

Cultivation of Sandalwood (*Santalum album*)



Santalum album L (Santalaceae) is known as Chandan in Bengali, Hindi and Oriya; Safed-chandan in Hindi and Gondassaro in Oriya also and Sandal tree or Sandalwood in English.

Santalum album is a small to medium sized, evergreen tree, hemiparasitic on the roots of a variety of plants; bark dark-grey, rough, wood hard and close grained, sapwood white scentless, heartwood yellowish-brown, strongly scented. Leaves simple, opposite, elliptic-lanceolate. Flowers brownish-purple, reddish-purple or violate. Fruits globose drupes, black, fleshy. Seed hard, globose or obovoid.

The species occurs naturally and distributed in Deccan Peninsula, especially in Karnataka, Tamil Nadu and Kerala, also cultivated elsewhere. It thrives best between 600-1000 m elevation.

Sandalwood is considered one of the world's most valuable commercial timbers. It is commercially valued globally for heartwood and oil. Indian sandal is considered best and is highly prized for its superior quality oil. Sapwood finds utilization in carving and turnery and is recognized as one of the finest woods for carving.

Due to over exploitation the species has been categorized as vulnerable by International Union for Conservation of Nature (IUCN). Government policies have now been relaxed to revive this important species in Karnataka and Tamil Nadu which are the main sandalwood growing states. Seeing its huge potential, other states have also shown keen interest in establishing sandalwood plantations.

The species is quite hardy, can grow in dry and degraded lands and over a variety of soils, it has potential to grow in combination with horticultural species as secondary hosts.

In its natural habitat, it is found flourishes best generally on red ferruginous loam of the underlying rock being often metamorphic, chiefly gneiss. It also found on rocky ground stony or gravelly soil. It grows best on moist fertile alluvium along the banks of stream. Those grown on proper soils are said to form more scented heartwood. It requires good drainage and does not tolerate water logging. Avoids saline and calcareous soil and is not generally found on black cotton soil.

Rainfall in the chief sandal tracts varies between 625 mm to 1625 mm and temperature ranges from 19°C to 28.5°C.

Artificial regeneration of *Santalum album*

Planting of *Santalum album* involves multi-step process including nursery preparation, proper soil and climate selection, planting during the monsoon, and the mandatory inclusion of host plants like *Sesbania grandiflora* (Agasti), *Senna siamea* (Minjiri), *Vachellia nilotica* (Babul) etc. as secondary host and *Mimosa pudica* (sensitive plant) or *Cajanus cajan* (pigeon pea) as primary host in nursery stage. As the sandalwood is a semiparasitic plant, so it needs a host for nutrient and water absorption, which must be planted alongside it. Seedlings are nurtured in nurseries until they attain a certain height, then transplanted into prepared pits with host plants, and cared for with regular watering and monthly fungicidal and insecticidal sprays.

Nursery technique

- ◆ Freshly collected sandal fruits from good seed collection areas are de-pulped and dried in shade. Ripe fruits collected during September–October yields best germination of seeds.
- ◆ Viability of seed is 25-40% up to one year. Seeds remain viable about 80% up to 9 months.
- ◆ Sandalwood seedlings are typically raised in nurseries in India starting in December for transplanting before the monsoon season, which begins in July. This allows for the seedlings to develop into plantable sizes (around 30 - 45 cm tall) after 6 to 7 months, as the ideal sowing period is in December to get them ready for July.

Pretreatment of seeds: Seeds are soaked for 16 hours in Gibbirellic acid (500 ppm) before sowing in germination beds with a dimension of 1m x 10m composed of fine river sand with underlying gravel layer. About 2.5kg seeds are spread uniformly over the bed and covered with sand up to 1cm and finally with straw over the covered seeds with sand and watered regularly.

Seeds are also treated by acid scarification which involves soaking seeds in concentrated sulfuric acid for 30 minutes, followed by a thorough washing, can also be used to break seed dormancy. Sometime seeds mixed with cow dung slurry are kept in pits for about 7-14 days to soften the thick seed coat which helps to overcome dormancy.

- ◆ The seeds take 4-12 weeks to germinate after dormancy period. Germination rate is about 60% under field conditions.
- ◆ The straw covering is removed when the leaves start appearing on the seedlings.
- ◆ Seedlings at 2-3 leaf stage are pricked and transplanted in 270cc root trainers containing potting media consisting sand:soil:compost in the ratio 35:15:50 with *Mimosa pudica* (sensitive plant) or *Cajanus cajan* (red gram/ pigeon pea) as primary host.
- ◆ Media is supplemented with NPK + micronutrients as foliar spray at 15 days periodic intervals.
- ◆ As prophylactic measure Dithane M-45 (0.25%) once in 15 days to avoid fungus attack and insecticide Ekalux (0.02%) are sprayed at monthly intervals to avoid nematode damage.
- ◆ Host plants are necessary to prune frequently so they don't outgrow the sandalwood seedlings.
- ◆ Healthy seedlings having height of 30-45 cm and collar diameter of 3.0 mm turning brown at the base, referred to as quality planting stock is ready in 6-7 months time.
- ◆ Sandal should ideally be raised in root trainers rather than polypots as the root system is far more established and better in root trainer raised seedlings as compared to polypot raised ones and showed better results in growth and establishment in



field. Moreover the root system development and haustorial association with primary host red gram (*Cajanus cajan*) in the case of sandal seedlings raised in 270cc root trainers is far better than polypotted seedlings. These seedlings are also found to establish and perform much better in field conditions.

Transplanting in the field

- ◆ Plantation site should at least be located in a warm climate (12°C to 35°C) and well-drained red sandy loam soil (pH 6.0 to 7.5) with good sunlight.
- ◆ Generally, transplanting pits of dimension 45cmX45cm X45cm are dug up at a spacing of 3.0 m X 3.0 m. Dug up soil is kept on both side of each pit well advance to get better pulverize and drying.
- ◆ The pits are filled with pulverized topsoil mixed thoroughly with 10 –15 kg FYM (farmyard manure) or compost.



Transplanting and optimum spacing:

- ◆ Healthy seedlings having height of 30-45 cm and collar diameter of 3.0 mm turning brown at the base are transplanted in the filled up pits during rainy season.
- ◆ Host plants like *Sesbania grandiflora* (Agasti), or certain acacia, cassia etc. species must be planted at the time of transplanting of seedling to provide nutrients and water.
- ◆ A light irrigation is provided just after transplanting for establishment of seedlings if there is no rain.
- ◆ Vacancy filling is done within 10-15 days of transplanting, so that uniform stand is achieved.

Selection of hosts:

- ◆ Best primary host in the nursery stage is *Cajanus cajan* (Arahar, pigeon pea)
- ◆ *Sesbania grandiflora* (Agasti), *Pongamia pinnata* (Karanj), *Vachellia nilotica* (Babul), *Wrightia tinctoria* (Indrajav), *Cassia fistula* (Amaltas), *Senna siamea* (Minjiri), *Albizia lebbek* (Sirish) are considered best secondary hosts in the field for a long time.
- ◆ Leguminous hosts, like *Sesbania* and *Cajanus*, are much beneficial due to nitrogen fixation, which may increase the number and size of haustoria connections (the parasitic root structures) on the sandalwood roots, leading to better nutrient uptake and growth.

Seedling transplanting rate:

- ◆ On an average 1250 root trainer seedling are required per hectare to get a stand of 1050-1100 trees at a spacing 3mX3m.

Irrigation practices:

- ◆ Irrigation is provided on regular basis until the establishment of the seedlings.
- ◆ After getting establishment Irrigations is provided as and when required depending upon the weather condition.

Application of manure and fertilizer:

Organic manure like compost and farmyard manure are applied at the time of pit filling and also during maintenance, along with balanced NPK fertilizers and micronutrients.

Interculture and maintenance:

- ◆ The plantation area is kept weed free manually.
- ◆ Soil around each plant to a radius of 50 cm once in a 6months is necessary to worked out.
- ◆ Dead or diseased branches of the trees are pruned carefully to maintain a healthy tree structure.
- ◆ Host plants are also pruned frequently so that sandal tree gets sufficient sunlight, as the host plant tends to overgrow sandal tree.



Plant protection:

- ◆ **Drought:** Capable of withstanding moderate drought, but prolonged drought kills it.
- ◆ **Fire:** Extremely fire tender and may be killed outright or injured and rendered unsound.
- ◆ **Grazing and browsing:** Moderate grazing does not seem to have any adverse effect. Though it is readily browsed by cattle and rabbits particularly in the dry season when grass is scarce and this constitutes the real danger to the plants.
- ◆ **Insects:** In its natural habitat the possible danger to the species is from some of the forest insects which are vectors of spike disease. This disease is responsible for very serious loss year after year as it ultimately kills the trees in all the stages. It is caused by a virus carried from tree to tree by perhaps some forest insects. Hosts are suspected to be highly influential in conferring relative resistance, against spike diseases. e.g., *Strychnos nuxvomica*, *Pongamia glabra*, *Azadirachta indica* and *Cassia siamea* are stated to give high resistance.

Maturity and harvesting:

- ◆ Trees are harvested when the heartwood is mature, which can take 12 to 30 years.
- ◆ The entire tree is uprooted, and the outer softwood is removed, leaving the heartwood.

Post harvest management:

- ◆ The heartwood is then processed into billets (about 0.75 m long), which are trimmed and allowed to dry in a closed warehouse to improve aroma.

Extraction of oil:

- ◆ The dried heartwood is chipped and powdered.
- ◆ The powder is soaked in water for 48 hours before the essential oil is extracted through distillation.

Legal restriction

Harvesting of the sandal tree requires permission from the state forest department. While private cultivation of sandalwood is legal, individuals are not permitted to sell the harvested wood directly to the open market.

The government grants permission for harvesting and then sells the wood on behalf of the farmer. These restrictions are to combat over-exploitation and habitat degradation.

Market Trend:

Sandalwood (*Santalum album*) is a highly valued aromatic wood used for essential oil, incense, Ayurveda, cosmetics, perfumery, and religious purposes. India (Karnataka, Tamil Nadu) and Australia are major legal suppliers.

Present price:

In India, heartwood prices typically range from Rs. 3,000 – Rs. 8,000 per kg, depending on oil content, age, and grade. Sandalwood oil is far more valuable, ranging roughly Rs. 1.5 – 3 lakh per kg in the global market. Australian plantation sandalwood trades slightly lower but with stable supply.

Current trend:

Demand remains consistently strong, especially from pharma, cosmetics, aromatherapy, and temple usage. Prices are relatively stable compared to red sandalwood due to organized plantations and clearer legal frameworks, though premium oil-rich wood still commands higher rates.

Future outlook:

Global demand is expected to grow at 7– 8% CAGR, driven by natural fragrance and wellness markets. With expanding plantations in India and Australia, prices are likely to remain firm with moderate growth, favoring long-term, legally cultivated sandalwood investments.



For more information please contact :

| | |
|--|--|
| Prof. (Dr.) Asis Mazumdar PI-cum-Nodal Coordinator coordinatorrrcfc@jadavpuruniversity.in | Dr. Soumyajit Biswas Project Manager rdrcfc@jadavpuruniversity.in |
|--|--|

Regional-cum-Facilitation Centre, Eastern Region (RCFC-ER)
National Medicinal Plants Board (NMPB), Ministry of AYUSH, Govt. of India
Jadavpur University, Kolkata - 700 032
Tel : +91-33-2414 6979, Fax : +91-33-24146886
E-mail : rfcnmpb@jadavpuruniversity.in

 RCFC-Eastern-Region-NMPB  @RCFC_ER  <http://rcfceast.org/>

