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Effect of Pre-Sowing Treatments on Seed Germination of *Tectona grandis*

M. A. S. Billah[1], M. H. Kawsar[1], A. P. Titu[1], M. A. A. Pavel[1, 2, *], K. M. Masum[1]

[1]Department of Forestry and Environmental Science, Shahjalal University of Science and Technology, Sylhet, Bangladesh
[2]Institute of Water and Flood Management, Bangladesh University of Engineering and Technology, Dhaka, Bangladesh

Abstract

A nursery based experiment was conducted to study the effect of varied pre-sowing treatments on seed germinations of *Tectona grandis* (Teak). Seeds of selected species were subjected to six different pre-sowing treatments. Results revealed that, the highest germination percentage was observed 86.67% in Pith method, followed by 73.33% in soaking in normal water (72 hours) and 45% in soaking in normal water (24 hours). The highest germination value was found in T_4 (21.82) followed by T_3 (13.52), 8.37 in T_5 (immersion in 80% concentrated H_2SO_4 for 20 minutes). Our result finds that pre-sowing treatment is obviously better than control. Pit method and soaking in normal water for 72 hours are highly recommended for maximum germination within the shortest period of time. These findings of the research will be helpful to take effective decision regarding the raising of large scale production of *Tectona grandis* (Teak) seedling in a cost effective way with ensuring their earlier germination.

Keywords

Pit Method, Soaking, Seed, Germination

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1. Introduction

From the beginning of the earth plants have been playing an important role for human and seeds are one of the most important medium through which plant can survive their existence in this earth (Hossain et al., 2005). Teak (*Tectona grandis* L.), is an important tropical timber species associated to the family Verbenaceae. The species is naturally distributed in South East Asia mainly Myanmar, parts of India, Thailand and Laos (Kaosa-Ard 1981). In many tropical countries, it is also grown as an exotic species in the continent of Asia, Africa, Central and South America (White 1991). Valuable wood properties including high durability and resistance to chemical give the species highly estimated value (Sandermann and Dietrichs 1959). Today Teak is considered as one of the widely planted hardwood timber species in the world, covering 2.25 million ha (Ball et al., 1999). Due to its high timber value, Teak is also considered as one of the promising timber species in Bangladesh which accounts for 60-70% of the annual plantation area (MOEF, 1993). However, though it has a great economic and medicinal value, people don't get interest in raising its seedling in nursery due to low germination percentage and more average time requirement for seed germination (Luna, 1996). In fact the drupes germinate slowly and irregularly if it is untreated (Jackson, 1994). This delayed and irregular germination of seeds in the nursery is a serious constraint for *T. grandis* for efficient nursery management and plantation establishment. Therefore it is essential to find out some pre-sowing treatments of their seeds for ensuring their earlier, successful germination. This will help people to minimize their production cost of seedlings on a broad scale. A

* Corresponding author
E-mail address: pavel.sust@gmail.com (M. A. A. Pavel)

considerable body of evidences suggest that pre-sowing treatments strongly enhance the germination process (Hossain et al., 2005; Palani et al., 1996; Azad et al., 2010a,b). A good numbers of studies also carried out on about breaking the dormancy of seed in order to ensure their faster and maximum germination (e.g. Palani et al., 1996; Alamgir and Hossain, 2005). However, research findings related to the pre-sowing seed treatments of *T. grandis*, are very scared. In addition, the studies are associated mainly with seedling growth performance of Teak but no detailed experiment to evaluate effects of fast and successful germination of Teak seeds (Chowdhury et al., 2008; Kwame et al., 2014).

Consequently, under the present condition, the purpose of the research is to explore the best methods to break the seed dormancy of *T. grandis* and to find out their germination period, germination percentage and germination value under a number of easily applicable low cost pre-sowing treatments.

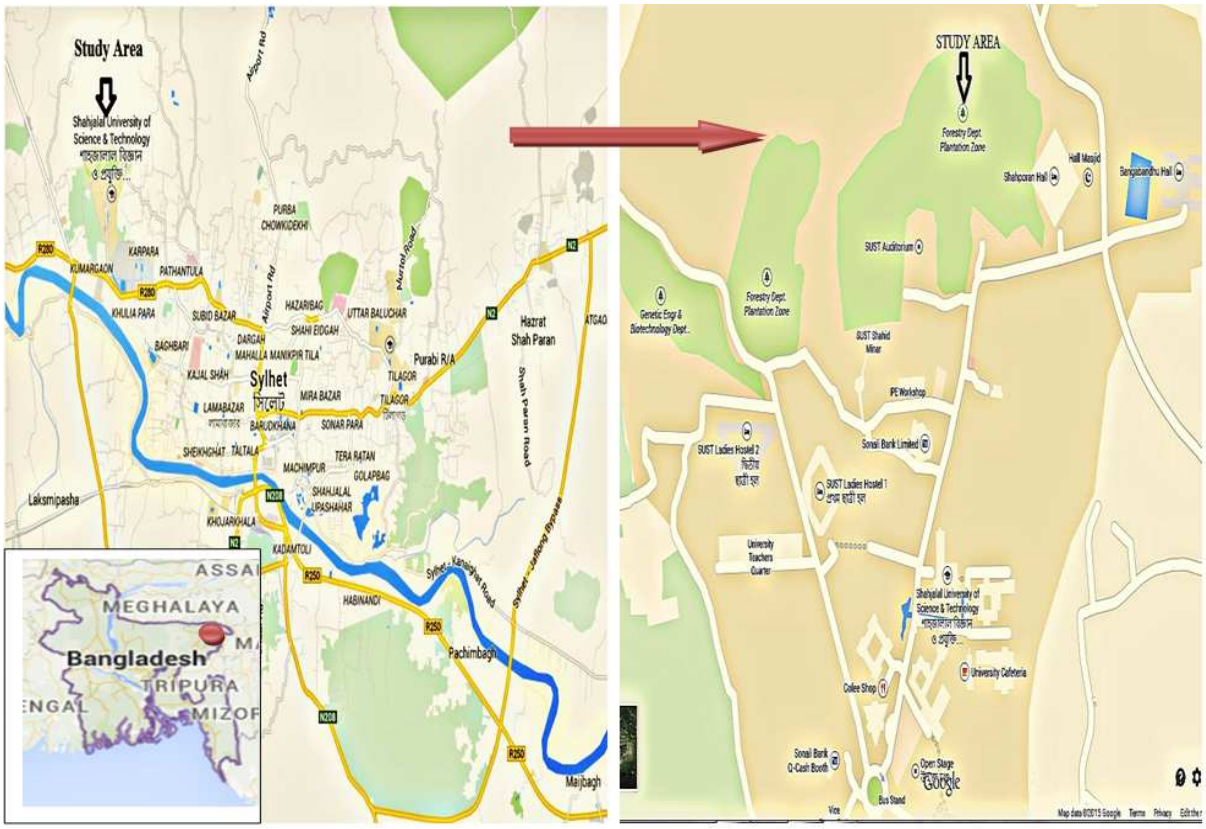

Figure 1. Location map of the study area (marked in red).

2. Material and Methods

2.1. Study Area

The experiment was conducted between the periods of 5th January 2014 to 5th July 2014. in the nursery of the Department of Forestry and Environmental Science, Shahjalal University of Science and Technology (SUST), Sylhet, Bangladesh. It is situated about five kilometers away from Sylhet city (Figure 1). The area stretches over 320 acres landscape of green hill, undulating valleys, moulds, plain grass land and abundant forests. SUST is geographically situated in the north-eastern part of Bangladesh, which lies approximately at the intersection of 24º92´ north latitude and 91º84´ east latitude. The climate of this area are humid subtropical with a predominantly hot and humid summer and a relatively cool winter. Annual maximum temperature is 33.2º C and minimum is 13.6ºC where as annual rainfall is 3334 mm. The soil of this area is generally reddish brown loam to clay loam (Uddin et al., 2008).

2.2. Materials

Tectona grandis seeds were collected from Shekhghat Nursery, Forest Department, Sylhet, Bangladesh. Seeds of uniform size were selected to reduce non-treatment variation. The potting media used for the filling the poly bags under the experiment were mixture of top and depth hill soil and decomposed cowdung. Soil and cowdung were mixed in a ratio of 3:1. The size of the bed was 5×1.5 m. The nursery bed was made on slightly height above the ground so that water cannot stand for a long time. After that, poly bags were arranged in the nursery beds. Then, the good and healthy

seed was sown in each polythene bag after applying pre-sowing treatment.

2.3. Experimental Design

A randomized complete block design with three replicates was used for the experiment. Seeds were subjected to 6 pre-sowing treatments including controls. Thirty (30) poly bags were used for each replication of each treatment. Therefore, a total of 180 seeds were subjected to six different pre-sowing treatments. The date of applying pre-treatment and sowing date were also recorded.

The treatments used in the experiment are as follows:

T_0: Control (Intact seeds without applying any treatment),

T_1: Soaking in normal water for 24 hours,

T_2: Soaking in normal water for 72 hours,

T_3: Soaking in hot water for 5 minutes,

T_4: Pit method*, and

T_5: Immersion in 80% concentrated H_2SO_4 for 20 minutes.

*"Pit method" is widely used for seeds of Teak and similar hard-coated seeds. A pit was dugged of 2-3 feet deep and 3-4 feet square and filled with water. Seeds were soaked for 72 hours in normal water and then kept in water during the day period under the sun, then put in the pit with layer of moist leaves (Teak) and finally covered with 6 inches of soil. 5 bamboo pipes, one in the middle and one each in the corners were placed. So that water can reach in all layers. Seed were kept in the pit for about 5 days and watering was done in every alternate day through the bamboo tubes.

2.4. Germination Percentage and Value

At the end of the germination period, the germination percentage and germination rate was calculated using the following equations (Maguire 1962)-

Germination percentage = (Number of germinated seeds)/ Total number of seed sown) ×100.

The germination value (GV) which is a composite value that combines both germination speed and total germination provides an objective means of evaluating the results of germination (Hossain et al., 2005). It was calculated by using the formula (Djavanshir and Pourbeik, 1976) as below-

$GV = (\sum DGs/N) \times GP/10$

Where,

GV = Germination value

GP = Germination percentage at the end of the test

DG = Daily germination speed obtained by dividing the cumulative germination percentage by the number of days since sowing

DGs = the total germination obtained by adding every DGs value obtained from the daily counts.

N = the total number of daily counts, starting from the date of first germination

10= constant

2.5. Data Collection and Analysis

The data was collected by observation and measurement. The effect of pre-sowing treatments was assessed periodically through germination and initial growth performance of the seedlings in the nursery. The germination was recorded everyday from the date of sowing seeds and continued till the last germination (43 days after seed sown). In this period; the number of species that germinate and the time required for germination for each treatment were recorded.

Statistically, data were analyzed by using Microsoft Excel; it provides better accuracy.

3. Results

The treatments that were applied in *Tectona grandis* were seeds sown without applying any treatment (T_0), soaking in normal water for 24 hours (T_1), soaking in normal water for 72 hours (T_2), soaking in hot water for 5 minutes (T_3), Pith method (T_4) and immersion in 80% concentrated H_2SO_4 for 20 minutes (T_5).

Seed germination started from 14 days after sowing and continued up to 43 days. The shortest period required for germination was observed in T_4 (14-27 days) followed by T_5 (17-29 days), T_3 (20-31 days), T_2 (21-32) and the longest period for germination was observed in T_0 (28-43). The highest germination percentage was found in T_4 (86.67%) followed by T_2 (73.33%), T_3 (60%) and the lowest germination percentage was found in T_0 (36.67%) (Table 1).

Table 1. *Tectona grandis* germination period and germination percentage under different treatments.

Treatment	No. of germination	Germination Period (days)		Germination (%)
		Start	Complete	
T_0	13	28	43	36.67
T_1	16	23	33	53.33
T_2	22	21	32	73.33
T_3	18	20	31	60
T_4	26	14	27	86.67
T_5	17	17	29	56.67

Mean daily germination varied in different days in different treatments for *Tectona grandis* seeds. The highest mean daily germination percent was observed 3.21 in T_4 (27^{th} days after sowing) followed by 2.29 in T_2 (32^{th} days after sowing), 1.95 in T_5 (29^{th} days after sowing), 1.94 in T_3 (31^{th} days after

sowing), 1.62 in T_1 (33th days after sowing) and 0.85 in T_0 (43th days after sowing).

Seed germination started in 14th days after sowing and continued up to 43th days (Figure 2). Cumulative germination percent rose sharply from 14th day to 33th day and remained constant up to the end of germination tests (43th days).

Cumulative germination percent of T_4 was always highest in comparison to other treatments. In general pre-sowing treatments showed both higher mean daily and cumulative germination percent in comparison to control (T_0) seeds (Figure 3).

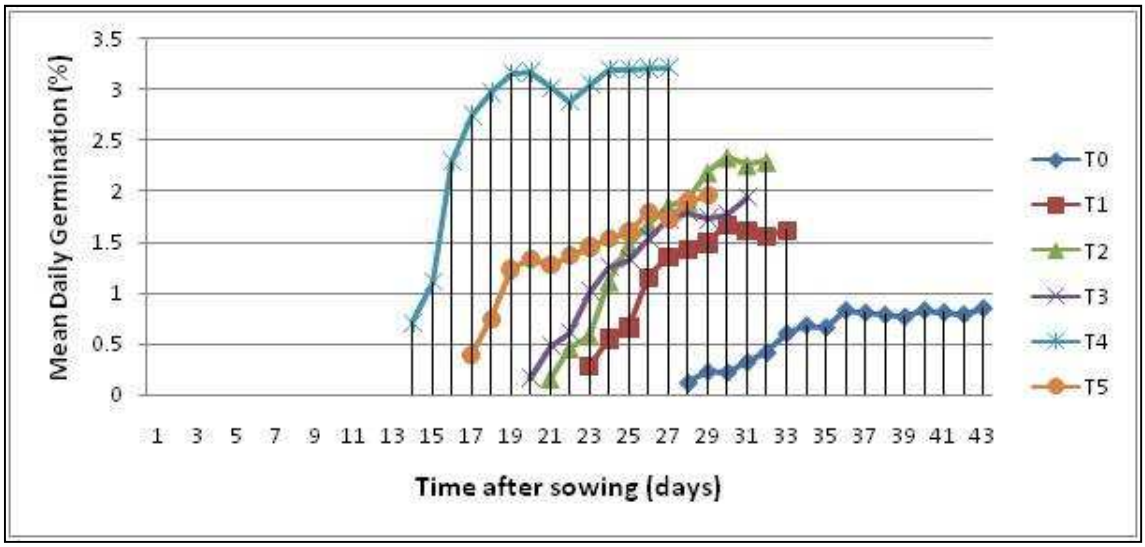

Figure 2. Mean daily germination (%) of *T. grandis* seeds under different treatments.

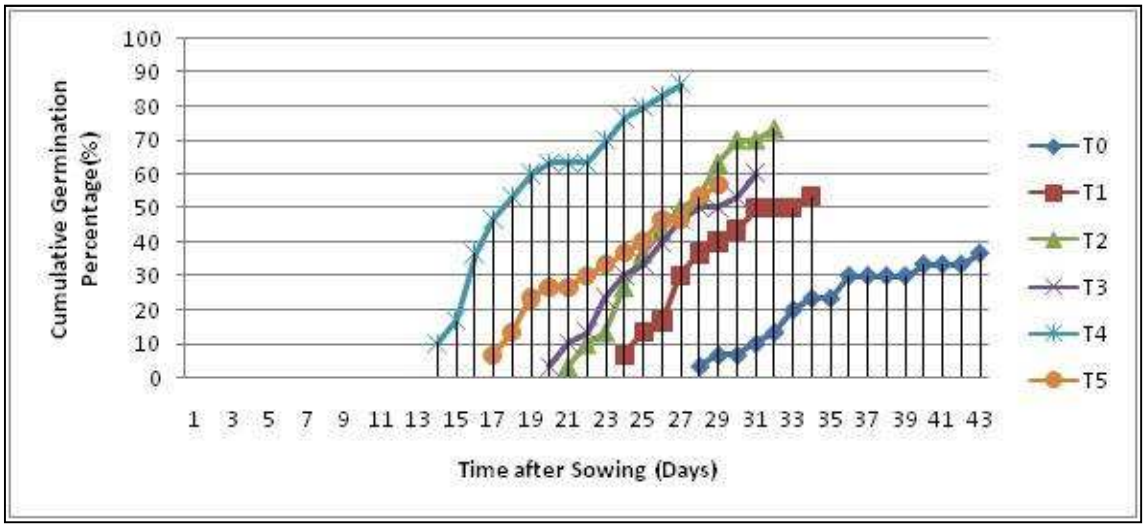

Figure 3. Cumulative germination (%) of T. grandis seeds under different treatments.

Germination value varied from 2.24 to 23.46 among the treatments. The highest germination value was found in T_4 (23.46) followed by T_2 (11.16), T_5 (7.97) and the lowest germination value found in T_0 (2.24). That means germination value varied from 2.77 to 23.46 (Table 2).

Table 2. *Tectona grandis* germination value under different treatments.

Variables						
Treatments	**T_0**	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**
Total germination period (day)	28-43	23-33	21-32	20-31	14-27	17-29
Germination (%)	36.67	53.33	73.33	60	86.66	56.67
Total mean daily germination (%)	9.77	13.41	18.26	15.33	37.89	18.29
Germination value	2.24	6.50	11.16	7.67	23.46	7.97

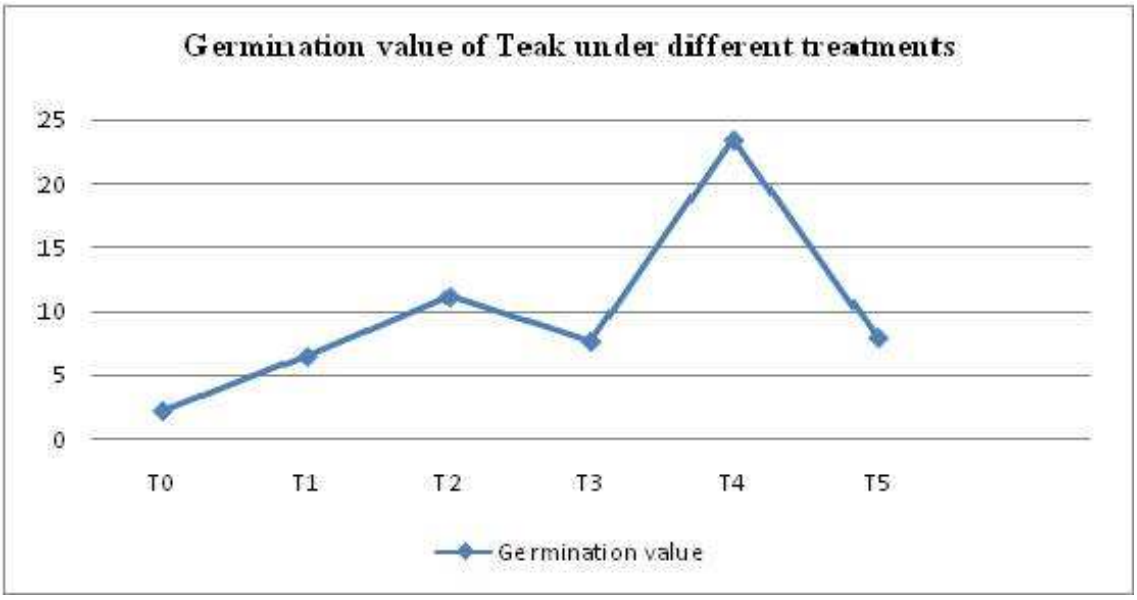

Figure 4. *Tectona grandis* Germination value under different treatments.

4. Discussion

Several authors have argued that different methods of pre-sowing treatments enhance the germination rate and speed up the germination process (Teketay, 1996; Alamgir and Hossain, 2005 and Azad et al., 2010a,b). Similarly findings of the present study revealed that seeds of *Tectona grandis* under different treatments ensured better germination period, germination percentages and germination value. Present study showed possible treatment variations in Teak seeds and find that there is no significant different among the pre-sowing treatments of Pith method, soaking in normal water for 72 hours and soaking in hot water for 5 minutes though all of them significantly differ from control that showed very poor germination percentage. One of the reasons behind this naturally hard coatness of Teak seeds tends to protect germination in the interior parts of the seeds which results in slower and unsuccessful germination. Azad et al., (2006) carried out an experiment of pre-sowing treatment of *Xylia carrii* seeds in Bangladesh, and they found a result of seed germination (84%) in 80% concentrated H_2SO_4 for 20 minutes. However, in the present study, this treatment showed poor germination percentage compared to other pre-sowing treatments. This treatment is also found costly and complex to be applicable on a large scale as it requires risky chemical on a laboratory under a certain environment. Hossain et al., (2005) found 66.67% germination in seeds of

Terminalia chebula in a pre-sowing treatment of soaking in normal water for 48 hours. Similarly the present study also found high germination (73.33%) in soaking in normal water for 72 hours of *Tectona grandis* although the highest result was found in Pith method (86.67%). The main reason behind the successful germination of Pith method may be of that seeds of Teak require continuous hot temperature in association with available water to germinate. Seed coat of Teak acts as a hard barrier substance for germination process. If the seeds are kept first time in normal water for 3 days, the seed coat become soft and after that if they get sufficient temperature in association with water, then their highest and successful germination is ensured. Therefore, seeds treated with Pith method are highly recommended for maximum seed germination in shortest period of time. As it is time consuming, seeds treated with soaking in normal water for 72 hours are also recommended for large scale seed germination of *Tectona grandis*.

5. Conclusions

The findings of the results are revealed that pre-sowing seed treatment significantly enhances the germination process. As the seed coat of Teak is hard, it takes more time to germinate with lower germination percentage in nursery establishment. However, effective pre-sowing treatments can ensure their successful germination. Among the treatments applied in the experiment, the best effective treatment found for *Tectona grandis* was Pith method in respect to faster germination, higher germination percentage and germination value. Since seed germination under soaking in normal water for 72 hours is quite simple and inexpensive, it is also recommended for *Tectona grandis* on a broad scale. Concentrated H_2SO_4 treatment is not recommended as it is a costly and troublesome method to be applicable in local farmer level on a broad scale. The result of the study will be helpful for the nursery practitioners to know the effect of pre-sowing treatments on germination and thereby they can apply these

treatments to get best quality seedlings within the shortest period of time. However, research related to growth performance of Teak after seedling stage is relatively rare. It has well recognized from many literatures that growth performance of many species is also associated with pre-sowing seed treatments. So, further studies are highly recommended on biomass production of Teak seedlings and their volume production performance including their root length, shoot length, leaf number, collar diameter and vigor index under different pre-sowing treatments of their seeds. It will be largely helpful for large volume production of quality timber of Teak in a cost effective way.

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