*Indian J. Agric. Res.*, **47** (4) : 347 - 352, 2013

AGRICULTURAL RESEARCH COMMUNICATION CENTRE
www.arccjournals.com / indianjournals.com

# STUDIES ON THE SEED GERMINATION AND SUBSEQUENT SEEDLING GROWTH OF GUAVA (*PSIDIUM GUAJAVA* L.)

**Manoj Brijwal* and Rajesh Kumar**

Department of Horticulture, College of Agriculture,
G.B. Pant University of Agriculture and Technology, Pantnagar-263 145, India

Received: 21-07-2012 Accepted: 13-12-2012

## ABSTRACT

**The present study was carried out to investigate the effect of pre-sowing treatments and environments on seed germination and seedling growth of guava (*Psidium guajava* L.). The study revealed that pre-soaking of guava seeds in hydrochloric acid (10%) for 2 minutes resulted in maximum seed germination percentage (54.16%). Scraping of seed coat with sand paper + soaking seeds in $GA_3$ 50 ppm for 24 hours has enhanced the seedling height (14.02 cm), stem girth (0.26 cm), number of leaves per seedling (15.24) and leaf area (3.38 $cm^2$) while highest root length (6.56 cm) of seedlings were found in scraping of seed coat with sand paper + soaking seeds in $GA_3$ 100 ppm for 24 hours. All the germination and growth parameters were found to be the best in protected environment (*viz.*, polyhouse) as compared to open field condition. Sowing of seeds without pre-sowing treatments showed poor results for all parameters.**

**Key words:** Environment, Guava, Pre-sowing, Seed germination.

## INTRODUCTION

Guava (*Psidium guajava* L.), a member of family Myrtaceae, is an important fruit of tropical and sub-tropical regions of India. Guava occupies an area of 219.7 thousand hectares in India with approximate production of 2572 thousand metric tonnes (Anonymous, 2010). Uttar Pradesh ranked first in area (39.9 thousand hectares) and production (486.7 thousand metric tonnes), however, maximum productivity (29 metric tonnes per hectares) was recorded in Madhya Pradesh.

As the area under guava increasing day by day, the demand of budded and grafted plants also increasing but this demand is not fulfilled because of unavailability of superior seedling rootstocks which might be due to poor seed germination and seedling growth. Guava seeds germinate poorly and unevenly and require more time for seedling emergence (Doijode, 2001 S.D. Doijode, Guava: *Psidium guajava* L.. In: S.D. Doijode, Editor, *Seed Storage of Horticultural Crops*, Haworth Press, New York (2001), pp. 65–67.Doijode, 2001). The dormancy in seeds might be due to hard seed coat and impermeability to water and gases. Different methods like water soaking, scarification and chemical treatments are used for breaking dormancy in seeds to improve germination and seedling growth. Hence the present studies were undertaken to standardize the pre-sowing treatments for raising seedling rootstocks of guava.

## MATERIALS AND METHODS

The present investigation was carried out at Horticultural Research Centre (HRC), Patharchatta, Department of Horticulture, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Uttarakhand in the year 2011-12. The experiment was laid out in two factorial randomized block design (RBD), with twelve treatments *viz.* soaking seeds in tap water for 24 hours ($T_1$), soaking seeds in tap water for 48 hours ($T_2$), scraping of seed coat with sand paper ($T_3$), scraping of seed coat with sand paper + soaking seeds in $GA_3$ 50 ppm for 24 hours ($T_4$), scraping of seed coat with sand paper + soaking seeds in $GA_3$ 100 ppm for 24 hours ($T_5$), soaking seeds in 5% hydrochloric acid for 2 minutes ($T_6$), soaking seeds in 10% hydrochloric acid for 2 minutes ($T_7$), soaking seeds in 5% sulphuric acid for 2 minutes ($T_8$), soaking seeds in 10% sulphuric

*Corresponding author's email: manoj.brijwal@gmail.com

acid for 2 minutes ($T_9$), soaking seeds in 0.1 % potassium hydroxide for 2 minutes ($T_{10}$), soaking seeds in 0.2 % potassium hydroxide for 2 minutes ($T_{11}$) and without pre-sowing treatments ($T_{12}$). Each treatment was replicated thrice in both the environments [*viz.*, open field ($E_1$) and polyhouse ($E_2$)]. The seeds which sank were used for sowing and rest were discarded. Hundred seeds per replication were sown on nursery beds in both open field and polyhouse. After sowing, the beds were covered with dry grasses, till the germination started light irrigation was provided in the morning and evening every day. The dry grasses were removed after germination. Observation on seed germination percentage was recorded on 45$^{th}$ days after sowing when the germination completely ceased and germination was expressed in percentage. After germination, five seedlings were selected at random from each replication and the observations on seedling height (cm) and root length (cm) were measured with the ruler, stem girth (cm) was recorded with Digital Vernier Callipers, number of leaves per seedlings was recorded by counting the total number of fully developed leaves and leaf area ($cm^2$) was recorded with the help of leaf area meter at 120 days after transplanting.

## RESULTS AND DISCUSSION

**Seed germination percentage:** The data on seed germination percentage revealed that different pre-sowing treatments, environments and their interaction significantly affected the seed germination percentage of guava (Table 1). Among the pre-sowing treatments, the maximum germination percentage (56.00%) at 45 days after sowing in polyhouse was recorded in seeds treated with 10% hydrochloric acid for 2 minutes ($T_7E_2$) followed by (50.33%) in scraping of seed coat with sand paper ($T_3E_2$) both of which were significantly superior to other treatments. The minimum germination percentage (19.66%) was recorded in soaking seeds in tap water for 24 hours ($T_1E_2$). In open field, significantly the maximum germination percentage (52.33%) at 45 days after sowing was recorded in the seeds treated with 10% hydrochloric acid for 2 minutes ($T_7E_1$) followed by (43.66%) in 0.1% potassium hydroxide for 2 minutes ($T_{10}E_1$) and the minimum germination percentage (23.66%) was recorded in without pre-sowing treatments ($T_{12}E_1$). Environment conditions were found to influence the seed germination percentage of guava. Seeds sown in polyhouse gave higher (36.00%) germination percentage than the seeds sown in open field (33.94%). The interaction between pre-sowing treatments and environment conditions [*viz.*, open field ($E_1$) and polyhouse ($E_2$)] showed a significant effect on seed germination percentage of guava. The maximum germination percentage (54.16%) was noticed in the seeds treated with 10% hydrochloric acid for 2 minutes ($T_7$) and the minimum germination percentage (23.50%) was recorded in without pre-sowing treatments ($T_{12}$) in polyhouse. This was possibly due to stimulating effect of acid scarification brings about the softening of hard seed coat by dissolution of deposited lipids, pectic substances and high density waxes which are responsible for hard seededness. This in turn makes the seed permeable to water and gases and induces germination (Denny, 1917). These results are in close conformity with the finding of Singh and Soni (1974) who reported that soaking of seeds of cultivar Allahabad Safeda in hydrochloric acid, sulphuric acid and nitric acid for 2-3 minutes improved the germination counts over control.

**Seedling height:** It is apparent from the data presented in Table 1 that pre-sowing treatments, environments and their interaction had non-significant effect on seedling height. In polyhouse the maximum seedling height (17.94 cm) was found in scraping of seed coat with sand paper + soaking seeds in $GA_3$ 50 ppm for 24 hours ($T_4E_2$) and minimum seedling height (10.59 cm) was recorded in without pre-sowing treatments ($T_{12}E_2$) while in open field the maximum seedling height (10.09 cm) was found in scraping of seed coat with sand paper + soaking seeds in $GA_3$ 50 ppm for 24 hours ($T_4E_1$) and minimum seedling height (cm) was recorded in without pre-sowing treatments ($T_{12}E_1$) after 120 days of transplanting. These results are in agreement with the findings of Biradar *et al.* (2005) in guava. The maximum seedling height with $GA_3$ pre-soaking treatment of seeds may be attributed to the cell multiplication and elongation in the cambium tissue of the internodal region, because $GA_3$ apparently activates the metabolic processes or nullifies the effect of an inhibitor of growth (Singh *et al.*, 1989).

**Stem girth:** Data presented in Table 1 showed that different pre-sowing treatments had a significant effect on stem girth of guava seedlings but the environment and interaction effect did not differ

TABLE 1: Effect of pre-sowing treatments and environments on seed germination percentage, seedling height and stem girth of guava seedlings.

| Treatments | Seed germination percentage | | | Seedling height (cm) | | | Stem girth (cm) of seedlings | | |
|---|---|---|---|---|---|---|---|---|---|
| | After 45 days of sowing | | | After 120 days of transplanting | | | After 120 days of transplanting | | |
| | Open ($E_1$) | Poly house ($E_2$) | Mean | Open ($E_1$) | Poly house ($E_2$) | Mean | Open ($E_1$) | Poly house ($E_2$) | Mean |
| $T_1$ ( Seeds soaking in tap water for 24 hours) | 38.00 | 19.66 | 28.83 | 9.64 | 13.93 | 11.79 | 0.19 | 0.25 | 0.22 |
| $T_2$ ( Seeds soaking in tap water for 48 hours) | 24.00 | 32.33 | 28.16 | 8.22 | 14.37 | 11.29 | 0.19 | 0.28 | 0.23 |
| $T_3$ (Scraping of seed coat with sand paper) | 36.33 | 50.33 | 43.33 | 9.20 | 14.78 | 11.99 | 0.13 | 0.24 | 0.18 |
| $T_4$ (Scraping of seed coat with sand paper + Soaking seeds in $GA_3$ 50 ppm for 24 hours) | 34.33 | 30.33 | 32.33 | 10.09 | 17.94 | 14.02 | 0.21 | 0.32 | 0.26 |
| $T_5$ (Scraping of seed coat with sand paper + Soaking seeds in $GA_3$ 100 ppm for 24 hours ) | 24.00 | 24.00 | 24.00 | 8.82 | 16.89 | 12.85 | 0.17 | 0.27 | 0.22 |
| $T_6$ (5% Hydrochloric acid for 2 minutes) | 37.33 | 40.66 | 39.00 | 8.80 | 12.91 | 10.85 | 0.14 | 0.22 | 0.18 |
| $T_7$ (10% Hydrochloric acid for 2 minutes) | 52.33 | 56.00 | 54.16 | 8.81 | 15.93 | 12.37 | 0.19 | 0.26 | 0.22 |
| $T_8$ (5% Sulphuric acid for 2 minutes) | 31.33 | 39.00 | 35.16 | 7.80 | 13.37 | 10.58 | 0.17 | 0.25 | 0.21 |
| $T_9$ (10% Sulphuric acid for 2 minutes) | 34.66 | 39.33 | 37.00 | 9.76 | 13.16 | 11.46 | 0.17 | 0.22 | 0.19 |
| $T_{10}$ (0.1 % Potassium Hydroxide for 2 minutes) | 43.66 | 34.33 | 39.00 | 9.42 | 16.00 | 12.71 | 0.19 | 0.27 | 0.23 |
| $T_{11}$ (0.2 % Potassium Hydroxide for 2 minutes) | 27.66 | 42.66 | 35.16 | 9.30 | 13.80 | 11.55 | 0.19 | 0.24 | 0.21 |
| $T_{12}$ ( without pre-sowing treatments) | 23.66 | 23.33 | 23.50 | 7.06 | 10.59 | 8.83 | 0.12 | 0.21 | 0.16 |
| Mean | 33.94 | 36.00 | 34.97 | 8.91 | 14.47 | 11.69 | 0.17 | 0.25 | 0.21 |
| | Env. (E) | Treat. (T) | E×T | Env. (E) | Treat. (T) | E×T | Env. (E) | Treat. (T) | E×T |
| C.D. at 5% | 2.95 | 7.24 | 10.24 | NS | NS | NS | NS | 0.03 | NS |
| S.Em.± | 1.03 | 2.54 | 3.59 | 0.45 | 1.10 | 1.56 | 0.004 | 0.010 | 0.015 |

significantly. Among the pre-sowing treatments, the maximum stem girth (0.32 cm) in polyhouse was observed in scraping of seed coat with sand paper + soaking seeds in $GA_3$ 50 ppm for 24 hours ($T_4E_2$). The without pre-sowing treatments ($T_{12}E_2$) recorded minimum stem girth (0.21 cm), whereas, in open field the maximum stem girth (0.21 cm) was recorded in scraping of seed coat with sand paper + soaking seeds in $GA_3$ 50 ppm for 24 hours ($T_4E_1$) and the minimum (0.12 cm) stem girth was observed in without pre-sowing treatments ($T_{12}E_1$) after 120 days of transplanting. The maximum stem girth in case of seedlings obtained from $GA_3$ pre-soaked seeds might be due to the fact that $GA_3$ application enhanced the rate of cell division and elongation of stem portion**.** Similar results of increased stem girth with $GA_3$ pre-sowing treatment were reported by Rashmi *et al*. (2007) also in Aonla.

**Number of leaves per seedling:** It is evident from the data presented in Table 2 that pre-sowing treatments had significant effect on number of leaves per seedling, but the environment and interaction effects did not differ significantly. The maximum number of leaves per seedlings (18.69) in polyhouse was observed in scraping of seed coat with sand paper + soaking seeds in $GA_3$ 50 ppm for 24 hours ($T_4E_2$) and the minimum (11.84) number of leaves per seedlings was observed in without pre-sowing treatments ($T_{12}E_2$). In open field, the maximum number of leaves per seedlings (11.79) was observed in scraping of seed coat with sand paper + soaking seeds in $GA_3$ 50 ppm for 24 hours ($T_4E_1$) and the minimum (7.40) number of leaves per seedlings was observed in without pre-sowing treatments ($T_{12}E_1$) after 120 days of transplanting. Similar results were also reported by Suryakanth *et al*. (2005) in guava. $GA_3$ moves into the shoot apex, increase cell division and cell growth apparently leading to increased development of young leaves (Salisbury and Ross, 1988). Therefore, the maximum number of leaves per seedlings in the present study with $GA_3$ may be due to the promotion of physiological processes and stimulatory action of $GA_3$ to form new leaves at a faster rate.

**Root length:** The effect of different pre-sowing treatments and environment on root length was found to be significant, but the interaction effect did not differ significantly (Table 2). The maximum root length (6.76 cm) at 120 days after transplanting in polyhouse was recorded in scraping of seed coat with sand paper + soaking seeds in $GA_3$ 100 ppm for 24 hours ($T_5E_2$). The minimum root length (3.92 cm) was observed in without pre-sowing treatments ($T_{12}E_2$) while in open field, the maximum root length (6.35 cm) at 120 days after transplanting was recorded in scraping of seed coat with sand paper + soaking seeds in $GA_3$ 100 ppm for 24 hours ($T_5E_1$) and the minimum root length (4.58 cm) was observed in without pre-sowing treatments ($T_{12}E_1$). Seeds sown in polyhouse gave maximum root length (5.95 cm) than the seeds sown in open field (5.41 cm). Among the interaction, the maximum root length (6.56 cm) was recorded in the scraping of seed coat with sand paper + soaking seeds in $GA_3$ 100 ppm for 24 hours ($T_5$) and the minimum root length (4.25 cm) was recorded in without pre-sowing treatments ($T_{12}$). Similar results of increased root growth with $GA_3$ pre-sowing treatment was also reported by Pampanna and Sulikeri (2001) in sapota cv. Kalipatti. In the present study the maximum root length in case of seedlings obtained from $GA_3$ pre-soaked seeds might be due to elongation of the cells in the sub-apical region of roots as also reported by Salisbury and Ross (1988).

**Leaf area:** Data presented in Table 2 show that different pre-sowing treatments had a significant effect on leaf area of guava seedlings but the environment and interactions effect did not differ significantly. The maximum leaf area (3.69 $cm^2$) at 120 days after transplanting in polyhouse was observed scraping of seed coat with sand paper + soaking seeds in $GA_3$ 50 ppm for 24 hours ($T_4E_2$) and the minimum leaf area (2.02 $cm^2$) was observed in without pre-sowing treatments ($T_{12}E_2$), whereas, in open field, the maximum leaf area (3.07 $cm^2$) at 120 days after transplanting was observed in scraping of seed coat with sand paper + soaking seeds in $GA_3$ 50 ppm for 24 hours ($T_4E_1$) followed by (3.06 $cm^2$) in seeds treated with 5% sulphuric acid for 2 minutes ($T_8E_1$) and the minimum leaf area (1.97 $cm^2$) was observed in without pre-sowing treatments ($T_{12}E_1$). Seeds sown in polyhouse gave maximum leaf area (2.98 $cm^2$) than the seeds sown in open field (2.55 $cm^2$). Among the interactions, the maximum leaf area (3.38 $cm^2$) was recorded in scraping of seed coat with sand paper + soaking

TABLE 2: Effect of pre-sowing treatments and environments on number of leaves per seedling, root length and leaf area of guava seedlings.

| Treatments | Number of leaves per seedling | | | Root length (cm) of seedlings | | | Leaf area ($cm^2$) of seedlings | | |
|---|---|---|---|---|---|---|---|---|---|
| | After 120 days of transplanting | | | After 120 days of transplanting | | | After 120 days of transplanting | | |
| | Open ($E_1$) | Poly house ($E_2$) | Mean | Open ($E_1$) | Poly house ($E_2$) | Mean | Open ($E_1$) | Poly house ($E_2$) | Mean |
| $T_1$ ( Soaking seeds in tap water for 24 hours) | 7.85 | 13.12 | 10.49 | 5.57 | 6.45 | 6.01 | 2.38 | 2.45 | 2.41 |
| $T_2$ ( Soaking seeds in tap water for 48 hours) | 9.18 | 17.07 | 13.12 | 5.35 | 5.79 | 5.57 | 2.49 | 2.71 | 2.60 |
| $T_3$ (Scraping of seed coat with sand paper) | 9.47 | 17.24 | 13.35 | 5.83 | 6.01 | 5.92 | 2.69 | 3.24 | 2.96 |
| $T_4$ (Scraping of seed coat with sand paper + Soaking seeds in $GA_3$ 50 ppm for 24 hours) | 11.79 | 18.69 | 15.24 | 5.16 | 6.59 | 5.88 | 3.07 | 3.69 | 3.38 |
| $T_5$ (Scraping of seed coat with sand paper + Soaking seeds in $GA_3$ 100 ppm for 24 hours ) | 8.48 | 15.97 | 12.23 | 6.35 | 6.76 | 6.56 | 2.18 | 2.72 | 2.45 |
| $T_6$ (5% Hydrochloric acid for 2 minutes) | 10.80 | 13.70 | 12.25 | 5.22 | 6.55 | 5.88 | 2.57 | 3.34 | 2.95 |
| $T_7$ (10% Hydrochloric acid for 2 minutes) | 9.00 | 15.58 | 12.29 | 5.53 | 6.49 | 6.01 | 2.76 | 3.29 | 3.02 |
| $T_8$ (5% Sulphuric acid for 2 minutes) | 8.03 | 17.64 | 12.84 | 5.33 | 6.00 | 5.67 | 3.06 | 3.22 | 3.14 |
| $T_9$ (10% Sulphuric acid for 2 minutes) | 8.18 | 12.69 | 10.43 | 5.02 | 5.34 | 5.18 | 2.98 | 3.09 | 3.04 |
| $T_{10}$ (0.1 % Potassium Hydroxide for 2 minutes) | 9.42 | 15.56 | 12.49 | 5.45 | 5.73 | 5.59 | 2.25 | 2.85 | 2.55 |
| $T_{11}$ (0.2 % Potassium Hydroxide for 2 minutes) | 7.50 | 13.82 | 10.66 | 5.55 | 5.73 | 5.64 | 2.26 | 3.11 | 2.68 |
| $T_{12}$ ( without pre-sowing treatments) | 7.40 | 11.84 | 9.62 | 4.58 | 3.92 | 4.25 | 1.97 | 2.02 | 1.99 |
| Mean | 8.92 | 15.24 | 12.08 | 5.41 | 5.95 | 5.68 | 2.55 | 2.98 | 2.77 |
| | Env. (E) | Treat. (T) | E×T | Env. (E) | Treat. (T) | E×T | Env. (E) | Treat. (T) | E×T |
| C.D. at 5% | NS | 2.45 | NS | 0.42 | 1.02 | NS | NS | 0.30 | NS |
| S.Em.± | 0.35 | 0.86 | 1.21 | 0.14 | 0.36 | 0.51 | 0.04 | 0.10 | 0.15 |

seeds in $GA_3$ 50 ppm for 24 hours ($T_4$) and the minimum leaf area (1.99 $cm^2$) was recorded in without pre-sowing treatments ($T_{12}$). The application of $GA_3$ might have boosted the leaf growth by increasing cell multiplication and cell elongation resulting in better leaf area. Similar results of increased leaf area with $GA_3$ pre-sowing treatment were reported by EI-Dengawy (2005) also in loquat.

## CONCLUSION

On the basis of experimental findings, it can be concluded that among the different pre-sowing treatments scraping of seed coat with sand paper + soaking seeds in $GA_3$ 50 ppm for 24 hours ($T_4$) was the most effective treatment for enhancing seedling height, stem girth, number of leaves per seedlings and leaf area. Acid scarification of guava seeds with 10% hydrochloric acid for 2 minutes ($T_7$) gave best results in respect of seed germination percentage. The germination and growth parameters were found best in protected environment (*viz.* polyhouse) as compared to open field conditions.

## REFERENCES

Anonymous, (2010). Indian Horticulture Database, National Horticulture Board, Ministry of Agriculture, Gov. of India.

Biradar, S., Mukund, G.K. and Raghavendra, G.C. (2005). Studies on seed germination in guava cvs. Taiwan guava and Allahabad Safeda. *Karnataka J. of Hort.*, **1**(3): 47-50.

Denny, E.E. (1917). Permetability of membranes as related to their composition. *Botanical Gazettee*, **63**, 468-485.

Doijode, S.D., (2001). Guava (*Psidium guajava* L.). *Seed Storage of Horticultural Crops*, **21**: 65–67.

El-Dengawy, R.F.A. (2005). Promotion of seed germination and subsequent seedling growth of loquat (*Eriobotrya japonica* L.) by moist-chilling and $GA_3$ applications. *Scientia Hort.*, **105**: 331-342.

Pampanna, Y., and Sulikeri, G.S. (2001). Effect of growth regulators on seed germination and seedling growth of Sapota. *Karnataka J. of Agri. Sci.*, **14**(4): 1030-1036.

Rashmi, K., Sindhu, S.S., Sehrawat, S.K. and Dudi, O.P. (2007). Germination studies in Aonla (*Emblica officinalis* G.). *Haryana J. Hort. Sci.*, **36**(1-2): 9-11.

Salisbury, F.B. and Ross, C.W. (1988). Plant Physiology. CBS Publishers and Distributors, Delhi, pp. 319-329.

Singh, M., Singh, G.N., Singh, L.N. and Singh, B.N. (1989). Effect of gibberellic acid on seed germination in Mosambi (*Citrus sinensis* Osbeck). *Haryana J. Hort. Sci.*, **18**: 29-33.

Singh, S. and Soni, S.L. (1974). Effect of water and acid soaking periods on seed germination in guava. *Punjab Hort. J.*, **14**(3-4): 122-124.

Suryakanth, L.B., Mukunda, G.K. and Raghavendraprasad, G.C. (2005). Studies on seed germination in guava cvs. Taiwan Guava and Allahabad Safeda. *Karnataka J. of Hort.*, **1**(3): 47-50.