International Journal of Ecology and Environmental Sciences 44 (4): 369-372, 2018
ISSN: 2320-5199 (Online)

Short Communication

Influence of Host on the Early Growth Performance of Sandal Tree (*Santalum album*) Grown in Farm Settings

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ABSTRACT

A field experiment was conducted during 2017 in Tamil Nadu (India) to study the early growth performance of sandal tree with different host plants (*Alternanthera sessilis*, *Sesbania grandiflora* and casuarina) under drip irrigation system. The five treatments, *viz*., T_1 - Sandal + *Alternanthera sessilis,* T_2 - Sandal + *Sesbania grandiflora*, T_3 - Sandal + *Alternanthera sessilis* + *Sesbania grandiflora*, T_4 - Sandal + Casuarina and T_5 - Sandal (Without host) were studied with four replication in randomized block design. Growth was measured in terms of height and basal diameter at the time of planting and 2, 4, 6 and 8 months later. Best growth of sandal was recorded in case of combined hosts *Alternanthera sessilis* + *Sesbania grandiflora*.

Key Words: Sandal Tree; Host-plant Association

INTRODUCTION

Sandal (*Santalum album* Linn.) tree is planted commercially for its essential oil from the heartwood. *Santalum album* is a small evergreen tree growing 12 to 15 m high with a girth of 1 to 2.4 m with slender drooping as well as erect branching. It grows well in early stages under partial shade but later shows intolerance to heavy overhead shade. The principal sandal tracts of India are most parts of Karnataka and adjoining districts of Tamil Nadu, Maharashtra and Andhra Pradesh by covering an area of 9600 km^2 (Gairola et al. 2007) and 90% (Dutt and Verma 2005) lies in south Indian states (Karnataka and Tamil Nadu). The sandal trees are mostly found in dry deciduous and scrub forests in India. The tree flourishes well from sea level up to 1800 m altitude in different type of soils like sand, clay, red soils, literate loam and even in black cotton soils and grows well in red ferruginous loam with varying fertility. Sandal tree is a partial root parasite that attaches to the roots of other trees; it needs 'nurse' species in the area of planting out. Host plants that fix nitrogen and provide light shade are preferred. During the germination and at seedling stage, the plant grows from the reserve nutrition present in seed material and the further growth and survival of seedling will be with the host association by fixing nitrogen to sandal tree (Barrett and Fox 1997). The selection of the host plant needs to be leguminous species or a nitrogen-fixing annual or perennial crop (Radomiljac 2000). Structurally, hosts provide protection from sun, wind and grazing as well as a possible source of nutrients and amino acids.

There is a huge demand in the sandal wood due to its high economic value, which leads to the illicit felling and smuggling and these leads to the major problems in the sandal tree-growing states. So to meet the demand, sandal tree needs to be established in the farmer's field.

Artificial regeneration through seeds and establishment of sandal tree have been problematic because of poor understanding of the host–parasite relationships (Surendran et al. 1998). Most of the growth influences on host relationship studies were carried out in nursery conditions (seedling stage) and there is no suitable studies related to field condition that to in farmlands. So the present investigation on earlier growth performance of sandal and its different host relation is carried out under field condition in farmlands.

MATERIAL AND METHODS

To understand the earlier growth performance of sandal tree under different host plant was studied during 2017 at Forest College and Research Institute, Mettupalayam with 11° 19' N longitude and 77° 56' E latitude and an altitude of 300 m above mean sea level with mean annual rainfall of 920.5 mm. The normal weather conditions of the experimental site prevailed during the study period was maximum and minimum temperature with 38.8°C and 17.7°C respectively. The soil of the experimental field was Illupanatham soil series and slightly alkaline (pH-7.87) in nature. The soil was loamy sand, well drained and non saline (EC-0.20 dS m^{-1}).

The sandal planted in field were grown with the following hosts namely, *Alternanthera sessilis* (Dwarf Copperleaf), *Sesbania grandiflora* (Vegetable hummingbird) and Casuarina. The five treatments, *viz*., T_1 - Sandal + *Alternanthera sessilis,* T_2 - Sandal + *Sesbania grandiflora*, T_3 - Sandal + *Alternanthera sessilis* + *Sesbania grandiflora*, T_4 - Sandal + Casuarina and T_5 - Sandal (without host) with four replication in randomized block design. The field trial was irrigated with drip irrigation and irrigation schedule of once in every three days during summer/non rainy days for first six months and in later stages it was irrigated twice a week. The discharge rate of drippers was 4.0 L hr^{-1} for one hour per day. The biometric characteristics *viz*., height and basal diameter were measured at initial (At time of Planting), 2 MAP, 4 MAP, 6 MAP and 8 MAP for studying the growth performance. The height of the trees was measured from the ground level to the leading terminal tip using the standard scale and is expressed in centimetre. Basal diameter is measured with the help of digital vernier caliper at the ground level and expressed in millimeter. The data obtained were subjected for statistical analysis to evaluate the possible relationship between the different parameters and to employ analysis of variance (Panse and Sukhatme 1985).

RESULT AND DISCUSSION

The establishment and survival of sandal tree in the field is entirely dependent on other woody plants, which serve as hosts. The possible competitions for aboveground resources, such as solar radiation and CO_2 should be minimum with sandal tree for effective growth and function (Rocha et al. 2014). The selection of the best suitable host for sandal leads to the increment of maximum growth by minimizing the competition for nutrients, water and light (Durairaj and Kamaraj 2016). The host species must be compatible with sandal seedlings under nursery and field cultural regimes, so it's helpful in the growth and vigor.

In the present study, the T_3 treatment (Sandal + *Alternanthera sessilis* + *Sesbania grandiflora*) recorded a maximum sandal tree height of 66.20 cm, 95.68 cm, 123.30 cm and 145.38 cm during 2 MAP, 4 MAP, 6 MAP and 8 MAP respectively with the average height of 93.93 cm. The next best height was observed in T_2 (Sandal + *Sesbania grandiflora*) with a mean height of 78.93 cm (Table 1, Figure 1).

Table 1. Effect of host association on the mean height (cm) of Sandal tree at earlier stage

Treatment	Month After Planting (MAP)					
	Initial	2 MAP	4 MAP	6 MAP	8 MAP	Mean
Sandal + *A. sessilis*	38.46	52.13	73.19	91.33	108.43	72.71
Sandal + *S. grandiflora*	36.69	58.66	86.44	100.56	112.28	78.93
Sandal + *A. sessilis*+ *S. grandiflora*	39.08	66.20	95.68	123.30	145.38	93.93
Sandal + Casuarina	38.20	50.69	69.53	87.26	99.78	69.09
Sandal (Without host)	39.02	48.91	58.47	67.92	74.66	57.80
SEd	0.758	0.955	0.913	1.195	0.928	
CD (0.05)	1.652	2.082	1.989	2.605	2.022	

Supporting the present investigation, increments in the height and collar diameter in sandal grown with hosts as compared with sandal seedlings without host were recorded also by Durairaj and Kamaraj (2016). They also reported that leguminous host supported the growth of sandal at the nursery stage and at initial establishment in the field. The sandal tree growing with host showed significantly highest ($p < 0.05$) plant water potential and

Figure 1. Growth of sandal (*Santalum album*) with different hosts: a. Sandal (without host); b. Sandal + *Alternanthera sessilis*; c. Sandal + *Casuarina*; d. Sandal + *Sesbania grandiflora*; and e. Sandal + *Alternanthera sessilis* + *Sesbania grandiflora*

biometric growth indicating that the host plant is supporting the sandal tree to absorb more water from the soil and also help in fixing the nitrogen (Ashokan and Krishnambika 2007). The lowest growth was observed in T_5 (Sandal without host) with the mean height of 57.80 cm. Durairaj and Kamaraj (2016) supported the present by indicating that sandal seedlings without a host did not show significant difference in growth up to 6 months as compared to seedlings with hosts.

Among the five treatments, T_3 treatment (Sandal + *Alternanthera sessilis* + *Sesbania grandiflora*) recorded a maximum basal diameter of 25.75 mm after 8 months and the lowest was exhibited in T_5 (Sandal) with only 9.14 mm after 8 months (Table 2). The present findings were in line with Radomiljac et al. (1998) reported that leguminous and non-leguminous species significantly improved seedling growth of *Santalum album* in terms of height and collar diameter. *Erythroxylum monogynum* tree species was found to be the best suited as a long term host for Sandal (Durairaj and Kamaraj 2016).

Table 2. Effect of host association on the basal diameter (mm) of Sandal tree at earlier stage

Treatment	Month After Planting (MAP)					
	Initial	2 MAP	4 MAP	6 MAP	8 MAP	Mean
Sandal + *A. sessilis*	4.20	7.55	10.16	11.66	14.29	9.57
Sandal + *S. grandiflora*	4.80	7.86	11.31	11.91	16.50	10.48
Sandal + *A. sessilis*+ *S. grandiflora*	5.03	8.53	14.57	16.89	25.75	14.21
Sandal + Casuarina	4.07	6.77	9.57	10.46	13.25	8.82
Sandal (Without host)	4.66	4.72	6.69	8.53	9.14	6.75
SEd	0.438	0.364	0.426	0.489	0.445	
CD (0.05)	0.956	0.793	0.929	1.066	0.969	

CONCLUSION

The better earlier growth performance was observed with sandal + *Alternanthera sessilis* + *Sesbania grandiflora* and whereas, the sandal tree without host showed poor biometric performance and this can be lead to failure of crop. On concluding, the sandal tree with leguminous crop leads to maximum growth and income in farmlands.

ACKNOWLEDGEMENT

We acknowledge the Chief Conservator of Forests and Dean (Forestry), Forest College and Research Institute, Mettupalayam for helping in establishing the sandal plantation.

Author contributions: A. Balasubramanian designed the study analysis and wrote the protocol; C.N. Hari Prasath wrote the first draft of the manuscript and managed the analyses of the study; S. Manivasakan performed the statistical analysis and analysed the leaf samples; S. Radhakrishnan managed the literature searches.

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Received 2 January 2018
Accepted 12 August 2018