



Effect of Pre-treatment on seeds of *Albizia lebbbeck* (L.) benth to enhance the germination percentage

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Abstract

The hard seed coat cause physical seed dormancy and low germination rate in *Albizia lebbbeck* (L.) to overcome this physical dormancy of seeds were pretreated with different external effects. Present study was investigated to find out the most suitable pretreatment method that will increase the germination percentage. The fresh seeds of *Albizia lebbbeck* (L.) were collected from three different localities viz. Chitrakoot, Naro and Papara belongs to Chitrakoot, Satna and Jigna forest range respectively. Different external effects were studied for breaking dormancy of seed viz. Environmental factors, Mechanical scarification, Electric shock, Photoperiod, Photosensitivity, Wavelength, Light intensity, Dry heat, Alternate temperature, Wet heat, Chilling, X-ray radiation, Ultraviolet radiation and far-red radiation were given to break the dormancy of seed germination of *Albizia lebbbeck* (L.). Maximum 100 percent germination was observed at far-red radiation treatment. However, Photosensitivity and Electric shock treatment were showed insignificant results.

Keywords: *Albizia lebbbeck*, seed dormancy, pretreatment, seed germination

Introduction

Albizia lebbbeck (L.) Benth commonly known as lebbbeck, siris or woman's tongue tree belongs to the family of Fabaceae and is amongst the most potential and useful fodder trees. Lebbbeck has a great ability to protect the soil through its rooting system that holds the soil together and reduces the effect of running water and prevailing winds. It has high nitrogen-fixing ability, provides shade, quality wood and it is used extensively for medicinal purposes. *Albizia lebbbeck* plays an important role in recycling soil nutrients in savannah and tropical areas of Nigeria (Orwa *et al.*, 2009) [20]. It is a general-purpose tree species remarkable for conservation to improve its impact on the livelihood and well-being of communities. The plant parts are used for the treatment of various diseases. Seed dormancy is the inability of viable seeds to initiate germination under favourable conditions for seeds to germinate. Germination of lebbbeck seed is irregular which makes propagation by seed very difficult. Baskin and Baskin (2004) [5] observed that seed coat impermeable to water is a very common type of dormancy in seeds of the Fabaceae family. Seed dormancy is the inability of viable seeds to initiate germination under favourable conditions for seeds to germinate. Germination of lebbbeck seed is irregular which makes propagation by seed difficult. In artificial regeneration, different forms of seed pretreatment are necessary where dormancy is strong to speed up germination and to achieve uniform germination of seeds. The use of organic compounds to enhance germination is still a growing aspect of research; its use for pretreatments of seeds of different tree species is been neglected and/or not yet known to so many tree breeders. According to Baskin and Baskin (2001) [4], organic compounds in the soil produced from different sources such

as soil organisms, seeds, plant roots and the remains of dead plants have the potentials to stimulate or hinder germination. Studies have shown the use of organic extracts to enhance germination and to break dormancy in different species. The use of bio extracts containing valuable elements (micro and macro elements) despite the active substances such as volatile compounds, improves the growth of plants through adequate supply of plant nutrients and assist in sustaining soil productivity and environmental health instead of synthetic chemicals (Rady and Seif El-Yazal, 2014) [24]. Previous studies on the influence of different pretreatment techniques in breaking the dormancy of seeds of some forest species proved mechanical scarification as an efficient means of breaking dormancy especially in legumes (Pacheco and Matos, 2009; Azad *et al.*, 2011; Santos *et al.*, 2013; Olatunji *et al.*, 2013) [21, 3, 26, 19]. The breaking of seed dormancy of *Albizia lebbbeck* has been found successful with the use of acid scarification (Ajiboye *et al.*, 2009) [1], the use of hot water (Missanjo *et al.*, 2013) [17] and mechanical scarification (Coelho *et al.*, 2014) [9] but all these methods have their limitations. Thus, there is a need for a more eco-friendly and affordable pretreatment technique that is easily accessible to farmers at all levels for effective germination and regeneration. Though Eyog-Matig *et al.* (2007) [13] successfully used organic compounds in breaking the seed dormancy of *Garcinia kola*, however, this method has not been used in breaking dormancy of *Albizia lebbbeck* seeds.

Material and Methods

A counted number of seeds were taken in each petridishes the petridishes were kept near the window in diffused light condition of the departmental laboratory at the room temperature. The observations were recorded daily and the

germinated seeds were removed from the petridishes after counting. The observations in all sets were continued for at least twenty days and were stopped when no further germination took place continuously after the specific period. Germination generally occurs between 4-20 days (Parrotta 1988) [23]. Germination and early seedlings development are favoured by sowing seeds just below the soil surface under light shade to full Sun (Troup, 1921). Different methods for breaking dormancy of seed viz. Environmental factors, Mechanical scarification, Electric shock, Photoperiod, Photosensitivity, Wavelength, Light intensity, Dry heat, Alternate temperature, Wet heat, Chilling, X-ray radiation, Ultraviolet radiation and far-red radiation were given to break the dormancy of seeds and also observed the seed germination of *Albizia lebbbeck* (L.).

Study area

On the basis of distribution and availability of the species three study sites Chitrakoot, Naro and Papara belongs to Chitrakoot forest range, Satna forest range and Jigna forest range respectively have been selected for study, collection of seeds and assess the ecological performance of *Albizia lebbbeck* (L.) in its forest community. The total area of the forest is about 15 square kms which has a hilly tract with undulating topography. The slope of area is gentle, steep and moderate.

Geology of this series has derived from the great Kaimur range which extends from Katni on the west to Mirzapur on the east, south Maihar and Rewa, thus geology of the tract is fairly complex, rocks consist of quartzites sand stones and sub ordinate shales inter bedded with joined porcellanite fragments. The soil is characterized by severe eroded reddish, sandy loam, devoid of humus with low depth. The seeds of plant *Albizia lebbbeck* (L.) were collected and preserved in glass stoppered bottles after getting cleaned and air dried in cool dry place at room temperature for experiment.

Result (Table 1)

1. **Environmental factors:** Seeds of *Albizia lebbbeck* (L.) were collected from different localities and germinated separately. Dormancy of seeds is biologically significant in delaying the germination process until the favourable environments are available. Germination control mechanism of seeds of certain arid and semiarid plants has an important role to play in the ecological life cycle of plants species after showing remained viable and germinate. During the present study various environmental factors have been studied for germination of seeds of *Albizia lebbbeck* (L.). The effects of locality indicate that the seeds of Chitrakoot region show significant result.
2. **Mechanical scarification:** In the present study mechanical scarification was carried out by the sand pounding, sand paper abrasion and seeds coat cutting at any end. Sand pounding for different timing, 10 healthy seeds was taken in a mortar pestle along with some quality of fine grained sand. The sand pounding was done gently for 5, 10, 15, and 20 minutes, and then these seeds were set for germination. Sand pounding and sand paper abrasion shows significant result, maximum germination was found 90 percent with sand pounding at 5 minutes treatment. The seed coat rupturing does not show significant result.
3. **Electric shock:** Electric shock treatment was done in a beaker containing acidified water and two copper electrodes immersed. Current of 240 volts was circulated from the main. Seeds were put in beaker shocks and were given for 2, 4, 6, 8, and 10 minutes duration. These treated seeds were set for germination test, results does not show any significant result.
4. **Photoperiod:** The seeds soaked in distilled water, were offered five cycles of 4, 8, 12, 16 and 20 minutes of light from a pair of cool white fluorescent lamps at a distance of 15 cm from the germinating dishes. The result shows that short time exposer was effective to enhance the germination percentage of seeds and long time exposer shows insignificant results.
5. **Photosensitivity:** To study the effect of photosensitivity on seed germination the petridishes were placed as under tree shade, room shade, bright and total darkness the germination percentage were recorded, result does not show any significant effect.
6. **Wavelength:** The seeds were arranged in petridishes and the dishes were covered with blue, green, yellow and red colour cellophane paper to obtain the monochromatic light. One set remain in natural light. It is treated as control. The result shows that effect of different wavelength of light is effective but under red light treatment 95 percent germination was recorded.
7. **Light intensity:** The seeds soaked in distilled water and subjected to continuous irradiation emanating from a pair of cool, white fluorescent lamps. Result indicates that germination percentage enhanced in light intensities ranging from 400-1200 lux, maximum germination percentage i.e. 95 percent was recorded under 400 lux intensity of light.
8. **Dry heat:** Mature dry seeds subjected to various dry heat temperatures (40, 50, 60, 80^o C) for different length of time range from 1 to 15 minutes, the pretreated seeds were set for germination test. The result shows that during dry heat treatment with increasing the time the percentage of germination was found in decreasing order. It is germinated 90 percent at 40^oC for one minute treatment. If the exposer time is increased the percentage of germination was decreased. (Figure 1)

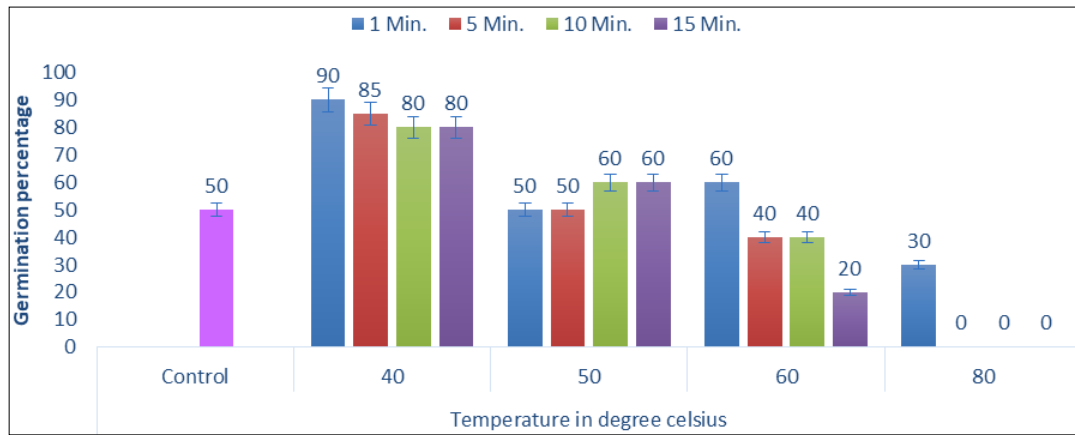


Fig 1

9. Alternate temperature: Alternate temperature treatment was carried out by keeping the moist seeds inside incubator at various range of low and high temperature (-10°C), the seeds were taken out after 24 hrs. of treatment, germination test were then set up. The result indicates that alternate temperature of various range had little effect for enhancing of seed germination. The range of 40-50°C shows maximum 90 percent germination, if the range of alternate temperature increased the percentage of germination decreased and show Nil at the range of 70-80°C.

10. Wet heat: Wet heat treatment was carried out by immersing the seeds in boiling water (98°C) for 1, 3, 5 and 7 minutes and seeds were allowed to cool to room temperature these treated seeds then set for germination test.

Results of wet heat (boiling water) treatment with increase in time the percentage of germination was gradually decreased. If the exposer time has increased up to 7 minutes the germination percentage decrease up to 60 percent. Boiling allow to cool at room temperature treatment also shows 80 percent germination.

11. Chilling: Chilling treatment was carried out by keeping seeds in ice chamber of refrigerator at 0°C for 3, 5, 7, 10 and 12 days. These pretreated seeds were subjected for germination test. The result indicates that during chilling treatment with increasing time, the germination percentage gradually decreases. Maximum percentage of germination is 90 percent after chilling the seeds up to 3 days

12. X-ray radiation: Freshly harvested were exposed to X-ray for a distance of 50 cm at 65 kv and 15 MA for a period 2, 4, 6, 8, 12, 16, 20 and 24 seconds in a local X-ray clinic, the seeds were set for germination test. X-ray radiation of 4 second treatment was noted suitable, but after that the germination percentage gradually decreased. Maximum germination was also recorded at 4 second treatment.

13. Ultraviolet radiation: Freshly harvested seeds were exposed to Ultraviolet radiation by Phillips 40 watt ultraviolet germicidal tube from a distance of 50 cm for a period of 30, 60, 90, 120, 150, and 180 minutes these treated seeds were subjected for germination test. The result of this treatment shows that ultraviolet radiation was effective in seed germination of *Albizia lebbek* (L.). The maximum 95 percent germination was observed at 120 minutes treatment of ultraviolet radiation.

14. Far-red radiation: Far-red radiations were provided by 60 watts Phillips infrared lamp covered with a black cloth to cut off visible radiations and kept a distance of one meter. The seeds were exposed for a period of 30, 60, 90, 120, 150 and 180 minutes. far-red radiation with increasing the time the percentage of germination was gradually increased but maximum duration of treatment of far-red reduce the germination percentage. Maximum 100 percent germination of seeds was recorded at 120 second treatment of far-red radiation.

Table 1

S. no.	Different external factors	Treatments	Time	Germination %
1	Effect of locality	Chitrakoot		80 ± 1.00
		Naro		70 ± 2.01
		Papara		70 ± 2.01
2	Mechanical scarification	Sand Pounding	5 Min.	90 ± 2.01
			10 Min.	70 ± 1.01
			15 Min.	30 ± 2.01
		Sand Paper Abrasion	5 Min.	80 ± 1.01
			10 Min.	40 ± 3.01
			15 Min.	20 ± 2.12
	Seed coat rupturing		50 ± 1.00	
	Control		60 ± 2.10	
3	Electric Shock	Electric Shock	2 Min.	50 ± 1.00

			4 Min.	40 ± 3.01
			6 Min.	30 ± 2.01
			8 Min.	10 ± 2.12
			10 Min.	10 ± 2.12
			Control	60 ± 2.10
4	Photoperiod	Photoperiod	8 Min.	60 ± 1.02
			12 Min.	90 ± 1.01
			16 Min.	40 ± 3.01
			20 Min.	20 ± 2.56
			24 Min.	10 ± 4.02
		Control		60 ± 2.10
5	Photosensitivity	Total darkness	During germination	30 ± 2.00
		Room shed	During germination	Nil
		Tree shed	During germination	30 ± 4.02
		Bright shed	During germination	25 ± 2.56
		Control		80 ± 1.00
6	Wavelength	Blue	During germination	60 ± 2.10
		Green	During germination	50 ± 1.00
		Yellow	During germination	70 ± 2.02
		Red	During germination	95 ± 2.01
		Control		60 ± 2.10
7	Light Intensities (Lux)	400	During germination	95 ± 3.01
		540	During germination	85 ± 2.01
		680	During germination	90 ± 1.01
		1200	During germination	85 ± 2.12
		Control		60 ± 2.10
8	Alternate temperature	20-30°C	24 hrs.	85 ± 2.50
		30-40°C	24 hrs.	80 ± 1.00
		40-50°C	24 hrs.	90 ± 1.12
		50-60°C	24 hrs.	60 ± 1.02
		60-70°C	24 hrs.	50 ± 1.15
		70-80°C	24 hrs.	Nil
		Control		60 ± 2.10
9	Wet heat	Boiling Water (98°C)	1 Min.	90 ± 1.10
			3 Min.	80 ± 1.25
			5 Min.	70 ± 2.00
			7 Min.	60 ± 0.15
		Boiling Water allowed cool (Room Temp.)		80 ± 1.00
		Control		40 ± 2.05
10	Chilling treatment	Chilling treatment	3 days	90 ± 2.10
			5 days	60 ± 0.2
			7 days	30 ± 1.50
			10 days	20 ± 1.5
			12 days	Nil
		Control		50 ± 1.50
11	X-ray	X-ray	2 Sec.	80 ± 2.12
			4 Sec.	90 ± 3.10
			8 Sec.	70 ± 1.15
			12 Sec.	50 ± 1.50
			16 Sec.	40 ± 2.05
			20 Sec.	30 ± 1.15
		24 Sec.	Nil	
Control		50 ± 1.50		
12	Ultraviolet radiation	Ultraviolet radiation	30 Min.	80 ± 1.05
			60 Min.	90 ± 2.01
			90 Min.	90 ± 0.02
			120 Min.	95 ± 2.05
			150 Min.	40 ± 0.15
			180 Min.	30 ± 1.25
		Control		40 ± 0.15
13	Far-red radiation	Far-red radiation	30 Min.	70 ± 2.15
			60 Min.	90 ± 1.15
			90 Min.	95 ± 3.05
			120 Min.	100 ± 1.25
			150 Min.	80 ± 0.05
		180 Min.	30 ± 1.05	
		Control		50 ± 1.50

Discussion

In the study seeds of *Albizia lebbeck* (L.) shows 70 percent germination, which was collected from Papara and Naro forest and 80 percent of Chitrakoot forest. It confirms that the seeds which was collected from higher elevation, shows less percentage of germination. Similar observations were also recorded by Sen (1977)^[28]. It is due to hard seed coat.

Seed dormancy has been the major cause of delayed seed germination and various methods have been suggested to overcome it. The seeds of most of the species indicated a high percentage of germination after certain pretreatment (Sen, 1977)^[28]. In the present investigation the seeds of *Albizia lebbeck* (L.) showed seed dormancy, various mechanical scarification treatment viz. sand pounding, sand paper abrasion and seed coat rupturing, and electric shock treatment has been given for different duration. The seed coat rupturing and sand paper abrasion does not show significant result, but sand pounding treatment enhanced the germination percentage up to 90 percent. Similar results were also observed by Saksena (1963)^[25] with *Hyptis suaveolens*, Chatterji (1975)^[8] with *Abutilon indicum* and Alvarez *et al.* (1977)^[2] with *Leucaena leucocephala*. Fraser (1916) and Fraser and Pidgeon (1933) observed the influence of electric shock on germination, but during present study the electric shock does not show any significant result.

Evenari (1965)^[12] reviewed the role of light in germination; Photoblastic seeds may positively or negatively produce result. Different photoblastic seeds require different quantum of light for germination. It is often stressed that there is dual action of white light on seed germination generally shorten exposer are promotive and longer once are inhibitory results (Borthwick, 1965; Pandeya, 1968 and Singh, 1972)^[22, 29]. In case of *Albizia lebbeck* (L.) seeds the effect of light for different periods shows various results but after 12 minutes treatment enhance in percentage of seed germination were observed. During different light conditions there is not any significant result. Effect of monochromatic light on seed germination of *Albizia lebbeck* (L.), indicates that under red light treatment enhance the germination percentage i.e. 95 percent, the blue green and yellow do not show any significant effect on the percentage of seed germination. The effect of different light intensity in germination percentage of *Albizia lebbeck* (L.) shows moderate effect. The light intensity of 400 Lux treatment shows 95 percentage of germination.

Temperature play an important role in germination of seeds (Vegis, 1964)^[34], seeds due to ecological requirements have a definite temperature range with in which they germinate. Santra *et al.*, (1981)^[27] have noticed a promotive effect of low temperature. The alternate temperature for the seeds of *Albizia lebbeck* (L.) was not much effective; it shows 90 percent of germination under the treatment 40-50°C. Various aspect of the effect of visible radiation on seed germination of some species has been studied by a number of workers (Evenari, 1952 and 1961; Kawahara and Takoda, 1961 and Joshi, 1962)^[10, 11, 15, 14]. A temperature range between 1°C to 10°C have been found to be most successful in bringing about the desired effect in a majority of plants. McDonough (1974) reported a temperature of 1°C to be the most effective for the achenes of *Senecio jacobina* seeds of *Amrosia attenissifolia* requires a temperature of 40°C for overcoming dormancy (Willemsen, 1978). Toole *et al.* (1964)^[32] noted that 25°C was the most effective

temperature for pea nuts. Baskin and Baskin (1975)^[6] reported application of more than one stratification period at different temperature regions of 10°C, 15°C and 20°C to be the most effective in the seeds of *Isanthus brachiatis*. Results are similar with the findings of Obiazi (2015)^[18] with *Leucaena leucocephala* treated with hot water. Similar results were also observed treated with hot water by Tiwari and Dhuria (2018)^[31] with *Albizia procera* and Tiwari *et al.* (2020)^[30] with *Albizia lebbeck*.

Conclusions

To overcome the physical dormancy with obtaining best seed germination pretreatment parameters, seeds pretreated with Red wavelength, 400 lux Light intensity, 120 minute Ultraviolet radiation and 90 minutes Far-red radiation treatment shows 95 percent seed germination. However, Far-red radiation treatment for 120 minutes shows 100 percent seed germination of *Albizia lebbeck* plants. So in order to produce large number of quality seedlings it is necessary for pre-sowing treatment because it play a vital role to enhance the germination. According to our studies, the above treatments for *Albizia lebbeck* is best for seed germination.

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