) + GA₃ (250 mg L⁻¹). Treated seeds were sown during last week of September in polythene bags of size 4" x 6" filled with potting mixture of vermicompost, soil, sand, and cocopeat in 2:1:1:1 ratio. Watering was done immediately after sowing and at regular intervals of (1-2 days).

Observations were recorded at 30, 45, and 60 days after sowing (DAS). From the first day onwards, days to first germination and days to 50% germination were assessed; seedling height (from base to tip, measured with a ruler and expressed in cm), root length (from seed to primary root tip, measured with a ruler and expressed in cm), number of leaves (averaged and expressed as numbers), fresh weight of roots and shoots (five plants per replication, weighed separately and expressed in grams), and dry weight of roots and shoots (five plants per replication, dried in a hot air oven at 60 °C for 1 hour and expressed in grams) were recorded.

3. Results and Discussion

3.1 Seedling Height

The treatment T₉ (GA₃ + KNO₃) significantly enhanced plant height in comparison to control (T₁), recorded the highest values of 22.13 cm at 30 days, 28.94 cm at 45 days

and 38.73 cm at 60 days, while T₁ gives the minimum values of 10.93 cm, 14.92 cm, and 19.87 cm at the respective intervals. This increase may be assign to GA₃ inducing α -amylase activity for starch hydrolysis, thereby mobilizing stored reserves, while KNO₃ supplies nitrogen for protein synthesis and activates nitric oxide signalling that loosens cell walls, promoting cell expansion and shoot elongation. Such synergistic action enhances dormancy relief and shoot growth resulting in taller seedlings. These findings are in line with Patil *et al.* (2018) [5] who reported the highest plant height of (41.37 cm) and the lowest of (27.43 cm) under their respective treatments.

3.2 Root Length

Root length was significantly he treatment T₉ (GA₃ + KNO₃), which recorded the highest values of 23.36 cm at 30 days, 31.29 cm at 45 days, and 41.16 cm at 60 days, while the control T₁ yielded the minimum values of 13.39 cm, 17.22 cm, and 22.28 cm at the respective intervals. This improvement can be attributed to GA₃ enhancing root meristem activity by degrading DELLA repressors, thereby sustaining cell division in the root apical meristem, while KNO₃ supplies nitrate that supports primary root elongation, auxin biosynthesis, and gravitropic signalling. This interaction promotes stronger geotropic bending and greater lateral root formation, resulting in longer and more profuse root systems. Sonkar *et al.* (2025) [9] similarly documented the maximum root length (35.42 cm) and the minimum (19.99 cm) across their treatments, showing the growth-promoting effects of GA₃-based applications on root development.

3.3 Number of leaves

Treatment T₉ (GA₃ + KNO₃) significantly enhanced the number of leaves in comparison to the control (T₁), Which records the highest values of 13.42 at 30 DAS, 20.26 at 45 DAS, and 23.81 at 60 DAS, while T₁ showed the minimum values of 6.51, 10.61, and 14.71 at the respective interval among all seed treatments. This is due be to GA₃ promoting the initiation and development of leaf primordia initiation and expansion, while KNO₃ improves nitrogen availability and enhances chlorophyll synthesis and leaf production. Uttamrao *et al.* (2022) [3] similarly reported the highest number of leaves (10.6) and the lowest of (8.4) under their respective treatments.

3.4 Root Fresh Weight and Dry weight

Root fresh and dry weight were recorded at 30,45 and 60 days after sowing (DAS), with the GA₃ + KNO₃ (T₉) treatment producing the highest root fresh weight and dry weight values of 0.994 g and 0.095 g at 30 DAS, 1.386 g and 0.135 g at 45 DAS, and 1.98 g and 0.189 g at 60 DAS, respectively. In contrast, the control (T₁) recorded the lowest values of 0.318 g and 0.028 g at 30 DAS, 0.434 g and 0.042 g at 45 DAS, and 0.62 g and 0.058 g at 60 DAS among all seed treatments. This improvement can be due to GA₃ stimulating root meristem activity and cell division, whereas KNO₃ enhances nitrogen nutrition and metabolic processes which promotes greater root biomass accumulation and better nutrient uptake. Whereas the combined effect led to increase cellular expansion, root elongation, and more efficient translocation of assimilates to the root system, resulting in higher fresh and dry weights. Bordoloi *et al.* (2025) [2] has found similar trends where one treatment gave the highest

root fresh weight (0.187 g) and dry weight (0.068 g), while another hit the lowest root fresh weight at 0.052 g and dry weight 0.013 g.

3.5 Shoot Fresh weight and Dry weight

Shoot fresh and dry weights were recorded at 30, 45, and 60 days after sowing (DAS), with the GA_3 + KNO_3 (T_9) treatment producing the highest shoot fresh weight and dry weight values of 8.61 g and 0.571 g at 30 DAS, 9.89 g and 0.79 g at 45 DAS, and 12.75 g and 1.129 g at 60 DAS, respectively. In contrast, the control (T_1) recorded the lowest values of 5.84 g and 0.348 g at 30 DAS, 6.63 g and 0.484 g at 45 DAS, and 7.34 g and 0.692 g at 60 DAS among all seed treatments. This improvement is due to GA_3 which

boosts cell division and cell elongation in the shoot apical meristem which results in biomass accumulation, while KNO_3 brings more nitrogen for protein synthesis, chlorophyll formation and overall metabolic growth, leading to higher photosynthetic efficiency and dry matter production. The combined effect gives stronger shoots, bigger leaves, hormonal stimulation and nitrogen nutrition results in more vigorous shoot growth, greater leaf area, better energy distribution to the shoots and enhanced shoots, which reflects in higher fresh and dry weights. Lepakshi and Reddy (2021) ^[4] also reported similar trends, with the highest shoot fresh weight (80.24 g) and dry weight (20.67 g) and the lowest values (53.40 g) and (14.12 g), respectively.

Table 1: Effect of pre-sowing treatments on seedling height, root length, and number of leaves of Jamun seeds at 30, 45, and 60 days after sowing (DAS).

Treatments	Seedling Height (cm)			Root Length (cm)			No. of leaves		
	30	45	60	30	45	60	30	45	60
T_1 : (Control)	10.93	14.92	19.87	13.39	17.22	22.28	6.51	10.61	14.71
T_2 : (Hydropriming)	14.54	20.76	25.62	16.74	23.06	28.02	9.31	16.51	19.36
T_3 : (Scarification)	15.11	21.83	27.43	17.31	24.13	29.83	9.03	17.16	20.76
T_4 : (Hotwater)	12.39	16.89	21.28	14.52	20.19	23.68	8.67	13.69	17.34
T_5 : (GA_3)	19.27	27.84	35.12	21.54	30.17	37.58	11.35	17.85	22.09
T_6 : (KNO_3)	16.81	22.94	30.54	19.21	25.24	32.97	10.02	15.76	21.49
T_7 : (Thiourea)	16.49	22.32	29.96	18.67	24.62	32.41	9.76	15.44	21.11
T_8 : (GA_3 + Scarification)	18.76	26.37	33.87	20.94	27.57	36.42	10.22	16.47	21.98
T_9 : (GA_3 + KNO_3)	22.13	28.94	38.73	23.36	31.29	41.16	13.42	20.26	23.81
T_{10} : (GA_3 + Thiourea)	19.89	25.64	36.26	22.18	27.64	38.26	12.67	18.43	22.57
SE (d)	0.408	0.408	0.408	0.727	0.727	0.727	0.408	0.408	0.408
SE (m)	0.289	0.289	0.289	0.514	0.514	0.514	0.289	0.289	0.289
LSD (0.05)	0.852	0.852	0.852	1.516	1.516	1.516	0.852	0.85	0.852

Table 2: Effect of pre-sowing treatments on root fresh weight and root dry weight of Jamun seeds at 30, 45, and 60 days after sowing (DAS).

Treatments	Root FW (g)			Root DW (g)		
	30	45	60	30	45	60
T_1 : (Control)	0.318	0.434	0.62	0.028	0.042	0.058
T_2 : (Hydropriming)	0.635	0.889	1.27	0.035	0.054	0.077
T_3 : (Scarification)	0.695	0.973	1.39	0.046	0.059	0.083
T_4 : (Hotwater)	0.477	0.658	0.94	0.031	0.041	0.064
T_5 : (GA_3)	0.875	1.225	1.75	0.079	0.109	0.148
T_6 : (KNO_3)	0.785	1.099	1.57	0.059	0.086	0.114
T_7 : (Thiourea)	0.731	1.022	1.46	0.052	0.074	0.101
T_8 : (GA_3 + Scarification)	0.816	1.134	1.62	0.067	0.091	0.122
T_9 : (GA_3 + KNO_3)	0.994	1.386	1.98	0.095	0.135	0.189
T_{10} : (GA_3 + Thiourea)	0.913	1.274	1.82	0.079	0.116	0.157
SE (d)	0.012	0.012	0.012	0.003	0.002	0.002
SE (m)	0.009	0.009	0.009	0.002	0.001	0.001
LSD (0.05)	0.026	0.026	0.026	0.007	0.003	0.003

Table 3: Effect of pre-sowing treatments on shoot fresh weight and shoot dry weight of Jamun seeds at 30, 45, and 60 days after sowing (DAS).

Treatments	Shoot FW (g)			Shoot DW (g)		
	30	45	60	30	45	60
T ₁ : (Control)	5.84	6.63	7.34	0.348	0.484	0.692
T ₂ : (Hydropriming)	6.07	7.14	8.21	0.376	0.499	0.713
T ₃ : (Scarification)	6.23	7.61	8.87	0.397	0.548	0.783
T ₄ : (Hotwater)	5.97	6.78	7.73	0.352	0.491	0.701
T ₅ : (GA ₃)	7.31	8.97	11.45	0.501	0.705	1.007
T ₆ : (KNO ₃)	6.92	8.42	9.31	0.438	0.613	0.876
T ₇ : (Thiourea)	6.64	7.94	9.06	0.412	0.575	0.821
T ₈ : (GA ₃ + Scarification)	7.03	8.59	9.43	0.489	0.67	0.957
T ₉ : (GA ₃ + KNO ₃)	8.61	9.89	12.75	0.571	0.79	1.129
T ₁₀ : (GA ₃ + Thiourea)	7.88	8.94	11.83	0.529	0.737	1.053
SE (d)	0.269	0.269	0.269	0.006	0.006	0.006
SE (m)	0.191	0.191	0.191	0.004	0.004	0.004
LSD (0.05)	0.562	0.562	0.562	0.012	0.012	0.012

4. Conclusion

It can be concluded from the above investigation that T₉ was the best treatment in breaking dormancy of jamun seeds, it also helps in improving all the germination and growth parameters studies helped in quality seedling production. The experiment demonstrated that pre-sowing in treatments enhances growth as well as germination behaviour of Jamun (*Syzygium cumini* L.). Among the evaluated treatments GA₃ + KNO₃ (T₉) emerged superior across parameters achieving maximum seedling height (38.73 cm), root length (41.16 cm), biomass accumulation germination at 60 DAS. GA₃ helped in breaking dormancy and KNO₃ enhancing nutrient rapid mobilization whereas the combination boosted the growth of seedlings which can be recommended for commercial nursery propagation for attaining uniform and vigour's growth.

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