**Original Research Article**

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

.

## 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 ($GA_3$ ) @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 $GA_3$ 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. $GA_3$ at 200 ppm and thiourea at 1000 ppm also showed promising results, though inferior to $GA_3$ at 400 ppm. The findings demonstrate that pre-sowing seed treatment with $GA_3$ (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.

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

## 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 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.

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.

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.

## 2. MATERIAL AND METHODS

The laboratory experiments were conducted at the Horticulture Laboratory, Faculty of Agricultural Sciences, Shree Guru Gobind Singh Tricentenary University, Gurugram, Haryana, India (28º27’ N, 77º00’ E) situated at 217 m above mean sea level during 2024–25.

Seeds of wild guava (*Psidium guajava* L.) of two age groups, *viz*. fresh and one-year-old, were used for the study. Healthy seeds were extracted from ripe fruits, separated from fleshy mesocarp, thoroughly washed, shade dried to about 12–15% moisture, and stored in cloth bags under room conditions. Before treatment, the seeds were immersed in 1% NaOCl solution for 10 min, rinsed thoroughly in running water for 3 min, and surface dried. The experiment was laid out in Completely Randomized Design (CRD) with ten treatments replicated thrice. Each treatment consisted of 30 seeds per replication. The treatments were: untreated control ($T_1$), water soaking for 48 h ($T_2$), hot water soaking at 70°C (1 min, $T_3$), hot water soaking at 80°C (1 min, $T_4$), sulphuric acid quick dip at 10% ($T_5$) and 20% ($T_6$), $GA_3$ soaking @ 200 ppm (24 h, $T_7$), $GA_3$ @ 400 ppm (24 h, $T_8$), thiourea @ 1000 ppm (24 h, $T_9$) and thiourea @ 2000 ppm (24 h, $T_{10}$). After treatments, seeds were thoroughly washed with tap water to remove residues.

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

**Standard germination (%):** Different pre-sowing seed treatments significantly influenced the germination percentage of guava seeds of both ages (fresh and one-year-old). Germination ranged from 38.6% to 57.6% in fresh seeds and 30.7% to 50.6% in one-year-old seeds. The maximum germination (57.6%) was observed with soaking in $GA_3$ @ 400 ppm for 24 h , which was statistically at par with $GA_3$ @ 200 ppm, whereas the minimum was recorded in control (38.6%). Similar trends were observed in aged seeds where $GA_3$ @400ppm recorded 50.6% germination as shown in the table no. 1 given below. The improvement under $GA_3$ treatments may be attributed to enhanced enzymatic activity, particularly the activation of α-amylase, leading to efficient mobilization of stored food reserves (Dinesh & Padmapriya 2022). These findings are in agreement with Barche *et al*. (2010) and Ramteke (2015), who reported improved germination of guava and papaya seeds following $GA_3$ treatments.

**Days to emergence of seedlings:** The number of days required for seedling emergence was reduced significantly under $GA_3$ treatments. The earliest emergence (17.0 days for fresh seeds and 20.3 days for aged seeds) was recorded in $GA_3$ @400ppm (table no.1), while the maximum days (25.0 and 30.0, respectively) were recorded in control. Faster emergence in $GA_3$ -treated seeds might be due to its role in promoting cell elongation and early radicle protrusion (Salisbury & Ross 1988).

**Mean germination time (MGT) :** Mean germination time decreased with pre-sowing treatments. The lowest Mean germination time (14.0 and 16.0 days for fresh and aged seeds, respectively) was recorded in $GA_3$ @ 400 ppm, while the highest (24.0 and 25.0 days) was observed in the control as given in the table no. 1. The reduced Mean germination time under $GA_3$ treatments suggests accelerated germination due to improved water uptake and enzymatic activity (Nayak & Sen 1999; Weitbrecht *et al.* 2011).

Table no. 1 Effect of treatments on standard germination %, days to emergence of seedling 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 $GA_3$ @ 200 ppm for 24 hrs | 56.07 | 49.46 | 17.67 | 21.00 | 14.67 | 16.67 |
| Soaking in $GA_3$ @ 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 |
| **C.D. @ 5%** | **2.38** | **1.21** | **0.70** | **1.04** | **0.99** | **0.77** |

**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 $GA_3$ @ 400 ppm, while the control recorded the minimum. Higher survival in $GA_3$ -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 $GA_3$ @ 200 ppm for 24 hrs | 55.67 | 52.00 | 5.56 | 4.18 | 325.33 | 279.33 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Soaking in $GA_3$ @ 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 |
| **C.D. at 5%** | **1.91** | **2.34** | **0.09** | **0.04** | **2.43** | **1.17** |

**Seedling length (cm):** Significant variation was observed in seedling length across treatments as presented in table no. 2. Fresh seeds treated with $GA_3$ @ 400 ppm for 24 h produced the longest seedlings (5.60 cm), followed by $GA_3$ @ 200 ppm (5.43 cm), while the shortest seedlings (3.03 cm) were in the control. Aged seeds showed similar results. The stimulatory effect of $GA_3$ on cell elongation and division could explain increased seedling length (Chavan 2021).

**Seedling dry weight (mg):** Seedling dry weight ranged from 186.0 mg to 328.0 mg in fresh seeds and 154.0 mg to 296.0 mg in aged seeds. The highest values were recorded in $GA_3$ @ 400 ppm, while control showed the lowest (table no.2). This increase may be attributed to better biomass accumulation through enhanced photosynthetic activity and assimilate distribution (Choudhary & Chakrawar 1981; Alvin 1960).

**Vigour Index – I:** The results (Table 3) indicated that pre-sowing treatments significantly influenced Vigour Index – I of guava seeds. The highest values were recorded with soaking seeds in $GA_3$ @ 400 ppm for 24 hrs (205.00 in fresh seeds and 105.67 in one-year-old seeds), which was statistically comparable with soaking in $GA_3$ @ 200 ppm for 24 hrs and soaking in thiourea @ 1000 ppm for 24 hrs. The lowest values (136.00 and 87.00, respectively) were obtained under the control. These results clearly demonstrate the positive role of $GA_3$ pre-soaking in enhancing seedling vigour by improving germination and growth performance, even in aged seed lots.

**Vigour Index – II:** Data presented in Table 3 showed that Vigour Index – II was also significantly affected by pre-sowing treatments. The maximum values were obtained with soaking seeds in $GA_3$ @ 400 ppm for 24 hrs (11,923.00 in fresh seeds and 7,493.00 in one-year-old seeds), which remained statistically at par with soaking in $GA_3$ @ 200 ppm for 24 hrs. The lowest vigour indices (7,153.00 and 5,857.33, respectively) were recorded in the control. The superiority of $GA_3$ treatments can be attributed to improved germination, greater shoot elongation, and enhanced metabolic activity, which facilitated efficient utilization of food reserves (Brain & Homming, 1955; Pamapanna & Sulikeri, 1995). These results are consistent with earlier findings in aonla (Barathkumar, 2019), papaya (Ramteke, 2015), Indian gooseberry (Rinku *et al.,* 2019), tamarind (Manoli *et al.,* 2018), and khirni (Ratna *et al.,* 2018).

**Speed of germination:** The speed of germination was improved under $GA_3$ treatments, with $GA_3$ @ 400 ppm recording the maximum values (1.88 and 1.78 for fresh and aged seeds, respectively) compared to the control (0.78 and 0.61) as shown in table no.3. This suggests rapid and uniform germination in $GA_3$ -primed seeds. The faster germination under $GA_3$ treatment may be attributed to its role in stimulating hydrolytic enzyme activity, particularly amylases, which accelerate the breakdown of stored food reserves into simpler forms readily utilized by the embryo. In addition, $GA_3$ enhances cell elongation and reduces mechanical resistance of seed coverings, thereby promoting quicker radicle protrusion and uniform seedling emergence.

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% $H_2SO_4$ treatment (Quick Dip) | 149.33 | 88.00 | 8,274.33 | 5,937.67 | 1.73 | 1.61 |
| 20% $H_2SO_4$treatment (Quick Dip) | 165.00 | 91.33 | 9,838.33 | 6,226.33 | 1.84 | 1.57 |
| Soaking in $GA_3$ @ 200 ppm for 24 hrs | 203.00 | 103.67 | 11,615.33 | 7,376.33 | 1.86 | 1.75 |
| Soaking in $GA_3$ @ 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 |
| **C.D. at 5%** | 6.53 | 2.66 | 376.41 | 104.52 | 0.03 | 0.03 |

## 4. CONCLUSION

The pre-sowing chemical scarification significantly enhanced germination, seedling growth, and vigour in both fresh and one-year-old guava (*Psidium guajava* L.) seeds. Gibberellic acid ($GA_3$ ) at 400 ppm for 24 hours emerged as the most effective treatment, promoting the highest germination percentage, earliest emergence, greatest seedling survival, and superior vigour indices. The treatments with $GA_3$ at 200 ppm and thiourea at 1000 ppm also improved seed performance, though to a lesser extent. These results underscore the efficacy of $GA_3$ (400 ppm) as a practical intervention for optimizing seedling establishment in guava nurseries.

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