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Research Article

EFFECTS OF PRESOWING TREATMENTS ON GERMINATION BEHAVIOUR OF *TOONA CILIATA* M. ROEM

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Abstract: The present study was carried out to evaluate the effects of presowing treatments on germination and growth parameters in the seeds of *Toona ciliata* at Punjab Agricultural University, Ludhiana, Punjab (India). Matured seeds of *Toona ciliata* were collected from two middle aged, healthy plus trees selected from the Ludhiana and were treated with five presowing treatments *viz*., T_1 (Control), T_2 (immersion in cold water for 24 hrs), T_3 (Immersion in cold water for 48 hrs), T_4 (immersion in boiled hot water for 24 hrs) and T_5 (immersion in hot water for 48 hrs). Results showed that, germination success (Germination percent, Mean Daily Germination, Peak Value and Germination value) and growth performance (seedling height) except collar diameter were significantly increased compared to that in control. Seeds of both genotypes showed the similar trend for the various treatments. Germination started on 4-5 days and completed on 10-15 days in all cases. Highest germination percent (58.0%), Mean Daily Germination (3.62), Peak value (10.84) was found in T_5 (immersion in hot water for 48 hrs), followed by 55.50%, 3.47 and 10.46 in T_3 (immersion in cold water for 48 hrs). Highest Germination value (37.76) was found in T_3 (immersion in cold water for 48 hrs) followed by T_5 (immersion in hot water for 48 hrs) with 35.65 cm. ANOVA revealed significant differences for germination indices. Hot water treatment for 48 hrs, followed by cold water treatment for 48 hrs may be recommended for early and efficient germination performance.

Keywords: Germination, ANOVA, Hot water treatment

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Introduction

Seed is a morphologically complex organism provides an imperative link in population dynamics by allowing the establishment of new individuals. Occurrence of growth cessation is a seed dormancy which has become problematic for maintaining a potential for growth without loss of biological integrity [1]. Seed dormancy often restricts the usage of particular species in nurseries for the production of seedlings as the healthy seeds are only beginners for any successful forest plantations. In many forest tree species, there occurs a lag period between accomplishment of seed maturity and seed germination. Such seeds fail to germinate, even when the conditions are generally conductive to germination and are termed as dormant seeds. Factors responsible for seed dormancy are associated either with embryo or with seed coat [2]. Seed dormancy has imposed a great disadvantage in forest nurseries where instantaneous and immediate seed germination is required. Thus, it becomes essential for the development of proper dormancy breaking approaches. Although a lot of investigation has been done on the factors inducing dormancy, much less is literally admitted about the mode of development of dormant phase in seeds. Physical dormancy is caused due to hard seed coat or fruit enclosure which hinders imbibition's and gases exchange. The physical seed dormancy may be overthrown by manual scarification of seed coat by blaring, nail clipping, nicking, flaming or filing with the assistance of blade, knife, needle, hot wire burner, abrasion or sand paper etc [3-5]. Furthermore, hot water treatment [6,7] or acid treatment [8-11] can also conquer the physical seed dormancy. *Toona ciliata* M. Roem, a member of family Meliaceae, is a fast growing, shade bearer, moderate deciduous tree with straight trunk, and attains good height with rounded and well spread crown. The species is popular for its versatile timber, flowers yield dye, and bark used as tan material, shade of its dense, dark green foliage in summer. In Punjab state, the species is not commercially adopted in agroforestry systems but found along cultivated fields, roadside, canal side in the Kandi region of the state. In Himachal Pradesh, the species is largely cultivated for farm grown timber, as agroforestry species and occasionally lopped for fodder and fuel purpose [12]. Toon foliage serve as the green animal fodder and inflorescence as food for honey bees because of presence of nector. The incorporation of superior genotypes in the traditional agroforestry systems of the state will remarkably increasing the productivity of these systems as well meet the quality timber requirements of wood based industries which in turn benefitting the farmers and contribute to national economy. So, various seed treatments are essential to favour the fast and uniform germination ensuring the early returns. The effect of various pre-treatment methods on seed germination of some tree species has been reported by [13-16]. Relevant pre sowing techniques of seed germination can boost germination rate and over all process [17,18]. Therefore, the main aim of the present investigation was to determine the best possible presowing treatment that maximized the seed germination and growth performance.

Materials and Methods

Study area

The experiment was carried out in the nursery at main experimental area of Department of Forestry and Natural Resources, PAU, Ludhiana, (30°58'N latitude 75°44'E longitude, 247 m altitude) which falls in central zone of Punjab. The climate of the study area is characterized with sub tropical andsemi arid. Hot and dry summers (April to June), hot and humid monsoon (July to September) and cold winters (November to January) are the three main seasons distinguish here. The temperature falls to 6-15°C in winter and rises up to 26-40°C in summer, but very occasionally it might be increase up to 42-47°C. The site receives an average rainfall of 500-750 mm which is not evenly distributed and most of it (75-80%) is received during July to September.

Plant Materials and Design of experiment

The golden and dark brown coloured, closed and partially dehiscent fruits (capsules) were collected manually from the middle aged, matured plus trees from different areas of Ludhiana during the month of June, 2017.

Table-1 *Effect of various pre sowing seed treatments on germination parameters of Toona ciliata*

Presowing treatments	Germination %			MDG			PV			GV		
	G_1	G_2	Mean	G_1	G_2	Mean	G_1	G_2	Mean	G_1	G_2	Mean
T_1	35	30.5	32.8^b	2.19	1.91	2.05^b	3.75	2.89	3.32^c	9.25	5.85	7.55^c
T_2	46	56.5	51.3^a	2.87	3.53	3.20^a	6.05	8.17	7.11^b	19.26	29.7	24.48^b
T_3	51	60	55.5^a	3.19	3.75	3.47^a	9.26	11.67	10.46^a	30.82	44.71	37.76^a
T_4	43.5	52	47.8^a	2.72	3.25	2.98^a	5.91	9.52	7.71^b	16.89	31.37	24.13^b
T_5	47.5	68.5	58.0^a	2.97	4.28	3.62^a	9.3	12.37	10.84^a	27.76	43.53	35.65^{ab}
Mean	44.6	53.5		2.79	3.34		6.86	8.92		20.8	31.03	
G Mean	49.05			3.07			7.89			25.91		
SE±	4.43			0.28			1.36			5.37		
$CD_{0.05}$	8.04											
G	12.71			0.5			0.96			7.37		
T	NS			0.79			1.51			11.65		
G×T				NS			2.15			NS		

G-Genotype, T-Treatment, MDG-Mean Daily Germination, PV-Peak Value, GV-Germination Value; T_1-Control, T_2-Cold Water Treatment For 24 Hrs, T_3-Cold Water Treatment For 48 Hrs, T_4-Boiling Hot Water Treatment For 24 Hrs, T_5-Hot Water Treatment 48 Hrs

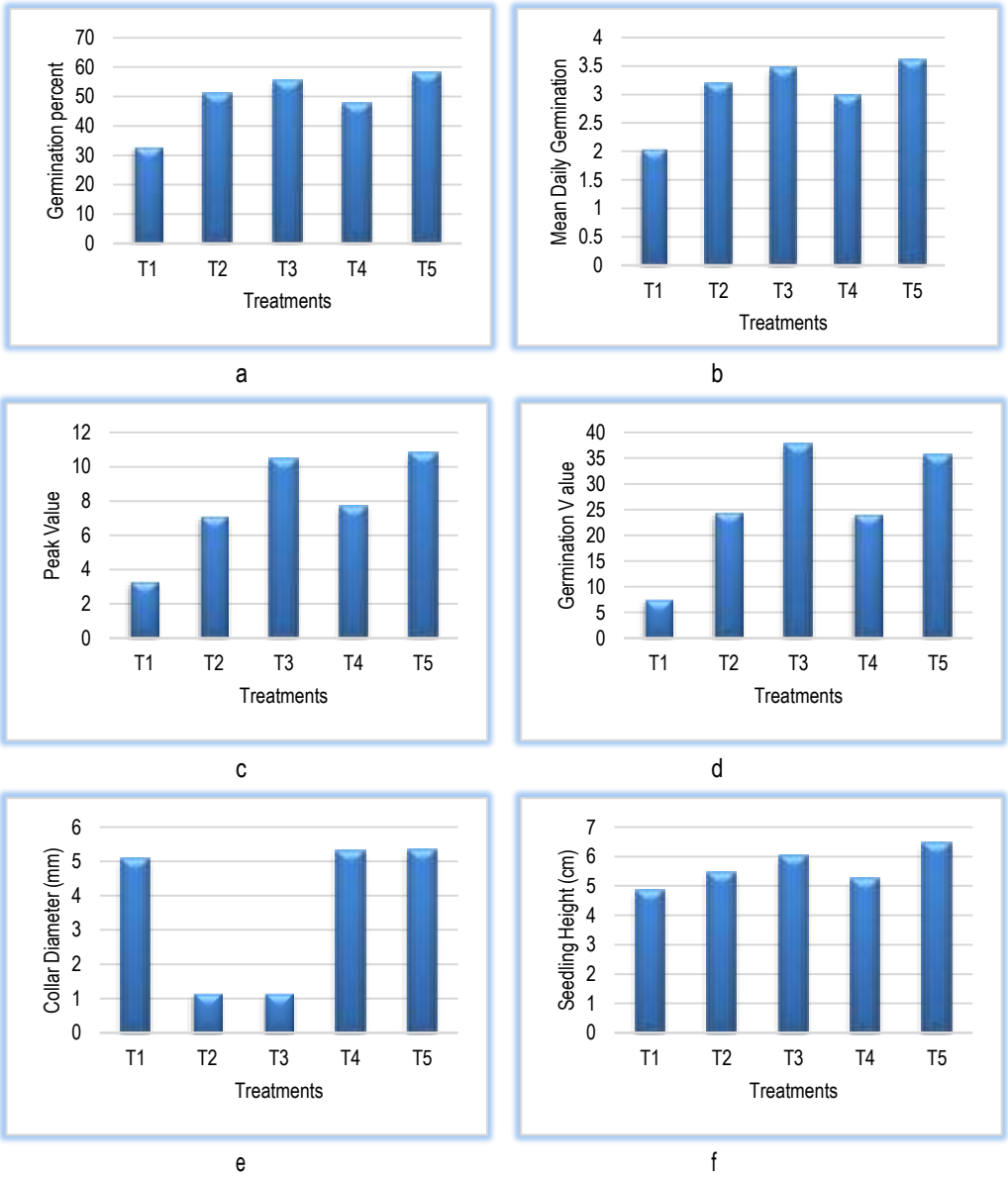

Fig-1 Effect of various presowing treatments on germination and growth parameters of *Toona ciliata*
Variation in (a) Germination percent, (b) Mean Daily Germination, (c) Peak Value, (d) Germination Value (e) collar diameter (f) seedling height

The collection was made from standing trees with bags using ladder, and by climbing on the trees because of small sized seeds which are more liable to be dispersed by wind. The mature capsules were exposed to sun drying for 2-3 days necessary to split or open the fruit walls completely to release the seeds easily. The seeds were then extracted from the completely opened capsules manually. The seeds were dried for 3-4 days to reduce the moisture. The collected seeds were checked to remove inert matter, discoloured, damaged seeds and healthy dried seeds were selected and used for further investigation. The seeds from two genotypes were used for present study. The germination test was done by sowing the seeds in large pots. The media of pots was sand and silt in the ratio of 1:1. Five treatments were set in the experiment i.e. T1: control, T2: immersion in cold water for 24 hrs, T3: immersion in cold water for 48 hrs, T4: immersion in boiling

hot water for 24 hrs, T5: immersion in hot water for 24 hrs. Pots were kept under shed with opened walls from four sides throughout the experiment. The seeds were sown approximately at a depth of 0.5-1.5 cm and were watered manually once a day through sprinkler. CRD with four replications was used for the experiment. Each replication was characterized by 100 seeds. The number of seed germinated in each treatment was recorded on every day after 4-5 days of sowing (27July 2017). Data was recorded up to 12 days when germination was no longer be observed Germination indices, germination percent, MDG, PV, GV worked out following [19].

Data Analysis

Analysis of Variance (ANOVA) and Dunken Multiple Range Test DMRT [20] were undertaken to analyze the data using MS Excel and Statistical software (CPCS1 version) to investigate the possible variation in pre treatments. Analysis of variance was carried out to determine the treatment effects on germination percent, MDG, PV, GV. DMRT was carried out to compare the traits under study in each presowing treatment.

Results

Seed Germination Traits

Germination traits of seeds in different treatments *viz*; germination percent, mean daily germination (MDG), peak value (PV), germination value (GV) were shown in [Table-1]. Data revealed that T_1 (Control) showed lowest value for the all the germination indices (germination %, MDG, PV and GV) which was significantly improved by other four treatments. All the four treatments were differed significantly with control. The highest germination percentage (58.00%) in T_5 (immersion in hot water for 48 hrs) differed significantly ($p<0.05$) with the lowest germination success (32.80 %) in T_1 (control). Germination percent in T_3 (immersion in cold water for 48 hrs) with 55.50%, T_2 (immersion in cold water for 24 hrs) with 51.30%, T_4 (immersion in boiling hot water for 24 hrs) with 47.80% showed no significant differences ($p>0.05$) with each other. Over the genotypes G_2 (53.5%) observed significantly more germination percent. Similarly, maximum value of MDG (3.62) was observed in T_5 (immersion in hot water for 48 hrs), followed by T_3 (immersion in cold water treatment for 48 hrs) with 3.47 and T_2 (immersion in cold water for 24 hrs) with 3.20. Lowest value (2.05) was observed in T_1 (control). MDG in T_5 (immersion in hot water for 48 hrs) with 3.62, T_3 (immersion cold water for 48 hrs) with 3.47, T_2 (immersion in cold water for 24 hrs) with 3.20 and T_4 (immersion in boiling hot water for 24 hrs) with 2.98 showed no significant differences with each other. The genotype G_2 (3.34) listed significantly more mean daily germination. The maximum peak value (10.84) was registered in T_5 (immersion in hot water for 48 hrs), followed by 10.46 in T_4 (immersion in cold water for 48 hrs). The lowest value (3.32) was found in T_1 (control). Among the treatments$_5$ (immersion in hot water for 48 hrs) with 10.84, T_3 (immersion in cold water for 48 hrs) with 10.46 were on par with each other for peak value. T_1 (Control) was registered the lowest value (3.32). G_2 (8.92) registered significantly more peak value. Significant variation was also observed in germination value with maximum (37.76) in T_3 (immersion in cold water for 48 hrs) and minimum (7.55) in T_1 (control). Germination values in T_5 (immersion in hot water for 48 hrs) with 35.65, T_2 (immersion in cold water for 24 hrs) with 24.48, T_4 (immersion in boiling hot water for 24 hrs) with 24.13 were on par with each other. Over genotypes, G_2 (31.03) registered significantly more germination value.

Discussion

Various authors contended that several presowing treatment of seeds can break the seed dormancy and by that boost the germination rate and improve the germination process. Findings of the present study exhibited that germination of *Toona ciliata* significantly improved by giving various treatments. However, the seed dormancy can vary from species to species, various stages of seed maturity and the extent of seed drying. So, pre treatment must be conformed on the basis of the status of seed dormancy. *Toona ciliata* seeds are orthodox seeds and may exhibit dormancy due to the morphologically immature embryo, seeds with internal dormancy and seed coat imposed dormancy [2]. According to Catalan and Machiavelli [3], Alamgir and Hossain [4], Tadros *et al* [5], Missanjo *et al* [14] and Azad *et al* [15] , the physical seed dormancy may be overthrown by manual scarification of seed coat by blaring, nail clipping, nicking, flaming or filing with the assistance of blade, knife, needle, hot wire burner , abrasion or sand paper etc. Furthermore, hot water treatment [6,7] or acid treatment [8-11] can also conquer the physical seed dormancy. Present study [Table-1] revealed that among the five pre sowing treatments, T_5 (immersion in hot water treatment for 48 hrs) performed significantly better than T_1 (control) for germination traits of *Toona ciliata* followed by T_3 (Cold water treatment for 48 hrs). Treatment T_5 recorded highest value for germination percent (58.0 %), MDG (3.62 %), PV (10.84%), GV (35.65). Furthermore, the treatments T_5 (hot water treatment for 48 hrs) and T_3 (cold water treatment for 48 hrs) were on statistically at par with each other for the traits under consideration. The present results are in line with [13] which reported the highest germination success (82.07%) for the seeds of *Albizzia procera* when treated or immersed in hot water (80°C) for 10 minutes followed by 79.00 % when immersed in hot water (100°C) for 1 minute. Tadros *et al* [5] found 66% germination in the seeds of *Leucaena leucocephala* when soaked in hot water 70°C for 20 min. Likewise, Azad *et al* [18] found 83% and 78% seed germination of *Acacia auriculiformis* in hot water treatment and scarification with sand paper. Missanjo *et al* [14] found hot water treatment was second best pretreatment method for enhancing the speed and amount of early seedling growth of *Acacia polyacantha* at nursery stage after nicking. Similar findings also presented by Azad *et al* [15] wherein, highest germination rate (96%) was recorded for the seed of *Albizzia richardiana* when immersed in in hot water followed by 87%, 83%, and 49 % in treatments with scarification, H2SO4 and control. The variations in seed germination success may be due to the differences in boiling time and temperature applied. Alamgir and Hossain [4] found cold treatment for 24 hrs was the second best pre treatment method which supported 42 % germination in *Albizzia saman* after nail clipping (50%).

Conclusion

Toona ciliata is a valuable tree species for social forestry programme and also well known for its quality timber, its association with crops (agroforestry), fuel wood purpose and green animal fodder. Hence the species is compelling the researchers to resolve appropriate and efficient seed germination techniques. Among the five presowing treatments with control, T_5 (immersion in hot water for 48 hrs), T_3 (immersion in cold water treatment for 48 hrs) performed very well for germination and growth parameters. Seed germination under hot and cold water treatment is however simple and inexpensive. Hence the knowledge of effective and low cost pre sowing treatment can be utilized to enhance the germination rate, seedling viability for early production and profit.

Application of research: Prior knowledge of pre sowing seed treatment is essential for obtaining early and effective germination.

Research Category: Seed germination

Abbreviations:

MDG: Mean Daily Germination
PV: Peak Value, GV: Germination Value
G: Genotype, T: Treatment

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Study area / Sample Collection: Department of Forestry & Natural Resources, Punjab Agricultural University, Ludhiana, 141004, Punjab

Cultivar / Variety name: *Toona ciliata* M. Roem

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