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Research Article

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Effect of different seed-sources on germination parameters by means of artificial seed germination of *Santalum album* L.

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ABSTRACT

Natural germination of white sandal (Santalum album L.*) seeds is very much problematic and time consuming. Therefore it needs to be improved the seed germination by artificial methods. In this case, seeds were collected from three different sources for the experiment of artificial seed germination. Indeed, dormancy period of Santalum album* L. *continues up to sixty days (Clarke and Doran, 2012) for freshly collected seeds. Those seeds were cleaned in normal tap water and depulped for easy germination. Then seeds were imbibed in different concentration of GA_3 solution for different hours of treatments. The germination behavior remarkably improved by a particular concentration of GA_3 in a specific hour of treatment. In this paper we have discussed the most successful method of GA_3 treatment. Different parameters of germination have been highlighted in this context.*

The aims and object of this experimentation were to find out the response of hormonal treatment in the germination activities of Santalum album L. *in-vivo condition.*

Keywords*: seed dormancy, artificial seed germination, hormonal treatment, germination behavior.*

INTRODUCTION

Indian sandal wood *S. album* L. is one of the best plant species out of 18 species of the genus *Santalum*. The particular species is widely recognized throughout the globe for its beautiful fragrance and tremendous medicinal importance. Indian white sandal has achieved an importance as a plantation crop in Srilanka, Australia, Hawaii and other African countries due to the increase of world wide demand for sandalwood and the decline of sandalwood natural resources and specifically due its high santalol productivity, sweet fragrance, persistent aroma and fixative property[1]. Propagation of sandalwood plant commonly takes place by seeds which are produced only once or twice in a year (June to September and or November to February). Natural regeneration of sandalwood plant is done through endozoochory. Failure of the seed dispersal due to natural calamity or any other hindrances the natural regeneration is hampered. In fact presently there is no specific way of artificial means of propagation other than seed germination for the improvement of sandal plant population as we required. Ecologically sandal plant has adapted in various agro-climatic as well as soil conditions for in situ regeneration[2,3,4].

MATERIALS AND METHODS

Seed collection

Experimental materials were collected from three different locations viz.,Hirbandh forest of Bankura district, West Bengal, Khandari forest of Burdwan distrct,West Bengal and IWST, Bangalore, Karnataka during the month of October- November 2012. After the collection of the mature fruits those were soaked in sterile water for thirty minutes then depulped and shade dried for seven days.

Preparation of Germination bed: Germination beds were prepared with the sieved river sand mixed with the saw dust 2:1 ratio. Three different beds were prepared with this same mixture material and labeled with the name of place of collection.

Seed treatment: The seeds were treated with 0.05 % GA3 solution for 24 hours and sown separately in a randomized manner in three replication and 100 seeds per replicate. In this case each location considered as a treatment in case of source study. The germination tray beds were maintained regularly with watering and treated with fungicide to avoid fungal attack.

Germination Parameters: Different types of germination parameters viz., percentage of germination, speed of germination, time taken for initial and completion of germination, peak value of germination and germination value have been shown here following under mentioned methodologies.

Percentage of Germination: The seeds germinated normally during the germination period were counted and the total number of seeds germinated was dived by the total number of seeds sown and the result was expressed as percentage.

$$\text{Germination}(\%) = \frac{\text{Number of seed/s germinated}}{\text{Total No.of seeds sown}} \times 100$$

Number of days taken to initiate(TTIG) and to complete(TTCG) germination: Number of days taken to initiation of germination and number of days taken from sowing to completion of germination were recorded for each treatment.

The seeds were considered as germinated only when the sprouted plumule along with the cotyledons had protruded about 0.5 cm above the bed.

Speed of germination: An index of speed of germination was calculated by summing up the quotient of the daily counts divided by the number of days of germination.

$$\text{Speed of germination (SG)} = \frac{G1}{D1} + \frac{G2}{D2} + \frac{G3}{D3} + \cdots + \frac{Gn}{Dn}$$

Where G1, G2, G3….Gn is the number of seeds newly germinated on 1, 2, 3… nth day respectively.

D1, D2, D3,…Dn count on 1, 2, 3,… nth day respectively.

Germination value: An index combining speed and completion of germination was calculated according to Czabator[5] as follows:

$GV = PV \times MDG$

Where,

GV = Germination Value

PV = Peak value of germination

$$MDG = \frac{\text{Number of seeds germinated}}{\text{Number of days taken}}$$

RESULT AND DISCUSSIONS

Table 1: Effect of seed sources on germination parameters in *Santalum album* L.

Source	Germination%	Germination speed	TTIG	TTCG	GV
Bankura	44.66	1.67	15.66	57.33	0.38
Burdwan	35.33	1.13	27.33	85.66	0.10
Bangalore	20.00	0.53	28.66	48.6	0.14
CD	17.89	0.18	14.77	15.01	ns

Table 2: Combined ANOVA on germination parameters in *Santalum album* L.

Parameters	Source of variation	df	MS	F	Remarks
Germination%	Replication Treatment Error	2 2 4	30.3333 465.333 22.6683	1.3379 20.5278	Significant at the 1% level of probability.
Germination speed	Replication Treatment Error	2 2 4	0.0010 0.9765 0.0002	4.3829 4151.4893	Significant at the 1% level of probability.
TTIG	Replication Treatment Error	2 2 4	10.1111 153.4444 15.4444	0.6546 9.9300	Significant at the 1% level of probability.
TTCG	Replication Treatment Error	2 2 4	3.1111 1123.4444 15.9444	0.19512 70.4599	Significant at the 1% level of probability.
GV	Replication Treatment Error	2 2 4	0.00002 0.05503 0.02549	0.0010 2.1587	ns

Where TTIG=Time taken to initiate germination, TTCG= time taken to complete germination and GV= Germination value.

Effect of seed sources on different germination parameters in *Santalum album* L. was experimented. All the observations from the replicated designs were recorded and computed in two way analysis of variance models according to Singh and Chaudhary[6]. The data over variance ratio value on each parameters were accumulated in a table at a glance (Table:1). Similarly another table on different germination parameters in *Santalum album* L. was also cited in details at a glance (Table 2).

Table 3: Geographical information of seed source locations

Name of the places	Latititude-longitude	Altitude	Annual rainfall	Temperature maximum-minimum	Soil types
Burdwan	23.25384°N 87.85067°E	150m	150 mm	20-46°C	Alluvial soil, in some parts lateritic soil.
Bankura	23.23469°N 87.07245° E	78m	1100-1400 mm	10-48°C	Undulating red and lateritic soil
Bangalore	12°58'N,77° 38' E	900m	974.5 mm	7.8 °C- 38.9 °C	Red lateritic and fine loamy to clayey soils.

The 'F' value was most significant in case of germination speed and the lowest was found in the case of TTIG. But the value of variance ratio was found to be not significant in case of germination value. From the calculated F value, it is proved that the locational effect on seeds produced in each location was most important factors along with the other agro-climatic factors. As all the seeds taken from three different locations were experimented in the laboratory of Burdwan the other parameters like germination percentage, germination speed, TTIG, TTCG were found to be significant at 0.01% level of probability. Range of germination was 20.00% (Bangalore) to 44.66% (Burdwan). The speed of germination was varied from 0.53 (Bangalore) to1.67 (Burdwan). The time taken to initiate germination ranged from 15.66 days (Burdwan) to 28.66 days (Bangalore). Time taken to complete germination as noted in table 2 varied from 48.66 days (Bangalore) to 85.66 days (Bankura) and the germination value as noted in table 2 was varied from 0.10 (Bankura) to 0.38 (Burdwan). From the combined table of ANOVA the data obtained on germination parameters showed that the difference between various seed sources which were found to be significant at P-0.01 level of probability in all the cases except GV. In respect of geographical factors in locations the seed sources were exhibited variability. As the seeds were freshly harvested and experimented within a month the viability factors did not affect on germination parameters in our experiment. Similar observations have been taken by Brand[7]. Though the germination percentages vary depending on the storage-method of seeds[8]. The variability of seed germination depends on microclimate, local environmental conditions and plant population in the growing area. It also depends on the age of mother tree and its habitat which may influence in the production of fertile seeds[9,10,11,12,13]. The time taken for the initiation of germination is influenced by pretreatment of seeds properly. The time taken for the completion of germination is also variable indifferent cases as observed by Maiden et. al[14], Khera et.al[15], Arya et.al[16]. The performance of germination parameters showed remarkable difference except germination value. It indicates that the locational potentiality supported by agro-climatic and edaphic factors[4,17].

CONCLUSION

In this present study the location of Bakura District performed the best result in connection with the time taken for completion of germination (TTCG). The location of Burdwn District proved itself the best result on germination percentage and time taken for initiation of germination (TTIG). Depending on all these information a comprehensive method of artificial seed germination may be followed to overcome germination problem. Beside this, seed collection programme may be undertaken to fulfill the need of seed germination programme to raise effective quality seedling stock for sandal tree improvement and social afforestration programme in eastern part of India.

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