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Full Length Article

Responses of some phyto-hormones for vegetative propagation of an ancient precious wood plant: *Santalum album* L.

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ABSTRACT

Sandal (*Santalum album* L.), a precious wood has been used for different purposes in general and in particular, for dedicating to the almighty by almost all religious community across the globe since ancient time. In spite of mass use of this, still a major problem of its propagation exists. So far, the only means of propagation is through e*ndozoochory*, which is the natural propagation through bird's droppings. But it requires a very specific agro-climatic and a critical edaphic conditions. Keeping all these views in mind, we started to propagate the plant vegetatively with the help of some phyto-hormones like IAA, IBA, GA_3, Kinetin etc. All the chemicals were applied singly and also in combinations. The aims and objectives of this experiment were to study the responsiveness of rooting chemical composition and doses in case of stem-cutting and their adaptability in different areas of Bankura and Burdwan districts, West Bengal.

Key words: endozoochory, edaphic conditions, rooting hormone, responsiveness, adaptability.

INTRODUCTION

There are many references of sandalwood in Indian mythology, folklore and ancient scriptures. It is our general belief that the sandal is indigenous to peninsular India. But some are of view that it was introduced to India from Timor in Indonesia Fischer, 1928; Fischer, 1938; Thirawat, 1955 and Shetty, 1977c.

Keeping all these views in mind we undertook a venture for producing disease free healthy saplings of *Santalum album* L. by means of vegetative propagation which would be helpful in mass plantation in different geographical areas considering its suitability and edaphic factors.

MATERIALS AND METHODS

Three to five years old sandal plants in the respective location were selected for the study. The juvenile stems were taken for the experiment. The Several types of vegetative propagation were practiced for multiplication of the parental lines of the experimental plant. In this case, we have undertaken the vegetative propagation by means of stem cuttings with the help of different hormones with various concentrations and combinations. Plant materials:

3-4 years old *Santalum album* L. plants grown in Hirbandh, beat office garden, Bankura(S) Division were selected for the experiment.

Phytohormones: IAA -1.5 mg/ml; IBA -1.5 mg/ml; Kinetin-1.5 mg/ml;GA3 -1.5 mg/ml.

The brief protocol as practiced for the experiment is mentioned below:

Cut the branch into pieces of about 15cm in length. 10 cuttings were bundled together with a thin thread.

Each bundle was dipped in different hormone solutions of different concentration and combination for various durations. The bundles were thoroughly washed with tap water and tagged with labels showing the name of the chemical combination and duration of the treatment. The one set of the treated cuttings was placed in the sand filled plot at the nursery bed. Another set was kept in almost air tight poly bags in humid condition and left for overnight. Next morning the cuttings were placed in the sand-field poly containers with two holes at the bottom for regulating proper drainage of excess water within the pot. These experimental sets were kept in open air i.e. in natural condition. The control-set of each treatment was also prepared simultaneously. Experimental sets were kept under strict observation. Each step of development was noted carefully day by day. Emergence of branches leaves and roots were noted properly. After a month successful saplings were transplanted in the poly bags and simultaneously in poly containers which are used in the modern nursery. These collected data were kept properly for further computation following Singh and Chaudhary (1954).

RESULTS AND DISCUSSION

Number of branches per cutting^{-}and number of leaves cuttings^{-1} were strictly observed and recorded all data properly for computation. Taking all these data in each treatment two way tables were tabulated following Singh and Chaudhary, 1985. From those ANOVA tables a combined ANOVA table (Table 4) has been exhibited. Components of variances (branch no.) and components of variances (leaves no.) have been calculated and noted separately in table 1 and table 2. Components of variances viz PCV, GCV, h^2 have calculated and exhibited in table 4.

From the combined ANOVA table (Table - 3), the value of variance ratio was significant in at 14 cases, either at 1% level of probability or at the 5% level of probability. It is evident that in all the cases the treatment component of variation was significant. From this result it is indicated that the treatment component of variation was effective for the plantation of the trees. The state of West Bengal is cited in the map of occurrence and distribution of *Santalum album* in India (Srinivasan *et al*., 1992). Though The hemi-parasitic nature of Sandal was first reported by Scott in 1871. Sandal can be a parasite on a wide variety of plants found in nature from grasses to trees. But Sandal shows different growth pattern with different host species. Limited studies conducted earlier in pot culture on the influence of hosts on growth of sandal have shown that certain hosts have performed better growth (Parthasarathy *et al*, 1974). Practically, a few studies were conducted in field conditions by means of artificial processes. An attempt was taken in 2010 to study growth & yield of sandal trees grown in Hirbundh Beat office compound of Khatra Range in Bankura South Division (Das, 2013a). Sandal seeds have been found to germinate faster when the seed coat is completely removed, or seeds are soaked in 0.05% gibberelic acid for 12-16 hours (Nagaveni and Srimathi, 1981). In sandal seeds, the duration of germination is much proplonged after the dormancy period. It starts 25 days and reaches hardly 50% in 90 days with 0.05% GA_3 soaking with GA_3 soaking for 16 hours (Das and Tah, 2013b).

Table 1: Effect of growth hormones on branch of the *santalum album* shows the components of variance.

Components	IBA	IAA	Kinetin	IBA+ GA3	IAA+ GA3	Kinetin+ GA3	IBA + IAA	IBA+ kinetin	IAA + Kinetin
$\delta^2 g$	0.77	3.43	4.735	5.77	5.91	0.55	4.583	0.89	3.92
$\delta^2 e$	2.24	1.96	1.36	3.11	2.14	0.64	1.25	2.08	1.55
$\delta^2 p$	3.01	5.39	6.095	8.88	8.05	1.19	5.833	2.97	5.47

Table 2: Effect of growth hormones on Leaves/branch of the *santalum album* shows the components of variance.

Components	IBA	IAA	Kinetin	IBA+ GA3	IAA+ GA3	Kinetin+ GA3	IBA+ IAA	IBA+ kinetin	IAA+ Kinetin
$\delta^2 g$	1.13	15.3	21.69	11.38	11.25	12.88	7.66	5.69	10.58
$\delta^2 e$	4.86	2.65	7.67	6.81	2.55	0.75	3.99	3.22	2.25
$\delta^2 p$	5.9	17.95	29.36	18.19	13.8	13.63	11.64	8.91	12.83

Table 3: Combined ANOVA for all metrical characters of branches and leaves of the *santalum album*

Characters	S.V.	df	SS	MS	F	CD	CV	Remarks
Branches (no.)/cutting treated with IBA	Trt. Repl^{n}. Error	4 2 8	18.26 2.8 17.94	4.565 1.4 2.24	2.03 0.625		0.658	ns
Leaves/branch(no.) treated with IBA	Trt. Repl^{n}. Error	4 2 8	33.07 3.74 38.93	8.26 1.87 4.86	1.69 0.384		1.000	ns
Branches (no.)/cutting treated with IAA	Trt. Repl. Error	4 2 8	49.06 2.14 15.74	12.26 1.07 1.96	6.25* 0.549	3.173	0.607	Sig. at 5%
Leaves/branch(no.) treated with IAA	Trt. Repl^{n} Error	4 2 8	194.2 7.6 21.2	48.55 3.8 2.65	18.32** 1.43	3.689	0.400	Sig. at 1%
Branches (no.)/cutting treated with Kinetin	Trt. Repl^{n} Error	4 2 8	62.26 12.4 10.94	15.57 6.2 1.36	11.44** 4.55	4.170	0.566	Sig. at 1%
Leaves/branch(no.) treated with Kinetin	Trt. Repl^{n}. Error	4 2 8	291.34 12.14 61.38	72.75 6.07 7.76	9.48** 0.791	10.405	1.440	Sig. at 1%
Branches (no.)/cutting treated with IBA+GA3	Trt. Repl^{n}. Error	3 2 6	61.33 12.67 18.67	20.44 6.33 3.11	6.57* 2.03	4.581	1.160	Sig. at 5%
Leaves/branch(no.) treated with IBA+GA3	Trt. Repl^{n}. Error	3 2 6	122.92 33.17 40.83	40.97 16.59 6.805	6.02* 2.437	6.770	1.485	Sig. at 5%
Branches (no.)/cutting treated with IAA+GA3	Trt. Repl^{n}. Error	3 2 6	59.66 10.5 12.84	19.88 5.25 2.14	9.28* 2.45	3.80	0.856	Sig. at 5%
Leaves/branch(no.) treated with IAA+GA3	Trt. Repl^{n}. Error	3 2 6	108.92 20.67 15.33	36.30 10.34 2.55	14.1** 4.05	4.148	3.476	Sig. at 1%
Branches (no.)/cutting treated with Kinetin+GA3	Trt. Repl^{n}. Error	3 2 6	6.91 1.5 3.84	2.30 0.75 0.64	3.59 1.17		0.850	ns
Leaves/branch(no.) treated with Kinetin+GA3	Trt. Repl^{n}. Error	3 2 6	118.25 2.17 4.50	39.41 1.09 0.75	52.54** 1.44	4.120	0.331	Sig. at 1%
Branches (no.)/cutting treated with IBA+IAA	Trt. Repl^{n}. Error	3 2 6	42 10.5 7.5	14 5.25 1.25	11.2** 4.2	4.865	4.583	Sig. at 1%
Leaves/branch(no.) treated with IBA+IAA	Trt. Repl^{n}. Error	3 2 6	80.92 25.17 23.91	26.97 12.59 3.985	6.76* 3.1	5.186	0.903	Sig. at 5%
Branches (no.)/cutting treated with IBA+kinetin	Trt. Repl^{n}. Error	3 2 6	14.25 2.17 12.5	4.75 1.09 2.08	2.28 0.52		1.920	ns
Leaves/branch(no.) treated with IBA+kinetin	Trt. Repl^{n}. Error	3 2 6	60.91 18 19.34	20.30 9 3.22	6.30* 2.7	4.660	1.430	Sig. at 5%
Branches (no.)/cutting treated with IAA+kinetin	Trt. Repl^{n}. Error	3 2 6	40 24.67 9.33	13.33 12.34 1.55	8.6* 6.16	3.280	0.582	Sig. at 5%
Leaves/branch(no.) treated with IAA+kinetin	Trt. Repl^{n}. Error	3 2 6	102 21.17 13.5	34 10.5 2.25	15.11** 4.70	7.126	0.675	Sig. at 1%

ns= not significant

Table 4: Statements of coefficient of variations.

Characters	PCV	GCV	h^2
Branches (no.)/cutting treated with IBA	51.06	25.89	0.257
Leaves/branch(no.) treated with IBA	50.37	21.87	0.190
Branches (no.)/cutting treated with IAA	71.98	57.40	0.630
Leaves/branch(no.) treated with IAA	64.19	59.26	0.850
Branches (no.)/cutting treated with Kinetin	102.8	90.66	0.776
Leaves/branch(no.) treated with Kinetin	102.24	87.87	0.738
Branches (no.)/cutting treated with IBA+GA3	112.06	90.30	0.649
Leaves/branch(no.) treated with IBA+GA3	93.13	73.65	0.625
Branches (no.)/cutting treated with IAA+GA3	116	97.24	0.734
Leaves/branch(no.) treated with IAA+GA3	312.92	255.10	0.815
Branches (no.)/cutting treated with Kinetin +GA3	145.65	99.15	0.464
Leaves/branch(no.) treated with Kinetin+GA3	153.1	148.90	0.944
Branches (no.)/cutting treated with IBA+IAA	80.5	71.30	0.785
Leaves/branch(no.) treated with IBA+IAA	77.36	62.75	0.658
Branches (no.)/cutting treated with IBA+kinetin	159.57	87.35	0.299
Leaves/branch(no.) treated with IBA+kinetin	132.68	106.01	0.638
Branches (no.)/cutting treated with IAA+kinetin	87.97	74.43	0.716
Leaves/branch(no.) treated with IAA+kinetin	107.5	97.67	0.824

h^2 values in all cases were found to be upto the persmissible limit i.e. below 1.0.

From the table 4 in which the statement of coefficient of variations were highlighted. In all the cases the value of heritability in broad sense exhibited the correct range of calculated value i.e. below 1.0. In the literature various plant organs can be used for cuttings e.g. part of the stem or leaf etc. Cuttings are usually placed into a suitable pot with rooting substrate and kept under high humidity until the roots and shoots are formed (IWST, 2008). Some relevant reports on vegetative propagation of sandal plant have been published by Rao and Srimathi, 1977; Vijayakumar *et al*., 1981; Srimathi, 1983; Uniyal et al., 1985. Plant propagation by cutting can yield a high multiplication rate and produce plant saplings as we desire true-to-type.

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