

# REPORT ON THE MARKETING OF SANDALWOOD IN INDIA



DIRECTORATE OF MARKETING AND INSPECTION  
MINISTRY OF RURAL DEVELOPMENT  
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## PREFACE

Sandalwood has perhaps been the most precious perfumery material in the world from antiquity down to modern times and its popularity has shown no signs of depression. Medieval chronicles mentioned regular caravans passing over the deserts of Persia, Arabia and Asia Minor carrying Indian sandalwood to Egypt, Greece and Rome. India was known all over the civilised world as the home of sandalwood, its oil and *Attars*. Sandalwood has generally been associated with religious and festive occasions in the country.

A brochure on the marketing of sandalwood and its oil in India was brought out earlier in the year 1961. Since then, the production and trade of sandalwood have undergone a tremendous change. This prompted revision of the earlier brochure to highlight the changes that have taken place during the last 20 years. To bring all facts to light, a technique of survey by personal interviews, observations and utilisation of secondary data and information has been adopted to make the report up-to-date.

Amongst the various valuable forest products in India, the sandalwood is the highest price fetching wood and maximum foreign exchange earner. Upto the Second world war, India was exporting its sandalwood to different countries for its distillation. This war proved a blessing in disguise since it led to the installation of a factory in Mysore (Karnataka) for the distillation of sandalwood. Now there are two factories in public sector in Karnataka State besides a number of private factories in the country.

In the earlier days, India was producing round about 5 to 6 thousand tonnes of sandalwood and was meeting the world demand of sandalwood oil to the extent of 80—90 per cent. Unfortunately the annual production of sandalwood has dwindled to merely 2500 tonnes. Out of this, 400 to 500 tonnes of sandalwood is still exported to different countries and rest of the wood is utilised for distillation purposes by our indigenous distillation industries. The prominent sandal forests of Karnataka have passed through a disastrous situation due to spike disease, poor regeneration and lack of development work. The forest area itself has shrunk due to its utilisation for other purposes. Due attention for sandal trees has not been given. To meet the general demand, 300—400 trees are sacrificed at pre-



sent to have a tonne of sandalwood while 5 to 10 trees were sufficient to give the same quantity of wood in the past. Since this is a tree which requires nearly 40 years to give good quantity and quality of heartwood, it requires proper pre-planning so that the projected need after 50 years could be met for our future generation.

It is heartening to note that the State Governments have realised this drawback and have initiated the work of regeneration. An institute known as sandal Research Centre, Bangalore has been established in 1977 to conduct research into the various aspects of sandal tree and to guide the Govts. and Forest Departments to solve the problems arising from time to time. This centre has done a commendable job by developing a "Tissue Culture Technique" for the better and disease free growth of sandal trees. They have also chalked out a programme with short and long-term strategies to improve the supply of sandalwood in the coming years.

Much of the information contained in this report has been collected from trade, State Forest Departments and other official sources. Necessary help of published literature has also been taken to bring scattered information together and to make report more useful. Various authorities have rendered co-operation and assistance in providing valuable information to our field officers to whom our thanks are due. We, particularly, thank Shri V. Jayappa, the Director of Sandalwood Oil & Soap Detergent Limited, Mysore, Mrs. R. A. Srimathi, Senior Scientist, Sandal Research Centre, Bangalore and Shri K. R. Venkatesan, Conservator of Forests, Bangalore who were kind enough to furnish valuable information. We are also thankful to Dr. Nagarajan and his staff, Publication and Information Directorate Library, Pusa Institute Compound, New Delhi for library facilities.

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The Govt. of India should not be regarded as assuming responsibility for any of the findings/comments appearing in this report.

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*Dated : August, 1984*



*Plate No. 1*  
*Sandalwood tree*

# 1. INTRODUCTION

Sandalwood and its oil perhaps have been the most valuable and wanted perfumery materials in the world from the time of infancy of civilisation when aromatic and perfumery materials made inroads into the civilised world. The literature available in the country reveals that the oil of sandalwood had been a precious and prestigious merchandise/trade item from India since the medieval days when the caravans carried it to far off places like Egypt, Greece and Rome etc.

The sandalwood oil has been the article of national and international trade for perfumery in the country and is known as the East-Indian Sandalwood oil in commerce throughout the world. It has been in use in cosmetics, medicines and in religious rites from time immemorial. Mention has also been made about its use and properties in many of our ancient literature.

## 1.1. Is Sandal Exotic or Indigenous ?

It has sometimes been said that sandal tree is exotic and not a native of India.<sup>(1)</sup> The reasons advanced in this behalf are stated to be—

(a) *Invasion factor* : When a new plant intrudes itself and settles down, it is invasion in terms of ecology. Sandal is making inroads into the natural forests, though slowly but steadily without any artificial aid. It is real invasion since this is not a usual character of any indigenous species.

(b) *Biotic factor* : Sandal is found to be dense in and around the villages and steadily becomes less dense as we go to the interior of the forests. Indigenous species rarely have such characteristics. Whenever there is a biotic interference in a plant community, generally degradation sets in resulting in the displacement of tender species by the hard ones. Biotic factors like fire, grazing, lopping etc. should usually result in depletion and retreat of all tender and browsed species like sandal around the villages. Yet such tender species would find refuge in the safety of the interior of the forests where they continue to propagate and live in harmony with the rest of the plant community.

(c) *Spike and sandal* : An indigenous species is always in harmony with the eco-system. It has its own parasites and

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(1) *Santalum album*—Rajagopal Shetty H. Sandal an Exotic? Indian For. 103(5): 359—367, 1977.

predators, diseases and defoliators and has its own means of defence and survival. A new disease and mass death are the characteristics of a new entrant in the eco-system, rather than that of time-tested members. Though there are examples of diseases bringing the mass death in some plants, just as spike disease in sandal, very few diseases are known of the indigenous plants for which the plants themselves do not have the remedy.

(d) *Sandal and climax forests* : Sandal comes up when introduced in tropical dry, thorn forests and also along the fringes of tropical wet evergreen forests or semi-evergreen forests. It comes up almost at sea level and also upto 1500 metres elevation. The sandal tree has got naturally regenerating quality with flowers and fruits as well. The seeds are dispersed both by birds and water. The seed has got good keeping quality and fine germinating power. By all these virtues, the sandal tree should be a cosmopolitan one and should be available in every forest. But it is observed that this is not so. It occurs only as an associate fringe species of some of our deciduous forests of Southern Plateau. This strange phenomenon is thought-provoking and one is apt to think that the sandal tree has been migrated into the eco-system, thus, it is found that there are some aspects of sandal which introduce elements of doubt about its nativity.

On the contrary, there are also some views in contradiction of the above and have strongly refuted it. These are on the basis of the survey of growing stock of sandal in Javadi hills of Vellore Division in Tamil Nadu. State which have thrown some light on its controversial issue. The details of investigations and findings are summarised as under :—

(1) *Locality factors* : The Javadi hills are offshoots of Eastern Ghats stretching north-east to south-west about 50 kilometres in length and 25 kilometers in breadth. The hills rise to a general height of about 800 meters above mean-sea level and form a plateau of undulating terrain. A few hills on top rise to over 1100 meters. The annual rainfall is about 900 mm. January to April being the dry months receiving less than 50 mm. of average monthly rainfall.

(2) *Forest types* : Major parts of these hills contain a mixed dry deciduous forests specially along the outer slopes. There is an increasing admixture of dry evergreen species in the forests occuring in the undulating plateau which sometimes predominates over extensive areas in sheltered valleys.

(3) *Earlier records on sandal* : Very little is on record about the sandal wealth of these forests till the beginning of 20th century. Realising the importance of sandal, the forests were stock mapped for sandal in three enumerations during a span of 60 years. The growing stocks of sandal in these enumerations are depicted below :

**Density and Spread of Sandal**

Period	Dense (51 trees and above per ha.)	Frequent (13 to 50 trees per ha.)	Spares (12 trees and less per ha.)	Total sandal area	Total non- sandal area	Total area of series	Remarks
1	2	3	4	5	6	7	8
1914-15 (Wilson's stock map)	—	—	—	2266	1781	4047	not classified into density classes.
1934-35 (Brand's stock map)	415	639	1466	2520	1527	4047	11.2% increase in sandal area over 20 years.
1974-75 (Present stock map)	684	1050	2070	3804	243	4047	51.0% increase in sandal area over 40 years.

(One series viz. Pattrakod North Sandal Series—4047 hectares in extent).

Brand reported an overall increase of 23.4 per cent in sandal area since 1914-15 till 1934-35 for the division, but with practical reference to this series it was only 11.2 per cent increase in 20 years. There is further increase of 51 per cent in the last 40 years as per 1974-75 indications. It amounts to an increase of 67.9 per cent in sandal area during the period of 60 years.

(4) *Record of progress* : As per records of enumeration by \*Wilson, the density of sandal was 15.8 trees per hectare for the whole division and 15.4 trees per hectare for this particular series in Pattrakod R.F. It was 31 trees per hectare for the sandal area of the entire division in 1934-35 according to Brand. The stock map of 1974-75 reveals the density as 28.6 trees per hectare for the series in spite of 51 per cent increase in the sandal area of Pattrakod R.F.

A total number of 34,989 sandal trees were reported in the year 1914-15 for the entire area of Pattrakod North Sandal series. By the year 1934-35, 77,838 sandal trees were estimated to exist in the area. The current (1974-75) survey reveals a total of 1,09,040 trees for the above series indicating an increase of 40.1 in 40 years and 211.6% in 60 years in the growing stock.

(5) *Spike disease and its effect* : Records show that little has been done and less achieved by way of artificial regeneration and tending during the period of last 60 years in these forests. On the other hand, spike disease appeared in early 1935 which spread rapidly and caused devastation, transforming dense sandal area into non-sandal or sparse sandal area in-between the stock mapping period of 1934-35 and 1974-75. Earlier remedial measures included felling of all sandal trees in the locality by the application of 'Atlas' solution which in fact proved more disastrous to sandal than to disease itself. Within a decade of appearance of the disease, 25,281 trees were removed as a spike control measure. As the spike continued to appear in all unexpected corners, in spite of all such drastic measures, it was later given up as hopeless. Spike is still lingering in several localities in a virulent and epidemic form in this region and continuing to take its toll in all age classes. Yet the fact that sandal has increased in density and expanded its territory speaks about the excellent suitability of the tract and the aggressive nature of the species.

The sandal tree is described well for its use and properties in many of our ancient literature. However, the fact remains that many of them are elaborations and embellishments of earlier

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\*Wilson CC. 1916 Working Plan for Javadis & Yelagiri Hills.

texts in later years. *Santalum album* is often mixed up with *Pterocarpus santalinus* which is an indigenous species beyond doubt and called by the same name in many languages. Its medicinal properties are well-known. Hence a mere mention of 'Chandanam' or 'Chandan' in some of our literature may not be conclusive proof of nativity of the species in the face of scientific contradictions to such belief. According to some belief about its probable introduction in India, it is argued that India's trade relations with Far East including Dutch, East-Indies are well-known from historical times. Perhaps it may be 2000 years or even more since the ships launched from east coasts of Tamil Nadu had a flourishing trade in these parts of the world. It is probable that this scented wood attracted the attention of early traders, who brought the seeds to this country alongwith the merchandise and established the plants, perhaps 1500 years ago, in the selected places in the plains where its spread was naturally slow. Its establishment and spread to the more salubrious hills must have been much later, where it found the conditions much more favourable for growth and spread. No doubt, it has now naturalised in India. We are proud of the fact that sandal is our monopoly and it is our own probably by domicile. The question of its nativity can remain only a matter of an academic dialogue. In the past, perhaps for its great usefulness in Indian homes and the enormous revenues it fetched, it was named as 'Royal Tree'. It will not be an exaggeration to call it now as 'Republican Tree'.

The sandal tree is the most important member of a family *Santalaceae*. Twenty other *Santalums* are known out only a few of them are of importance today. Most of them have vanished. The nomenclature of sandal in different Indian languages is as follows :—

1. Bengali : Chandan, Peetchandon, Srikhanda, Sufaid-chandan.
2. Coorg : Chandana, Tolu-Gandha, Chandana.
3. Gujarati : Sukhad, Sukhet.
4. Hindi : Safaid chandan, Sandal.
5. Kannada : Sandanam, Velocidam, Kulavuri.
6. Konkan : Srigandha.
7. Malayalam : Chandanam, Chandana-mutti, (wood).
8. Marathi : Chandan, Gandh-Chakoda.

9. Oriya : Chondona, Gondassaro.
  10. Punjabi : Chandan.
  11. Sanskrit : Chandana, Anaditam, Taliaparnam.
  12. Tamil : Srigandha, Gandha, Agarugandha, Bavanna, Bhandrasyi.
  13. Telugu : Chandanamu, Chandanapuchettu, Tellagandhapu-chettu (tree), Gandha-taruva (tree), Srigandhamu, Gandhappachakka (wood)
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## 2. OCCURRENCE AND HABITAT OF SANDAL TREE

### 2.1 Occurrence in World

The natural occurrence of true sandal, besides South India, is in East Indian Archipelago comprising the islands of Java, Timor, Celebes where this is known as Macassar wood, being exported from Macassar. No real and extensive forests of sandal have been maintained there. The species is distributed over vast areas and occurs in two or three trees only. The main producing region of sandal wood and sandalwood oil in Indonesia is the islands of Timor in the South Eastern part of the Indonesian Archipelago with Kupang as its centre. A report (1) mentioned that in 1973-74 in the region of Kupang, inventorisation of sandalwood trees had the following estimates—

Full grown (age 20 to 50 years)—45,000 trees.

Young grown (age 1 to 20 years)—32,000 trees.

Newly planted (less than 1 year)—102,000 trees.

It is also mentioned that the sandalwood trees were in large quantities in the islands of Wetra, Tanimbar and later in the neighbourhood of Timor island.

Different plant families and genera which are commonly but erroneously stated to yield sandalwood are scattered in other parts of the world. Australia produces a wood which however, is not a *Santalum* species and have changed its name later to *Santalum cygonorum* then to *Eucarya spicatum* and finally now it is known as *Fusanus spicatum*. Its oil had an antiseptic value and was also used in perfumery. This is a very slow growing species and its approximate annual production of wood is around 15 tonnes. South Australian sandalwood oil is the product of *Fusanus acuminatus* synonyms with *Eucarya accuminata* and is natively called Quandong and the fruit of which is known as the native peach. Another species, *Santalum lanceolatum* occurs in New South Wales, Queensland and northern-western parts of Western Australia.(2)

(1) Extract from the lecture "The essential oil situation in Indonesia by Dr. H.L. Tan at the 7th International Congress on Essential Oils at Kyoto—1977.

(2) Rao B.S. Sudborough J. 3, West Australian Sandalwood J. India Inst. Sci. 5, 103-78-1977.

The wood marketed by West Indies is known as *Amyris balsenufera* Linn. It does not belong to the *Santalaceae*, and the oil obtained from it has brown colour and exhibits a weak balsamic odour. The wood and oil marketed by East Africa is from a plant species known as *Osyris tenuifolia* which however belongs to the *Santalaceae*. It is stated to be bush and not a tree. But wood appears somewhat similar to sandalwood and is easy to adulterate the real scented wood. It has an agreeable smell due to a resin present in it. Another oil is reported from Mauritius with characteristics almost identical with the Indian sandalwood oil. The oil is obtained both from the heartwood and the sapwood of the tree. Details about the species are reported to be being collected. Madagascar exported a wood known as Tagger wood which lends itself for adulteration with Indian sandalwood. Fizi sandalwood is the product of *Santalum yasi*. New Caledonium sandalwood oil is the product of *Santalum austro Caledonium* which is similar to but not identical with the oil of *Santalum spicatum*. New Hebrides sandalwood oil, not of much commercial importance, comes from unknown plant species. Tahiti sandalwood oil unknown to commerce is probably the product of *Santalum frey cinetianum*. Thursday island sandalwood oil resembles the oil from *Santalum album* but differs there from in its specific gravity (0.9622 to 0.9687) and optical rotation ( $-27^{\circ} 22'$  to  $-37^{\circ} 30'$ ). Sandal tree is also grown in Zanzibar and Nepal. It also occurs in parts of Malaysia, New Zealand and Palynesia extending to the Hawaiian Archipelago and Jaun Fernadez islands (Chille) and also in Soematra and Tjendama.

## 2.2 Occurrence in India

In India, sandal is found throughout the length and breadth of the country. South India, particularly the States of Karnataka and Tamil Nadu which occupy more than 90 per cent of the sandal of the entire nation and cover more than 8000 sq. km. area in these two States, is the prominent part of the country that carries sandal. The principal natural tracts of sandal trees are confined to Mysore and Coorg districts of Karnataka and Nilgiris, North Arcot and Salem districts of Madras (Tamil Nadu) State.

It is also sparsely scattered in the southern districts of Maharashtra. A forest of sandal is also found in the heads of ravines in the Gerumatergaon around Borala in the Bul-

dhana district of Berar (old Madhya Pradesh now in Maharashtra State). The tract of sandal forests running from Kolhapur (Maharashtra) to Bellary (Karnataka) and Chittoor (Andhra Pradesh) form the north-fringe of this region. Chittoor to Erode and on to Mettupalayam (Tamil Nadu) forms the eastern and southern boundaries while the approximate western sandal border runs along from Mettupalayam through Kerala to Mercera and Mangalore (Karnataka) then extending to Sugara and on to Kolhapur in the north to the starting point. It also occurred in the Anjinaad valley (Northern Travancore) in wild State.

The other States which carry sandal trees are Bihar, Kerala, Himachal Pradesh, Maharashtra, Madhya Pradesh, Manipur, Orissa, Rajasthan and Uttar Pradesh.

## 2.3 Occurrence of Sandalwood tree in major States of India

2.3.1 *Karnataka*—The State of Karnataka is the home of sandal in India. An area of 5245 sq. kms. is covered under sandal in this State which comprises about 50 per cent of the total area under sandal in India. Sandal is distributed on the southern parts of the State, but isolated populations are also found in northern parts of the State. A luxurious belt of sandal trees about 400 kms. long and 30 kms. wide flanks the most evergreen forests of Mysore on the eastern edge and the other clearly discernible belt runs along from Coorg in the north east right upto some districts of Andhra Pradesh. The area of Makaravalli in Hangal Range, S. M. and R. M. Blocks of Sandur, Huliurdurga of Kollegal, Yedehalli of Bhadravathi, Thindlu of Hosekote and Sandal Research Centre campus (nearly 1000 trees per hectare carry dense populations while in the rest of the area, populations are either medium or sparse. The districts of Shimoga, Hassan, Mysore, Coorg, Kolar, Bangalore, Dharwar, Belgaum, North Kanara and South Kanara, Chickmagalur, Tumkur, Mevera, are important pockets where sandal is grown. The area covered from 1961-62 to 1969-70 and 1970-71 in different divisions of Bangalore is given in Annexure I. Apart from these natural forests, sandal trees are also found on the private holdings. An enumeration done between 1961 and 1970 in this State shows about 10,00,000 trees (above 15 cm. girth) are under private lands which works out to be i.e. an incidence of less than 2 trees per hectare.

Most of the populations contain higher girth classes in smaller proportions whereas, higher classes are missing in Makera-

valli. Shikaripur, Kunchanahalli, Basavanandihalli, Sandur, Thindlu and Vakkaleri contain populations of superior heart-wood. Amongst these, Yedehalli and Shikaripur have light brown heart-wood which account for higher oil yield. Thindlu, Vakkaleri and Ammenakotte trees have grown heart-wood with narrow sap. Arabbi-thittu and eastern parts of Kolar division which were originally spiked are now spike free. Ramapuram range of Kollegal division still remains healthy though surrounded by spike. These are likely to contain spike resistance sandal.

Natural regeneration is not good enough in the majority of the areas. In some areas as in the Somathpur sandal reserve near Gundhupet sandal plantations have been systematically raised with species by Forest Department of Karnataka. There are several plantations raised by dibbling, aged upto 45 years. None of them can be considered as superior except individual trees. Most of the populations are not dense and are devoid of bigger girth classes mostly due to smuggling and partly to departmental felling of green-trees. Natural regeneration in most of the populations is poor due to annual fire and grazing.

In this State, the sandal wood tree is the property of the State and the sandal industry is a monopoly of the Karnataka Government.

2. 3. 2 *Tamil Nadu*—Next to Karnataka, Tamil Nadu is the State where vast area is covered under sandal. Of the total area covered under sandal in India, Tamil Nadu's share is 20 per cent. The area in Tamil Nadu extends over 3,040 sq. kms. It is mostly in the northern parts of the State but small isolated populations are also formed in other areas.

In this State, sandalwood occurs mainly in North Arcot, Salem, Periyar, Coimbatore and Vellore districts and as scattered growth in Nilgiris, Madurai, Tiruchy districts. It is found in Kodai Hills of Madurai district, Javadi and Yelagiri hills of north Arcot district. Of late it is being cultivated in some parts of Dharmapuri and Periyar districts to replenish the declining stocks and to improve the quantity of wood.

Dense populations are found in the Chitteries, the Javadis, parts of the Shevaroyes, the Tamalmalais and parts of the Nilgiris. Higher girth classes are found in most of these popula-

tions. Natural regeneration is good in most of the areas. Due to working plan prescription of extracting only the dead trees, heart-wood formation is superior. Several plantations have been raised by planting container plants in small areas all over the State. They cover several ecological conditions. Special mention may be made of plantation at Sholapuram, experimental garden where a few trees have developed heart-wood even in the 7th year.

### 2. 3. 3 *Andhra Pradesh*

This is the third large State from the production viewpoint of sandalwood. It carries sandal forest in an area of about 175 sq. kms. Chittoor district of Andhra Pradesh is a major sandal producing area which covers about 11,824 hectares of its total area of 60,823 hectares *i.e.* about 20 per cent area of the district. It is also found in Cuddapah, Hyderabad and Kurnool districts and reported to have established in Anantpur, where it is tending to spread into the plantations of *Pterocarpus santalinus*. Plantations are regularly being revised and during 1969-70, an area of 11,000 hectares was under these trees. The average density of trees per hectare is 204 and the average number of trees cut every year is 100 per hectare besides the significant number of trees which die due to disease. Area sown under sandalwood in Andhra Pradesh from 1960 to 1980 is shown in Annexure 2. Some trees are also planted in private lands. In Aruku valley, 7 trees were planted in a row around 1959 in a garden. Examination of these trees in 1979 showed that they range in girth from 60 cms. to 100cms.

### 2. 3. 4 *Madhya Pradesh*

In Madhya Pradesh State, the sandalwood trees are found scattered in the forests. The effective area in sandal in the State is about 33 sq. kms. From the year 1978, the Forest Department has taken up a systematic plantation of sandal plants in Forest Divisions of Sehora, Sagar and Seoni. Prior to it, whatever sandal plants existed in the forests were the natural growth. These plants were not considered viable plants by the forest department for the reasons that there are no traders and processing units of sandalwood oil in Madhya Pradesh State. It is also reported that sandal trees occur near Bhopal, Ujjain, Indore, Rewa and Neemuch.

The area and number of plants planted from the year 1978, as per forest department authorities in the State, are given in the following table :

TABLE 2.3.1

Name of Forest	Place	Year of Plantation	Area in hec.	No. of Plants
Division Seoni South	Amargarh (Chandanbaug)	1978	7000	25,000
Seoni North	Shikara range		20	4,000
Distt. Seoni	Binauri, Ghandsaur range	1979	30	10,000
	Dhurna range		30	6,850
	Chhapara range			9,500
	Kathani range			4,000
	Shikara range			6,260
	Binauri Ghandsaur range			6,135
	Dhurna range	1980	30	7,500
	Kabani range		10	2,000
	Chhapara range	1981	20	2,800
	Dhurna range (Narsingharh)		20	2,000
		Total	7280	86,045
Sehor Division	Kantora range	1978	53	9,661
Distt. Rajgarh	Jagaboo range		83.5	2,327
		Total	136.5	11,988
Sagar Division	Kurai range	1978	25	4,750
Distt. Sagar	Rehali range		30	6,230
	Dhana range		20	3,980
		TOTAL	75	14,960
		G. TOTAL	7481.5	112,993

It will be seen from the table that in Madhya Pradesh, an area of 7481.5 hectares was under sandal plantation (about 0.02% of the total area) wherein, a total of 1,12,993 trees were planted.

### 2.3.5 Maharashtra

This State is reported to have an area of about 8 sq. kms. spread over in isolated patches of sandal plantations. Sandal is found in the plateau and adjacent region in Deccan being widely scattered in the forest areas of Kolhapur, Pune, Nasik, Aurangabad, Amravati, Satara and Nagpur. The bulk of production is in Kolhapur district. The forest department reported that they do not have any record about area of occurrence of sandalwood. It is pointed out that sandal wood is termed as a minor forest produce by the forest department of the State.

In Chanda (Chandrapur) and Buldhana districts of Maharashtra, the area has become devoid of sandal plantations. In Pune, it is replacing *Acacia Milotica Subsp. Indica Branan Syn. Arabica* on the river-sides.

The Sillari sandal population is the most dense in the State. In Yeotmal, sandal population is said to be the best. None of the populations contain higher girth classes. Sillari and Bohr populations consist of trees which are superior in heartwood.

Natural regeneration is good near Ajanta Caves and seedlings from Sillari plantations have been raised in the recent years in Aurangabad and Yeotmal divisions.

There is a private estate owned by Shri Prabhakar Sabnis in the village Turkewadi of Chandagarh Taluk, Kolhapur District, extending over 16 hec. The area is divided into four hectare plots leaving a 3 m. margin. Around 1920, this strip was planted with sandal and bamboos (*onytenanthera*). The area occupied by this small strip in the entire estate measured about 1 hec. The enumeration of number of trees with their girth area is as under :—

Year	Girth	No. of trees
1943	112 cm.	50
1948	112—125 cm.	87
1959	75—100	150
1972	75—100	225

The stock of trees above 15 cm. girth is about 2,500.

Most of the populations of sandal wood in the State are not dense and they are devoid of bigger girth classes due

to smuggling. In some of the protected areas, e.g. Sillari-Ajanta caves and Prabhakar Sabnis Garden, Turkewadi, the population is good. It is interesting to note that there is no incidence of spike disease in the State.

### 2.3.6 Orissa

Sandal is found over an area of about 25 sq. kms. in this State. The forest of this State has been divided into several divisions. Jeypore, Rayagarda, Kalahandi and Parlakhmedi divisions are important for the vegetation of sandal. The areas under natural growth and plantation of sandal in these divisions are as follows :—

Sl. No.	Name of the Forest Division	Area under natural growth (acres)	Area under plantation (acres)
1.	Jaypore . . . . .	4895	41.20
2.	Rayagarda . . . . .	2430	47.00
3.	Kalahandi . . . . .	15	Nil
4.	Parlakhmedi . . . . .	Nil	143

In case of plantations 1,500 plants have been planted per hectare. According to forest authorities about 10 per cent of the trees survive in case of plantation. Plantation of sandal is not the regular practice of the State. Though plantations have been raised in both Koraput and Jeypore divisions, but none of them could be considered as genetically superior. Natural regeneration is profuse in overall probability due to lesser cattle. Patches of dense populations are found around Jeypore, while it is medium at other places. But bigger girth class trees are found in small numbers.

In Jainguda of Rayagada division higher girth class sandal trees are found. The trees in these areas have fast growth probably due to deep soil and higher rainfall. Nand-gad populatio consists of trees with narrow sapwood which is the indication of plants of good quality and possess maximum heart-wood.

No spike disease is found in the sandal trees in this State.

### 2.3.7 Bihar

The history of rearing the sandal plants in Bihar is reported to be dated back in twenties of the 19th century when a Britisher named as Phulisaheb planted the sandalwood on Parasnath



Hills in Giridih district. The plantation area of sandal on Parasnath Hill was, therefore, known as Phulibagan which is now renamed as Chandan chowk. This Hill was under the control of a Jain Trust. The haphazardous exploitation of sandalwood trees of this area without the knowledge of the State Government authorities, continued illegally till about 1955. A lot of damage was done to sandal vegetation. By the time, the Government Forest Department took over the area under their control, only few trees were left out there. The forest department has thereafter started rearing new plants on the remains of the roots.

There is only a single coupe of sandal of about 10 hectares on the slopes of Parasnath Hills (Giridih District) and is popularly known as 'Chandan Chowk'. The distance from Giridih Headquarters to the location of this sandal coupe is about 35 kms. The whole plantation is still under trial stage and most confidentially manned by the Forest Department of the area. Except this coupe there is no other area where sandal is available in Bihar. However, it was reported that there is scattered growth along the Tarai Belt upto Darbhanga.

Presently, the age group of sandalwood trees of Parasnath hills is between 5 and 22 years. As per the enumeration conducted during 1980 by the Forest Department, the total number of trees available at Parasnath hills were 471. The diameter of these trees were classified as follows:—

Diameter slab (in cms.)	No. of trees
2.5 to 7.5	129
7.5 to 15.0	150
15.0 to 25.0	109
25.0 to 30.0	59
30.0 to 40.0	17
40.0 to 45.0	5
45.0 and above	2
	471 Nos.

It appears from the above table that over 50 per cent trees are very young, probably below the age of 10 years. The exact species of the trees of Parasnath hills is yet to be ascertained. Few trees are the survived plants from artificial plantation carried out by forest department in the same coupe and their final enumeration is yet to come.

### 2.3.8 Rajasthan

Sandal trees are found in Jhalawar Division in an area of about 2 sq. kms. In this pocket sandal trees of 22-23 cms. diameter girth are prominent. In Pratapgarh Division in Gandher block, some trees are reported to be found but possess no heart-wood. In Udaipur Division, isolated sandal trees are found in cultivators' fields which have not been exploited for their commercial use. During 1956, some trees were also planted in Samalpura area where the trees have grown about 15 cms. diameter girth. At present more than 240 trees having girth more than 76 cms. are still standing. National reproduction of sandal trees from the introduced plants have been reported near Ajmer on poor shallow soil. In the east of Chittorgarh there are about 250 plants standing but are stated to be devoid of heart-wood.

It has also come to notice that the artificial regeneration\* of sandal was also undertaken in Chittorgarh forest division in 1956 on being encouraged by the presence of *Santalum album* trees and their natural regeneration in this area and the efforts are still continued to increase the population of this useful species in the forest. There is no commercial exploitation of sandal in this State. The reason stated by the Office of the Chief Conservator of Forest, Rajasthan, Jaipur is that there are not much sandal trees in the forests of Rajasthan and whatever sandal exists does not produce any scented wood and is devoid of producing the desired essential oil etc.

It would be interesting to know the quality of wood and search out the utility of these sandal trees with the help of silviculturist and Sandal Research Institute, Bangalore.

### 2.3.9. Uttar Pradesh

Sandal occurs naturally in far north as Talbehat forest range of Bundelkhand Forest Division, District Jhansi on the south of Yamuna river in the south-west corner of the State. Sandal occurs in patches in some of the quartz ridges near Bar village over an area of about 35 acres in this block. The stock of sandal trees including seedlings of 3 to 4 feet was enumerated in October, 1957 and the results obtained were as under :—

	0—1"	1—6"	6—12"	12—18"
1. Diameter . . . . .	50	347	235	168
2. No. of plants in each class				

The maximum height was about 30 to 35 feet and average maximum girth was 2 to 3 feet.

\*Artificial regeneration of *santalum album* in Rajasthan, Indian Fort. 87(1) : 37—39, 1961 Reprint.

Samples of sandalwood from this area were examined in 1957 for essential oil content and were found to yield 0.67%, 2.6% and 1.2% essential oil on zero moisture basis from sandal trees of 2", 4" and 6" diameter respectively. The optimum yield was given by 4" diameter trees. The quality of the oil was similar to that of Mysore sandalwood.

There was an extension of sandal stocking from about 11 acres with 100 trees in 1925 to about 35 acres with 800 trees in 1958 and the sandalwood of this area showed heart-wood development. The latest data could not be available for this area.

The sandal tree is also found in scattered growth in the forests of Behraich, Sitapur, Lakhimpur, Basti and also in Haldwani, Dehra Dun and Saharanpur districts of Uttar Pradesh. However, the attempts made at some other places on artificial regeneration did not show very encouraging results.

### 2.3.10 Kerala

In Kerala, sandal is apparently a wild growth. Very small isolated populations of sandal are found in Wynaad, Marayoor and Thenamalai totalling about 7 sq. kms. Natural regeneration is medium which is on 3,400 acres area in Idukki district. A small attempt has also been made at Kuppadi from 1979 for plantation. However, the production of sandalwood in the state of Kerala is restricted to the ghat ranges of Marayoor and Kanthaloor and in Kottayam districts on the slopes of western ghats adjoining Munnar ranges of Devicolam Taluk.

The population at the Marayoor reserve of Anjanaad valley is the most dense not only in the State but also in the whole of India (500 trees/hectare). It has also been reported as the best seed stand which may serve the purpose of National Seed Stand. Very recently, it has come to the notice that these trees have also been attacked by spike disease. In this area, the higher girth class trees are abundant and the population consists of trees containing superior heart-wood. Hence there is a need to preserve it by all possible measures.

### 2.3.11 Himachal Pradesh

The forest of Himachal Pradesh also have sandal plantations but are mostly unknown to public. These are found in Kangra valley near Jwaladevi and the area is about 30 to 35 hectares. This contains nearly 4000 trees some of which are stated to be 30—35 years old. The quality of the heart-wood, oil content, and actual species is yet to be

found out. This hidden treasure needed to be exploited, protected and regenerated. There does not appear to be any disease in the field but it is to be confirmed.

### 2.3.12 Manipur

It is reported that the importance of sandal plant in the state has not yet been realised for the reason it occurs as a wild plant and the quantity also stated to be very less. It has also been reported by State authorities that the quality of wood is yet to be ascertained. Hence the due care to this tree is not being given in the forests. The figures of area, production and concentration of trees etc. are not available.

### 2.3.13 Gujarat

It is also found in Rajpipala\* forest spread over to Nanded, Jhagadia, Sagbara, Ankleshwar and Valia Taluks of Broach Distt. Mangrol Taluk of Surat Distt. also contain some sandal trees. In these areas, the sandalwood is being cultivated for medicinal purpose. It is floral of reddish nature.

### 2.3.14 West Bengal

It was reported that sandal trees have been introduced in this State and some of the introduced trees have developed fair-sized scented heart-wood, but when the State authorities were contacted in this regard, it was reported that sandal trees do not occur in this State.

### 2.3.15 Assam

It was earlier known that sandal trees have been introduced in this State. However, the State authorities have reported that sandal trees do not occur in this State.

## 2.4 Habitat

The *Santalum album* is a small evergreen tree. In its earliest stage, it is partial to shade and thrives under cover of hedge rows and thickness of scrubs. In the middle and later life it is intolerant of heavy overhead shade. Only biotic factors are unfavourable for the profuse reproduction. It has a dense foliage capable of stopping the wind velocity and survive well along with other tree crops. It is a hemiroot parasite and is stated to obtain its requirement of lime and potash, directly from the soil

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\*Joshi M.C. & Audichya Bull. Medico Ethno Pharma Botany Res. 2(2) 150-92, 1981.

through its roots while for nitrogen and phosphorous, it particularly depends on its host, absorbing the element through the haustoria. This has no specific edaphic and climatic requirements and hence found throughout the length and breadth of India.

Sandal is capable of growing from sea-level to 1800 metres height, from 500 mm. to 3000 mm. and even upto 5000 mm. rainfall and soils like sand clay, red soils laterite loam and even on black cotton soils. Even very poor and rocky soils can support sandal. It can thrive well in very dry as well as wet areas. It flourishes best between altitudes of 600 to 1050 metres. It is a tree of upland plateau growing chiefly on undulating ground and is often found on the hill sides and in open spaces along the banks of the rivers and in revines. Although it grows best in rainfall zone of 600 to 1600 mm. it is sometimes grown in gardens where the rainfall may be as high as 2500 mm. or even more. The most common type of soil on which it grows is the red ferruginous loam with varying fertility, the underlying rock often having metamorphic chiefly genesis. It is frequently found on rocky ground or on stoney or gravelly soils. It shows the best growth on rich and fairly moist fertile soils. Trees on poor soils and particularly on stoney or gravelly soils although do not attain much large dimensions, are said to have more highly scented wood. It avoids saline and calcareous soils. It can grow in all situations like 0°C and 40°C temperature.

In general, the sandal tree flourishes in regions where the climate remains cool with a moderate rainfall, much sunshine and long periods of dry weather. Sandal, by virtue of its adaptability to climatic conditions can be grown practically in all the States except in very cold places and is one of the best species for afforestation work in all states except in the high Himalayas. *Santalum album* is one of the important species recommended for the dry zone afforestation.

The natural forests in (Mysore State) Karnataka are found on the plateau and the immediately adjacent regions of the Deccan at a height of 1200 metres with a rainfall of 50 to 187.5 cms. during the two monsoons with long periods of dry weather. Some of the richest stands are found in mixed deciduous forests.

In Tamilnadu, the most important sandal tracts are in (i) the Javadi and Yelagiri hills ranges in North Arcot and Salem districts at elevations between 600 to 1200 metres occasionally descending to 360 metres with a rainfall of 75 to 150 centimetres. (ii) Shiveroy hills in the Salem district at altitude of 450 to 1350

metres with a rainfall of 75 to 150 centimetres, (iii) the plateau lands of Coimbatore district at elevation of 600 to 1350 metres with a rainfall of 100 to 125 centimetres and (iv) the south-east Wynaad.

In Bihar, laterite soils on the slopes of Parasnath hills is exposed to the sun. The slopes elevation at the height of 1000 to 15000 feet is best starting point where plantation can obtain optimum climatic conditions required by it. Average rainfall in Somnath hills area is well over 120 centimetres and the climatic conditions, there can be termed as such tropical since it is very cold in winter and very hot during summer with plenty of rains.

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### 3. CULTIVATION

#### 3.1 Natural growth

Sandal is capable of regenerating itself profusely through the seeds, provided there are no adverse conditions like fire or grazing. With necessary protection, any sandal area having only a few scattered trees can be stocked with adequate natural regeneration. Sandal plant is also grown in gardens and other places outside its habitat where conditions are favourable, in natural growth the birds play a vital role in the propagation of sandal tree. They eat the fleshy coat of the seed leaving the hard seed. The seed falling on the suitable soil give rise to the plants. Thereafter, the natural regeneration depends upon :

- (1) Availability of suitable host plants;
- (2) Protection against excessive heat of the sun or drought;
- (3) Facility for free and natural expansion of the crown right from the young age; and
- (4) Availability of overhead light.

Principal natural vegetation tracts of sandal trees occur in Karnataka. Beside Karnataka, natural growings of sandal tree occur in Tamil Nadu, Kerala and also in Andhra Pradesh, Orissa, Rajasthan, Uttar Pradesh and Maharashtra.

The artificial regeneration of sandal is necessary in places where there is no sandal or the places where in spite of the best conditions, there is absence of natural regeneration. In the past, planting of sandal was not artificially undertaken but left to the nature. This had resulted in a disastrous situation which unfurl the imperative for its extensive cultivation in an intensive manner. Concerning the depleting stock of sandal trees in the natural forests, some efforts for artificial regeneration of sandal trees was adopted in some of the forests.

#### 3.2 Artificial regeneration

For the regenerating sandal artificially, it is not necessary to plant the entire area. Small plots of one hectare or so may be formed here and there but well distributed over the area. For example, if a 100 hectare forest area is to be regenerated, 5 to 10 plots of one hectare size may be estab-

lished, which would be enough to regenerate and also easy to protect with proper distribution for the entire area. Once the plants are established in such small plots, they will start fruiting and the birds, air etc. will do the propagation work by which the entire remaining area will also be filled up. Later, the entire area of 100 ha. is needed to be protected from grazing and fire to save the regeneration which will come up under bushes. As the heartwood formation seems to be depending on genetical factors, it is always desirable to obtain seeds from known superior populations. For this, good seed sources have been identified at Chitteri hills of Dharampuri Divisions of Tamil Nadu, Yedahalli forests of Bhadravathi divisions, in Karnataka, Thindlu sandals of Bangalore division, Karnataka and Marayoor of Kerala.

In the case of artificial regeneration care is taken to provide suitable host plants and protection against heat, fire, browsing animals in the initial stages. Some of the important and newly developed techniques of regeneration are described below :—

### 3.2.1 *Nursery technique*—(pre-germination of seed and planting of seedlings.)

In this technique, instead of preparing mother bed, or directly dibbling of seeds in polipots, seeds are pre-germinated and transplanted into polipots. The seeds, either whole or cracked or decoated are used according to the convenience. It has been found that sound seeds after removal of the hard mesocarp when kept in an atmosphere of high humidity and at a temperature of 24°–27°C start germinating during the course of 10 days. The total germination is 85 to 100 per cent in about 30 days.

Prior to sowing, seeds are dressed with any of the seed dressing chemical like agrason, cerason and treatment with 0.05% Gibberallic acid for 12–16 hours etc. The seeds are spread close together in one layer and covered with hay. Watering is done twice a day. As soon as germination starts *i.e.* as soon as radicle comes out of the seed, they are transferred to polipots.

Instead of germination beds, mother beds are also formed for which seeds are sown @ 0.5 kg. per square metre. Before sowing the seeds, the bed is thoroughly mixed with insecticides and fungicides. The seedlings are retained in the bed for not more than 4 months and in the meantime necessary periodical treatment to the bed with fungicides and insecticides is given to avoid the seedling disease which may cause a heavy toll. Thereafter, the seedlings are transplanted in polipots.



## Preparation of polipots and soil

Polipots measuring 13 cms. × 30 cms. of 300 gauge which have adequate number of holes at the bottom for good drainage are considered good for the purpose. These may be filled with any soil provided it is neither clayey nor too sandy. No manure is required initially but the soil filled in polipots is watered profusely so that the water reaches the bottom.

The pre-germinated seeds are sown into polipots with the radicle down, when the seedlings are young and if there is hot sun, partial shading is provided. Watering is done judiciously so that there is no excess moisture or desiccation. Farm-yard manure is added when the seedlings are about 10 cms. tall. While removing the polipots, care is taken not to disturb either the soil or the root system of sandal host.

The correct size for planting out in the field is when seedlings are at least 30 cms tall, with at least 10 cms. of dark brown dark and the leaves are green and healthy. This size and conditions are obtained when the seedlings are 8 to 12 months in age. All replacement of casualties are done in the same planting season and if needed a second replacement is also done during the second planting seasons.

## Cultural operation

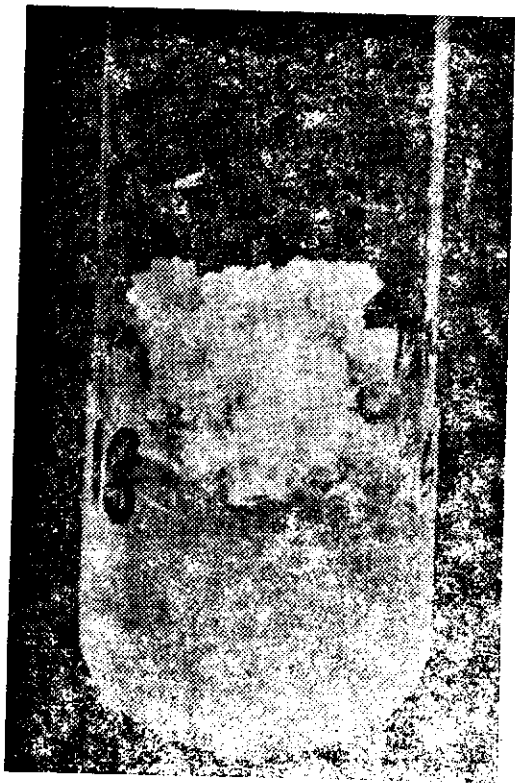
Planting is done after the onset of the monsoon, *i. e.* during June, July and August. The soil workings in a radius of 50 cm. is done in the first year and the other one in the second year ensures better growth. Trimming of host plants also becomes necessary from the third year onwards when the host plants tend to top up sandal. In such cases either the branches are pruned or the trees top-worked.

### 3.2.2 Tissue Culture Technique<sup>(1)/(2)</sup>

A recent method of healthy sandalwood through tissue culture has been successfully developed in Indian Institute of Science, Bangalore. This is an important technique for rapid multiplication of selected varieties of plants. Tissue culture consists of growing cell aggregates and single cells under controlled conditions. The conditions are different for different plant species and each plant species seem to have its own requirements.

<sup>1</sup> Rao P. S., Bapat V. A. Vegetative propagation of sandalwood plant through Tissue culture Canadian J. Bot 56(9)53, 1156, 1978.

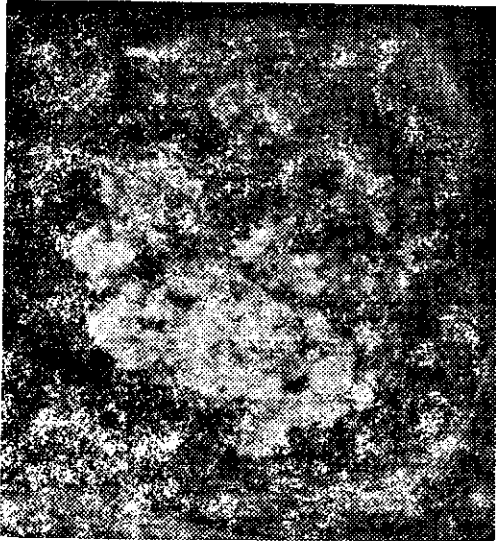
<sup>2</sup>Lakshmi Sita et al Current Science 49(5) 196—198, 1980.



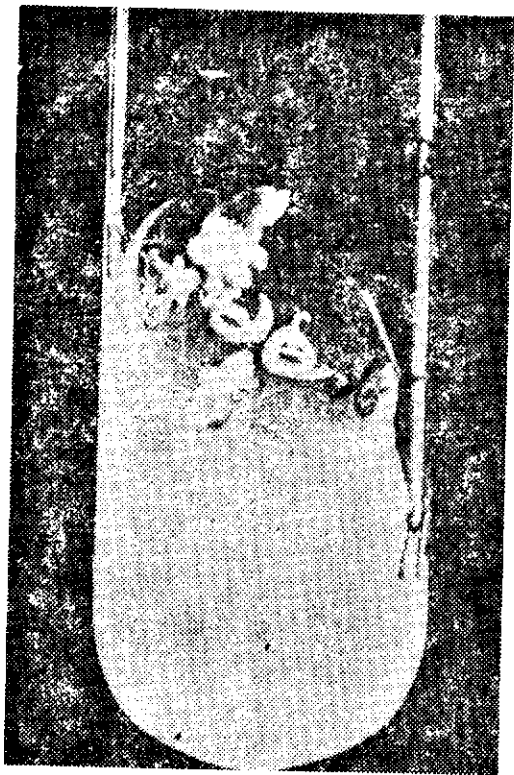
*Plate No. 2 (a) Callus tissue induced from a shoot segment*



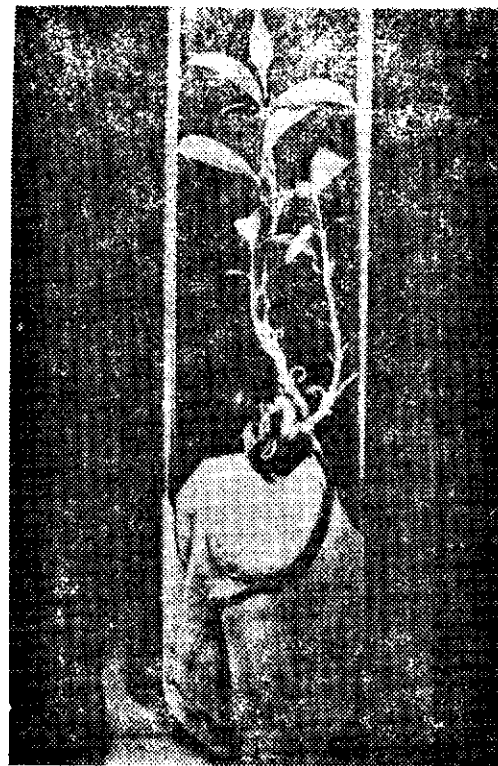
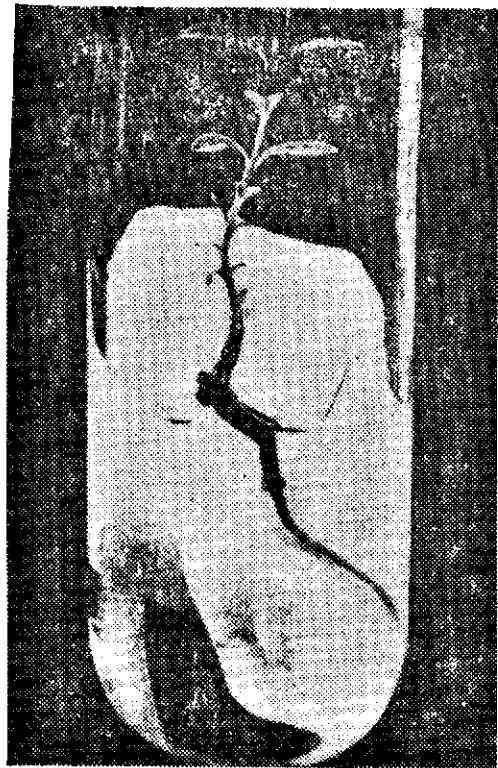
*Plate No. 2 (b) Callus on sub-Culture*



*Plate No.2 (c) Callus showing differentiation of embryoids*



*Plate No. 2 (d) & (e) Embryoids developing into plantlets on solid medium*



*Plate No. 2 (f) & (g) Fully grown plantlets with well developed top-root system on filter paper supports*



*Plate No. 2 (h) Potted tissue culture plants*

Under sterile conditions, a small piece of plant tissue is placed in a test tube containing a chemical medium of nutrients and hormones. This medium stimulates the wounded tissue to produce new cells which develop into an unorganised mass called 'Callus'. The cells of this 'Callus' are similar to those of the original material. At the proper time, small pieces of 'callus' are sub-cultured to another medium which promotes the development of different types of cells *i.e.* induces differentiation. In this new medium, the undifferentiated cells begin to differentiate and eventually develop into plantlets.

The Indian Institute of Science, Bangalore, has produced hundreds of sandal plants from shoot callus *via* the embryogenesis method. In such cases, tissues from 20—25 years old sandalwood trees were used. The production of plantlets *via* somatic embryogenesis from callus culture of natural sandal trees marks a significant contribution for the possible rapid multiplication of spike resistant varieties.\*

Developmental stages from Callus to fully developed plant sandalwood is shown in the photographs on page No. 24 to 28. The success of tissue culture method of producing healthy and spike resistant varieties of sandalwood plants is very encouraging.

### 3.2.3 Other traditional methods

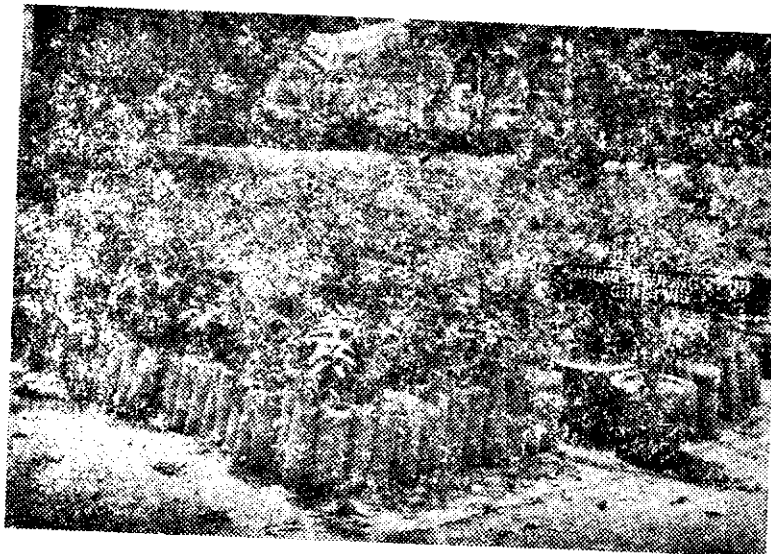
The sandal has also been successfully regenerated artificially by the following methods :—

- (1) Dibbling of seeds into bushes.
- (2) Dibbling of seeds in pits, heaped earth mounds under the trench and under rab.
- (3) Raising plantations using containers grown seedlings.

Though the first method has given good results in selected few places when done under strict supervision, many foresters do not prefer this method as this is not amenable to checking in the field. The second method may be resorted to wherever there is assured monsoon. The method of growing seedlings in the nursery and planting out gives highly satisfactory results, provided good sized healthy seedlings are planted. In places where the monsoon is erratic, this method is superior to sowing. However, this is a costly method. In many parts of Karnataka and Tamilnadu, the seedlings suffer from a root disease in the nursery and the mortality rate is very high in the nursery.

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\*Laksmi Sita G. et al. Current Science 49(5) 196—98:1980

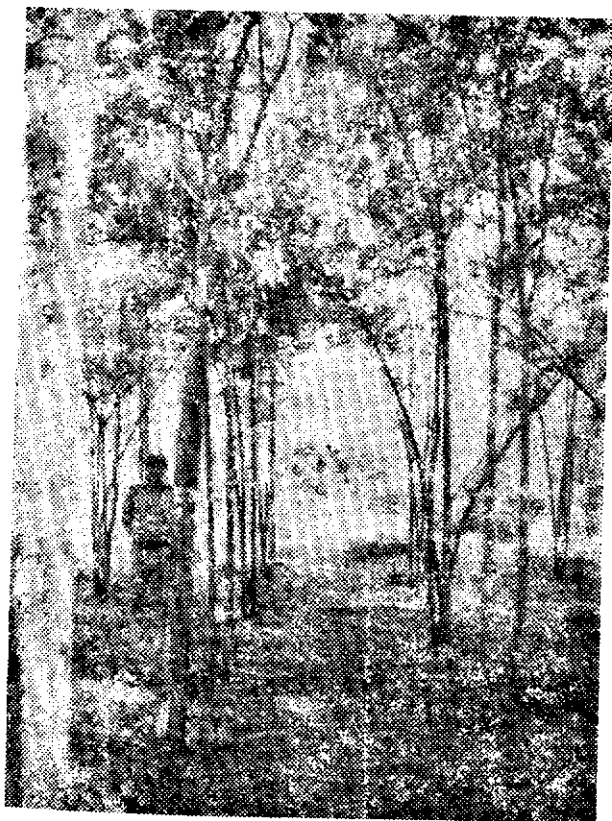


*Plate No. 3 (a)*  
*Sandal seedlings for grafting*



*Plate No. 3 (b)*  
*Diseased and healthy plants at younger stage*





*Plate No. 4*  
*Sandal plantation at Sholavaram in Tamil Nadu.*



*Plate No. 5*  
*Flowering and Fruiting in Sandal tree*

### 3.2.4 Other Trials

A fertiliser trial to improve the growth of the seedlings was initiated using urea (Nitrogen) super phosphate (Phosphorus), Muriate of Potash at different levels and combinations. Sandal seedlings which have received fertilisers at 15 kg./hectare showed improved growth over the control. Vegetative propagation by cutting has not been successful. Out of the different methods of grafting, top left grafting has given the best results.

In Karnataka, several plantations are raised by dibbling. Seeds are sown on the mounds alongwith the seeds of some forest species, of which *Cassia siamea* is favoured one because of the ease with which this species can be artificially raised and is not browsed.

In Tamil Nadu several plantations have been raised by planting container plants in small areas all over the State. In Sholavaram experimental garden, a few trees have developed heartwood even in 7th year. Sandal has also been tried in some parts of Dharmapuri and Pariyar Districts to replenish the declining stock and to improve the quantity of wood.

In Andhra Pradesh, few plantations have been raised by dibbling mostly in the Chittoor East and West Divisions. These are of recent origin. In Kerala, a small attempt of artificial regeneration has been made at Kuppadi from 1979.

In Maharashtra, plantations have been raised in Aurangabad and Yeotmal divisions in the recent years. In Orissa, plantations have been raised in both Koraput and Jeypore division but none of them could be considered genetically superior. In Madhya Pradesh, sandal has been raised in Seoni in two areas extending over 2 hectare of land each. The results are fair. The area under plantation is 7491.5 hectares and the number of trees are 1, 12, 93. In Bihar, sandal trees have been raised by plantations only. 50 percent of the trees are very young. Seedlings were obtained from seeds and later on transplanted in field surrounded by host plants. Though the sandal reproduces freely from seed, it had not spread into all suitable areas. Often the plantations formed by transplanting from the nursery or by dibbling or sowing *in situ* appear to have succeeded for the first ten years or longer after which the plants become unhealthy and died gradually.

### 3.3 General Growth

Investigations on growth on the sandal revealed that whereas the sandal grows at the rate of 1 cm. girth per year in general, the

growth can be as much as 5 cm. girth per year depending on individual tree and favourable soil factors. Seven year old plants are stated to be known to attain a diameter of 15 cms at about 4-5 feet height under very good conditions and from scented heartwood.

### 3.4 Flowering and Seeds

Sandal in general, bears flowers and fruits twice a year. 53 trees in the Sandal Research Centre Campus kept under observations showed the following pattern:—

No. of trees	Flowering
13	Throughout
22	Once a year
9	Twice a year
9	No flowers at all

The flowering in sandal usually starts at the fourth year. Moreover, sandal is capable of flowering and fruiting in 1½ years as observed in the experimental plot in the State Forest Research Institute, Jabalpur.

*Santalum spicatum* in Western Australia produces flower once a year during June—August and the flowering commences after 7 years. Indian sandal fruits, dark in colour when ripe, are collected fresh from the tree or as soon as they have fallen on the ground. The seeds can be obtained in September/October and also in March-April. However, more quantity is available in the month of September and October, but the seeds of both the seasons behave alike. Seeds collected during September-October and sown in April-May give maximum germination in minimum duration. For obtaining good seed, seeds should be depulped and dried soon after collection for greater viability and germination. The persistency of germinability is more in depulped and dried seeds than in the seeds stored with pulp, as pulp renders easy access for infection resulting in reduced viability. The excess moisture content in the seeds is found to decrease viability due to metabolic changes in the fat reserves of the seeds. Sandal seeds have fatty acids as food reserves. According to Vincent (1929), in the advancing age, food value will be decreased due to change in the fat reserve. The more oil in the seeds, the sooner they lose their viability. As sandal seeds have more unsaturated fatty compounds, they are liable to be less viable on storage for longer duration. Storing of seeds in the gunny bags and air tight storage under dry conditions are the cheapest and the best methods upto 9—12 months. Seeds collected from younger and

older trees behaved alike. Age of the tree has no effect on the viability and germination percentage of seeds. The germination percentage is about 80 per cent and the plant percentage is 75. Thus a kilogram of sandal seed containing about 6000 seeds can reproduce about 4,500 plants, if there is no seedling disease. The seeds have usually a dormancy period of 2 months and retain their maximum viability upto 8 months.

### 3.5 Hosts

Sandal tree is a parasite and requires host trees from which it draws its nourishment. Though many authors favour the view that sandal is an obligate parasite, a few authors have vehemently contradicted this and stated that it is an antophyte. The fact that the sandal tree is a root parasite was established in 1871 by Mr. John. Scoth; Curator of Royal Botanical Gardens, Calcutta. The presence or even nearness of host roots is not necessary for the development of haustoria on sandal roots and haustoria will even attach themselves firmly to small pebbles. It is found that seedlings grown in pure sand without the aid of host have survived for over a year and the haustoria in sandal arise from the external layers of the root let. The formation of haustoria is more or less confined to the younger roots; the main roots although clothed with large haustoria, probably take little part in the absorption of nutrient. Although the sandal plant may attach the roots of almost any other plant, it shows a decided preference for and grows best in the company of certain species.

Certain hosts are very suitable for its good growth while others are not. The Mysore Government (Karnataka) Forest Department has made several experiments to find out the most suitable host plants and have found *Cassia siamea*, *Pongamia glabra* and *Lantana acuminata* to be the best so far. Amongst those which are less suitable are *Bassia latifolia*, *Dalbergia* and *Zizyphus oenoplia* species. It has also been found that if all the neighbouring host trees are removed, the roots of sandal tree go farther and farther in search of sustenance and even attach themselves to roots of grasses and the tree perishes without the presence of a suitable host plant to feed upon. Sandal draws a part of its nutritions (calcium and potassium) from the soil, from the root ends and a part of nutrition (nitrogen and phesphorus) from host plants through haustoria.

Though it is stated that sandal does not require a host upto 12 months, as the roots of young seedings are known to attach themselves to hosts. Host plants like *Cassia siamea*,



*Plate No. 6*

*Haustoria (button-like structure) of sandal roots*

*Azadirachta indica*, *Pongamia glabra* etc., which are considered to be good hosts may be introduced at a distance of about 10 cms. when the seedlings are about 15 cms. tall. The other host of leguminous species such as *Cassia*, *Acacia*, *Pongamia*, *Sesbania* etc. and *Eucalyptus* are some of the good host plants of sandal. Arhar (Thuverai), *Cajanus cajan* is also a good primary host. Their introduction is necessary as the studies revealed that sandal can grow without hosts but growth is comparatively better when a host is provided. The host should not overgrow to cover sandal plants and hence requires to be pruned periodically.

In Karnataka State for the soil conservation and afforestation of areas, sandal seeds are sown on the mounds along with seeds of some forest species of which *Cassia siamea* is the favoured one because of ease with which this species can be artificially raised and is not browsed. Generally, sandal seeds are dibbled around its host plants in the ratio of 1:3. Sandal, along with host plants *Calotropis gigantea*, is raised in different batches. In parasnath hills, Arhar, all types of *Lantana camera* family wild plants, Akawar and Arju/Benja bush is considered as the best host trees for propagation of sandal trees.

In the district of Chittoor, Andhra Pradesh, *Cassia siamea* is the main host plant which protects from browsing. Sandal has great ability to grow along with teak, bamboos and miscellaneous tree crops due to its capacity to tolerate certain amount of shade. Bamboos in general and particularly the mali bamboo plantations offer excellent conditions for introducing sandal as a mixed crop for better utilisation of land and enhancing the value of the plantation.

So far, more than 300 hosts for sandal have been searched out. These have been roughly classified into four groups according to the apprehended influence of host plants on the parasites sandal plant *vis-a-vis* the spike disease:

- (i) Apparently highly resistant : *Azadirachta indica* (Neem), *Bombusa arundinacea*, *Dalbergia sissoo* (exotre) *Erythrina* sp., *Ruta* sp; *Semicarpus anacardium*, *Strychnos nuxbomica* and *Ziliphus* sps.
- (ii) Apparently resistant : *Cassia siamea*, *Casuarine equisetifolia*, *Dodonia Viscosa*, *Ficus lengalensis*, *Nelia indica*, *Mimusopa elenni* and *Sarcocaphatus acidum*.
- (iii) Apparently susceptible : *Acacia surna*, *Cassia montana*, *Caesalpina coriana*, *Dalbergia latifolia* and *Ocimum Santum*.

- (iv) Apparently very susceptible : *Lantana camera*, *Acacia farnesiana*, *Cajanus cajan* (Arhar) *Mundulsa sericea* and *Pongamia pinnata*.
- (v) Other host plants : *Cassia fistula*, *Murraya Roenigir*, *Syzygium cunini* (Jambo), *Toddalia aculeata*, *Leucaena lucaphale* (Kubabool), *Accacia*, *Concinna*, *Aintsia*, *Alangium lamercket*, *Albizzia*, *Lebbek*, *A. odoratissima*, *A. suma*, *Casearia tomentosa*, *cassia auriculata*, *Eucalyptus globulus* (exotic), *Gossipium arboreum* (Cotton) *Mallotus philippinensis*, *Morinda citrifolia*, *Pongamia glabra*, *Thespesior populnea* (exotic), *Vitex negundo*, *Wrightia*, *Tinctoria*, *Lantana acuminata*, *Limonia acidissime*, *Melia azadirachta*.



## 4. HEARTWOOD IN SANDAL TREE

### 4.0 Heartwood

Sandal tree (*Santalum album* Linn) is mainly exploited for its scented heartwood which is quite rich in fragrant sandalwood oil.

### 4.1 Heartwood Formation

Many divergent opinions have been put forward regarding the formation of heartwood in sandal trees. Cameroon<sup>(1)</sup>(1900) reports that the tree attains commercial maturity (the age at which it pays best to fell it down) at 27 to 30 years and at this period the heartwood is well developed at a general depth of 5 cms. below the surface.

Moderate rainfall, stoney and gravelly soil, an elevation of 750 m. to 1050 m. and long spells of dry weather are some of the factors reported to be conducive to the formation of heartwood containing good scented oil. It is paradoxical to see that though best growth of sandal is reported to be attained in well drained, deep alluvial soil and in places where there is good rainfall, but in such trees the formation of heartwood was considered poor both qualitatively and quantitatively.

Troup<sup>(2)</sup> expressed the doubt about the prevalent notion that better heartwood and oil are formed in drier localities with gravelly and stoney soils. Troup also clarified it by citing that the trees grown in rich soils like river banks had better heartwood formation. He was also of the opinion that sandal growing in plains or at lower levels does not develop any heartwood in it. He also mentioned that when sandal grows rather luxuriantly and with a heavy virtue of a crown, the formation of the scented heart wood is much restricted. On the other hand, when the tree grows on hill slopes or in gneise rocky soils with limited number of hosts around it, heartwood formation is said to be excellent. It is generally believed that heartwood formation starts after a period of 20 years so that the more aged a sandal plant is, the more heartwood is formed therein. Venkatarao<sup>(3)</sup>

(1) Forest Trees—D 234—242.

(2) Troup, R.S. (1921) silvicultural of Indian Trees, Clariondon Press, Oxford, Vol. III P. 799—819

(3) Venkatarao MG (1934) unpublished diary notes.

(1939) reported that the scented heartwood does not form till the tree attains an age of 15-20 years. Bhatnagar (1) (1965) reported that the sandal trees reach full maturity at an age of 50 to 80 years or more and a tree may reach physiological maturity without forming any heartwood. Better growth of sandal trees seems to be conducive to the formation of scented heartwood. It was said that trees presenting a gnarled appearance, are said to be full of oil.

Attempts were made to correlate the age of sandal by the number of rings formed but its reliability is somewhat limited. However, no correlation had been recorded between the age and girth of sandal in respect of heart-wood formation.

A preliminary survey conducted by Sandal Research Centre, Bangalore showed that the formation and development of heartwood is not dependent on age, growth, soil, rainfall, elevation or the host plants. Sandal may develop heartwood in any situation and in all places. It is believed that the formation and development of heartwood is dependent upon and controlled by individual genetic factors as the trees growing in the same locality differ from one another both in the quantity and quality of heartwood produced. The environmental factors seem to be playing a secondary role.

#### 4.2 Parameter for maximum heart-wood

The parameter for maximum heartwood is taken as the depth (that varies from 0.5 to 6 cm.) at which the heartwood is formed/found. Smaller the width of the sapwood, more is the quantity of heartwood.

#### 4.3 Colour of heartwood vis-a-vis the oil content

In trade, the superiority of wood is generally judged on the basis of the colour of the heartwood and the portion of the tree from which the wood has been taken, as this is having direct bearing on oil content of wood. It is, therefore, felt necessary to discuss this matter. Various views have been expressed in this regard. According to one view, the colour of the heartwood does not depend on soils but seems to determine by individual tribe of trees. In another view, the colour of the heartwood has been reported to have direct correlation with the type of soil

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(1) *Santalum album* Linn, Sandal wood Tree No. 112(2) Bulletin of National Botanical garden, Lucknow.

on which the tree was grown. The views of Ludlow (1869), Venkata Rao (1939) are summarised in Table :—

TABLE 4.1

Soil type	Age	Colour of the wood and scent
(1) Red and inferior black soil mixed with iron stone or quartz.	24	Red coloured, moderately scented wood.
(2) Dry, red surface soil sub-soil gravelly quartz.	20	Red coloured scented.
(3) Black soil, free from stones.	30	Yellow Coloured light scented wood.
(4) Garden soil	40	Do.
(5) White stoney soil	10	Pale red coloured wood.

From the above reports, this could be seen that the formation of heartwood, its colour and yield of oil, are all dependent on the climatic and edaphic conditions under which sandal trees are grown. This may seem to be contradictory to the views that the heartwood formation is not dependent on soil, climatic conditions, etc.

Heartwood of sandal are of different colours ranging from light yellow to dark chestnut brown. Analysis of the mature wood of different colours and the oil content is given in Table 4.2:—

TABLE 4.2

Colour of wood	Oil percentage	Santalole percentage
Yellow . . . . .	1.3—3.5	90
Light brown . . . . .	2.5—6.2	85—90
Brown . . . . .	About 2.5	Less than 85
Dark brown . . . . .	Less than 2.5	75—85

Highest oil percentage has been found in light brown woods. The yellow wood usually contain less oil but more santalol.

#### 4.3.1 Oil content of heartwood

The oil content in roots is slightly more than that in the trunk and it varies in the wood from 2.11 to 7.25 per cent. The conditions determine the higher or lower oil content in a wood are not clear. It is said that an average 1 tonne of a good wood would yield on distillation 112 lbs of oils<sup>(1)</sup>.

(1) Rangaswami & Griffith A. L., Indian Forest Records (M.S.) Silvicultural series, 1941.

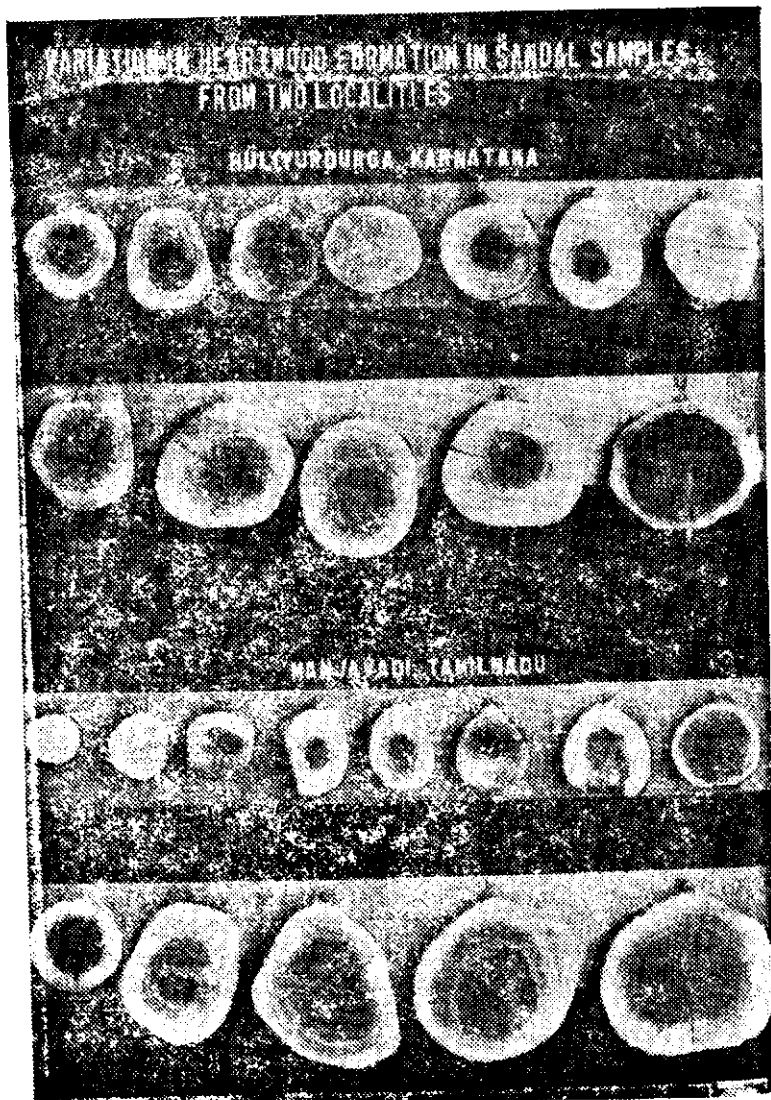


Plate No. 7  
*Variation in heartwood and sapwood content*



*Plate No. 8*  
*A cross-section of fully matured heart-wood*

## 4.4 Extraction of heartwood and its yield

### 4.4.1 Extraction of Heartwood

Extraction of the heartwood is generally made from dead sandal trees or trees above 50 years. Rarely, a green living tree is cut for extracting the heartwood. In Karnataka, the selection of sandal trees for extraction entirely rests with the Forest Deptt. No land owner shall have the right over a sandal tree standing on his land to be removed on any ground. Some working plans have prescribed a minimum girth limit for sound trees. In Coimbatore, the limit has been fixed 32" girth, in Salem at 36" girth about 41.5' height whereas the working plan for Javadi and Yelagiri hills prescribed the removal of dead trees and dying trees only.

### 4.4.2 Yield of heartwood

Difference in growth, yield and colour of heartwood seem to depend on genetic factors. However, on an average the expected yield may be seen in table 4.3 :—

TABLE 4-3

Girth class in cms.	Yield of heartwood in kgs.
1—15 . . . . .	2.4
16—30 . . . . .	6.0
31—45 . . . . .	16.5
46—60 . . . . .	39.0
61—75 . . . . .	74.0
75—90 . . . . .	127.0

It is assumed that each tree is capable of yielding at least 1 kg. per year of heartwood after 20 years. The quantity of heartwood is normally 1/2 to 3/4 of a tonnes in a tree. It can be even upto 1.2 tonnes of scented wood.

## 4.5 Assessment of oil content in heartwood in sandal trees

The functional method for determining the oil content in heartwood was to smell it. This was not feasible and scientific specially when the small trees were to be judged for the oil contents in their heartwood. This necessity forced to devise an instrument to judge the oil content of heartwood in the standing trees which have very small amount of heartwood. For the present, Pressler's borer is used to extract the heartwood, but it does not serve the purpose well. This has already been realised by Sandal Research Centre and the scientists/technicians are busy in search of a micro-method to determine oil content of heartwood in standing trees.

## 4.6 Deterioration and loss of heartwood

Heartwood is found to deteriorate by a fungus. Its attack has been observed on several species of heartwood that have rendered soft. The identity of the fungus and the potential damage are yet to be established. Heartwood of sandal is also attacked by a wood rotting fungus when the trees are standing. The bark feeding caterpillar, *Inderbela quadrinotata* also appears to be responsible for boring the outer heartwood. Heartwood borer has been causing a considerable loss to the heartwood. In general practice, the trees after extraction, are stored in the open for a considerable time when the insect and fungies do their usual damage to the heartwood. This age old practice of storing the uncleaned sandal trees in the open is not desirable.

### 4.6.1 Loss of Heartwood

Dead trees remaining for a pretty long time in the forest with the entire sapwood gone and parts of the heartwood deteriorated were common feature in Tamil Nadu. Sometimes many such trees got burnt and stolen. Extraction of roots was often not done properly, with the result, that plenty of valuable heartwood was left in the forest soil and caused a substantial loss. This might be due to lack of staff for enumeration of dead trees, large number of trees and area to be covered besides, inadequate sanctioned rate for extraction of trees. The cleaning is also sometimes not done properly, the tendency being to shave away some of the heartwood and add such good heartwood pieces to the sapwood lots. The net loss due to these improper logging and cleaning is considerable. A conservative estimate of loss at the rate of about 2 per cent for Tamil Nadu, accounts the losses to be about 30 tonnes valued at Rs. 8 lakhs and for Karnataka, it may be about 20 tonnes valued at Rs. 6 lakhs.

### 4.6.2 Availability of qualitatives heartwood

Superior strains capable of producing maximum heartwood and good amount of oil are found in the various States which are given below:—

#### 1. Karnataka

Shikaripur, Kunchanahalli, Basavanandihalli, Sandur, Yedahalli, Thindlu and Vakkaleri contain populations of superior heartwood. Amongst these Yedehalli and Shikaripur have light brown heartwood which account for higher oil yield. Thindlu, Vakkaleri and Ammanakatta trees have brown heartwood with narrow sap.

## 2. Tamil Nadu

Superior populations are found in the Chitteris, the Javadis and parts of Talamalais.

## 3. Andhra Pradesh

Horsely hills contain superior heartwood trees of sandal.

## 4. Kerala

Marayoor population consists of trees with superior heartwood.

## 5. Maharashtra

Sillaria and Bohr population consists of superior trees.

## 6. Orissa

Nandgad population consists of trees with narrow sapwood; i. e. more quantity of heartwood and are superior.

## 7. Madhya Pradesh

Superior populations are found in south Seoni area.

## 4.7 Economics of Sandal Production

The economics of sandal production is not very easy to work out because of the various difficulties involved in it. However, for a 100 km. square of sandal estate, a probable account of it has been tried by Mr. K. R. Venkatesan, Conservator of Forest, Bangalore, which is reproduced here to have a general outlook of sandal production and its benefits.

### Staff requirement for a 100 km. square sandal estate

Deputy Conservator of Forests . . . . .	1
Asstt. Conservator of Forests . . . . .	1
Range Forest Officers . . . . .	5
Foresters . . . . .	25
Forest guards . . . . .	100
Office auxiliary staff . . . . .	25

Financial implications (10 trees per hac. initially of say one lakh trees per 100 sq. kms.



## I. For the first 10 years

*Expenditure*

1. Staff salary @ Rs. 1 lakh per year for 10 years	Rs. 10.00 lakhs
2. Works including fencing about half the area, regeneration works etc. @ Rs. 1000/- per hac.	Rs. 100.00 lakhs
3. Vehicles & their maintenance . . . . .	Rs. 3.00 lakhs
4. Telecommunications . . . . .	Rs. 2.00 „
5. Buildings including residential . . . . .	Rs. 50.00 „
6. Other expenditure . . . . .	Rs. 10.00 „
<b>TOTAL</b>	<b>Rs. 175.00 lakhs</b>

Per year expenditure  $\frac{175}{10}$  Rs. 17.50 lakhs

Interest on Rs. 175 lakhs @ 12%

$$\frac{175 \times 12}{100} \div 1/2 \times 10 = \text{Rs. 105 lakhs}$$

Total expenses including interest Rs. 280.00 lakhs

*Income :*

(1) No. of dead trees @ 8% mortality per year for 100 square kms. $100,000 \times 8 \div 100$ . . . . .	8000
(2) Income from extraction of dead trees @ 5 kg per tree (sandalwood price @ Rs. 40/- per kg.) for 10 years $8000 \times 5 \times 40 \times 10$ . . . . .	Rs. 160 lakhs
<b>Deficit</b>	<b>Rs. 120 lakhs</b>

## II. For the next 10 years

*Expenditure*

1. Salaries @ Rs. 1.5 lakhs per year $\times 10$ . . . . .	Rs. 15 lakhs
2. Works @ Rs. 500 per hac. . . . .	Rs. 50 lakhs
3. Vehicles and telecommunication . . . . .	Rs. 5 lakhs
4. Other expenses . . . . .	Rs. 10 lakhs
5. Interest on deficit of Rs. 120 lakhs . . . . .	Rs. 144 lakhs
6. Deficit . . . . .	Rs. 120 lakhs
<b>TOTAL</b>	<b>Rs. 344 lakhs</b>

*Income :*

1. From sandal @ 50 trees/hac. and a mortality @ 8% first 5 years 40,000 × 5 × 40 × 5 . . . . .	Rs. 400 lakhs
2. From sandal @ 100 trees per hac. for the next 5 years @ 8% mortality 80,000 × 5 × 40 × 5 . . . . .	800 lakhs
<b>Total</b>	<u>1200 lakhs</u>
	<b>Profit Rs. 856 lakhs.</b>

*Income after 20 years :*

At a moderate stock of 200 trees per hac. and on a death rate of 8% each year 16 trees will be available. At a minimum yield of 10 kg. tree, each tree will fetch 16 × 10 × 40 . . . . .	Rs. 6400
For 100 kms. Squares 6400 × 100 × 100 . . . . .	Rs. 640 lakhs per year
Expenditure may not exceed . . . . .	Rs. 100 lakhs per year
	<u>Net Profit 540 lakhs or Rs.</u>
	5400/- per hac. per year.

From the example, it can be seen that the sandal growing is quite beneficial especially when the sandal does not require fertile land, but only the unutilised land and hilly tracts, which is the best utilisation of the waste land otherwise. Besides this, the sandal growing has so many other benefits for the welfare of the society, like providing employment to the educated persons, skilled workers and also to the unskilled workers, which will facilitate to create employment in the rural areas for which our Government is striving hard. This envisages an employment opportunity to nearly 10 to 15 thousand people every year. Moreover, this creates ecological conditions, controls atmospheric pollution, increases in avian population, increase in production of timber and other minor forest produce from the miscellaneous trees grown alongwith the sandal.

India has already lost half of its forest area between 1900 and 1965 and is facing the threat of complete disappearance of the forests within the next 40 years if the present forest clearance continued unabated. According to an U. N. Estimate, (1), "50 per cent of the total land area in India is seriously affected by water and wind erosion and the country is losing 6 million tonnes of plant nutrients due to annual displacement of 6000 million tonnes of fertile soil". The afforestation of sandal will help a lot in conservation of the soil and also avoid

above stated losses. The cultivation cost of sandal growing may be reduced further if incentives are given to private land owners. The benefits will be much more to the producers. But since it is a long duration crop, the people may hesitate to come forward to take up afforestation of sandal, unless they are given some incentives in this regard. One of the incentives may be enhanced share to the producer out of the income earned from the private trees. Secondly, people interested in growing sandal may be given improved seed and seedlings and necessary guidance to control diseases at different stages in consultation with Sandal Research Centre, Bangalore and Conservators of Forests. Due attention to the sandal forests may also be assured by the Forest Department as is being done for the growth of rubber, tea and coffee plantations by their respective organisations.

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*Plate No. 9.*  
*Spiked sandal tree*

## 5. DISEASES AND PESTS OF SANDAL

### 5.1 History

Sandal is subject to only a few diseases of which the spike-disease is the most serious and distinct one. It has attracted world-wide attention. The earliest detection with its detailed account has come to light in the year 1893 when C.D. M.c. Carthy, Dy. Conservator of Forest, Coorg, reported to the Secretary to the Chief Commissioner of Coorg that the sandal area of Coorg Forest has been attacked by a mysterious disease. This was later on termed as spike disease for the reason that the trees affected by this disease acquired a spike like appearance. But the published record of this disease appeared in the report of forest administration only in the year 1898-99. Since then, its references have been made very frequently. The first area to be affected was in the neighbourhood of Frazerpart on the old Coorg, Mysore (now Karnataka) state boundary. The most important contribution in the study of this disease was achieved by the eminent entomologist, Dr. L.C. Coleman (1) (1917, 1923) the then Director, Department of Agriculture, Mysore State, who showed that the disease can be communicated by grafting diseased sections on the originally healthy stock.

### 5.1 Diseases (2)

Spike disease of sandal is a yellow type of disease 'showing witch broom effect'. The disease is said to be caused by microplasma like organism, root contacts and insects. However, the etiology of the disease is yet to be established. In different times, discrepant type of diseases have been propounded in this regard. M/s Venkatrao and Iyengar (3) referred to two types of spike from the book. 'Sandal and Spike Diseases' written by Smith in 1937. The exact form of the disease has been differentiated as "Posette Spike" while the second is known as "Pendulous Spike" (Smith, 1957).

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1. Spike disease of sandal Mysore, Deptt., Agriculture, Mysore, Seri, Bulletin No. 3, 1917.
  2. Sandal tree and its disease by Chaudhury J.C. Basu—Indian Forest 89 (7) : 456—62, 1963
  - (3) Iyengar AVV—Contributions to the study of spike disease of sandal Part xvii J., Indian Institute of Science 20(A)-1—14, 1937.

### 5.1.1 Rossette spike of sandal

This disease was found spreading over in the area of Coorg, Mysore, Madras, North Coimbatore in South India and its progressive increase in incidence was found towards South and south-east India. Surprisingly, this disease never spread foot towards north. It was slow to this direction due to which half of Mysore State and adjacent sandal areas in Dharwar and Kanara were still free of spike. It is reported that *Chlorogenus santali Holmas* is the causative organism of this disease and also have the synonyms of sandal spike virus—*Coleman* and *Santalum*—*Smith*. Its symptoms are as under :

#### Symptoms of disease

1. The characteristic symptoms of the disease are decreasing in the size of leaves accompanied by shortening of internodes. Thus, the leaves become closely crowded together on the leaf bearing branches—a condition approximating to “witch’s broom” is formed. This condition does not appear all over the “diseased” tree at the same time, but is gradually spreading and appearing on the entire tree.

2. The diseased leaves display the tendency to stand out stiffly from the branch, thus giving rise to the spike like appearance of the affected branches and hence the popular name is derived.

3. With the progress of disease, the fresh leaves produced become smaller and smaller. A healthy normal sandal leaf measure 3" in length and 1" in width but in the advanced spiked stage, the affected leaf measures about 1/3" long and 1/16" wide.

4. Continuous growth and excessive branching in a tree or parts of tree attacked by spike disease are observed. This is a characteristic feature of the rosette type of disease.

5. A very important symptom of the disease is the pale green colour of diseased leaves. In acute cases, the leaves take reddish colour. This is perhaps due to presence of the virus called *chlorogenus*, this group of virus causing diseases is known as “yellows” e.g. yellow aster disease, yellow peach disease etc.

6. Phyllody is commonly observed in affected trees. Although in early stage of the disease, flowers have been observed on the spike portions of a tree but in an advanced stage suppression of blooming is a note-worthy feature.

7. In the advanced stage of the disease—root ends die, the haustoria either shrivels up or gets servoxed from the host roots. It is note-worthy to mention here that sandal is a root parasite (obligatory parasite) and hence the death of roots tips and haustoria have profound significance on the physiology of spike diseases.

### Syndromes

- (1) Straight, stiff, bristly leaves progressively becoming smaller and narrower.
- (2) Failure to produce flower or fruits on spiked portions.
- (3) The transmission of infection to healthy trees by mechanical grafting.
- (4) The death of affected trees within a period of 2-3 years.
- (5) The average period from appearance of symptoms of the disease to the death of tree is about 15 months, varying with the girth (Rangaswamy and Griffith 1940).
- (6) The average period required to show the manifestation of the disease under field conditions is 7 months and 4-1/2 months under artificial conditions.

#### 5.1.2 *Pendulous spike of sandal*

The disease is very similar to rosette spike disease of sandal. Mr. Rao and Gopala Iyenger, 1934 suggested the following morphological and symptomological variations :

- (1) The individual infected shoots show continuous apical growth attaining length of 1—3 feet.
- (2) The distribution of leaves is confined to half to one-third the length of the growing tip.
- (3) The growth in the length of shoot is disproportionate to that in thickness. The infected twig assumes a conspicuous drooping habit hence named as "Pendulous spike disease".
- (4) Dormant buds on spiked shoots of the pendulous spike type do not develop or grow.
- (5) Remarkable abnormal changes occur in the flowers affected with pendulous disease namely :

(a) Pedicels elongate 3-4 times than the normal length.

- (b) Buds considerably reduced in size.
  - (c) The anthers develop reddish colour.
  - (d) The pistil is abnormally developed into a thick cylindrical body.
- (6) The flowers are sterile and do not form fruits.
- (7) The root ends and tips do not die as in rosette type of spike disease.

### Causes of disease

Various efforts have been made to find out the causes of spike disease. In such efforts the possibility was thought for the deficiency of micro nutrients of soils like Copper, Zinc, Magnesium, etc. But the research thereon showed deficiency of major or minor elements like, N, P, K and Calcium, Copper, Zinc, Magnesium, Molybdenum and Cobalt have no effect. In another report, it was stated that a special auxin<sup>1</sup> was present in the diseased sandal extract which was found absent in the healthy plants. Mistopathological anatomy of diseased sandal root, stem and leaf revealed that there is phloem necrosis, nuclear inclusions, multinucleate condition, derangement of wood and phloem elements.

The diseased trees grow thin, till a very advanced stage of disease has been reached and the tree dies. When the trees die, naturally fruit cessation cannot be attributed to the disease alone, but also to the stoppage of metabolic and reproductive functions of the tree.

### 5.2 Transmission of spike

It has been reported that for successful transmission of spike disease, a minimum of sixty *Nephotettix Virescens* distant adults and an overnight acquisition feeding on diseased leaves and exposure period of a minimum of two days are required.<sup>2</sup>

### 5.3 Control of spike disease

From the very inception of this disease, it has been an eye sore to the foresters. Various scientists, research scholars etc. who tried to accept its challenge but sandal spike disease went on without any tangible solution for the past nine decades. There

(1) Indian For. 93(12)-832-833 1967

(2) Indian Forster, Vol. 104, No. 4, 202-205, 1978.



is a contribution of about 350 research papers on this disease. Many attempts were made to control this disease. Some of them are of interest and are described below :—

### 5. 3. 1 *Application of antibiotics*

It was reported that the application of antibiotics and a proprietary fungicide to spiked sandal plants induced reversion in them to the healthy state (1). Application of tetracycline in different concentrations and different frequencies were tried at Denkanikota on spiked trees. Other antibiotics like ledermycin, terramycin, actromycin, etc. were also tried. The result of ledermycin and terramycin proved superior to others. Though the treatment brought about remission for a short duration, it was not found effective in preventing the death of sandal trees.

### 5. 3. 2 *Application of fungicides*

Some systemic fungicides such as Benlate, Bevasstin, Plantian and Vilavax, etc. were tried and the effect of Benlate proved better amongst all. But under the existing forestry conditions, there are practical difficulties in adopting the chemotherapeutic methods to control the disease.

### 5. 3. 3 *Disease resistance through host selection*

Host plants are reported(2) to have a considerable bearing on the incidence of infection and the sandal associated with certain hosts is more susceptible to disease than others. Therefore, attempts were made to control the disease in sandal, through pests selection and manurial treatments to encourage resistance in the healthy plants, but the results were negative. Root stimulants were tried by Sreenivasaye (3) in the hope of reactivating diseased roots to enhance resistance to spike infection. This was equally unsuccessful. In his view, only an association of sandal with *Cassia siamea* showed very limited infectivity to artificial infections, indicating that in the field it might prove a more useful host for the sandal to resist the infection. Plots were opened in several spike infected localities culturing sandal with the species. But the disease did spread inspite of this treatment, belying the hope entertained therein. This was stated in a report on the parasitism of sandal. It is found that the Eucalyptus plantations (where the distance between 2 trees varies

(1) Ray Choudhury, etal, Current Science 1972, 41(2)72

(2) Indian Forester 64:656-69, 1938 & Ibid 65:335-45, 1939

(3) Current Science 31, 250, 1934

from 10m. to 20m.), all the sandal plantation raised along with the Eucalyptus hybrid in Karnataka are free from spike disease. Hence it was being advocated by plant pathologists that the disease can be controlled by vector host plant. Though disease control through vector host plant is ideal, practical and lasting but on experiment, it was proved that disease resistance through host selection is impossible.

#### 5.3.4 Other trials on control measures

Sukhim Thisawat<sup>(1)</sup> suggested some alternative methods of controlling spike in sandal. In one method, he suggested sandal be introduced from the Malayan Region into India, hoping that the disease would not spread to it because there was no spike in that region. In the second one, he wanted the Australian sandal *F. spicatus* to be cultured here for the same reason. In Mysore, itself the idea of bringing *santalum yasi* and breeding resistant varieties by suitable methods between *Santalum album* (Indian Sandal) and the exotic was mooted. However, this was given up. But *santalum yasi* is available in Bangalore in the mini forest. The approach was unsound because in that, disease resistance was the only issue but not the heartwood formation or the essential oil content of the hybrid.

In the earlier investigation on spike disease in sandal, curative methods did not gain currency because the number of trees to be cured in the forest were counted in thousands in several forest divisions, within a decade of the discovery of spike. Only preventive methods were undertaken with a view to arrest the ravages of disease, since a diseased plant does not recover and dies finally in a matter of weeks or months. In the beginning, mechanically removing live and dead spiked plants was arranged. It was incomplete, not being thorough at all. In a report by Coleman,<sup>(2)</sup> it was recorded that between 1903 and 1910, seven lakhs of spiked trees were removed in Mysore district and one lakh each in Coorg and Madras. It was recognised that this was incomplete and ineffective also since spiked rootlets left in the soil produced spiked plants only. Mechanical extraction does not avoid this defect. Nearly three-quarter of an area in sandal in Mysore is under spike.

#### 5.4 Techniques for disease survey

Recent experiment trial shows that the diseased trees can be clearly marked in Infra-red-false colour aerial photographs.

(1) Sukhim Thisawat Indian Forester 1955, 81, 804.

(2) Coleman, L. C. Dept. Agric. Mysore, Mycol. Bull. No. 3, 1917

## 5.5 State-wise incidence of spike disease

### 5.5.1 Karnataka

The disease is in a virulent form in Mysore Chamarajanagar and Kollegal Divisions of Karnataka. Nearly 3/4th of the Coorg Division has been affected by this disease Arabbithittu and eastern parts of Kolar Divisions which were originally spiked, are now spike free. Ramapuram range of the Kollegal Division still remains healthy though surrounded by spike. These appear to contain spike resistant sandal.

### 5.5.2 Tamil Nadu

The disease is still ravaging in Hosur and Coimbatore North Divisions. About 60 per cent of the area in Tamil Nadu is said to be infected and a number of sandal trees have been wiped out. In the Javadis and in the entire Salem Division, where the spike was rampant in fifties, it has now become rather rare and the remaining trees also appear to be spike resistant sandal trees. It is pertinent to note that in spite of virulent spike disease from 1917 onwards in Javadi Hills of Tamil Nadu, periodic enumerations in one reserve forest revealed that sandal has increased its geographical extent by 68 per cent and in density by 212 per cent over a period of 60 years<sup>(1)</sup> (working plan by Sri Rajagopala Shetty).

### 5.5.3 Andhra Pradesh

Spike disease was not found in any of the areas in the State. However, now it is reported that an average number of 100 trees per hectare died due to diseases in Chittoor District.

### 5.5.4 Kerala

The Director, Kerala Forest Research Institute, reported a fresh outbreak of sandal spike disease in the Marayoor sandal area in Kerala. This was also confirmed by the scientists of Sandal Research Centre, Bangalore and reported that this was the first invasion of spike disease in Kerala. However, the incidence of spike disease has not been found reported in the States of Maharashtra, Orissa and Madhya Pradesh.

## 5.6 Losses due to spike disease

This disease was noticed around 1893 and the area of its incidence was observed to be about 30 sq. Kms. in 1899. It has been reported that in 1903—1910 about 9 lakhs of spiked trees were

(1) Rajagopala Shetty, Indian Forestry 103(5) 367-1977

uprooted in Mysore, Coorg and Madras State. Similarly between 1919 and 1931, in Jowalagiri area in Madras 3,49,312 plants were uprooted. Coleman (1) estimated the loss at the rate of Rs. 5 per tree on an average but when the trees of different sizes were considered, he fixed it between Rs. 7 and Rs. 15 per tree, per year. Thus a loss of more than 25 lakhs of rupees was evident from it. In the year 1926, the area invaded by this disease was about 1300 sq. miles, which expanded upto 5,210 sq. miles in 1934. The affected area was reported to be 18,35,792 hectares in the year 1950-51 and the estimated area worked out was about 7,100 sq. miles. Troup in 1921 had put the losses caused by this disease for some years in Mysore and Coorg to the extent of about 5/6 lakhs and 1 lakh of rupees respectively. In Salem area of Tamilnadu, during 1917 and 1925, about 98,734 sandal trees were extracted. In the year 1953, Narasimhan (2) calculated the annual loss due to spike disease of sandal in south India to the extent of Rs. 6 to 7 lakhs. In the year 1961, Shri Varadaraja Iyengar mentioned the toll of spike disease in an area of sandal in south India depending upon its girth. He conducted this study to know the susceptibility of trees to the spike disease and his findings were as under :—

Girth in inches	No. of trees	Wood secured (Qrts = 28 lbs.)	Girth in inches	No. of Trees	Wood secured (Qrts.)
1	2	3	4	5	6
0—6 . . . . .	2400	646	42—48	1000	24500
6—12 . . . . .	27520	14400	48—54	400	14000
12—18 . . . . .	31000	43100	54—60	180	6940
18—24 . . . . .	17000	52440	60—66	45	2300
24—30 . . . . .	8990	56300	66—72	22	1310
30—36 . . . . .	4800	56800	72—78	6	510
36—42 . . . . .	2080	36350	78—84	3	264

From the above table, he concluded that the lower girth tree were more prone to disease than the higher girth trees. Thus in a small area, he counted about 10,000 dead trees, which also indicated a heavy loss.

The Govt. of India had also studies (3,4) the spike disease critically to have a control over it. But no concrete remedial

(1) Deptt. Agriculture Mysore—Bulletin No. 3, 1917.

(2) Indian For. 80(11) : 690 : 1954

(3) Report to the Govt. of India on the sandal spike disease expanded Technical Assistance, Programme FAO Rome. No. 1229, 3100, 1960 For. Abst. 22(1) : 96 Abst. 740. 1961.

\*(4) Kelkar Committee Report, 1966.

measures could however be obtained. This disease is still prevalent in the Karnataka State and is reported to be spreading in an area of about 5000 sq. miles. In a Communique,<sup>(1)</sup> the Chief Conservator of Forests, Madras stated in 1961 that the disease was spreading over an area of about 2000 sq. miles. This had affected the sandal wood production which used to be 80 to 100 tonnes per year, that has come to a downfall of 10 tonnes per year now. Similarly, it is reported that on account of rapid spreading over of this disease, the supply of wood in Karnataka fell from 2400 tonnes to nearly 1200 tonnes a year. Thus, it can be seen that the spike disease has caused a significant loss to the sandal forests and the total loss could be accounted in several lakhs of rupees in a year.

## 5.7 Other diseases

### 5.7.1 Sandal leaf-cure mosaic virus

This disease is spread over to southern part of India and *Marmor Santali* is stated to be the causative organism which has synonyms *santalum virus II*.

#### Symptoms

Leaves become small, curled, wrinkled, thickened, brittle, abscising, systemic chlorotic mottling.

Internodal length normal. Infected twigs produce both flowers and fruits. Transmission takes place by ring bark grafts.

### 5.7.2 Damping off of sandal seedlings

Damping off of sandal seedlings has been observed on several occasions. No definite cause has been attributed to the disease. It is generally believed that damping off of seedlings owing to an excessive amount of dense wet herbaceous undergrowth is in some situations a hinderance to reproduction.<sup>(2)</sup>

## 5.8 Climbers

The tree climbers also cause damage to sandal. The Sandal trees in Bar Village (Jhansi U.P.) were found in grip of *Manlain*, *Badrasin*, *Amarbel*, *Kepoti* and *Makoh*.

1. Correspondence Paper of Chief Conservator of Forest, Madras.

2. Group, 1921 Silvicultural of India Trees, Clarendon Press, Oxford Vol. III, P.812.



*Plate No. 10*  
*Hollowed sandal wood due to *Aristobia* insect attack*



*Plate No. 11*  
*Borer attacked sandal wood*

## 5.9 Other damages

A certain amount of damage is caused to the young root suckers and coppice by chital, sambhar and chinkara, pigs, squirrels, hares, rats and porcupines also cause damage to young plants, seeds as well as seedlings. Rats pull out the seedlings and eat fleshy hypocotyl. Monkeys do considerable damage to loading shoots of young trees. Sandal seedlings are also very much prone to insect attacks and are sensitive to it but no deaths due to insects have been reported.

## 5.10 Pests

### 5.10.1 Heartwood borer of sandal

It has been observed in many cases that heartwood contained several bore holes. Several trees have also come to notice which possess barely 1 to 2 cm. of heart-wood sticking to the inner surface of the sapwood. The bore-holes are seen on both the branches and the main stem, depending upon the site and the number of oviposition. The heartwood have two kinds of hollowness (1) central core partially hollowed having only a very thin (just one cm. or slightly more) strip of heartwood all round sticking to the inner sapwood and (2) most of the tunnels getting fused in the periphery leaving a socket like heartwood core in the centre with a surrounding hollow portion. The presence of the bore holes and the hollow heart-wood is not found restricted to the old trees only but also is found in younger and medium aged trees. A survey of the sandal koties, conducted by Sandal Research Centre, Bangalore in 1977, in Tamil Nadu, Karnataka and Andhra Pradesh revealed that 25-40 percent (1) of the trees were having bore holes in the heartwood as well as hollows. In one lot from a locality in Vellore Division, 90 per cent of the trees were affected. The heartwood was found to be affected to the extent of 90 per cent. In the past, efforts were made to know the cause of formation of their hollowness.

Beeson (2) (1941), Mathure et al (3) (1961) and Brown (4) (1968) have recorded *Aristobia octofasciculata* Aurvillius (*Cerambycidae: Coleoptera*) boring the small branches and stem of saplings. The grub attacks the heartwood and the adult eats the

(1) V.R. Sivaramakrishnan, K. R. Venkatesan, Sandal Research Centre, Bangalore.

(2) Ecology and Control of forest insects of India and Neighbouring countries, Vasant Press, Dehradun p. 1007-1941.

(3) Indian Forest Bulletin 191(8) New Series Entomology, 1961.

(4) Pests and diseases of Forest Plantation trees, Clariondon Press, 1965.

bark of twigs causing drying. The twig drying may be some times epidemic.

The pest is found on sandal in the usual sandal tracts as well as far off places where there was practically no continuity between the sandal populations. It is also found in isolated patches of sandal trees in several parts of Tamilnadu like Vellore, Tirupathur, Dindigul, Tirunelvely, Salem, Marakkanam near Pondicherry, Chittoor in Andhra Pradesh, Kollegal, submer-sion areas of Chamarajanagar, Kolar, Shimoga, Mudigere, Bangalore in Karnataka and Ajra in Maharashtra. So far sandal is the only recorded host of this pest. Therefore, even sandal trees with no heartwood are also attacked. As a result of its feeding, the younger plants die and the branches break in a strong wind or the top dries completely.

Of all the pests and diseases of sandal, heart-wood borer is likely to be the most serious. It is because even young saplings are attacked by this. In such attacks the twigs dry out, heart-wood bored causing hollowness of the heartwood. This is considered to be of higher damage potential than even the spike disease as this pest attacks the most valuable heartwood thereby reducing the quantity and quality.

#### 5.10.2 Losses

It has been calculated that a bore hole caused by *Aristobia octofasiculata* measuring about 2 cms in dia. and an average length of 2 m. can result in a loss of about 0.5 kg. If 20 such bore holes are found, a tree may lose as much as 10 Kgs. of heartwood which at the present value will mean a loss of Rs. 400. As the hollowness in trees is also attributed to this borer, the damage to the heartwood due to the hollowness is much more. In a rough appraisal, an average hollow tree may lose as much as 30 per cent of its heartwood. Taking an average tree to have 20 Kgs of heartwood, it will lose 6 Kgs of heartwood. Thus in such cases, there is a direct loss of revenue from a tree to the extent of 30 per cent. Assuming a low estimate of 5 per cent of the trees with hollowness, the estimated loss for T.N. and Karnataka which produces about 2500 tonnes of sandal per year will not be less than Rs. 15 lakhs.

#### 5.11 Diseases in *Santalum spicatum* in western Australia

Heartwood borer is very common in dry areas. The wood extracted from these areas showed a number of borer holes. The



borer-attack is less common in areas where the tree is covered with sand upto one metre height from ground levels(1).

## 5.12 Other Pests

### 5.12.1 Borers

*Zeuzera coffeases Netther*, commonly known as the "Red Borer" or "Coffea Borer", was recorded to cause damage to sandal. The attacked plants die back to the point at which they are girdled by the tunnel of the borer or are killed outright. About 25 per cent of the sandal at pole stage in Holekere, Mandya Division (Karnataka) was found to suffer from the attack of this borer.

Several insects species have been recorded(2) attacking different vegetative parts of sandal. But it appears from the point of view of fruit setting, the sap sucking bug *Saissetia spp.* is a very potential pest and has been recorded to affect seed setting in sandal.

During the survey(3) of the insect pests responsible for the mortality in sandal due to causes other than spike disease, two *Saissetia spp.* were recorded attacking the leaves, tender stems, flowers and fruits as well. An investigation in the details revealed the presence of two bug species. *Saissetia-hemisphaerica-Targioni-Tozzetti* and *Saissetia nigrum Netther* on the fruit buds which drop off ultimately. Even the open flowers when attacked drop down.

These two bugs *Lecanium (Saissetia) hemisphaerica* and *Lecanium (Saissetia) nigrum* occur together on the same plant feeding on the sap of tender shoots, stems, leaves, flowers and fruits of numerous plants including *Santalum album*.

### 5.12.2 Nature of damage

The feeding insects excrete "honey dew", when the ant attenders tickle these scales. This "honey dew" secretions cause black sooty mould fungus formation on the leaves. The direct injury to the host is usually aggravated by the development of sooty moulds since they interfere with the physiological function of the leaves e.g. photosynthesis etc. leading to the death of the infected branches.

(1) Information collected from Mr. K. Hughes and M. P. L. Richmond during their visit to Sandal Research Centre, Bangalore on 26-2-1980.

(2) V.R. Sivaramakrishnan etc. of Sandal Research Centre, Bangalore.

(3) Sandal Research Centre, Bangalore.

The dome shaped adult females harbour the parthenogenic nymphs more actively on the plant and feed on the sap. Feeding of such nymphs and adults in large numbers leads to a several drain of the sap resulting in the dry and ultimate death of the particular plant part. In the case of open flowers, the flowers fade and fall off even though the flowers are already fertilised. In the case of fruits, feeding by the nymphs and adults on the fleshy, pericarp results in their drying and dropping off.

### 5.12.3 *Control measures*

Since these bugs have any collateral hosts, they can spread very rapidly to the neighbouring plants.

Heavily infested trees by these coccid bugs, *Saissetia hemisphaerica* and *Saissetia nigrum* have shown resistance to spraying systemic-cum-contact insecticide such as Ekalux. In Sandal Research Centre Campus, the following treatment was given to the heavily infested trees. The branches heavily infested by these coccid bugs were lopped and burnt. The trees were later sprayed with 0.5 per cent Ekalux and 2.5 per cent of B.H.C. solution which had given a better flowering pattern and expected to give a good harvest of fruits.

### 5.12.4 *Biological control and predators*

Several hymenopterous parasites and predators like mantids were recorded. Parasites seem to be potential controlling agents. Since there are a large number of collateral hosts, an integrated method of control like this alongwith the release of predators may be ideal for the successful control of the pests.

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## 6. PRODUCTION OF SANDAL WOOD

Karnataka and Tamilnadu States together contribute the bulk of country's production of sandalwood. Till recently average annual production in Karnataka was around 2000 tonnes of heartwood. In Tamil Nadu, it was around 1200 tonnes out of which about 800 tonnes of wood was obtained annually from the Javadi hills in North Arcot district which is generally considered as homeland of sandal. The supplies (production) from Mysore (Karnataka) had commenced almost over 100 years ago.

### 6.1 All India Production

The production of sandalwood in India solely depends on the production trend of sandalwood in Karnataka and Tamil-Nadu. The production of sandalwood in 1960-61 was estimated to be 2,995 tonnes which increased to 3,183 tonnes in 1961-62 but declined to 2,849 tonnes in 1962-63. It subsequently increased in 1963-64 to 3,210 tonnes and went up further to 3,647 tonnes in 1964-65. The average production during this quinquennium was 3,176.8 tonnes per annum. The production in 1964-65 was higher by about 21.7 per cent when compared with the production for the year 1960-61.

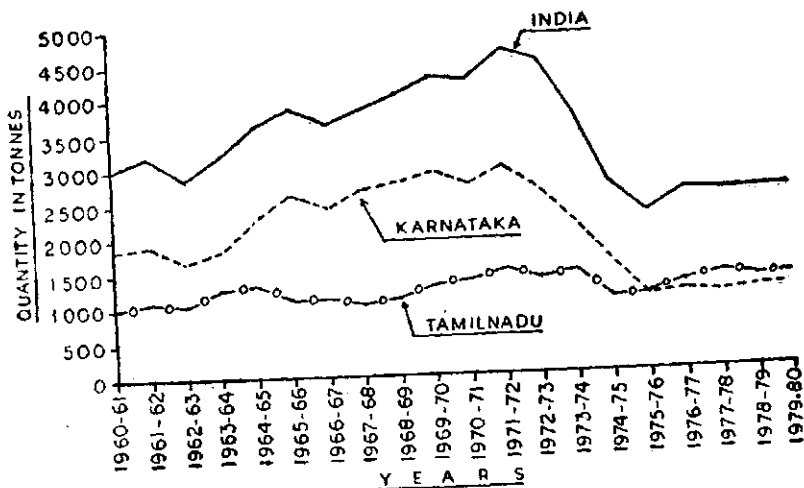
The second quinquennium *i.e.* 1965-66 to 1969-70 started with an increased production of 3,867 tonnes in 1965-66. It, however, dipped to 3,632 tonnes in 1966-67, but maintained an upward trend during the years 1967-68, 1968-69 and 1969-70 with a recorded production at 3,845, 4,014 and 4,256 tonnes respectively. The average production during this quinquennium was 3,922.8 tonnes which was higher by about 23.5 per cent when compared to the previous quinquennium. The increase over the production between the first year *i.e.* 1965-66 when compared with last year *i.e.* 1969-70 of this quinquennium was about 10 per cent. This quinquennium also has the distinction of attaining the highest production of 4,256 tonnes in the entire decade of 1960-61 to 1969-70.

The average production during this quinquennium of 1970-71 to 1974-75 was 3841.6 tonnes which was lower by about 2 per cent to the previous quinquennium. The production in the last year of this quinquennium was found to be lower by 36 per cent as compared to last year, was at peak in the year 1971-72 which recorded a production of 4,631 tonnes.

GRAPH NO.

# ESTIMATED PRODUCTION OF SANDALWOOD IN INDIA. FOR THE YEARS 1960-61 TO 1979-80

SCALE:  
1 CM = 1 YEAR  
1 CM = 500 TONNES



The average production in the 3rd quinquennium presented a gloomy picture as the production achievement was at 2,517.6 tonnes. This was the lowest average production among all the four quinquennia and was lower by 34 per cent in comparison with the average production of the previous quinquennium. The production of the last year of this quinquennium was higher by 13 per cent of the first year of this quinquennium.

The data regarding production of sandalwood are patchy and lack micro authenticity as the statistics are not maintained properly. The estimated production figures of sandalwood for the years 1960-61 to 1979-80 in Karnataka, Tamilnadu, Andhra Pradesh and other States are given in Annexure-III. A comparative position of All India production with that of Karnataka and Tamil Nadu may be seen in the Graph No. 1. Statewise production situation of sandalwood in the country is as follows:—

### 6.1.1 Karnataka

Karnataka is the most important sandal producing state in the country. Right from 1882, sandal trees have been extracted from all over the erstwhile Mysore (now Karnataka) State. The exploitation of sandalwood was started by the then Maharaja of Mysore, which after independence, became the State monopoly and now almost the entire wood produced in the State is utilised by State distilleries *i.e.* at Mysore and Shimoga.

The State contributed 1871 tonnes of sandalwood during 1960-61 which was about 62 per cent of the total production in the country. The production rose to 1938 tonnes in the year 1961-62, but stepped down to 1,671 tonnes in the year 1962-63. (Please see Graph No. 2). An increase was noticed in the year 1963-64 when the production reached to the maximum of 1,820 tonnes. It gained further impetus and reached to 2,247 tonnes which was the highest for the quinquennium 1960-61 to 1964-65. This increase was about 20 per cent over the production of 1960-61. However, this increase was at the cost of more number of trees sacrificed for the extraction of wood. The average production of wood during this quinquennium was 1909.4 tonnes which accounted for 60 per cent of the average production of sandalwood in the country during the quinquennium.

The production of sandalwood further rose to 2,616 tonnes in 1965-66 but declined to 2,403 tonnes in 1966-67. Thus a

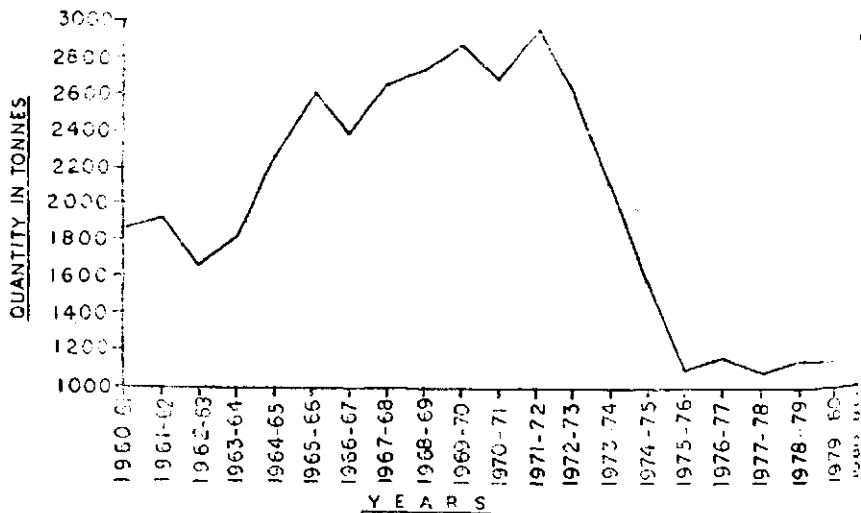
GRAPHIC

# ESTIMATED PRODUCTION OF SANDALWOOD IN KARNATAKA. (1960-61 TO 1979-80)

SCALE:

1CM = 1 YEAR

1CM = 200 TONNES



fall of about 200 tonnes was noticed in this year. The production of wood was made to increase to meet out the demand. As a result of it the production could be brought to 2,670 tonnes in 1967-68 and further to 2,748 tonnes in 1968-69 and touched to a new height of 2,800 tonnes in 1969-70 which was 929 tonnes more than that of the production obtained in 1960-61. During this second quinquennium, the average production was 2,647.4 tonnes. The share of Karnataka was about 67 per cent to the average All India Production of Sandalwood during this quinquennium. Karnataka thus showed an increase of about 39 per cent in production of wood in this quinquennium improving its own share by 7 per cent to the total All India Production over the previous quinquennium. The total increase in the year 1969-70 over 1960-61 was thus witnessed to 49.6 per cent:

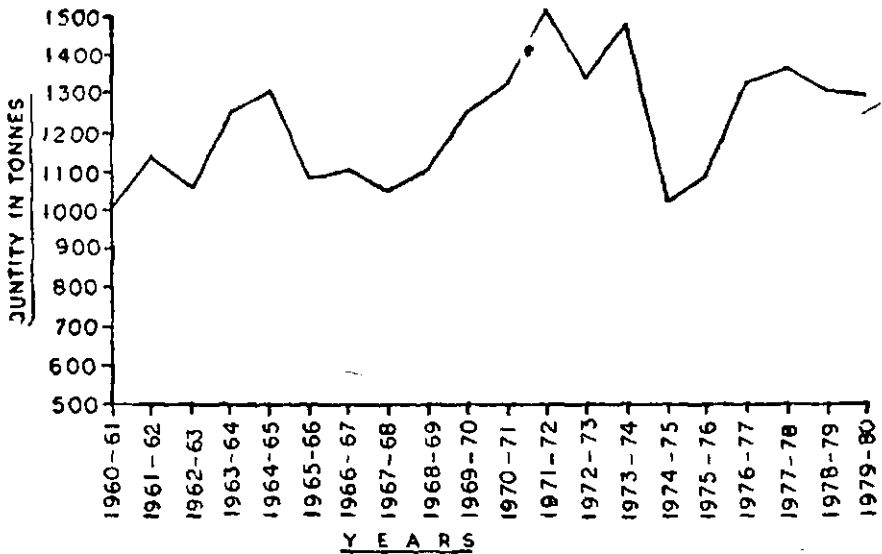
The appreciable production of 1969-70 descended to 2705 tonnes in 1970-71. However, the year 1971-72 witnessed a peak production when it touched the height of 2977 tonnes. In this year, although the production trend was having an upward move, it was only at the cost of reckless felling of trees. The quantity of wood obtained from trees continued to decline for the reason that green or immature sandal trees were extracted to meet the world demand of valuable sandalwood oil. In 1972-73, the production was 2633 tonnes, which was the beginning of era of declining production. After this period, the production steadily descended to 2134 tonnes in 1973-74 and 1570 tonnes in 1974-75. During this third quinquennium, the average production was 2403.8 tonnes in the State. The share of Karnataka was still maintained at 63 per cent in the average total production of the country. The fall of average production of the previous quinquennium was about 9 per cent. The decrease in the average production during the first quinquennium and the 3rd quinquennium was to the tune of about 26 per cent.

The production further declined to 1096 tonnes in 1975-76. The year of 1976-77 was considered a respite year, in which the production was raised to 1150 tonnes, probably to meet the outside demand of sandalwood oil. The production went down to 1079 tonnes in 1977-78 and established at 1150 tonnes during the years 1978-79 and 1979-80. In these years, a set back was noticed to sacrifice more and more trees as the mature trees were already extracted in the preceding years.

Thus in the quinquennium 1975-76 to 1979-80, the average production of sandalwood in Karnataka was the lowest *i. e.* 1125 tonnes. The share of Karnataka during this quinquennium was only 45 per cent to the average All India Production of this quinquennium. The decline when compared to 1970-71 to 1974-75

GRAPH NO. 1

**ESTIMATED PRODUCTION OF SANDALWOOD IN TAMILNADU STATE.** (1960-61 TO 1979-80)





quinquennium was 53 per cent which was the lowest. The production of 1979-80 when compared to 1960-61 was lower by about 39 per cent. A more dismal picture emerges when the production for 1980-81 (1150 tonnes) is compared with the peak production of 2977 tonnes in 1971-72, shows the decline in production by about 61 per cent. This is a gloomy picture of our sandal estate which needs a careful attention to keep alive with the spirit of demand of sandalwood oil in foreign markets and to fetch more and more foreign exchange to the country's exchequer. One of the reasons of the downward trend of production besides the spike disease is reckless lopping, uncontrolled grazing of trees and rampant smuggling of sandalwood from the forests of the states. The quantity of sandalwood stated to be seized by the forest officers from the thieves during the years 1972-73 to 1979-80 (upto July, 1979) is given in the following table :-

TABLE 6.1

Years	Qty. involved (tonnes)	Value (in Rs. lakhs)
1972-73	48.3	5.03
1973-74	29.0	3.46
1974-75	70.0	16.13
1975-76	37.0	13.81
1976-77	—	—
1977-78	N.A.	16.40
1978-79	78.0	43.59
1979-80 (upto 31-7-79)	27.4	16.78

The above table shows merely a glimpse of magnitude of theft. A lot of quantity is expected to have been remained untraced. It is also feared that for the next decade or so, the state is likely to face an acute shortage of sandalwood yield. The loss of forest area for various purposes from 1953 onwards is 2,22,728 hectares, out of which atleast 1,00,000 hectares must be sandal areas. This is also one of the factors affecting the production of sandalwood in this state.

### 6.1.2 Tamil Nadu

Tamilnadu ranks second in production of sandalwood in the country, after Karnataka. (Please see graph No. 3) The state has got the distinction of maintaining its production to an average of 1220 tonnes per year during the last two decades (1960-61 to 1979-80) barring some deviations. The production of sandalwood in 1960-61 was 997 tonnes which rose to 1144 tonnes during 1961-62. Though it declined to 1054 tonnes in 1962-63, it captured its position to 1261

tonnes in 1963-64 and further to 1307 tonnes in 1964-65 which was the peak production of the quinquennium *i. e.* 1960-61 to 1964-65. During this quinquennium, average production was about 1153 tonnes and the year 1964-65 gained an increase of 31 per cent over the production of 1960-61. The State's contribution to the total average All India Production during this quinquennium was 36 per cent. There was a significant fall in production during 1965-66 which registered 1084 tonnes *i. e.* a decline of about 17 per cent when compared to production of previous year 1964-65.

Next 3 years *i. e.* 1966-67 to 1968-69 showed a slightly fluctuating trend in production, It was nearly 1108, 1054 and 1092 tonnes respectively. The year 1969-70 was a brighter year when the production touched to 1260 tonnes. This was higher by 16 per cent of the production recorded in 1965-66. During the quinquennium 1965-66 to 1969-70, the average production of the state was about 1121 tonnes and its share to the average All India Production during this period was 38 per cent. It will thus be seen that while the average production in this quinquennium when compared to the previous quinquennium was lower by about 3 per cent, its contribution to All India Production increased by 2 per cent over the previous year.

The production during 1970-71 stepped up to 1310 tonnes and gained further momentum to reach 1512 tonnes in 1971-72. During 1972-73, it dropped to 1327 tonnes but revived to 1475 tonnes during 1973-74. However, during 1974-75 the production slumped to 1015 tonnes. This quinquennium is important, in the sense that a peak production for a duration of 20 years was witnessed in it. It is considered that this rise in production was at the cost of felling of green trees also due to fear of spreading of spike disease therein. The production declined from 1310 tonnes in 1970-71 to 1015 in 1974-75 *i. e.* about 23 per cent. During this quinquennium average production was 1328 tonnes which was more by 16 per cent of the previous quinquennium. The States share to the (average) All India Production was 35 per cent which was less by 3 per cent compared with the quinquennium 1965-66 to 1969-70.

During 1975-76, 1976-77 and 1977-78, the production increased progressively to 1085, 1330 and 1373 tonnes respectively. However, it declined to 1313 tonnes and 1300 tonnes during 1978-79 and 1979-80 respectively. During this quinquennium, the average production of the State was 1280 tonnes, which was slightly lower than the average production of the previous quinquennium. One remarkable aspect of this quinquennium was that the States

share in the average production of this quinquennium was 51 per cent which was about 16 per cent more compared to previous quinquennium.

Sandal production in private patta lands of this State is estimated to be 60—90 tonnes every year. If the sandal forests are not tendered due importance and care, the stocks are likely to go down in future. In Tamilnadu (erstwhile Madras State) 1 tonne of sandalwood was generally obtained by cleaning about 40 trees in 1923. It increased to 260 trees in 1932 being smaller in size. Today one has to dress over 300 trees to secure the same quantity of wood.

### 6.1.3 Andhra Pradesh

During the years 1960 to 1980, the average production of sandalwood in the State was about 32.35 tonnes per year. In Chittoor Distt. The production is about 1 tonne per hectare. During the year 1960-61, the estimated production was 42 tonnes. Except in the year 1965-66 when the production was 47 tonnes, there was a downward trend till 1967-68. The production increased in 1968-69 to 82 tonnes and further moved upto 107 tonnes during 1969-70 which were the highest during these two decades. Thereafter, the production gradually decreased and touched its lowest ebb of 15 tonnes during 1974-75. Thereafter, the production showed a staggering trend and it never reached even the production level of 1960-61.

Some production of sandalwood is also on private patta lands which is directly sold to distillers in the State usually through valid permits.

### 6.1.4 Kerala

The production of sandalwood from 1964 to 1979 is reported as under:—

TABLE 6.2

Years	Qty. (tonnes)
1964	58.26
1965	9.57
1966 to 1973	N.A.
1974	12.48
1975	11.44
1976 to 1978	N.A.
1979	8.62

Though the estimated production of sandalwood in the State was placed at 50 tonnes by official sources yet the data provided for the years 1965, 1974, 1975 and 1979 do not reflect and have never touched the estimation and hence this appears to be an exaggeration.

#### 6.1.5 Orissa

Yearwise data on production figures of sandalwood are not available for this State. However, it is reported that during 1979-80 the production was 1.40 quintals and during 1980-81 it was 60.32 quintals.

#### 6.1.6 Madhya Pradesh

Yearwise production figures are not available for this State. It is reported that in the forest division Seoni (south) 100 quintals of sandalwood was auctioned in 1980-81 and the balance of 250 quintals was lying unsold for want of purchasers. The production of sandalwood during 1980-81 was reported to be 35 tonnes.

#### 6.1.7 Maharashtra

It has been reported that in the district of Kolhapur, following quantities of sandalwood were sold during the years 1974-75 to 1977-78 :—

TABLE 6.3

Year	Qty. (Kg)
1974-75	34068
1975-76	29155
1976-77	1480
1977-78	17280

However, the wood reported to have been auctioned (confiscated from smugglers) in Aurangabad district, in various years was as under :—

TABLE 6.4

Years	Qty. (Kg)
1970-71	3000 Kg.
1971-72	3423 "
1972-73	1000 "
1973-74	200 "
1974-75	Nil
1975-76	50 "
1976-77	Nil
1977-78	40 "
1978-79	Nil
1979-80	5000 "
1980-81	Nil

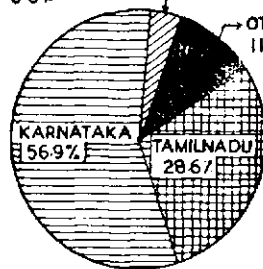
## QUINQUENNIUM-WISE SHARE PERCENTAGE OF SANDALWOOD IN MAJOR STATES.

ANDHRA PRADESH 1.10%      OTHERS 2.6%



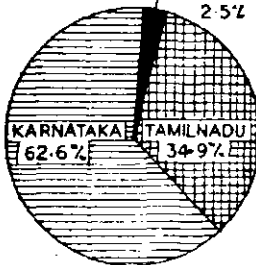
**QUINQUENNIUM**  
1960-61 TO 1964-65

ANDHRA PRADESH 3.0%      OTHERS 11.5%



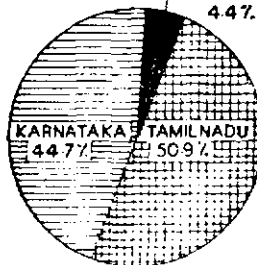
**QUINQUENNIUM**  
1965-66 TO 1969-70

OTHERS 2.5%



**QUINQUENNIUM**  
1970-71 TO 1974-75

OTHERS 4.4%



**QUINQUENNIUM**  
1975-76 TO 1979-80

Many reasons have been advanced for reduction in the production of sandalwood in the country. The important of these are release of sandal bearing forest lands for non-forestry purposes, low regeneration, lack of protection from fire, grazing theft, over exploitation of sandal trees and diseases and pests. The circular diagram on Page No. 75 gives an idea of the percentage of contribution to the production of sandal wood in the country (Quinquennium-wise for the years 1960-61 to 1979-80).

## 6.2 Area and Production of Red Sanders in Andhra Pradesh

In Andhra Pradesh, both white sandalwood as well as red sanders are grown for commercial purposes. The production of red sanders and its commercial utilisation is very restricted. It is sown in Vizag, Kurnool and Anantapur circles of Andhra Pradesh. Area sown in Vizag circle, in 1960 was about 6.07 hec. and in Kurnool circle, it was sown in about 233 hect. during the years 1960-1965. In Anantapur circle during 1960-63, the covered area was about 237 hec. From 1966 to 1970 its area in Kurnool was extended further by 118 hectares while in Anantapur, it was extended by 55 hectares only. From 1971 to 1980 in Kurnool Circle, the area further increased by about 297 hectares and in Anantapur circle, it was about 205 hectares. The details have been shown in Table No. 6.5.

TABLE 6.5  
*Area covered under Red sanders in Andhra Pradesh*

Years	Name of the circle	Area covered (in hectares)
1960	Vizag	6.07
1960-63	Anantapur	237.0
1960-65	Kurnool	233.0
1966-70	Do.	351.0
1966-70	Anantapur	292.0
1971-80	Kurnool	648.0
1971-80	Anantapur	497.0

The production figures for red sanders were not available in the years 1960-64. During 1965 to 1970, (except) 1967, production was 88,225, 353, 415 and 200 tonnes respectively. However, there was no production in 1967. The Production during 1971 was quite high and is stated to be 2015 tonnes while in 1973 and 1974, it was about 1393. tonnes and 1003 tonnes respectively. In 1975 the production of red sanders was only 37 tonnes while there was no production of red sanders in

1972—1976 and 1980. However, the production during 1977, 1978 and 1979, is stated to be 181, 293 and 191 tonnes respectively. A detailed statement is illustrated in Table No. 6.6.

TABLE 6-6

*Production of red sanders in Andhra Pradesh*

Years	Quantity in Tonnes
1965 . . . . .	88.0
1966 . . . . .	225.0
1967 . . . . .	353.0
1968 . . . . .	N.A.
1969 . . . . .	415.0
1970 . . . . .	200.0
1971 . . . . .	2015.0
1972 . . . . .	N.A.
1973 . . . . .	1393.0
1974 . . . . .	1003.0
1975 . . . . .	37.0
1976 . . . . .	Nil
1977 . . . . .	181.0
1978 . . . . .	293.0
1979 . . . . .	191.0
1980 . . . . .	Nil

Red sanders (*Pterocarpus santalum*) is a heavy dark red heartwood. This is used as a dye and also for making popular musical instruments such as 'Shamisen' in Japan, which fetches a fabulous price of US \$ 200 per set. India is exporting red sanders' wood (unfinished product) to international markets although India has skilled artisans and reputed craftsmanship to prepare such instruments.



*Plate No. 12*

*Sandal wood tree cutting into billets*



## 7. PREPARATION, ASSEMBLING AND DISTRIBUTION

### 7.1 Preparation

Sandal tree is unique in its character and importance. It is well-known all over the country for its commercial value and is treated separately from other forest produce. The method of extraction of sandal tree also varies from State to State. In most states, its extraction is done by arranged labourers. Karnataka is the only exception where it is extracted through a Government agency. Although all the major states have laid down certain norms for the extraction of trees, but they differ from state to state. Countries like Western Australia have also fixed norms for the extraction of trees, where usually the trees of *Santalum spicatum* when attain a size of what is known as the bear bottle size are extracted. The big trees having diameter of 25 to 30 cms are stated to be rare in this country. The age of such trees would be more than 100 years. In our country, the norms and practices followed in major states for extraction and extraction of sandalwood are discussed below :—

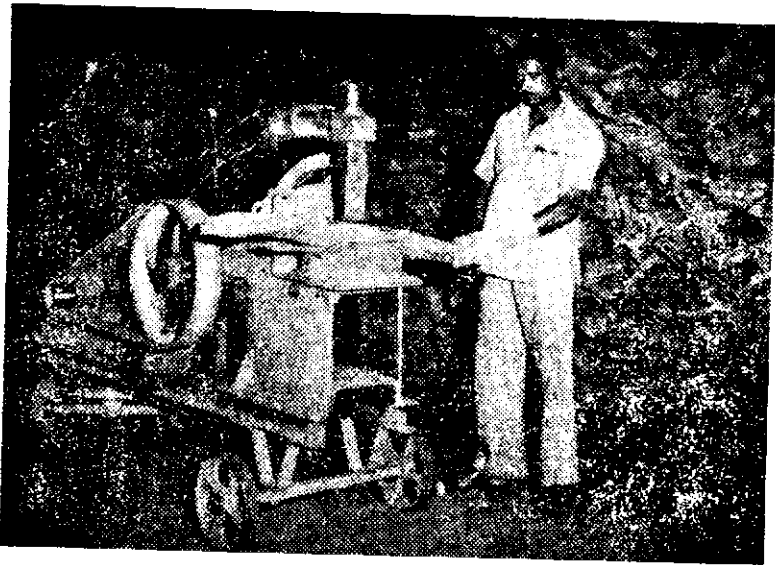
#### 7.1.1 Tamil Nadu

In Tamil Nadu State, some working plans have been devised according to which a minimum girth limit for extraction of sandal tree has been fixed. But it differs from district to district. In Coimbatore, the limit has been fixed at 32" girth and in Salem at 36" girth at about 4.5' height. In these areas, the forests having sandal trees are divided into several coupes each coupe having 2500 to 4500 hectares under the charge of a Forest Range Officer. Coupes are visited by a Range Officer at an interval of three years for marking the trees to be felled. Each tree in the coupe is extracted in serial order. All 'trees' stems and roots are uprooted by digging round them deep enough and then cutting the bigger roots so that the tree falls by its own leverage. No root that contains heartwood of more than the size of a half rupee coin is allowed to be left in the ground. After the tree is uprooted, the pit is marked with the number given to the tree for checking. All sapwood trees (spike-diseased ones etc. which do not contain heartwood) are uprooted and preserved separately in the forest depot.

Rough cleaning of the wood is done in the forest itself. After uprooting the tree, the branches that do not contain heartwood are lopped off. There is no need to saw off the root or branches



*Plate No. 13*  
*Dressing of sandal wood*



*Plate No. 14 (a) Mechanical Splitting of sandal wood*



*Plate No. 14(b) Chipping of sandal wood*

containing heartwood unless the tree is too large to be transported to the forest depot in a single piece. Otherwise, the roots are sawn off at the crown so as not to include any portion of the stem. If necessary the branches of the stem are also sawn off. Immediately after the tree is sawn off, the cut ends are hammer marked in order to prevent theft. The number of trees as well as the number of the roots, stems and branches with its distinguishing letter are marked on each and every piece. The trunk, branches and roots are then rough cleaned suitably so that there will be a uniform thin layer of sapwood covering the scented wood. The stem when cut, is made into pieces. Since now-a-days skilled labourers and storage godowns are available in the auction depot itself, normally all operations of cleaning are done at the Government sales depots. The uncleaned tree is brought from forest depot through lorry to sales depot. The actual cutting is done by contractors. The felled sandal trees are transported to warehouses. Forest guards keep a constant watch against any theft. Here the roots, trunk, branches are sawn off, bark removed, cut into pieces of 1 to 1.2 m. length. In the final preparation, the thin layer of sapwood is then carefully removed. If any heartwood chips are obtained in the process, they are collected and stored separately. The mud and other impurities found in the hollows of the pieces are removed completely. The yield of the final cleaned wood of the lot is then classified under various classes and the number of pieces are as well as the total weight of each of the pieces, known as billets and root classes are taken and recorded at the final cleaning depot. Sapwood chips are collected and stored separately. The reduction of weight in the final cleaning process is to be justified as driage, mud and other impurities removed. If this is more than usual, the losses are properly accounted for. The dressed wood is sorted out and stored according to the classification, the details of which are given in Annexure-IV.

However, it has come to notice that the good old system of enumeration of dead trees and checking by a gazetted officer is not strictly followed now-a-days. It is probably due to the shortage of officers for this purpose and large number of trees and areas to be covered. Another fact noticed is that the extraction of trees in the State is based on the contract system at a fixed rate per tree. This rate is said to be inadequate with the result that the contractor usually extracts the trees which are conveniently available within the easy reach. In the interior of the forest, the dead trees remaining for a pretty long time in the forest in a decayed condition and even with parts of the heartwood appear to be common in Tamil Nadu. Many trees got burnt and stolen. The staff employed for extraction do not appear to give proper attention for the extraction of the roots.

As a result of this, a lot of valuable wood is left in the forest soil causing a substantial loss.

The cost of extraction of sandalwood is stated to be about Rs. 650 to Rs. 700 per tonne which include transportation, cleaning, final weighing before storage. This cost is borne by the State Government.

### 7.1.2 Karnataka

In this State also a prescribed working plan is in vogue for the extraction of sandal trees. Accordingly, the forest officials mark the trees to be cut and extracted. Only dead, matured and the trees showing signs of death or spike disease are allowed to be cut by forest officials in the respective divisions of the State. After taking into account the number of trees to be extracted, respective divisional officer invites tenders for remunerative extraction and transportation to the respective Kotys. Usually the lowest quotation is accepted. These extracted trees are transported to the Kotys (stores) namely Mysore, Kushalnagar, Hassan, Tarikera, Shimoga and Dharwar which are situated in Mysore State in the different forest regions. In these Kotys, the wood obtained from private as well as Government sandal estate is stored. Here again, the accounts of trees etc. are made and tenders are further invited for the preparation of good wood. In these depots the trunks, branches, etc. are cut into pieces, and further dressing as well as classification of rough wood received from divisions is done. The sapwood is removed by skilled labourers to see that no wastages of heartwood occur while chipping with the axe. The different parts are separated according to the classifications mentioned in Annexure-IV and are stored in the godowns for their use.

Often, the expenses of extraction varies from place to place depending upon the tenders quoted for it. In some places, the expenses are about Rs. 400 to Rs. 500 per tonne and in other cases it is about Rs. 600 per tonne.

### 7.1.3 Andhra Pradesh

In Andhra Pradesh, the sandal is grown on private lands as well as in Government forests but cutting/extraction of sandal trees is regulated by the Government agencies. In respect of sandal trees on private lands, the Revenue Authorities demand the claimant to establish the bonafides of ownership of that particular tree. On the basis of these bonafides, the owner of the tree(s) is required to apply to the district forest office for inspection and issue of cutting orders. On receipt of orders, the

tree(s) are extracted and brought to a place specified by the private owner (approved depot). After bringing the tree in the said premises, the private owner of the trees again applies to obtain permission in writing for a rough cleaning of the trees. When rough cleaning is done, he seeks orders for final cleaning from the concerned district forest office. The district forest official on the request of the private owner of the sandal tree inspects the tree so cut and issue final cleaning orders subject to his satisfaction. This is done to prevent mixing of unaccounted or inferior wood obtained from other sources. In the final cleaning, the entire sapwood portion of a tree is removed. Heartwood is retained and cut into convenient sizes but not exceeding one meter in length. The wood thus obtained is sorted out, packed and sealed in gunny bags in the presence of the District Forest Officer or a person authorised by him.

The sandal wood trees in reserve forests are maintained by the State Government *i.e.* Forest Department. All exploitations of sandalwood is carried out by the Forest Deptt. according to the following plans :—

- (1) All dead sandalwood trees occurring in one coupe of the year will be extracted.
- (2) All green sandal trees of above 45 cms girth at about 4.5 ft. over bark occurring in the coupe of the year in general are extracted.
- (3) All dead and green sandal trees of above 45 cms girth at about 4.5 ft. over bark existing in the unreserved adjoining of the annual coupe of the year are also extracted.

This extraction plan was devised to control the depleting reserves of sandal trees in the State. In Chittoor district, the felling cycle was drawn long enough to allow the growth of sandal trees to the exploitable sizes cycle after cycle. Since the growth of sandal in these tracts is usually slow (annual girth increment being about 0.75 cm.) a felling cycle of 9 years was decided. Hence the sandal trees having a girth of 45 cms and above are only exploited. At the end of 5 years, a decision is taken by the Territorial Conservator of Forests as to whether the series of trees should be worked out or not. The series is known as Mandanapalle series. On the basis of this, the exploitations of sandal wood is carried out by the department. The mature trees are cut as per the orders of the Forest Department. After cleaning, dressing and cutting into proper sizes, it is classified and packed in gunny bags under seal and sent to Central depots.

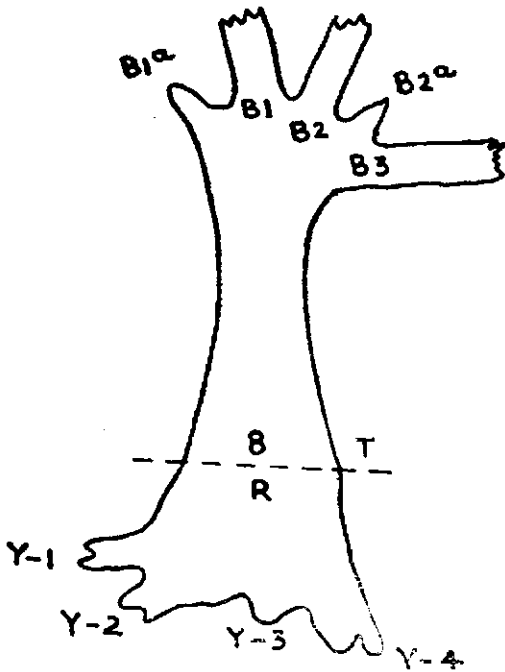


DIAGRAM SHOWING THE METHOD OF MARKING  
THE EXTRACTED SANDALWOOD TREE.

### 7.1.4 Kerala

In Kerala, the sandal is grown in the estates of private individuals. To extract a mature tree, the owner has to remit Rs. 25 per tree to the Forest Department which makes arrangements to cut the tree and stock the wood in the godown.

### 7.1.5 Orissa

In Orissa as per the rules, only the Forest Authorities are authorised to extract and assemble the sandal trees from forest. In this State no classification of wood is done as prevalent in the States of Tamilnadu and Andhra Pradesh. However, trunks and other portions of sandalwood are kept in separate lots.

## 7.2 Assembling

Some details about the assembling of sandalwood have been covered in discussion in the extraction and preparation of wood. The sandal trees are assembled from the forest through trucks or lorries after doing rough cleaning. When the trees are brought to the forest depot, every piece of sound cleaned wood is weighed and further particulars regarding name of the range, felling series and number of the coupe are marked in code on each and every piece and suitable entries made in the registers. The wood extracted in the forest is sent for final cleaning and to the sales depot under the supervision of a responsible escort. The trees at the time of delivery at the final cleaning depot are reconstructed from their pieces to check, if any parts of the tree are missing and list of such discrepancies are recorded by the depot keepers.

After reconstruction of the tree which is not yet fully cut into the required number of pieces, is taken up for further cutting. The figures given in the margin will illustrate how numbering of roots, branches and billets is done after full cutting. In this diagram, the tree number is 8, R represents the main root; Y1 Y2, Y3, Y4, represent side roots and T represents the trunk. When the trunk is cut into billets, the billets are numbered T1, T2, T3, etc. (Billet is a piece of wood, 3 feet in length) either from the trunk or from the branch. Short billet is a piece of the stem or branch wood less than 3 feet long. B1 B2, B3, represent main branches. If B1, the main branch is big enough to be made into billets, the pieces will be numbered B1(1), B1(2), B1(3) and so on in addition to the distinct letters to show the name of the working circle and code number of the coupe etc.



## 7.3 Distribution and Sales System

### 7.3.1 Tamil Nadu ¶

In Tamilnadu, the classified wood so assembled is auctioned twice in a year *i.e.* July and December at Tirupattur, Satyamangalam and Salem (from 1978 onwards). Just a month before auction, scheduled dates are fixed, sale notices showing classwise quantity of cleaned wood, proposed to be auctioned, terms and conditions for bidding etc. are sent to all registered dealers by the District Forest Offices of the concerned divisions. According to these terms and conditions, the bidders are supposed to have valid registered licence for sandalwood and are required to deposit an earnest money of Rs. 10,000 in each centre before taking part in the auction. The successful bidder is asked to deposit 20 per cent of the value of the wood or a bank guarantee for the value immediately. The balance money is however, required to be paid within 90 days either in one or two instalments after the auctions are confirmed before taking delivery of the wood. The confirmation is done by the State Govt. at the Minister's level. On failure to take delivery within the stipulated period by the respective bidders, they are liable to pay godown charges and interest on the total cost of wood which add up to the total cost. Usually 95 per cent of the assembled wood is sold. Sapwood is sold separately. The successful bidder has also to pay all other charges like weighing, stitching in the gunny bags and labour charges etc. before transporting the wood to his destination. The quantities of sandal wood released for auction during 1971-72 to 1980-81 are given in the table:

TABLE 7.1

*Quantity of Sandalwood auctioned (in tonnes) in Tamil Nadu*

Year	Tirupattur	Satya- mangalam	Salem	Total (*)
1970-71	1010	450	—	1460
1971-72	985	470	—	1455
1972-73	950	440	—	1390
1973-74	1000	370	—	1370
1974-75	807	300	—	1107
1975-76	885	300	—	1185
1976-77	1050	400	—	1450
1977-78	1084.5	400	—	1484.5
1978-79	618.0	208	118.750	944.75
1979-80	582.75	229.0	354.00	1165.750
1980-81	792.00	287.0	468.00	1547.00

\* Quantity released for auction.

Some quantity of sandalwood *i.e.* 300 to 500 kgs. is given to temples for religious rites and about 1000 kgs. of sandalwood to skilled artisans for carving art pieces. About 2 to 5 per cent of the wood purchased in auction by the distiller, is exported as billets or chips. The rest is used in distillation for the extraction of sandalwood oil. Sometimes, the billet classes are made into some pieces of 3", 6" and 9" and sold to the public. This practice is however, not followed by the private distillers. In case of exports, the exporters further clean the wood, polish and transport by lorries to the ports generally through agents. Private land owners of sandalwood, after obtaining the valid permit generally sell the wood to the exporters/distillers through negotiations which is sold at lower rate than the auction prices at the Government centres.

### 7.3.2 Karnataka

In Karnataka, there is no auction of sandalwood. Only white chips obtained in the preparation of heartwood are disposed off in auction sales to *Agarbatti* manufacturers and entire heartwood obtained is supplied to the State owned distilleries. The rates of sandal wood are fixed by the Forest Deptt. on the basis of average rate obtained in half yearly auctions in Tamilnadu. The disposal of the wood is done as per the instructions of the department. Some quantity of wood is however, made available to public for domestic and religious purposes through M/s Mysore Sales International, the sole selling agents under the Karnataka Government. Some good variety of wood (Ghatbadla and Gotta Wood) is supplied to carvers of handicrafts department and also to private consumers. In case of wood obtained from private owners of sandal tree (The owner of sandal tree has to abide by the rates stipulated in the relevant forest act as given in the Annexure XI for ready reference.) 50 per cent of the value of the class wood is given to these owners as a sort of incentive for rearing and protection. Under the contract nearly 1100 tonnes of heartwood is supposed to be supplied to Govt. sandalwood factories. 10 per cent of the wood is made available for handicrafts. 25 per cent of the value of class wood round-about Rs. 68 per kg. is recovered from carvers and the rest is reimbursed by the industries department in order to encourage the sculpturist and artisans. Some good wood is given to temples through the Endowment Commissioner for religious purposes. Irrespective of the sale, the value of the good wood is calculated and in addition, 4 per cent sales tax, 8 per cent forest development tax and 1 per cent surcharge on sales are recovered on every sale.

Since sandal trade and industry is a state monopoly, the question of arrival into market and despatches to other centres for sales does not arise. Inter-state movement of sandalwood is not allowed. However, some clandestine operations of smuggling of sandalwood appears to persist.

### 7.3.3 Andhra Pradesh

In Andhra Pradesh, auctions are conducted by the Department in every six months and the highest bidder gets the lot. Sales authorities are under the control of Forest Deptt. Private persons also handle the sandalwood through direct sales, based on mutual negotiations after obtaining permission from the Govt. (See Annexure No. XII for the relevant Rules regulating the possession of Sandalwood in the state). In the district of Chittoor, the handling of sandalwood is regulated by the Govt. As per the transit rules at Annexure No. XIII. Unauthorised movement of sandalwood from one place to another is a cognisable offence under the rules in force in the Chittoor district. The assembly and distribution by different agencies are given in table 7.2 as under :—

TABLE 7.2

Agencies	Assembling and percentage of total arrivals	Distribution as percentage of total arrivals
(1) (a) Grower . . . . .	15	10
(b) Forest Officer . . . . .	60	70
(2) Village merchant . . . . .	10	10
(3) Wholesalers . . . . .	—	—
(4) Commission agents . . . . .	10	—
(5) Exporter . . . . .	—	—
(6) Co-operatives . . . . .	—	—
(7) Others . . . . .	5	10
TOTAL . . . . .	100	100

In this district, the movement of private wood is also controlled by Government. Hence the buyers who purchased the wood are allowed to transport goods to the factory under the Way Bill issued by the forest officials. Only then the produce reaches the destination for its consumption. The year-wise quantities of sandalwood auctioned in Chittoor district during 1969-70 to 1979-80 are given in Annexure-V.

### 7.3.4 Kerala

In Kerala, the production of sandal is not under any planned cultivation. Private land as well as forest departments are the source of sandalwood. The sale is carried out by the Government Forest Department periodically for the wood procured. The owner of the tree(s) grown in private land, is paid 70 per cent of the sale proceeds after auction. The stock of wood, if any, is retained in the godown of Forest Deptt. until the auction is conducted. But these auctions are not regular. The major auction centre is at Marayoor and the yearwise quantities auctioned at this centre during 1961 to 1975 are given in Annexure. V. The last auction was conducted in the year 1975. Most of the wood thus purchased was utilised for the recovery of sandalwood oil and a part of it in different forms, was exported to different countries.

### 7.3.5 Orissa

In this State also the sale procedure is similar to other States. The Sandalwood is put for auction once in a year and the forest officers prescribe the minimum floor price per kg. of each lot for bidding purposes. If the highest bid does not reach, the minimum price fixed by the Government (forest authorities) the same is withdrawn and put to auction second time. Otherwise, the highest bidder is allowed to lift the consignment. So far only the Jeypore Centre has auctioned some quantity of wood in the last few years. During 1980-81, the sandalwood was auctioned twice and the quantities were 60.32 qtls. and 1.39 qtls. respectively. The entire wood was purchased by private traders. Most of the quantity produced in the State was purchased by distillers of the other states as there was no distilling unit in the State and the quantity produced in the State was also not much.

### 7.3.6 Maharashtra

In this State, the sandalwood is sold through auction only. The prominent sale centre is Ajra in Kolhapur district. The quantities of sandalwood auctioned for the years 1974-75 to 1977-78 are shown in table No. 7.3 as under :

TABLE 7.3

Year	Heartwood sold in Kg.
1974-75	34,068
1975-76	29,155
1976-77	1,480
1977-78	17,280

The traders of different States take part in the auction and mostly Bombay distillers purchase major quantity of sandalwood from this centre for the preparation of sandalwood oil. Scattered plantations and rare auctions has also come to notice in Aurangabad areas. In this State, the production is not very significant and only a small quantity of wood is available.

Only a few states follow rigid rules of movement of sandalwood. Other States are not so strict in this regard and hence handling of sandalwood is as free as any other wood. Therefore, there is every scope for smuggling of the sandalwood within or outside the states depending upon the demand. In respect of private sales in some States, there is every possibility of adding unauthorised sandalwood with the produce, for which permission is obtained. Inflow of sandalwood is not being arrested especially for the movements from other states to the states where no restrictions or rigid rules are followed. This encourages the smuggling activities in sandalwood. The smuggled wood thus poses competition with the Government produce. It is also reported that large scale smuggling of sandalwood often takes place from the various forest divisions. The private sandalwood producers not only afford protection to such smuggling but also create price imbalance.

#### 7.4 Market charges

The market charges for sandalwood varies from State to State and market to market. In Tamil Nadu State, the State Government bear the expenses of Rs. 650 per tonne for cleaning of wood and its transportation to godown. The wood meant for export is subjected to polishing and cleaning for which the exporter has to pay an extra amount of Rs. 200 per tonne. Besides this, he has also to incur Rs. 100 as licence fee per year and Rs. 50 as postage and telegram charges. In case the exporter is interested in sample, he can have a sample of 100 gms. wood at the cost of Rs. 5. The buyer has also to pay *ad valorem* @ 5% as sales tax on the purchase and 4% as Central sales tax.

In Andhra Pradesh, the trees from private land as well as from forest are collected for its sale as per the legislation laid down in the State. For the trees gathered from the private land, the owner has to pay Rs. 50 per tonne for cleaning of wood, besides the other charges as prescribed by the Government. The weighment charges of Rs. 50 per tonne is to be paid by the buyer. In case of wood purchased from the private patta land, the buyer as well as the seller have to pay a commission @ 2.5%

TABLE 7-4

## MARKET CHARGES

State/Items	Andhra Pradesh	Tamil Nadu	Uttar Pradesh	Bihar	West Bengal	Delhi	Karnataka	Orissa
1	2	3	4	5	6	7	8	9
1. Cleaning of wood	Rs. 50						—	
2. Transportation charges upto Godown		Rs. 650 (S)					—	
3. Rough cleaning of wood							—	
4. Polishing, Cleaning & Labour Charges		Rs. 200						
5. Weighment charges	Rs. 50 per tonne	—	Rs. 50 per tonne		Rs. 25 per tonne		Rs. 30 per tonne	
6. Sales Tax	(a) 4% on the wood to be used in the State	@ 5% + CST 4%	13% in general	9% ST + 4% CST		5% ST	4%	
	(b) 8% to be sold outside of State		4% on 'K' Form					
	(c) 4% against 'C' form							
	(d) 5.32% in Hyderabad							
7. Sur Charge		—	—	—	—	—	1%	

8. Commission charges	. 2.5% from each ('B' & 'S')	--		
9. Brokerage	. Rs. 100 each ( 'B' & 'S' )	--		
10. Octroi	. . . . .	--	Rs. 50 per tonne	3%
11. Licence Fee	. . . . .	--	Rs. 100 per year	--
12. Postage Telegram charges	. . . . .	Rs. 5	Rs. 50	
13. Sample cost 100 gms.	. . . . .	Rs. 3	Rs. 5	
14. Forest Devc. Tax	. . . . .			8%

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N.B.—(B) Buyer has to pay above taxes. The payment a seller makes is marked 'S'.

alongwith the brokerage of Rs. 100 . The postage and telegram charges are also collected from the buyer but the amount charged is only Rs. 5. The buyer can also have a sample of 100 grams of wood at the cost of Rs. 3. The Sales Tax in this State vary at various counts *i.e.* the wood used in the State itself is charged @4% while the sandalwood meant for export to other State is charged @ of 8%. However, the Sales Tax is only 4% aganist 'C' form. In Hyderabad, the sales tax is charged @5.32%, the reason for this could not be known.

In Karnataka, most of the sandalwood is utilised by the State distilleries. The little quantity sold for various purposes is charged @Rs.30 per tonne as weighment charges. Other taxes leviabale on sandalwood are forest development tax @8 per cent, Sales Tax @4 per cent and a surcharge thereon @ 1 per cent.

In Bihar, Sales Tax is charged @9% and Central Sales Tax @4% only.

In Orissa and Delhi, the Sales Tax is charged @10% and 5% respectively, while in Uttar Pradesh, the weighment charges are Rs. 50 per tonne and a similar amount is charged as octroi. Besides this, the Sales Tax is also charged @13% in general and 4% on 'K' form.

In West Bengal, weighment charges are Rs. 25 per tonne and the octroi charges are @3% *ad valorem*.

## 7.5 Market Finance

Mostly, the finance are arranged by the traders through the nationalised banks by hypothecating their wood or sandalwood oil or other properties depending upon the economic situations. Sometimes the traders avail the financial facilities aganist the Letter of Credit of their orders likely to be executed by them. It is learnt that the rate of interest charged by different banks differ from bank to bank depending upon the hypothecated goods.



## 8. UTILISATION

Sandal tree (*Santalum album* Linn) is mainly exploited for its scented heartwood which gives the sandalwood oil. The rich oil content and its fragrance attracted the *homo sapiens* for the extraction of oil. It is exploited for various purposes since when it has come to their knowledge. The tree has got omni-value as its leaves are used extensively as fodder in certain areas like Andhra Pradesh. The leaves are also used as green manure for paddy. However, the nutritive value of leaves as fodder and potential manure are being investigated in Sandal Research Centre, Bangalore.

The roots and heartwood present in the stems and branches are exploited for the extraction of sandal oil since they are the sources of sandalwood oil. Bark and sapwood were destroyed in the past as unutilised bye-products in the preparation of heartwood. These have also now been proved to be of enormous value and the various possible uses have been found out by different investigators which have been described in the research part of this report. Bark of sandal trees is also used by local villagers in Karnataka State as a colouring agent for betelnut, also for colouring the walls after white wash. The wood and oil both are used in internal consumption as well as for export purposes.

### 8.1 Internal consumption

The sandalwood is not attacked by white-ants etc. and hence it is very popular for carving and inlay ivory work. Such work is generally done on cottage industry scale and is flourishing in several parts of Karnataka, Tamil Nadu and in some other parts. The class of people working on sandalwood carvings are known as "Gudigars" (in Karnataka State) and are famous from ancient times. The skill of carvings in this class of people is handed down from one generation to the other. This craft is encouraged by the Govt. of Karnataka. There are many cooperative societies in Sagar and Sorali in Shimoga districts of the State where the sandalwood handicraft materials are being manufactured. In Delhi also, some people use sandalwood for handicraft purposes. The skilled workers are also found in Thanjavoor, Trichirapalli, and Madurai Districts of Tamil Nadu. It is reported that in Nagina (District Bijnor) U.P., sandalwood carving industry was quite prominent about 15 years ago, which is nearly extinct due to non-availability and prohibitive prices of sandalwood which is beyond the purchasing capacity of these

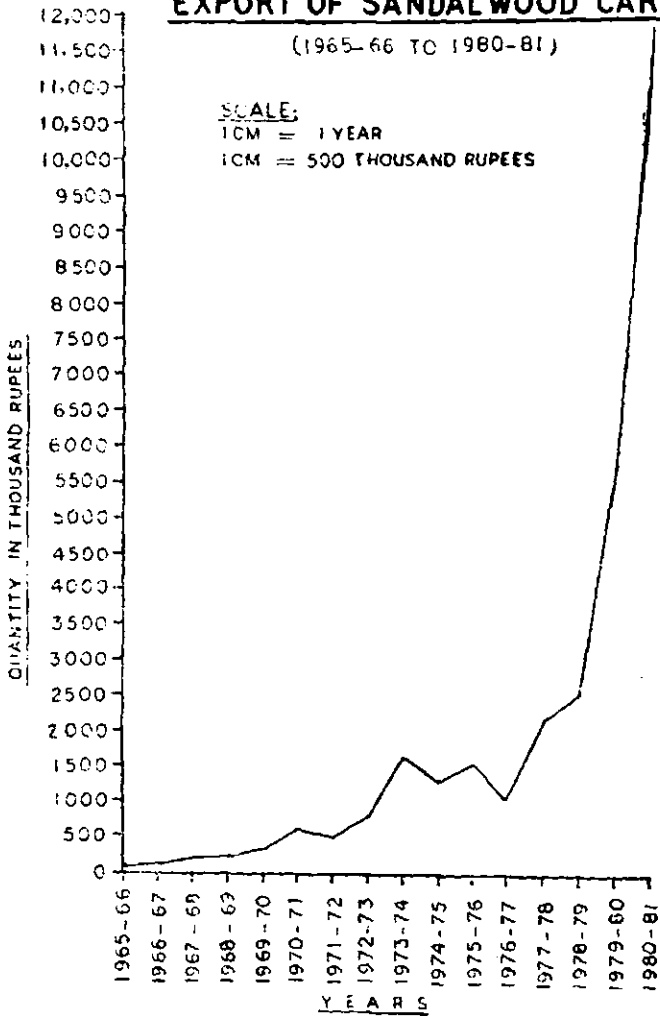
**EXPORT OF SANDALWOOD CARVINGS**

(1965-66 TO 1980-81)

SCALE:

1CM = 1 YEAR

1CM = 500 THOUSAND RUPEES



artisans. But in Karnataka, the Government has taken a lot of interest for the improvement of handicraft industries. They are supplying wood to the carvers at about 25 per cent cost of the original prices and the rest is borne by the department of industries so as to encourage and keep alive the skill and craft and also to earn the foreign exchange for the country. The carvings fetch handsome prices. The sandalwood articles like beautiful images of Gods and Goddesses, small boxes, combs, cabinet panels, walking sticks, Jewellery cases, book marks, picture frames, table-lamps, Calendars, paper-Cutters, animal replicas, etc. are very common and famous. Other items such as pen-holders, trays, card cases chess board, chessmen, caromcoins, flower vases, etc. are also carved and made out of sandalwood. The carvings and art pieces made of sandalwood have won universal acclamation. The waste obtained after carving of articles is generally used for manufacturing incense *agarbattis* or joss sticks.

Sandalwood is used for religious purposes specially by Hindus and Parsis. The Hindus use it in funeral pyres. Sandal is also used for Ayurvedic medicines. As it has got cooling effect, it is common amongst priests to apply tilak on the foreheads. Its fine powder has got place in perfumery, cosmetic industries and is stated to possess quality of keeping skin moist and enhance the skins, beauty. Some quantity of wood is utilised in temples also for making sandal paste which is used on the diety of Gods/Goddesses and is given as *Prasadam* to devotees which is supposed to cure many diseases.

On an average, 5 to 10 per cent of the total production of sandalwood is utilised for the above stated purposes and about 10 to 20 per cent of the sandalwood is exported in different forms like dust, chips, etc. to different countries either on special requests or on the basis of general demand from them. The rest of the sandalwood is utilised for extraction of sandalwood oil in various States by different distilling units.

The value-wise exports of carvings to different countries for the years from 1965-66 to 1980-81 are given in Annexure VI. From this Annexure, it can be seen that India could export sandalwood carvings of worth Rs. 62.4 thousands in the year 1965-66. A very significant increase was noticed during the year 1973-74 when the carvings' export was worth Rs. 16.77 lakhs. This further increased to Rs. 25.16 lakhs during the year 1978-79. Thus the exports have gone up by over 40 times during these fifteen years. The figures from 1970-71 onwards include the carvings from other precious wood also. Graph no. 4 gives the trend of export of sandalwood carvings from India.

## 8.2 Export

Sandalwood is referred to be in trade as the East Indian sandalwood probably because the East Indian countries exported the wood to Europe to meet their requirements. However, the exports market for the Indian products was tapped only during the last decade of 19th century. Most of the sandalwood produced in India used to be exported before World war I. The main buyer was Germany where the wood used to be distilled and the oil was sent to different countries for medicinal and perfumery purposes. The advent of Ist World War blocked the entire prospects of overseas export of sandalwood, with the result that the then Govt. of Mysore established immediately a factory for extraction of sandalwood oil in 1916 at Bangalore which was later shifted to Mysore in 1917.

Since the Indian sandalwood was of supreme quality and was most preferable when compared to so called sandalwood from other countries, it has been and is commanding the world demand and hence the prices of sandalwood of other countries are often influenced by the prices fetched by Indian sandalwood. The Indian sandalwood is preferred for carvings and insense perfumes in these importing countries.

Usually sound, strong, healthy, long pieces of higher girth and cleaned or first, second and third class billets Ghatbadla, Ghotila Bagarded and even Jajpokal (special) class without cracks, holes and weighing more or less 60 kgs are preferred for exports as billet classes.

The Government has reimposed a ban from November, 1977 which was lifted in 1974 on export of sandalwood in the billet form. But the export of chips, dust (powder) and spent wood powder is allowed. No sandalwood has been exported from the Government factories in Karnataka which in the past, used to export sandalwood to a concern of U.S.A. The export of sandalwood during the year 1963-64 to 1980-81 is given in Table No. 8.1 below:-

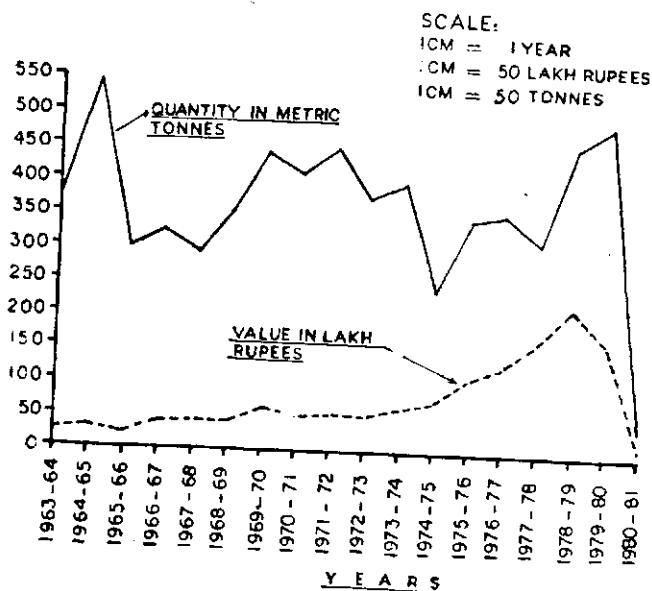
TABLE 8.1

Years	Quantity	Value
	(In tonnes)	(In rupees)
1963-74	373	24,74,703
1964-65	544	29,37,963
1965-66	297	23,61,971
1966-67	324	36,92,321

GRAPH NO. 5

**EXPORT OF SANDALWOOD FROM INDIA**

(1963-64 TO 1980-81)



Year	Quantity	Value
1967-68	294	36,66,67
1968-69	354	44,85,818
1969-70	440	60,82,629
1970-71	417	55,06,479
1971-72	451	57,02,464
1972-73	381	51,40,569
1973-74	399	70,17,316
1974-75	244	77,24,129
1975-76	349	114,80,555
1976-77	354	130,46,940
1977-78	318	166,65,670
1978-79	463	220,77,772
1979-80	495	169,25,498
1980-81	44	11,43,808*

\*Tentative figures.

From the above table, it will be seen that the export of sandal wood during the year 1963-64 was 373 tonnes which rose to 544 tonnes in the next year. This was the highest quantity of export during the entire seventeen years' period from 1963-74 to 1979-80. During 1965-77 it came down to 297 tonnes i. e. about half of the previous year. Not much variations were seen during the next three years. In the year 1969-70, the exports of sandalwood went upto 440 tonnes which remained nearly at the same level during the next few years. There was a fall in export during 1972-73 to the extent of 381 tonnes which after gaining to 399 tonnes in the next year dropped to the lowest ebb of 244 tonnes during 1974-75. This was the lowest quantity exported during the entire period of 17 years i.e. 1963-64 to 1979-80. On lifting of ban on export of sandalwood in 1974, the exports rose by 105 tonnes thus raising to 349 tonnes during 1975-76 and further to 354 tonnes during 1976-77. It dipped to 318 tonnes during 1977-78, perhaps due to imposition of ban on export of sandalwood in 1977.

However, a paradoxical position was observed during 1978-79 when the exports of sandalwood again rose to 463 tonnes and further to 495 tonnes during 1979-80, inspite of the ban on exports of sandalwood. Graph No. 5 depicts the trend of export of sandal wood both by quantity and value for the period from 1963 to 1981.

It would be seen from Annexure VII that Japan was at the top in the list of countries to whom the sandalwood was exported during these two years.

As has been said earlier, the export of chips, dust and spent dust is allowed. Probably this is meant for the spent dust and chips from lowest class (sapwood) which does not contain any sandalwood oil. Export of chips and dust during the years 1965-66 to 1980-81 are given in Annexure VIII. the average export price per tonne of sandalwood powder and chips can be seen from table no. 8.2. as given below :

TABLE 8.2

*Price of sandalwood chips and powders*

Year	cost per tonne
1972-73	1,416
1973-74	3,986
1974-75	3,643
1975-76	5,378
1976-77	9,241
1977-78	7,703
1978-79	11,173
1979-80	17,453
1980-81	22,985

The abrupt increase in export prices during 1978-79 and 1979-80 is an indicative of good demand in foreign countries viz. U.S.A. Brazil, Rhodesia, Indonesia, Hongkong/Singapore and in Arabian countries for manufacturing perfumes and incense sticks. However, it is imperative to check that good quality wood is not converted in the form of chips and powder. The export of raw materials to foreign countries should not be encouraged, in order to maintain the good name of East Indian sandalwood oil and not to allow to inhibit the growth of indigenous industries. To encourage the indigenous industries, some incentive should be given to the manufacturers to export finished products.

### 8.3 Import of so-called Sandalwood

There has been no import of the so-called sandalwood produced in other countries, into India in the recent years. Such woods if imported may be misused, thereby bringing a bad name to the Indian oil of sandalwood. It would, therefore, be in the national interest to maintain the restriction.

### 8.4 Agarbatti Industry

The sapwood of sandal tree and the spent dust obtained after extraction of sandalwood oil are widely used for manufacture of

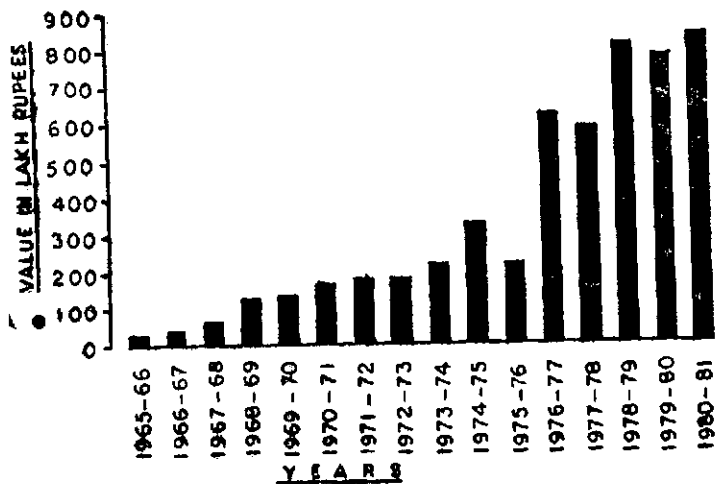
## EXPORT OF AGARBATTIS FROM INDIA

(1965-66 TO 1980-81)

SCALE:

1 CM = 1 YEAR

1 CM = 100 LAKH RUPEES





*Agarbattis* or incense sticks. These are also known as Joss sticks in foreign countries. Thousands of people are employed in this industry which is having a very good export market. These are rightly called, 'Fragrant ambassadors' from India as these are exported to a number of countries. The year-wise value of export of *Agarbattis* is given in Annexure-IX.

The export trend has been quite encouraging. Please see Graph no. 6. But there had been some obstacles faced by the *Agarbatti* Industry. These are imitation of reputed brands and underpricing by some unscrupulous interest, export of raw *agarbattis* which are further processed in foreign countries, ignorance of foreign markets inability to compete with the products from other countries, shoddy packages, improper sizes of sticks, lack of proper fragrance and lack of international business tactics, product adaptation, communications and catering to various types of demand in different markets. These are some of the reasons which require due consideration to up-keep and maintain the engendered encouraging trend of import of *agarbattis*.

## 9. PRICES

Sandalwood is perhaps the most valuable wood and even a chip of sandalwood has some worth of it. At most of the places, the sandalwood is auctioned under the control of the respective State Governments. The most systematic way of auction is followed in Tamil Nadu where auction is held half yearly at three centres namely Tirupattur, Satyamangalam and Salem. The auction at Salem has started only from the year 1978 while at the other two places, it continued from the past. In general, the prices of sandalwood all over the country are said to be governed by the prices realised in the auctions held in Tamil-Nadu.

During the past hundred years, the prices of sandalwood have seen many ups and downs. During 1882-83 to 1887-88, in the erstwhile Mysore state, the sandalwood was sold at the following rates :—

Year	Price (Rs. per ton)
1882-83	328
1883-84	300
1884-85	307
1885-86	329
1886-87	337
1887-88	302

The above prices illustrate that there had not been much variations in prices.

At the commencement of this century, sandalwood fetched a little over Rs. 400 per ton which in the next few years scrambled to Rs. 500. In 1913 the prices shot up to Rs. 1000 per ton which doubled to Rs. 2000/-per ton in the year 1914. This skipping in prices was partly due to spike disease resulting in shortfall in the supply of wood. Thus the price of wood prior to World War II had aggrandized to Rs. 5000 a ton which remained almost stable till 1957-58.

### 9.1 Wholesale Prices

The average wholesale prices prevalent in the country at different places during the years 1975 to 1981 are given below:—

TABLE 9.1

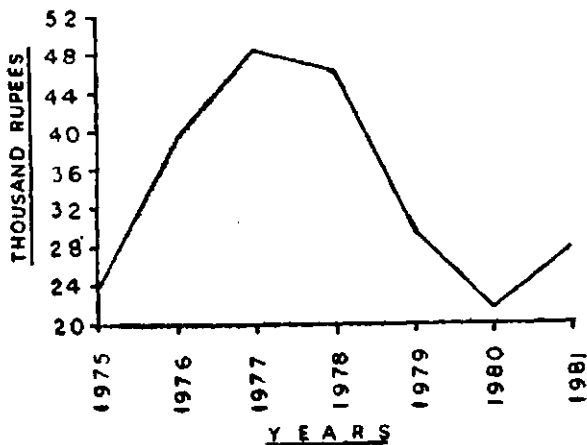
Year	Tamilnadu			Karnataka	A.P.	Maharashtra	Average
	Tirupattur,	Satyamang- lam	Salem	Bangalore	Chittoor	Bombay	
1	2	3	4	5	6	7	8
1975	21105	18970	—	12000	29840	37667	23916
1976	39726	41408	—	13500	44459	58833	39585
1977	47686	48254	—	15750	70053	61500	48649
1978	41592	38374	—	22500	67534	61167	46233
1979	31370	26888	29609	24750	34666	N.A.	29457
1980	20669	19460	20419	27000	21000	N.A.	21710
1981	26420	27892	28455	NA.	N.A.	N.A.	27589

ALL INDIA AVERAGE WHOLESALE  
PRICES OF SANDALWOOD. (1975-1981)

SCALE:

1 CM = 1/2 YEAR

1 CM = 4000 RUPEES



From the above table, the fluctuations noticed during the various years are quite significant. The average wholesale prices of sandalwood were at the peak during the year 1977 when it touched Rs. 48649 a tonne. In the same year, the Government imposed ban on export of sandalwood due to which prices did not go up in the open auction. This has rather caused a slight decrease in the prices. However, traders were of the opinion that Government may lift the ban in the successive years. The prices of sandalwood clinged on to the higher side in the year 1978. But in the subsequent year when they realised that the Government was not going to lift the ban, the buyers did not come forward to purchase the wood which ultimately resulted in the slashing of prices of sandalwood. The average wholesale prices for the year 1979-80 dwindled to Rs. 29457 and 21710 per tonne respectively. Graph No. 7 gives the trend of average wholesale prices of sandalwood in the country for the period 1975—81

### Tamil Nadu

The auctions held in Tamilnadu in the months of July and December of every year is on the basis of different classes of sandalwood. The class-wise auction prices for the State were not readily available. Therefore, the average prices of sandalwood realised in half-yearly auction in Tamilnadu for heartwood and mixed wood for the years 1962 to 1974 are presented below in Table No. 9.2

TABLE 9-2

Average price per tonne of sandalwood realised in the half-yearly auction sale by Tamil Nadu Government

Year	Heartwood			Mixed wood		
	July	December	Average	July	December	Average
1	2	3	4	5	6	7
1962	8,717	6,415	7,566	5,778	4,273	5,026
1963	6,659	6,135	6,397	3,893	3,685	3,789
1964	6,838	7,412	7,125	4,272	4,930	4,601
1965	6,458	6,362	6,410	3,718	3,814	3,766
1966	9,094	12,203	10,649	6,460	7,751	7,106
1967	11,793	12,332	12,063	6,818	6,407	6,613
1968	12,000	11,461	11,731	6,185	5,334	5,760
1969	10,857	10,250	10,554	5,248	5,358	5,303
1970	9,830	9,820	9,825	5,130	5,015	5,073
1971	9,702	9,513	9,608	5,010	4,747	4,879
1972	10,958	12,104	11,531	5,364	5,457	5,411
1973	16,280	28,200	22,240	8,668	16,395	12,532
1974	51,657	25,209	38,433	32,288	11,077	21,683

GRAPH No. 8

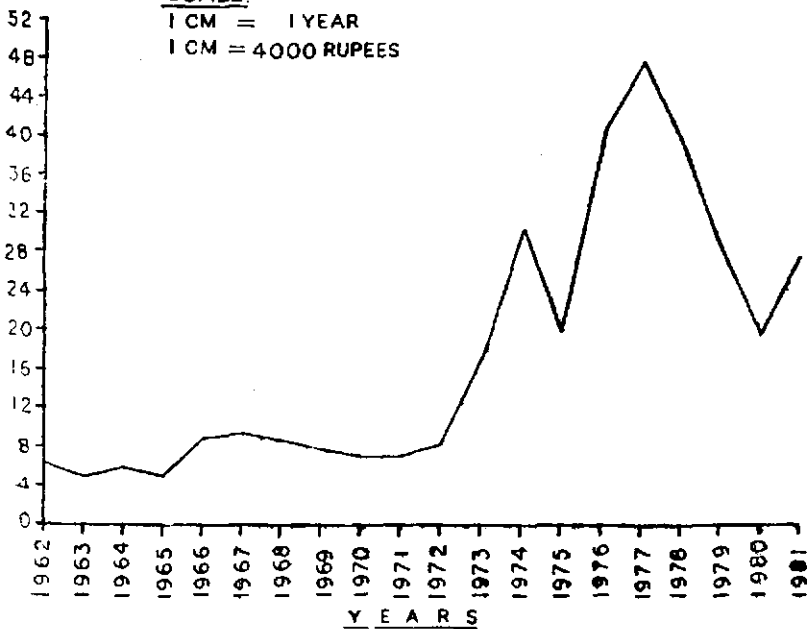
AVERAGE WHOLESALE PRICES IN TAMILNADU

(1962-81)

SCALE:

1 CM = 1 YEAR

1 CM = 4000 RUPEES



The average wholesale prices prevailed at three centres of the sale during July and December auctions for the years 1975 to 1981 are given in table No. 9.3. (Please see Graph No. 8 also.)

TABLE 9.3

*Average wholesale prices of sandalwood in Tamil Nadu Based on the State's auction*

Year	July			Half-yearly average price	December			Half yearly Average price	Annual Average/Tonne
	Tirupattur	Salem	Satya-mangalam		Tirupattur	Salem	Satya-mangalam		
1	2	3	4	5	6	7	8	9	10
1975	19458	—	16989	18223	22751	—	20950	21850	20037
1976	31576	—	31509	31542.5	47876	—	51307	49591	40567
1977	53162	—	54952	54057	42210	—	41555	41882.5	47970
1978	49283	—	42525	45904	33900	—	34223	34061.5	39983
1979	39462	35042	30815	35106	23098	24176	22961	23412	20182
1980	22419	21702	20802	21641	18918	19136	18117	18723	20182
1981	24560	25221	25880	25220	28280	31688	29903	29957	27589

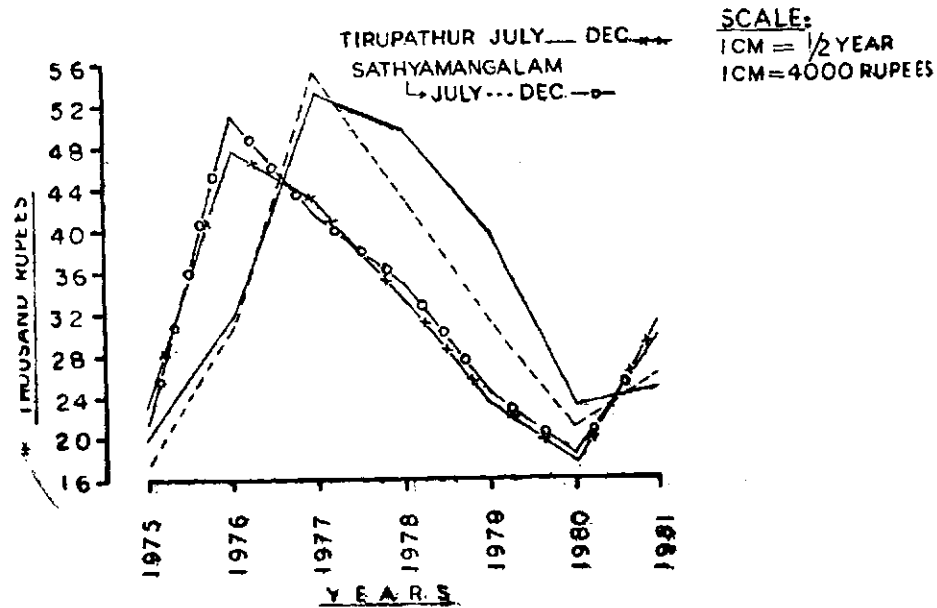


From Table Nos. 9.2 and 9.3, it may be observed that the average annual wholesale prices of wood in the year 1970 were about Rs. 7,449 per tonne which increased to Rs. 17,386 per tonne in 1973 due to the demand. It has stepped up to Rs. 30,058 per tonne in 1974 but deflated to about Rs. 20,000 during 1975. During 1976, the prices began to rise and this accretive trend was also observed in 1977 when the average prices shot up to about Rs. 48,000 per tonne. This was due to spurt in sandalwood oil prices to Rs. 1359 a kg. during the period 1976-77. However, the wholesale prices started declining in 1978 and the trend was observed till 1980 (Rs. 20,182 per tonne). The cause for this decline in prices was mainly due to the ban imposed on the export of sandalwood of billet classes by the Govt. of India. Gradually the average wholesale prices of sandalwood tilted to higher side with the apprehension that the Government of India may either lift the bans soon for enhance the quota of wood *i.e.* 300 tonnes allotted for export in 1978. But when no sign of lifting the ban was observed, its impact was reflected in the auction prices at Tamil Nadu for two successive years since the existing demand was only for distillation class of wood. Consequently, the sandalwood oil prices which were around Rs. 1300 per kg. in August, 1977 also started declining and during 1980 the price came down to about Rs. 710 per Kg. The exporters of wood and the distillers did not want to take risk without knowing the policy of the Government of India on the export of sandalwood since huge cost of wood was involved.

In July, 1981 auction, the average wholesale prices improved to around Rs. 25,200 per tonne because of the demand for oil from perfumery traders for their perfume industry. In December, 1981 auction, the whole sale prices of wood rose further as the delivery of wood of July, 1981 auction, was affected only in October/November, 1981. Most of the traders who could not get wood in July auction were after the wood to have it even at higher prices in the December auction in order to fulfil their earlier commitments. Besides, most of the traders who had taken part in July auction also participated in the December auction with a hope that the Govt. of India may lift the ban on export of heart-wood and billet class of wood. The Other reason for participating in this auction by north-Indian traders, who were already having some stock of wood, perhaps may be that these traders wanted to dispose of their wood for export as chips classes instead of distilling, since export of chips fetches higher margin than by converting it into oil. Although the Government had fixed a floor price of Rs. 800 per kg. for export of oil. The Mysore State Government was selling the oil at Rs. 900 per kg. while

GRAPH No 9

## AVERAGE WHOLESALE PRICES AT TIRUPATHUR AND SATHYAMANGALAM (1975-81)



the private distillers were selling the oil at lower rates between Rs. 825 and Rs. 875 per kg. This also has contributed to increase in the auction prices of sandalwood.

The distillers/traders also purchase 5 to 10 tonnes of wood from private *patta* land owners depending on their needs. It was at rates of Rs. 2000 to Rs. 3000 per tonnes lower than the auction price for that class of wood provided all formalities are fulfilled. Since the prevailing price of sandalwood oil was about Rs. 950 per Kg. and with the supply orders already in hands pending execution, it may not be possible for any of the trader to sell the sandalwood oil at a lower price than Rs. 950 a kg. from the sandalwood procured in the auction of December, 81. As such the price of sandalwood was bound to rise further depending upon the extent of demand.

## 9.2 Class-wise auction

The class-wise and centre-wise average prices of sandalwood in biannual auctions at three centres of Tamilnadu State during the years 1975—1981 are given in Annexure X. It may be seen from this Annexure that the prices of Ghatbadla class of sandalwood which was auctioned at Rs. 35,010 per tonne in July, 1975 at Tirupattur increased to Rs. 86,820 per tonne. In July, 1978 auctions showing an accretion of about 148 per cent. But the prices declined to Rs. 62,721 per tonne in July, 1979 auction which was lower by about 28 per cent. Prices of Bagardad class wood also showed similar upward trend in July, 1978 auction and it touched to Rs. 68,133 per tonne. However in December, 1977 auction, the prices dwindled to Rs. 42,200 per tonne.

The roots 1st class which was auctioned at Rs. 20,103 per tonne at Tirupattur centre in July, 1972 auction also showed a rising trend in July, 1977 auction when it skipped to Rs. 60,337 per tonne by about 200 per cent increase. Thereafter, the prices began to decline till December, 1980 except in July, 1978 when slight gain was noticed. December, 1980 prices fell to the level of July, 1975. The auction prices improved in July, 1981 and further in December, 1981 in which auction prices were higher by about 41 per cent when compared to July, 1975 but these prices were lower by about 53 per cent when compared to July, 1977. Graph No. 9 gives the trend of average wholesale prices prevailing at different auction centres in Tamil Nadu for the period 1975-81.

## Karnataka

In Karnataka State, since the entire sandalwood trade is the State monopoly, no auctions are held for sandalwood.

Practically the entire sandalwood is supplied to the Govt. owned sandalwood oil factories at the rate fixed by the Government in consultation with the Forest Department and the Company Management. These rates are inveterated on the basis of average rates obtained in half-yearly auctions in Tamil Nadu.

The average wholesale prices per tonne of sandalwood for the years 1970-71 to 1980-81 for heartwood and mixed wood in the State were reported as under:—

TABLE 9.4

Years	Heartwood	Mixed wood	Average
1970-71	7500	4500	6000
1971-72	7500	4500	6000
1972-73	8000	4750	6375
1973-74	14000	8000	11000
1974-75	30000	20000	25000
1975-76	14000	10000	12000
1976-77	15000	12000	13500
1977-78	17500	14000	15750
1978-79	25000	20000	22500
1979-80	27500	22000	24750
1980-81	30000	24000	27000

The prices of sandalwood in Karnataka had maintained in general increasing trend except in the year 1974-75 when the prices skipped to Rs. 25,000 per tonne while in the preceding and succeeding years these were Rs. 11,000 and Rs. 12,000 per tonne respectively. But these prices had no significant impact over the general market trend of sandal wood as it is only for the account adjustment and for the evaluation of production of the State.

### Andhra Pradesh

In Andhra Pradesh, most of the wood is bought by the distillers participating in Tamil Nadu auctions. Chittoor district is the important centre for sandalwood from the marketing point of view. The average wholesale prices of sandalwood per tonne for the years 1970-71 to 1980-81 are reported to be as under:—

TABLE 9.5

Year	Price per tonne
1	2
1970-71	11198
1971-72	11020
1972-73	12630
1973-74	16372

1	2
1974-75	52497
1975-76	29840
1976-77	44459
1977-78	70053
1978-79	67534
1979-80	34666
1980-81	21000

### Maharashtra

The wholesale average prices of sandalwood in Bombay market have been reported as under:—

TABLE 9-6

(Price per tonne)

Year	Classes of Wood			Average price
	Logs	Pieces	Roots	
1	2	3	4	5
1974-75	57500	37500	25000	40000
1975-76	48000	33000	32000	37333
1976-77	64000	55500	57000	50833
1977-78	75000	55500	54000	61500
1978-79	65000	62500	56000	58167

In his State, the major auction centre is Ajra in Kolhapur Dist. where there had not been any auction during the year 1978—80. However, the auction prices for the years 1974-75 to 1977-78 as reported by the Forest Utilisation Officer, Pune are as under:—

TABLE 9-7

Year	Qty. sold in Kg.	Revenue realised (Rs.)	Rate/Kg. (Approx.)
1974-75	34068	516210	15
1975-76	29155	289820	10
1976-77	480	6847	14
1977-78	17280	236900	14

### Orissa

In Orissa, sandalwood is put to auction once in a year by the forest authorities wherein they fix the minimum rate for each lot. It is learnt that the wood is not segregated for its various classes as is done in Tamil Nadu. Only in few cases, the wood is classified and put to auction. For the auction, the rates are fixed per Kg. and the highest bidder is allowed to take the consignment. During the year 1980-81, the highest bid was Rs. 7.50 per kg. only which was the minimum price fixed by the forest department. Another lot comprising of 139.5 kgs. of wood was also put to auction which fetched a total value of Rs. 1,375 i.e. about Rs. 10 per kg. As the regular sales of sandalwood do not take place, the year-wise prices where not available.

### Kerala

In Kerala State also, there is not much production of sandalwood. Therefore, no regular auctions take place. The prices at the different auctions held during the period of study could not be available. However, the rate of sandalwood for the year 1975 auction in Marayoor Range is reported to be Rs. 8,000 per tonne.

### Madhya Pradesh

In Madhya Pradesh, the sandalwood production is scattered at various places. Production is very small and hence auction is not a regular practice. However, it was reported by the forest authorities that at Seoni South, sandalwood was auctioned @ Rs. 10,000 per tonne during the year 1980. Some wood was left over for which no buyers were available.

### 9.3 Retail Prices

Sandalwood is also sold in retail in small pieces mainly for religious purposes. The retail prices are generally higher than the prices of sandalwood sold in auctions in Tamil Nadu and the best quality of sandal is normally not readily available in retail. The people are also not much aware of the quality of wood. The retail prices shoot up on the eve of festivals like Dussehra and Diwali. In Bombay and in north Indian Markets, billet classes like Jajpokal etc. are cleaned, polished after cutting in to small pieces of 3", 6", 9" and so on and sold in retail markets around Rs. 60 to 70 per kg.

In Karnataka only 10 to 20 per cent of the total production of sandalwood is sold to retailers. The retail prices per quintal are fixed on the basis of average rates realised at the biannual sandalwood auctions of Tamilnadu. In Tamil Nadu, there is no retailselling of sandalwood and is mainly for export purposes. In Andhra Pradesh, it is reported that sandalwood is sold only on wholesale basis. In other places of the country, sandalwood is available with Kirana merchants and perfumers but only in very small quantity to cater to the religious needs.

#### 9.4 Factors influencing the prices of sandalwood

The important factors which have significant bearing over the prices of sandalwood are as under:—

- (1) Different rules followed by different State Govts.
- (2) Smuggling from free zones to restricted zones.
- (3) Demand and supply of sandalwood carvings and sandalwood oil from abroad.
- (4) Availability of qualitative sandalwood.
- (5) Lack of adequate supply of sandalwood from Forest Departments.
- (6) Ravages due to spike diseases.
- (7) Rampant smuggling resulting in decrease in supply of wood and non-uniformity of laws which have hindered checking of smuggling.
- (8) Variations in demand due to religious rites.
- (9) Availability of coal and power to the distillers for distilling sandalwood oil.



*Plate No. 15*  
*Big sandal logs kept in the forests*



## 10. STORAGE, HANDLING AND TRANSPORTATION

### 10.1 Storage

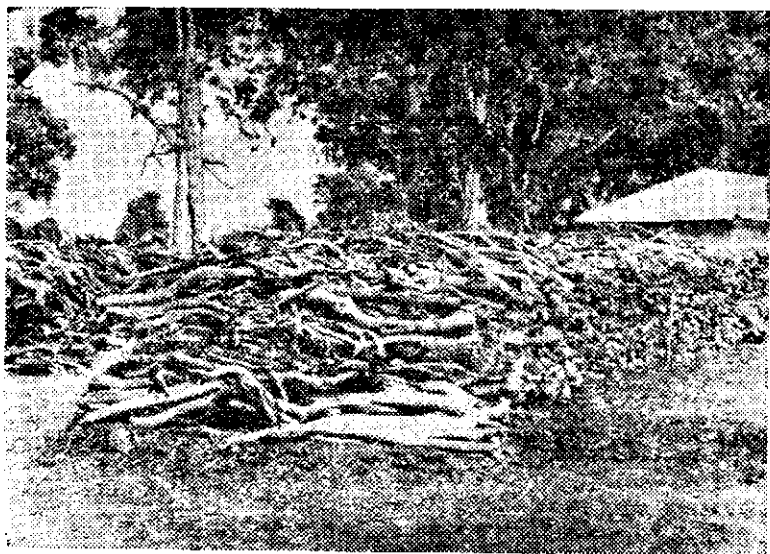
In Tamil Nadu, the extracted trees are pruned at the place of its extraction and thereafter rough cleaning is carried out at the forest range depots where it is cut into roots, billets, etc. It is then directly despatched to the pre-nominated sales depots from the specified range depots under the supervision of a responsible escort. The cleaned and classified wood thus obtained from the various ranges is stored at the sales depots in double lock rooms where the keeper puts one lock with proper seal over it and the other lock is put by the District Forest Officer or his assistant with proper account of wood, arrived from different areas or different forest range officer of the district or from other districts. Here again, after fulfilling the required formalities the wood is cleaned and kept in the stores. The sap-wood chips are collected separately and after proper inspection by the concerned authorities these are allowed to be disposed of for which permission is obtained from higher authorities. The main storage centres are at Tirupattur, Sathyamangalam and Salem in the State.

In Karnataka, there are six kotys or forest warehouses situated at Mysore, Kushalnagar, Hassan, Tarikare, Shimoga and Dharwar which receive the wood either from private owned land or from sandal forests. The wood carried from the sandal forest is generally escorted by the forest guards who keep constant watch against theft etc. This is especially done for the reasons that when the heartwood is exposed after removal of its sap-wood it gives characteristic small or fragrance which attracts the thieves. (It is reported that these thieves come with onion bags to steal the wood so that when they carry it, the characteristic odour to sandalwood is depressed by the onion odour and thus they succeed in the pilferage of wood. After cleaning the wood obtained from all the sources, the major portion of it is distributed or supplied to the Government owned factories situated at Mysore and Shimoga.

In Ardhra Pradesh, Chittoor district is the major centre where the wood is stored from private land as well as from the Government owned forests. The trees obtained from the Government forest, after proper scrutiny are allowed for cleaning where bark, branches and sapwood are separated. The authorities allow to cut the sandalwood into pieces not exceeding 3' in length which are sorted into and collected in different classes and packed in gunny bags under proper seal and cover and stored in the cen-



*Plate No. 16(a)*  
*Root wood extracted and stacked at Kotys.*



*Plate No. 16(b)*

☞ *Sandal wood tree stocked after extraction in the sandal Kotys*

tral depot of the Govt. One officer is exclusively made responsible for the storage of this prepared wood. The wood of private lands is allowed to be preliminarily cleaned with proper approval and sanction by the responsible authorities at the approved premises and the final cleaning is done in a central depot where, after necessary formalities, the classified wood is sealed in gunny bags and stockpiled properly with its due account. Necessary receipt for it is also given to the private land tree owner, on the basis of which he claims his due share of sale proceeds.

In Orissa, as for the rules, only forest authorities are allowed to collect the sandalwood from the forest which is stored at the forest depot in one lot comprising of roots, trunks and other portions of the sandalwood tree. This wood also includes confiscated one, if any, from the smugglers etc.

In Maharashtra and Kerala, the sandalwood is stored at the Government depots. The storages etc. are maintained by the Governments. No data are available to assess the storage cost of wood. In Delhi, the storage of sandalwood is reported to be in gunny bags and in pucca godowns where the storage cost is stated to be about 10 per cent. In Uttar Pradesh, it is reported to be about 12 per cent. General mode of packaging is in gunny bags only.

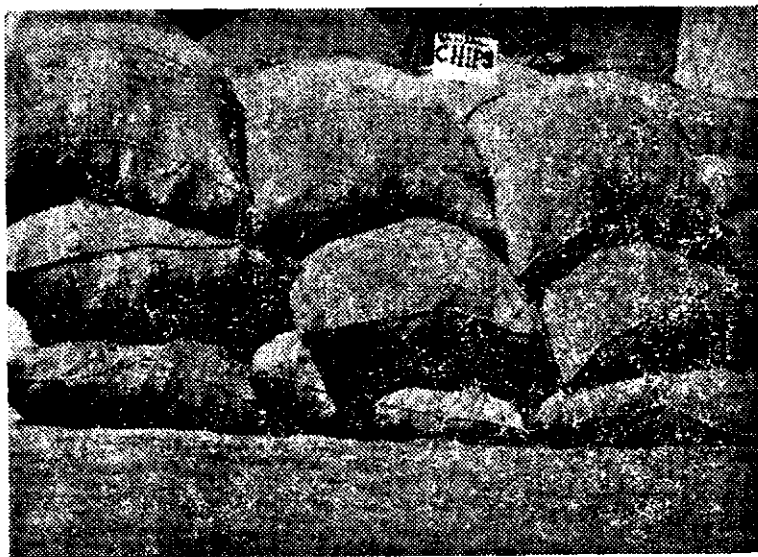
As stated above, the storage etc. appears to be very fool-proof and are more sophisticated methods as are being followed. Even then, it has been reported that in the Government owned forests or wherever the extraction of trees is carried out by the contract system or through other agencies, the wood or trees remain lying idle for a considerable time in the open forest with the result that the insects and fungi do their usual damage both to sapwood and heartwood. The cleaning by the contractor's labour is also not done properly and the tendency of these labourers is to shave away some of the heartwood and add even a small heartwood to the sapwood lot. According to an estimate, the loss is reported to be about 2 per cent on over all basis. At this rate, the total loss for Tamilnadu is calculated to be about 6 to 7 lakhs rupees and for the Karnataka State to be about Rs. 5 to 6 lakhs of rupees.

## 10.2 Handling

In all the States, the sandal trees are extracted manually and pruning and other processes such as preliminary cleaning, dressing of the trees and bringing to the forest range depot etc. are all done by the labourers. Sorting of wood into



*Plate No. 17(a)*  
*Storage of billet class of sandalwood*



*Plate No. 17(b)*  
*Storage of chips class of sandalwood*

different classes, packaging of wood at the central depots and the weighment of wood etc. at the auction depot, are also done by the manual operations only. Thus the entire operation of handling of wood is done by the concerned agencies with the assistance of skilled labourers. At the railway stations and airports also the wood is handled by labourers. Charges for handling at various stages, namely from forest to forest range office and from forest range office to sales depot and thereafter to the respective despatching head of sandalwood have not been calculated separately by any agency. However, according to an estimate, charges work out to about 1.5 to 2.5 per cent of a price realised from wood, when compared to 0.1 per cent in the past. The reasons for increase are attributed to cleaning and dressing of a larger number of trees required to get one tonne of sandalwood and a general hike in labour charges.

### 10.3 Transportation

The transportation of sandalwood from the forest to forest range depots is done by bullock-carts or lorries. The transportation of wood to the extent of 95 per cent of the produce is done by means of lorries or trucks. But the export consignments usually are carried upto the port by train or trucks depending upon the urgency of the shipment and are either air-lifted or shipped to foreign countries. Air-lifting is very casual for exports. Sometimes due to high cost of transportation, the exporters usually ship the wood to its destination through different shipping agencies under proper insurance cover.

The traders prefer to transport their wood by trucks or lorries which is being economical and quicker and safer than transportation by railways. According to an estimate about 80 to 85 per cent of wood is transported through trucks or lorries and 2 to 3 per cent of wood through air-services. The rest of wood is stated to be transported by railways.

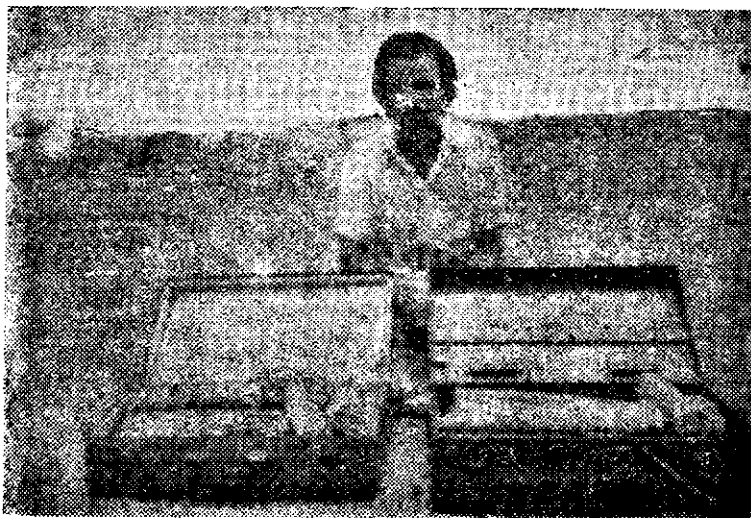
The cost of transport by road varies considerably in different cases depending mainly on the volume of trade, destinations, conditions of the roads, weather, possibility of getting the return-load and competition with other means of transport. The transportation costs have increased considerably in recent years due to hike in fuel prices. The transportation charges for some important points/places are given in the following table :

TABLE 10·1

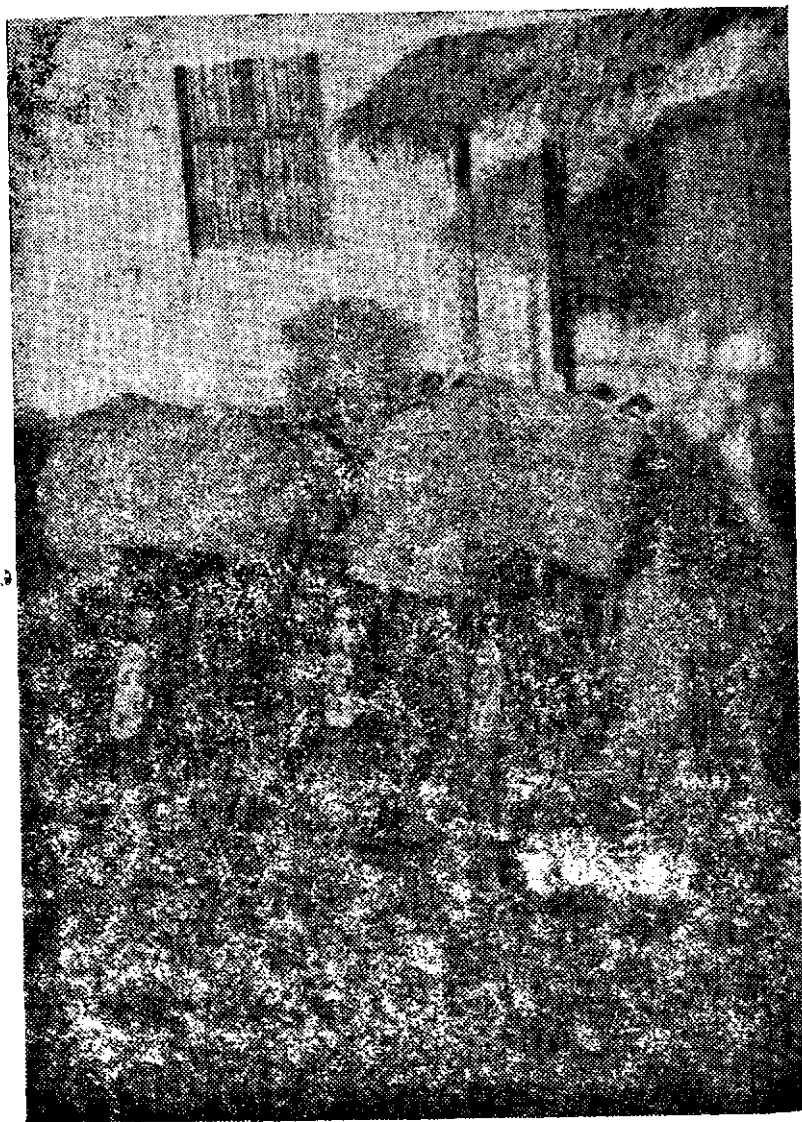
*Transport charge of sandalwood*

From	To	Distance	Mode of transport	Cost per tonne
1	2	3	4	5
Auction centres . . . . .	Destination	100 kms.	Lorry	Rs. 50—60
Market (Chittoor) . . . . .	Railway St.	1 Km.	Lorry	Rs. 5
Rly. St. (Chittoor) . . . . .	Conserving centre	1 Km.	Rail	Rs. 1
Forest range . . . . .	Kuppam Centre	1 Km.	Lorry	Rs. 5
Kuppam . . . . .	Madras	320 Kms.	Rail	Rs. 200
Market . . . . .	Rly. St.	—	Road	Rs. 50
Madras . . . . .	Delhi		Rail	Rs. 350 approx.
			Truck	Rs. 600 approx.
			Air	Rs. 4750 to 5000
Airport . . . . .	Local market		Lorry	Rs. 50 approx.





*Plate No. 18(a)*  
*Stealthy transportation of sandalwood in suit cases*



*Plate No. 18(b)*  
*Smuggling of sandalwood on bicycles.*

From the above table, it will be observed that the transportation charges from Madras to Delhi are approximately Rs. 350, Rs. 600, Rs. 4750 by train, truck and by air respectively. Thus the transportation by train is considerably low but even then the trade prefers to transport the wood by truck. It is because while transporting the wood through railways, the traders have to incur some expenditure to bring the consignment to railway station and further to spend some money again to transport the wood from station to the market, apart from the other charges of loading and unloading etc. In transporting by truck, the traders get the goods delivered directly to their premises. Secondly, it saves their time and relieve them of fear of probable pilferage in transportation by railway. Air lifting is seldom resorted to for its high cost.

### Smuggling of Sandalwood

Sandalwood is a valuable forest produce. The prominent States like Karnataka, Tamil Nadu and Andhra Pradesh have laid down legislation for the possession of sandalwood. However, in other States there is no such law or restrictions. In the above stated States, a possession licence is a must for storage of more than 20 kgs. wood. Even in the case of Patta land holders growing sandal, valid permits are issued by the forest authorities after proper inspection of their estates, so that a check on Sandalwood movement could be made.

Possession of sandalwood beyond the exemption limit of 20 Kgs. is an offence in the above States. Kerala is an adjacent State to the Sandal producing region where most of the sandalwood is stated to be smuggled in because there is no such law or restriction for sandalwood storage, transportation or movement.

It is also stated that there is no legal provision empowering the forest officers to act beyond the limit of their State. This also makes a smuggler to feel free just after crossing the border of these States.

Smuggling of sandalwood also takes place in the interior of forests. The area being large and due to lack of communication among forest range officials, the smugglers' work becomes easy. The smuggled sandalwood is often marketed to private distillers who purchase the same at a lower price and earn more profits. It is stated that this business has flourished very much in Kerala-Karnataka border. A number of small distillers have come up there. Some of the oil distilled by these distillers is brought to Kuppam/Salem. Rest of the oil finds market at Calicut, Cochin

for Mangalore where the dealers have established their business in sandalwood oil without having a distillery. They also offer a stiff competition to the genuine distillers by selling their product at a cheaper rate. It is stated that a huge quantity of sandalwood is smuggled every year from the Sandal Forests for which there is no account anywhere.

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## 11. RESEARCH AND DEVELOPMENT WORK

### 11.1 Quick Germination Seeds

Sandal seeds are collected during September-October and sown in April-May give maximum germination in minimum duration. Seeds in air-tight gunny bags could be stored from 9 to 12 months. Seeds collected from younger and older trees behave alike and have no varied effect on the viability and germination percentage of seeds. To reduce dormancy period and to quicken germination, either removal of outer seed coat and giving a coating of any seed dressing chemical such as Agrosan or Gerason or treatment of seed with 0.05% Gibberellic acid for 12 to 16 hrs. can be adopted.

The effect of different dosages of gamma rays on the germination of sandal seeds revealed that the percentages of germination was normal on applying 5 to 20 kg. dosages. Treatment with 30 to 50 KR, arrested the growth of the seedlings after the emergences of the radicle and plumule. But in the dosages above 60 KR although the radicle emerged a few, no further growth was observed and these dosages appeared to be lathal. The final study revealed that the percentage of germination, survival and growth rate were found to be indirectly proportional to the dosage of gama rays (1)

### 11.2 Chemical Constituents of sandal seed coating

Sandal seed has an average weight of 0.15 gms. and 30 to 40% of this weight constitutes the seed coat. The chemical constituents of the seed coat have been identified to be Betulinic acid, a triterpene hydroxy unsaturated acid described in literature as an eye inflammatory chemical, occurring to the extent of 0.8%. A liquid fatty oil (1.6% yield) composed of Palmitic, Oleic and santalbic glycerides and semi solid fatty oil (1.2% yield) containing mostly Palmitic and Oleic glycerides, has also been isolated from the seed coat. Further, the seed coat was found to contain 2.2% of tannins (2).

### 11.3 Sandal Seed Oil

Little is known about the sandal seed oil except that the seeds are edible and rich in fatty oil<sup>(3)</sup> (50 to 55% yield) which

1. Srimathi R.A. and Kulkarni H.D. S.R.C. Bangalore-3.
2. Sankaranarayana K. H. Srimathi R. A. Venkatesan K. R. Sandal Research Centre.
3. Sreenivasaya, M. et. al, Journal of I. I. Sc. 16A, 1 (1936).

readily polymerises<sup>(1)</sup> and the oil absorbs 15% of its weight of oxygen from the air in 4 days becoming an elastic mass (this which thickens further at 200°C. The oil has acid value 9- and contains 7 to 10% highly unsaturated resinous unsaponifiable matter of iodine value around 300. The viscous oil contains 88% of santalbic glyceride and the mixed acids (excluding the unsaponifiable matter) consists of 95% of santalbic acid and an acetylenic acid. The soxhlet extraction of the oil reported to give an yield of 60 to 63% in petroleum ether (60-80°C).

The industrial utilisation of this oil was not explored so far. This has been tried at Sandal Research Centre, Bangalore which has now reported that the oil obtained from sandal seed after hydrogenation could be utilised for any soap industry. The hydrogenated oil is significantly low in unsaponifiable matter. The characteristics of the partially hydrogenated oil<sup>(3)</sup> determined by the standard methods<sup>(4)</sup> are shown in Table No. alongwith characteristics of the hydrogenated oil :

TABLE 11.1

Characteristics	Sandal seed oil	Partially hydrogenated sandal seed oil
Colour . . . . .	Pale greenish Yellow	Light yellow
Appearance . . . . .	Viscous, thickens in air.	Mobile, does not thicken.
Refractive index . . . . .	1.479/60°C	1.473/25°C
Specific gravity . . . . .	0.9304/25°C	0.8962/25°C
Iodine value (Hanus)	145—155	95—105
Saponification value)	185—195	202—212
Acid value . . . . .	9—15	5—6
Acetyl value . . . . .	21—23	15—19
Unsaponifiable matter . . . . .	7—10%	0.2—0.4%
Reichert Meissl value . . . . .	2—3	1.7
Polenske value . . . . .	0.2—0.3	2.5

1. Gunstone F. D. and Russel W. C., J. Chem., Soc. 3782 (1955).
2. Iyer Y. V.S., Analyst 60,319 (1935).
3. K. H Shankaranarayana, Sandal Research Centre, Bangalore (J.O.T.A.I. Vol. XI-4, 1979).
4. Cocks L. V. and Van Rede, C. Lab. Hand book for oil and fat analysts, Academic Press, London & New York (1966).

A comparison of the characteristics of the hydrogenated oil with those of other conventional oils are given in Table 11.2. This shows that the partially hydrogenated sandal seed oil could be utilised for manufacture of soap.

TABLE 11.2

Characteristics	Partially hydrogenated sandal-seed oil	Cotton seed oil	Groundnut oil	Olive oil
1	2	3	4	5
Specific gravity	0.8962/25°C	0.916/20°C	0.913/20°C	0.910/20°C
Refractive index	1.473/25°C	1.473/20°C	1.472/20°C	1.470/20°C
Saponification value	202—212	189—198	190—196	188—196
Iodine value	95—105	90—115	84—99	90
Unsaponifiable matter	0.2—0.4%	1.5%	1%	1.5%

The methyl esters of mixed acids from partially hydrogenated oil prepared by absolute methanol sulphuric acid method\* and analysed by a gas chromatogram (F & M Model) using a 8 ft. column, containing EGSS.  $\times$  15% on chromosorb W 80-100 mesh at 200°C, carrier gas being Nitrogen (flow rate 3600 ml/hr.) with flame ionization detector and identifying peak by comparison of their retention times with those of the methyl esters of authentic fatty acids run under identical conditions, revealed the percentage composition of the fatty acids as follows :

C12, C16, C18 traces; C20-6.3%, C18-1; C18-2  
and C18-3 = 13%

#### 11.4 Sandal Bark

The chemical constituents of the sandal bark had not been so far subjected to a systematic chemical examination. Recently, these have been determined from the extract obtained by the solvent extraction of sandal bark (\*\*). The sandal bark was reported to contain 14% of the tannins. The air-dried powdered bark was reported to be subjected to sequential extraction with petroleum ether (60-80°C), benzene, chloroform, acetone and methanol. The petroleum ether extracted a waxy material

(\*) Modern methods of plant analysis, Vol. II Peach K and Tracey.

(\*\*) Narayana, K. H. S. Ayyer K.S. & Rao G.S.K., Chemical Constituents of the bark of *santalum album* Linn, Curr. Sci. 49(5). 198—99, 1980.

from which no pure compound could be isolated, the benzene extract (2-3% of yield) gave on repeated chromatography of its petroleum ether elute over basic alumina, a crystalline solid (0.1 to 0.3% of yield) m.p. 115-116°C (ET&DAC) ( $\alpha$ ) 24°D+20° (CHCl<sub>3</sub>) identified (IR, NMR and MS) as Urs 12en-3Byl. palmitate, which was found to exhibit a phenomenal insect growth inhibition and chemo-sterilant activities. Topical application of this compound in microdoses on freshly formed pupae of some forest insects (*viz.* *Altevefabriciella*, *Eligma narcissus*, *Eupterote geminata* etc.) produced morphologically defective adults with crumpled wings and shorter abdomen, who did not successfully mate and lay eggs. Such compounds, of late are becoming popular as "third generation pesticides" in controlling forest pests without the bad side-effects of the common organic pesticides.

### 11.5 Seedlings

The young host-less sandal seedling struggling to grow, on haustorisation with a host, has repeatedly been observed to exhibit a sudden and spectacular burst of vegetative activity. Then the seedling puts on a "new look". This striking phenomenon which constitutes an important event in the life history of the sandal is an unmistakable indication of the fact that the seedling has launched on its parasitic career. The cyto and histo-chemical studies on the haustorial organ of sandal revealed the occurrence of an increase in the number of chromosomes in the sections of haustoria.

The spectacular increase in the rate of the growth of the sandal is to be related to the increase in number and size of chromosomes. This is reported to be the case of endopolyploidy, a phenomenon generally associated with secretion glands. The haustoria may be looked upon as a gland, particularly in view of the other findings that the organ has been found to contain indole acetic acid and other related phyto hormones.

### 11.6 Sapwood

The sapwood of sandal known as white wood is a bye-product in the extraction of heartwood. It is reported that about 230 tonnes of sap-wood is available per year in the country which has no special use except a little quantity used in the manufacture of cheap *agarbattis* by few manufacturers. Its industrial use has been suggested for preparation of various things of utility as discussed in the chapter on utilisation. Its utility has been confirmed by the Institute of Sandal Research, Bangalore. The findings revealed that sap-wood has its nail holding capacity to



the extent of 3 times to that of teak and a little more than that of mango. Hence it is good for the preparation of packing cases and crates.

### 11.7 Sandalwood Oil

The main constituents of sandalwood oil, forming the higher boiling fractions are alpha and beta Santalols (Sesquiterpene alcohols) occurring to the extent of 90 to 94 per cent. The lower boiling fractions comprising of 4 to 6 per cent, chiefly composed of sesquiterpenes, alpha and beta santalenes. All these isomers have been isolated in their pure form by silicagel column chromatography<sup>(1)</sup>. The other ingredients, viz. acids, aldehydes, ketones etc. form only a comparatively minor part. The volatile constituents of sandalwood oil<sup>(2)</sup> have revealed the occurrence of some aromatic compounds like paramethyl acetophenone, paratolyl valeraldehyde, furfuryl pyrrole, alpha and beta curcumenes etc.

### 11.8 Development

The depleting resources of sandalwood have caused a great concern to Karnataka Government as well as to the Central Government. The sandal forests are declining fast mostly due to spike disease. Most of the sandal forests are invaded by spike disease. Efforts so far made to control it have been totally failure. No check could be exercised so far. Various committees have also been set up to suggest measures to control this disease. On the basis of these committees' recommendations, an institute known as Sandal Research Centre, Bangalore, was established by the Government in 1977. This Institute have chalked out some developmental programmes which are discussed in succeeding paragraphs.

#### 11.8.1 *Tree improvement programme*

The object of this programme is to produce sandal wood trees which are capable of yielding maximum heartwood and oil in a minimum period and at the same time resistant to spike disease and heartwood borer. In brief, this programme has been described in Chart Form on page No. 135

#### 11.8.2 *Gene resources*

Under this programme, the available resources distributed not only in India but also elsewhere in the world have to be taken

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(1) K. H. Shankaranarayana, *Indian Perfumer*, 23, 1973, 625 and *ibid* 24, 1980, 40.

(2) Demole E., *Engisst, P. Helv. Chin, Acta*, 59, 1976, 737.

into account. Resort to gene resources of allied species of *Santalum* growing in the South Eastern hemisphere of the world are also being taken into account. All the available gene resources will be collected and established in the form of Germ-plasm Banks, distributed in various parts of sandal States.

### 11.8.3 *Breeding Programme*

The main strees of the breeding programme is mass selection. Besides this, hybridization and mutation breeding are also being attempted in a limited way.

### 11.8.4 *Mass selection*

Due to increasing demand in the commercial markets for sandal, many States are coming forward to plant sandal trees on a large scale. As good quality seeds are to be made available as early as possible, mass selection has been adopted in this programme. For the fulfilment of the above programmes, they have adopted two types of strategies (i) short-term and (ii) long-term strategy.

(i) *Short-term strategy* : This will consist of selection of superior seed stands for collection of seeds and conversion of seed stands into seed production areas.

Seeds stands : Several superior populations of sandal have been identified by this centre and the States have been requested to form seed stands.

(ii) *Long-term strategy* : Selection of superior plus trees are being selected for the following characters :-

(a) fast growth (b) maximum heartwood and good smell and (c) resistance to spike disease and heartwood borer.

### 11.8.5 *Progeny trials*

Progenies of selected plus trees and morphologically different phenotypes have been raised in the nursery study of the seedlings which show interesting segregation patterns. The half-sib progenies of 12 plus trees are also planted out in the field at Nellal of Bangalore Division.

### 11.8.6 *Clonal orchards*

Efforts have been made to start the clonal orchards of the superior plus trees. For this purpose the clonal propagation

by various methods was tried. Stem cuttings using different root inducing hormones under natural conditions have not given adequate results. Most of the propagation methods gave a small percentage of success. However, tissue culture techniques have been found to be successful. They have developed some plants by tissue culture techniques. It is hoped that this technique will prove very successful in the propagation of sandal forests.

### 11.9 Leaf morphology

Tetraploids of sandal have been developed in Forest Research Institute, Dehradun by use of Colchicine, an alkaloid, with an aim to combat spike disease and to improve the quality and quantity of oil. 11 years old tetraploids have not flowered while diploids have flowered at the age of 4 to 5 years. The seeds obtained from these plants would be tried in the spiked sandal area.

In another study, a change in leaf morphology in the experimentally synthesized auto tetraploids of sandalwood done by Forest Genetic Branch, Forest Research Institute and Colleges, Dehradun<sup>(1)</sup> has revealed that these tetraploids appeared very distinct from their corresponding diploids because of a marked change that has been brought about in the morphology of the leaves and the angle in which they are held on the branches. To quantify these differences, measurements were recorded on the length, width and thickness of leaf. Length, thickness and angle of petiole, frequency and size of stomata, length of leaf and petiole and frequency of stomata per unit area showed a decrease in the tetraploids whereas for width and thickness of leaves, thickness of petiole and length and width of stomata, the tetraploids showed an increase over the measurement of diploids.

### 11.10 Indian Sandalwood Advisory Board

*Organisation*—The above organisation was set up long ago to look after the interests of sandalwood forests and the sandalwood trade. Accordingly their constituent members are the conservators of forests of major sandal producing States and important traders. The Board is constituted of 11 members of which 6 are Government officers and 5 traders. Out of 5 traders, 4 are from Tamil Nadu and Karnataka States and one

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(1) H.L. Kapoor and Kedharnath, Forest Genetics Branch, F.R.I., Dehradun, Indian Forests Vol. 102, No. 8, August, 1976.

from Bombay. The Government official members are as under :—

- |  |                |
|--|----------------|
| (1) Chief Conservator of Forests,  | Tamilnadu      |
| (2) Do.  | Karnataka      |
| (3) Do.  | Kerala         |
| (4) Do.  | Maharashtra    |
| (5) Do.  | Andhra Pradesh |
| (6) Director of Industries & Commerce,<br>Government of Tamilnadu, Madras. |                |

In the meetings of the Board, the special invitees from different organisations and industries who are able to contribute their views for the activities of the board are also invited. Besides, representatives of different organisations are also invited as observers. The Chief Conservator of Forests, Tamilnadu is the Convenor.

The meetings of the Board as per laid-down norms are restricted to 2 per year. These are held alternatively at Madras and Bangalore. But in actual practice, the meeting of the Board is held once in two years.

### Activities of the Board

The main activities of the Board are to discuss their forest problems and to get the solution thereof in consultation with different experts. They also discuss the traders' problems and try to solve them within their possible approach, otherwise they forward such matters to the related State Governments for their consideration. However, the functions of the Board are of advisory nature only.

The Board has been successful in enlightening on the problems of the forests with the result that an institute known as Sandal Research Centre was established at Bangalore. This Centre is dealing with the various problems of regeneration, better utilisation of sandal waste bye-products, etc. They have also been successful to get the forest guards equipped with wireless sets to protect the sandal wealth from theft and to get necessary help at the time of emergency.

They have also tried to gather data on production and processing and inter-state movements of sandal products but most of the traders are not co-operating in this regard due to various reasons such as sales tax, customs, purchase of smuggled wood, recovery of oil, quantity produced and sold.

## Views

The Board has a limited role to play as it does not enjoy the statutory powers and status as bestowed in the Boards for Coffee, Tea and Rubber etc. This commodity is of equal importance from the view point of forest based industries, employment creation and a good mint of foreign exchange, provided we develop our industries based on it as raw materials. This requires an integrated approach for its development to increase the production in the forest, exploitation of every part of sandalwood for the finished product, development of new techniques of processing and preparation of various perfumes with the help of other essential oils ingredients available in the country.

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## 12. SUMMARY AND RECOMMENDATIONS

### 12.0 SUMMARY

The Sandalwood and its oil have been the proud and precious products of India. They are renowned throughout the world for quality and special characteristics from the ancient times. Various authors and scientists have put forth the different views about its origin. Some of them are of the view that it is exotic one and on the other hand, others have proved it to be of Indian origin.

India is the principal country in the world growing *Santalum album* Linn although various species have been found out by various countries to produce oil, very similar to sandalwood oil of India. Some new countries have also emerged as producers of *Santalum album* Linn as new competitors to India. These countries are trying to overcapture the foreign markets where India had monopoly. Karnataka is the major State producing sandalwood and its oil to the extent of 50 to 70 per cent of total Indian produce. Other States are Tamil Nadu and Andhra Pradesh, scattered growth of sandalwood is also found in Kerala, Madhya Pradesh, Maharashtra, Orissa, Uttar Pradesh, Bihar, Himachal Pradesh, Rajasthan and Manipur.

Most of the wood is obtained from the natural forests although organised regeneration with the help of different techniques like nursery, dibbling and tissue culture are also being followed and the results are stated to be quite encouraging. It is parasitic in nature, therefore, different types of host plants for its proper growth have been identified recommending for afforestation.

The tree is evaluated on the basis of quantity of heartwood and oil obtained from it. The formation of heartwood is explained by different factors stated to be responsible for it. But no definite conclusion could be drawn in this regard. To judge the quality of heartwood formation in newly generated trees was a problem as it was determined by extracting sap from standing sandalwood tree. It was due to non-availability of a proper device for it. The task was a difficult one. This has been simplified by developing suitable instrument by the Sandal Research Centre, Bangalore.

The economics of sandalwood cultivation gives a clear picture of its remunerative value and employment generation. No

doubt this is a long term crop but it has various advantages like maintaining ecological order, social and recreative forestry, inducing rains, soil conservation, cattle feed and a source of new generation pesticides. Spike disease is the main disease known to have ravaged the sandalwood forests in India. It has invaded nearly all sandal forests. Recently, the incidence of this disease has been reported in Kerala in Marayoor area—famous for disease free sandal forests and good heartwood. This disease has been identified as Rosette spike and Pendulous spike. Both the diseases have got different symptoms to be identified in the involved area. The causative organism has been identified as *Chlorogenus Santali Holmes* having the synonym of sandal spike virus, *Santalum virus-I*. The various measures to control these diseases by means of fungicides, insecticide and other chemicals have been tried at different times but unfortunately no remedial measures could be effective so far. A price of Rs. 10,000 was declared to the inventor to control this disease by the Maharaja of erstwhile Mysore State. Various attempts were made in the past to estimate the losses due to spike disease which now runs to several lakhs of rupees. Thus situation has arisen requiring an immediate attention to control the disease by all possible means to check the depleting stocks of sandal. The other diseases like sandal leave curl disease and damping of sandal seedling have also been observed. But their incidence is not so much alarming. Some pests like heartwood borer etc. have also been found to cause damages to sandal heartwood in both standing and fallen trees. This is also causing a loss of several lakhs of rupees a year.

The production situation of sandalwood is another matter of great concern as it has dwindled fast. There was a time when Karnataka produced more than 3000 tonnes of heartwood which has come down to merely 1100 tonnes a year. The annual production of sandalwood in India has also declined from about 5000 tonnes to 3000 tonnes only. The sandalwood being a good foreign exchange earner, this has caused a significant loss of foreign exchange to Indian exchequer.

Extraction and preparation of sandalwood is done by Karnataka and Tamilnadu Governments through contract labour. These labourers also do not pay due attention. It is due to lack of supervision which may be attributed to the shortage of manpower with the forest authorities. Sometimes the roots which are rich in oil content are left over in the ground itself which are later on extracted stealthily by the labourers and sold in the under-world markets. Similarly in Tamilnadu contract system for extraction of sandal tree is in vogue wherein the

charges are fixed per tree. As a result, the contractors extract the trees within easy approach leaving the other extractable trees in the interior forests. Sometimes wood is left over for a pretty length of time in the forest leading to smuggling of the wood and insect infestation resulting the loss of revenue to the State.

The wood thus extracted is transported to kotys or sales depots by means of trucks or lorries, where it is dressed and classified into its various classes and is packed and stored in the central depot for its sale. All these operations are carried out under the supervision of forest authorities.

In Karnataka, practically the entire extracted wood is given to Govt. owned sandal factories and accounted for by their set procedure. The forest department feels that the revenue thus obtained to their account is invariably low. In Tamil Nadu, the classified wood is auctioned usually in the months of July and December every year. Only registered traders take part in these auctions through open bidding. The highest bidder is allowed to take the consignment within a period of 90 days but requires to pay 20 per cent immediately on the fall of hammer. If the bidder fails to make payment within 90 day's interest and godown charges are also charged extra.

The market charges vary from State to State. These vary from 3 per cent to 17 per cent. The highest charges are Stated to be in Uttar Pradesh.

The Sandal tree is of omni-value. Leaves are used as fodder. The bark obtained as a bye-product is stated to be rich in tannin content, although it is not exploited for commercial purposes. Another compound has also been isolated and named Urs—12 en—3 BYL palmitate which has proved to be insect growth inhibitor and chemo-sterilent activist. Sapwood still remains unexploited although its usefulness has been identified for the household utility items. Some trees without heartwood are left over as useless product. They are also of importance for the preparation of furniture etc. Seeds obtained from the trees are also rich in oil content. The oil obtained from seed is an unsaturated one but has proved to be of commercial importance after the hydrogenation. Sandalwood oil is well known for its commercial importance throughout the world.

Export of sandalwood has been of the order of about 300 to 500 tonnes annually which fetched a foreign exchange worth rupees 169.25 lakhs during 1979-80. Other products like sandal carvings, dust and chips also exported to different countries fetched Rs. 221 lakhs in 1978-79. During 1979-80 dust and



chips were exported to the tune of 498.75 tonnes fetching a foreign exchange of the order of rupees 87 lakhs and carvings earned about 25.16 lakhs of rupees during 1978-79. The other bye-product is the spentwood obtained after the distillation of oil from the wood. It is also being exported to different countries besides its internal demand in *Agarbatti* industries. The joss stick industry has also brought fame in the international markets and is rightly called 'Fragrant ambassadors' from India. Its export has increased by 20 times. A strict quality control before shipment of product would be more essential to maintain its quality and reputation in the world markets.

A general trend in wholesale prices from 1962 to 1972 was almost static, only minor fluctuations were observed. From 1973-77 a rising trend in prices was observed. Thereafter, prices started declining fast and touched the lowest level in 1980 when the average wholesale prices were Rs. 20,000 a tonne in the State of Tamil Nadu. After 1980, a slight increase has been noticed and the average wholesale prices during 1981 were about Rs. 28,000 per tonne.

## 12.1 RECOMMENDATIONS

1. To meet the challenge of declining production, more areas should be brought under sandal afforestation to increase the production.
2. All forests in different States situated at the height of 360 to 1350 meters should be surveyed with the help of silviculturists to know the existence of sandal trees, their species and quality of wood obtained from such trees, to guide the State Governments to preserve and protect such sandal forests. Manipur State has already requested for this assistance and is ready to co-operate in this regard.
3. Enumeration at proper intervals should be done invariably in all sandal producing regions and a proper record of it needs to be maintained to know the general growth of the sandal forest and to plan the necessary regeneration to meet the gap between demand and supply position.
4. Adequate staff should be provided to guard and supervise the forests.
5. Proper statistics for acreage of plantation, development, number of trees extracted and number of trees died, prevailing diseases and number of trees affected, any new disease observed etc. should be maintained in every forest range and reported to their departments.

6. Proper supervision during extraction of trees and their transportation immediately after extraction is most essential to avoid loss of roots in earth, smuggling and damages by insect infestation etc.

7. Adequate protection measures are needed to be taken to protect the newly regenerated plants in the forest by a ban on grazing etc.

8. Suitable varieties of high yielding heartwood and oil content may be developed by Sandal Research Centre, Bangalore to raise plantation on the hillocks of different States.

9. Some preventive measures to check fire hazards also need to be devised and implemented.

10. In order to create the interest among public to grow more sandal trees, the share of revenue should be given to the extent 70% as is being followed in Kerala. Besides, necessary seedlings be also provided to the interested people of the State together with the technical guidance for their raising.

11. Suitable measures to control the spike disease is the utmost need of the time. It would be desirable to seek the assistance and collaboration in this regard from the foreign institution/agencies such as Tropical Research Institute, England.

12. To control smuggling of sandalwood, incentives be given to both informers and detecting staff.

13. A uniform legislation for the possession and movement of sandal wood needs to be drawn under Indian Forest Act and necessary provision for the punishment of culprits be made.

14. Every part of sandalwood should be used for different purposes as suggested in the Chapters on utilisation, research and development.

15. Annual fixation of prices of sandalwood procured from their own forests in Karnataka State by the Karnataka Soap & Detergents Ltd. for the purposes of conversion into oil may be in corresponding to the average prices of respective classes of wood realised in Tamil Nadu auctions which will facilitate to judge the efficiency of sandalwood factory.

## ANNEXURE I

## PART I

Area covered and sandalwood trees enumerated from 1961-62 to the end of 1969-70 under the supervision of the Forest Utilisation Officer, Bangalore

S. No.	Name of the Division	Area covered (Acres)	Sandalwood trees enumerated	Remarks
1.	Mysore	34,97,134-00	5,70,052	During 1970-71 2 separate divisions Bangalore & Hassan were created for the purpose.
2.	Hassan	81,303-00	3,966	
3.	Shimoga	2,74,305-00	26,740	
4.	Mercara	2,37,515-00	6,324	
5.	Hunsur	47,719-00	13,023	
6.	Bangalore	19,81,644-00	2,14,729	
7.	Kolar	1,34,932-00	23,208	
8.	Tumkur	1,07,504-00	2,795	
9.	Bellary	5,17,633-00	1,63,106	
Total		68,79,709-00	10,03,943	
		or		
		10,749.545 Sq. Miles		

## PART II

Area covered and sandalwood trees enumerated during 1970-71 under the supervision of Divisional Forest Officer ISES, Bangalore Division, Bangalore

Sl. No.	Name of the division	Area covered (Acres)	Sandalwood trees enumerated	Remarks
1.	Kollegal	4,10,229-00	32,577	The division started functioning from 25-6-1970. The work was done under the supervision of the Forest Utilisation Officer, Bangalore, during first 3 months of the year 1970-71. The work was stopped during the middle of Feb. 1971 for want of Budget grants.
2.	Tumkur	12,24,844-13	41,497	
3.	Kolar	11,00,321-01	61,692	
4.	Bellary	3,99,643-00	694	
Total		31,35,037-14	1,36,460	
		or		
		4,898.495 Sq. Miles		

## Area of sandal sown and cut in Andhra Pradesh (Circle-wise)

(Unit Area in hectare)

Year	Vizag Circle		Kurnool Circle		Anantapur Circle		Guntur Circle		Hyderabad Circle		Khammam Circle	
	Area sown	Area cut	Area sown	Area cut	Area sown	Area cut	Area sown	Area cut	Area sown	Area cut	Area sown	Area cut
1	2	3	4	5	6	7	8	9	10	11	12	13
1960	105.62	N.A.	—	N.A.	—	N.A.	—	—	—	—	—	—
1961	—	—	—	—	2.02	N.A.	—	—	—	—	—	—
1962	—	—	—	—	0.80	N.A.	N.A.	—	—	—	—	—
1963	—	—	—	—	2.02	N.A.	—	—	—	—	—	—
1964	—	—	—	—	—	—	—	—	—	—	—	—
1965	—	—	—	198.50	—	6.50	—	—	—	—	—	—
1966	—	35.620	—	101.00	44.52	13.820	—	—	—	—	—	97.50
1967	—	—	—	40.00	44.51	—	—	—	—	—	—	—
1968	—	—	—	3.984	18.62	68.183	—	—	—	—	—	—
1969	—	—	—	—	25.10	204.85	—	—	94.00	—	—	—
1970	—	—	—	—	34.00	151.461	—	—	200.00	—	—	—
1971	—	—	—	—	20.25	49.962	—	—	—	—	—	—
1972	—	—	—	—	16.20	—	—	—	—	—	—	—
1973	—	—	—	—	40.05	7.60	—	—	—	—	—	—
1974	—	—	10.00	—	56.20	7.041	—	—	—	—	—	—
1975	—	—	50.00	—	—	21.00	—	—	—	—	—	—
1976	—	—	50.00	—	—	85.568	—	—	—	—	—	—
1977	—	—	400.00	0.069	116.96	40.308	—	—	—	—	—	—
1978	—	—	—	—	—	32.393	—	—	—	—	—	—
1979	—	—	—	—	—	2.683	—	—	—	—	—	—
1980	—	—	218.00	—	250.00	32.322	—	—	—	—	—	—

## ANNEXURE III

Estimated production of sandalwood in India for the years 1960-61 to 1980-88

(Unit—Tonnes)

Year	Karnataka	Tamil Nadu	Andhra Pradesh	Other State	Total
1	2	3	4	5	6
1960-61	1871	997	42	85	2995
1961-62	1938	1144	34	67	3183
1962-63	1671	1054	28	96	2849
1963-64	1820	1261	31	98	3210
1964-65	2247	1307	36	107	3647
1965-66	2616	1084	47	120	3867
1966-67	2403	1108	32	89	3632
1967-68	2670	1054	26	95	3845
1968-69	2748	1097	82	87	4014
1969-70	2800	1260	107	89	4256
1970-71	2705	1310	63	97	4175
1971-72	2977	1512	21	121	4631
1972-73	2633	1327	18	45	4023
1973-74	2134	1475	28	67	3704
1974-75	1570	1015	15	75	2675
1975-76	1096	1085	18	83	2282
1976-77	1150	1330	29	91	2600
1977-78	1079	1373	26	85	2563
1978-79	1150	1313	28	76	2567
1979-80	1150	1300	34	92	2576
1980-81	1150	1300	32	90	2572*

\*Tentative data.

## ANNEXURE IV

## Classification of Sandalwood

Sandalwood is sorted under the following classes before being passed for sale.

- |  |   |
|--|---|
| I. First class billets (or vilayat budh) | Consists of thoroughly sound billets, weighing not less than 9 kgs. and not exceeding 112 pieces to the tonne.                                |
| II. Second class billets (or China budh) | Consists of slightly inferior billets, weighing not less than 4.50 kgs. and not exceeding 224 pieces to the tonne.                            |
| III. Third class billets (or Panjam)     | Consists of billets having small knots, cracks and hollows, weighing not less than 2.2 kgs. & not exceeding 448 pieces to the tonne.          |
| IV. Ghotia (or billets of short length)  | Consists of short sound pieces, no limit as to weight or number.  |
| V. Ghat badala                           | Consists of billets with knots, cracks & small hole at either end, weighing not less than 4.5 kgs. and not exceeding 240 pieces to the tonne. |
| VI. Begarded                             | Consists of solid pieces without limit as regards dimensions, weight or number.   |
| VII. Roots (First Class)                 | Consists of pieces weighing not less than 6.75 kgs. and not exceeding 150 pieces to the tonne.  |
| VIII. Roots (Second class)               | Consists of pieces weighing not less than 2.25 kgs. and not exceeding 448 pieces to the tonne.  |
| IX. Root (Third class) Ghat              | Consists of small and side roots below 2.25 kgs. in weight.   |
| X. Jajpokal (First class) or Badala      | Consists of hollow pieces weighing not less than 3.10 kgs. and not exceeding 320 pieces to the tonne.   |
| XI. Jajpokal (Second class)              | Consists of hollow pieces weighing not less than 1.3 kgs.   |

XII. Ain bagar psuedoghat	Consists of solid, cracked and hollow pieces weighing not less than 450 kgs.
XIII. Cheria (or large chilta sali)	Consists of pieces and chips of heartwood weighing not less than 2.25 gms.
XIV. Ain chilta	Consists of pieces and small chips of hardwood.
XV. Hatrichilta	Consists of heartwood, chips and having obtained by planing billets with Hatri or Randha (Plane).
XVI. Milva Chilta	Consists of pieces and chips having in far proportions heartwood and sapwood.
XVII. Basola Bukni (Gamti teacha short chips)	Consists of small heartwood and sapwood chips.
XVIII. Saw dust or powder	Obtained in sawing the sandalwood.

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**N.B.:**—Billets of Classes V & VI are not planed nor are their edges rounded off.

## ANNEXURE V

## Quantities of sandalwood auctioned in Andhra Pradesh and Kerala

Sl. No.	District & State	Year	Name of the Market	Quantity in tonnes
1.	Chittoor (Andhra Pradesh)	1969-70	Chittoor sales Department at	106.6
		1970-71	District Forest Officer	57.8
		1971-72	Office (Western Region)	17.8
		1972-73		4.6
		1973-74		24.7
		1974-75		10.86
		1975-76		16.4
		1976-77		26.78
		1977-78		23.43
		1978-79		7.3
		1979-80		32.00
Quantities auctioned at Marayoor Centre Kerala				32.00
		1961		26.40
		1962		58.26
		1964		9.67
		1965		12.48
		1974		11.44
		1975		

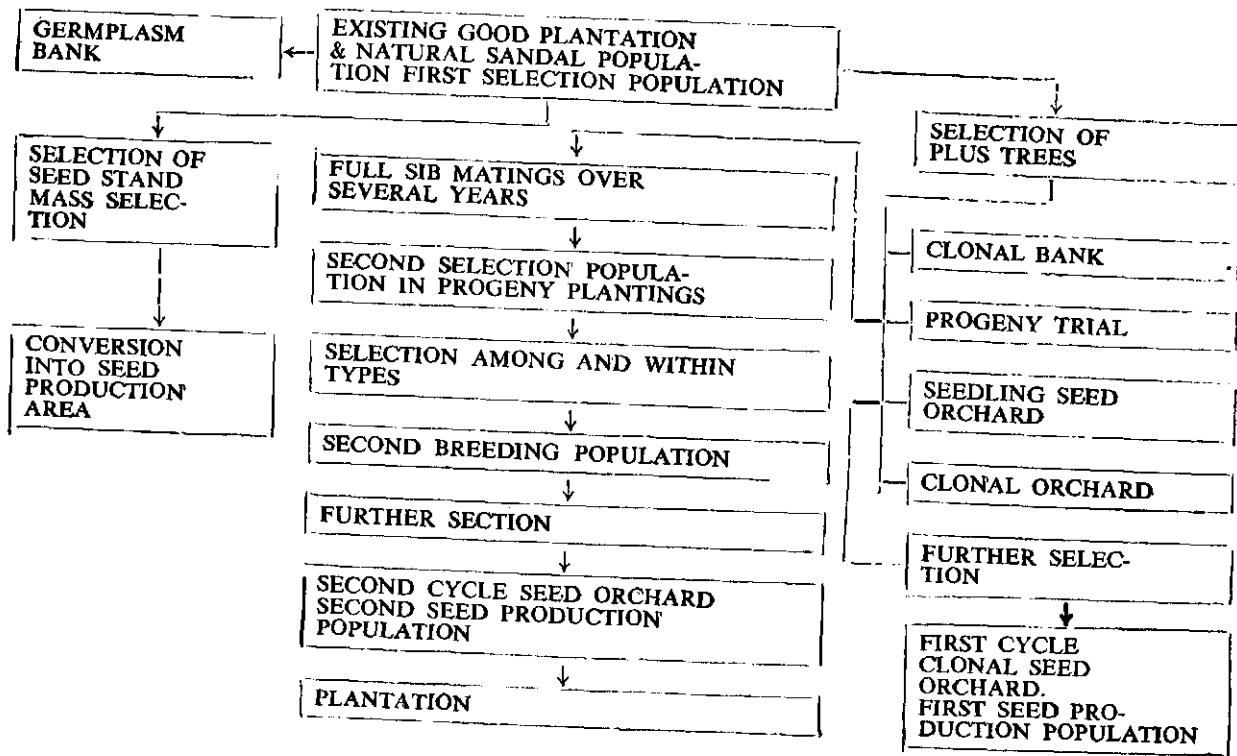


## ANNEXURE VI

## Exports of sandalwood carvings\*

Year	Value (in '000 Rs.)
1965-66 . . . . .	62.40
1966-67 . . . . .	107.17
1967-68 . . . . .	205.02
1968-69 . . . . .	230.21
1969-70 . . . . .	359.26
1970-71 . . . . .	632.55
1971-72 . . . . .	525.20
1972-73 . . . . .	781.58
1973-74 . . . . .	1677.87
1974-75 . . . . .	1290.52
1975-76 . . . . .	1590.77
1976-77 . . . . .	1021.19
1977-78 . . . . .	2175.13
1978-79 . . . . .	2516.86
1979-80 . . . . .	5703.27
1980-81 . . . . .	11768.53

\* SOURCE : Monthly Statistics of Foreign Trade of India Vol. I (SITC : 8960725).



1	2	3	4	5	6	7	8	9	10
U.S.A. . . . . Q.	170	141	25	—	42	1	—	1	10
. . . . . V.	1044·65	790·60	140·90		315·00	12·19	0·21	5·20	125·00
Germany F.R. . . . . Q.							3		4
. . . . . V.							24·00		62·63
Burma . . . . . Q.	14	25	20			15	72	33	
. . . . . V.	93·47	243·25	215·00			234·50	1093·00	515·59	
U.K. . . . . Q.		7	10		5			7	3
. . . . . V.		41·11	73·28		64·58			76·14	9·32
Switzerland . . . . . Q.									
. . . . . V.									
Malaysia . . . . . Q.			9		—	—	2		
. . . . . V.			65·70		8·73	1·25	22·49		
Others . . . . . Q.	14	20	7	210	1	7	1	10	1
. . . . . V.	102·57	145·43	50·60	2604·62	30·77	37·77	25·30	167·81	47·61
Total . . . . . Q.	373	544	297	324	294	354	440	417	451
. . . . . V.	2474·71	2937·96	2361·96	3692·39	3666·67	4485·83	6082·64	5506·49	5702·46

## ANNEXURE VII—Contd.

## Country-wise export of sandalwood—Contd.

(Q) Qty. in Tonnes  
(V) Value in '000 Rs.

Destination	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81
1	11	12	13	14	15	16	17	18	19
France . . . . .	Q. —	—	—	5	169	7	—	—	—
	V. —	—	—	135.00	6121.78	381.00	—	—	—
Hong Kong . . . . .	Q. 105	96	52	141	—	74	—	—	—
	V. 1518.70	2127.37	1919.12	5000.00	—	4381.99	—	—	—
Japan . . . . .	Q. 45	99	22	36	36	50	149	256	15
	V. 639.46	1801.35	905.14	1430.59	1773.71	1978.24	6316.83	4717.21	678.19
Oman . . . . .	Q. —	—	—	—	—	11	—	—	3
	V. —	—	—	—	—	704	—	—	61.20
Saudi Arabia . . . . .	Q. —	—	4	21	—	5	61	—	20
	V. —	—	100.47	612.30	—	310.73	3759.12	—	140.85
Singapore . . . . .	Q. 95	76	34	60	58	80	79	73	—
	V. 1380.38	1434.14	1612.26	2198.67	2726.56	4652.78	4126.62	3358.32	—
Somalia . . . . .	Q. —	—	—	—	—	20	—	—	—
	V. —	—	—	—	—	901.48	—	—	—
Sudan . . . . .	Q. 121	81	75	30	66	35	88	66	2
	V. 1403.38	1024.41	2115.06	779.36	1700.11	1596.94	4007.33	3430.71	106.68
Sweden . . . . .	Q. —	—	—	—	—	15	—	—	—
	V. —	—	—	—	—	698.78	—	—	—
U.A.E. . . . .	Q. —	—	—	1	—	7	—	—	2
	V. —	—	—	16.61	—	302.85	—	—	65.83

I		11	12	13	14	15	16	17	18	19
U.S.A.	. . . Q. V.	—	—	27 384·03	30 504·23	—	—	—	—	—
Germany F.R.	. . . Q. V.			— 3·89	—	—	—	—	—	—
Burma	. . . Q. V.				18 532·30		4 313·14			
U.K.	. . . Q. V.			12 203·78						
Switzerland	. . . Q. V.			10 315·00						
Malaysia	. . . Q. V.									
Others	. . . Q. V.	15 198·65	47 530·05	8 165·41	7 271·54	25 724·78	10 443·33	86 3867·77	100 5418·76	2 91·06
Total	. . . Q. V.	381 5140·57	399 6917·32	244 7724·16	349 11480·60	354 13046·94	318 16665·67	463 22077·77	495 16925·50	44 1143·81

SOURCE: Monthly statistics of Foreign Trade of India Vol. I (SITC : 2472125)

ANNEXURE VIII  
Export of sandalwood chips and dust

(Q) Qty in Tonnes  
(V) Value in '000 Rs.

Sl. No.	Name of the Country	1965-66	1966-67	1967-68	1968-69	1969-70	1970-71	1971-72	1972-73
1	2	3	4	5	6	7	8	9	10
1.	Hungary	Q.	—	—	2.00	4.00	15.00	25.00	—
		V.	—	—	6.06	12.10	5.43	11.20	—
2.	Belgium	Q.	—	—	—	—	—	—	—
		V.	—	—	—	—	—	—	—
3.	Ethiopia	Q.	—	0.50	0.50	—	—	—	0.25
		V.	—	0.55	15.60	—	—	—	7.70
4.	France	Q.	—	—	2.50	1.00	3.00	1.00	0.75
		V.	—	—	3.48	2.80	6.00	3.00	2.80
5.	Germany FR	Q.	4.00	3.20	4.00	2.00	2.00	2.00	2.00
		V.	9.27	7.60	12.10	—	6.10	6.10	6.22
6.	Hong Kong	Q.	46.06	78.40	69.00	89.25	102.00	111.00	108.00
		V.	116.44	33.10	67.86	111.60	39.64	151.00	221.87
7.	Italy	Q.	3.30	4.50	3.00	8.50	5.00	7.50	5.00
		V.	4.89	10.33	8.75	23.37	13.29	19.10	12.70
8.	Japan	Q.	110.80	212.00	144.15	148.05	138.53	219.60	177.25
		V.	92.69	124.51	221.86	157.40	82.47	199.12	108.40
9.	Malaysia	Q.	28.96	160.18	12.43	4.91	1.39	3.17	1.34
		V.	45.21	31.87	28.21	17.78	7.63	13.00	9.28
10.	Nigeria	Q.	2.97	12.00	9.00	6.00	20.00	11.00	25.00
		V.	8.6	38.17	30.00	20.12	65.80	28.32	76.32

1	2		3	4	5	6	7	8	9	10
11.	Oman	Q. V.	—	—	—	—	—	—	—	—
12.	Saudi Arabia	Q. V.	2·96 6·20	0·96 5·24	2·56 13·12	2·45 15·70	9·60 74·03	3·75 17·68	3·97 17·85	2·45 7·52
13.	Singapore	Q. V.	—	4·25 31·57	7·26 70·95	4·23 14·58	15·67 42·63	5·41 25·64	5·58 37·92	8·86 21·02
14.	Sudan	Q. V.	25·40 157·53	6·50 23·96	16·00 35·08	33·90 302·24	4·70 19·80	29·50 328·17	1·70 6·42	—
15.	Sweden	Q. V.	—	—	—	—	—	—	—	—
16.	U.A.E.	Q. V.	—	—	—	—	—	—	—	—
17.	U.S.A.	Q. V.	213·35 892·48	82·60 525·66	50·00 372·75	0·30 3·30	12·44 6·04	2·47 8·78	0·97 4·35	0·10 0·43
18.	U.K.	Q. V.	—	3·10 8·08	3·82 13·91	8·27 28·53	0·50 1·39	—	0·65 1·37	3·23 6·16
19.	Ceylon	Q. V.	16·65 28·02	8·57 20·77	8·95 26·89	18·08 39·45	5·50 13·53	2·77 5·91	5·00 11·86	5·66 12·98
20.	Czechoslovakia	Q. V.	—	—	—	—	—	—	—	—
21.	Switzerland	Q. V.	—	—	—	—	—	0·25 0·80	0·10 0·20	—
22.	Others	Q. V.	24·45 58·96	11·70 28·82	17·95 72·66	11·83 43·00	11·73 53·18	8·53 38·40	9·99 63·08	38·17 189·74
Total		Q. V.	478·90 1420·29	588·28 890·23	351·12 993·22	340·77 785·93	336·06 443·63	421·95 850·45	372·30 591·74	439·05 622·06

## ANNEXURE VIII—Contd.

## Export of sandalwood chips and dust

(Q) Qty in Tonnes  
(V) Value in '000 Rs.

Sl. No.	Name of the Country	1973-74	1974-75	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81
1	2	11	12	13	14	15	16	17	18
1.	Hungary . . . . .	Q.	1.00	—	—	—	—	—	—
		V.	12.70	—	—	—	—	—	—
2.	Belgium . . . . .	Q.	—	—	—	—	1.15	—	—
		V.	—	—	—	—	4.10	—	—
3.	Ethiopia . . . . .	Q.	—	—	—	0.10	1.10	0.10	0.15
		V.	—	—	—	3.30	6.40	7.35	2.70
4.	France . . . . .	Q.	5.55	2.50	4.50	14.70	7.00	2.20	14.76
		V.	14.00	9.90	17.16	164.45	176.20	16.60	96.64
5.	Germany FR . . . . .	Q.	6.00	6.00	—	4.01	12.50	13.33	7.90
		V.	28.50	35.33	—	31.05	128.65	242.34	643.20
6.	Hong Kong . . . . .	Q.	40.00	146.00	126.00	164.00	232.80	214.20	97.30
		V.	76.40	408.31	526.57	608.00	2185.62	2598.90	1355.94
7.	Italy . . . . .	Q.	7.00	6.00	2.20	11.00	1.02	5.00	1.00
		V.	15.80	62.14	17.26	106.32	12.74	42.52	5.96
8.	Japan . . . . .	Q.	205.00	240.50	50.50	169.78	203.00	122.22	65.27
		V.	276.03	483.17	142.31	17.19	34.18	2.47	24.80
9.	Malaysia . . . . .	Q.	1.27	32.60	162.06	42.91	84.25	28.78	93.55
		V.	12.70	84.94	239.76	10.00	10.00	5.00	10.00
10.	Nigeria . . . . .	Q.	15.00	13.00	10.00	10.00	10.00	5.00	10.00
		V.	65.00	87.81	49.32	54.70	40.27	40.15	81.02



1	2		11	12	13	14	15	16	17	18
11. Oman		Q.	—	—	—	3·27	2·23	10·67	2·86	8·430
		V.				106·28	135·16	154·53	67·41	219·860
12. Saudi Arabia		Q.	32·55	24·30	15·50	18·25	10·00	34·80	30·02	66·060
		V.	274·12	256·98	152·29	413·99	176·00	393·92	660·77	1708·307
13. Singapore		Q.	25·87	4·24	72·71	130·02	34·90	108·57	49·16	141·231
		V.	75·04	27·25	723·53	1345·12	713·27	2046·93	680·69	1838·034
14. Sudan		Q.	13·50	15·10	22·57	123·27	21·50	18·14	83·91	109·770
		V.	173·17	112·10	630·10	3581·26	189·57	724·51	4179·22	5502·237
15. Sweden		Q.	—	—	—	—	2·00	—	5·00	—
		V.					11·46		260·36	
16. U.A.E.		Q.	—	—	—	—	1·84	6·80	16·07	11·138
		V.					99·09	165·45	263·22	610·111
17. U.S.A.		Q.	0·45	4·57	—	1·30	0·70	8·10	21·61	6·057
		V.	2·13	48·58		9·82	61·08	75·36	318·24	40·292
18. U.K.		Q.	10·96	14·11	8·10	—	—	—	0·05	8·000
		V.	151·30	199·52	21·11				3·50	45·600
19. Ceylon		Q.	2·75	—	—	0·10	—	8·00	—	0·300
		V.	8·33			2·17		33·30		3·300
20. Czechoslovakia		Q.	—	—	—	—	—	—	—	—
		V.								
21. Switzerland		Q.	—	—	—	—	—	—	—	—
		V.								
22. Others		Q.	82·09	16·14	14·77	79·02	6·06	80·60	0·14	44·445
		V.	604·52	96·88	109·97	678·22	946·98	897·78	51·01	964·040
Total		Q.	448·99	525·06	488·91	771·73	640·05	666·51	498·75	637·829
		V.	1189·74	1912·91	2629·38	7131·87	4930·77	7447·11	8704·77	14660·212

## ANNEXURE—IX

Country-wise export of *Agarbattis* from India from the years 1965-66 to 1980-81

(value in '000 Rupees)

Sl. No.	Country	1965-66	1966-67	1967-68	1968-69	1969-70	1970-71	1971-72	1972-73	1973-74	1974-75
1	2	3	4	5	6	7	8	9	10	11	12
1.	Bahrain	20.47	36.78	41.43	87.10	45.90	30.37	47.10	38.17	55.70	50.19
2.	Canary Is.	10.30	—	85.82	44.43	58.93	105.69	188.65	551.64	226.84	256.11
3.	Ethiopia	423.03	925.40	922.90	1182.20	1375.68	1550.90	1379.19	1593.20	1316.60	3672.93
4.	France	22.20	25.18	34.70	38.54	104.28	105.52	199.70	319.43	627.36	1121.90
5.	Kenya	286.20	457.56	442.20	621.62	433.52	463.20	436.08	293.60	288.60	382.25
6.	Kuwait	30.35	77.00	57.36	43.84	74.01	80.70	90.43	82.64	167.15	214.42
7.	Malaysia	739.27	486.55	505.10	480.42	513.62	518.10	359.40	442.38	545.57	564.40
8.	Mauritius	99.87	136.84	166.29	217.26	135.80	104.00	174.03	119.13	128.23	254.87
9.	Nigeria	128.29	209.11	87.21	311.31	338.00	394.30	875.42	1753.80	1705.91	3463.64
10.	Saudi Arabia	334.50	158.75	159.38	235.49	311.40	339.75	269.03	189.36	690.03	933.64
11.	Singapore	—	450.90	535.91	709.10	857.00	1078.69	1207.75	1303.67	1837.49	1946.10
12.	Spain	16.67	9.55	5.64	19.90	7.59	4.08	18.55	61.37	71.40	40.90
13.	Sudan	53.30	76.00	279.28	79.68	106.70	207.36	256.20	41.76	51.00	10.19
14.	U.A.E.	—	—	—	—	—	—	—	—	—	—
15.	U.K.	63.73	85.45	193.90	275.88	378.50	555.53	614.41	756.71	1259.34	2010.87
16.	U.S.A.	42.90	162.79	885.60	3068.27	2622.77	4304.52	4081.61	3763.52	4029.20	3021.79
17.	U.S.S.R.	—	66.96	—	2324.84	2707.67	2910.87	3921.03	5.69	—	7752.51
18.	Others	835.93	—	1538.92	2324.84	2707.67	2910.87	3921.03	6877.65	9047.84	7752.51
Total		3105.01	3364.82	5941.54	12064.72	12779.04	15664.45	18039.61	18193.72	22048.26	33449.22

Sl. No.	Country	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81
1	2	13	14	15	16	17	18
1.	Bahrain	946.37	2755.57	822.23	360.66		193.990
2.	Canary Is.	250.32	1493.50	1974.92	927.68		713.985
3.	Ethiopia	2074.69	7214.90	2076.57	651.68		3151.792
4.	France	923.82	1516.97	2535.98	4803.25	5279.72	3560.134
5.	Kenya	339.32	278.61	113.01	349.15		356.935
6.	Kuwait	340.87	1447.03	3257.44	3451.56		5365.839
7.	Malaysia	941.44	708.95	738.55	1085.33		1945.670
8.	Mauritius	305.25	531.00	565.13	451.48		824.438
9.	Nigeria	5928.69	7248.72	13401.05	11890.05	16415.36	22044.388
10.	Saudi Arabia	1901.20	2473.40	8107.50	5344.78	9015.00	12923.258
11.	Singapore	2212.10	2865.71	4482.39	3358.45	3706.29	4046.035
12.	Spain	52.41	207.27	164.90	804.08		195.429
13.	Sudan	—	620.94	242.70	249.91		809.150
14.	U.A.E.	—	—	355.81	7941.53	6965.04	7124.257
15.	U.K.	1065.96	1876.00	1567.00	1648.00		3599.422
16.	U.S.A.	3019.01	4273.00	4667.51	3248.50	4847.63	3437.294
17.	U.S.S.R.	—	—	1001.14	—		450.150
18.	Others	1423.80	27308.79	11870.82	34856.80	31771.26	18574.577
Total		21725.25	62820.36	57944.65	81422.89	78000.30	89316.763

SOURCE.—Monthly Statistics of Foreign Trade of India Vol. I (SITC : 5530051)

## ANNEXURE X

Centre-wise average auction prices of different classes of sandalwood in the State of Tamil Nadu

(Unit : Rs. per tonne)

Class of Wood	1975		1976		1977		1978		
	July	December	July	December	July	December	July	December	
1	2	3	4	5	6	7	8	9	10
1. Ghatbadla	1. Tirupattur	35010	38769	47507	56616	63904	51606	86820	—
	2. Salem	No bid	No bid	—	—	—	—	—	—
	3. Satyamangalam	Do.	Do.	47507	55155	60255	57560	65550	No bid
2. Begardad	1. Tirupattur	—	34000	—	49100	60050	42200	68133	—
	2. Salem	—	—	—	—	—	—	—	—
	3. Satyamangalam	No bid	No bid	—	—	—	48000	60000	—
3. Roots I	1. Tirupattur	20,103	22827	36893	47699	60337	46869	51023	—
	2. Salem	—	—	—	—	—	—	—	—
	3. Satyamangalam	20250	22470	36993	50996	63218	50515	51114	39410
4. Roots II	1. Tirupattur	20048	25352	39094	53706	64142	56734	53900	40186
	2. Salem	—	—	—	—	—	—	—	—
	3. Satyamangalam	20562	25917	39094	57167	65799	56623	—	39010
5. Roots III	1. Tirupattur	21291	26605	39539	58556	65851	59816	56530	41612
	2. Salem	—	—	—	—	—	—	—	—
	3. Sathyamangalam	22035	27529	39539	64270	67026	61289	—	40900
6. Jajpokal I	1. Tirupattur	22668	23420	31025	51135	57488	42837	58911	40290
	2. Salem	—	—	—	—	—	—	—	—
	3. Satyamangalam	21010	23369	31025	49549	57517	42683	49902	39910
7. Jajpokal II	1. Tirupattur	20044	21239	30998	49164	54756	40679	45712	39010
	2. Salem	—	—	—	—	—	—	—	—
	3. Satyamangalam	18241	22545	30998	48925	56010	40548	44408	380101

1	2	3	4	5	6	7	8	9	10
8. Ainbagar	1. Tirupattur	20010	21081	30452	49009	53700	40483	43846	39010
	2. Salem	—	—	—	—	—	—	—	—
	3. Satyamangalam	18190	21563	30452	48615	53038	38988	40625	—
9. Cheria	1. Tirupattur	20233	21033	20035	47933	51784	39992	42640	38510
	2. Salem	—	—	—	—	—	—	—	—
	3. Satyamangalam	18510	20180	30035	46155	51055	37015	40010	37510
10. Ainchilta	1. Tirupattur	20570	23175	32500	51854	38200	45242	46000	39010
	2. Salem	—	—	—	—	—	—	—	—
	3. Satyamangalam	18230	20900	32500	46275	55010	39515	40300	36100
11. Milvachilta	1. Tirupattur	11029	12800	21255	31335	37359	26693	25949	20879
	2. Salem	—	—	—	—	—	—	—	—
	3. Satyamangalam	10125	14953	21255	35095	37703	23960	24250	19100
12. Basola Bukni	1. Tirupattur	8514	12492	18758	28710	35178	23975	24917	20392
	2. Salem	—	—	—	—	—	—	—	—
	3. Satyamangalam	9513	14538	18758	31167	37826	22714	23721	18055
13. Saw dust	1. Tirupattur	10050	16010	20050	32000	39000	27010	27100	20100
	2. Salem	—	—	—	—	—	—	—	—
	3. Satyamangalam	10210	16490	20050	25000	—	26010	27100	—
14. Charred roots	1. Tirupattur	21010	25700	—	54000	60337	—	54900	—
	2. Salem	—	—	—	—	—	—	—	—
	3. Satyamangalam	—	—	—	—	—	—	—	—
15. Charred Billets	1. Tirupattur	20736	24005	—	57316	55339	46339	62067	—
	2. Salem	—	—	—	—	—	—	—	—
	3. Satyamangalam	—	—	—	—	—	—	—	—

## ANNEXURE X —Contd.

Centre-wise average prices of different classes of sandal wood in the State of Tamil Nadu—contd.

(Unit : Rs. per Tonne)

Class of Wood	1979		1980		1981		1982	
	July	December	July	December	July	December	July	
	11	12	13	14	15	16	17	
1. Ghatbadla	1. Tirupattur	62721	—	—	—	No bid	No bid	44267
	2. Salem	—	—	—	—	No bid	40010	—
	3. Satyamangalam	No bid	No bid	—	—	27349	34000	45610
2. Bagardad	1. Tirupattur	—	—	—	—	No bid	No bid	43590
	2. Salem	—	—	—	—	28610	39010	—
	3. Satyamangalam	—	—	—	—	26917	—	44000
3. Roots I	1. Tirupattur	40440	—	23952	20551	24777	28361	37889
	2. Salem	40251	30020	23306	21500	26740	30953	38381
	3. Satyamangalam	40003	30537	23500	21010	28106	31480	39000
4. Roots II	1. Tirupattur	40667	30126	26807	22974	28830	31698	43455
	2. Salem	41573	30361	26245	23315	31248	35132	43940
	3. Satyamangalam	40113	30955	26630	23869	32329	35589	43770
5. Roots III	1. Tirupattur	42152	31573	30128	26060	33102	35749	49677
	2. Salem	42828	31647	30388	25121	35279	40554	48419
	3. Satyamangalam	41230	31872	30010	25751	35351	41005	49114
6. Jajpokal I	1. Tirupattur	43109	26704	22610	19169	25882	30279	40229
	2. Salem	42647	26752	22578	19154	27236	35142	38232
	3. Satyamangalam	39111	25533	21515	18581	28374	32569	38242
7. Jajpokal II	1. Tirupattur	39166	24199	22372	18386	26796	30228	38631
	2. Salem	38760	22921	22018	17984	24673	32176	36642
	3. Satyamangalam	38264	22565	21010	17612	26641	30358	36748

1	2	11	12	13	14	15	16	17
8. Ainbagar	1. Tirupattur	38981	22098	22134	18328	25916	30088	37690
	2. Salem	38140	22067	22015	—	23075	31797	35258
	3. Satyamangalam	27018	22007	—	17015	26593	30077	35200
9. Cheria	1. Tirupattur	38510	22210	20978	18340	25483	29263	37753
	2. Salem	28070	—	20366	17572	No bid	30269	34577
	3. Satyamangalam	—	21760	20440	16435	26330	29613	34890
10. Ainchilta	1. Tirupattur	38420	22237	23300	—	27050	31420	41846
	2. Salem	36033	22010	22765	19600	25015	35110	40165
	3. Satyamangalam	35010	22010	22210	17510	26720	30030	42000
11. Milvachilta	1. Tirupattur	21447	15147	15898	14010	17724	21823	26492
	2. Salem	22664	15223	15825	14330	No bid	21590	23927
	3. Satyamangalam	19830	14595	14510	13488	18214	No bid	24166
12. Basola Bukni	1. Tirupattur	20050	12120	10539	9018	12033	16227	19719
	2. Salem	18425	12421	10306	9040	12250	16693	18860
	3. Satyamangalam	17570	11675	12169	9011	14636	16200	19201
13. Saw Dust	1. Tirupattur	—	17010	—	17010	16510	18417	19010
	2. Salem	21100	17000	16010	—	18500	19010	20100
	3. Satyamangalam	—	—	—	—	17050	18010	—
14. Charred Roots	1. Tirupattur	40040	28736	26400	22600	29000	34000	45100
	2. Salem	40210	29510	26900	22570	26010	36700	43100
	3. Satyamangalam	—	12070	—	19010	No bid	—	—
15. Charred Billets	1. Tirupattur	41662	25013	23905	20569	26182	30083	40069
	2. Salem	—	—	22510	20310	24010	31180	37420
	3. Satyamangalam	—	25013	16030	—	26710	—	37030

## ANNEXURE-XI

**Provisions relating to sandal wood in Karnataka**

83. *Forest rights of inamdars and persons entitled to sandal trees*—(1) All inamdars and other persons who by the terms of their sannads, grants, or by judicial decisions or otherwise are, prior to the commencement of this Act, legally entitled to the sandal trees in their lands shall not fell or sell any such sandal trees.

(2) The Chief Conservator of Forests may cause any sandal tree growing in such lands to be cut and sold on behalf of the inamdars or other persons in accordance with such rules as may be prescribed.

84. *Sandal tree exclusive property of Government*—Notwithstanding anything contained in any law, contract, grant or other instrument or judicial decision—

- (i) all sandal trees which may grow in any land after the date of the commencement of this Act, and
- (ii) all sandal trees existing on any land prior to the commencement of this Act, the ownership in which vested in the State Government.

85. *Responsibility of occupants and holders of land for the preservation of sandal trees*—(1) Every occupant to holder of land shall be responsible for the due preservation of all sandal trees growing thereon, which are the exclusive property of the State Government & shall in the event of any injury to any such tree from whatever cause or its theft, at once report such fact to the nearest Forest Officer or Police Officer.

(2) Any occupant to holder who fails to report any such case of injury or theft as aforesaid or to prove to the satisfaction of such officer, not lower in rank than the Divisional Forest Officer that such injury or theft was not caused either by his own act or by any neglect or default on his part, or by any other person at his instigation or with the connivance, shall notwithstanding any other penalty to which he may be liable, be liable to pay to State Government such compensation on account of such injury or theft as the Forest Officer may deem reasonable :—



Provided that the Forest Officer aforesaid, may in cases in which he is satisfied that the person responsible for the act, neglect, default, instigation or connivance resulting in the injury to theft was any tenant of the occupant or holder or any other person holding under or through an occupant or holder direct that such tenant or other person shall primarily be liable for the compensation and be processed against in the first instance for recovery thereof.

*Explanation* :—The word “injury” used in this section includes the lopping of branches of trees resulting in material injury to them.

86. *Penalty to offence in regard to sandalwood*—In any case of a forest offence having reference to the cutting, uprooting, removal or damage to sandal tree or any part of a sandal tree belonging to Government, the offender shall on conviction, be punishable with imprisonment for a term which may extended to two years or with fine which may extend to two thousand rupees or with both.

87. *Regulation of sale and manufacture of sandal wood and sandal wood oil*—(1) No person shall possess, store or sell or attempt to store or sell sandal wood or disintegrate or attempt to disintegrate sandal wood in mills or by other contrivance manufacture or distil, or attempt to manufacture or distil oil from sandal wood, or re-distil, refine or sell oil extracted from sandalwood, except under a licence obtained from such Forest Officer on payment of such fees, & subject to such restrictions & conditions as may be prescribed.

Provided that no such licence shall be refused in respect of distillation of oil from sandal wood & possession & storage of sandal wood for purposes of distillation & the sale of sandal wood oil so distilled, by persons bonafide of this Act, in any area of the State.

Provided further that no such licence shall be necessary for possession of sandal wood upto seven pounds bonafide domestic use.

(2) Whoever contravenes the provisions of sub-section (1) shall, on conviction, be punishable with imprisonment for a term which may extend two years or with fine which may extend to two thousand rupees or with both.

### A. Declaration of sandal trees grown on private lands.

100. *Definitions*—In this chapter unless the context otherwise requires,—

- (a) "Licensee" includes his servants or agents engaged in carrying out the purposes of the licences granted under the rules.
- (b) 'Mature sandal tree' for purposes of the rules is one which is showing signs of decay as indicated by the following external symptoms :—
  - (i) Dead main branches and leading shoot.
  - (ii) Decay of bark.
  - (iii) Pale colour and diminutive size of leaves. A further and infallible test is that the heartwood must not be at a lower depth than 2 1/2 cm. from the surface.
- (c) Owner includes occupants of such occupants have got a right or interest over sandal trees.
- (d) 'Sandal tree' includes saplings and seedlings.

104. *Declaration to be filed*—(1) All owners of private land shall file with the Divisional Forest Officer or any other officer duly authorised by him a declaration in Form 12 alongwith a certificate from Tahsildar regarding the ownership of the land and or right over the sandal tree within such date as may be notified in the official Gazette by the Divisional Forest Officer.

(2) Every owner of land shall report at intervals of not less than five years and when such information is called or by notification in the Official Gazette by the Divisional Forest Officer about all sandal trees that were declared as below 10 cms in girth at 1.37 m. from ground level at the time of the first declaration and all sandal trees further recruited in the land when they attain a girth of 10 cms at 1.37 m. from ground level to the Range Forest Officer or any other Officer authorised in this behalf.

105. *Acceptance of the declaration*—(1) The Divisional Forest Officer or Range Forest Officer or the officer authorised to receive such declaration shall, after a notice issued to the owner of the land, hold a spot inspection of the land and the sandal trees growing thereon in the presence of the owner of such land if he desires to be present and after satisfying himself about the correctness of the particulars furnished by the declarant, if

necessary, in consultation with the concerned Revenue Authorities pass the declaration as accepted and give numbers to the trees the girth of which are 10 cm or more at 1.37 m. from ground level.

(2) The original of the declaration shall be preserved in the concerned Range Forest Office, the duplicate shall be sent to the Tahsildar & the triplicate returned to the owner of the land.

(3) A register shall be maintained in the office of the Divisional Forest Officer & the Range Forest Officer in Form 13 & every declaration of sandal trees recorded in it with full particulars after verification of the sandal trees in the concerned Revenue Records from the list furnished to him.

(4) Every declarant of sandal trees shall renew the numbers marked on the trees periodically & always keep them legible.

106. *Forest Officer may remove sandal trees*—Any Forest Officer authorised by an Officer not below the rank of a Ranger in this behalf may, after due notice to the owners, enter any private land and uproot or remove any sandal tree growing on such land subject to the such provisions as are laid down under these rules. The land owner shall afford such Forest Officer necessary facilities in the discharge of such duties & shall not obstruct him in such work.

107. *Failure to file declaration*:—(1) No owner of land shall be entitled to receive the value of sandal trees in his land unless he makes the declaration of sandal trees existing on his land under rule 104.

(2) Any owner of land who fails to make the declaration in respect of sandal trees the right of ownership of which rests with the Government shall forfeit his claim to the bonus, provided that special cases the Conservator of Forests may sanction the payment of the bonus notwithstanding anything contained in this rule.

108. *Exploitation of sandal trees from private lands the owners of which possess a right thereto*—(1) Any person who wants any of the sandal trees declared by him under rule 114 extracted departmentally shall apply to the concerned Range Forest Officer in writing, furnishing particulars regarding the village survey number or other particulars of the land, the serial number marked on the tree at the time of

declaration, the approximate height, girth at 1.37 m. from ground level & the condition of the trees and the reasons for its removal.

(2) On receipt of such application the Range Officer shall, after such enquiry as he deems necessary, if satisfied about ownership of the applicant to the trees and that they have been declared by the applicant and are fit for exploitation, report the matter to the Divisional Forest Officer shall, after such enquiry as he deems necessary, if satisfied about ownership of the applicant to the trees and that they have been declared by the applicant and are fit for exploitation, report the matter to the Divisional Forest Officer who after such further enquiry as he deems necessary is satisfied about the bona fides, order the removal of the trees. The trees thus permitted to be felled shall be noted in the register in Form 13.

(3) Every tree ordered to be felled shall be marked by the Range Forest Officer with a hammer mark bearing the monogram "F" just above the root stock after removing the outer bark and white wood. It shall be given a serial number marked on it corresponding with that given in a register in Form 14 by the Range Forest Officer showing all the trees marked by him for removal from private lands. An extract of register in Form 14 shall be sent to the Divisional Forest Officer every month.

(4) Thereafter, the tree shall be uprooted and roughly dressed, leaving a ring at the point where the girth measurement was taken, measured and sent to the Depot under a transit pass in the remarks giving a receipt to the owner of the land in Form 15.

(5) Trees containing no heartwood or heartwood less than 1 cm. in diameter shall be felled and destroyed in the presence of the Range Forest Officer and the owner of the land or his agent under a mahazar. The owner thereof shall not be entitled for the value of such trees.

(6) The Officer in charge of the depot, on receipt of the tree, shall check its measurements, weigh it and pass on a receipt to the Forest Guard accompanying the tree and get the sandal wood cleaned, prepared, assorted and classified in exactly the same manner as the Govt. sandal wood. He shall submit to the Divisional Forest Officer the list of sandal trees of private ownership received and the quantity of assorted and cleaned wood obtained from such trees in Form 16, forwarding a copy of it to the concerned Range Forest Officer from whom he had received the tree.

(7) The rates at which the value of sandal wood has to be paid to the owners of sandal trees shall be fixed by Govt. from time

to time based on the average prices obtained for sandal wood in the auction sales held in the State or in the neighbouring States. After deducting the cost of extraction, transport, preparation, supervision and other incidental charges, as fixed by the Chief Conservator of Forests, the value of sandalwood shall be paid to the owner, as soon as possible on bills countersigned by the Divisional Forest Officer.

109. *Felling of sandal trees which are the exclusive property of the State Government from private lands—*(1) The selection of sandal trees for extraction shall entirely rests with the Forest Department and no land owner shall have the right to insist that a sandal trees standing on his land be removed on any ground than that of obstruction to cultivation or to object to the removal of any trees by the Forest Department in the course of its ordinary operation.

(2) Every sandal tree intended for felling shall be marked by the Range Forest Officer with a 'F' hammer mark just above the root stock after removing the outer bark and white wood and given a serial number marked on it corresponding with that contained in a register in Form 14 maintained by the Range Forest Officer showing all the trees marked by him for removal from private lands. Monthly extract there from shall be sent to the Divisional Forest Officer.

(3) The trees thus marked shall be uprooted, roughly dressed, leaving a ring at the point where the girth measurement was taken, measured and sent to the Depot accompanied by a transit pass in the 'remarks' column of which the name of the owner and his address shall be noted.

(4) Any land owner may get any sandal tree growing in his holding removed if it interferes with the legitimate use of his land, by making an application in that behalf to the Tahsildar, giving the survey number in which the sandal tree is situated and furnishing the approximate height and girth of such tree and the serial number marked on it at the time of declaration. The Tahsildar shall, after such enquiry as he deems necessary, if satisfied about the bona fide of the applicant's request, forward the application with his recommendations to the Divisional Forest Officer who after such verification and enquiry as he deems necessary, if satisfied about the bona fides, may order the removal of the trees on payment of such compensation by the owner as may be prescribed in that behalf. The Divisional Forest Officer shall be final.

(5) No compensation shall be levied on mature trees removed under sub-rule (4) supra and the owner or occupant is entitled to get bonus for such mature trees where it is admissible.

(6) Compensation—The amount of compensation payable under sub-rule shall be as follows :—

Girth at breast-height i.e., 1.37 m. above ground level.	Amount of compensation payable to Govt. by the occupant.
Class :	Rs.
I. Less than 30 cm.	—
II. 30 cm. to 60 cm.	4
III. Above 60 cm. up to 75 cm.	8
IV. Above 75 cm.	12

110. *Waving the compensation payable*—Claim for compensation may be waived in suitable cases—

- (i) by Divisional Forest Officer if the amount does not exceed Rs. 25.
- (ii) by Conservator of Forests if the amount does not exceed Rs. 100 and
- (iii) by the Chief Conservator of Forests if the amount does not exceed Rs. 250.

111. *Dead sandal trees*—If any sandal tree dies before attaining maturity, but is otherwise undamaged, and the Divisional Forest Officer is satisfied that the premature death of the trees was solely due to nature causes such as disease, lightning etc., over which the occupant had not control or which he could not have prevented such a tree shall be removed by the Department and sent to the depot if it contains heart-wood of 1 cm. and above in diameter and shall be paid such bonus as may be prescribed in these rules. Tree containing no heart-wood or heart-wood less than one cm. in diameter shall be destroyed in the presence of the Range Forest Officer and the owner of the land or his agent under a mahazar and no bonus shall be paid for it. No bonus shall be paid for trees which have been destroyed by fire or other causes or for trees which have been killed or have died through culpable neglect on the part of the land owner.

112. *Receipt to be given to the owner if he is entitled for bonus*—The Range Forest Officer shall, while removing sandal trees from private lands where the owner of such land is entitled to the bonus under these rules, issue a receipt in Form 15 which shall be surrendered to the Range Forest Officer at the time of payment of the bonus.

113. *Trees to be cleaned and classified in the depot*—The Officer-in-charge of the depot, on receipt of the trees, shall check its measurements, weigh it and pass a receipt to the Guard accompanying the tree and get the sandal wood cleaned, prepared, assorted and classified in exactly the same manner as the sandal wood from Government lands. He shall submit to the Divisional Forest Officer the list of sandal tree received from private holdings of every owner and the quantity of assorted and cleaned wood obtained from such trees in Form 16, forwarding the copy of it to the concerned Range Forest Officer from whom he had received the trees.

114. *Bonus*—(1) The Owner of private land from which the sandal trees have been extracted by the Department shall be entitled to get a bonus equivalent to 50% of the net value (gross value of wood, less a cost of extraction, transport, cleaning, supervision and other incidental charges) of the wood evaluated at the rules sanctioned by Govt. from time to time for this purpose, but he shall not be entitled to get any bonus for trees which have been destroyed by fire or other cause or for trees which have been killed or have died through culpable neglect on his part.

(2) Bonus shall be paid by the Range Forest Officer as soon as possible on bills countersigned by the Divisional Forest Officer.

115. *Removed trees to be deleted from the register*—The Range Forest Officer shall score out from the register of sandal trees in 13, the sandal trees removed from private lands and report the fact to the Divisional Forest Officer and Tahsildar.

**B. Damage, destruction and theft of sandal trees belonging to Government in private lands.**

116. *Damage for theft of sandal trees* :—Every Forest Police, Revenue or village Officer shall report to the concerned Divisional Forest Officer every case of damage or theft of sandal tree belonging to Govt. in occupied land as it comes to his knowledge.

117. *Damage or theft of sandal trees in private lands over which the land owners possess a right of ownership*—All cases of damage or theft of sandal trees in private lands and over which the land owners possess a right thereto shall be reported by such owners to the nearest forest or police officer. In cases of theft of such sandal trees, the Range Forest Officer shall conduct such investigation as he deems necessary to ascertain if there is complicity of the owner.

**C. Possession storage sale and disintegration of sandalwood, distillation and sale of sandal wood oil**

118. *Application of licence*—(1) all applications for grant or renewal of licences under section 87 shall be made to the Divisional Forest Officer concerned, with the fees specified in sub-rule (2) furnishing the following and such other particulars as the Divisional Forest Officer may require :—

- (i) The kind of quality of sandalwood for which the licence is sought for.
- (ii) Licence for what purpose ?
- (iii) Sandalwood where from obtained and when ? (necessary documents and passes to be enclosed.)
- (iv) Period for which the licence is sought.
- (v) Particulars of the locality and place where the sandal wood is sought to be stored, sold, disintegrated or the oil distilled.
- (vi) Nature of the mill, plant or other contrivance for disintegrating sandalwood or distilling oil from sandalwood.
- (vii) Whether he holds a licence, if so :—
  - (a) The previous licence number and the date of its expiry and return.
  - (b) Whether the applicant has maintained the stock accounts in the prescribed form and rendered them to the Divisional Forest Officer ? If so, up to what period ?



(c) The stock of sandalwood with the applicant on the date of application.

(2) The fees specified in column (3) of the table below shall be charged for the grant or renewal of a licence specified in column (2) thereof :—

Sl. No.	Nature of licence	Fees	
1	2	3	
		Rs.	
1.	For possessing and storing of sandalwood not exceeding 1 quintal.	45	per year or fraction thereof.
2.	For possessing and storing of sandalwood exceeding 1 quintal.	10	Do.
3.	For possessing, storing and selling of sandalwood, or oil distilled from sandalwood.	100	Do.
4.	For running a disintegrator or any other contrivance for disintegrating sandalwood.	50	Do.
5.	For running a distillery or plant for distilling oil from sandalwood.	250	Do.

Provided that no fee shall be charged for the possession and storage of sandalwood by temples and Muzarai institutions and for disintegration of wood and distillation of oil by Government Departments.

(3) On receipt of application and the fee, the Divisional Forest Officer shall, after such enquiry as he deems necessary, if satisfied that there is no objection grant or renew the licence in Form 17 having regard to the safeguarding of the Government sandalwood and the antecedents of the applicant, grant or renew licence subjects to such conditions as may be prescribed therein.

(4) The Divisional Forest Officer may, after giving the applicant an opportunity of being heard in the matter and for reasons to be recorded in writing, reject any application for grant of a licence or its renewal, whereupon the applicant, unless he appeals against orders of rejection under rule 122, shall be entitled to the refund of the fee remitted by him under sub-rule (2).

119. *Duplicate copy of licence* — The Divisional Forest Officer may, on payment of a fee of rupees 3, issue a duplicate of the licence if he is satisfied that the original licence issued to a licensee is lost, destroyed or otherwise rendered useless.

120. *Cancellation or suspension of licence*—The officer issuing the licence may, at any time, for reasons to be recorded in writing, cancel or suspend any licence after giving the licensee an opportunity of being heard in the matter.

121. *Copies of the order* — A copy of every order rejecting the application for the grant or renewal of a licence under rule 120 shall be granted to the applicant or the licensee, as the case may be, by the Divisional Forest Officer making such order.

122. *Appeal* — Any person aggrieved by an order of the Divisional Forest Officer under sub-rule (4) of rule 118 or rule 120 may, within 30 days of the receipt of the order under rule 121 present an appeal thereupon in writing to the Conservator of Forest, whose decision thereon shall be final. Appeals received after the specified period shall be summarily rejected.

123. *Maintenance of accounts by the licensee*—The licensee shall maintain accounts or transactions in a stock register in Form 18 and produce them for inspection and check when demanded by any Forest or Police Officer not below the rank of a Ranger or Sub-Inspector of Police. Any refusal to produce the register of accounts or the non-maintenance of the accounts or the maintenance of incorrect accounts shall entail cancellation of the licence, in addition to any other penalty that may be imposed under the provisions of these rules.

## ANNEXURE-XII

**THE ANDHRA PRADESH SANDAL WOOD POSSESSION  
RULES, 1969**

III.—In exercise of the powers conferred by section 32 and 33 read with section 68 of the Andhra Pradesh Forest Act, 1967, (Act I of 1967), the Governor of Andhra Pradesh hereby makes the following rules to regulate the possession of sandal wood in the State.

**RULES**

1. These rules may be called the Andhra Pradesh Sandal wood Possession Rules, 1969.

2. In these rules, unless the context otherwise requires—

- (a) 'dealer' means a person who deals in sandalwood ;
- (b) 'Divisional Forest Officer' means the Divisional Forest Officer having jurisdiction over the area concerned;
- (c) 'form' means a form set-forth in the schedule appended to these rules ;
- (d) 'Licence' means a licence prescribed under these rules ;
- (e) 'Sandal wood Transit Rules' means the Sandalwood Transit Rules for the time being in force in the States ;
- (f) 'stockist' means a person who stocks sandalwood for conversion into sandal wood oil or other products but not for disposal of sandal wood as such.

3. (1) No person shall possess sandal wood in excess of the limit specified in section 32 of the Act, except under a licence issued in this behalf in Form-II by a Divisional Forest Officer. Every application for a grant of licence shall be in Form I and accompanied by authenticated documents and other material in support of the origin of procurement of sandal wood and a fee of Rs. 100 per annum.

Provided that no fee shall be payable by institutions like temples which stock, sandal wood for their bona fide requirements.

(2) A dealer or stockist shall not at any time possess over and above one metric tonne of sandal wood obtained from patta lands.

(3) The licence shall be for a certain period, not exceeding one year commencing from the 1st April, when initially issued, provided that a permanent licence may be issued in regard to pooja material and other materials of worships.

(4) The fees chargeable for the renewal of a licence shall be Rs. 100.

(1) A duplicate licence shall be granted only after satisfying the conditions laid down in these rules.

(2) The fee chargeable for grant of the duplicate licence shall be Rs. 50.

(3) The Divisional Forest Officer, may, on an application made to him by the licensee, renew his licence.

(4) The fees chargeable for the renewal of a licence shall be Rs. 100.

(5) If at any time, it appears to the Divisional Forest Officer that the licensee has contravened or failed to comply with any of the conditions laid down in these rules, he may cancel or suspend the licence after giving the said licence 15 days notice in writing for making his representation against such cancellation or suspension.

(6) (1) Whenever a dealer or stockist intends to possess any consignment of sandal wood, he shall immediately inform the Divisional Forest Officer in writing of the actual source from which he intends obtaining such sandal wood and supply such information as the Divisional Forest Officer may require to satisfy himself about bona fides of such sandal wood.

(2) The dealer or stockist who comes into possession of a consignment of sandal wood shall, within 24 hours of such possession, intimate the Divisional Forest Officer having jurisdiction over the area in which the sandal wood is stored about the fact of actual possession and the same shall be inspected by an officer not below the rank of a Forester without any delay; and till such inspection is over, the dealer shall not tamper with the identification marks that may have been already placed on such sandal wood.

(3) A dealer or stockist shall not convert such sandal wood if such conversion is sought to be done except under orders in writing by the Divisional Forest Officer.

(4) (1) A stockist storing the sandal wood and its by-products obtained by manufactures or conversion including sandal wood of smaller billets, sandal wood powder, toilet articles or scented

stocks shall furnish to the Divisional Forest Officer full particulars of the place of storing together with a certified sketch of the premises. The premises should be distinguishable by a Notice Board conspicuously displayed. Any change in such place shall be immediately intimated to the Divisional Forest Officer.

(2) The dealer or stockist shall maintain at the premises a stock register showing receipts and issues of sandal wood and all its products including oil.

(3) A true extract from the stock register shall be submitted to the Divisional Forest Officer every year by the 15th April or before renewal of the licence, when it has been issued for a part of the year.

8. (1) The stock register and the stocks of sandal wood shall be kept open for inspection at any time by any Forest Officer not below the rank of a Forester.

(2) The inspecting officer may remove such accounts or stock of sandal wood or birch and the animals, vehicles, vessels or any other conveyance actually used in contravention of the provisions of the licence and thereafter take or authorise the taking of all measures for the production of the stocks of sandal wood vehicles and the like removed, in a court and for their safe custody pending such production.

3. Movements of sandal wood from and to the licenced premises shall be in accordance with the provisions of the Andhra Pradesh sandal wood and Red sanders Wood Transit Rules, 1969.

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**FORM I***(See rule 4)***(Counterfoil to be retained by the issuing authority)**

Permit No.

1. Name and residence of the person to whom the permit is granted.
2. Quantity
3. Description of sandalwood/red sanderswood :
4. Fees paid, if any :
5. Marks, if any; on the sandal wood/red sanderswood.
6. From what forest or depot removed.
7. To what place being removed.
8. Route.
9. Time allowed.
10. Remarks  
Camp.  
Date.

**(Signature of the Issuing Officer, Designation)****FORM I***(See rule 4)***(Duplicate to be sent to the Officer incharge of Forest)**

Permit No.

1. Name and residence of the person to whom the permit is granted.
2. Quantity :
3. Description of sandalwood/red sanderswood :
4. Fees paid, if any :
5. Marks, if any, on the sandalwood/red sanderswood.
6. From what forest or depot removed.
7. To what place being removed.
8. Route.
9. Time allowed.
10. Remarks  
Camp.  
Date.

**(Signature of the Issuing Officer, Designation)****FORM I***(See rule 4)***(Permit for the Export/Transport of sandalwood/red sanderswood from Government sale depot.)**

Permit No.

1. Name and residence of the person to whom the permit is granted.
2. Quantity :
3. Description of sandalwood/ red sanderswood :
4. Fees paid, if any :
5. Marks if any, on the sandalwood/red sanderswood.
6. From what forest or depot removed.
7. To what place being removed.
8. Route.
9. Time allowed.
10. Remarks  
Camp.  
Date.

**(Signature of the Issuing Officer, Designation)**

(Endorsements of Tanadar or other officer  
incharge of the checking).

1. Date and time of check :
2. Entry number in the Register maintained-  
by him.
3. Signature in token of approving the  
further movement.
4. Full name in block letters.
5. Designation and address.  
Name and situation of checking station.



**FORM II**

(Counterfoil to be retained by the person issuing the permit)

Permit No.

1. Name and residence of the person to whom the permit is granted.
2. Quantity.
3. Description of sandalwood/red sanderswood.
4. Marks, if any, on the sandalwood/red sanderswood.
5. Whence obtained.
6. To what place being removed.
7. Route.
8. Time allowed.
9. Remarks.

Date :

Station :

Form No. II.—Contd.

Designation of the person granting the permit.

**FORM II**

(Duplicate to be sent to the Divisional Forest Officer)

Permit No.

1. Name and residence of the person to whom the permit is granted.
2. Quantity.
3. Description of sandalwood/red sanderswood.
4. Marks, if any, on the sandalwood/red sanderswood.
5. Whence obtained.
6. To what place being removed.
7. Route.
8. Time allowed.
9. Remarks.

Date :

Station :

Signature of the person granting the permit.

Note : The time to be entered in column (8) should not exceed the period calculated at 15 miles per day except with the special permission of the Divisional Forest Officer.

**FORM II**

(Permit for the import/export/transport of sandalwood/red sandalwood of private lands or foreign territory)

Permit No.

1. Name and residence of the person to whom the permit is granted.
2. Quantity.
3. Description of sandalwood/red sanderswood.
4. Marks, if any, on the sandalwood/red sanderswood.
5. Whence obtained.
6. To what place being removed.
7. Route.
8. Time allowed.
9. Remarks.

Date :

Station :

Signature of the person granting the permit.

Note : The time to be entered in the Column (8) should not exceed the period calculated at 15 miles per day except with the special permission of the Divisional Forest Officer.

(Endorsement of Tandar or other officer-in-charge of the checking station).

1. Date and time of check.
2. Entry number in the register maintained by him.
3. Signature in token of approving the further movement.
4. Full name in block letters.  
Designation and address.  
Name and situation of checking station

**FORM III**

(See Rule 7)

**LIST OF SANDALWOOD TREES PROPOSED TO BE EXTRACTED FROM PRIVATE LAND OF ..... VILLAGE**

S. No.	Date of assignment	Name of owner	Serial number of trees	Girth in Centimetres over bark at breast height above ground level	Anticipated height in metres of bole containing heartwood	Remarks
1	2	3	4	5	6	7

**FORM IV**

(See Rule 7)

**LIST OF RED SANDERSWOOD TREES FELLED, NUMBERED AND CLEANED, WHICH ARE AWAITING REMOVAL FROM THE LIMITS OF SURVEY**

Field ..... S. No. .... of ..... Village in the .....  
 taluk ..... district ..... to ..... depot situated in ..... village

Period of felling	Serial number of trees felled	Girth of tree over bark at breast height in cm.	Description and number of piece obtained		Outturn of wood from each tree	Remarks
			Stem	wood		
1	2	3	4	5	6	6

**FORM V**  
(See Rule 7)

(Counterfoil to be retained by the Issuing Officer in duplicate diglot Certificate of Registration)

**CERTIFICATE OF REGISTRATION**

Name of person registering	Description of device or property mark	Description and quantity of sandal-wood/red sanders-wood reg.	Date of registration or renewal	Remarks
(1)	(2)	(3)	(4)	(5)

1. Name of person registering
2. Description of device or property mark.
3. Description and quality of sandal-wood/red sanders wood reg.
4. Date of registration or renewal
5. Remarks

Certified that..... residing at has registered/renewed the above device or property for the official year ending 31st March, 19

Divisional Forest Officer

Date : 19

Certified that..... renewed the above device or property for the official year ending 31st March, 19

Divisional Forest Officer

Date : 19

Residing at.....has registered/mark for the official year ending 31st March, 19

Divisional Forest Officer

**FORM VI**

*(See Rule 7)*

**LIST OF SANDALWOOD TREES UPROOTED, NUMBERED, CLEANED AND WEIGHED  
WHICH ARE AWAITING REMOVAL FROM THE LIMITS OF SURVEY**

Field..... S. No..... of ..... Village in the.....  
taluk..... district..... to ..... depot situated in..... vilage.

Period of felling	Serial number of tree uprooted	Girth of tree over bark at breast height in cms.	Description/number of pieces obtained		Outturn of scented wood from each tree	Remarks
			Root wood	Stem and branch wood		
(1)	(2)	(3)	(4)		(5)	(6)

**FORM VII**

*(See Rule)*

**LIST OF RED SANDERS, WOOD, TREES PROPOSED TO BE EXTRACTED FROM PRIVATE LAND ..... VILLAGE**

S. No.	Date of assignment	Name of owner	Serial No.	Girth in Cms. over bark at breast height above ground level	Anticipated height in metres if bole containing heartwood	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)

## ANNEXURE-XIII

**The Andhra Pradesh sandalwood and red sanderswood Transit Rules, 1969**

In exercise of the powers conferred by section 29 read with section 68 of the Andhra Pradesh Forest Act, 1967 (Act I of 1967) and of all other powers hereunto enabling and in super-session of all previous notifications and rules on the subject, the Governor of Andhra Pradesh hereby makes the following rules to regulate the transit of sandalwood and red sanderswood in the State.

**RULES**

1. *Short title*—These rules may be called the Andhra Pradesh Sandal Wood and Red Sanders Wood Transit Rules, 1969.

2. *Definitions* —In these rules, unless the context otherwise requires :—

(i) “checking station” means any place specified by the Government in this behalf to be a checking station and notified by the Divisional Forest Officer as such in the District Gazette or the Andhra Pradesh Gazette;

(ii) “Form” means a form appended to these rules.

3. *Condition for import, exports and movement*—No person shall import sandalwood or red sanderswood into, or export sandalwood or red sanderswood from or move sandalwood or red sanderswood within, any place in the whole of the State unless such sandalwood or red sanderswood is accompanied either by a permit referred to in rule 6 and unless such sandalwood or red sanderswood bears the authorised marking of the Government or any other agency as provided in rule 7 or bears the property mark in respect of such sandalwood or red sanderswood which has been only registered in accordance with rule 7.

4. *Form of permits*—(1) In the case of sandalwood or red sanderswood purchased from Govt. the permit shall be in Form I.

(2) In the case of sandalwood or red sanderswood purchased at the Government sale depots in any other State and imported into this State, the permit shall be that (used by the Government of that State or any authority in that State responsible for the sale of sandalwood or red sanderswood in that

State and such permit shall be valid only for transport of the sandalwood or red sanderswood to the destination specified therein.

(3) In the case of imported sandalwood or red sanderswood other than that referred to in sub-rule (2), the permit shall be in Form II. The forms of the permit shall, on application, be applied by the Divisional Forest Officer having jurisdiction over the area on payment of rupee one per book of 100 permits. No form of permit other than that supplied by the Divisional Forest Officer shall be used.

(4) In the case of subsequent movement of imported sandalwood or red sanderswood and the transport of all local sandalwood or red sanderswood other than that for which Form I is prescribed, a permit in Form II shall be used. The forms of the permit shall, on application, be supplied by the Divisional Forest Officer having jurisdiction over the area on payment of the price referred to in sub-rule (3). No form of permit other than that supplied by the Divisional Forest Officer shall be used.

5. *Issue of permits*—(1) Permits in Form I shall be in triplicate and shall have all columns filled up by the Divisional Forest Officer or of a subordinate duly authorised by him in this behalf. The Divisional Forest Officer or the subordinate so authorised, as the case may be, shall hand over the original to the purchaser, send the duplicate to the Range Officer and retain the triplicate as counterfoil for record in his office.

Permits in Form II shall be in triplicate and shall have all columns filled up by the person disposing of the sandalwood or the red sanderswood or by his authorised agent. The original shall be handed over to the person authorised to remove the sandalwood or the red sanderswood, the duplicate shall be forwarded by post or by messenger to the Divisional Forest Officer having jurisdiction over the area by the person issuing the permit who shall retain custody of the sandalwood or the red sanderswood in his store or his land for purposes of check for a period of not exceeding fifteen days from the date of despatch of the duplicate to the Divisional Forest Officer or from the date of delivery to him by messenger, as the case may be. The triplicate of the permit shall be retained by the person issuing the permit for not less than six months from the date of issue of the original of the permit and shall be produced for inspection at any time within the period on demand by any Forest Officer not below the rank of a Forest Guard.

6. *Checking of permits*—(1) All sandalwood or red sanderswood, as the case may be, in transit shall be produced for exami-

nation at every checking station enroute even without being asked by any officer for it or when called upon to do so.

(2) The Officer-in-charge of the checking station shall, after satisfying himself that the sandalwood or the red sanderswood, as the case may be, has actually come from the place and is of the kind, stated in the permit issued by the concerned State Government or by any authority empowered in his behalf, and the permit is in Form I or Form II, as the case may be, and is not in excess of the quality specified therein, endorse on the permit suitably in token of having passed the consignment and also make necessary entries in the register maintained at the checking station is not so satisfied and refuses to endorse in token of passing the consignment, he shall retain the sandalwood or the red sanders wood, as the case may be, and the permit of the concerned State Government or the permit in Form I or Form II, as the case may be, and report the case for orders of the Divisional Forest Officer having jurisdiction over the area stating clearly his reasons for the action taken.

(3) The quantity of sandalwood or red sanderswood, as the case may be, in transit shall not be greater than that entered in the permit and if it is less, the same permit shall not be used again to cover the deficiency.

(4) The permits referred to in the preceding rules shall in the case of the imported sandalwood or red sanderswood and sandal or red sanderswood for export, be produced with the sandalwood for the red sanderswood, as the case may be, for examination at every checking station enroute on which the sandalwood or the red sanderswood may be taken.

(5) Any Revenue Officer not below the rank of a Revenue Inspector in charge of a Firka or any Police Officer in uniform, not below the rank of a Head Constable or any Forest Officer not below the rank of a Forest Guard or Tandar-in-charge of a checking station may stop any vehicle reasonably suspected of carrying sandalwood or red sanderswood, as the case may be, for checking its contents and the permits, and such vehicle shall not proceed therefrom until permitted to do so by the said Officer of the Revenue, Police or the Forest Department or the said Tandar.

*Explanation*—In this sub-rule vehicle includes lorries, stage carriages, contract carriages, motor-cars, tractors hand carts, bullock carts, buffaloe carts, horse drawn carriages such as jutkas and rickshaws such as cycle rickshaws, auto-rickshaws and handpulled rickshaws.



(6) No person shall take any sandalwood or red sanderswood off, or pass it from any road on which a checking station has been placed with intent to evade the production of the sandalwood or red sanderswood at a checking station.

7. *Use and registration of property marks*—(1) All sandalwood or red sanderswood imported from other States and all Government sandalwood or red sanderswood disposed of locally shall bear the marks of the Government of origin in the following manner :—

Every piece of sandalwood or red sanderswood shall bear its own Government mark and in the case of chips and saw dust carried in bags, the latter shall be closed and the fastening sealed with the above mark.

2.(a) The ownership of all sandalwood or red sanderswood grown and moved within any area in the State shall be indicated by a property mark affixed in the manner provided in clause (b).

(b) All such property marks shall be registered at a Divisional Forest Office :—

(i) in accordance with the provisions of sub-rule (3) if the marks relate to sandalwood or red sanderswood extracted from private lands within the area; and

(ii) in accordance with the provisions of sub-rule (4) if the marks relate to sandalwood or red sanderswood, as the case may be, other than that extracted from private lands within the area.

(c) A fee of Rs. 25 shall be charged in respect of registration or renewal of a property mark.

(3) (i) Every application for the registration of a property mark in respect of sandalwood or red sanderswood, as the case may be, to be extracted from private lands within the State shall be accompanied by a statement in Form III/Form IV in which all the particulars therein prescribed shall be furnished to the Divisional Forest Officer concerned and also by six facsimiles of the mark proposed. Form III/Form IV may be in manuscript and shall be prepared by the applicant.

(ii) After the application together with facsimiles and the statement in Form III/Form IV as specified above are received, the Divisional Forest Officer or the subordinate authority by him, is all, if he is satisfied that the Government have no interest in the trees, inspect trees, as soon as possible and with

the consent of the owner of the land affix the departmental hammer mark on each tree after blazing it at breast height from ground level and issue written permission for the extraction of the trees and grant a certificate of registration of the property mark in Form V for the transport of the trees to a central place in the nearest village for final clearance if so desired by the applicant :

Provided that the Divisional Forest Officer may, by a written order, refuse to give permission for extraction of the trees and to grant the certificate of registration of the property mark if he has reasons to believe that the trees belong to Government or that the applicant has committed fraud in respect of such trees. Against any order passed by the Divisional Forest Officer under this proviso, an appeal if preferred within thirty days from the date of receipt of the orders by the aggrieved party, shall lie to the Conservator of Forests having jurisdiction over the area, whose decision thereon shall be final.

(iii) Every uprooted sandalwood tree, bearing heart wood shall be cleaned upto its heart wood limits. In so cleaning the uprooted sandalwood tree, the departmental hammer marks at the breast height shall be left intact and ring of bark and sapwood 5 to 7 centimeters wide surrounding the departmental hammer mark shall be left uncut.

(iv) Red sanderswood tree shall be felled so as to retain in the hammer mark on the stool affixed under clause (ii).

(v) Every sandalwood tree so uprooted and cleaned, and every red sanderswood tree so cut shall bear its distinct serial number which shall be written legibly in tar anywhere on it if it has not been cut up into pieces or when it has been cut up into pieces or billets and roots, all parts of such tree so cut up shall each bear at their cut ends, the original serial number assigned to the tree so as to admit of identification and check subsequently by the Divisional Forest Officer or his subordinates.

(vi) The exact situation of the land where each of the sandalwood trees containing heart wood was extracted shall be indicated on the ground by a stout numbered peg which shall be well-driven home in the pit formed in the process of uprootal; the number on the peg being the same as that written on the wood concerned. Such pegs shall be retained until such time as the Divisional Officer or his subordinate checks the sandalwood and verified the locality of the fellings.

(vii) (a) The heart wood obtained from each of the sandalwood trees shall thereafter be weighed and the result recorded

in the statement in Form VI, indicating in it at the same time the number of root and stem wood pieces obtained from each of such trees with an abstract in the remarks column showing the total number of sandalwood trees extracted and cleaned, their total outturn expressed in number of pieces (roots, billets, separately) and the aggregate of all pieces in respect of which the registration of the property mark is desired.

(b) Form VI/Form VII shall on application be supplied by the concerned Divisional Forest Officer having jurisdiction over the area on payment of fee fixed by the Government, from time to time. No form other than that supplied by the Divisional Forest Officer shall be used.

(viii) (a) After receipt of the application for the removal of the sandalwood or the red sanderswood, as the case may be, with the statement in Form VI/Form VII containing all the particulars wherein prescribed is received, the Divisional Forest Officer or any Officer authorised by them in this behalf as soon as possible, inspect and identify the sandalwood or red sanderswood, as the case may be, by verifying the girth and the Departmental hammer mark put on the standing tree and by assembling all parts of each tree and satisfying himself that the wood is of the same tree that was hammer marked standing and that the details furnished by the applicant in Form VI/Form VII are correct and without error thereafter mark all sandalwood or the red sanderswood, as the case may be, with the Divisional pass hammer, thereafter, the Divisional Forest Officer shall, subject to provisions of sub-clause (b) grant a certificate of registration in Form V with as little delay as possible.

(b) The Divisional Forest Officer or any subordinate authority authorised by him may require from any person, either when presenting a property mark for registration or at any subsequent time, information as to the source of origin and the quantity of sandalwood or red sanders wood, period of felling, agency, routes, depots, destination and such other details regarding his method of felling, trading or working as the Divisional Forest Officer may think necessary. The working as the Divisional Forest Officer may think necessary. The Divisional Forest Officer may, by order, refuse registration or cancel the registration of any property mark if the information required is not given or if he considers that such property mark varies from a property mark, or from a property mark used by another person or if he has reason to believe that the person using the property mark is or has been concerned in any illegal practice with regard to the sandalwood or red sanderswood or for any other good and sufficient reason. The reason for such refusal or cancellation

shall in every case be recorded by the Divisional Forest Officer. An appeal against any such order of the Divisional Forest Officer may be preferred to the Conservator of Forests concerned within thirty days from the date of receipt of such orders by the aggrieved party and the decision of the Conservator of Forests shall be final.

(4) (a) Every application for the registration of property mark in respect of sandalwood or red sanderswood other than that extracted from private land shall be accompanied by f acsimilies of the marks proposed.

(b) After the receipt of the application, the Divisional Forest Officer or the subordinate authority authorised by him, shall check such sandalwood or red sanderswood, as the case may be, and if the result of checking is satisfactory, the Divisional Forest Officer shall subject to the provisions of sub-clause (b) of clause (vii) of sub-rule (3) grant a certificate of registration in Form V with as little delay as possible.

(c) All the sandalwood or the red sanderswood, as the case may be, in respect of which a property mark is registered under this sub-rule shall be marked with the Divisional Pass Hammer by the Divisional Forest Officer or by the subordinate authority by him to do so.

8. *Date upto which and description and quantity of sandalwood or red sanderswood for which registration of property mark has effect*—The registration and each renewal of registration of a property mark shall be valid only in respect of the description and quantity of the sandalwood or the red sanderswood entered in Form V and be in force only from the date of such registration or renewal until the first day of April following unless otherwise stated.

9. *Exemption of small quantities of sandalwood or red sanderswood carried by a bonafide traveller or cut and carried by ryots for their own use*—Nothing in these rules shall apply to :—

- (a) Sandalwood not exceeding 10 Kgs. in weight carried by any bonafide traveller or under his authority for his personal use; or
- (b) Sandalwood cut and carried by a ryot for his personal use from trees growing on the patta lands of the said ryot or of any neighbouring ryots from whom title to

such sandalwood is derived, provided that he obtains a certificate of title from the village munsiff and that the quantity cut and carried on each occasion does not exceed 10 Kgs. in weight;

- (c) red sanderswood fashioned into dolls, images, toys and vessels;
- (d) red sanderswood cut and carried by a ryot for his own use from trees growing on the patta lands of the said ryot or of any neighbouring ryots from whom title to such red sanderswood is derived provided that he obtains a certificate of title from the village munsiff and that the quantity cut and carried on each occasion does not exceed one log 4.50 metres in length 40 cms. in girth at the butt end.

10. *Special facilities for companies and persons engaged in the distillation of Sandalwood*—The Divisional Forest Officer may, in his discretion, include the name of any company or person engaged in the distillation of sandalwood or in the manufacture of any its by-products, in any approved list to be maintained by him and he may also at his discretion remove the name of any such company or person from such list. The Divisional Forest Officer may, by written order, exempt any company or person, whose name is included in the approved list from the provisions of sub-rule (2) of rule 5 in so far as it relates to the retention of sandalwood in custody for purposes of check and from the provisions of clauses (b) and (c) of sub-rule (4) of rule 7 and may cancel any such order.

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