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RESEARCH ARTICLE

QUALITY ASSESSMENT OF SANDALWOOD (*SANTALUM ALBUM* L.) FROM BANKURA DISTRICT IN WEST BENGAL, INDIA

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ABSTRACT

Sandalwood (*Santalum album* L.) is a precious timber plant which has been serving the world's population since human civilization. Its valuation depends on the quantity of oil and santalol contents of the heartwood. Normally, heartwood formation starts after 12-15 years of plant age. It depends on the soil characteristics and other climatic factors. Some other factors viz. host plant association, mycorrhizal association etc. can play important role for the survival of the sandalwood plants. Keeping all these views in mind, a venture was undertaken to quantify the produce and to assess the oil quality of the heartwood. The role of host plant association in different gardens of the forest division and oil & alcohol contents (α- and β - santalol) were measured.

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INTRODUCTION

Sandalwood is the fragrant heartwood of some species of genus *Santalum*, belongs to the family Santalaceae, many of which being completely or partially parasitic (John, 1947). The extraction and disposal of sandal came under the Forest Department in 1864 in Mysore State (Adkoli, 1977). Watt (1893) described the technique of raising sandal seedlings in tile pots in the nurseries and planting in the field. Brandis (1903) suggested that though sandal is a root parasite, it may derive part of its nutrition from the soil as well. Barber (1905) noted that haustoria formation occurred only on certain roots of sandal and not on all of them. This plant forms a non-obligate relationship with a number of host plants (Nagaveni & Vijayalakshmi, 2004). Sandal is a moderate sized evergreen large shrubs or small trees (*S. spicatum*) to tall trees of 12-15 m in height (*S. album* in India and *S. paniculatum* in Hawaii) and the girth of 1.0 -2.4 m (Sen Sarma, 1982). It is believed that Sandal was introduced to India from Timor of Indonesia (Shetty, 1977). In India, *S. album* is mainly distributed in the Deccan Plateau. Ecologically sandal has adapted various agro - climatic and soil conditions for *in situ* regeneration with an exception of waterlogged areas and very cold places.

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Distribution of *Santalum album* is also found outside India, e.g. in Sri Lanka and South East Asia (Timor, Indonesia, Malaysia, Cambodia, Vietnam, Myanmar, Thailand and China), the Pacific (Papua New Guinea, Fiji, New Caledonia and Hawaii) and to some extent northwest of Western Australia (Kanunurra). Recently the Govt. of Australia had undertaken the venture of commercial cultivation of Sandalwood especially they considered the Indian Sandalwood species (*Santalum album*) is the best due to its higher oil and santalol content. Sapwood is white to pale yellow, sharply demarcated from the yellowish brown to dark brown heartwood, hard, heavy, lustrous, straight-grained to slightly wavy, fine textured with pleasant characteristic smell (Rao *et al*., 2007). Sandalwood trees are famous and very costly because of its fragrant heartwood and oil. Sandal oil is nearly colourless to golden yellow, viscous liquid. Sandal oil has been extensively studied for chemical constituents, their isolation, synthesis and quantitative evaluation (Yadav and Bisarya, 1982).

Sandalwood (*Santalum album* L.) was tried in various locations of South West Bengal since nineteen sixties. The area has predominantly laterite soil having rainfall from 1200mm to 1600mm with maximum temperature 45^0C and minimum temperature 7^0C. The demand for Sandalwood and Oil is increasing and the gap between demand and supply is

widening. To bridge the gap between demand and supply, afforestation and plantation programme should aim at increasing the productivity of plantations. In sixties Sandalwood trees were also planted in Hirbundh Beat Office compound under Hirbandh Range of Bankura District. Trees started flowering after 10-12 years and lot of natural regeneration has started coming up in Hirbundh Block both in forest areas and in the adjoining non-forest areas of the Block from the bird droppings. But very few records of growth and yield of white sandals grown in South West Bengal is available. An attempt was being taken in 2009-10 to study growth and yield of sandal trees grown in Hirbundh Beat office compound of Hirbandh Range in Bankura South Division (Das, 2013).

Status of Sandalwood in West Bengal

Sandalwood is an exotic in West Bengal. The principal sandal tracks are confined to some parts of Karnataka (70%), Kerala and Tamilnadu, though it is reported in other parts of India sporadically. It thrives best at an elevation of 600 to 900 m. It was tried experimentally in Sukna and Arabari nurseries in 1960s. Sandalwood (*Santalum album* L.) is found mostly in the laterite tracts of South West Bengal both in forest area and in adjoining non-forest areas of the blocks (Table 1).

Table 1. Showing distribution of Sandalwood in South – West Bengal

Name of Division	Name of Range	Mouza where white Sandal is found	No. of Trees	Girth class	Remark
Midnapur Division	Arabari Range	1.Arabari , 2.Burisal 3.Ghagra, 4.Chandmura	6,000 -8,000	< 20 cm bhg	
Bankura(S) Division	Hirbandh Range	1.Hirbandh (Forest)	3840	< 10-60 cm bhg	
		2.Amjuri (Forest)	316	< 10-50 cm bhg	
		3.Basudevpur (Private)	1920	< 10-50 cm bhg	
		4.Chakadoba (Private)	227	< 10-30 cm bhg	Mostly natural
Burdwan Division	Guskara Range	Karotia (Aushgram Beat)	Forest land – 100, Private land - 150	20 – 40 cm bhg 10 – 30cm bhg	regeneration (N.R.)
	Panagarh Range	1.Khandari,(Forest)	2000	<30cm bhg	
		2. Natungram, Kota, Gopalmath (Private)	500	20-50cm bhg	
	Aara Range	Rest House compound	50	30-50cm bhg	planted
Birbhum Division	Bolpur Range	Bolpur Forest	20	< 20 cm bhg	Natural
			04	20-40 cm bhg	(N.R)

MATERIALS AND METHODS

Mature seeds of *Santalum album* L. were collected from the sandalwood trees of Hirbundh mouza of Hirbundh Range under Bankura South Forest Division during the month of November-December and May-June of 2011 and 2012 for experimentation. 6 samples each of 300 sandalwood seeds were taken and tied in markin cloth. 3 containers (1 liter each) were taken for 3 different concentrations (0.0125%, 0.025%, 0.05%) of gibberelic acid. 2 seed samples were dipped in each container for 16 hours & 24 hours soaking. The treated sandalwood seeds were then sown in the sand bed, got 67% germination for 24 hours soaking in 0.05% GA_3 and 69% germination for 24 hours soaking in 0.1% GA_3 (Das & Tah,2013). The germinated seedlings were transplanted in polypot (8″x4″ & 9″x 5″) and 300 cc hycopots in nursery at 3 to 4 leaf stage. Quality of the sandalwood is assessed mainly on the basis of oil and santalol (α-santalol and β-santalol) content of the heartwood. To estimate oil & santalol content, heartwood of sandal was collected from the existing stock of sandal plants available in Hirbandh block of Hirbandh Range in Bankura District. The oil content of sandalwood was determined by following the standard method described by Bureau of Indian Standard (B.I.S) i.e. steam distillation followed by Gas chromatography (G.C).

RESULTS AND DISCUSSION

Results

Quality assessment (oil & alcohol content) of Sandalwood

Quality of sandalwood depends on the oil and alcohol (santalol) content of the heartwood. The oil content of sandalwood was estimated collecting wood samples from the existing stock of Hirbandh Block. The wood samples were analyzed in the Institute of Wood Science and Technology (IWST), Bangalore. The results show that the heartwood contains α-santalol-59.40% and β-santalol-30.25%. Hence, total santalol content is 89.65% which is excellent in nature. The oil content of the heartwood is also estimated and it is recorded as 4.0%. The quality of the heartwood of sandal of this region is cited in a tabulated (Table 2) form below-

Table 2. Oil and Santalol content of heartwood of sandal

Sl. No.	Name of Chemical	% content
1.	α-santalol	59.40% of Oil
2.	β-santalol	30.25% of Oil
3.	total santalol	89.65% of Oil
4.	oil content	4.0% of Wood

DISCUSSION

Heartwood of sandal is the economically important product and is the source of oil. It is believed that the wood with finest odour is obtained from the driest region particularly on red or stony ground (Gunther,1952) and the yield of oil will be much higher than those grown in fertile tracts (Bhatnagar,1965). Puran Singh (1911) determined the variation in the oil content growing in different locations in different soils. He observed that specimens obtained from trees on relatively poor rocky gravelly soils had higher oil content than those of specimens

from fertile soils. Sreenivasaya and Rangaswamy (1931) found that sandal growing on rocky soil and in association with xerophytic conditions have higher proportion of oil bearing heartwood than the one thriving on fertile soil enjoying good rainfall and nourished by vigorous hosts, are not comparable since in 1st case growth is exceedingly slow while in the 2nd case girth increment is rapid. Arti Rani *et al.* (2014) studied on molecular approaches to understand decode oil production in sandalwood and found that the principle chemical constituents are sesquiterpenoid compounds mainly α – santalol (40-55%) and β – santalol (12-27%) which constitute > 90% of the distilled oil. The findings of my experiment also corroborate with the findings of above Scientists and the quality of sandalwood in South- West Bengal is excellent.

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