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RESEARCH NOTE

Host plant species influencing the growth performance of sandalwood (*Santalum album* L.) seedlings in the nursery

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An experiment was conducted at College of Forestry, Sirsi in order to know the most favourable host plant species influencing the growth of sandalwood in nursery. Nine different host plant species, *viz., Albizia lebbeck, Acacia auriculiformis, Melia dubia, Casia fistula, Cajanus cajan, Casuarina equisetifolia, Dalbergia latifolia, Mimosa pudica and Simarouba glauca* along with the control (sandal seedlings without any host plant) were evaluated based on growth performance (seedling collar diameter, seedling height, number of leaves per seedling, fresh and dry weight of root, shoot and of complete seedling and quality indices) of sandal seedlings. From the results maximum increase in collar diameter (mm), seedling height (cm), number of leaves, root and shoot biomass, sturdiness quotient and quality index of sandalwood seedlings is noticed when planted with *Albizia lebbeck* (T_2) and *Dalbergia latifolia* (T_8). Among the sandalwood seedlings, those grown along with legume hosts in general gave better results as compared to non leguminous hosts and control.

Key words: Growth parameters, Hemi-parasite, Host, Quality index

Sandalwood (*Santalum album* L.) is a small evergreen hemi root parasitic tree of the family 'Santalaceae' known for its aromatic oil and fragrant heartwood. Over exploitation, illicit felling, rampant smuggling and illegal trade of sandalwood have resulted in decline of natural population and genetic erosion has reduced the supply (Annapurna *et al.*, 2007). Hence, it is necessary to put larger area under commercial cultivation. In order to meet the growing demand and sustainable utilization of sandalwood, good planting stock is required for improving the yield by bringing sandalwood under domestic cultivation.

One of the major problems encountered during the nursery stage is poor understanding of host plant relationship. Three stages of parasitism have been identified for the successful establishment of *Santalum album* plantations. These are nursery hosts (initial or primary), intermediate hosts (bridging nursery and field) and long-term (secondary) hosts. The primary host is planted into a container having sandalwood seedling during nursery propagation. Intermediate host is required during the stage between nursery and field transplanting and the secondary host is required throughout the rest life of sandalwood tree in the field condition. Poor understanding of host parasite relationship has been a problem during regeneration and establishment of sandal tree (Surendran *et al.,* 1998). Studies have shown that host plants influence mineral nutrient and water uptake by sandal seedlings (Hiremath, 2004). Sandal cannot grow normally without a host plant. It depends on its host for nitrogen, phosphorus, potassium and magnesium. Sandal plants with hosts have a higher survival rate, an increased plant height and volume of the main stem than those without host. Structurally, hosts provide protection from sun, wind and grazing as well as a possible source of nutrients and amino acids.

Keeping in view the above problem encountered during the nursery stage, an effort was made to evaluate different host plant species that influence growth performance of sandalwood seedlings. The experiment was conducted in a mist chamber for 180 days at College of Forestry, Sirsi, Karnataka during the year 2017-18 and the statistical design laid out was Completely Randomized Design (CRD). The experiment comprised ten treatments *viz.,* T_1 : Control (without host), T_2 : *Albizia lebbeck*, T_3 : *Acacia auriculiformis*, T_4 : *Melia dubia*, T_5 : *Casia fistula*, T_6 : *Cajanus cajan*, T_7 : *Casuarina equisetifolia*, T_8 : *Dalbergia latifolia*, T_9 : *Mimosa pudica*, T_{10} : *Simarouba glauca.*

Thirty days old seedlings with 4 to 6 leaves, were transplanted into polybags along with nine different hosts. The potting medium used was the mixture of sand, soil and farm yard manure in the ratio of 2:1:1. The seedlings were watered regularly and weeding was done as and when required. The fast growing host seedlings were pruned at regular interval to reduce the suppression of sandalwood seedlings. Various plant growth parameters, *viz.,* collar diameter (mm), seedling height (cm), number of leaves were measured at 60 days interval, while destructive sampling was carried out at the end of the experiment (180 days) for seedling biomass (both fresh and dry). The data collected on various parameters during the investigation were statistically analysed using SPSS data analysis software as applicable to Completely Randomized Design. The level of significance used in F-test was P= 0.05.

The effect of different hosts taken *viz., Albizia lebbeck, Acacia auriculiformis, Melia dubia, Casia fistula, Cajanus cajan, Casuarina equisetifolia, Dalbergia latifolia, Mimosa pudica and Simarouba glauca* on growth and development of sandal seedlings differed considerably with respect to plant height, collar diameter, number of leaves per plant, root- shoot length, sturdiness quotient, seedling quality index, fresh and dry weight of shoot, root and whole plant have been presented in respective tables and discussed.

Maximum collar diameter at 180 DAT (2.83 mm) was observed in T_2 (*Albizia lebbeck*) followed by T8 (*Dalbergia latifolia*) with collar diameter of 2.74 mm. However both the treatments were on par with each other. The minimum collar diameter at 180 DAT (2.03 mm) was observed in T_1 (control) followed by T_4 (*Melia dubia*) with collar diameter of 2.10 mm (Table 1). This may be due to the fact that *Albizia lebbeck* and *Dalbergia latifolia*, being leguminous in nature hosted the sandal seedlings in a better way to nourish and establish as compared to other non-leguminous hosts as well as the control

Table 1. Growth parameters of *Santalum album* seedlings at 180 DAT as influenced by different host plants

Treatments	Seedling height (cm)	Collar diameter (mm)	Number of leaves	Sturdiness quotient (SQ)
T_1 : Control (without host)	12.55	2.03	5.53	6.42
T_2 : *Albizia lebbeck*	15.01	2.83	14.13	4.60
T_3 : *Acacia auriculiformis*	12.63	2.39	13.26	5.64
T_4 : *Melia dubia*	15.65	2.10	11.16	6.40
T_5 : *Casia fistula*	12.61	2.35	11.90	5.80
T_6 : *Cajanus cajan*	14.85	2.55	8.23	5.83
T_7 : *Casuarina equisetifolia*	13.28	2.20	10.43	6.08
T_8 : *Dalbergia latifolia*	13.78	2.74	12.06	5. 03
T_9 : *Mimosa pudica*	12.70	2.23	8.67	5.67
T_{10} : *Simarouba glauca*	12.33	2.18	7.96	6.21
Mean	13.54	2.35	10.33	5.85
S.Em.±	0.54	0.13	0.51	0.35
C.D. at 5 %	1.62	0.40	1.52	1.03

(without any host). Similar results have been reported by Surendran *et al*. (1998), where they carried out a research on various silvicultural approaches to encourage regeneration of sandal and its subsequent establishment. They found that among the various host species introduced, *Albizia saman* improved the growth and development of sandal seedlings. Gomes and Adnyana (2017) also reported that legumes have significant influence on the growth (Diameter, number of leaves, number of haustoria and height) as compared to non legume hosts and control (sandalwood seedling alone or without any host plants).

Maximum height at 180 DAT was observed with T_4 (*Melia dubia*), followed by T_2 (*Albizia lebbeck*) and T_6 (*Cajanus cajan*), which were on par with each other. The lowest height (12.33 cm) was observed with T_{10} (*Simarouba glauca*) and was lower than the control (12.55 cm) as depicted in Table 1. Such response might be due to the dense, rounded and overlapping whorls of *Simarouba glauca* with more shade effect and consequently affecting as a limiting factor for the growth of the host plants as compared to other hosts. At 60 DAT, the result for number of leaves per seedlings was found to be non significant for all the treatments. At 180 DAT, maximum number of leaves per seedling (14.13) was found with T_2 (*Albizia lebbeck*) followed by T_3 (*Acacia auriculiformis*: 13.26) as presented in Table 1. Both the treatments were on par with each other. The control had the lowest number of leaves per seedling (5.53). The number of leaves per seedlings increased in the initial stage during the month of November but reduced during the period of December-January and again increased in February-March with most of the treatments. This might reflect seasonal (winter) leaf fall effect on sandal seedling and low temperatures prevailing during this period due to reduced biological activity.

T_2 (*Albizia lebbeck*) had the most desirable sturdiness quotient (4.60) followed by T_8 (*Dalbergia latifolia*) having the quotient 5.03 (Table 1). Which were on par with each other. However, the most undesirable treatment having maximum sturdiness quotient (6.42) was T_1 (control) followed by T_4 (*Melia dubia*) with sturdiness quotient of 6.40. Similar results were also observed in case of quality index with the highest value (0.10) with *Albizia lebbeck*, followed by *Dalbergia latifolia* with the value of 0.07 as presented in Table 2. Surendran *et al*. (1998) observed that despite the large host range of the majority of parasitic plants, many of them also show high level of host preference. Similarly Tennakoon and Cameron (2006) also advocated successful haustorial formation and is the key to the survival. Annapurna *et al*. (2006) reported that host plays a significant role in the growth of sandalwood seedlings in terms of height, collar diameter, total dry weight and quality indices. The present study also supports this report indicating the significant role of host plants on growth performance of sandal seedlings.

In present study the results for screening of primary host suggests that *Albizia lebbeck* and *Dalbergia latifolia* as the best host for sandal (in terms of plant height, collar diameter, fresh and dry weight of whole plant, root and shoot, sturdiness quotient and seedling quality index of sandal seedlings) followed by *Cajanus cajan, Acacia auriculiformis, Casia fistula, Mimosa pudica and Casuarina equisetifolia* among the host species

Table 2. Fresh weight, dry weight, total seedling weight and quality index of *Santalum album* seedlings as influenced by different host plant species

Treatments	Fresh weight (g)		Dry Weight (g)		Total seedling weight (g)		Quality
	Root	Shoot	Root	Shoot	Fresh	Dry	Index (QI)
T_1 : Control (without host)	0.13	0.37	0.08	0.16	0.53	0.26	0.03
T_2 : *Albizia lebbeck*	0.76	2.13	0.27	0.34	2.90	0.61	0.10
T_3 : *Acacia auriculiformis*	0.24	0.39	0.15	0.27	0.58	0.43	0.06
T_4 : *Melia dubia*	0.21	0.85	0.23	1.03	1.03	1.26	0.03
T_5 : *Casia fistula*	0.18	0.89	0.14	0.20	1.04	0.35	0.04
T_6 : *Cajanus cajan*	0.22	1.00	0.11	0.12	1.08	0.24	0.03
T_7 : *Casuarina equisetifolia*	0.15	0.81	0.09	0.21	0.92	0.29	0.04
T_8 : *Dalbergia latifolia*	0.32	0.74	0.17	0.40	1.23	0.55	0.07
T_9 : *Mimosa pudica*	0.18	0.41	0.14	0.34	0.59	0.47	0.04
T_{10}: *Simarouba glauca*	0.14	0.59	0.10	0.21	0.72	0.30	0.05
Mean	0.25	0.82	0.15	0.32	1.03	0.47	0.05
S.Em.±	0.013	0.02	0.01	0.01	0.073	0.016	0.003
C.D. at 5 %	0.040	0.06	0.03	0.04	0.216	0.047	0.010

studied. *Cajanus cajan* has been reported as an effective species for nourishing sandal in nursery. However Annapurna *et al*. (2007) has reported several disadvantages, such as its fast growth, high level of competition with sandal seedlings for light and nutrients, susceptibility to fungal attacks, insect pests and also the requirement for intensive management.

Sandalwood seedlings grown with host plant showed significantly increase in growth parameters, sturdiness quotient and seedling quality index as compared to seedlings grown without host. The results indicated maximum increase in collar diameter (mm), seedling height (m), number of leaves, root and shoot biomass, sturdiness quotient and quality index of sandalwood seedling when planted with *Albizia lebbeck* (T_2) and *Dalbergia latifolia* (T_8). The sandal seedlings, grown along with legume hosts gave better results as compared to growing with non leguminous hosts.

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