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Effect of pre-sowing treatments on seed germination of Harad (*Terminalia chebula* Retz.) in the nursery condition

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Abstract
Seed germination is the initial stage in the development of plant growth, and in this instance, some factor serves as a catalyst. The study was conducted to determine how different pre-sowing seed treatments affected the germination behavior of *Terminalia chebula* Retz. (Harad) in the nursery, as germination is limited by Harad's hard rocky seed coat. The pre sowing treatment *viz.*, Cold water soaking for 24, 48, and 72 hours (T_2, T_3, T_4), dipping in 50% sulphuric acid for 20, 25, and 30 minutes (T_5, T_6, T_7), immersion in cow dung slurry for 15, 30, and 45 days (T_8, T_9, T_{10}), breaking seed coat through stone (T_{11}), and control (T1) were all applied to break the hard seed cover with the various treatments. The mechanical treatment (T_{11}) had the highest (70.6 percent) seed germination and the control treatment (T_1) had the lowest (9.33 percent). In comparison to the other treatments, T_{11}-breaking seed coat through stone had the highest peak value and germination value, whereas the control treatment had the lowest. The number of days it took for seedlings to emerge was lower in the mechanical treatment than in the other treatments, and it was maximum in the control treatment. As a result, the study concluded that mechanical treatment (T_{11}) is the optimum way in terms of seed germination % and the number of days it takes for seed germination to occur.

Keywords: Harad, seed, germination, pre-sowing treatment, seed coat

Introduction
The seed is such an important component of plant production that it has a significant impact on the success or failure of both natural and artificial regeneration (Nwoboshi, 1982) [8]. Seed germination and early seedling growth stages are crucial for generating a successful crop because they directly influence crop stand density and, as a result, crop production. (Hossain and colleagues, 2005) [1]. Seed germination and seedling growth are said to be influenced by a variety of intrinsic and extrinsic factors that vary by species. Many trees have been recognized as fast-growing, however many tree species have hard seed coats that are impervious to water, preventing them from germinating under typical conditions. As a result, research into the elements that influence germination and seedling growth for a specific species is required. *Terminalia chebula*, sometimes known as black or chebulic myrobalan, is a Terminalia species endemic to South Asia, ranging from India and Nepal east to Yunnan in southwest China, and south to Sri Lanka, Malaysia, and Vietnam. This tree can be found in India in sub-Himalayan pathways from Ravi to West Bengal and Assam, up to an altitude of 1500 meters in the Himalayas. Northern India's woods, including Uttar Pradesh, Bengal, Madras, Tamil Nadu, Karnataka, Mysore, and Southern Maharashtra, are home to this tree. *Terminalia chebula* is a medium to big deciduous tree with a trunk up to 1 m in diameter and a height of 30 m (98 ft). *Terminalia chebula* is a key component in the Ayurvedic remedy Triphala, which is used to treat kidney and liver problems. In Ayurveda, the dried fruit is utilized as an antitussive, cardiotonic, homeostatic, diuretic, and laxative. The species produces the most important commercial tannin. *T. chebula* is a significant source of tannin (25-32%) (Hukkeri *et al*., 2010) [5]. Finely powdered dry fruits are used as a dentifrice, while coarsely powdered fruits are often used for smoking in a pipe to relieve asthma, ashes mixed with butter make a nice salve for wounds, and fruit is suggested for snake bites in combination with other treatments (Hukkeri *et al*., 2010) [5]. However, because to the low germination percentage (about 50%) and longer average time (up to 2-3 months) required for seed germination, people are not interested in producing seedlings of the species in a nursery (Luna, 1996) [7]. The stiff seed coat and thick meaty pulp of the fruits are thought to be the cause of the low germination percentage and extended time needed. Pre-sowing treatments have been shown to improve germination of seeds with a hard seed coat, according to a large body of evidence (Palani *et al*., 1996) [10].

The drupes germinate slowly and randomly if left untreated. Inefficient nursery management and plantation establishment are hampered by the delayed and irregular germination of seeds in the nursery. As a result, much research has been conducted to create effective seed treatments for removing dormancy and breaking the hard seed coat of various species in order to assure faster and more effective germination. However, there are few studies that have looked into the effects of *T. chebula* seed treatments. As a result, the current study aims to investigate the seed germination duration and behavior of *T. chebula* under a variety of low-cost pre-sowing treatments.

Materials and Methods

Study site

Experiment was carried out in Udaipur, Gomati District, Tripura, between June and September 2021. The Gomati District is located between East longitude 91 degrees 18 minutes and 91 degrees 59 minutes, and North latitude 22 degrees 56 minutes and 23 degrees 45 minutes. The study region has a mostly mild climate, with a humid summer and a dry, frigid winter, with frequent showers from July to October. During the growth season, the experimental location receives about 137.8 cm of rain, with temperatures ranging from 32 to 25 degrees Celsius on average.

Seed collection area

Seeds were collected from the forest stands of the Dhamtari district, Chhattisgarh. The seeds were collected in the month of January and February 2021.

Pre-sowing treatments

Seeds of *Terminalia chebula* were treated to eleven different pre-sowing treatments to assess the germination behavior of seeds in different treatments. Table 1 lists the specifics of eleven different treatments.

Table 1: Different methods of pre-sowing treatments

Sl. No.	Treatments
T_1	Control
T_2	Soaked in cold water for 24 hours
T_3	Soaked in cold water for 48 hours
T_4	Soaked in cold water for 72 hours
T_5	Dipped in 50% Sulphuric acid for 20 minutes
T_6	Dipped in 50% Sulphuric acid for 25 minutes
T_7	Dipped in 50% Sulphuric acid for 30 minutes
T_8	Immersed in cow dung slurry for 15 days
T_9	Immersed in cow dung slurry for 30 days
T_{10}	Immersed in cow dung slurry for 45 days
T_{11}	Breaking of Seed coat through stone

Experimental design

The germination test was set up in a complete randomized design (CRD). There were eleven treatments in total, including a control, and each treatment had three replications. To investigate the influence of pre-sowing treatments on *Terminalia chebula* seed germination, twenty-five seeds were sown in poly bags in the nursery for each replication (one seed in each Poly bag). A sample of 75 seeds per treatment was taken for conducting the experiment and was sown in polybags. The following observation was taken to study the germination behavior of seeds of *Terminalia chebula.* The germination observation taken daily after seed sown in the nursery When the seedling emerged after sowing, the seedling emergence count was obtained. The number of seedlings that had fully emerged above the soil surface was counted and the number of days was recorded.

Germination percent

Germination of seeds in each treatment was recorded daily up to 90 days. The seeds were considered as germinated when the cotyledonary leaves emerged out of the soil. From the daily germination count, percent seed germination was recorded.

Germination percentage = (Number of seeds germinated × 100)/ (Number of seeds sown)

Mean daily germination (%) = (Cumulative percent germination) / (Total number of days)

Peak value (PV) =Maximum mean daily germination reached at any stage of the germination period.

Germination value = Mean daily germination X peak value

Fig 1: Different pre-sowing treatments

Fig 2: Emergence of cotyledonary leaves

Result and Discussion

The goal of the present study was to see how different pre-sowing treatments affected seed germination of *Terminalia chebula*.

No. of days to Seedling Emergence

Pre-sowing treatments have a positive impact on control treatment. The seeds which were mechanically treated (Breaking of Seed coat through stone - T_{11}) recorded the fewer numbers of days (20.33 DAS) for the emergence of seedlings followed by T_{10} – immersed in cow dung slurry for 45 days the germination occurs in 25 DAS followed by T_6 – Dipped in 50% Sulphuric acid for 25 minutes seed germinated in 27.66 DAS. In control treatment (T_1) the seed germination took place 49.33 DAS (Table 2). Olmez (2011) [9], Bhuse *et al.* (2001) [3] reported in *Hippophae rhamnoides, Cassia angustifolia*, respectively the effect of pre-treatments for decreasing no of days to seedling emergence.

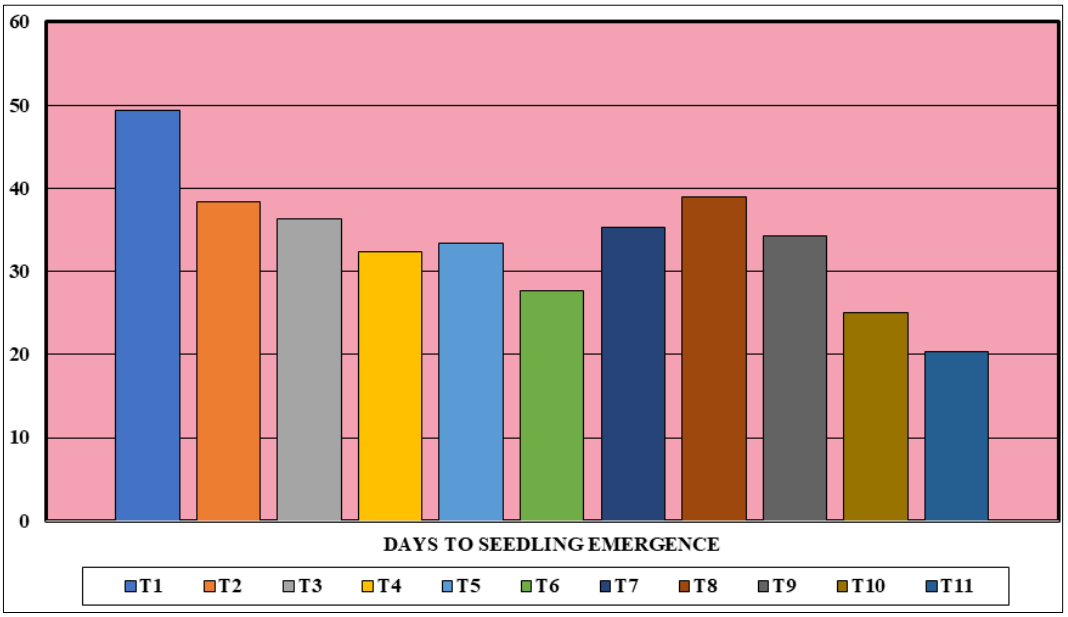

Fig 3: Effect of different pre-sowing treatments on no of days to seedling emergence of *Terminalia chebula*

Germination percentage

The highest germination percentage (70.6%) was observed in treatment T_{11} - mechanical breaking of Seed coat through stone and sowing of seed followed by T_5 – Dipped in 50% Sulphuric acid for 20 minutes (38%), T_6 – Dipped in 50% Sulphuric acid 25 minutes (36%). The control treatment (T_1), on the other hand, had the lowest germination percentage (9.33%). However, the germination under 20, 25, and 30 minutes sulphuric acid treatments was significantly higher than that of cow dung scarification treatments for 15, 30, and 45 days as well as cold water soaking for 24, 48, and 72 hours (Table 2). It is also observed that the germination percentage reduces with the increase of the soaking time period of seed in Sulphuric acid treatment. Kumar, V. (2016) [6] reported that the highest germination percentage (47.50) observed for the seeds of *Terminalia bellerica* with removed pulp and soaking in water for 24 hrs. However, the species is different (*Terminalia bellirica*) from the present investigation (*Terminalia chebula)* therefore, the difference in hardness of seed coat may be the reason that *Terminalia bellirica* having less germination as compared with the present investigation (70.6%). Highest germination percentage of Harad in mechanical treatment is in accordance with the findings for *Albizia saman* (Alamgir and Hossain, 2005) [4], *Pouteria campachiana* (Amoakoh *et al.* 2017) [2], *Terminalia chebula* (Saleem *et al.* 2013) [11].

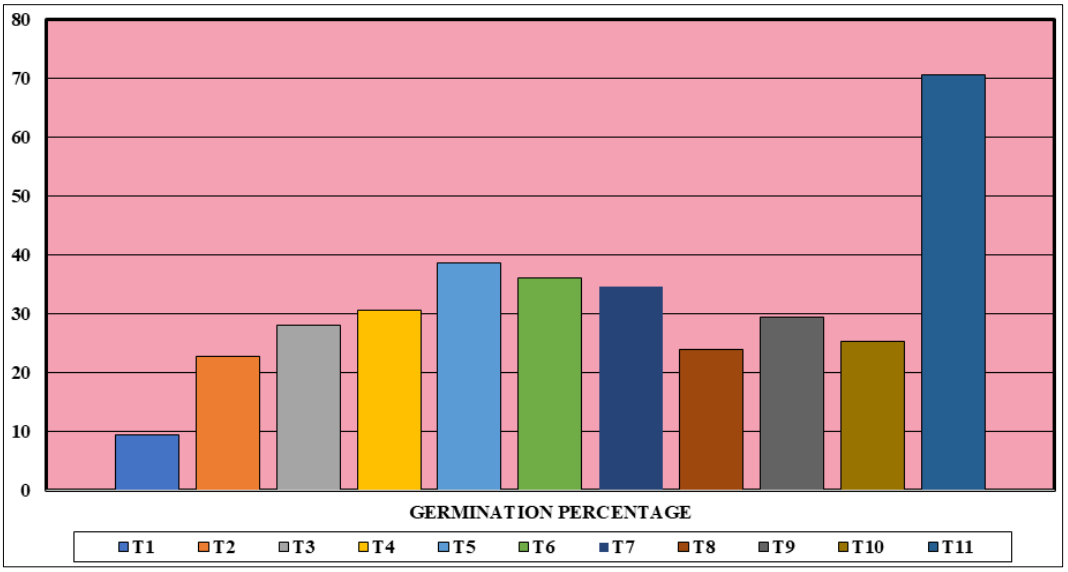

Fig 4: Effect of different pre-sowing treatments on germination percentage (%) of *Terminalia chebula*

Mean Daily Germination

The highest (0.78) Mean daily germination was observed in seeds that were mechanically treated (Breaking of Seed coat through stone-T_{11}) followed by T_5 -Dipped in 50% Sulphuric acid 20 minutes (0.42) followed by T_6 – Dipped in 50% Sulphuric acid 25 minutes (0.4) while the lowest (0.10) was observed in control treatment (Table 2). Kumar, V. (2016) [6] also found highest mean daily germination in seeds (*Terminalia bellerica*) with removed pulp and soaking in water for 24 hours.

Peak value

The peak value was significantly varied due to various pre-sowing treatments. The highest (1.23) peak value was

observed in Seeds that is mechanically treated (T_{11} - Breaking of Seed coat through stone) followed by T_6 – Dipped in 50% Sulphuric acid for 25 minutes (0.6) while the minimum (0.10) was observed in the control treatment (Table 2). Kumar, V. (2016) [6] reported the highest peak value of germination (1.63) were observed for the seeds (*Terminalia bellerica*) with removed pulp and soaking in water for 24 hrs.

Germination value

The highest (0.96) germination value was observed in seeds that were mechanically treated (T_{11}-Breaking of seed coat through stone) followed by T_6-Dipped in 50% Sulphuric acid for 25 minutes (0.24) while the lowest (0.01) was observed in control (Table 2). Kumar, V. (2016) [6] reported the highest germination value (0.52) was observed for the seeds (*Terminalia bellerica*) with removed pulp and soaked in water for 24 hrs. Hossain *et al.* (2005) [4] reported that the highest germination value (4.41) was observed in the fruit depulped and soaked in cold water for 48 hours, and the lowest was obtained from controlled seeds in *Terminalia chebula*.

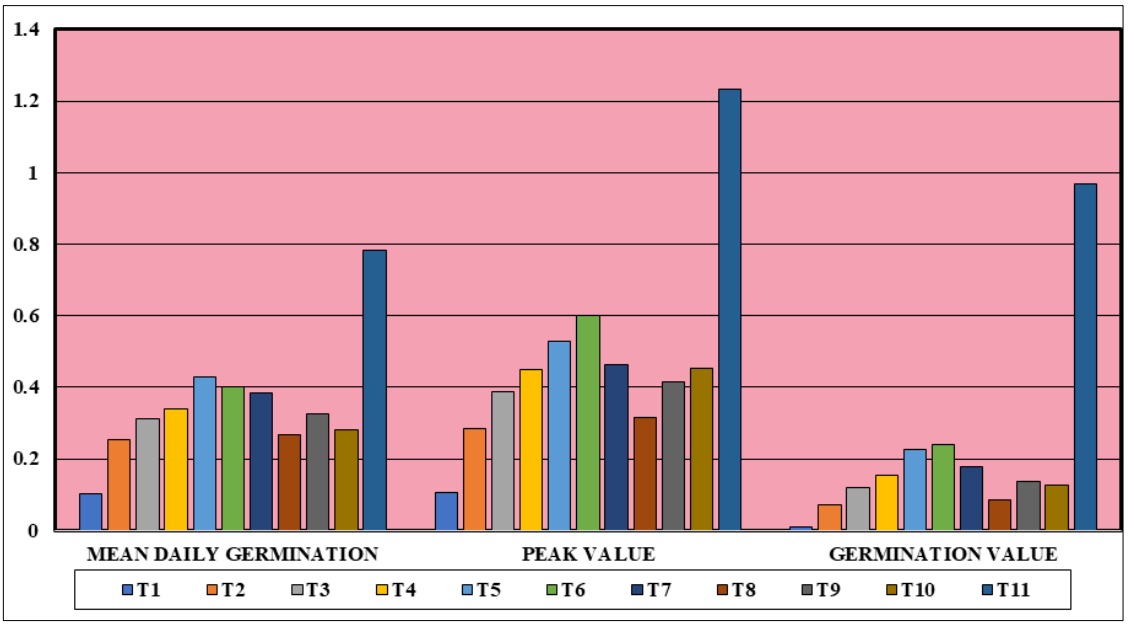

Fig 5: Effect of different pre-sowing treatments on mean daily germination, peak value, and germination value of *Terminalia chebula*

Table 2: Effect of different pre-sowing treatments on seed germination behavior of *Terminalia chebula*

Treatment	No of days to seedling emergence	Germination percentage	Mean daily germination	Peak value	Germination value
T_1– Control	49.33	9.33	0.10	0.11	0.01
T_2- Soaked in cold water for 24 hours	38.33	22.66	0.25	0.28	0.07
T_3 – Soaked in cold water for 48 hours	36.33	28	0.31	0.39	0.12
T_4 – Soaked in cold water for 72 hours	32.33	30.66	0.34	0.45	0.15
T_5 – Dipped in 50% Sulphuric acid for 20 minutes	33.33	38.66	0.43	0.53	0.23
T_6 – Dipped in 50% Sulphuric acid for 25 minutes	27.66	36	0.4	0.6	0.24
T_7– Dipped in 50% Sulphuric acid for 30 minutes	35.33	34.66	0.39	0.46	0.18
T_8 – Immersed in cow dung slurry for 15 days	39	24	0.27	0.32	0.08
T_9 – Immersed in cow dung slurry for 30 days	34.33	29.33	0.33	0.42	0.14
T_{10}–Immersed in cow dung slurry for 45 days	25	25.33	0.28	0.45	0.13
T_{11} - Breaking of Seed coat through stone	20.33	70.6	0.78	1.23	0.97
F test	S	S	S	S	S

Note: S= significant at 0.5%.

Conclusion

Pre sowing treatment is essential to enhance the germination % of such species having low germination either to break the dormancy or to break the hard seed coat. The raising a seedlings in nursery of a specific species in order to produce a maximum number of quality seedlings at the lowest cost, time, and labor. Because *Terminalia chebula* seeds have a hard seed coat, they take longer to germinate and have a lower germination rate in nurseries. The current investigation of seed pre-sowing treatments has practical applications in comparison to the control/ traditional method of seed sowing in nursery general practice. The various treatments used in the trial for *T. chebula*, breaking the seed coat through stone was found to be more efficient in terms of faster germination, high germination percentage, maximum mean daily germination, peak value, and germination value and followed by Sulphuric acid treatment.

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