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***Full Length Research Paper***

# Effects of Pre-Sowing Treatments on Germination and Seedling Growth of *Terminalia chebula Retz. - A*n Important Medicinal Plant

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**Abstract**

*Terminalia chebula* a large deciduous tree belongs to family Combretaceae and it grows naturally in greater part of India. However, raising the seedlings of *T. chebula* is seen very less in nursery due to low germination percentage and more requirements for seed germination. With this background present study was carried out to study effects of pre-sowing treatments on germination and seedling growth of *T. chebula*. Seeds were exposed to eight different pre-sowing treatments including control. The study revealed that, in general depulping the fruits, soaking in cow dung slurry for various periods and in particular alternative soaking, drying and soaking in cow dung slurry for 24, 8 and 24 hours respectively had significantly enhanced seed germination and seedling growth. Seed germination started 26 days after sowing and continued up to 90 days. The highest germination percentage, germination value, germination energy and vigor index was also obtained in T6 treatment followed by T5 which were significantly ($p$<0.05) different from the control treatment. Shoot length, root length, collar diameter and leaf number followed the same trend of higher value for T6 followed by T5 and least was observed in control (T0). Similar trend was also observed in shoot, root and total seedling dry weight. Therefore, pre-sowing treatments were more effective in germination and production of quality seedling of *T. chebula* in the nursery.

***Key words:*** *Depulping, imbibition period, germination value, Terminalia chebula, vigor index.*

## Introduction

Forests have played key roles in the lives of people living in both mountains and lowland areas by supplying fresh water and oxygen as well as providing a diversity of valuable forest products for food and medicine. The age-old traditional values attached with the various forest types and the varieties of forest products (i.e., medicinal plants) have gained tremendous importance in the present century.

*Terminalia chebula*, locally known as Arale mara or Horitoki, belonging to the family Combretaceae. *T. chebula* is a medium to large deciduous tree with short cylindrical bole, rounded and spreading crown. It is found in deciduous forests throughout the greater part of India, Sri Lanka, Pakistan, Bangladesh and Myanmar, in most parts of India the species occurs naturally. The fruits are used for medicinal purposes in combination with *Emblica officinalis* and *Terminalia belerica*, under the name of "Triphola Churna," which is used in Ayurvedic medicine.

*T. chebula* is widely used for medicinal and other purposes in India. However, people don't get interest in raising the seedlings of the species in nursery due to low germination percentage (around 50%) and more average time (up to 2-3 months) requirement for seed germination (Luna, 1996). Low germination percentage as well as long time requirement is believed due to the hard seed coat and thick fleshy pulp of fruits. Many evidences suggested that germination of seeds with hard seed coat is enhanced by seed pre-sowing treatments. If untreated, the drupes germinate slowly and irregularly. This delayed and irregular germination of seeds in the nursery is a serious constraint of efficient nursery management and plantation establishment. Therefore much research has been carried out to develop low cost and effective seed treatments to remove the dormancy to ensure faster and maximum germination. However, literatures, which have examined the effect of seed treatments of *T. chebula,* are very rare. So, under the present circumstances the research work has been designed to explore the seed germination period, germination percentage and initial growth performance of *T. chebula* under a number of easily applicable low cost pre-sowing treatments.

## Materials and Methods

***Study site***

Present study was carried out for over a period of six months from December to May, 2012. Soil media was prepared with the ratio of 3:1:1 i.e. soil: sand: FYM and filled in poly bags of 15 x 10 cm size.

Fruits of *T. chebula* were collected from matured healthy trees from the forest area. The fruit of *T. chebula* is drupe that means one seed in each fruit. Uniform seeds were used for the treatments to reduce non-treatments variation since germination percentage and seedling vigor was found positively correlated with seed size.

***Experimental design and treatment combinations***

A Randomized Complete Block Design (RCBD) was adopted for the study. There were eight treatments including control and 4 replications for each treatment. For the purpose some seeds were depulped at two ends with sharp knife in such a way that the embryo was not damaged while others were kept intact for using as control. The pre-sowing treatments used in the experiment were:

T0: control (intact fruits without depulping and soaking)
T1: fruits were depulped but were not soaked in cow dung slurry
T2: fruits were depulped and soaked in cow dung slurry for 12 hours
T3: fruits were depulped and soaked in cow dung slurry for 24 hours
T4: fruits were depulped and soaked in cow dung slurry for 36 hours
T5: fruits were depulped and soaked in cow dung slurry for 12 hours and alternately dried for 8 hr and again soaked for 12 hours
T6: fruits were depulped and soaked in cow dung slurry for 24 hours and alternately dried for 8 hr and again soaked for 24 hours
T7: fruits were depulped and soaked in cow dung slurry for 36 hours and alternately dried for 8 hr and again soaked for 36 hours

In each replication fifty seeds (one seed in each poly bag) were sown to explore the effect of pre-sowing treatments on germination. Adequate care and maintenance were taken from the time of seed sowing up to the harvesting of seedlings. The effects of different seed pre-sowing treatments were assessed periodically through counting germination and initial growth performance of the seedlings. At the age of four months, five dominant seedlings from each treatment were randomly selected and uprooted very carefully to estimate the seedling biomass. The seedlings were measured for shoot length, collar diameter, root length and total oven dry weight (shoot and root components). Shoot and root was oven dried at $70^{O}$C for 48 hours until the constant weight is obtained. The germination and growth data were analyzed statistically by using Microsoft excel program for determining the morphological growth variation. Germination energy was calculated using the formula of Djavanshir and Pourbeik (1976). Vigor Index was calculated according to Abdul-Baki and Anderson (1973).

## Results

***Seed Germination:***

***Germination period:*** Seed germination started 26 days after sowing and continued up to 90 days. Different treatments significantly affected the germination period for the species. The fastest germination *e.g.* least imbibition period (26 days) was observed in T6 and delayed germination, *e.g.* highest imbibition period (38 days) was found in (T0) control (Table 1).

**Table 1:** Imbibition period, germination period, germination percentage, germination value and germination energy of *T. chebula* seeds under different pre-sowing treatments.

| Variables | Treatments | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | T0 | T1 | T2 | T3 | T4 | T5 | T6 | T7 |
| Imbibition period (day) | 38a±1.8 | 34ab±0.4 | 34ab±0.4 | 34ab±0.4 | 30bc±0.0 | 30bc±0.0 | 26cd±0.0 | 30bc±0.0 |
| Total germination Period (day) | 44.0a±1.5 | 51.5ab±2.0 | 55.7bc±2.0 | 55.3bc±1.5 | 55.3bc±0.0 | 59.3cd±2.0 | 63.5cd±1.5 | 56.0bc±1.5 |
| Germination (%) | 47.0b±2.1 | 49.0b±1.9 | 53.0b±2.3 | 52.0ab±2.4 | 59.5ab±2.3 | 63.0a±2.2 | 65.0a±2.6 | 60.5ab±2.3 |
| Germination Value | 1.8 | 1.9 | 2.4 | 2.0 | 3.0 | 3.2 | 3.7 | 3.1 |
| Germination Energy (%) | 46 | 48 | 50 | 50.5 | 56 | 61.5 | 62.63 | 56.5 |

***Note: * the same letter (s) are not significantly different at p<0.05. ± indicates the standard error of mean.***

***Germination percentage:*** The highest germination percentage (65.04) was observed in T6 (alternative soaking, drying and soaking in cow dung slurry for 24, 8 and 24 hr respectively) followed by T5 (63.0), which was significantly higher than T0, T1 and T2. The lowest germination percentage (47.0) was recorded from control treatment (Table 1).

***Germination value and germination energy:*** Germination value varied from 1.8 to 3.7 among the treatments. The highest germination value was found in T6 (3.7) followed by T5 and lowest was in T0. Similarly, the highest germination energy (61.5%) was in T6 followed by 61.5 % in T5 and lowest (46.0%) was in T0 (Table 1).

***Germination pattern:*** Mean daily germination percent varied in different days in different treatments for *T. chebula* seeds. The highest mean daily germination percentage was observed 70 days after sowing in T2,74 days in T6, 78 days in T0,T4, T7 and 82 days in T1, T3 and T5 (Figure 1). Seed germination started 26 days after sowing and continued up to 90 days (Figure 2). The cumulative germination percent in treatment

T6 rose sharply from 34 day to 86 days after sowing the seeds and changed slightly at the end of the test (90 days).

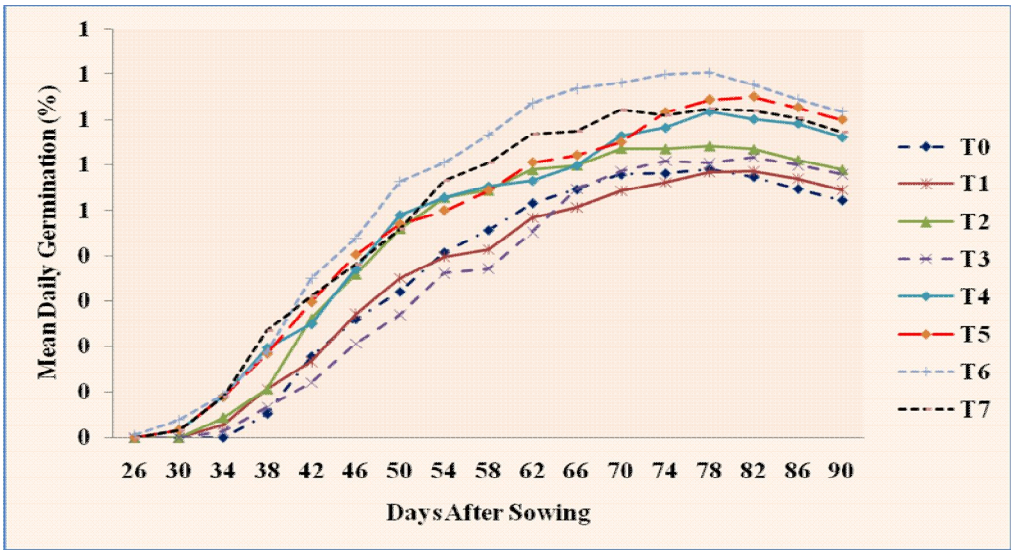


**Fig. 1:** Mean daily germination percent of *T. chebula* seeds under different treatments.

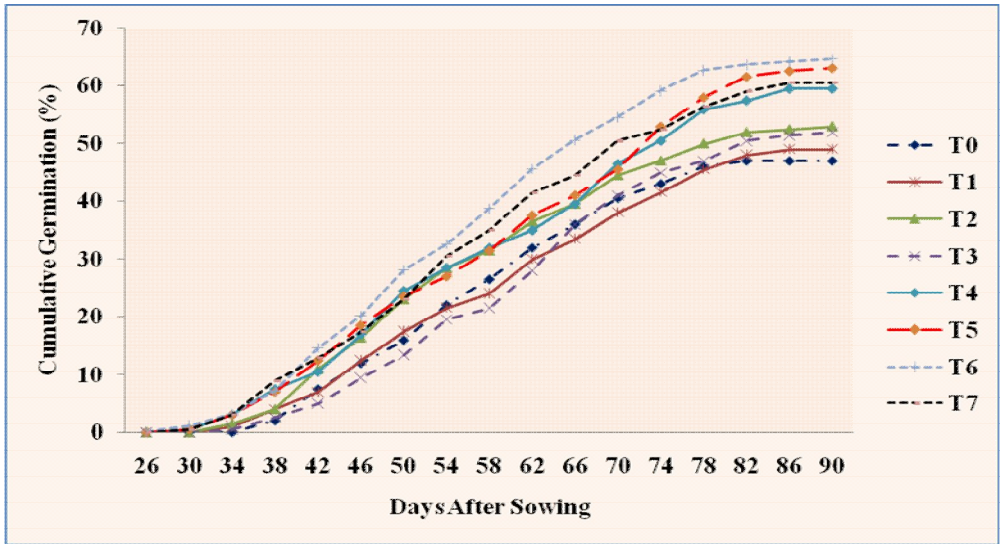


**Fig. 2:** Cumulative germination percent of *T. chebula* seeds under different treatments.

***Growth performance:*** Shoot length, root length, total length, collar diameter and vigor index of the seedlings developed under different treatments were highest in T6 followed by T5, which was significantly higher than that of control and T2. Highest leaf number of *T. chebula* seedlings was found in T5 (53.53) followed by T7 and lowest was in T0 (Table 2).

***Seedling biomass production:*** Biomass production significantly varied among the treatments, all treatments were recorded significantly higher biomass over the control treatment (Table 3).

## Discussion

Generally most of forest tree seeds always exhibit some kind of dormancy and as per the international seed certification standards of 70% of the 178 species required dormancy breaking treatment (ISTA, 1985). Seeds of many trees s germinate readily when subjected to favorable conditions of moisture, substratum, light and temperature. Dormancy in forest tree seeds can be

exogenous, or seed coat dormancy, endogenous or embryo dormancy and a combination of the two (seed coat and embryo dormancy). In general, exogenous dormancy is most common in tropical trees seeds (Ramprasad, 1999). In many studies chemicals like inorganic ions, organic acids and growth regulators have been found to eliminate dormancy and stimulate germination and the water dissolve the inhibitors, which are in seed coat and leach it out (Shearer, 1961).

In the present investigation, depulping of fruits and soaking the seeds in cow dung slurry at different intervals significantly improved the imbibition period, days taken for maximum germination, germination per cent, vigor index and seedling attributes. In general depulping of fruits and soaking in cow dung slurry for various periods and in particular alternative soaking, drying and soaking in cow dung slurry for 24, 8 and 24

hours respectively had significantly enhanced seed germination and seedling growth parameters. Generally the seeds with hard seed coat were reported to enhance germination with pre-sowing treatments (Khan *et al*., 2001 and Hossain *et al*., 2005). However, the findings of the present study show that depulped seeds of *T. chebula* soaked in cow dung slurry increased germination speed, germination percentage and seedling growth and biomass production in comparison to the control treatments. Jackson (1994) and Hossain *et al.*, (2005) described that seeds soaking in water for 48 hours improved germination. Again, clipping the seeds at the wide end without damaging the embryo and soaked in cold water for about 36 hours, provides about 80% germination.

The perusals of the present results are also supported by the findings of the many authors. For example Rashid *et al*. has shown that, fruits of *T. chebula*, soaked in water for 48 hours with successive treatment by 10 % sulfuric acid for 20 minutes showed up to 70 % germination. A germination success of up to 50% was obtained when depulped fruits were sown at BFRI. Nainar *et al.* (1999) has shown that among the different pre-treatments including mechanical scarification (MS), hot water treatment (with or without removing the testa) and sulfuric acid treatment (with or without breaking the testa), mechanical scarification gave the highest germination percentage (60%) in *T. chebula.*

**Table 2:** Shoot length, root length, total length, number of leaf, collar diameter and vigor index of *T. chebula* seedlings grown under different treatments (five months after sowing).

| Variables | Treatments | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **T0** | **T1** | **$T_2$** | **$T_3$** | **$T_4$** | **$T_5$** | **$T_6$** | **$T_7$** |
| **Shoot length (cm)** | 22.28c* ± 3.29 | 27.17b ± 2.04 | 30.26b ± 2.04 | 31.25ab ± 2.04 | 33.67ab ± 4.37 | 34.37ab ± 3.25 | 37.74a ± 2.33 | 32.19ab ± 4.08 |
| **Root length (cm)** | 26.10b ± 1.63 | 28.66b ± 6.35 | 29.23b ± 5.38 | 28.34b ± 0.92 | 32.32ab ± 1.92 | 35.67ab ± 1.43 | 40.63a ± 3.55 | 30.27b ± 1.41 |
| **Total length (cm)** | 48.38c ± 2.49 | 55.83bc±8.39 | 59.49b ± 6.39 | 59.59b ± 2.84 | 65.99ab ± 2.96 | 70.04ab ± 3.17 | 78.37a ± 4.8 | 62.46b ± 2.96 |
| **Leaf number.** | 28.29d ± 3.21 | 40.67c ± 2.84 | 46.53bc±2.67 | 49.34b ± 6.67 | 52.14a ± 4.42 | 53.53a ± 6.43 | 52.22a ± 7.36 | 52.48ab ± 4.17 |
| **Collar diameter (mm)** | 3.86b ± 0.53 | 4.73ab ± 0.17 | 5.33a ± 0.15 | 4.13b ± 0.46 | 4.73ab ± 0.43 | 4.84ab ± 0.17 | 5.52a ± 0.15 | 4.26b ± 0.37 |
| **Vigor Index** | 2273.86c | 2735.67bc | 3152.97b | 3098.68b | 3926.405ab | 4412.52a | 5094.05a | 3778.83a |

***Note: * the same letter (s) are not significantly different at p<0.05. ± indicates the standard error of mean.***

**Table 3:** Biomass in terms of shoot dry weight, root dry weight and total dry weight of *T. chebula* seedlings grown under different treatments (five months after sowing).

| Variables | Treatments | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **T0** | **T1** | **$T_2$** | **$T_3$** | **$T_4$** | **$T_5$** | **$T_6$** | **$T_7$** |
| **Shoot dry weight (g)** | 1.61 b ± 0.25 | 2.96 ab ± 0.32 | 3.17 a ± 0.34 | 3.46 a ± 0.17 | 3.65 a ± 0.06 | 3.74 a ± 0.26 | 3.97 a ± 0.21 | 3.52 a ± 0.039 |
| **Root dry weight (g)** | 0.49 b ± 0.16 | 0.61 ab ± 0.21 | 0.71 ab ± 0.09 | 0.77 a ± 0.09 | 0.71ab ± 0.14 | 0.89 a ± 0.10 | 0.93 a ± 0.03 | 0.73 ab ± 0.14 |
| **Total dry weight (g)** | 2.1 b ± 0.49 | 3.57 ab ± 1.41 | 3.88 ab ± 0.49 | 4.23 a ± 0.37 | 4.36 a ± 0.26 | 4.60 a ± 0.17 | 4.91 a ± 0.28 | 4.25 a ± 0.28 |

***Note: * the same letter (s) are not significantly different at p<0.05. ± indicates the standard error of mean.***

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