

## The Effects of Woody Hosts on *Santalum Album* L. Tree Growth under Agroforestry in Semi-arid North Gujarat, India

Suitable hosts play an important role in the survival, establishment and growth of *Santalum album* L. Growth and heartwood contents of *S. album* trees aged 6 years cultivated on farm land in association with *Citrus aurantium*, *Punica granatum* and *Casuarina equisetifolia* as host species, were studied to identify the most suitable host. Survival, height, collar diameter, crown size and clear bole of *S. album* trees were greater when grown with *C. aurantium* than the other two hosts. Heartwood formation in *S. album* was initiated in trees >9 cm diameter at breast height (DBH), irrespective of host species. Relatively greater value of DBH: height ratio of *S. album* in the case of *P. granatum* indicates suitability of this species as a long term host. Soil organic carbon and available  $\text{NH}_4\text{-N}$ ,  $\text{NO}_3\text{-N}$  and  $\text{PO}_4\text{-P}$  were highest under the canopy zone soil of *C. equisetifolia* and lowest under the soil of *C. aurantium*. *C. aurantium* was the best host at 6-7 years of age as indicated by an efficient utilization of soil resources enhancing the growth of *S. album*, whereas *P. granatum* may be suitable long term host. These host species may be replicated in other regions for greater benefits to farmers.

**Key words:** Agroforestry, *S. album*, Heartwood formation, Soil nutrients, Woody hosts.

### Introduction

Indian sandalwood (*Santalum album* L.) is a root hemi-parasite, highly prized for scented heartwood and oil. Nearly 90 per cent of sandal occurs naturally in about 9600 km<sup>2</sup> of deciduous forests in the Deccan region of Peninsular India (Gairola *et al.*, 2007). While native sandalwood stands have been heavily over-exploited, the monoculture plantation of *Santalum album* in its natural areas is in great decline (Kumar *et al.*, 2012). This led to this species being placed in the vulnerable category (ARW, 1998; Meera *et al.*, 2000). Production of sandalwood has fallen from 4000 tons in 1950 to 500 tons in 2006 and 250 tons in 2016 (Gairola *et al.*, 2007; Luedi, 2017). This is considerably lower than the international demand of about 4000 tons per year and is going to increase by five-folds by 2025 (Luedi, 2017). To meet the international demand of sandalwood oil and to avoid its harvesting from the wild (smuggling), there is need to cultivate *S. album* through plantation (da Silva *et al.*, 2016).

Being a root hemi-parasite, sandalwood depends upon host plants for nutrients and water for survival and growth (Fox *et al.*, 1996). Host plants with nitrogen fixing ability and light shade appear to be the most suitable for good sandalwood growth (Surata, 1995; da Silva *et al.*, 2016). Studies also show that *Alternanthera* is a good primary host at the nursery stage, while *Cajanus cajan* and *Crotalaria juncea* acts as a 'bridging agent' between early and long term hosts promoting growth of *S. album* (Radomiljac and McComb, 1998; Nagaveni and Vijayalakshmi, 2003; Annapurna *et al.*, 2006). *Embllica officinalis* Gaertn. and *Macrotyloma uniflorum* (Lam.) Verdc. were found to be suitable hosts for sandalwood in agroforestry in southern India (Viswanath *et al.*, 2009a). Recent improvements in plantation technologies have encouraged sandalwood plantation development (Viswanath *et al.*, 2009b). The new plantations are now becoming a

Growth of  
*Santalum album*  
was best  
facilitated by  
*Citrus aurantium*  
up to 6-7 years of  
age by utilizing  
soil resources  
efficiently.

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Received April, 2017  
Accepted March, 2018