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Response of pre-sowing treatment on seed germination and seedlings growth characteristics of *Albizia lebbeck*

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Abstract
The objective of this study was to identify the most suitable pre-treatment method that will increase germination and enhance seedling growth of *Albizia lebbeck*. The fresh seeds of A. lebbeck were collected by own hands to study the germination and growth characteristics of A. lebbeck after pre-sowing treatment. The experiment was carried out at Forestry Nursery (Rani Lakshmi Bai Central Agricultural University, Jhansi), India. Six pre-treatment methods were employed i.e., soaking in cold water for 12 hrs & 24 hrs, in hot water for 10-15 min, treatment with 75% H_2SO_4, treatment with 1% KNO_3 and control. These all pre-treatments were undertaken separately and compared with control i.e. after each pre-treatment. The result show significant differences ($P \leq 0.05$) in germination percentage and seedling growth by pre-sowing treatments as compared to control. The overall results confirm the stimulation in the aforementioned germination and growth characteristics of *A. lebbeck* by 75% H_2SO_4 for producing quality seedlings.

Keywords: Albizia lebbeck, nursery, pre-treatment and H_2SO_4.

Introduction
Albizia lebbeck (L.) Benth. (Family: Fabaceae) is commonly known as Siris, Shiris in Hindi; Lebbeck Tree in English and Bhandi, Sitapuspa, Sukapriya, Mrdupuspa in Sanskrit. It is mainly distributed in tropical and subtropical areas of India, Andaman Island, Myanmar, tropical Africa, Asia and northern Australia (Verma *et al.*, 2013) [23]. Although siris will grow in the humid tropics, its natural range is in semi-arid to sub-humid areas of the tropics and subtropics that have marked dry and reliable wet seasons. However, it may be established under conditions of low (400 mm/year) and irregular rainfall. Plants can succeed at elevations from sea level to 1,800 metres in areas where annual daytime temperatures are within the range 26-36c, but can tolerate 12 - 48c. It prefers a mean annual rainfall in the range 600 - 2,000mm, but tolerates 500 - 2,500mm. Seedlings will not tolerate frost, but trees are moderately frost resistant when established. *A. lebbeck* require a well-drained, moisture-retentive soil and a position in full sun. Plants are able to succeed in most soil types, including saline but excluding cracking clay, so long as they are well drained.

It is a multipurpose, medium-sized, deciduous tree species and is characterized by its rapid growth, ability to fix nitrogen and improve soil structure (Faisal *et al.*, 2012) [11]. *A. lebbeck* is grown for shelter belts, and as a shading tree in coffee and tea plantations (Orwa *et al.*, 2009) [20]. Due to its coppicing ability, site adaptability and nitrogen fixing property, it is one of the most suitable tree species for reforestation of degraded sites, fuel wood plantations and agroforestry systems.

Since *Albizia lebbeck* suffers from seed germination problems throughout the country due to presence of hard seed-coat and thereby resulted poor seed germination (Azad *et al.*, 2006) [7]. A kind attention is required by the forest tree breeders to overcome this problem in *Albizia lebbeck*. There are many other forest tree species where they suffer from the same problem, but their germination and growth was stimulated by giving them certain type of presowing treatments. The results of pre-sowing treatments were found efficient in *Acacia auriculoformis* (Azad *et al.*, 2011) [8], *Albizia procera* (Azad *et al.*, 2012; Ali *et al.*, 1997; Alamgir and Hossain, 2005) [6, 3, 2], *Melia azedarach* (Khan *et al.*, 2001) [13], *Dalbergia sissoo* (Matin *et al*, 2006) [16] and *Albizia lebbeck* (Azad *et al.*, 2006) [7].

On the other hand several studies showed poor seed germination in Albizia species when seed sowing was done without any pre-treatment (Alamgir and Hossain, 2005; Ajiboye *et al.*, 2009; Azad *et al.*, 2010; Merou *et al.*, 2011; Azad *et al.*, 2012; Nongrum and Kharlukhi, 2013) [2, 1, 9, 17, 6, 19]. Keeping in view the results of these researchers, the present study was designed to

Identify the most suitable pre-sowing treatment which will stimulate seed germination and also to shorten the germination periods as well as enhance seedling growth of *A. lebbeck*.

Materials and Methods

Study area: The study was carried out at Rani Lakshmi Bai Central Agricultural University, Jhansi to find out the best pre-sowing treatment for enhancing seed germination and seedling growth of *A. lebbeck.*

Seed collection

The mature seeds of *A. lebbeck* collected by picking the pods off from the trees or by knocking them off with the aid of a long stick. The seeds were separated from the pods, cleaned and dried for a week at room temperature (25±2 °C). The seeds were surface sterilized in 70% ethanol for 1 min followed by 5% hypochlorite for 10 min and then washed with sterile distilled water before an experimental procedure to prevent contamination for one day and kept for storage.

Pre-treatment and nursery practices

In order to hasten the germination of *A. lebbeck* seeds, six pre-treatments were selected which include soaking in normal and boiling water and acid treatments in different concentrations and duration (Table 1). Hundred seeds in four replications were prepared for each pre-treatment. After subjecting to pre-treatment, the seeds belonging to respective treatments were sown in prepared raised nursery beds and the following cultural practices were adopted.

Watering: The regular supply of clean water is essential to plant growth. Plants are made out of more than 90% water. When grown in containers, nursery plants have only a limited volume of substrate and do not have the ability of mature trees to search for water from below the soil surface; hence the bed was watered daily against protection from scarcity of water.

Shading: Construct a shade to protect the seeds from direct sunlight for two to three weeks by using locally available materials such as grass, mats, or banana fibbers for shade construction.

Weeding: Weeds are a threat to healthy seedlings development. They compete with seedlings for nutrients, water and light, hence they must be controlled. With our own hand removed all the weeds around the beds unless ensure that this can be converted to compost.

Mulching: Just after seed sowing until germination mulching is done and it reduces evaporation, retain moisture, and prevent soil erosion. After planting the soil surface of the planting holes is covered with some materials (dry grass/leaves/twigs) to avoid evaporation or help the plant to retain water.

Table 1: The various pre-treatments adopted prior to sowing of *Albizia lebbeck* seeds.

Treatments	Presowing Parameters
T_1	Soaking in cold water for 12 hrs.
T_2	Soaking in cold water for 24 hrs.
T_3	Soaking in hot water for 10-15 min.
T_4	Soaking in 75% H_2SO_4 for 12 hrs.
T_5	Soaking in 75% KNO_3 for 12 hrs.
T_6	Control

Germination evaluation

The daily germination counts were made on the seeds until no further germination occurred. The following observations viz. the imbibition period, the germination percentage, speed of germination, mean daily germination (MDG), peak value of germination (PV) and germination value (GV) were also made as suggested by Czabator [10].

Imbibition period: Number of days from sowing to commencement of germination of the seeds.

Speed of germination: Speed of germination was calculated by the following formula

Speed of germination= n1/d1+n2/d2+n3/d3+----------

Where, n = number of germinated seeds, d= number of days.

Mean daily germination (MDG): Mean daily germination can be calculated by the following formula

MDG = Total number of germinated seeds/ Total number of days

Peak Value (PV): Peak value was calculated by the following formula

PV = Highest seed germinated/ Number of days

Germination Value (GV): Germination value was calculated by the following formula

GV = PV X MDG

Germination percentage: Number of germinated seeds / Total number of seeds × 100

Seedling vigour

The germinated seedlings belonging to different pre-treatment were grown under similar environmental condition for 30 days. The seedlings were evaluated as described in Seedling Evaluation Handbook (AOSA, 1991) [5]. At the end of the experiment all seedlings were measured for shoot length, root length and total height. The seeds showing the higher seedling growth are considered to be more vigorous.

Data analysis

Variation in germination parameters due to different seed pre-treatments was compared by using analysis of variance. The data obtained were subjected to statistical analysis where ever necessary as per the procedure suggested by Gomez and Gomez [12]. However, the effects exhibit significance at 5 per cent level of probability, the critical difference (CD) was calculated. Analysis was carried out on computer using the package "STATISTICS"

Results and Discussion

Germination parameters

Observations on germination pattern of the seeds indicated that the germination started 4 days after sowing and continued up to 28 days. Different pre-sowing treatments significantly affected various germination parameters of the seeds (Table 2). The imbibition period of the seeds varied strikingly with pre-treatments applied. The fastest germination i.e. the least imbibition period (4 days) was observed in seeds soaked 75% H_2SO_4 for 12 hrs. (T_4) whereas; the highest imbibition period (10 days) was recorded in T_6 (control). The variation in

germination percentage of the A. lebbeck seeds due to different pre-treatment is given in Table 2. With regard to germination percentage, the highest value (74.67%) was observed in T_4 (soaking of seeds in 75% H_2SO_4 for 12 hrs.) and lowest (34.33%) was in T_6 (control). The MDG, PV and GV of the seeds subjected to different pre-treatments are given in Table 2. The highest MDG was observed in T_4 (2.67) and T_5 (2.35) and the lowest MDG was recorded in T_6 (1.23). Similar to germination per cent, the highest MDG was recorded in seeds treated with 75% H_2SO_4 for 12 hrs. and the lowest was in control. Peak value of germination also showed somewhat similar trend, with seeds treated with hot water (T_3) recording the highest value (0.87), followed by 75% H_2SO_4 (0.79) and the lowest was in T_6 (0.42). Germination value which is product of GV and MDG also showed similar trend, the highest germination value was recorded in T_4 (2.12) followed by T_3 (1.71) and the lowest was in T_6 (0.51). The variation in speed of germination of the siris seeds is given in the table 2. The treatment with 75% H_2SO_4 produced the highest speed of germination (7.06) and the lowest speed of germination was recorded in control (2.21) treatments.

Table 2: The variation in germination parameters of *Albizia lebbeck* seeds due to pre-treatment

Treatments	Germination Parameters					
	Imbibition period (days)	Speed of germination	Peak value	Mean daily germination	Germination value	Germination percentage (%)
T_1	8	3.46	0.52	1.78	0.94	41.45
T_2	7	4.28	0.64	1.88	1.56	49.62
T_3	6	5.20	0.87	1.96	1.71	55.00
T_4	4	7.06	0.79	2.67	2.12	74.67
T_5	5	5.71	0.60	2.35	1.40	65.67
T_6	10	2.21	0.42	1.23	0.51	34.33
S. Em.	0.92	0.23	0.03	0.08	0.06	0.98
C.D. @ 5	1.97	0.48	0.06	0.17	0.12	2.09

Seedling growth

The variation in seedling growth attributes as affected by pre-treatments at the end of four weeks are presented in the Table 3. Analysis of variance revealed significant difference in the growth attributes of the seedlings due to pre-treatment at five per cent significance level. The mean shoot length of the seedlings under various treatments was the highest (6.2 & 5.9 cm) in T_4 (75% H_2SO_4) and T_5 (1% KNO_3) whereas, least was observed in T_6 (control, 3.1 cm). Highest root length was recorded in T_4 & T_5 (6.5 & 6.1 cm) and lowest in T_6 (3.4 cm). The highest seedling height after 28 days were observed in the seedling obtained from seeds soaked in 75% H_2SO_4 for 12 hours (12.70 cm) and the lowest (6.50 cm) for the control.

The pre-sowing treatments influence the germination percentage of *A. lebbeck* seeds. The seed dormancy affect the use of dormant species in nurseries for the production of seedlings, it is known that seed dormancy vary from species to species, so the type of pre-treatments should be given in accordance with the forest tree species (Amen, 1968; Rees, 1996) [4, 22]. Several authors viz, Kobmoo and Hellum (1984) [15], Khasa (1992) [14], Yadav (1992) [24] have discussed different methods of pre-sowing treatments for seed germination in order to break dormancy and enhance the rate of germination and speed up the germination process. The findings of the present study shows that seed germination of *A. lebbeck* under different pre-treatment methods significantly increased (P>0.05) over the control. Among the six pre-treatments, seeds pre-treated with 75% H_2SO_4 had optimum germination than those pre-treated with hot-water and normal water treatment. The results of this study are in agreement with the findings of Mwase and Mvula (2011) [18] and Azad *et al.* (2012) [6]. Mwase and Mvula (2011) [18] and Palani *et al.* (1996) [21] also reported more or less similar results in *Bauhinia thonningii* Schum and *A. procera* respectively. The pre-treatment methods that affecting germination also influenced seedling growth reflected in the study and the highest seedling length (12.70 cm) were recorded with seeds treated with 75% H_2SO_4 during present investigation.

Table 3: Growth attributes of the *Albizia lebbeck* seedlings as affected by different pre-treatment.

Treatments	At the end of 28 Days		
	Shoot length (cm)	Root length (cm)	Total seedling height (cm)
T1	3.4	3.7	7.10
T2	4.1	4.3	8.40
T3	4.9	5.0	9.90
T4	6.2	6.5	12.70
T5	5.9	6.1	12.00
T6	3.1	3.4	6.50
S. Em.	0.23	0.12	0.36
C.D. @ 5	0.50	0.25	0.76

Conclusion

The present studies revealed that there were a difference in seed germination and seedling growth among the different seed pre-treatments, so in order to produce large number of quality seedlings it is necessary to apply best pre-sowing treatments because it plays a vital role to enhance the seed germination and seedling growth. Our investigation showed that immersion of *A. lebbeck* seeds in 75 H_2SO_4 for 12 hrs resulted in maximum germination as well as better seedling growth. Hence, this pre-sowing treatment can be used for breaking the seed dormancy and getting the improved germination and seedling growth.

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