

**Original Research Article**

**Optimizing Seed Germination in fresh and aged Guava (*Psidium guajava* L.)  
seeds using different Chemicals Scarification Treatments**



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## ABSTRACT

The present investigation entitled “Optimizing Seed Germination in fresh and aged Guava (*Psidium guajava* L.) seeds using different Chemicals Scarification Treatments” was conducted during 2024–2025 at the Horticulture Laboratory of Shree Guru Gobind Singh Tricentenary University, Gurugram (Haryana). The study evaluated the influence of various pre-sowing treatments, including water soaking, hot water soaking (70° C and 80° C) , sulphuric acid (10% and 20%) , gibberellic acid (GA<sub>3</sub>) @200 ppm and 400 ppm , and thiourea (@1000 ppm and 2000 ppm) , on seed germination and seedling growth parameters in both fresh and one-year-old guava seed lots. The data were recorded on standard germination percentage, days to emergence of seedling, mean germination time, survival percentage, seedling length, seedling dry weight, vigour indices- I and II and speed

of germination. The results revealed that GA<sub>3</sub> at 400 ppm for 24 hours consistently outperformed other treatments, recording the highest germination percentage (57.61% in fresh seeds and 50.56% in one-year-old seeds), minimum days to emergence (17 and 20.33 days, respectively), maximum survival percentage (59.67% and 54.00%), longest seedling length (5.60 cm and 4.20 cm), and greatest seedling dry weight (328.00 mg and 281.00 mg). This treatment also enhanced vigour indices- I and II and speed of germination. GA<sub>3</sub> at 200 ppm and thiourea at 1000 ppm also showed promising results, though inferior to GA<sub>3</sub> at 400 ppm. The findings demonstrate that pre-sowing seed treatment with GA<sub>3</sub> (400 ppm) is highly effective in improving germination and seedling growth of guava seeds, thereby offering a practical strategy for enhancing seedling establishment in nurseries.

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*Keywords: Guava, seed germination, pre-sowing treatment, gibberellic acid, seed vigour, seedling growth.*

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## 1. INTRODUCTION

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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 widely known as the “Apple of the Tropics” due to its affordability and year-round availability (Gupta & Sanikommu, 2021). India is the world’s largest producer, contributing nearly 45% of global guava output, with major cultivation in Uttar Pradesh, Bihar, Madhya Pradesh, and Haryana (NHB, 2024). In 2023–24, Haryana produced about 183,643 metric tonnes of guava from 16,750 hectares, with Allahabad Safeda, Hisar Safeda, Hisar Surkha, and Sardar as prominent cultivars (Hortharyana, 2024). The crop plays a significant role in the state’s fruit economy, generating employment and supporting processing industries.

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Guava is valued for its high vitamin C content, dietary fiber, pectin, minerals, and antioxidants, making it important for both nutrition and processing into products such as jelly, jam, and nectar (Naseer *et al.*, 2018). Although commercial propagation relies mainly on vegetative methods like air layering and grafting, seed propagation remains essential for raising rootstocks. However, guava seeds exhibit physical dormancy due to a hard seed coat and have short viability, which results in delayed germination and poor seedling establishment (Sourabh *et al.*, 2020). Since raising healthy rootstocks is vital for vegetative propagation in Haryana’s expanding guava orchards, pre-sowing treatments such as soaking, scarification, and growth regulators are needed to improve germination and seedling vigor.

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Pre-sowing treatments, including soaking, acid scarification, growth regulators, and chemicals, have been applied to improve seed germination and seedling vigor. The present study was therefore undertaken to assess the effects of different pre-sowing seed treatments on germination, seedling growth, and seed quality of guava seeds of varying ages.

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## 2. MATERIAL AND METHODS

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The laboratory experiments were conducted at the Horticulture Laboratory, Faculty of Agricultural Sciences, Shree Guru Gobind Singh Tricentenary University, Gurugram, Haryana, India (28°27' N, 77°00' E) situated at 217 m above mean sea level during 2024–25.

70 Seeds of wild guava (*Psidium guajava* L.) of two age groups, viz. fresh and one-year-old,  
 71 were used for the study. Healthy seeds were extracted from ripe fruits, separated from fleshy  
 72 mesocarp, thoroughly washed, shade dried to about 12–15% moisture, and stored in cloth  
 73 bags under room conditions. Before treatment, the seeds were immersed in 1% NaOCl  
 74 solution for 10 min, rinsed thoroughly in running water for 3 min, and surface dried. The  
 75 experiment was laid out in Completely Randomized Design (CRD) with ten treatments  
 76 replicated thrice. Each treatment consisted of 30 seeds per replication. The treatments were:  
 77 untreated control ( $T_1$ ), water soaking for 48 h ( $T_2$ ), hot water soaking at 70°C (1 min,  $T_3$ ),  
 78 hot water soaking at 80°C (1 min,  $T_4$ ), sulphuric acid quick dip at 10% ( $T_5$ ) and 20% ( $T_6$ ),  
 79 GA<sub>3</sub> soaking @ 200 ppm (24 h,  $T_7$ ), GA<sub>3</sub> @ 400 ppm (24 h,  $T_8$ ), thiourea @ 1000 ppm  
 80 (24 h,  $T_9$ ) and thiourea @ 2000 ppm (24 h,  $T_{10}$ ). After treatments, seeds were thoroughly  
 81 washed with tap water to remove residues.

82 For standard germination test, 30 seeds of each treatment in three replicates were placed in  
 83 moist sand medium and kept at  $27 \pm 1^\circ\text{C}$  with 80–85% RH in a seed germinator.  
 84 Germination count was recorded at regular intervals up to 30 days, and normal seedlings  
 85 were considered as per ISTA (2001) rules. Mean germination time (MGT) was calculated  
 86 using the formula of Moradi Dezfuli *et al.* (2008). Seedling length was measured from 10  
 87 randomly selected normal seedlings, and dry weight was recorded after oven drying at  $65 \pm$   
 88  $2^\circ\text{C}$  for 48 h.

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### 91 3. RESULTS AND DISCUSSION

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93 **Standard germination (%):** Different pre-sowing seed treatments significantly influenced  
 94 the germination percentage of guava seeds of both ages (fresh and one-year-old).  
 95 Germination ranged from 38.6% to 57.6% in fresh seeds and 30.7% to 50.6% in one-year-  
 96 old seeds. The maximum germination (57.6%) was observed with soaking in GA<sub>3</sub> @ 400  
 97 ppm for 24 h, which was statistically at par with GA<sub>3</sub> @ 200 ppm, whereas the minimum  
 98 was recorded in control (38.6%). Similar trends were observed in aged seeds where GA<sub>3</sub>  
 99 @400ppm recorded 50.6% germination as shown in the table no. 1 given below. The  
 100 improvement under GA<sub>3</sub> treatments may be attributed to enhanced enzymatic activity,  
 101 particularly the activation of  $\alpha$ -amylase, leading to efficient mobilization of stored food  
 102 reserves (Dinesh & Padmapriya 2022). These findings are in agreement with Barche *et al.*  
 103 (2010) and Ramteke (2015), who reported improved germination of guava and papaya  
 104 seeds following GA<sub>3</sub> treatments.

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106 **Days to emergence of seedlings:** The number of days required for seedling emergence  
 107 was reduced significantly under GA<sub>3</sub> treatments. The earliest emergence (17.0 days for  
 108 fresh seeds and 20.3 days for aged seeds) was recorded in GA<sub>3</sub> @400ppm (table no.1),  
 109 while the maximum days (25.0 and 30.0, respectively) were recorded in control. Faster  
 110 emergence in GA<sub>3</sub>-treated seeds might be due to its role in promoting cell elongation and  
 111 early radicle protrusion (Salisbury & Ross 1988).

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113 **Mean germination time (MGT) :** Mean germination time decreased with pre-sowing  
 114 treatments. The lowest Mean germination time (14.0 and 16.0 days for fresh and aged  
 115 seeds, respectively) was recorded in GA<sub>3</sub> @ 400 ppm, while the highest (24.0 and 25.0  
 116 days) was observed in the control as given in the table no. 1. The reduced Mean germination  
 117 time under GA<sub>3</sub> treatments suggests accelerated germination due to improved water uptake  
 118 and enzymatic activity (Nayak & Sen 1999; Weitbrecht *et al.* 2011).

119 Table no. 1 Effect of treatments on standard germination %, days to emergence of seedling  
 120 and mean germination time .

Treatment Details	Germination (%)		Days to emergence		Mean germination time	
	Fresh	1yr old	Fresh	1yr old	Fresh	1yr old
Control	38.62	34.36	25.00	30.00	24.00	25.00
Water soaking for 48 hrs	46.36	44.73	19.67	25.67	17.33	18.67
Hot water soaking at 70°C for 1 min	42.91	41.59	21.67	27.33	20.00	20.67
Hot water soaking at 80°C for 1 min	44.56	43.89	21.00	27.00	18.67	19.67
10% Sulphuric acid treatment (Quick Dip)	39.89	36.37	24.67	29.00	23.33	23.67
20% Sulphuric acid treatment (Quick Dip)	41.10	39.39	22.67	28.33	21.67	22.00
Soaking in GA <sub>3</sub> @ 200 ppm for 24 hrs	56.07	49.46	17.67	21.00	14.67	16.67
Soaking in GA <sub>3</sub> @ 400 ppm for 24 hrs	57.61	50.56	17.00	20.33	14.00	16.00
Soaking in thiourea @ 1000 ppm for 24 hrs	51.96	48.46	18.00	21.67	15.33	17.33
Soaking in thiourea @ 2000 ppm for 24 hrs	49.84	46.77	19.00	24.00	16.33	18.00
<b>C.D. @ 5%</b>	<b>2.38</b>	<b>1.21</b>	<b>0.70</b>	<b>1.04</b>	<b>0.99</b>	<b>0.77</b>

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**Seedling survival (%):** Seedling survival percentage ranged between 30.0% and 59.7% in fresh seeds, and 24.7% to 54.0% in aged seeds (table. no.2). The maximum survival was noted in GA<sub>3</sub> @ 400 ppm, while the control recorded the minimum. Higher survival in GA<sub>3</sub> - treated seeds could be linked to stronger seedlings with better root systems, enabling higher establishment (Palepad *et al.* 2017; Urvashi *et al.* 2020).

Table no. 2 Effect of treatments on seedling survival %, seedling length and seedling dry weight .

Treatment details	Survival %		Seedling length		Seedling dry wt.	
	Fresh	1yr old	Fresh	1yr old	Fresh	1yr old
Control	30.00	24.67	4.50	3.80	284.00	257.00
Water soaking for 48 hrs	42.67	43.00	5.33	4.13	316.00	271.67
Hot water soaking at 70°C for 1 min	38.67	36.00	5.14	4.04	311.00	267.33
Hot water soaking at 80°C for 1 min	40.33	40.67	5.26	4.11	313.67	269.33
10% Sulphuric acid treatment (Quick Dip)	33.00	28.00	4.63	3.83	288.00	259.00
20% Sulphuric acid treatment (Quick Dip)	36.00	32.33	4.83	3.95	305.00	264.00
Soaking in GA <sub>3</sub> @ 200 ppm for 24 hrs	55.67	52.00	5.56	4.18	325.33	279.33

Soaking in GA <sub>3</sub> @ 400 ppm for 24 hrs	59.67	54.00	5.60	4.20	328.00	281.00
Soaking in thiourea @ 1000 ppm for 24 hrs	50.33	49.67	5.44	4.17	321.00	277.67
Soaking in thiourea @ 2000 ppm for 24 hrs	45.67	46.67	5.38	4.15	318.33	275.00
<b>C.D. at 5%</b>	<b>1.91</b>	<b>2.34</b>	<b>0.09</b>	<b>0.04</b>	<b>2.43</b>	<b>1.17</b>

129 **Seedling length (cm):** Significant variation was observed in seedling length across  
 130 treatments as presented in table no. 2. Fresh seeds treated with GA<sub>3</sub> @ 400 ppm for 24 h  
 131 produced the longest seedlings (5.60 cm), followed by GA<sub>3</sub> @ 200 ppm (5.43 cm), while the  
 132 shortest seedlings (3.03 cm) were in the control. Aged seeds showed similar results. The  
 133 stimulatory effect of GA<sub>3</sub> on cell elongation and division could explain increased seedling  
 134 length (Chavan 2021).

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136 **Seedling dry weight (mg):** Seedling dry weight ranged from 186.0 mg to 328.0 mg in fresh  
 137 seeds and 154.0 mg to 296.0 mg in aged seeds. The highest values were recorded in GA<sub>3</sub>  
 138 @ 400 ppm, while control showed the lowest (table no.2). This increase may be attributed to  
 139 better biomass accumulation through enhanced photosynthetic activity and assimilate  
 140 distribution (Choudhary & Chakrawar 1981; Alvin 1960).

141 **Vigour Index – I:** The results (Table 3) indicated that pre-sowing treatments significantly  
 142 influenced Vigour Index – I of guava seeds. The highest values were recorded with soaking  
 143 seeds in GA<sub>3</sub> @ 400 ppm for 24 hrs (205.00 in fresh seeds and 105.67 in one-year-old  
 144 seeds), which was statistically comparable with soaking in GA<sub>3</sub> @ 200 ppm for 24 hrs and  
 145 soaking in thiourea @ 1000 ppm for 24 hrs. The lowest values (136.00 and 87.00,  
 146 respectively) were obtained under the control. These results clearly demonstrate the positive  
 147 role of GA<sub>3</sub> pre-soaking in enhancing seedling vigour by improving germination and growth  
 148 performance, even in aged seed lots.

149 **Vigour Index – II:** Data presented in Table 3 showed that Vigour Index – II was also  
 150 significantly affected by pre-sowing treatments. The maximum values were obtained with  
 151 soaking seeds in GA<sub>3</sub> @ 400 ppm for 24 hrs (11,923.00 in fresh seeds and 7,493.00 in one-  
 152 year-old seeds), which remained statistically at par with soaking in GA<sub>3</sub> @ 200 ppm for 24  
 153 hrs. The lowest vigour indices (7,153.00 and 5,857.33, respectively) were recorded in the  
 154 control. The superiority of GA<sub>3</sub> treatments can be attributed to improved germination,  
 155 greater shoot elongation, and enhanced metabolic activity, which facilitated efficient  
 156 utilization of food reserves (Brain & Homming, 1955; Pamapanna & Sulikeri, 1995). These  
 157 results are consistent with earlier findings in aonla (Barathkumar, 2019), papaya (Ramteke,  
 158 2015), Indian gooseberry (Rinku *et al.*, 2019), tamarind (Manoli *et al.*, 2018), and khirni  
 159 (Ratna *et al.*, 2018).

160 **Speed of germination:** The speed of germination was improved under GA<sub>3</sub> treatments,  
 161 with GA<sub>3</sub> @ 400 ppm recording the maximum values (1.88 and 1.78 for fresh and aged  
 162 seeds, respectively) compared to the control (0.78 and 0.61) as shown in table no.3. This  
 163 suggests rapid and uniform germination in GA<sub>3</sub> -primed seeds. The faster germination under  
 164 GA<sub>3</sub> treatment may be attributed to its role in stimulating hydrolytic enzyme activity,  
 165 particularly amylases, which accelerate the breakdown of stored food reserves into simpler  
 166 forms readily utilized by the embryo. In addition, GA<sub>3</sub> enhances cell elongation and reduces  
 167 mechanical resistance of seed coverings, thereby promoting quicker radicle protrusion and  
 168 uniform seedling emergence.

169 Table no. 3 Effect of treatments on vigour index – I and II and speed of germination.

Treatment details	Vigour Index – I		Vigour Index – II		Speed of germination	
	Fresh	1yr old	Fresh	1yr old	Fresh	1yr old
Control	136.00	87.00	7,153.00	5,857.33	1.72	1.53

Water soaking for 48 hrs	192.33	97.67	10,555.33	6,889.00	1.80	1.54
Hot water soaking at 70°C for 1 min	179.33	94.33	10,036.67	6,421.33	1.75	1.58
Hot water soaking at 80°C for 1 min	187.67	96.33	10,218.67	6,573.00	1.78	1.64
10% H <sub>2</sub> SO <sub>4</sub> treatment (Quick Dip)	149.33	88.00	8,274.33	5,937.67	1.73	1.61
20% H <sub>2</sub> SO <sub>4</sub> treatment (Quick Dip)	165.00	91.33	9,838.33	6,226.33	1.84	1.57
Soaking in GA <sub>3</sub> @ 200 ppm for 24 hrs	203.00	103.67	11,615.33	7,376.33	1.86	1.75
Soaking in GA <sub>3</sub> @ 400 ppm for 24 hrs	205.00	105.67	11,923.00	7,493.00	1.88	1.78
Soaking in thiourea @1000 ppm for 24 hrs	200.33	101.33	11,229.67	7,280.33	1.83	1.72
Soaking in thiourea @2000 ppm for 24 hrs	198.00	100.00	10,990.00	7,154.67	1.81	1.67
<b>C.D. at 5%</b>	6.53	2.66	376.41	104.52	0.03	0.03

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#### 4. CONCLUSION

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