

Effects of Pre-Sowing Treatment on Seed Germination and Seedling Growth Performance of *Sapindus mukorossi* Gaertn

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ABSTRACT

Present study was carried out in forest nursery of Rani Lakshmi Bai Central Agricultural University Jhansi (U.P) in the year 2020-21. To study the effects of pre-sowing treatment on the seed germination and seedling vigour, fresh seeds are collected from Shidh seed sale corp Dehradun (UK) and Seed are clean and graded seeds were subjected to five different pre-sowing treatments for germination viz., Concentrated H_2SO_4 for 20 minutes followed by rinsing under running tap water (T_1), Hot water treatment ($100^\circ C$) for 10 second (T_2), Cow dung treatment for 7 days (T_3), Cow urine treatment for 24 hours (T_4) and normal water treatment for 48 hours (T_5). The study revealed that seed pre-sowing treatments of the *Sapindus mukorossi* were significantly influenced the seed germination and seedling vigour. Germination percent Seeds subjected to different pre- sowing treatments ranged from 65 to 30 %. Acid treatment (T_1) sowing the high germination per cent which is significantly at par with the other treatments. Germination energy was follow these trends $T_1 > T_2 > T_3 > T_4 > T_5$. Seedling length was depicted highest value (21.75 cm) in T_1 (H_2SO_4 treatment for 20 minute) which is statistically at par with the other treatments while the minnum value was depicted in T_5 (9.83cm). In case of collar daimeter, maximum value was recorded in T_1 (4.80 mm) and lowest in T_5 (2.51 mm). Whereas, mean root length of the seedlings was highest in T_1 (16.58 cm) and lowest in T_5 (9.31 cm). The root- shoot ratio also varied significantly among different pretreatments and the highest root- shoot ratio was recorded in T_1 i.e. seeds soaked in H_2So_4 for 20 minute (0.26) and the least in T_5 (0.15). With regards to seedling vigour index, the highest vigour index was recorded in T_1 (16.72) scarifying the seeds in H_2SO_4 for 5 minutes and the lowest in T_5 (4.37).

Keywords: Pre-sowing treatments, Germination energy, Germination per cent, Root shoot ratio seedling vigour.

INTRODUCTION

Sapindus mukorossi is commonly known by several names such as washnut, soap berry,

soapnut, aritha and ritha is important MPTs of north India, belongs to family Sapindaceae.

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This tree is native to Japan and China and widely cultivated in North India, in moister tracts of Himalayas from Ravi eastwards up to 1500 m asl elevation. Dry fruits of this plant have medicinal and economic value. Fleshy portion of fruit contain saponin, which is a good substitute for washing soap and also insecticidal properties and it is traditionally used for removing lice from the scalp. Other medicinal properties of this fruits are treating various diseases like excessive salivation, pimples, epilepsy, chlorosis, migranes, eczema and psoriasis (Kirtikar & Basu, 1991). The powdered seeds are employed in the treatment of dental caries, arthritis, common colds, constipation and nausea (Dhar et al., 1989).

This species required proper nursery management technique because of its hard seed coat, their germination is slow and therefore direct sowing of this species is not successful (Anon, 1972). Poor seed germination of ritha seed is one of the prime causes hinders the cultivation of the plants and deferred nursery establishment. Seed treatments can influence seed germination rate and germination process (Azad et al., 2006a; Azad et al., 2011 & Azad et al., 2012). The effect of pre-sowing treatments on seed germination of some tropical forest tree species has been reported by a number of authors (Ahamed et al., 1983; Matin & Rashid, 1992; Koirala et al., 2000; Khan et al., 2001; Alamgir & Hossain, 2005; Azad et al., 2006b; Matin et al., 2006 & Haider et al., 2014). Present studies were carried out to identify of suitable pre-sowing treatment necessary for quicker and higher seed germination in order to recommend suitable pre-sowing treatment for *S. mukorossi*.

MATERIALS AND METHODS

The present study was conducted in the nursery of Rani Lakshmi Bai Central

Agricultural University Jhansi (Uttar Pradesh). Ritha seed were collected from Shidh seed sale corp, Dehradun (UK) during the month of July. Seed are sown in the month of August in the nursery bed. Experimental field was prepared by ploughing the field twice and made smooth by harrowing followed by planking during month of August, 2020. The sunken nursery beds (5m × 1m) were prepared in the nursery area to accommodate all the treatments. The 160 seeds/bed were sown in each Treatment. In each treatment there were four replication, in each replication 40 seed are sown. Seeds were subjected to five pre-sowing treatments viz, T₁ (Seeds soaking in concentrated sulfuric acid for 20 minutes followed by rinsing under running tap water), T₂ (Seed soaking in Hot water (100°C) for 10 second, T₃ (Cow dung slurry for 7 days), T₄ (Seeds are soaking in Cow urine for 24 hours) and T₅ (Seed soaking in normal water for 48 hours). The graded and treated seeds (160 for each) of ritha were sown at prepared plot. Nursery beds were kept moist by sprinkling water and kept free from weeds.

The experiment was laid down in the nursery in randomized block design with four replications. The following observations were also made. The imbibition period *i.e.* number of days from sowing to commencement of germination of the seeds, subjected to different pretreatments was recorded. The days taken for completion of germination also was noted. From the daily germination counts, the germination percentage, germination energy, mean daily germination (MDG), peak value of germination (PV) and germination value (GV) were worked out as suggested by Czabator (1962). Germination energy was calculated as the per cent, by number of seeds in a given sample which germinate up to the time of peak germination. Mean daily germination was calculated by using the following formula.

$$MDG = \frac{\sum \text{Cumulative germination percent}}{\text{Number of days after sowing}}$$

Peak value is the maximum mean daily germination reached at any time during the period of germination test (Czabator, 1962).

Germination value was calculated as $GV = PV \times MDG$. The germination index (GI), which is expressed as speed of germination was

$$GI = \frac{\text{No of germinated seed}}{\text{Days of first count}} + \dots + \frac{\text{No of germinated seed}}{\text{Days of final count}}$$

Seedling vigour

The germinated seedlings belonging to different pretreatments were grown under similar environmental condition for 60 days. The seedlings were evaluated as described in Seedling Evaluation Handbook (AOSA, 1991). At the end of the experiment all seedlings were measured for total height and collar diameter. Twelve seedlings from each treatment were

randomly selected for the destructive sampling. The seedling vigour index was determined by multiplying the average germination percentage and seedling length after 45 days of germination. The seeds showing the higher seedling vigour index are considered to be more vigorous (Abdul-Baki & Anderson, 1973).



Plate 1: Five different pre-sowing treatments given to the seed of *Sapindus mukorossi*

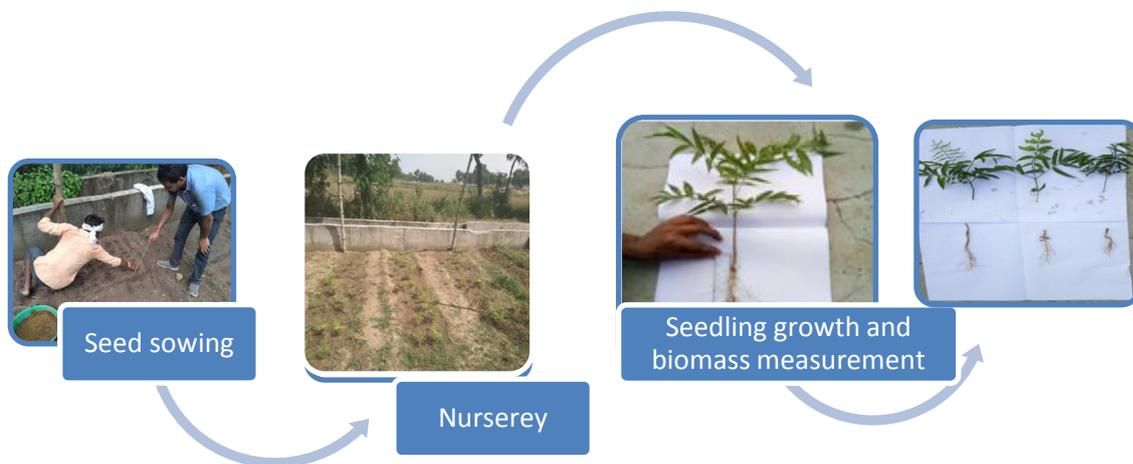


Plate 2: Field experiment of seed germination and biomass study of seedling of *Sapindus mukorossi* in nursery (RLBCAU Jhansi)

RESULTS AND DISCUSSION

Germination of seeds of *Sapindus mukorossi* subjected to varying pretreatments ranged from 65 to 30% (Fig.1). Treatment T₁ sowing the high germination per cent which is significantly at par with the other treatment. Seed germination energy was showing these trend T₁> T₂> T₃> T₄ > T₅. The imbibition

period of the seeds varied strikingly with pretreatments applied. The fastest germination *i.e.* the least imbibition period (14 days) was observed in seeds soaked in acid treatment followed by hot water treatment (16 days) seeds. Whereas, the highest imbibition period (22 days) was recorded in T₅ (water soaked for 48 hours). The MDG, PV and GV of the seeds

subjected to different pretreatments are given in Fig. 2. The highest MDG was observed in T₁ (1.07) which is significantly at par with the other treatment, respectively. While lowest MDG was recorded in T₅ (0.49). Peak value of germination also showed similar trend, with seeds treated acid (T₁) recording the highest

value (0.81), followed by T₂ (0.63) and the lowest was in T₅ (0.32). Germination value which is product of GV and MDG also showed similar trend, the highest germination index was recorded in T₁ (0.81) followed by T₂ (0.63) and the lowest was in T₅ (0.32) (Table-1).

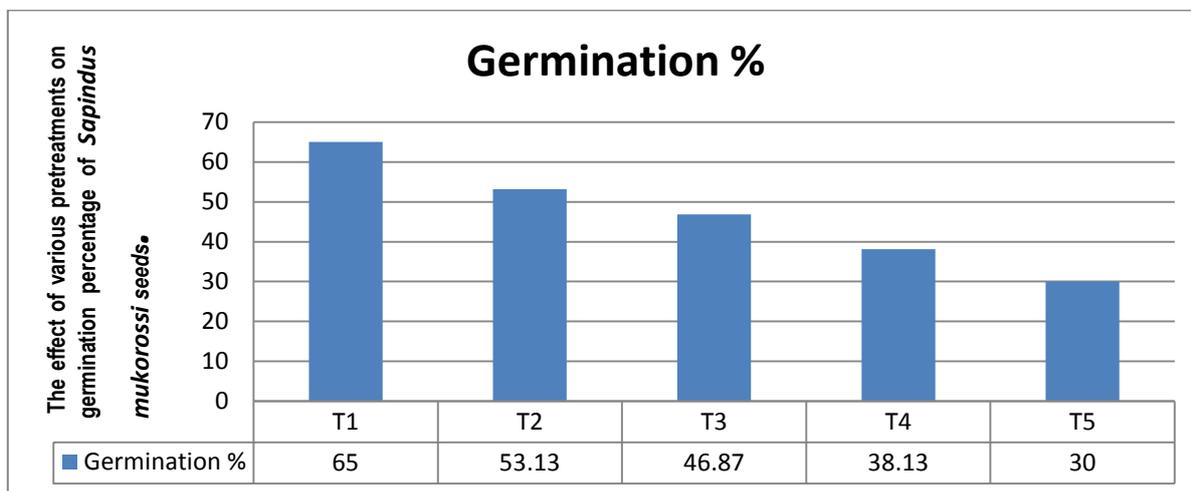


Fig. 1: The effect of various pretreatments on germination percentage of *Sapindus mukorossi* seeds.

Out of the five pre-sowing treatments studied, concentrated H₂SO₄ for 20 minutes followed by rinsing under running tap water (T₁) resulted in to higher germination. The

concentrated H₂SO₄ soften the seed coat causing uniform inflow of water and unrestricted expansion of embryo.

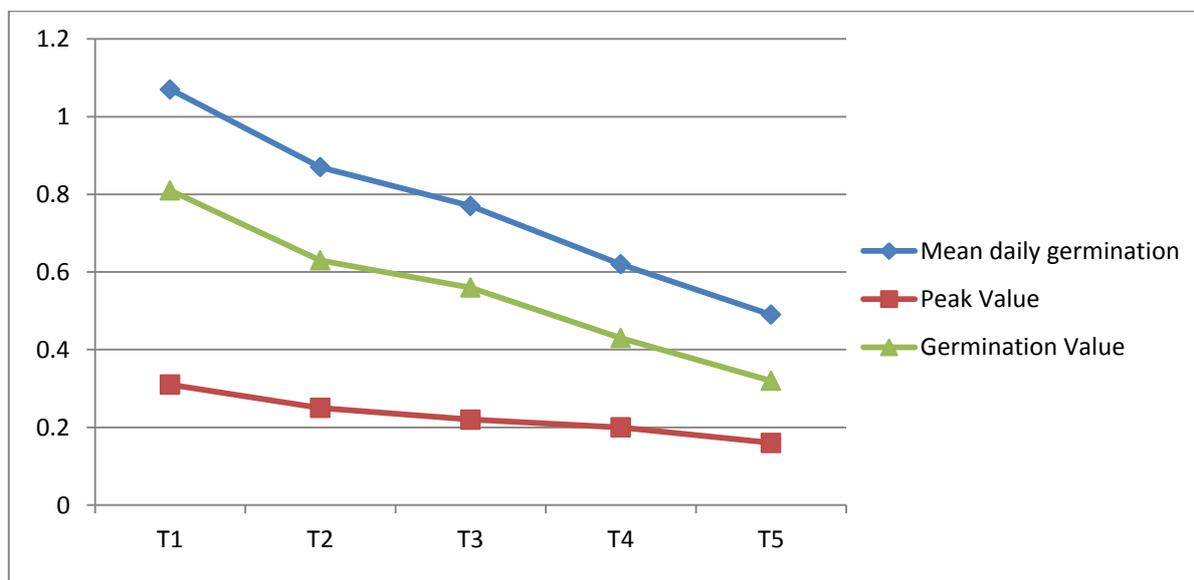


Fig. 2: The MDG, PV and GV of the seeds subjected to different pretreatments

Increased germination have also been reported in *Albizia lebbek* and *Cassia siamea* (Agboola et al., 2005), *Quercus leucotrichophora* (Gautam & Bhardwaj, 2001), *Acacia nilotica*

(Khera & Saxena, 2003), *Leucaena leucocephala* (Puri et al., 2001), *Cassia siamea* (Kobmoo & Hellum, 1984) and *Albizia richardiana* (Roy & Pathak, 1983).

Germination energy also differs significantly due to pre-sowing treatments. The results are in harmony with those reported in *Ribes orientale* (Sharma et al., 2005), *Acacia*

auriculiformis (Marunda, 1990), *Indigofera pseudotinctoria* (Jinnui et al., 2008), *Grewia optiva* (Singh et al., 1997) and *Terminalia bellerica* (Chakraborty et al., 1992).

Table 1: Effects of pre-sowing treatments on the seeds of *Sapindus mukorossi*

Treatment	Germination per cent	Germination energy	Imbibition period	Mean daily germination	Peak Value	Germination index
T ₁	65.00	45.00	14.75	1.07	0.31	0.81
T ₂	53.13	41.25	16.00	0.87	0.25	0.63
T ₃	46.87	35.63	18.00	0.77	0.22	0.56
T ₄	38.13	27.50	19.00	0.62	0.20	0.43
T ₅	30.00	26.25	22.00	0.49	0.16	0.32
CD _{0.05}	4.39	4.69	1.32	0.07	0.05	0.05

Effects of pre-sowing treatments on the variation of seedling growth are shown in Table 2. Analysis of variance revealed significant difference in the growth attributes of the seedlings due to pretreatment at five per cent significance level. The mean shoot length of the seedlings under various treatments was follow the following trend T₁>T₂>T₃>T₄>T₅. Seedling length was recorded highest value

(21.75 cm) in T₁ (H₂SO₄ treatment for 20 minute) which is statistically at par with the other treatment while the minimum value was depicted in T₅ (9.83cm). In case of collar diameter, maximum value was recorded in T₁ (4.80 mm) and lowest in T₅ (2.51 mm). Whereas, mean root length of the seedlings was the highest in T₁ (16.58 cm) and lowest in T₅ (9.31 cm).

Table 2: Growth attributes of the seedlings as affected by different pretreatments

Treatment	Shoot length	Collar diameter	Root length
T ₁	21.75	4.80	16.58
T ₂	17.42	4.38	13.83
T ₃	13.25	3.24	12.73
T ₄	11.42	2.77	11.49
T ₅	9.83	2.51	9.31
CD _{0.05}	1.12	0.16	0.92

Analysis of variance also indicated that the biomass production, root shoot ratio and seedling vigour sowing the higher value in acid treatment whereas minimum value was found in seed treated with normal water. Soaking in H₂SO₄ for 20 minute recorded the highest root biomass (T₁, 4.98 g) and it was followed by T₂ i.e. soaking in hot water (3.72 g). The lowest shoot biomass (2.30g) was recorded in control (T₅). Meanwhile, the total root biomass was the highest in T₁ i.e. H₂SO₄ acid scarification for 20 minute (1.28g) followed by T₂ (0.69 g) and the least value was recorded in the control (0.34g) seedlings. The root shoot ratio also varied significantly among different pretreatments and the highest

root shoot ratio was recorded in T₁ i.e. seeds soaked in H₂SO₄ for 20 minute (0.26) and the least in T₅ (0.15). With regards to seedling vigour index, the highest vigour index was recorded in T₁ (16.72) scarifying the seeds in H₂SO₄ for 5 minutes and the lowest in seed were treated with normal water for 24 hours T₅ (4.37) (Table 3.). This results was closely support by the study conducted by Attri et al., 2015 giving different pre-sowing treatments viz., Immersion in conc. H₂SO₄ for 20 minutes followed by rinsing in running tap water (T₁) were found to be more effective in enhancing the Germination attributes, growth and biomass characteristics viz. germination per cent (66.22%), minimum number of days to

initiate (22.00 days) and complete germination (65.11 days), shoot length (26.97 cm), root length (21.24cm), seedling height (48.21 cm), collar diameter (4.73 mm), number of lateral roots (58.00), dry shoot weight (3.66 g), root weight (1.03 g), and total dry weight 94.69 g). Hard seed coat acts as a barrier for the general seedling growth in natural growing conditions. Increased germination has been reported in *Acacia nilotica* (Khera & Saxena, 2003), *Albizia lebbek* and *Acacia siamea* (Agboola et al., 2005). Similar results have been reported in *Dacryoides edulis* when seeds are treated with acid, for significantly improve the performance of seedling as regard to plant

height and collar diameter (Agbogidi et al., 2007). Increase in seedling height has been reported in *Acacia nilotica* (Khera & Saxena, 2003). The effect of pre-sowing treatments varied significantly with respect to biomass production of *Sapindus mukorssi* seedlings. The data indicated that among the five different pre-sowing treatments, immersion in concentrated H₂SO₄ for 20 minutes followed by rinsing under running tap water (T₄) were found to be most effective in enhancing shoot dry weight, root dry weight and total dry weight. Similar results of increased biomass with sulfuric acid treatment were reported in *Acacia nilotica* (Khera & Saxena, 2003).

Table 3: Biomass production, root: shoot ratio and vigour index of seedling as affected by pretreatments

Treatments	Shoot biomass	Root Biomass	Total biomass	Shoot/Root	Seedling vigour
T ₁	4.98	1.28	6.27	0.26	16.72
T ₂	3.72	0.69	4.44	0.19	9.83
T ₃	3.36	0.60	3.99	0.18	8.39
T ₄	2.72	0.43	3.14	0.16	5.94
T ₅	2.30	0.34	2.64	0.15	4.37
CD _{0.05}	0.12	0.09	0.16	0.02	1.76

CONCLUSION

The summarization of the present study indicates that the presowing treatments affected the germination parameter of the sapindus seeds and seedling growth also. The treatment with acid once again proved to be the best pretreatment, however, the organic pretreatments like soaking in cow dung slurry and cow urine also produced good germination. The soaking in normal water for 24 hours reduced the germination of the seeds.

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