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Seed attributes, germination responses and seedling growth of silk cotton tree *Bombax ceiba* L.

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Abstract

In vitro Seed germination through different treatments, and seedling growth of *Bombax ceiba* were studied from April 2009 to January 2010. Fifty seven per cent seed germination at control condition was enhanced up to 63% by continuous tap water washing for 48 h duration. Freshly collected seeds in April did not germinate in May and June. Stem diameter and height of one and 6 months old seedlings were 0.3 cm, 1.2 cm and 1.2 cm, 87.1 cm, respectively.

***Key words*:** *Bombax ceiba*, germination, seeds, scarification, tap water washing

Introduction

Silk cotton tree- *Bombax ceiba* L. (Bombaceae) is a large deciduous tree native to tropical areas in western Africa, the Indian sub-continent, south East Asia and northern Australia. It is a keystone species of riverine forest ecosystem. It provides shelter to birds in general and vultures, eagles and honey bees in particular. It gives Industrial raw materials for matches and stuffing materials for various purposes. The tree is overexploited in Nepal and its natural regeneration capacity is at risk.

Seeds contain necessary stored materials for the early growth and development of the next generation of plants. Information on seed germination behavior contributes to a better understanding of certain biological aspects like reproductive strategies, life history traits, adaptation to habitat, etc. (Baskin & Baskin, 2006). Much information is available on the socio-economy and ecological aspects of *Bombax ceiba* (CSIR, 1972; Pratap, 1997; Jha *et al.*, 2006; K.C., 2007/08). The seeds possess dormancy due to impermeable seed coats (Chattarji & Sen, 1964; Athaya, 1990). Present study was aimed to study requirements for the effective seed germination.

Materials and Methods

Collection and storage: Dry capsules were collected from superior *B. ceiba* trees from Humse-Dumse community forest, Damak, Jhapa, eastern Nepal in the last week of April 2009. Seeds were separated from the floss and dried in shade for 7 days. Air dried seeds were kept in sealed polythene bags and stored at ambient condition in the laboratory.

Seed attributes: Colour, shape, weight and number/capsule of air dried seeds were recorded with adequate replicates (n=10). Seed viability was determined as per Moore (1962). Pre weighed air dried seeds were soaked in water for 24 h and reweighed for water imbibition.

Germination test: It was carried out in Department of Botany, Post Graduate Campus, T.U. Biratnagar, Nepal from May to August, 2009 (laboratory temperature 30±5°C). Germination was performed in sterilized petridishes (dia 9 cm) with a double layer of water saturated blotting paper. Moisture level was maintained by frequent addition of distilled water. Seeds in triplicates containing 10 healthy seeds in each petridish were placed on the table in laboratory at room temperature which received diffused light through windows. Following tests were applied.

1. Water soaking: Seeds were put inside 500 ml beaker containing tap water for 1, 2, 3, 4 and 5 days duration.
2. Water washing: Inside the cotton bag seeds were washed continuously with slow running tap water for 1, 2, 3, 4 and 5 days duration.
3. Stratification: Seeds were immersed for 5 min in hot water at various temperatures (40^0C, 50^0C, 60^0C, 70^0C, 80^0C).
4. Sand scarification: Air dried seeds were rubbed with sand in mortar and pestle for 2, 4, 6, 8 and 10 min duration.
5. Acid scarification: Seeds were treated with 98% H_2SO_4, for 2, 4, 6, 8 and 10 min by glass rod stirring. They were placed in fine wire meshes and washed for 15 min in running tap water.
6. Control: Seeds were immerged for 1 h in tap water.
   Test seeds were sterilized with 0.2% $HgCl_2$ solution and ringed with distilled water before germination.

Seedling growth: Twenty days old *B. ceiba* seedlings were transplanted in earthen pots (dia 15 cm, depth 20 cm) containing garden soil, sand and compost (2:1:1). They were placed in the field and received frequent watering. Diameter of the stem above 5 cm from the ground level and height of the seedling were measured by centimeter scale at monthly intervals. The seedling growth was observed from August 2009 to January 2010.

Results and Discussion

The data on the physical attributes and biological characteristics of silk cotton seeds are presented in tables 1 and 2. Oval and brown coloured seeds had 83.3% viability however; they had only 57% germination under control condition. Seed output per capsule was 285 and one kg air dried seeds contained 24,400 individuals. The number of air dried seeds per kg varies between 21000-45000 according to Jackson (1994).

Table 1. Physical attributes of *B. ceiba* seeds (mean ± SE).

Colour	Shape	Length (mm)	Breadth (mm)	Size index (l/b)	Shape index (l×b)	Weight (g)
Brown	Oval	6.4±0.8	4.5±0.6	1.4±0.3	28.5±1.6	0.4±0.2

Table 2. Biological characteristics of *B. ceiba* seeds (mean ± SE).

Number/kg	Output/capsule	Imbibition (%)	Viability (%)	Germination (%)
24400±49.4	285±5.3	11.6±1.5	83.3±2.8	57.0±3.3

Freshly collected seeds in April had no germination in May and June. The seeds germinated only after July at the onset of rainy season. Essentiality of two months storage for freshly collected seeds in dry ambient room condition may be an indication of underdeveloped embryos requiring after-ripening period. In some primitive tropical species underdeveloped embryos grow slowly after seed dispersal and they eventually germinate (Grushvitzky, 1967). Germination was initiated after 8 days and was completed within 21 days of seed

sowing. Jackson (1994) reported 50% or less germination which started after few days of sowing and completed within a month.

Hot water treatment at 40°C improved germination up to 60% but above it had adverse effect (Tab. 3). Concentrated H_2SO_4 scarification beyond 4 min had adverse impact. Water soaking/ washing for 48 h duration improved germination from 60-63%. Continuous tap water washing for 48 h was most effective (63%) in silk cotton seed germination (Tab. 4). Other time period of soaking/washing had no significant effect up to 120 h. Sand scarification for 4 min enhanced the germination (60%), however beyond this had inhibitory effect.

Table 3. Effect of hot water treatment on seed germination of *B. ceiba*.

Temp. (°C) for 5 min	Germination %
40	60
50	50
60	43
70	20
80	12

Table 4. Seed germination of *B. ceiba* by acid/sand scarification and water soaking/washing for different durations.

Test	Duration (h)	% Germination	
		Water soaking	Water washing
Soaking / washing	24	50	50
	48	60	60
	72	53	53
	96	43	43
	120	40	40
		Sand rubbing	Conc. H_2SO_4
Scarification	2	50	56
	4	60	43
	6	43	33
	8	36	13
	10	30	6

November was the most favourable month for seedling growth. One month old seedling with 12.7 cm height attained 87.1 cm height in 6 month (Tab. 5).

Table 5. Growth of *B. ceiba* seedlings up to 6 month (mean ± SE).

Age of seedling/month	Temperature max/min (^{0}C)	Relative humidity (%)	Stem diameter (cm)	Height (cm)
1st month/ August	32.5/26	89.5	0.3 ± 0.17	12.5 ± 1.1
2nd month/ September	34.2/25	84.5	0.4 ± 0.20	20.2 ± 1.4
3rd month/ October	32.2/21.1	83.5	0.6 ± 0.24	43.4 ± 2.0
4th month/ November	29.0/15.2	84.3	0.9 ± 0.30	74.7 ± 2.7
5th month/ December	24.5/11.3	96.4	1.1 ± 0.33	79.3 ± 2.8
6th month/ January	23.4/11.4	98.7	1.2 ± 0.34	87.1 ± 2.9

Increased germination (60-63%) of silk cotton with water washing/ soaking up to 48 h may be due to water soluble phytotoxin in the dry pericarp that could inhibit germination. Warang (1994) reported water soluble phytotoxin in the dry pericarp of mesquite (*Prosopis*

juliflora) seeds this might be an extension of the vivipary-avoidance processes and a safeguard against potential intraspecific competitions. Furthermore, enhancement in seed germination percentage in contrast to control with hot water treatment (40^0C) and water soaking for 48 h in the present study might be due to softening of seed coat and making it permeable to water. The relatively lower germination percentage in untreated seeds could be attributed to existence of impermeable seed coat or due to the presence of inhibitory substances in it (Suryawanshi *et al.*, 2001; Girase *et al.*, 2002).

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