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Nepuni Rinaldi
Department of Silviculture and Agroforestry, College of Horticulture and Forestry, Central Agricultural University (I), Pasighat, Arunachal Pradesh, India

Bikram Singh
Associate Professor, Department of Silviculture and Agroforestry College of Horticulture and Forestry, Central Agricultural University (I), Pasighat, Arunachal Pradesh, India

Athikho Kayia Alice
College of Horticulture and Forestry, Central Agricultural University (I), Pasighat, Arunachal Pradesh, India

Corresponding Author:
Bikram Singh
Associate Professor, Department of Silviculture and Agroforestry College of Horticulture and Forestry, Central Agricultural University (I), Pasighat, Arunachal Pradesh, India

Influence of pre-sowing treatments on seed germination of *Michelia champaca* Linn. Under Eastern Himalayas, India

Nepuni Rinaldi, Bikram Singh and Athikho Kayia Alice

Abstract
The aim of this paper was to find the effect of pre-sowing treatments on the germination parameters of *Michelia champaca* L. which has low germination status in nature. The experiment was conducted with fourteen treatments in four replications carried out in the laboratory and nursery bed to improve germination on fresh seeds after removal of fleshy aril. Significant differences in germination were observed with maximum of 43.8% germination when seeds were soaked in gibberellin acid (500 ppm) for 24 hr. and subsequently soaked in 4% hydrogen peroxide for 24 hr. (T_{14}) followed by T_6 (41%) soaked in 4% hydrogen peroxide for 12 hr. were the most effective methods to enhance germination rates. In contrast, the germination percentage of seeds of treatments T_8 (1.30%) and T_9 (1.50%) was lower than control T_1 (2.50%) may be due to detrimental effect of nitric acid, the results of the present study may be useful for the production of planting stock in nurseries for plantation and commercial purposes.

Keywords: *Michelia champaca*, dormancy, aril, GA_3, H_2O_2, pre-sowing treatment

Introduction
Michelia champaca L. (Magnoliaceae) commonly known as Champa is an evergreen timber tree with average height of 33 m and a girth of 2.4 to 3.7 m attaining straight bowl, grows naturally in low lands to mountainous rainforests of the Eastern sub-Himalayan region as well as the Western Ghats of India (Troup, 1921; Negi and Gupta 1987; Chopra *et al*., 2005) [15, 11, 5]. The fruit are follicles that dry at maturity and split open at one side consist of dark brown angular oily seeds enclosed in a pink arillus and ripens from August to September. The natural regeneration is poor but removal of the aril enhances germination (Robbins, 1988; Zabala 1990; Candiani *et al*., 2004) [14, 18, 3]. Champa is a multipurpose timber tree, its wood, leaves, flower and fruits are used in various purposes according to the locality and knowledge (WWF, 2019) [17]. Besides, being an ornamental tree and its economic importance, the species is becoming scarce in natural forests. Many valuable tree species seeds have difficulty in germination affected by seed coat dormancy leading to decrease in their population. Whereas, the dormancy is an adaptation to cope up the environmental conditions and germinate when are favourable for survival. Breaking of seed dormancy by various pre-sowing method enhances the germination procedure and facilitates plantation programs (Kaur *et al*., 2020) [10]. The purpose of the present study was to investigate the best pre-sowing treatment that can enhance the percentage germination responses of *Michelia champaca* seeds to increase the planting stock for planting program.

Materials and Methods
Mature seeds of *Michelia champaca* L. were collected in the month of August, 2016 from Sugnu, Manipur (24˚17′N latitude; 93˚52′E longitude). The present investigation was carried out during month of August 2016 in laboratory and nursery at College of Horticulture and Forestry, Central Agricultural University, Pasighat, East Siang District, Arunachal Pradesh of India situated at 28°04′43″ N latitude and 95°19′26″ E longitude with an altitude of 153 msl. Immediately after collection seeds were cleaned by removing the fleshy aril manually, and were employed for pre-sowing treatments. The pre-treated seeds were air dried in shade for 24 hrs before sowing. The treated seeds were sown in laboratory in plastic trays (48×35×8 cm) filled with mixture of soil, sand and farm yard manure in the ratio 3:1:1 and same treatments were sown in raised bed composing Soil: Sand: FYM (3:1:1) respectively at nursery.

Watering was carried out manually once a day as per requirements and observed daily for initiation and progress of germination until no more germination was observed. Visible emerging shoot appearance on the surface was recorded as criteria of seed germination. The germination data was taken daily after commencement of germination until it was over. The germination data was recorded from the 22nd day after sowing to a maximum of 45th day.

All of the experiments were carried out using statistical design with14 pre-sowing treatments including control and 4 replications for each treatment. For each replication hundred seeds were sown (ISTA, 2003) [9]. Except for control all the treatments were without aril, the pre-sowing seed treatments details were denoted as follows: T_1 -control (untreated seed with aril); T_2 -seeds without aril and no treatment; T_3 -soaked in water for 24hr at ambient temperature; T_4 -soaked in Luke warm water for 24hr; T_5 -soaked in 2% hydrogen peroxide (H_2O_2) for 12hr; T_6 -soaked in 4% hydrogen peroxide (H_2O_2) for 12hr, T_7 -soaked in 6% hydrogen peroxide (H_2O_2) for 12hr, T_8 -scarified in 20% nitric acid (20% HNO_3) for 15 minutes, T_9 -scarified in 30% nitric acid (30% HNO_3) for 10 minutes, T_{10} -seed chilled at 0˚C for 24hr; T_{11} -soaked in gibberellin acid 200 ppm for 12hr; T_{12} - soaked in gibberellin acid 500 ppm for 12hr; T_{13} - soaked in gibberellin acid 1000 ppm for 12hr; T_{14} - soaked in gibberellin acid (500 ppm) for 24hr followed by dipping in hydrogen peroxide (4%) for 24 hr.

Germination percentage: The germination test was worked out in four replicates of 100 seeds each (ISTA, 2003) [9] using the formulae as:

$$\text{Germination Percentage} = \frac{\text{Number of seeds germinated}}{\text{Total number of seeds used}} \times 100$$

Peak value and germination Value: Peak value was calculated as the maximum mean daily germination (MDG) reached at any time during the period of test. Germination value is a composite value combining both germination speed and total germination providing an objective means of evaluating the results of germination test was calculated using the formula of Czabator (1962) [6].

Germination Value = Final DGS X Peak value; where DGS is (Daily Germination Speed)

Data analysis: The experimental layout arranged in a Completely Randomized Design (CRD) in laboratory and Randomized Complete Block Design (RCBD) was adopted for nursery conditions. Significance of the treatments was determined by analysis of variance (ANOVA) and the differences between the means were compared by Fisher's least significant difference (LSD) test at 0.05 level following the model suggested by Panse and Sukhatme (1985) [13]. Result data (in per cent) were transformed to arcsine values before statistical analysis.

Results

Results of table 1 and fig.1 indicate that for the germination parameters characterizing germination percent, peak value and germination value, tested in both laboratory and nursery conditions were significantly affected by pre-sowing treatments ($P < 0.05$). Under laboratory conditions the highest germination percentage (43.8) was obtained from T_{14} (soaked in Gibberellin acid (500 ppm) for 24hr. and subsequently soaked in 4% hydrogen peroxide for 24hr.) followed by (41%) T_6 (soaked in 4% hydrogen peroxide for 12hr.) which is at par with T_{14} were the most effective methods to enhance germination. The treatments T_{13}, T_{12} and T_{11} also exhibited satisfactory germination with 38.3%, 38.0% and 37.8% respectively. In contrast the germination percentage of seeds from treatments T_8 (1.30%) and T_9 (1.50%) was lower than control T_1 (2.50%) may be due to detrimental effect of nitric acid. Graphically depicted in Fig 1, similar trends were observed in nursery conditions in raised nursery bed with T_{14} (43.75%) and T_6 (39.75%) being highest in germination and lowest for T_8, T_9 and control T_1.

Table 1: Effect of seed pre-sowing treatment on germination parameters of under fourteen treatments (laboratory conditions)

Treatments	Germination percent (Arcsine Value)	Peak Value	Germination Value
T_1	2.50 (08.87)	0.09	0.005
T_2	5.50 (13.44)	0.17	0.024
T_3	13.50(21.53)	0.39	0.140
T_4	7.00 (15.29)	0.21	0.038
T_5	33.30(35.19)	0.96	0.720
T_6	41.00(39.81)	1.17	1.250
T_7	28.30(32.09)	0.81	0.600
T_8	1.30 (06.49)	0.05	0.001
T_9	1.50 (06.98)	0.05	0.001
T_{10}	17.08 (08.80)	0.26	0.570
T_{11}	37.80 (37.90)	1.08	1.069
T_{12}	38.00 (38.06)	1.10	1.096
T_{13}	38.30 (38.20)	1.09	1.095
T_{14}	43.80 (41.44)	1.24	1.410
Mean ± SE (Range)	25.17±1.11 6.49-41.44	0.62±0.01 0.09-1.24	0.57±0.015 0.001-1.410
MSS	797.73	0.9165	1.1588
C.V. %	6.27	3.99	4.609
F-Test	1086.29*	339.869*	588.771*
C.D. (5%)	2.25	0.04	0.044

*Significant at the 0.05 *p* level.

The highest germination value 1.410 (T_{14}) was followed by 1.250 (T_6) in lab condition and similar trend was recorded in nursery bed for the different treatments were elucidated in fig.1. The maximum peak value in laboratory was observed in T_{14} (1.24) and T_6 (1.17) and the lowest was recorded in lowest for T_8 and T_9 (0.05) each. In nursery conditions the peak value of germination also showed similar trends of recordings from highest to lowest value as revealed in laboratory investigation.

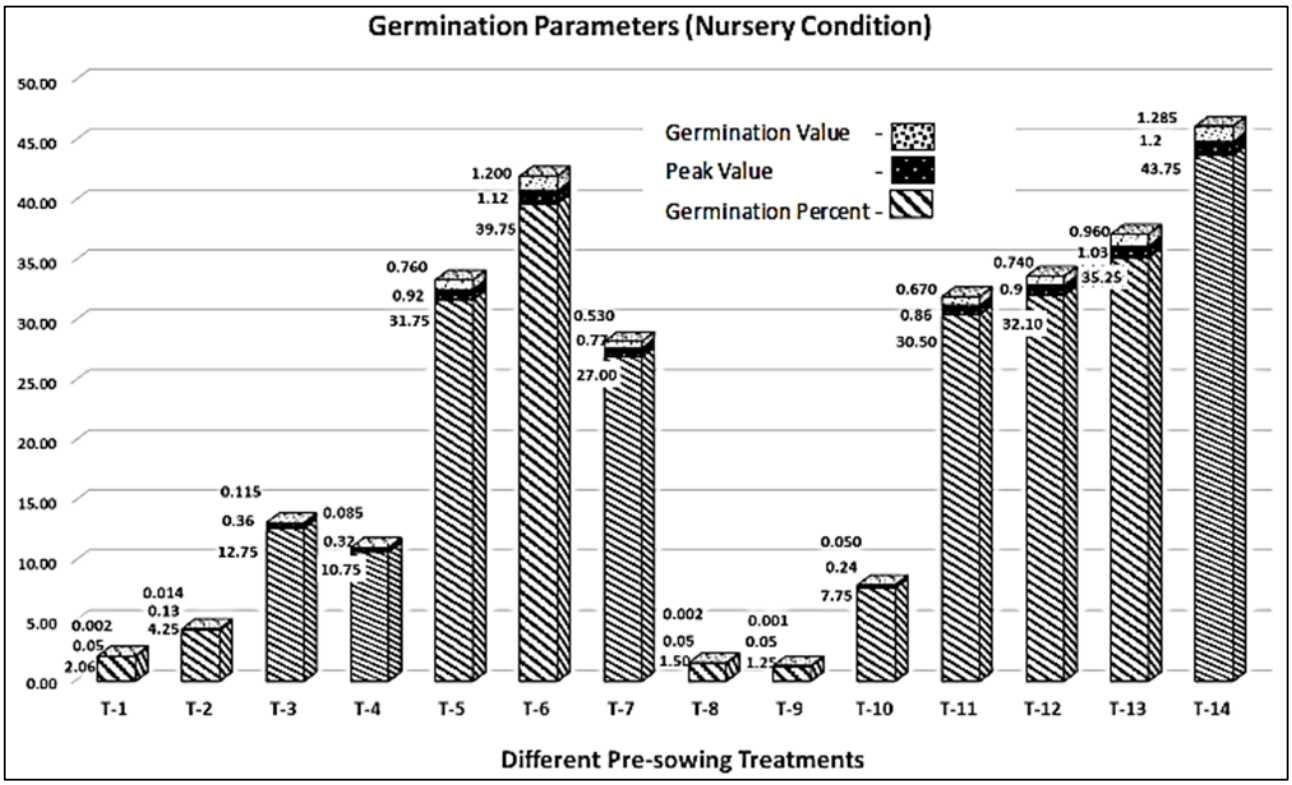

Fig 1: Effect of different presiding treatments on seed germination percentage, peak and germination value of *Michelia champaca* L. under nursery condition

Discussions

Several pre-sowing treatments have been used to enhance seeds germination and various treatments differ significantly (Table 1) in the present investigation. The seed dormancy exhibited in the Magnoliaceae family and seeds of *M. champaca* reported low germination by many investigations (Dirr and Heuser, 1987; Beniwal & Singh, 1989; Candiani *et al*., 2004; Zheng *et al*., 2008) [7, 2, 3, 19], however, high germination occurred when treated with gibberellin acid (growth regulator) showing the presence of physiological dormancy (Bahuguna *et al*., 1988; Fernando *et al*., 2013; WWF, 2019; Wang *et al*., 2021) [1, 8, 17, 16] and hydrogen peroxide (chemical) can accelerate oxygen production there by promote germination by breaking dormancy (Chien and Lin, 1994; Omokhua *et al*., 2015) [4, 12]. These reports accord with our findings using gibberellin acid and hydrogen peroxide to improve the germination rate. The results obtained by different pre-sowing treatments T_{14}, T_6, T_{13}, T_{12} and T_{11} indicated that seed priming by removal of fleshy aril and treating with gibberellin acid and hydrogen peroxide enhances seed germination in *Michelia champaca*.

Conclusion

The present investigation taken for pre-sowing treatments suggested that seeds after removing the aril and treated with combinations of gibberellin acid and hydrogen peroxide enhances germination from 30 to 43 % which may be helpful for the nursery production of planting stock for raising artificial plantations and commercial purposes.

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