Original Research article

Influence of Pre-Sowing Seed Treatments on Vigor and Biochemical Activity in Fresh and Aged Guava (*Psidium guajava* L.) Seeds

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ABSTRACT

The study titled "Impact of Different Pre-Sowing Seed Treatments on Germination and Seedling Growth of Guava (Psidium guajava L.)" was conducted during 2024–2025 at the Horticulture Laboratory of Shree Guru Gobind Singh Tricentenary University, Gurugram, Haryana, to evaluate the effects of various pre-sowing treatments on germination and seedling growth parameters of fresh and one-year-old guava seeds. Treatments included water soaking (48 hours), hot water soaking (70°C and 80°C for 1 minute), sulphuric acid (10% and 20% quick dip), gibberellic acid (GA_3) at 200 ppm and 400 ppm (24 hours), thiourea at 1000 ppm and 2000 ppm (24 hours), and a control. Parameters assessed included Vigour Index – I and II, speed of germination, accelerated aging test (24, 48, 72, and 96 hours), peroxidase activity, dehydrogenase activity, and electrical conductivity. Results showed that soaking seeds in gibberellic acid (GA_3) at 400 ppm for 24 hours consistently outperformed other treatments, recording the highest Vigour Index – I (205.00 for fresh, 105.67 for aged seeds), Vigour Index – II (11,923.00 for fresh, 7,493.00 for aged), speed of germination (1.88 for fresh, 1.78 for aged), and germination percentages under accelerated aging, alongside the highest peroxidase (710.00 µmol/gm DW for fresh, 640.33 for aged) and dehydrogenase activities (0.23 OD for fresh, 0.18 for aged), and the lowest electrical conductivity (9.43 µS/cm/sample for fresh, 10.08 for aged). The control consistently showed the lowest values across all parameters. Gibberellic acid at 200 ppm and thiourea at 1000 ppm also performed well but were inferior to GA_3 at 400 ppm. These findings demonstrate that pre-sowing treatment with GA_3 at 400 ppm significantly enhances germination, seedling vigour, and seed quality, offering a practical approach for improving guava seedling establishment in nurseries.

Keywords: Guava; Pre-sowing seed treatment; Gibberellic acid (GA_3); Seed germination; Seedling vigour; Accelerated aging; Enzyme activity; Seed quality.

1. INTRODUCTION

Guava (*Psidium guajava* L.), a member of the family Myrtaceae, is a small to medium-sized fruit tree native to tropical America, particularly Mexico and Peru. In India, it ranks fifth among fruit crops after mango, banana, papaya, and citrus, and is popularly referred to as the "Apple of the Tropics" owing to its affordability, nutritional value, and year-round availability (Gupta & Sanikommu, 2021). India is the largest producer of guava globally, contributing nearly 45% of total world production, with major growing states including Uttar Pradesh, Bihar, Madhya Pradesh, and Haryana (NHB, 2024). During 2023–24, Haryana recorded an estimated production of 183,643 metric tonnes of guava from 16,750 hectares, with prominent cultivars such as Allahabad Safeda, Hisar Safeda, Hisar Surkha, and Sardar (Hortharyana, 2024). The crop holds significant economic importance in the state, contributing to rural employment and serving as a key raw material for the fruit processing industry.

Guava is highly valued for its rich nutritional composition, being a good source of vitamin C, dietary fiber, pectin, minerals, and antioxidants, which makes it suitable for both fresh consumption and processing into products such as jams, jellies, and nectar (Naseer et al., 2018). Although commercial propagation is primarily achieved through vegetative methods such as air layering and grafting, seed propagation remains crucial for raising uniform and vigorous rootstocks. However, guava seeds exhibit physical dormancy due to a hard seed coat and possess short viability, leading to delayed and poor germination, which adversely affects seedling establishment (Sourabh et al., 2020).

Considering the importance of healthy and vigorous rootstocks for vegetative propagation in Haryana's expanding guava orchards, pre-sowing seed treatments such as soaking, scarification, and the application of growth regulators are essential to overcome dormancy and enhance germination potential. Therefore, the present study was undertaken to evaluate the impact of different pre-sowing seed treatments on germination, seedling growth, and seed quality of guava seeds of varying ages.

2. METHODOLOGY

The laboratory experiment was conducted during 2024–2025 at the Horticulture Laboratory, Faculty of Agricultural Sciences, Shree Guru Gobind Singh Tricentenary University, Gurugram, Haryana, India (28º27′ N, 77º00′ E; 217 m above mean sea level). Seeds of wild guava (*Psidium guajava* L.) belonging to two age groups—fresh and one-year-old—were used for the study. Healthy seeds were extracted from fully ripe fruits, separated from the mesocarp, thoroughly washed, and shade-dried to achieve a moisture content of approximately 12–15%. The dried seeds were stored in cloth bags under ambient laboratory conditions until further use. Prior to the application of treatments, seeds were surfacesterilized with 1% sodium hypochlorite (NaOCl) solution for 10 minutes, rinsed under running tap water for 3 minutes, and air-dried.

The experiment was laid out in a Completely Randomized Design (CRD) with ten treatments replicated three times, each replication consisting of 30 seeds. The treatments included: untreated control (T_1), water soaking for 48 hours (T_2), hot water soaking at 70°C for 1 minute (T_3), hot water soaking at 80°C for 1 minute (T_4), sulphuric acid quick dip at 10% (T_5) and 20% (T_6), gibberellic acid (GA_3) soaking at 200 ppm (T_7) and 400 ppm (T_8) for 24 hours, and thiourea soaking at 1000 ppm (T_9) and 2000 ppm (T_{10}) for 24 hours. After each treatment, seeds were thoroughly rinsed with tap water to remove any chemical residues and then surface-dried before sowing.

For standard germination test, 30 seeds of each treatment in three replicates were placed in moist sand medium and kept at 27 ± 1°C with 80–85% RH in a seed germinator. Germination count was recorded at regular intervals up to 30 days, and normal seedlings were considered as per ISTA (2001) rules. Mean germination time (MGT) was calculated using the formula of Moradi Dezfuli *et al.* (2008). Seedling length was measured from 10 randomly selected normal seedlings, and dry weight was recorded after oven drying at 65 ± 2°C for 48 h.

3. RESULTS AND DISCUSSION

Vigour Index – I- The data presented in Table no.1 revealed that pre-sowing seed treatments had a significant effect on Vigour Index – I of guava seeds. The highest values were recorded in seeds soaked in GA_3 at 400 ppm for 24 hours, achieving 205.00 in fresh seeds and 105.67 in one-year-old seeds. These values were statistically comparable with those obtained from seeds soaked in GA_3 at 200 ppm for 24 hours and thiourea at 1000 ppm for 24 hours. The minimum vigour index values (136.00 and 87.00, respectively) were observed in the untreated control. The results clearly demonstrate that GA_3 pre-soaking markedly enhanced seedling vigour by promoting higher germination and better seedling growth, even in aged seed lots.

Vigour Index – II- Similarly, pre-sowing treatments significantly influenced Vigour Index – II (Table no. 1). The highest values were observed in seeds soaked in GA_3 at 400 ppm for 24 hours (11,923.00 in fresh seeds and 7,493.00 in one-year-old seeds), which were statistically on par with GA_3 at 200 ppm for 24 hours. The lowest indices (7,153.00 and 5,857.33, respectively) were recorded in the control. The superior performance of GA_3-treated seeds may be attributed to enhanced germination, increased shoot elongation, and improved metabolic activity, which together facilitated efficient mobilization and utilization of seed reserves (Brain & Homming, 1955; Pamapanna & Sulikeri, 1995). These findings corroborate earlier reports in aonla (Barathkumar, 2019), papaya (Ramteke, 2015), Indian gooseberry (Rinku *et al*., 2019), tamarind (Manoli *et al*., 2018), and khirni (Ratna *et al*., 2018).

Table no. 1 Vigour Index –I and vigour index - II

Treatment details	Vigour Index – I		Vigour Index – II	
	Fresh	1 yr old	Fresh	1 yr old
Control	136.00	87.00	7,153.00	5,857.33
Water soaking for 48 hrs.	192.33	97.67	10,555.33	6,889.00

Hot water soaking at 70°C for 1 min.	179.33	94.33	10,036.67	6,421.33
Hot water soaking at 80°C for 1 min.	187.67	96.33	10,218.67	6,573.00
10% Sulphuric acid treatment (Quick Dip)	149.33	88.00	8,274.33	5,937.67
20% Sulphuric acid treatment (Quick Dip)	165.00	91.33	9,838.33	6,226.33
Soaking seeds in GA_3 @ 200 ppm for 24 hrs.	203.00	103.67	11,615.33	7,376.33
Soaking seeds in GA_3 @ 400 ppm for 24 hrs.	205.00	105.67	11,923.00	7,493.00
Soaking seeds in thiourea @1000ppm for 24 hrs.	200.33	101.33	11,229.67	7,280.33
Soaking seeds in thiourea @2000ppm for 24 hrs.	198.00	100.00	10,990.00	7,154.67
C.D. @ 5%	6.53			

Peroxidase Activity Test - The data presented in Table no.2 indicated that pre-sowing treatments significantly affected germination percentage under accelerated aging conditions in guava. In the fresh seed lot, the highest germination percentages were recorded in seeds soaked in GA_3 at 400 ppm for 24 hours (T_8), with 14.63%, 10.00%, 4.67%, and 1.95% at 24, 48, 72, and 96 hours, respectively, followed by GA_3 at 200 ppm (T_7) with 14.37%, 9.78%, 4.50%, and 1.88%. The lowest germination values were observed in the control (T_1) with 6.00%, 4.00%, 1.35%, and 0.68%, respectively. A similar trend was recorded in the one-year-old seed lot, where T_8 exhibited the highest germination percentages of 9.98%, 5.00%, 2.69%, and 0.67% at 24, 48, 72, and 96 hours, respectively, while the control (T_1) consistently recorded the lowest values of 4.63%, 3.00%, 0.69%, and 0.00%. These findings confirm the superiority of GA_3 at 400 ppm in maintaining seed vigour and viability by enhancing metabolic efficiency and delaying aging-induced deterioration.

Table no. 2 Peroxidase Activity Test.

Treatment details	**@24 hrs**		**@48 hrs**		**@72 hrs**		**@96 hrs**	
	Fresh	**1yr old**	**Fresh**	**1yr old**	**Fresh**	**1yr old**	**Fresh**	**1yr old**
Control	6.00	4.63	4.00	3.00	1.35	0.69	0.68	0.00
Water soaking for 48 hrs.	11.54	7.78	7.98	4.51	3.42	1.95	1.43	0.57
Hot water soaking at 70°C for 1 min.	11.93	6.51	6.78	4.31	2.46	1.59	1.25	0.45
Hot water soaking at 80°C for 1 min.	10.34	6.99	7.27	4.45	3.02	1.83	1.35	0.53
10% H_2SO_4 treatment (Quick Dip)	7.19	4.95	4.72	3.48	1.98	0.87	0.80	0.21
20% H_2SO_4treatment (Quick Dip)	8.25	5.69	5.64	3.94	1.51	1.06	1.04	0.33
Soaking seeds in GA_3@200ppm for 24 hrs.	14.37	9.61	9.78	4.94	4.50	2.55	1.88	0.64
Soaking seeds in GA_3@400ppm for 24 hrs.	14.63	9.98	10.00	5.00	4.67	2.69	1.95	0.67
Soaking seeds in thiourea @1000ppm for 24hrs.	13.50	8.82	9.21	4.78	4.12	2.42	1.67	0.62
Soaking seeds in thiourea @2000ppm for 24hrs.	12.92	8.15	8.47	4.64	3.87	2.26	1.58	0.60
C.D. @ 5%	**0.44**	**0.33**	**0.38**	**0.13**	**0.15**	**0.10**	**0.08**	**0.05**

Dehydrogenase Activity Test - The results (Table no.3) revealed that pre-sowing treatments significantly influenced dehydrogenase activity in guava seeds. The highest activity was recorded in seeds soaked in GA_3 @ 400 ppm for 24 hours (0.23 in fresh and 0.18 in one-year-old seeds), which was statistically at par with GA_3 @ 200 ppm (0.22 and 0.17) and thiourea @ 1000 ppm (0.22 and 0.18), while the lowest was observed in the control (0.09 and 0.06). The enhanced dehydrogenase activity under GA_3 and thiourea treatments indicates improved enzymatic metabolism and respiratory efficiency, which are vital for better seed vigour and germination (Khan, 1971; Ramteke, 2015; Rinku *et al.,* 2019).

Table no. 3 Dehydrogenase Activity Test and Electrical Conductivity Test

Treatment details	**Dehydrogenase Activity**		**Electrical Conductivity (µS/cm)**	
	Fresh	1 yr old	Fresh	1 yr old
Control	0.09	0.06	16.20	24.15
Water soaking for 48 hrs.	0.12	0.08	11.51	13.73
Hot water soaking at 70°C for 1 min.	0.15	0.14	13.74	16.29
Hot water soaking at 80°C for 1 min.	0.17	0.17	12.85	14.67
10% H_2SO_4 treatment (Quick Dip)	0.10	0.07	15.72	20.44
20% H_2SO_4 treatment (Quick Dip)	0.12	0.07	14.88	18.33
Soaking seeds in GA_3@200ppm for 24 hrs.	0.22	0.17	9.68	10.66
Soaking seeds in GA_3@400ppm for 24 hrs.	0.23	0.18	9.43	10.08
Soaking seeds in thiourea@1000ppm for 24 hrs.	0.22	0.18	10.11	11.08
Soaking seeds in thiourea@2000ppm for 24 hrs.	0.18	0.11	10.73	12.65
C.D. @ 5%	0.01	0.01	0.29	0.48

Electrical conductivity - Electrical conductivity (Table no.3) was significantly affected by pre-sowing treatments. The lowest values were obtained in GA_3 @ 400 ppm for 24 hours (9.43 µS/cm in fresh and 10.08 µS/cm in one-year-old seeds), which was statistically comparable with GA_3 @ 200 ppm (9.68 and 10.66), whereas the highest values were recorded in the control (16.20 and 24.15). Lower electrical conductivity values in GA_3-treated seeds indicate reduced membrane leakage and higher seed vigour, signifying better membrane integrity and metabolic efficiency (Pamapanna & Sulikeri, 1995; Manoli *et al*., 2018; Barathkumar, 2019).

4. CONCLUSION

The pre-sowing seed treatments markedly enhanced seed vigour, germination, and metabolic efficiency in guava (*Psidium guajava* L.). Among the treatments, soaking seeds in gibberellic acid (GA_3) at 400 ppm for 24 hours proved most effective, recording the highest Vigour Index–I and Vigour Index–II in both fresh and one-year-old seeds. This treatment also resulted in superior dehydrogenase activity and the lowest electrical conductivity values, indicating improved enzymatic metabolism and better membrane integrity. Furthermore, under accelerated aging conditions, GA_3-treated seeds maintained higher germination percentages even after prolonged stress periods, demonstrating enhanced resilience and delayed seed deterioration. Overall, GA_3 at 400 ppm for 24 hours emerged as the most reliable pre-sowing treatment for promoting germination, seedling vigour, and physiological stability in guava, offering a practical approach for improving nursery establishment and seedling quality.

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