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Effect of Different Pre-Sowing Treatments on Pod Germination of *Pterocarpus santalinus* (Linn. F.)

MAHANTAPPA SANKANUR, L. VENKATESH AND C. NAGARAJAIH

Department of Forestry & Environmental Sciences, University of Agricultural Sciences, GKVK Bangalore 560065, India

Abstract

Pterocarpus santalinus (redsanders or rakta chandana) is a large deciduous, endemic and endangered multipurpose tree species of India. It is renowned for its highly prized characteristic timber and superlative technical qualities. Due to this there is large scale demand for the quality planting stock for various reforestation or large scale plantations. But redsanders has been reported to have extremely hard fibrous seed coat and phenolic compounds in it, which inhibits germination and hence, low per cent of germination. So, keeping these points in view the present study was carried out to improve the pod germination in redsanders. Among the 12 treatments tried, treatment with pods soaking in 40% HCl for 24 hours (T_5) showed maximum germination per cent, mean daily germination, peak value, germination value, germination rate (75.67%, 2.52, 3.78, 9.53 and 1.26, respectively). This was followed by scarification of pods by rubbing with sand paper and treatment with 100 ppm of gibberlic acid for 6 hours (T_{11}) showed 71.33% germination and germination parameters viz., mean daily germination (2.38), peak value (3.69), germination value (8.79) and germination rate (1.19), respectively. Whereas, untreated control (T_1) registered the lowest germination and its attributes throughout experiment.

Key words : Mean daily germination, Peak value, Germination value, Germination rate, Seedling germination parameters.

Pterocarpus santalinus (Linn. F.) is an endemic and an endangered species of India. The demand for medicinal plants is increasing in both developing and developed countries because of products being non-narcotic, having no side effects, easily available at affordable prices and some time the only source of health care available to the poor. With increasing demand for medicinal plants their commercial cultivation is essential to reduce the pressure on forest and to retain the safe population in natural conditions. *P. santalinus* is one of such species, which having high medicinal properties due to which it is being exploited recklessly and which is already included in the endangered category of IUCN red list. The genus *Pterocarpus* Linn. F. belongs to the family Papilionaceae / Fabaceace and popularly known as Red Sanders (1). *P. santalinus* is endemic to Eastern Ghats of Andhra Pradesh and in the adjoining regions of Karnataka and Tamil Nadu. In Karnataka, mainly distributed in Devarayanadurga (Thakur), Sandur (Bellary), and Karpakapalli (Bidar) Medicinal Plant Conservation Areas (2). Because of presence of wavy grain, deep-red colored heartwood, having medicinal value and durability of timber makes the high demand for the timber, which further leads to over exploitation and the illicit felling without commensurate replenishment of natural stands. This inturn resulted to disappearance of native *P. santalinus* throughout naturally distributed areas (3). Natural regeneration is through seeds and it is curtailed by poor pod set, presence of hard fibrous seed coat and phenolic compounds in it which inhibits germination (4) and low per cent of germination. Hence, there is need to encourage the reforestation of these species in the wild. In reforestation and / or large scale plantation of this species, the seed material is the major propagation material. But, the earlier reports indicated that, the germination is rather poor with 10 to 12% in Karnataka and 25 to 30% in Tamil Nadu (5). Hence, keeping these points in view the present study was undertaken to improve the pod germination of *P. santalinus.*

Methods

The study was conducted in mist chamber. The

Table 1. Effect of different pre-sowing treatments on pod germination of *Pterocarpus santalinus*. Figures in parentheses are arcsine-transformed values. MDG- Mean daily germination ; PV-Peak value ; GV-Germination value ; GR-Germination rate.

	Treatments	Germination (%)	MDG	PV	GV	GR
T_1	Control	17.33(24.58)	0.58	0.65	0.38	0.29
T_2	Pods soaking in water for 72 hours	40.00(39.23)	1.33	1.54	2.05	0.67
T_3	Alternate wetting (water) and drying of pods for three days (12 hrs. each)	38.00(38.06)	1.33	1.46	1.94	0.63
T_4	Pods soaking in hot water for 10 minutes (60 ^{0}C)	35.00(36.27)	1.23	1.31	1.62	0.59
T_5	Pods soaking in 40% HCl for 24 hours	75.67(60.40)	2.52	3.78	9.53	1.26
T_6	Pods soaking in conc. H_2SO_4 for 5 minutes	34.33(35.85)	1.14	1.27	1.45	0.58
T_7	T_2 + dipping for 10 minutes in Beejamrutha	42.00(40.40)	1.40	1.70	2.38	0.70
T_8	Edge cutting of pods with secature	52.00(46.15)	1.73	2.36	4.09	0.87
T_9	Scarification of pods by rubbing with sand paper	58.33(49.78)	1.94	2.92	5.66	0.98
T_{10}	T_9 + 200 ppm of GA_3 for 3 hours	66.00(54.33)	2.20	3.05	6.70	1.10
T_{11}	T_9 + 100 ppm of GA_3 for 6 hours	71.33(57.98)	2.38	3.69	8.79	1.19
T_{12}	Stratification (a layer of sand and pods)	46.00(42.71)	1.53	1.77	2.73	0.77
	Mean	48.00	1.61	2.13	3.94	0.80
	SE ±	1.11	0.03	0.05	0.16	0.02
	CD 5%	3.25	0.10	0.15	0.47	0.06

aim of study was to standardization of pre-sowing treatments to improve pod germination of *P. santalinus*. Totally twelve different pre-sowing treatments were given to bold and mature pods of *P. santalinus*, which were collected from healthy trees as follows : T_1—Control, T_2—Pods soaking in water for 72, T_3—Alternate wetting (water) and drying of pods for three days (12 h each), T_4—Pods soaking in hot water for 10 min (60 C), T_5—Pods soaking in 40% HCl for 24 h, T_6—Pods soaking in conc. H_2SO_4 for 5 min, T_7—T_2 + dipping for 10 min in Beejamrutha, T_8—Edge cutting of pods with secature, T_9—Scarification of pods by rubbing with sand paper, T_{10}—T_9 + 200 ppm of GA_3 for 3 h, T_{11}—T_9 + 100 ppm of GA_3 for 6 h, and T_{12}—Stratification (a layer of sand and pods).

After the acid treatments of T_5 and T_6 the pods were washed with running tap water and water treatment in T_2 was changed once in 24 hours. The experiment was laid out in completely randomized design (CRD). The treatments were replicated thrice. Fully matured pods were collected from the *P. santalinus* tree. The uniform sized pods were chosen for the germination trial. After pre-sowing treatment, pods were sown in the sand beds. For each replication 50 pods were sown. Watering was done daily using rose can. The numbers of seeds germinated on each day were counted ; emergence of plumule above the sand was taken as the criteria of germination. The germination was recorded upto 30 days from the day of sowing. Based on daily germination count the following parameters were computed.

$$\text{Germination percentage} = \frac{\text{Number of normal seeds germinated}}{\text{Number of seeds sown}} \times 100$$

$$\text{Mean daily germination (MDG)} = \frac{\text{Cumulative germination percent (final)}}{\text{Total number of days}}$$

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

Germination value (GV) = Mean daily germination × Peak value

$$\text{Germination rate} = \frac{G_1}{T_1} + \frac{G_2}{T_2} + \ldots\ldots \frac{G_n}{T_n} \quad \ldots\ldots 1$$

Where G_1 = Number of seeds germinated on first day, G_2 = Number of seeds germinated on secondary, G_n = Number of seeds germinated on nth day, T_1 = Day one, T_2 = Day two, T_n = nth day.

Watering was done daily using the rose can. There was mortality was observed in germinated seedlings. For this Bavisten (1 ml / liter) was sprayed.

Results and Discussion

Data on germination and its attributes influenced by various pre-sowing treatments are presented in Table 1. There was significant difference in germination per cent, mean daily germination, peak value, germination value and germination rate among the various pre-sowing treatments (Table 1).

Treatment with pods soaking in 40 per cent HCl for 24 hours (T_5) showed maximum germination per cent, mean daily germination, peak value, germination value and germination rate (75.67%, 2.52, 3.78, 9.53 and 1.26, respectively), which was followed by scarification of pods by rubbing with sand paper and treatment with 100 ppm of gibberlic acid for 6 hours (T_{11}) showed germination parameters viz., germination per cent, mean daily germination, peak value, germination value and germination rate (71.33, 2.38, 3.66, 8.79 and 1.19, respectively).

Particularly the increased germination in 40% HCl for 24 hours may be due to softening of pod coat and leaching of germination inhibitory substances and the decreased pod germination in other concentrated acid soaking treatment (soaking of pods in conc. H_2SO_4) may be due to injury to the embryos by the chemical, though the treatment helped in the softening the hard pod coat. These results are in agreement with Kalimuthu and Lakshmanan (6) in *P. santalinus.* They reported maximum germination percentage of 75.80 for the pods treated with 40% HCl for 24 hours and lowest was recorded in control (17.00%).

Increased germination in all the treatments might be due to either damaging impermeable fibrous hard seed coat, leaching of phenolic compound or softening of pod coat process spreads from the initial site of imbibition into the whole seed coat ; which made the easy permeability of water to cotyledons. Thus increased imbibitions led to the higher germination per cent compared to control.

Perhaps the increased mean daily germination, peak value, germination value and germination rate in treatment with the pods soaking in 40% HCl for 24 hours compared to control, due to the increased germination per cent and reduced germination period, this might have led to the increased daily germination, peak value, germination value and germination rate, thus lowest height in the control.

Present findings also receive support form Hanumantha et al. (7) in *Acacia nilotica* and Gouda et al. (8, 9) in *Garcinia indica* were also of the same opinion that the increased germination per cent and reduced germination period, due to softening pod coat and leaching of germination inhibitory substances, thus enhances the germination process and subsequently, it increases the mean daily germination, peak value, germination value and germination rate compared to the control.

The maximum germination was followed by scarification of pods by rubbing with sand paper and treatment with GA_3 (100 ppm) for 6 hours, it might be due to causing damage to pod coat by abrasion paper, which made the easy permeability of water to cotyledons and effect of growth regulator (GA_3) in overcoming the inhibitory effects of phenolic compounds.

Further the increased mean daily germination, peak value, germination value and germination rate in treatment with scarification of pods and as well as treatment with GA_3 50 ppm for 12 hours compared to control, due to the increased germination per cent and reduced germination period, this might have led to the increased daily germination, peak value, germination value and germination rate, thus lowest height in the control.

Thus it clearly shows that scarification of pods by rubbing with sand paper alone did not influence much on germination but the further treatment with GA_3 (100 ppm) for 6 hours also allowed early germination process by activating enzyme production (GA_3 play a central role in the early germination process by activating enzyme production, mobilizing storage reserves and thus overcome the inhibitory effects as *P. santalinus* pods contain phenolic compounds as inhibitors, in turn it leads to increased the germination percentage and germination parameters. These results are in agreement with that of Gouda et al. (9) in *Garcinia indica.* They observed that the both scari-

fication and as well as treatment with GA_3 50 ppm for 12 hours had showed higher germination (80.00%) compare to only mechanical scarification (71.00%). So it can be opined that the reduced germination in *P. santalinus* may be mainly due to impermeable fibrous hard seed coat and presence of germination inhibitory compounds. Presently there are no such studies conducted in *P. santalinus.* Thus, these findings receive support from Venkataramaiah et al. (4) in *P. santalinus.* They hypothesized that reduced germination is due to presence of both impermeable fibrous hard seed coat and germination inhibitory compound.

Whereas control registered the lowest germination and other germination parameters viz., germination per cent, mean daily germination, peak value, germination value and germination rate i.e. 17.33, 0.58, 0.65, 0.38 and 0.29.

The lowest germination in control may be attributed to impermeable fibrous hard seed coat and presence of germination inhibitor substances (phenolic compounds) in it. The present findings receive support from Gouda et al. (9) in *Garcinia indica.* They reported lowest seed germination per cent (51.33%) in control, due to presence of fibrous gummy seed coat and presence of germination inhibitor substances. Whereas, the decreased mean daily germination, peak value, germination value and germination rate in control treatment due to the decreased germination per cent and prolonged germination period, due to impermeable fibrous hard seed coat and presence of germination inhibitor substances (phenolic compounds) in it, thus inhibits the germination process and subsequently, it decreased the mean daily germination, peak value, germination value and germination rate.

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