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Seed germination studies on three predominant tree species of southern Uttar Pradesh

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ABSTRACT

The paper deals with the germination behaviour and the relative salt tolerance of *babul (Acacia arabica)*, *khair (Acacia catechu)* and *siris (Albizzia lebbek)* at the Forest Research Laboratory, Kanpur. These species have been recognised as useful for industrial and important domestic purposes. The shape index determinations, various pre-treatments for sowing of the seeds alongwith the relative salt tolerance studies were conducted under nursery and laboratory conditions. The study reveals that if the seeds are treated before sowing, germination and seedling emergence of the species are enhanced. The germination of these species were also studied under various salinity levels and tolerance ranges were worked out for all the three species.

INTRODUCTION

Some aspects of seed germination were studied on the tree species like *Acacia arabica (babul), Acacia catechu* (*khair*) and *Albizzia lebbek* (*siris*), belonging to the family Mimosoideae. These species frequently occur in the southern part of Uttar Pradesh forest and are recognized as useful for industrial and important domestic purposes. Studies were conducted under nursery and laboratory conditions at Kanpur (26° 30′N and 80° 15′E) to evaluate the optimum conditions to have maximum number of seedlings within the shortest possible time. The germination of these three species was also assessed under various salinity levels, since it is one of the major problems of this region, and specific tolerance ranges were worked out.

MATERIAL AND METHODS

Seeds collected from the Southern forest region of Uttar Pradesh were stored in stoppered glass bottles at room temperature. Various parameters regarding seed morphology were worked out. Healthy and uniform seeds of all the three species were selected. Acid scarification treatment was given with conc. H_2SO_4 for different durations. Absorbability of water was determined by using glass distilled water for different durations. After the acid scarification treatment the seeds were washed in running water, sown under nursery beds at different depths and seedling emergence recorded after 3 weeks.

To study the effect of various salt concentrations on seed germination, five concentrations of sodium chloride (NaCl), sodium sulphate (Na_2SO_4) and calcium

chloride ($CaCl_2$) in 2:1:1 ratio was prepared to obtain solutions of different electrical conductivity (E.C.) (mmhos/cm) viz. 2,4,8,12 and 15, alongwith a control (0 E.C.) as suggested by Bhumbla *et al.* (1968) and also used by Sharma and Gupta (1971). The seeds were placed between moist filter papers and in sterilised petri dishes and the final germination counts were made after a week for each species in triplicate. Care was taken to always keep enough quantity of solution (3 ml) in each dish to maintain the filter papers moist. Sufficient number of seeds (20 seeds in each petri dish in triplicate) were taken to analyse the data statistically.

RESULTS AND DISCUSSION

Size and weight of seed

The species have almost similar shape index, yet they differ in their individual length and breadth. Seed weight also differs (Table 1).

Germination of seeds after scarification at different depths

The maximum percentage of seedling emergence in *Acacia arabica* occurred at 2 cm depth in almost all the treatments followed by 4 cm. The value decreased gradually in 6 and 8 cm. The emergence of the seedlings was rapid at 2 and 4 cm depths (Table 2).

In *A. catechu* the maximum percentages of seedling emergence occurred at 1 and 2 cm depths in all the treatments studied. In 12 and 24 h of water soaking 4 cm depth also gave better emergence, which decreases considerably at 6 cm depth (Table 3).

The germination of *Albizzia lebbek* was found maximum in 24 h of water soaking at 1 cm depth and 10 min of acid scarification upto 3 cm depth. The values declined subsequently (Table 4).

Effect of salt concentrations on seed germination

In the case of *A. arabica* germination was observed to be good upto 12 E.C. after which it declined. *A. catechu* performed well upto 8 E.C. Salt tolerance of *A. lebbek* was almost similar to that of *A. arabica.* All responses were statistically significant ($P < 0.05$). *Babul* and *khair* appear to be more salt tolerant than *siris* (Table 5).

Placement of seeds in the soil at a proper depth governs the successful emergence of seedlings and subsequent growth because of the prevailing micro environment at various soil depths (Pathak, 1967). In nature, seeds get

Table 1. Average weight and size of seed

Species	Weight (gm)	Length (cm)	Breadth (cm)	Shape index (length/breadth, ratio)
Acacia arabica	0.053	0.72 ± 0.101	0.59 ± 0.065	1.22
Acacia catechu	0.060	0.66 ± 0.083	0.55 ± 0.076	1.20
Albizzia lebbek	0.086	0.87 ± 0.006	0.71 ± 0.003	1.22

Table 2. Effect of water soaking and acid scarification *vs.* sowing depth on germination percentage of *Acacia arabica*

Treatment	Depth of sowing (cm)			
	2	4	6	8
Without water soaking	72.0 (58.05)	33.0 (35.06)	11.0 (19.37)	11.0 (19.37)
12 h water soaked	72.0 (58.05)	56.0 (48.45)	33.0 (35.06)	22.0 (27.97)
24 h water soaked	56.0 (48.45)	78.0 (62 03)	45.0 (42.13)	6.0 (14.18)
5 min acid scarification	45.0 (42.13)	45.0 (42.13)	22 0 (27.27)	0.0 (0)
10 min acid scarification	39.0 (30.65)	28.0 (31.95)	18.0 (25.10)	0.0 (0)

Values in parenthesis are angular transformations.
C.D. ($P < 0.05$). Scarification x depth (10.63).

Table 3. Effect of water soaking and acid scarification *vs.* sowing depth on germination percentage of *Acacia catechu*

Treatment	Depth of sowing (cm)				
	1	2	3	4	6
Without water soaking	26.0 (48.45)	6.0 (14.18)	6.0 (14.18)	18 0 (25.10)	6.0 (14.18)
12 h water soaked	45.0 (42.13)	22.0 (27.97)	18.0 (25.10)	18.0 (25.10)	6.0 (14.18)
24 h water soaked	28.0 (31.95)	22.0 (27.97)	33.0 (55.06)	22 0 (27.97)	11.0 (19.37)
2 min acid scarification	22.0 (27.97)	28.0 (31.95)	18.0 (25.10)	11.0 (19.37)	11.0 (19.37)
3 min acid scarification	18.0 (25.10)	11.0 (19.37)	0 0 (0)	0.0 (0)	0.0 (0)

Values in parenthesis are angular transformations.
C.D. ($P < 0.05$). Scarification x depth (9.77).

Table 4. Effect of water soaking and acid scarification *vs.* sowing depth on germination percentage of *Albizzia lebbek*

Treatment	Depth of sowing (cm)				
	1	2	3	4	6
Without water soaking	22.0 (27.97)	64.0 (55.13)	43 0 (40.98)	43.0 (40.98)	29.0 (32.58)
12 h water soaked	50.0 (45.00)	29.0 (32.58)	50.0 (45.00)	7.0 (15.34)	29.0 (32.58)
24 h water soaked	79.0 (62.72)	71.0 (57.42)	64.0 (53.13)	43.0 (40.98)	43.0 (40.98)
5 min acid scarification	71.0 (57.42)	64.0 (53.13)	64.0 (53.13)	64.0 (53.13)	43.0 (40.98)
10 min acid scarification	71.0 (57.42)	86 0 (68.03)	86.0 (68.03)	43.0 (40.98)	36.0 (36.87)
15 min acid scarification	57.0 (49.02)	64.0 (53.13)	19.0 (25.84)	50.0 (45.00)	14.0 (21.97)

Values in parenthesis are angular transformations.
C.D. ($P < 0.05$). Scarification x depth (12.06).

Table 5. Effect of salt concentrations on germination percentage of (a) *Acacia arabica*, (b) *Acacia catechu* and (c) *Albizzia lebbek* seeds

Salt concentration E.C. (mmhos/cm)		No. of sets (replicates) I	II	III
0	a	25.0 (30.00)	20.0 (26.56)	25.0 (30.00)
	b	70.0 (56.79)	70.0 (56.79)	70.0 (56.79)
	c	44.0 (41.55)	50.0 (45.00)	20.0 (26.56)
2	a	25.0 (30.00)	35.0 (36.27)	25.0 (30.00)
	b	65.0 (53.73)	75.0 (60.00)	80.0 (63.44)
	c	40.0 (39.23)	35.0 (36.27)	20.0 (26.56)
4	a	50.0 (45.00)	25.0 (30.00)	25.0 (30.00)
	b	80.0 (63.44)	70.0 (56.79)	70.0 (56.79)
	c	30.0 (33.21)	30.0 (33.21)	35.0 (36.27)
8	a	35.0 (36 27)	40.0 (39.23)	35.0 (36.27)
	b	95.0 (77.08)	90.0 (71.56)	90.0 (71.56)
	c	30.0 (33.21)	40.0 (39.23)	60.0 (50.77)
12	a	50.0 (45.00)	50.0 (45.00)	70.0 (56.79)
	b	85.0 (67.21)	65.0 (53.73)	70.0 (56.79)
	c	40.0 (39.23)	45.3 (42.13)	35.0 (36.27)
15	a	45.0 (42.13)	15.0 (22.79)	35.0 (36.27)
	b	75.0 (60.00)	85.0 (67.21)	55.0 (47.87)
	c	50.0 (45.00)	30.0 (33.21)	35.0 (36.27)

Values in parenthesis are angular transformations.
C.D. ($P < 0.05$). Concentration, a (11.06), b (9.98), c (11.71).

scarified presumably by the decomposing action of soil microbes, chemical action of organic and inorganic acids, mechanical action of soil particles, fluctuating temperatures, or other factors such as soil moisture, gaseous concentration etc. either working singly or together (Mayer and Mayber, 1975). Treatments of seeds before sowing enhance the germination and seedling emergence of the species. Sen and Chatterji (1968) reported that scarification improved the germination of many hard coated leguminous seeds. In the present investigation acid treated and water soaked seeds when sown upto 4 cm of depth gave good emergence in all the three species. The maximum emergence at upto 2 cm of depth indicates that when depth of sowing is accompanied by scarification, seeds should not be sown deeper. Profile microbial activity also plays an important role in seed germination. Pathak and Debroy (1975) suggested the sowing of *Leucaena leucocephala* at 2-4 cm depth. Singh *et al.* (1973, 1975) in their study of kail (*Pinus wallichiana*) and spruce (*Picea smythiana*) suggested that the seeds of these species should not be sown deeper.

The electrical conductivity of the extract of saturated soil is regarded as the most suitable index for appraising soil salinity and its relation to crop growth. Moderately salt tolerant species may do well on soils where the conductivity does not exceed 8 mmhos/cm. Restricted growth may be possible at conductivities between 8 and 15 mmhos/cm (Ramakrishnan, 1977). Excess of salts in the soil often occurs in regions of arid and semi-arid climate, where there is low rainfall and high temperature. This is further aggravated due to high water table. *Babul* and *khair* appear to be more salt tolerant as compared to *siris* and germinated well upto 12 E.C.

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