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# Edaphic, environmental and genetic factors associated with growth and adaptability of Sandal (*Santalum album* L.) in provenances

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## Abstract

Sandal tree grows under different edaphic and eco climatic conditions. Considering large genetic distance between provenances, it is concluded that under diverse locality factors sandal adapts very well in terms of growth, heartwood and oil content.

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## Introduction

Nearly 90% (8100 sq.km) of the total area of Sandal (*Santalum album* L.) in India is in Karnataka and Tamil Nadu. The rest is distributed in most other States: Andhra Pradesh, Kerala, Madhya Pradesh, Orissa, Maharashtra, Rajasthan, Uttar Pradesh, Bihar and Manipur.

Sandal tree is mainly exploited for its heartwood which yields the renowned East Indian Sandalwood oil, rated very high for its sweet fragrant, persistent, spicy, warm, woody note, tenacious aroma and fixative property. Sandal heartwood currently priced at Rs.12 lakhs per ton and its oil Rs, 22,000/-per kg.

At present, India produces 1000 tons of heartwood and 40 tons of oil per annum. For many years till now, sandalwood oil alone contributed nearly 25% of the revenue earned from the export of various essential oils.

The aim of this provenance investigation is to gather improved knowledge of genetic variation of the species. It is therefore, necessary that the purpose of provenance testing should combine both genetic variability and environmental factors.

## Material and Methods

Nine sandal bearing areas within India were identified as potential provenances on the basis of population density, phenotypic character, latitude,

and longitude and eco-climatic (Jain *et al* 1998). Status of these provenances were confirmed by isoenzyme studies (Angadi *et al* 1999), which also found that the girth of sandal tree influences the percentage of oil. Heartwood from young trees (around 10 years of age, height <10m, girth <50 cms) contains 0.2 to 2% of oil and that from the mature trees (30 to 50 years of age, height 20 m, girth 100 cms) contains 2.8 to 6.2% of oil.

“The existence of different provenances within species may be taken into consideration while making a choice of planting material for further multiplication and mass propagation”

In Table 1, data in respect of area, density, latitude, longitude, altitude, rainfall, temperature, soil type, pH, percentage of oil and genetic distance (Angadi *et al.* 2003), from all nine sandal provenances is shown.

## Results and Discussion

The provenances Bangalore, Marayoor and Thangli (Table 1) are growing well at an altitude of 1000m, average annual rainfall 850-1450 mm, max. temperature 33-38°C, minimum temperature 8-12°C, on soil red sandy loam or black clay having slightly acidic to slightly basic pH (6.5 to 7.5) and moderate nutrient status. The genetic distance (D) existing between populations of provenances was found

to vary from 0.052 to 0.292. Thus the larger genetic distance between different provenances concludes that they are of separate varieties or races.

The observed variation in trees from widely different parts of the species range could be referred to as geographical or racial variation. From the history, it is known that the sandal seeds are originally either spread through natural selection or by means of propagation from central provenance of Mysore State. Over a period of years these trees might have adjusted to local environmental and edaphic factors leading to the establishment of geographical races or provenances in this species, which has a large genetic distance. The existence of different provenances within species may be taken into consideration while making a choice of planting material for further multiplication and mass propagation. It is seen from Table 1 that, sandal adapts very well under diverse locality factors in terms of growth, heartwood, oil content and biochemical characteristics.

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Shankaranarayana K.H., V.G. Angadi,

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**Table 1.** Edaphic, environmental and genetic factors of Sandal provenances.

Provenance	Forest Division State	Sandal bearing area ha.	Density trees/ha in area	Latitude Longitude	Altitude	Mean Annual Rainfall mm	Temp. Max. Min. °C	Soil Type	pH	% of oil	Girth range (cm)	Genetic identity	Genetic distance
Bangalore	Bangalore Karnataka	24648.00	500	12° 58' N 77° 38' E	1000 m	850	36.8 12.2	Red loam	6.3-6.5 Acidic	3.19	30-140	0.75	0.125
Thangli	Chickamagalur Karnataka	47121.00	300	13° 40' N 76° 00' E	766 m	1500	44.0 10.5	Red loam & Alluvium	7.5-7.8 Alkaline	2.76	30-100	0.56	.052
Mandagadde	Shimoga Karnataka	65529.00	100	13° 9' N 75° 40' E	650 m	2000	38.1 13.0	Red loam	5.5-5.8 Acidic	1.55	30-70	*	*
Chitteri	Harur Tamil Nadu	60000.00	70	12° 0' N 78° 6' E	1050 m	1000	35.2 8.2	Red sandy loam	6.0-6.3 Acidic	2.06	30-60	0.51	0.292
Javadis	Tirupattur Tamil Nadu	16517.00	90	12° 3' N 78° 7' E	930 m	1200	38.0 12.4	Red loam	6.6-6.7 Acidic	1.59	30-70	0.51	0.292
Marayoor	Munnar Kerala	1496.67	500	10° 1' N 77° 1' E	1000 m	1450	36.0 10.0	Black clay	6.2-6.7 Acidic	3.15	30-100	0.74	0.131
Koraput	Rayagad Orissa	2540.00	200	19° 55' N 82° 35' E	859 m	1525	38.0 4.5	Red sandy loam	6.2-6.6 Acidic	0.8	30-50	0.0025	-
Seoni	Seoni Madhya Pradesh	3000.00	60	22° 1' N 79° 5' E	900 m	1600	40.0 5.0	Laterite	6.4-6.9 Acidic	2.06	30-80	0.69	0.161
Horsely Hills	Chittoor East	3050.00	70	13° 5' N 78° 8' E	4312 m	900	30.0 5.0	Red loam	6.5-6.8 Acidic	3.34	30-80	#	#

\* Genetic identity / Genetic distance measured from Mandagadde provenance

# Newly identified provenance work is in progress