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Influence of Pre-Sowing Treatments on Germination of *Canarium strictum* Roxb

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A B S T R A C T

Nursery and lab-based experiments were conducted to study the influence of different pre-sowing treatments on germination of *Canarium strictum* Roxb. Results have shown that significant variation ($p<5$) among treatments was observed with the highest germination percentage in T_8-Soaking in 4% H_2O_2 overnighting both nursery (74.75 %) and lab conditions (76.67 %). As such the peak value and germination value were recorded in T_8 (1.54 and 1.65) and T_9 (1.26 and 1.70). No germination was observed in unpluped seeds in both nursery and lab conditions.

Introduction

Canarium strictum Roxb. commonly known as black dammar or kala dammar and regionally known as 'Silum', is a species of tree in the family Burseraceae and is highly valued socio-economically important semi-evergreen tree species.

The species is indigenous of the country and is naturally distributed in the state of Arunachal Pradesh, Assam, Meghalaya, Orissa, Maharashtra, Karnataka, Kerala Sikkim, and Tamil Nadu and in the Andaman Islands (Singh *et al.*, 2018). *C. strictum* exudates a resin called 'Sambrani' or 'Dammar' which has medicinal as well as commercial uses. It is widely used among tribal and folk people for medicinal purposes in different parts of India. It is also used in the Siddha system of medicine. It also finds its uses in incense and varnish industries and as a substitute for a burgundy pitch in making medicinal plasters (Meena *et al.*, 2012). The resin powder of *Canarium strictum* is given orally to cure rheumatism, fever, cough, asthma, epilepsy, chronic skin disorders, syphilis, and hernia and also helps to improve complexion (Ravikumar and Ved, 2000). The fruit and seed kernel is edible and its oil is used in confectionery (Meena *et al.*, 2012).

In both nursery and lab conditions, soaking in 4% H_2O_2 showed maximum germination percentage as well as germination value and peak value.

Unchecked over-exploitation, unstable tapping practices by girdling the bark for gum and the loss of habitat, dammar tree is found to be endangered species and is now placed on the IUCN red list as vulnerable and threatened in the region of Kerala, Karnataka and Tamil Nadu. A 20% reduction in its population was found in the last decade due to habitat fragmentation, landscape changes, pollinator, and seed dispersal limitation and exploitation for resin and wood (Meena *et al.,* 2012). In contribution to the above-said problems *Canarium strictum* also suffers from unsuccessful germination and establishment due to its fleshy, stone-hard pericarp and seed coat which leads to dormancy and also affects its viability. Considering the above facts this study was undertaken to find the appropriate pre-sowing treatments for successful germination of the species.

The natural regeneration of this species is insignificant and scanty due to the inhibiting pericarp for germination. Further, it has been observed that the populations of this species are declining at an alarming rate in its natural habitat, largely because of resin tapping and drupes' harvesting. The conservation of this species is essential for the future availability of the source through seedling production and their ascertained afforestation programming. The pre-sowing treatment is especially essential in forest seeds which take much longer time to germinate or exhibit varying types of dormancy (Gupta and Raturi, 1975). The influence of pre-sowing treatments on seed germination of some tropical forest tree species has been stated by few authors Azad *et al.,* (2011); Merou *et al.,* (2011); Mwase and Mvula (2011) and Khan (2015).

Materials and Methods

Mature fruits of *Canarium strictum* Roxb. were collected in the month of January 2018 from Ruksin Forest Range Area (27°50'N latitude; 95°13'E longitude, at 131MSL elevation, GPS DD Coordinates, Field Survey), East Siang District, Arunachal Pradesh. The collected fruits/seeds were then processed and cleaned, which were employed for 14 treatments of 4 replications each. Four hundred fruits/seeds with a hundred fruits/seeds per replication were taken for each treatment (ISTA, 2005). Each replication of seeds were subjected to the following treatments: T_1-(Control-A: with pericarp), T_2-(Control B: without pericarp), T_3-(soaking in water overnight at ambient temperature), T_4-(nicking at distal end), T_5-(nicking at distal end and soaking in water overnight), T_6-(nicking at distal end at soaking in 500 ppm GA_3 overnight), T_7-(soaking in 2% H_2O_2 overnight), T_8-(soaking in 4 % H_2O_2overnight), T_9-(nicking at distal end and soaking in 2% H_2O_2 overnight), T_{10}-nicking at distal end and soaking in 4% H_2O_2 overnight), T_{11}-(hammering without breaking the seed cover), T_{12}-(hammering and soaking in water overnight), T_{13}-(soaking in luke-warm water overnight), and T_{14}-(alternate drying and wetting: 2days drying + 1 day soaking in water + 2 days drying + 1 day soaking in water). Immediately after the treatments, the seeds were sown in nursery beds and germination trays for lab conditions at a depth of 2 cm in the month of February, 2018.

Irrigation was given twice a day in alternative and daily observation was done to check the initiation and progress of germination until no more germination was observed. The germination data was recorded from the 28th days after sowing and expressed as days to initial germination and this was taken as a visible sign of successful germination until the last seedling emerged was recorded, which was expressed as days to final germination.

The various germination parameters such as germination percentage, peak value, and germination value were recorded at the end of the experiments. Each treatment and the control were laid in Completely Randomized Design. Values of germination percentage were transformed (arcsine-square-root transformation) prior to analysis and were back-transformed for tabular presentation. At the end of the germination period, the germination percentage, peak value, germination values were calculated using the following equations:

Germination Percentage

The germination test was carried out in which four replicates of 100 seeds each were used (ISTA, 2003). The germination percentage was calculated using the formulae as:

$$\text{Germination Percentage} = \frac{\text{No. of seeds germinated}}{\text{Total No. of seeds used}} \times 100$$

Peak value

The peak value was calculated as the maximum mean daily germination (MDG) reached at any time during the period of the test (Czabator, 1962).

Germination value

Czabator's formula (1962), which quantifies germinative energy by combining speed and completeness of germination, was used for evaluation of the treatments.

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

Statistical Analysis

The data were statistically analysed by using OPSTAT software and were subjected to a one-way analysis of variance following the model suggested by Panse and Sukhatme (1967).

Results and Discussion

Significance variations (p<0.05) among the treatments were observed in both nursery and lab conditions as depicted in Tables 1 and 2 respectively. The data have shown that the highest germination percentage among all treatments in nursery conditions was recorded in T_8 (74.75%), which was followed by T_9 (65.25%), T_7 (63.50%) and T_6 (63.25%). The minimum germination percentage in nursery condition was recorded in T_2 (29.25%). Likewise, the maximum germination percentage of 76.67% in lab condition was recorded in the treatment T_8 which was followed by T_9 and T_{14} (62.50%) and the minimum germination percentage was observed in T_2 (23.33%). There were significant ($p < 0.05$) differences among the treatments for peak value and germination value (Table 1 and 2) for treatments with higher germination percentages (T_8, T_9, T_2,). The highest peak value and germination value in nursery conditions was recorded in T_8 (1.27 and 1.54), followed by T_9 (1.14 and 1.26) and the lowest peak value was obtained in T_2 (0.51 and 0.26).

Similar trends were observed in lab conditions where treatment T_9 (1.30 and 1.70) followed by T_8 (1.24 and 1.65) was found to be significantly higher than other treatments and the minimum peak value among all the treatments was observed in T_2 (0.40 and 0.17). This indicates a better degree of seed performance which is a requirement for the fast and uniform seed germination that guarantees rapid and good seedling growth in the field (Al-Absi, 2010 and Shuaibu *et al.*, 2015).

These findings are supported by that of Ching (1959) in *Pseudotsuga menziesii*; Shearer and Tackel (1960) in *Larix occidentalis* and *Pseudotsuga menziesii* var *glauca* and Ghildiyal *et al.*, (2007) in *Pinus rocburghii* where the germination percentage and the overall germination parameters was higher in H_2O_2 treated seeds than control.

A similar finding was reported by Conner (2008) in *Vitis rotundifolia*. The mode of action of H_2O_2 in the promotion of germination is unclear but may involve the scarification of the seed coat (Chien and Lin, 1994; Keeley and Fotteringham, 1998) or oxidation of germination inhibitors (Ogawa and Iwabuchi, 2001). Schaefer (1989) reported that seeds of some tropical and sub-tropical species completely failed to germinate without extraction from their fleshy fruit pulp. A similar finding was observed in this study in which T_1 (unpulped seeds) showed zero germination in both conditions.

Table.1 Effect of seed pre-treatment on germination parameters of fourteen treatments (nursery condition)

Treatments	Germination % (Arcsine Value)	Peak Value	Germination Value
T_1	0.00 (0.00)	0.00	0.00
T_2	29.25 (32.72)	0.51	0.26
T_3	56.00 (48.73)	0.96	0.92
T_4	47.75(43.69)	0.84	0.68
T_5	54.50 (47.56)	0.95	0.87
T_6	63.25 (52.66)	1.10	1.17
T_7	63.50 (52.82)	1.10	1.18
T_8	74.75 (59.85)	1.27	1.54
T_9	65.25 (53.89)	1.14	1.26
T_{10}	56.50 (48.72)	0.97	0.92
T_{11}	38.25 (38.17)	0.64	0.41
T_{12}	32.75 (34.89)	0.52	0.27
T_{13}	37.75 (37.87)	0.60	0.36
T_{14}	52.75 (46.56)	0.89	0.86
Mean ± SE_m	48.02 ± 1.37	0.82 ± 0.03	0.76± 0.04
(Range)	(0 – 74.75)	0-1.27	0 - 1.54
M.S.S.	1469.69	0.45	0.81
F-Test	196.69*	154.51*	104.87*
C.D (5%)	3.91	0.08	0.13
C.V %	5.69	6.59	11.56

***Significant at the 0.05 *p* level**

Table.2 Effect of seed pre-treatment on germination parameters of fourteen treatments (lab condition)

Treatments	Germintion %(Arcsine Value)	Peak Value	Germination Value
T_1	0.00 (0.00)	0.00	0.00
T_2	23.33 (28.76)	0.40	0.17
T_3	57.50 (49.37)	0.99	1.00
T_4	39.17 (38.72)	0.69	0.48
T_5	41.67(40.12)	0.71	0.54
T_6	60.00 (50.93)	1.02	1.07
T_7	52.50 (46.42)	1.07	1.31
T_8	76.67 (61.23)	1.24	1.65
T_9	62.50 (52.26)	1.30	1.70
T_{10}	56.69 (48.83)	0.82	0.86
T_{11}	36.67 (37.17)	0.63	0.40
T_{12}	32.50 (34.62)	0.58	0.35
T_{13}	42.50 (40.64)	0.78	0.54
T_{14}	62.50 (52.40)	1.03	1.13
Mean ± SE_m	46.01 ± 2.37	± 0.10	0.80 ± 0.15
(Range)	(0 – 76.67)	0 – 1.30	0 – 1.70
M.S.S.	865.80	0.482	1.130
F-Test	36.64*	12.00*	12.16*
C.D (5%)	6.78	0.29	0.44
C.V %	11.40	25.01	38.16

***Significant at the 0.05 *p* level**

The removal of pericarp (depulped seeds), treated with nicking, overnight soaking in 0.05% gibberellic acid, either depulped, nicking, soaking in ambient water for 24 hrs or adopting economical method of depulped, sun drying or depulped, soaking in ambient water for 24 hrs results in earlier onset of enhanced germination (Hossain *et al.*, 2014).

Due to its fleshy and firm pericarp club with a bony seed coat, *Canarium stricum* suffers from unsuccessful germination in the natural conditions. The rapid and complete germination of seeds is usually a desirable objective in the production of tree seedlings; hence the findings indicate the need for seed pre-treatment in *Canarium strictum* due to negligible and scanty natural regeneration. Therefore for successful germination, findings of the present study reveals that after depulping the seeds of *C. strictum* can be treated with treatments such as soaking in 4% H_2O_2 overnight, nicking at distal end and soaking in 4% H_2O_2 overnight, alternating wetting and drying for 6 days, soaking in 4% H_2O_2 overnight and nicking at distal end and soaking in 500 ppm GA_3 overnight may be suggested for economic cultivation of this species by the forest departments, NGOs, researchers, nursery owners, and farmers.

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