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IMPACT OF PRE-SOWING SEED TREATMENTS ON GERMINATION AND SHOOT PARAMETERS OF GUAVA (*PSIDIUM GUAJAVA* L.)

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ABSTRACT

A field experiment was conducted to study the impact of pre-sowing seed treatments on guava germination and seedling development (*Psidium guajava* L.). The study comprised fifteen treatments, such as soaking in GA_3 (100–300 ppm), thiourea, HCl, H_2SO_4, cow urine, Bijamrut, and an untreated control. The findings showed significant variations across treatments for every parameter studied. Among them, soaking seeds in GA_3 200 ppm for 12 hours (T_4) resulted in the earliest germination (16.02 days) and the highest germination percentage (85.04%). This treatment also produced the maximum seedling height (49.44 cm), stem diameter (3.75 mm), number of leaves (24.56), leaf area (26.46 cm²), and both fresh and dry biomass. The control treatment (T_{15}) recorded the lowest values across all parameters. These findings show that guava seed germination and seedling vigor are greatly increased by GA_3 at 200 ppm for 12 hours, and it can be recommended for successful nursery-level propagation.

***Keywords*:** Guava, seed, germination, pre-sowing treatments, GA_3.

Introduction

Guava (*Psidium guajava* L.) is a small tree indigenous to tropical America, specifically ranging from Mexico to Peru. It is an evergreen tree or shrub with spreading, square branches that grows slowly. Guavas, which belong to the Myrtaceae family, are an important fruit in India's tropical and subtropical zones. Known as the "apple of the tropics" and the "common man's apple" because of its low cost, guava is prized for its remarkable nutritional qualities (Dhara *et al.*, 2017).

India is one of the leading producers of guava globally, with substantial cultivation occurring in several states. The country produces a significant portion of the world's guava, with an estimated annual production of around 4.7 million tons (Anonymous, 2023). India is the world's top producer of guava, and the crop is important to the nation's fruit economy. In 2022–2023, 4,516 thousand metric tons of guava were produced on 307 thousand hectares of guava cultivation in India. In addition to Madhya Pradesh, Bihar, Andhra Pradesh, Haryana, Punjab, West Bengal, Chhattisgarh, Gujarat, Karnataka, and Maharashtra, Uttar Pradesh is a major producer of guavas. High-quality guava is especially well-known in the Uttar Pradesh region of Allahabad. Guava is rich in vitamin C, pectin, phosphorus, and calcium. The vitamin C

(ascorbic acid) content ranges from 75 to 260 mg per 100 grams of pulp, while pectin content varies between 0.5% and 1.8%. In addition to ascorbic acid and pectin, guava fruits are also good sources of vitamin A, thiamine (B_1), and riboflavin (B_2).

Propagation of guava is typically achieved through methods such as stooling, inarching, veneer grafting, patch and shield budding, and air layering, all of which facilitate rapid multiplication. The yield and quality of the fruit produced are directly correlated with the quality of the planting material (Singh *et al.,* 2011). The lack of suitable rootstocks makes it difficult to find high-quality planting material, which is a significant obstacle when starting guava orchards. The limitations of vegetative propagation techniques also become more apparent as high-density, ultra-high-density, and meadow orchard systems are adopted more frequently. The main method for developing an orchard framework in guava is softwood grafting, which emphasizes the significance of high-quality rootstocks. The lack of a taproot system makes air layering difficult, despite its benefits.

The hard seed coat of guava seeds, which is impermeable to gases and water, frequently causes a delay in germination (Banyal *et al.,* 2022). For the production of rootstock, seed propagation is especially crucial. As a result, methods that reduce the germination time and enhance the guava seeds' ability to germinate through different pre-sowing treatments must be developed.

Material and Method

The experiment was conducted during 2023–2024 at Dr. B.R. Ambedkar University of Social Sciences, Mhow, Indore, situated on the Malwa Plateau in western Madhya Pradesh. The study aimed to evaluate the impact of pre-sowing seed treatments on reducing the germination period and enhancing the germination capability of guava seeds.

The experiment was laid out in a Randomized Block Design (RBD) with fifteen treatments and three replications. Fifteen treatments combination are given T_1: Soaking of seeds in tap water for 12 hrs; T_2: Soaking of seeds in hot water (70°C) for 10 min T_3: Soaking of seeds in GA_3 100 ppm for 12 hrs; T_4: Soaking of seeds in GA_3 200 ppm for 12 hrs.; T_5: Soaking of seeds in GA_3 300 ppm for 12 hrs; T_6: Soaking of seeds in Thiourea 3000 ppm for 12 hrs; T_7: Soaking of seeds in Thiourea 4000 ppm for 12 hrs; T_8: Soaking of seeds in 2.5 % HCl for 3 min; T_9: Soaking of seeds in 5.0 % HCl for 3 min; T_{10} :Soaking of seeds in 2.5 % Sulphuric acid for 3 min; T_{11}: Soaking of seeds in 5.0 % Sulphuric acid for 3 min; T12: Soaking of seeds in 2 % Cow dung slurry for 12 hrs; T_{13}: Soaking of seeds in 2 % Cow urine for 12 hrs; T_{14}: Soaking of seeds in 5 % Bijamrut for 12 hrs; T_{15} Control (without pre-sowing seed treatment). Preparation of different chemical and organic solutions, including GA_3 (100 ppm, 200 ppm, and 300 ppm), Thiourea (3000 ppm and 4000 ppm), HCl, H_2SO_4, tap water, hot water, cow urine, Bijamrut, and cow dung slurry, was carried out for the respective seed treatments. The data collected on various observations during the course of the study were statistically analyzed using the method suggested by Panse and Sukhatme (1995). Mean values were used for comparison and interpretation of the results.

Result and Discussion

Germination Parameters

Table 1 displays the data on the number of days needed for guava seed germination, which showed a considerable difference between the various pre-sowing seed treatments. Starting 15 days after seeding, germination lasted for up to 75 days. Soaking of seeds in GA_3 200 ppm for 12 hrs was recorded early seed germination than any other seeds treatment. This might be due to exogenous application of GA_3 might have increased endogenous content of gibberellins besides, antagonizes the effect of germination inhibitors increased the endogenous gibberellin like substances. A similar result was also reported by Suryakanth *et al*. (2005) and Kalyani *et al*. (2014), Boricha *et al.* (2020) in guava seeds.

The highest germination percentage (85.04%) was observed in T_4 (soaking in GA_3 200 ppm for 12 hours). The lowest germination percentage (45.04%) was recorded in T_9 (soaking in 5% HCl for 3 minutes), indicating that pre-sowing treatments had a significant effect on guava seed germination. The increased germination percentage in gibberellic acid treated seeds might be due to its participation in the synthesis of enzymes like alpha-amylase, which converts starch into simple sugars during the process of germination. These sugars provide energy required for various metabolic processes associated with seed germination. A similar finding was also reported by Suryakanth *et al.* (2005), Kalyani *et al.* (2014), Dinesh *et al.* (2019) and Boricha *et al.* (2020) in guava seeds, Pandit *et al.* (2001), Deb *et al.* (2010), Dhinesh Babu *et al.* (2010), Barche *et al*. (2010) in papaya.

Growth Parameters

The different pre sowing treatments exerted a significant influence on seedling height, stem diameter and number of leaves per seedling as showed in Table 2. The highest seedling height at 60, 90, 120 and 150 days after sowing (DAS) *i.e.* 7.58, 14.93, 27.06 and 49.44 cm respectively was recorded in T_4 (soaking in GA_3 200 ppm for 12 hours), while the lowest *i.e.* 4.71, 8.43, 12.88 and 26.63 cm respectively was noted in T_{15} Control (without pre-sowing seed treatment). The maximum seedling height in GA_3 treated seeds may be attributed to the cell multiplication and elongation in the cambium tissue of the internodal region, because of GA_3 apparently activates the metabolic processes or nullifies the effect of growth inhibitors. The observations are in agreement with the findings of, Suryakanth *et al*. (2005), Dinesh et *al*. (2019) and Boricha *et al*. (2020) in guava, in ber, Gurung *et al*. (2014) in passion fruit, Pandit *et al.* (2001), Deb *et al.* (2010), Barche *et al.* (2010). The maximum stem diameter at 60, 90, 120 and 150 days after sowing (DAS) *i.e.* 1.01, 2.58, 2.89 and 3.75 mm respectively was also recorded in T_4 (soaking in GA_3 200 ppm for 12 hours), while the minimum 0.50, 0.64, 1.80 and 2.40 mm respectively was observed in T_{15} control (without pre-sowing seed treatment). The maximum stem diameter in case of seedlings pre-soaked in GA_3 200 ppm for 12 hrs solution seeds might be due to the fact that it plays a vital role in stimulation of cambium and its immediate cell progeny resulted in cell elongation and cell division of stem portion there by increased stem diameter. Similar result was expressed by Dinesh *et al*. (2019), Boricha *et al*. (2020) in guava, Deb *et al*. (2010) and Barche *et al*. (2010) in papaya.

Regarding leaf production, the maximum number of leaves per seedling at 60, 90, 120 and 150 days after sowing (DAS) *i.e.* 8.56, 16.21, 18.80 and 24.56 was respectively recorded in T_4 (soaking in GA_3 200 ppm for 12 hours), whereas the minimum 5.08, 7.89, 11.65 and 14.76 respectively was observed in T_{15} control (without pre-sowing seed treatment). This might be due to its activity at apical meristem resulting in more synthesis of nucleoprotein responsible for increasing leaf initiation and leaf expansion (Sen and Gunthi, 1976). Similar effect of GA_3 treatment on number of leaves per seedling was also reported by Boricha *et al*. (2020) in guava, Pandit *et al.* (2001), Deb *et al*. (2010) and Barche *et al.* (2010) in papaya. Leaf area was also significantly influenced by the treatments, The maximum leaf area (26.46 cm^2) was recorded in treatment T_4 (soaking in GA_3 200 ppm for 12 hours) while the minimum leaf area (17.77 cm^2) was recorded in the treatment T_{15} (control-without pre-sowing seed). The maximum leaf area found in seedlings treated with GA_3 200 ppm for 12 hrs prior to sowing might be due to the enhanced leaf growth by increasing cell multiplication and cell elongation. Similar effect of GA_3 treatment on leaf area of seedling was also reported by Barche *et al*. (2010) in papaya, Bajaniya *et al*. (2018) in khirni.

The fresh shoot weight was highest in T_4 (soaking in GA_3 200 ppm for 12 hours) (14.22 g) and lowest in T_{15} control (without pre-sowing seed treatment) (7.91 g). This was might be due to fact, gibberellic acid seed treatment can be attributed to increase plant height, number of leaves, leaf area and stem diameter which causes rapid growth of plant which reflect into maximum fresh shoot weight of seedlings. The results are conformity with Boricha *et al*. (2020) in guava, Gurung *et al.* (2014) in passion fruit. The maximum dry shoot weight (4.93 g) was also recorded in T_4 (soaking in GA_3 200 ppm for 12 hours), while T_{15} control (without pre-sowing seed treatment) recorded the minimum (2.83 g). This was might be due to fact that, gibberellic acid seed treatment can be attributed to maximum fresh shoot weight and which ultimately results in maximum dry weight of shoots. The results are conformity with Boricha *et al*. (2020) in guava, Gawade (2008) in custard apple, Gurung *et al*. (2014) in passion fruit.

Conclusion

On the basis of experimental findings, it can be concluded that among the various pre-sowing seed treatments, soaking guava seeds in GA_3 at 200 ppm for 12 hours (T_4) proved to be the most effective. This treatment resulted in the minimum number of days required for germination, the highest germination percentage, and significantly improved subsequent growth parameters such as seedling height, stem diameter, number of leaves, leaf area and shoot development.

Table 1: Impact of pre-sowing seed treatments on germination percentage (%), days required for germination, Fresh weight of shoot (g) and Dry shoots weight (g) and Leaf area (cm^2)

Treatment details		Germination percentage (%)	Days required for germination	Fresh weight of shoot (g)	Dry shoots weight (g)	Leaf area (cm^2)
T_1	Soaking of seeds in tap water for 12 hrs.	57.54	21.73	9.91	20.87	3.49
T_2	Soaking of seeds in hot water (70°C) for 10 min.	57.04	22.23	9.67	20.72	3.41
T_3	Soaking of seeds in GA_3 100 ppm for 12 hrs.	82.04	17.21	13.47	25.32	4.71
T_4	Soaking of seeds in GA_3 200 ppm for 12 hrs.	85.04	16.02	14.22	26.46	4.93
T_5	Soaking of seeds in GA_3 300 ppm for 12 hrs.	82.54	16.45	13.39	24.77	4.65
T_6	Soaking of seeds in Thiourea 3000 ppm for 12 hrs.	58.04	21.23	10.09	22.36	3.55
T_7	Soaking of seeds in Thiourea 4000 ppm for 12 hrs.	60.04	19.11	10.28	22.50	3.62
T_8	Soaking of seeds in 2.5 % HCl for 3 min.	50.04	23.13	9.23	19.35	3.27
T_9	Soaking of seeds in 5 % HCl for 3 min.	45.04	24.23	8.89	18.75	3.15
T_{10}	Soaking of seeds in 2.5 % Sulphuric acid for 3 min.	55.54	22.73	9.62	22.07	3.40
T_{11}	Soaking of seeds in 5 % Sulphuric acid for 3 min.	50.54	23.11	9.53	20.22	3.37
T_{12}	Soaking of seeds in 2 % Cow dung slurry for 12 hrs.	81.04	18.73	11.71	23.59	4.09
T_{13}	Soaking of seeds in 2 % Cow urine for 12 hrs.	63.04	19.13	10.62	23.10	3.73
T_{14}	Soaking of seeds in 5 % Bijamrut for 12 hrs.	66.04	18.46	11.93	24.57	4.17
T_{15}	Control (without pre-sowing seed treatment).	52.54	27.71	7.91	17.77	2.83
	SE.m±	**2.75**	**0.97**	**0.09**	**0.71**	**0.08**
	CD (P=0.05)	**7.71**	**2.71**	**0.25**	**1.98**	**0.22**

Table 2: Impact of pre-sowing seed treatments on height of the seedling (cm), stem diameter(mm) and number of leaves/seedling

Treatment details		Height of the seedling (cm)				Stem diameter (mm)				Number of leaves/seedling			
		Days after sowing				Days after sowing				Days after sowing			
		60	90	120	150	60	90	120	150	60	90	120	150
T_1	Soaking of seeds in tap water for 12 hrs.	5.56	9.95	16.27	36.12	0.59	1.59	1.91	2.63	6.10	9.86	15.67	18.53
T_2	Soaking of seeds in hot water (70°C) for 10 min.	5.42	9.70	15.44	35.02	0.57	1.58	1.90	2.59	5.82	9.64	14.76	18.12
T_3	Soaking of seeds in GA_3 100 ppm for 12 hrs.	7.09	14.70	25.64	46.15	0.98	2.33	2.73	3.65	8.50	15.03	18.72	22.79
T_4	Soaking of seeds in GA_3 200 ppm for 12 hrs.	7.58	14.93	27.06	49.44	1.01	2.58	2.89	3.75	8.56	16.21	18.80	24.56
T_5	Soaking of seeds in GA_3 300 ppm for 12 hrs.	6.25	14.23	24.78	44.45	0.96	2.63	2.66	3.60	7.93	14.72	17.85	22.33
T_6	Soaking of seeds in Thiourea 3000 ppm for 12 hrs.	5.23	9.81	20.68	34.72	0.60	1.65	1.88	2.83	6.22	9.55	13.97	18.73
T_7	Soaking of seeds in Thiourea 4000 ppm for 12 hrs.	5.84	10.28	21.62	39.32	0.60	1.64	1.93	2.91	6.56	9.95	16.47	19.82
T_8	Soaking of seeds in 2.5 % HCl for 3 min.	4.98	9.34	14.27	28.66	0.53	1.36	1.85	2.51	5.32	8.60	13.67	16.57
T_9	Soaking of seeds in 5 % HCl for 3 min.	4.86	8.79	13.53	28.14	0.52	1.07	1.82	2.46	5.24	8.51	12.72	16.36
T_{10}	Soaking of seeds in 2.5 % Sulphuric acid for 3 min.	5.09	9.27	14.56	30.76	0.56	1.56	1.88	2.56	5.65	9.48	14.59	17.06
T_{11}	Soaking of seeds in 5 % Sulphuric acid for 3 min.	5.04	9.21	14.34	30.57	0.55	1.53	1.87	2.54	5.52	9.30	14.52	16.90
T_{12}	Soaking of seeds in 2 % Cow dung slurry for 12 hrs.	6.06	13.54	24.65	42.66	0.63	2.21	2.39	2.88	7.46	12.86	17.28	20.58
T_{13}	Soaking of seeds in 2 % Cow urine for 12 hrs.	6.00	11.43	24.25	41.06	0.64	1.76	2.16	3.09	7.23	12.52	17.22	20.32
T_{14}	Soaking of seeds in 5 % Bijamrut for 12 hrs.	6.07	13.57	24.89	42.99	0.68	2.25	2.58	3.26	7.68	13.81	17.41	21.03
T_{15}	Control (without pre-sowing seed treatment).	4.71	8.43	12.88	26.63	0.50	0.64	1.80	2.40	5.08	7.89	11.65	14.76
	SE.m±	**0.36**	**0.47**	**0.79**	**1.02**	**0.06**	**0.13**	**0.09**	**0.18**	**0.18**	**0.39**	**0.51**	**0.69**
	CD (P=0.05)	**1.01**	**1.31**	**2.12**	**2.85**	**0.16**	**0.36**	**0.25**	**0.51**	**0.51**	**1.09**	**1.42**	**1.93**

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