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Pre-Sowing Treatments Accelerate Germination Percent for Restoration of Fourteen Threatened Tree Species in Bangladesh

G.N.T. Hasnat*, M.A. Hossain and M.K. Hossain

Institute of Forestry and Environmental Sciences, University of Chittagong, Chittagong-4331, Bangladesh

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Abstract

Ecologically valuable native tree species are becoming threatened due to deforestation, forest fragmentation and preference of fast-growing exotics than the native ones in plantation. One of the main reasons for the preference of exotic species than the native ones is its higher rate of germination and rapid growth. The effect of different pre-sowing treatments was studied on fourteen threatened tree species of Bangladesh to find out the appropriate treatments for speed up germination rate and initial seedling growth. These species are ecologically valuable multipurpose indigenous trees of Bangladesh. Methanol extract of *Castanopsis indica* leaves could decrease the tumor Ehrlich Ascites Carcinoma volume and weight. *Lophopetalum wightianum* is a globally threatened tree species. Hard coated seeds of *Canarium resiniferum*, *Castanopsis indica*, *Protium serratum*, *Quercus acuminata* and *Vitex peduncularis* were treated with sand paper, nicking, normal water, hot water, H_2SO_4 and HCl. Soft coated seeds of *Brownlowia elata*, *Dichopsis polyantha*, *Firmiana colorata*, *Lophopetalum wightianum*, *Pterospermum acerifolium*, *Pterospermum semisagittatum*, *Pterygota alata*, *Schleichera oleosa* and *Sterculia villosa* were sown in polybags, propagator house and nursery bed in normal, flat and 45^o angle positions. Among all hard-coated seeds, *Castanopsis indica* showed significantly higher germination percentage (67%) after seeds treated with sandpaper in comparison to control (25%). Soft-coated seeds of *Lophopetalum wightianum* showed significantly higher germination percentage (90%) among all studied species when sown in propagator house, whereas in natural condition it provides only 26% germination rate. This paper will help to restore ecologically valuable threatened species.

Keywords: Pre-sowing treatment, globally and nationally threatened tree species, germination rate, hard or soft-coated seed, Bangladesh

1. Introduction

Bangladesh had a rich floral diversity containing about 5,700 species of angiosperms (Khan, 1977; Hossain, 2001). However, the floral diversity has been disrupted (Haque et al., 1997; Uddin and Misbahuzzaman, 2007; Hossain et al., 2012) and the natural forests have been degraded along with its native tree species (Hossain, 2001; Hossain et al., 2012). Native tree species are becoming threatened due to forest disturbance and hazardous invasion of fast-growing exotics (Islam, 2003; Afrin, 2010; Mangla et al., 2011). A total of 486 plant species in Bangladesh are considered as threatened of which 449 are angiosperms (Irfanullah, 2011). Among these, some valuable timber species are also included, which are ecologically and economically important (Khan et al. 2001; Hossain et al. 2004). One of the ecologically valuable timber species is *Castanopsis indica* (Roxb.), commonly known as Shil Batna, which has medicinal value too. Methanol extract of *Castanopsis indica* (MECI) leaves has a significant effect on Ehrlich Ascites Carcinoma (EAC) cell. A dose of dependent manner can decrease the tumor volume and tumor weight, and elevate the life span of EAC tumor bearer (Dolai et al., 2012).

*Correspondence: gnthasnat@yahoo.com
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Another important native tree of Bangladesh is *Lophopetalum wightianum* (Arn.), locally known as Raktan, a globally threatened tree species (IUCN, 1998). Natural regeneration of exotic species through seed dispersal is too high than native tree species (Flores-Moreno, 2013). The germination rate of major plantation exotic species is also greater than native species (Klink, 1996; Wainwright and Cleland, 2013). In natural forests as well as in plantation, natural regeneration of some native species is very low (Hossain, 2003; Uddin et al., 2013) because of poor germination percentage in comparison to fast-growing species (Pallewatta et al., 2003; Afrin, 2010). Nursery pre-sowing treatment is the primary and only step to recover these ecologically valuable threatened native trees by increasing their germination rate to compete with economically valuable exotics (Hossain and Pasha, 2001; Myers and Bazely, 2003). Appropriate pre-sowing treatment could only speed up germination rate and thus assure more germination of seeds sown. The present investigation was designed to find out the appropriate pre-sowing treatments for maximum germination percent of the species, particularly fourteen native threatened tree species of natural forests of Bangladesh. This paper will be a paradigm for future studies on pre-sowing treatment effects of other valuable tree species to restore on the earth from becoming extinct.

2. Methodology

2.1 Study site, seed collection areas, times and pre-sowing treatments

The experiment was carried out during 2012-13 in the Seed Research Laboratory, propagator house[1] and the nursery of the Institute of Forestry and Environmental Sciences, Chittagong University (IFESCU), Bangladesh. The species along with their seed collection time, seed collection area and pre-sowing treatments are shown in Table 1.

2.2 Germination percentage/ germination rate

Germination was observed and recorded at every day after seeds sown and continued up to six months to find out the last germination of the seeds. Germination percentage was calculated by counting the number of seeds germinated out of 100 from beginning to end of the experiment (Dwivedi, 1993; Kumar, 1999).

$$\text{Germination percentage} = \frac{\text{Number of seeds germinated}}{\text{Number of seeds sown}} \times 100 \quad (1)$$

3. Results and Discussion

The highest germination percentage (100%) was found in *P. semisagittatum* when seeds were sown in commonly used polybags in flat position. Except *P. serratum*, highest germination was found only after providing pre-sowing treatments in the remaining 13 species. In *B. elata*, 96% germination was found when seeds sown in normal polybags without any pre-sowing treatment (control) and highest germination percentage (98%) observed when sown in propagator house (Figure 1). *C. resiniferum* provided 20% germination rate when seeds sown without any pre-sowing treatment in normal polybags (control). But highest germination (33%) was found in normal water treatment for 24 hours and H_2SO_4 treatment (10%) for 3 minutes (Table 2). *C. indica* attained only 25% germination when seeds sown in polybags without any pre-sowing treatment (control), but highest germination (67%) was observed when seeds were treated with sandpapers rubbing at the distal end and sown in polybags (Figure 1). *D. polyantha* showed 29% germination rate when seeds sown in normal polybags without any pre-sowing treatment (control), but germination increased up to 47% when sown in propagator house (Table 2).

[1]**Propagator house:** Greenhouse is a structure, primarily of glass, in which temperature and humidity can be controlled for the cultivation or protection of plants. Propagator house is one type of greenhouse with a bed consists of *Sylhet* sand with controlled temperature and humidity.

Table 1: Seed collection areas, collection time and pre-sowing treatments provided to the species.

Scientific name	Local name	Hard/ soft coated	Seeds collected from	Fruit/seed collection (month)	Pre-sowing treatments
Brownlowia elata	Moos	Soft	Ukhiya	August	Control[i], seeds sown in propagator house, nursery bed, polybags with soil only
Canarium resiniferum	Dhup	Hard	Adampur, Moulavi Bazar	October	Control, whole fruits sown in polybags, propagator house, seeds treated with sandpaper, nicking, normal water (24 hours), hot water (1 minute), H_2SO_4 (3 and 5 minutes), HCl (3 and 5 minutes), seeds sown in propagator house
Castanopsis indica	Shil Batna	Hard	Dulhazara	August	Control, seeds treated with sandpaper, nicking, normal water (24, 48, 72 hours), hot water (1 minute), H_2SO_4 (5 minutes), HCl (5 minutes), seeds sown in propagator house
Dichopsis polyantha	Tali	Soft	Hazarikhil	March	Control, seeds sown in propagator house
Firmiana colorata	Udal	Soft	Ampu Para, Bandarban	April	Control, seeds sown in propagator house
Lophopetalum wightianum	Raktan	Soft	Lawachara	August	Control, seeds sown in propagator house and nursery bed
Protium serratum	Gutgutia	Hard	Kaptai	September	Control, seeds treated with sandpaper, nicking, normal water (24 hours), hot water (1 minute), H_2SO_4 (1 and 3 minutes), HCl (1 and 3 minutes), fruits sown in propagator house
Pterospermum acerifolium	Moochkunda	Soft	Kaptai	April	Control, seeds sown in shade, flat position
Pterospermum semisagittatum	Lana Asaar	Soft	Chunati, Satkania	April	Control, seeds sown in shade, flat position
Pterygota alata	Narikeli	Soft	Rangpur	January	Control, seeds sown with more than 45° angles, under shade with straw, under shade with chatai, in propagator house
Quercus acuminata	Kali Batna	Hard	Dulhazara	August	Control, seeds treated with sandpaper, nicking, normal water (24, 48, 72 hours), hot water (1 minute), H_2SO_4 (5 minutes), HCl (5 minutes), seeds sown in propagator house
Schleichera oleosa	Kusum	Soft	Madhupur Sal Forest, Tangail	September	Control, seeds treated with sandpaper, nicking, normal water (24 hours), seeds sown in propagator house
Sterculia villosa	Udal	Soft	Jibannagar, Bandarban	April	Control, seeds sown in propagator house
Vitex peduncularis	Horina Goda	Hard	Dulhazara	August	Control, seeds sown in propagator house, nursery bed

Table 2: Germination percentage of fourteen native threatened tree species after providing pre-sowing treatments in comparison to without any treatment (control).

Scientific name	Local name	Family	Germination (%) (*Control)	Highest germination (%)	Pre-sowing treatment(s) for Highest	Fruits/seeds sown in
B. elata	Moos	Apocynaceae	96	98	Seeds sown in Propagator house	Propagator house
C. resiniferum	Dhup	Burseraceae	20	33	Normal water (24 hours), 10% H_2SO_4 (3 minutes)	Polybag
C. indica	Shil Batna	Fagaceae	25	67	Seeds treated with sandpaper	Polybag
D. polyantha	Tali	Sapotaceae	29	47	Seeds sown in Propagator house	Propagator house
F. colorata	Udal	Sterculiaceae	83	95	Seeds sown in Propagator house	Propagator house
L.wightianum	Raktan	Celastraceae	26	90	Seeds sown in Propagator house	Propagator house
P. serratum	Gutgutia	Burseraceae	30	30	Control	Polybag
P. acerifolium	Moochkunda	Sterculiaceae	63	77	Seeds sown flat position	Polybag
P. semisagittatum	Lana Asaar	Sterculiaceae	87	100	Seeds sown flat position	Polybag
P. alata	Narikeli	Sterculiaceae	74	86	Seeds sown in Propagator house	Propagator house
Q. acuminata	Kali Batna	Fagaceae	77	88	Seeds treated with sandpaper	Polybag
S. oleosa	Kusum	Sapindaceae	25	42	Seeds treated with sandpaper, normal water (24 hours)	Polybag
S. villosa	Udal	Sterculiaceae	76	80	Seeds sown in Propagator house	Propagator house
V. peduncularis	Horina Goda	Verbenaceae	38	46	Seeds sown in Propagator house	Propagator house

*Control: Seeds sown in normal position in commonly used polybags (4"x6") only with a sowing media of soil and cowdung (3:1) in sun lights and without any pre-sowing treatment.

F. colorata seeds provide 83% germination in commonly used polybags without any pre-sowing treatment (control), but highest germination (95%) was observed in propagator house (Table 2). In *L. wightianum*, only 26% germination was found in seeds without any pre-sowing treatment and sown in normal polybags (control) but it increased to 90% in propagator house. Highest germination of *P. serratum* was 30% and it was found in control (Figure 1).

Germination percentage of *P. acerifolium* and *P. semisagittatum* were 63% and 87% respectively in control while highest (77% and 100% respectively) were found when seeds sown in flat position in polybags (Figure 1). In case of *P. alata*, 74% seeds were germinated when sown in polybags without any treatment, and highest germination (86%) was found in propagator house. *Q. acuminata* exhibits 77% germination in control and highest rate (88%) was observed when seeds rubbed with sandpaper at the distal end and sown in polybags (Table 2).

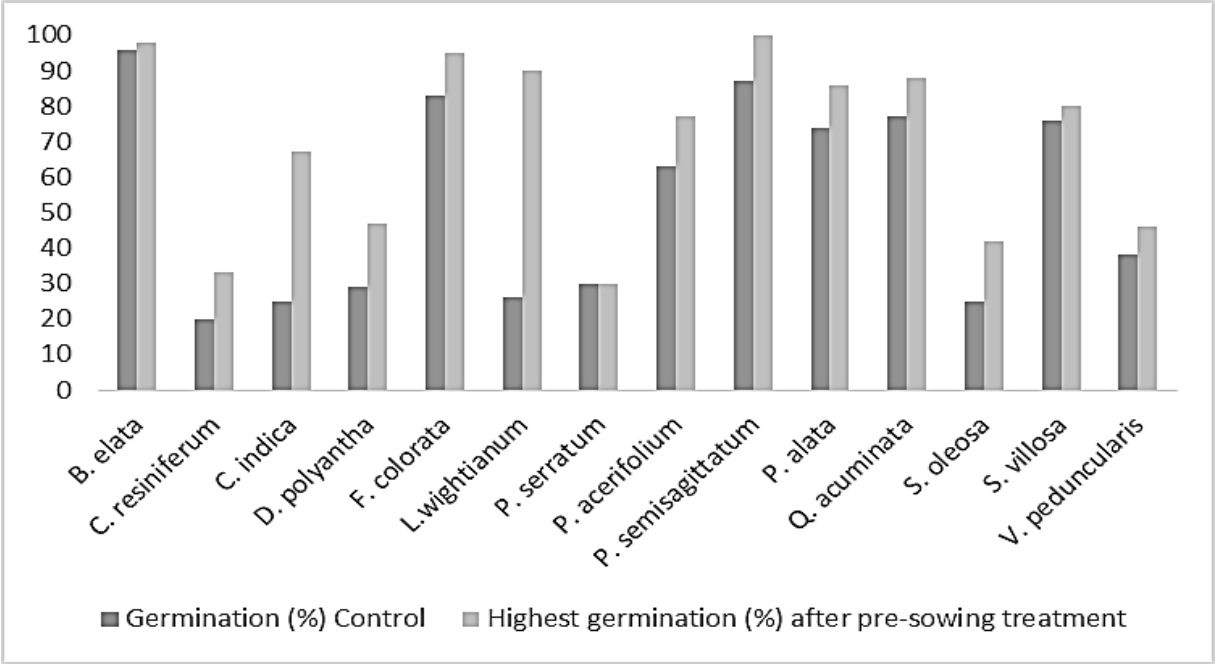

Figure 1. Germination percentage in control and highest germination percentage after pre-sowing treatment.

Highest germination percentage (42%) of *S. oleosa* was found in seeds sown in polybags after treated with sandpaper rubbing at the distal end and normal water immersion treatment for 24 hours. However, without any pretreatment, it was only 25% (Figure 1). In *S. villosa* maximum germination (80%) was found when seeds sown in propagator house, but in control it was 76% only. *V. peduncularis* seeds germinated 38% without any pre-sowing treatment (control) and highest germination rate was 46% found in seeds sown in propagator house (Table 2).

The findings of the study showed that, seeds sown in propagator house in sand bed offered highest germination percentage 98%, 47%, 95%, 90%, 86%, 80% and 46% respectively in soft-coated seeds of six species namely, *B. elata* (Figure 2), *D. polyantha* (Figure 5), *F. colorata* (Figure 6), *L. wightianum* (Figure 7), *P. alata* (Figure 11), *S. villosa* (Figure 14) and hard-coated seeds of *V. peduncularis* (Figure 15). Seeds with hard coat treated with normal water for 24 hours and 10% concentrated H_2SO_4 for 3 minutes provided highest germination percentage (33%) in *C. resiniferum* (Figure 3) that supports the findings of Bebawi and Mohamed (1985); Hasnat et al. (2017); Laurent and Chamshama (1987) and Some et al. (1989). Hard coated seeds of *C. indica* (Figure 4) and *Q. acuminata* (Figure 12) showed maximum germination (67% and 88% respectively) with sand paper treatment which supports the reports of Schmidt (2000). Soft-coated seeds of *S. oleosa* (Figure 13) also provided maximum germination (42%) both in sandpaper treatment and normal water treatment for 24 hours (Hasnat et al., 2014). In *P. acerifolium* (Figure 9) and *P. semisagittatum* (Figure 10), maximum germination (77% and 100% respectively) was observed when the seeds sown flat position in normal polybags. These results support that different pre-sowing treatments enhance germination rate of different species (Bewley and Black, 1982; Doran et al., 1983; Kumar, 1999; Napier, 1987; Palani et al., 1995; Schmidt, 2000). Only in *P. serratum* (Figure 8) the highest germination (30%) was found in control.

Figure 2. 60 days old seedling of Moos (*Brownlowia elata*) in poly-bag.

Figure 5. 90 days old seedling of Tali (*Dichopsis polyantha*).

Figure 3. 90 days old seedling of Dhup (*Canarium resiniferum*).

Figure 6. 30 days old seedling of Udal (*Firmiana colorata*).

Figure 4. 90 days old seedling of Sil Batna (*Castanopsis indica*).

Figure 7. 45 days old seedling of Raktan (*Lophopetalum wightianum*).

Figure 8. 15 days old seedling of Gutgutya (*Protium serratum*).

Figure 11. 30 days old seedling of Buddho Narikel (*Pterygota alata*).

Figure 9. 90 days old seedlings of Mochkunda (*Pterospermum acerifolium*).

Figure 12. 40 days old seedling of Kali Batna (*Quercus acumunata*).

Figure 10. 90 days old seedling of Lana Assar (*Pterospermum semisagittatum*).

Figure 13. 150 days old seedlings of Kusum (*Schleichera oleosa*) [germinated in polybag (left) and transplanted from propagator house (right)].

Figure 14. 30 days old seedling of Udal (*Sterculia villosa*).

Figure 15. 50 days old seedling of Horina (*Vitex peduncularis*).

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