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EFFECT OF SCARIFICATION TREATMENTS ON SEED GERMINATION OF GUAVA (*PSIDIUM GUAJAVA* L.) UNDER SOUTH-WESTERN REGION OF HARYANA

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KEYWORDS

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ABSTRACT

A field experiment was conducted to study effects of scarification treatments on seed germination of guava *(Psidium guajava* L.*)*. The objective of the study was to get maximum germination of guava seeds. Three scarification methods were used *i.e.* water soaking (for 24, 48 and 72 hours), hot water soaking (at 70, 80, 90 and 100ºC) and sulphuric acid soaking (at 10, 20, 30, 40 and 50 % dilution). Duration for hot water soaking and sulphuric acid soaking was kept as quick dip (5 seconds), 1 minute and 3 minutes. All these treatments significantly decreased days to emergence of seedling over control (25 days). Among the scarification methods and durations used, treatment of guava seeds with 20 per cent sulphuric acid for 3 minutes was judged best with maximum germination per cent (51.7 %), minimum days to emergence (11.7 days) and girth of seedlings (3.50 mm after 150 days of sowing). Seeds without any scarification treatment also showed poor germination (24.7 %). On the basis of the findings, it can be concluded that the scarification of guava seeds with 20% sulphuric acid would result in better seedling emergence and further development.

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INTRODUCTION

Guava (*Psidium guajava* L.) is one of the commonly grown and an important commercial fruits in India. In India guava cultivation commenced from 17th century and present ranks fourth in position after mango, banana and citrus in terms of area and production (Radha and Mathew, 2007). Guava occupies an area of 2.682 lakh hectares in India with annual production of 36.67 metric tonnes (Anonymous, 2014) with annual productivity of 13.7 metric tonnes/hectare. In recent past in Haryana, area (10700 hectares) and production (1.25 metric tonnes) of guava has increased substantially (Anonymous, 2014) which shows that farmers have shown an interest towards guava cultivation but have to cope with the shortage of quality propagational material. The 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). Besides, there is no standard scarification method for treatment of guava seeds. The dormancy in seeds might be due to hard seed coat and impermeability to water and gases. Different scarification methods like water soaking, acid scarification and chemical treatments are used for breaking dormancy in peach seeds to improve germination (Thakur and Singh, 2015). Soaking of seeds in water promotes germination by softening the hard seed coat, activating the enzymes and minimising the effects of inhibitors. Water soaking of seeds for 12 hours or in hydrochloric acid for 3 minutes gives about 90% germination (Haq *et al.,* 1973). Pandey and Singh (2000) reported 90% germination of seeds of cultivar Allahabad Safeda by soaking in water for 36 hours before sowing. Despite, the advances in use of scarification, a little is known about its usage in raising guava seedlings from seed. Hence the present research work was undertaken get acquainted with the different effects that scarification treatment brings in seed germination and vegetative parameters in guava.

MATERIALS AND METHODS

The experiment was conducted in Randomized Block Design during March-November, 2015 at the experimental orchard of the Department of Horticulture, CCS Haryana Agricultural University, Hisar. Hisar has a typical semi-arid climate with hot and dry summer and extremely cold winter. Guava seeds were collected from fully ripe fruits of L-49 variety. A total of 31 treatments replicated thrice were given to guava seeds and they were sown in nursery under uniform agronomic conditions. 100 seeds per treatments were used. Details of treatments are given below-

A. Hot water soaking

70ºC

80ºC

90ºC

100ºC

B. Sulfuric acid soaking

10% solution

20% solution

30% solution

40% solution

50% solution

Note: Duration of each of the above treatments under A and B was kept as quick dip (5 seconds), 1 minute and 3 minutes.

C. Water soaking (24, 48 and 72 hours)

D. Control (untreated)

Seed viability (%) was calculated in laboratory by soaking twenty five seeds of each treatment replicated thrice in 50 ml water for 16 hours at 25ºC to activate dehydrogenase enzymes (ISTA, 2001). After longitudinal sectioning of seeds with sharp blade, the seeds were stained in 0.01% tetrazolium solution (2,3,5-triphenyl tetrazolium chloride) for 5 hours at 38ºC, in petri plates. After that solution was poured off and seeds were washed in tap water and examined under magnifying glass. The completely red stained seeds were considered as normal viable seeds and expressed in percentage. Statistical analysis of data collected during the study was done by applying the technique of analysis of variance (ANOVA) as suggested by Gomez and Gomez (1984) and Panse and Sukhatme (1961). All the statistical analysis was carried out by using OPSTAT statistical software.

RESULTS

Seed viability (%)

The data regarding effect of different scarification treatments on seed viability of guava is given in Table 1. The results indicate that under different scarification treatments, seed viability of guava in laboratory was significantly influenced and it ranged from 31.1 to 65.6 per cent. The maximum seed viability (82.7 %) was recorded with control treatment that was statistically at par with 24 hours soaking in water and quick dip in 70^{0}C hot water treatment (77.3 %). Except these two treatments, seed viability decreased significantly as compared to control treatment. The minimum seed viability (26.7 %) was recorded when seeds were soaked in 50 per cent sulphuric acid solution for 3 minute.

Germination (%)

The data on seed germination percentage presented in table 1 reveals that different scarification treatments significantly affected the seed germination percentage of guava in nursery.

The germination per cent varies from 14.7 and goes up to 51.7 per cent. The maximum germination (51.7 %) was recorded with 3 minute soaking in 20 per cent sulphuric acid that was statistically at par with quick dip and 1 minute soaking in 30 per cent sulphuric acid (50.3 and 51.3 %, respectively).The minimum germination (14.7 %) was reported with 3 minute soaking in 50 per cent sulphuric acid solution. Results showed that water soaking of seeds (24, 48 and 72 hours) increased the germination per cent as compared to control treatment. Similarly, quick dip and soaking of guava seeds in 70^{0}C, 80^{0}C, 90^{0}C and 100^{0}C hot water also significantly increased the germination per cent except 3 minutes soaking in 100^{0}C hot water where it decreased non-significantly. Quick dip and soaking of seeds in10, 20 and 30 per cent sulphuric acid solution significantly improved the germination per cent of guava seeds over control. Quick dip in 40 per cent sulphuric acid solution significantly increased the germination per cent, while, 1 minute soaking non-significantly decreased it as compared to control treatment. 40 per cent (3 minutes) and 50 per cent (quick dip, 1and 3 minutes) sulphuric acid solution soaking significantly decreased the germination per cent as compared to control treatment.

Days to emergence of seedlings

It is apparent from the data presented in Table 1 that all scarification treatments significantly reduced the days to emergence of guava seedlings as compared to control. The emergence of guava seedlings ranged from 11.7 to 25.0 days under different treatments. The minimum days of emergence (11.7 days) was reported with 3 minute soaking in 20 per cent sulphuric acid solution that was statistically at par with quick dip in 90^{0}C hot water, quick dip, 1 and 3 minutes soaking in 30 per cent sulphuric acid(12.3,12.0, 12.3 and 12.3 days, respectively). The control treatment took maximum days for emergence of seedlings (25.0 days).

Girth of seedling

Data depicted in Figure 1 shows that different scarification treatments had a significant effect on stem girth of guava seedlings at different days after sowing. Girth of seedlings at 150 DAS ranged from 1.56 to 3.50 mm under different scarification treatments. The minimum girth of seedlings (1.56 mm) was reported with treatment of 3 minute soaking in 50 per cent sulphuric acid solution. The maximum girth of seedlings (3.50 mm) was recorded with 3 minute soaking in 20 per cent sulphuric acid solution that was statistically at par with quick dip in 90^{0}C hot water and 30 per cent sulphuric acid solution (3.39 and 3.39 mm, respectively) and 1 and 3 minute soaking in 30 per cent sulphuric acid solution (3.45 and 3.37 mm, respectively) and 80^{0}C hot water treatment (3.41 and 3.44 mm, respectively).

Height of guava seedling

The effect of different scarification treatments on seedling height at 60, 90, 120 and 150 days after sowing is illustrated in Fig. 2. The minimum (14.6 cm) and maximum (42.0 cm) height of seedlings was reported with treatment of 3 minutes soaking in 50 per cent sulphuric acid solution and quick dip in 30 per cent sulphuric acid solution, respectively. Results showed that water soaking of guava seeds significantly increased the height of seedlings over control. Similarly, quick dip and soaking of seeds in 70^{0}C, 80^{0}C and 90^{0}C hot water also significantly increased the height of seedlings. However, effect of quick dip in 100^{0}C hot water was non-significant, while soaking (1 and 3 minute) significantly decreased the height of seedlings as compared to control.

DISCUSSION

Seed viability (%)

Tetrazolium test distinguishes between viable and dead tissues

Table 1: Effect of different scarification treatments on guava seed viability and seed germination %

Treatments		Seed Viability (%)	Germination %	Days to emergence of seedling
Water soaking	24 hrs	77.3 (61.6)	33.7 (35.4)	20.0 (4.58)
	48 hrs	73.7 (59.1)	36.0 (36.9)	17.3 (4.28)
	72 hrs	71.3 (57.6)	30.3 (33.4)	16.3 (4.16)
Hot water soaking	70°C QD	77.3 (61.6)	38.7 (38.4)	18.0 (4.36)
	1 min	72.0 (58.1)	37.3 (37.6)	17.3 (4.28)
	3 min	69.3 (56.4)	30.3 (33.4)	16.7 (4.20)
	80°C QD	71.7 (57.8)	41.7 (40.2)	17.7 (4.32)
	1 min	68.0 (55.5)	44.7 (41.9)	13.7 (3.83)
	3 min	56.0 (48.4)	46.0 (42.7)	13.0 (3.74)
	90°C QD	64.0 (53.1)	43.7 (41.3)	12.3 (3.65)
	1 min	60.0 (50.8)	33.3 (35.2)	15.7 (4.08)
	3 min	49.3 (44.6)	30.7 (33.6)	18.0 (4.36)
	100°C QD	49.3 (44.6)	28.7 (32.4)	19.3 (4.51)
	1 min	45.0 (42.1)	27.0 (31.3)	19.7 (4.55)
	3 min	40.0 (39.2)	23.7 (29.1)	21.0 (4.69)
Sulphuric acid soaking	10%QD	76.0 (60.7)	28.7 (32.4)	19.0 (4.47)
	1 min	69.7 (56.6)	34.7 (36.1)	17.7 (4.32)
	3 min	66.3 (54.5)	37.3 (37.6)	17.0 (4.24)
	20%QD	75.3 (60.2)	37.3 (37.6)	18.7 (4.43)
	1 min	69.7 (56.6)	40.3 (39.4)	18.3 (4.40)
	3 min	66.7 (54.7)	51.7 (45.9)	11.7 (3.56)
	30%QD	74.7 (59.8)	50.3 (45.2)	12.0 (3.60)
	1 min	66.7 (54.7)	51.3 (45.7)	12.3 (3.65)
	3 min	58.0 (49.6)	43.7 (41.3)	12.3 (3.65)
	40%QD	49.3 (44.6)	27.7 (31.7)	18.0 (4.36)
	1 min	38.7 (38.4)	23.3 (28.9)	19.0 (4.47)
	3 min	33.0 (35.0)	22.3 (28.2)	21.0 (4.69)
	50%QD	44.0 (41.5)	20.7 (27.0)	19.3 (4.51)
	1 min	33.3 (35.2)	17.7 (24.8)	19.7 (4.54)
	3 min	26.7 (31.1)	14.7 (22.5)	20.3 (4.62)
Control		82.7 (65.6)	24.7 (29.8)	25.0 (5.10)
CD (p = 0.05)		6.4 (4.0)	2.2 (1.4)	1.4 (0.16)

*hrs – Hours, min – Minute/s, QD – Quick dip; (Figures in the parenthesis are square root transformed)

of the embryo on the basis of their respiration rate. Seed viability is interpreted according to the topographical staining pattern and staining pattern of the embryo and intensity of colouration. The untreated seeds showed the highest viability percentage of 82.7 per cent which decreased to 26.7 per cent in seeds treated with 50 per cent sulphuric acid for 3 minutes. The decrease in viability by various scarification treatments may be due to over exposure of the seeds to scarification treatments. Sulphuric acid have a negative effect as it can end up damaging the seed, when the acid can penetrate into the seed via its exposed micropyle (Ells, 1963). The results are in accordance with the findings of Musara et al. (2015) in okra. Hot water soaking at higher temperature (90ºC and 100ºC) for longer duration may also damage the seed embryo and viability is reduced.

Germination percentage

Seeds treated with 20 per cent sulphuric acid for 3 minutes gave maximum germination percentage as compared to rest of the treatments. However, the germination of seeds treated with quick dip 30 per cent sulphuric acid was at par with the maximum. Treatment of seeds with 50 per cent sulphuric acid for 3 minutes gave minimum germination percentage. This increase in germination by sulphuric acid treatment may be due to the stimulating effect of sulphuric acid which softens seed coat and allows easy permeability to air and water. These results are in close conformity with the findings of Singh and Soni (1974) and Brijwal *et al*. (2013) as they reported that soaking of guava seeds in sulphuric acid for 3 minutes improved the germination counts over control. Ali *et al*. (2007) reported higher guava seed germination (85%) using 5 sulphuric acid for 12 hours. They reported negative effect of increased acid concentration on seed germination which explains the lower germination percentage at higher sulphuric acid concentration. The effectiveness of boiling water treatment in enhancing germination has been attributed to the release of physical dormancy from hard seeded species by causing ruptures in the seed wall thereby allowing imbibition, O, diffusion and germination to occur (Egley, 1989; Maslin, 2004 and Sedbrook, 2006). The decline of germination at higher water temperature could be attributed to embryo damage caused by wet heating (Powell, 1990) or probably due to low O, availability at high temperature which resulting in destruction of certain enzymatic components (Teketay, 1998). Reisman-Berman *et al*. (1989) reported that the decrease in germination per cent in 72 hours water soaking treatment may be attributed to water trapped in tissue between the embryo and seed coat creating an oxygen barrier. Moreover, Norton (1986) concluded that anoxia caused by prolonged soaking of seeds may result in irreversible injury due to accumulation of toxic metabolites hence poor germination.

Days to emergence of seedling

Each scarification treatment significantly decreased the days

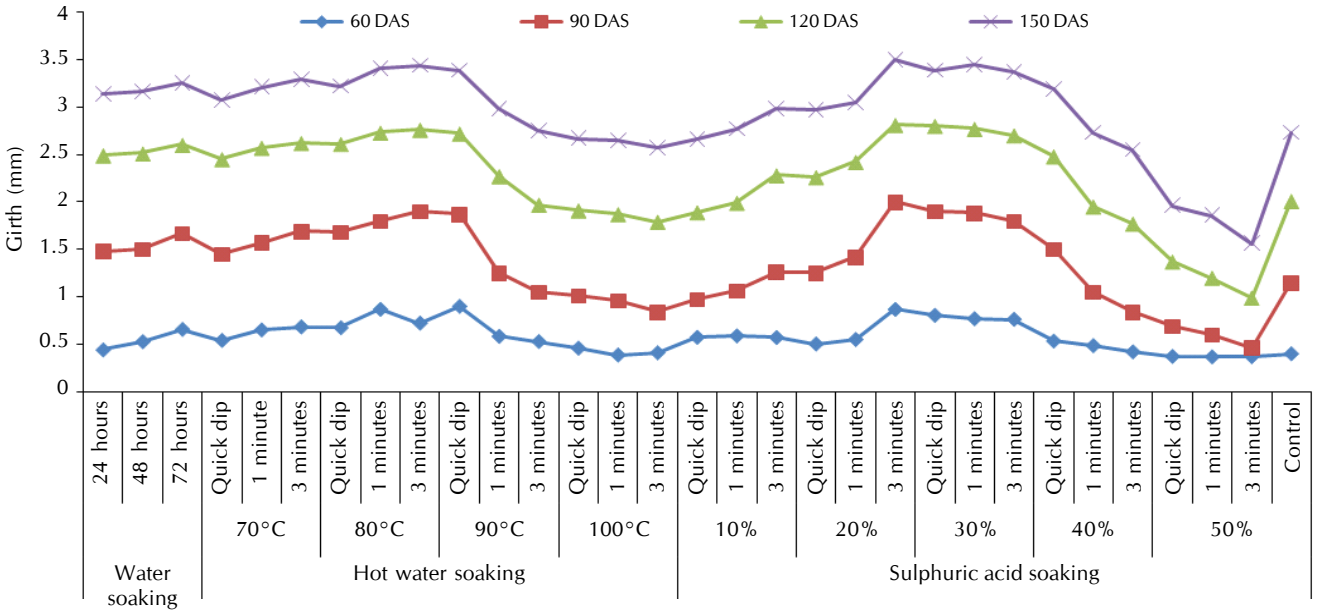

Figure 1: Effect of different scarification treatments on girth of guava seedlings (mm)

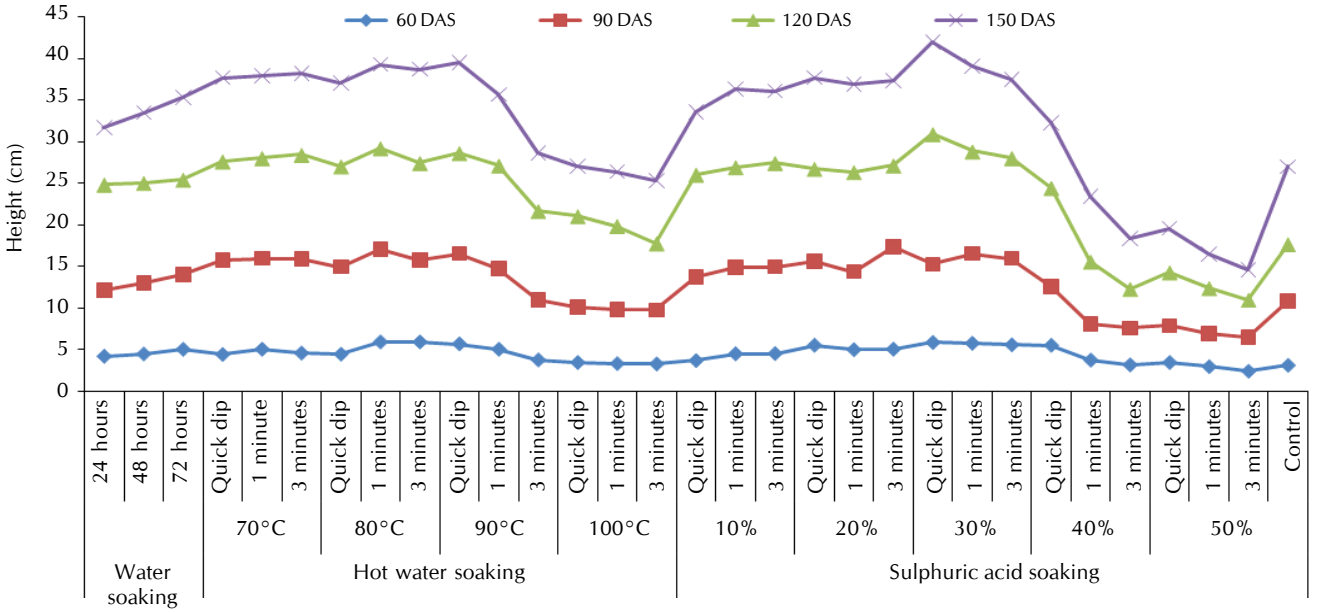

Figure 2: Effect of different scarification treatments on height of guava seedlings (cm)

to emergence of seedling over control. The seeds subjected to 20 per cent sulphuric acid for 3 minutes recorded minimum number of days to emergence of seedling whereas control treatment took maximum days to emergence of seedling. The minimum number of days required for seed germination in case of acid scarified seeds might be due to the softening of hard seed coat which resulted in minimum time required for germination as also reported by Chattopadhyay and Dey (1992). These results are in accordance with the findings of Hayes (1953) as he reported that acid scarification of guava seeds shortened the time required for germination without any adverse effect on germination percentage.

Girth of seedling

Girth of seedling at 150 DAS (days after sowing) was maximum in 20 per cent sulphuric acid soaking for 3 minutes and minimum in 50 per cent sulphuric acid soaking for 3 minutes. Girth at 60, 90 and 120 days also followed the same trend. The reason behind this may be due to the corresponding number of days to emergence of seedling and mean germination time with corresponding treatments. Also, higher concentration of sulphuric acid and higher temperature

damages the embryo and decreases seed vigour as reported by Abdul-Baki (1973).

Height of seedling

Same pattern was obtained for height of seedling at the time interval of 60, 90, 120 and 150 days after sowing of seeds in nursery and the maximum seedling height at 150 DAS was recorded in 30 per cent sulphuric acid treatment as quick dip duration while the minimum height was recorded in 50 per cent sulphuric acid soaking for 3 minutes. This may be due to the same reasons as discussed in girth of seedlng. Also; the enhanced root and shoot length, increased fresh and dry weight of seedling. Thus the increase in root and shoot length have lead to the overall assimilation and redistribution of photosynthates within the plant and increased dry matter assimilation (Gurung *et al.*, 2014).

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