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PLANT PHYSIOLOGY

Effect of Hot Water and H_2SO_4 on Physical Dormancy in the Seeds of Sponge Gourd

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ABSTRACT:

Luffa sponge gourd (*Luffa aegyptiaca* Mill.; also *L. cylindrica*) is a major cucurbit crop, affected by the physical dormancy, which is caused by the hardness of the seed coat. In the present study, luffa seeds were treated with H_2SO_4 and hot water. This experiment is conduct as seeds of sponge gourd were socked in hot water (100^{o}C) for 2, 5, 10 and 15 minutes durations and in various concentration of H_2SO_4 (0.5, 1 and 2%) for 1, 3 and 5 minutes durations in each concentration along with control. The highest germination percentage (92.33 ±0.8) was recorded with hot water treatment for 2 min. H_2SO_4 Treatment had no effect in breaking physical dormancy, but it showed variability in the germination of sponge gourd. But it can not be considered as an effective method.

HIGHLIGHTS:

- The hot water treatment for 2 min can be suggested as an effective method for breaking physical dormancy in sponge gourd.

Keywords: Physical dormancy, hot water, H_2SO_4, luffa sponge gourd

Luffa sponge gourd (*Luffa aegyptiaca* Mill.; also *L. cylindrica*) belongs to the Cucurbitaceae along with squash and pumpkin (*Cucurbita* spp.), gourd (*Cucurbita* spp., *Lagenaria* spp.), melon (*Cucumismelo* L.), and cucumber (*Cucumis sativus* L.). It is an annual climbing vine with tendrils, growing primarily in tropical and subtropical regions. In most countries, it is cultivated in small plots in family gardens, usually for domestic consumption, with commercial cultivation being of secondary importance. However, it is beginning to appear in the international market place (6, 7). Germination percentages of several vegetable species have been shown to increase after seed treatment with chemicals and various osmotica (1, 4, 10, 13, 18). Luffa seed germination has been reported to be slow and sporadic (2). Low percentage of seed germination is a major problem in establishing a luffa crop, with typical rates of less than 75% (17). The seeds of many species of cucurbits are non endospermic and germination is epigeal. Dormancy can be severe problem in some cucurbit species. It is comparatively easy to induce dormancy by testing the seeds for germination in unfavorable environments. In particular, the germination test substrate should not be too moist and only very low intensity light treatments should be applied. In most cases, it is probably best to perform seed germination tests in darkness. Successful

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dormancy-breaking treatments in sponge gourd are observed to be use of constant temperatures with optimum range of 30 to 35°C, scarification of the seeds before germination, cracking the seed coat before germination, and use of moist sand for the germination medium. Poor field emergence and erratic stands lead to increased variation in plant development which can result in yield reduction. Since a species cannot become established in and colonize new habitat until it has completed the stages of germination and seedling establishment, it is most important to study the effect of soil factors on the germinating seeds and young seedlings (12).

There is little published information found on the effects of seed treatment on germination of luffa gourd. It would be useful to increase the germination rate of luffa seeds, especially for those interested in commercial production of the crop. Therefore, the objective of this study was to determine if treating luffa sponge gourd seeds prior to planting would improve the germination rate.

MATERIALS AND METHODS

The present study was carried out with the objective, to break the physical dormancy in the seeds of sponge gourd. To conduct the experiment seeds of sponge gourd were socked in hot water (100°C) for 2, 5, 10 and 15 minutes durations and in various concentration of H_2SO_4 (0.5, 1 and 2%) for 1, 3 and 5 minutes durations in each concentration. Three replications of 100 seeds each were taken for each treatment, concentration and duration and soaked in hot water and H_2SO_4 concentrations as given in Table -1. After presoaking, the seeds were placed in the wet towel paper for seed germination test and kept in to the seed germinator (25°C temperature and more than 80% humidity) and observations were reported as the percentage of germinated, hard and dead seeds. The details of treatments are as given below:

RESULTS AND DISCUSSION

The results of following experiments are shown in the table 2, given below. Significant difference was found between the performance of sponge gourd seeds along with different treatments of H_2SO_4 and hot water.

As per the table 2, it was observed that maximum germination percentage of 92.33 ±0.8 % was recorded with hot water treatment at 100° C for 10 minutes along with T4 (48.33 ±4.2), T9 (47.00 ±0.5) and T8 (44.66 ±0.6) showed prominent results in germination. As compare to the performance of different treatments, control (T14) showed 43.66 ±0.8% germination. Similar results were also reported by Chaodumrikul *et al.* (2016), when they clipped the sponge gourd seeds and recorded highest germination.

Table 1: Treatment, Concentration and Duration used to break the physical dormancy in the seeds of sponge gourd

Treatments	Concentration	Seed Socking Duration	Symbol Used
H_2SO_4	0.5%	1 minute	T1
	0.5%	3 minute	T2
	0.5%	5 minute	T3
	1%	1 minute	T4
	1%	3 minute	T5
	1%	5 minute	T6
	2%	1 minute	T7
	2%	3 minute	T8
	2%	5 minute	T9
Hot Water Treatment (100°C)	—	2 minute	T10
	—	5 minute	T11
	—	10 minute	T12
	—	15 minute	T13
Control (Without Socking)	—	—	T14

Above results showed that when the duration of hot water treatment was increased, less germination was recorded, even it recorded the least germination percentage in T13, in which sponge gourd seeds were soaked in hot water treatment for 15 minutes. In addition to it, different concentration of H_2SO_4 treatment did not show the prominent results, mostly recorded less than 50 %. Ballard (1973) and Egley (1989) stated that dry heat improves the seed germination due to damage in the palisade layer of the seed coat. Corral *et al*. (1989) also reported that high temperature enhanced the cracking of the seed coat. This change in seed coat structure allows the seed to improve the water uptake ability of the seeds, which enhance the imbibition uptake. Hence, it results in improved germination in the seeds.

The results of following table showed that maximum % of dead seeds (100.00 ±0.0 %) was recorded in T13, in which sponge gourd seeds were soaked for 15 minutes in hot water, along with T12 (91.33 ±0.6%) and T11 (67.66 ±1.4). They were treated with hot water for 10 and 5 minutes respectively, which shows that seed embryo has been dead along with the rise in the duration of hot water treatments. Results were compared with all other treatments. SO, it may be assumed that rise in the temperature along with duration caused damage in seed embryo, Hence seeds were found dead. Similar results were also observed by FAO (1983), when seeds were exposed to high temperature and it resulted in decline in seed germination.

As per the table 2, maximum hard seeds were found in T1 (63.66 ±3.8 %), T2 (57.66 ±1.8 %) and T7 (57.00 ±1.5 %), which were treated by H_2SO_4 in 0.5% and 2 % concentration for 1,3 and 2 minutes respectively, which shows that these treatments were not suitable for the breaking physical dormancy in sponge gourd. Other treatments of H_2SO_4 also had no effect in breaking the seed dormancy and they reported more number of hard seeds. It exposes that H_2SO_4 treatment did not induced the seed germination.

Physical dormancy in sponge gourd is caused by the water impermeability of seed coat which occurs due to the presence of the palisade layer on the seed coat (Baskin and Baskin, 2014). The seed coat is obstacle in the significant germination of sponge gourd,which inhibits the imbibation in seeds and caused disturbance in the metabolic activities of seed embryo. The hardness of seed coat also inhibits the gaseous exchange in the embryo, which affects the respiration in seed embryo. Hence, It results in poor germination. This is one of the most common type of dormancy, which has also been reported

Table 2: Effect of hot water and H_2SO_4 treatment on Seed Germination

Treatments	Germinated Seed (%)	Hard Seed (%)	Dead Seed (%)
T1	32.00 ±3.0	63.66 ±3.8	4.33 ±0.8
T2	35.33 ±2.8	57.66 ±1.8	7 .00±1.1
T3	44.00 ±2.6	50.00 ±2.5	6.00 ±0.5
T4	48.33 ±4.2	45.66 ±4.7	6.00 ±1.5
T5	42.66 ±0.8	52.66 ±1.7	4.66 ±1.2
T6	40.00 ±0.5	53.33 ±1.4	6.66 ±1.8
T7	39.00 ±0.5	57.00 ±1.5	4.00 ±1.7
T8	44.66 ±0.6	51.66 ±3.1	7.00 ±1.7
T9	47.00 ±0.5	45.66 ±2.3	7.33 ±1.7
T10	**92.33 ±0.8**	**0.00 ±0.0**	**7.66 ±0.8**
T11	32.33 ±1.4	0.00 ±0.0	67.66 ±1.4
T12	8.66 ±0.6	0.00 ±0.0	91.33 ±0.6
T13	0.00 ±0.0	0.00 ±0.0	100.00 ±0.0
T14	43.66 ±0.8	49.333 ±1.764	7.00 ±1.0
C.D. at 5%	*5.646**	*6.681**	*3.611**
SE(m)	*1.932*	*2.285*	*1.235*
SE(d)	*2.732*	*3.232*	1.747
C.V.	8.516	10.523	9.171

**Significant.*

in *Cannaceae, Convolvulaceae, Fabaceae, Geraniaceae,* and *Malvaceae.*

Hartmann *et al*. (1997) states that the hard seed dormancy can be broken by soften the covering of the seed coat. Hardseededness is influenced by several abiotic conditions during seed development and storage (Baskin and Baskin 1998). It may be suggested that seeds should be harvested when they are immature and have some higher moisture content, only after ensuring their desiccation.

CONCLUSION

Above study shows that seeds treated with hot water treatment for 2 minutes had the highest germination (92.33 ±0.8)., which shows that hot water treatment was capable to break the hard seed coat dormancy of sponge gourd seeds. So, we can conclude that hot water may be used as an effective method for improving the seed germination of sponge gourd seeds. It is also suggested that the temperature of hot water should not be increased, else it may lead to the death of embryo and poor germination.

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