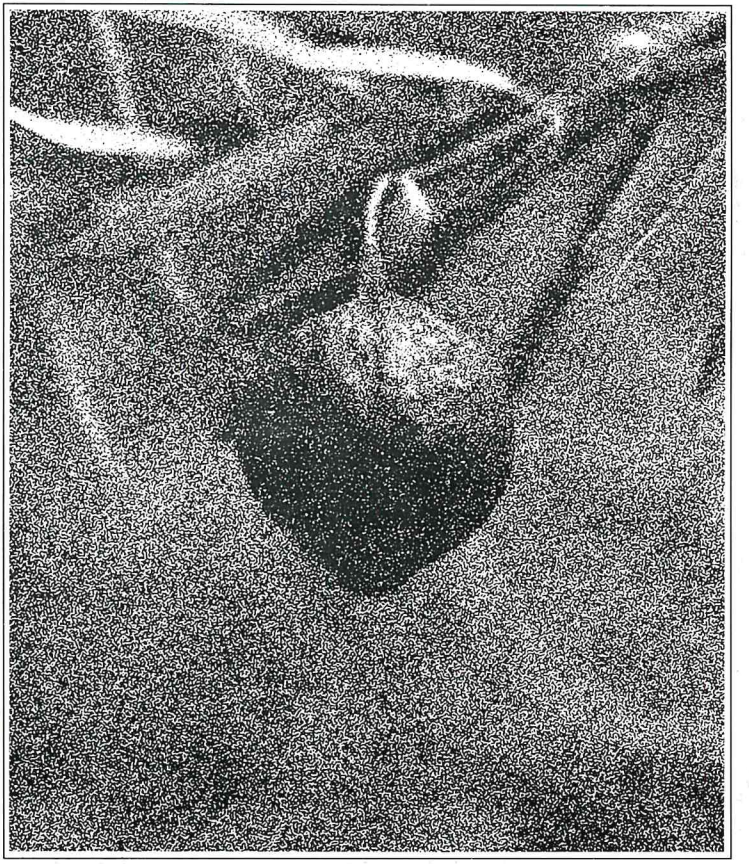


GROWING WESTERN AUSTRALIAN SANDALWOOD FROM SEED

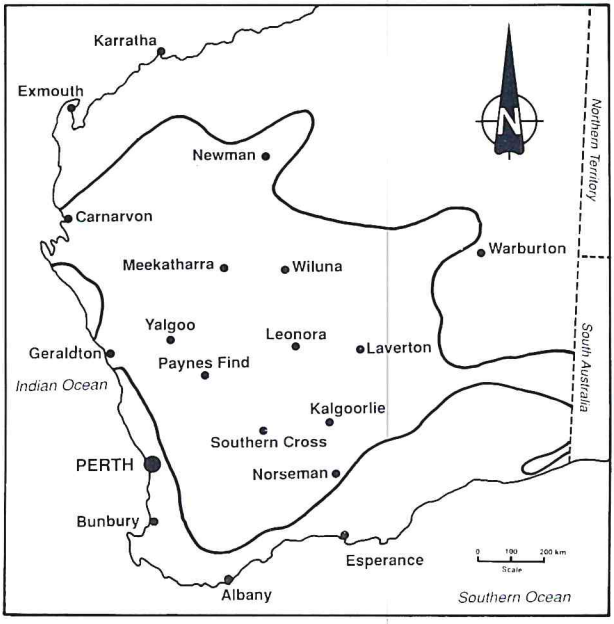
DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

BACKGROUND

Sandalwood is an integral part of the history and ecology of Western Australia. In addition to its inherent biological value, the tree is prized for its beautiful, fine grained, perfumed wood.

The wood was first shipped abroad in 1845 and soon became a lucrative income earner, its main use being in the production of incense (joss) sticks for the Asian market. At present, the sandalwood industry is stable and profitable, operating under strictly controlled, environmentally acceptable conditions.

The natural distribution of sandalwood is from just north of Carnarvon, through the Wheatbelt and Goldfields into South Australia, then westwards to the drier fringes of the Darling Scarp. Clearing for agriculture and harvesting for commerce over the years have reduced sandalwood's natural occurrence in the Wheatbelt to occasional remnants. Throughout the remaining area of its range, sandalwood is widespread although patchy.



Map showing the natural distribution of WA sandalwood (Santalum spicatum) throughout Western Australia

Four types of *Santalum* species occur in Western Australia. Western Australian sandalwood (*Santalum spicatum*) is found only in WA and South Australia and is the main species with scented wood. The other three species, quandong (*S. acuminatum*), plumbush (*S. lanceolatum*) and bitter quandong (*S. murrayanum*), are widely distributed across Australia. There is a small industry based on plumbush in Queensland and the Northern Territory.

Western Australian sandalwood is a small tree or shrub, growing from two to occasionally eight metres tall, with a trunk diameter of 100 to 300 millimetres when mature. It has irregular, spreading branches and dull, grey-green, fleshy leaves. It is well adapted to drought and is very slow growing, taking between 50 and 100 years to attain a harvestable size. Sandalwood is an obligate semi-parasite that uses the roots of other plants, known as hosts, to supply some of its nutrition.

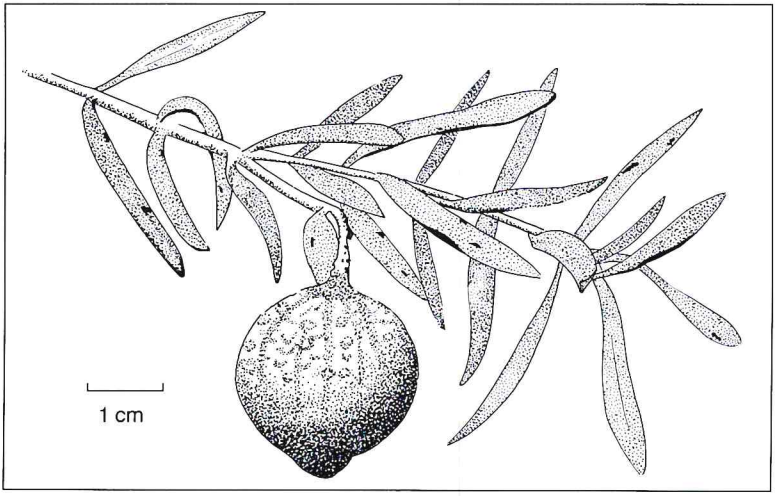
Flowers are small and produced in clusters all over the canopy. They are green to palest red on opening, turning progressively deeper red as they age. Fruits ripen over a number of months, mostly between September and December in the Mediterranean climatic zones, although flowering and fruiting are very dependent on rainfall and can occur at any time of the year or not at all. Fruits are large with a red-brown, leathery outer covering surrounding a smooth, hard, round nut, which may be up to 20 millimetres in diameter and weigh about three grams. The nutritious and palatable kernels are eaten by humans, but further study is required to assess their suitability for widespread consumption.

The germination rate of planted nuts is variable, and survival of germinants is usually very low except in years of above average rainfall. These factors, combined with loss of land to human activities, a susceptibility to fire, grazing by introduced and native herbivores, and minimal coppicing, mean that natural regeneration is low outside conservation areas.

GENERAL GUIDELINES FOR PLANTING

Collecting and Storing Seeds

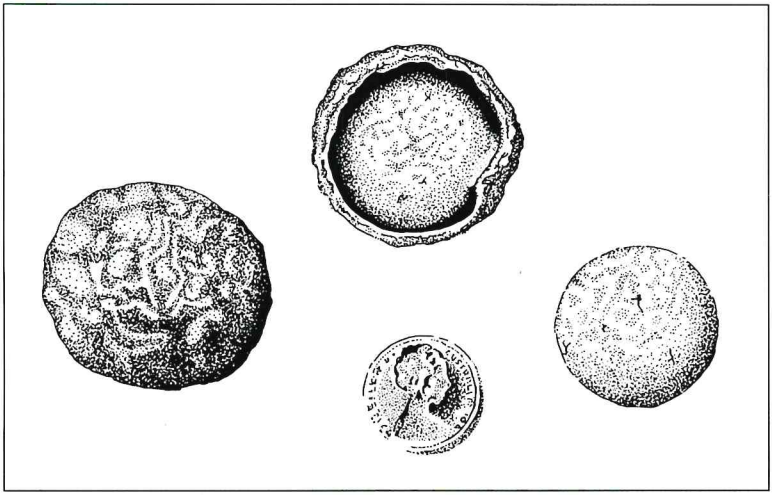
Seeds may be bought from the CALM Seed Store in Manjimup or Como. You can also collect them from your property or nearby land. However, a licence is required from CALM to take fruits or seeds from Crown land and it is not permitted to collect from conservation reserves, public road verges and other specified areas. Fruits may be gathered from the ground or picked from trees if ripe and loosely attached. The outer covering, which becomes browner and drier with time, should be removed and the nuts (seeds) stored in a dry, cool, well-ventilated place. They are best used in the first or second year after collection.



Mature sandalwood fruit hanging from a branch.

Seed Preparation For Planting

Nuts can be planted without further treatment, they can be cracked in some way, the hard shell can be removed altogether or the seeds can be soaked in water. However, in larger scale planting no treatment is given to seeds prior to planting. It is easier and cheaper to plant seeds whole. There is less likelihood that they will deteriorate and, if they do not germinate immediately, they will survive and remain viable longer, possibly into future seasons.



From left to right: Whole sandalwood fruit; fruit with outer covering partially removed to show the enclosed nut (seed); and the hard-shelled nut.

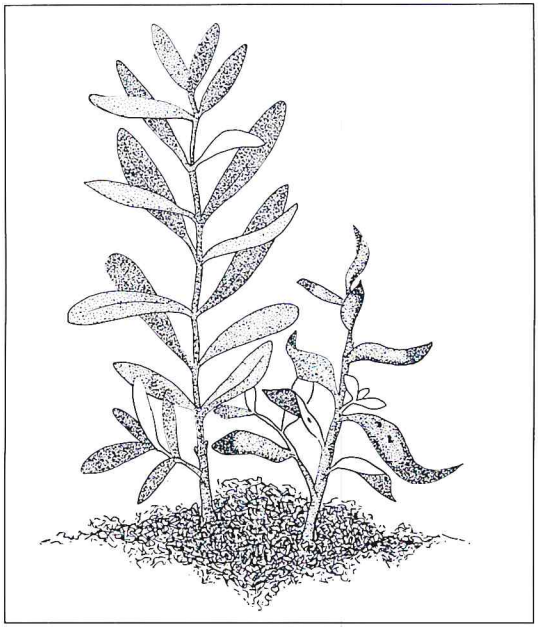
POINTS TO CONSIDER WHEN PLANTING IN THE FIELD

Location

Sandalwood grows on a broad range of soils, preferring lower slopes and loam or sandy loam soils, with best stands occurring where there is a mix of vegetation types and the widest selection of hosts. If sandalwood occurred or occurs naturally in the area, conditions are likely to be favourable. The sites should be water gaining, but well drained. Waterlogged or heavy clay soils are not suitable. Sandalwood can be grown in remnant bush areas, on land which has been withdrawn from production, along accessways, in reclamation areas or in trial plantations.

Host Plants

It is necessary to have suitable host trees in sufficient numbers on the site. Wattles (*Acacia* spp.) and sheoaks (*Allocasuarina* spp.) are generally considered among the best hosts. These include jam (*Acacia acuminata*), mulga (*Acacia aneura*), manna wattle (*Acacia microbotrya*), curara (*Acacia tetragonophylla*), *Acacia saligna*, *Allocasuarina campestris*, and *Allocasuarina huegeliana*. Wandoo (*Eucalyptus wandoo*), York gum (*Eucalyptus loxophleba*) and various species from other families, including trees, shrubs, herbs and weeds, are also commonly associated with sandalwood. Planting areas with a variety of host species is best, and there should be at least as many hosts and sandalwood trees.



Sandalwood seedling (left) planted close to a low-growing host species. As the sandalwood grows, its roots will spread and make use of other larger, more distant hosts.

If suitable potential hosts are not present, they should be planted or allowed to grow one or two years prior to planting the sandalwood. Since seedling establishment seems to be determined mainly by the availability of host roots, the aim is to ensure that these are present in the area where sandalwood will be planted. Depending on their lifespan, new hosts may have to be planted from time to time.

Shade

For the first few summers shade is preferable for the survival of young plants. Shade may be important in tempering the immediate environment of seedlings and allowing for increased plant water status. The best use of shade is obtained by planting seed within the shadow cast by the host during the hottest part of summer days (south to south-east of host trees). Sandalwood can be planted directly under the canopy of host species, perhaps one to three metres from the stem, depending on the size of the host. Limited weed and shrub growth also modifies the environment, providing temporary host roots and shade. Leaf litter is beneficial and should be left as mulch and protection.

Site Cultivation

Planting in paddock areas should be in ripped, contoured furrows about four metres apart. The depressions act as water traps. Loosened soil should be pushed down to remove air pockets. Roots from any surrounding vegetation damaged by ripping may proliferate in the disturbed soil and provide a suitable network of fine potential host roots. Trees to act as hosts should be planted about four metres apart in the rip line a year or two ahead of the sandalwood.

With small-scale planting, or when planting in bushland, individual sandalwood planting sites should be prepared by breaking up the soil, removing weeds and slightly hollowing the surface to retain water. Only a small soil area should be disturbed.

Water

An adequate supply of water favours sandalwood germination. When planting seed, moisture conditions can be optimised by paying attention to site selection and preparation, and to factors which minimise water loss and desiccation, as discussed above. If irrigation is possible over the first and even the second summers, and other factors are favourable, loss of seedlings will be reduced.

Fertiliser

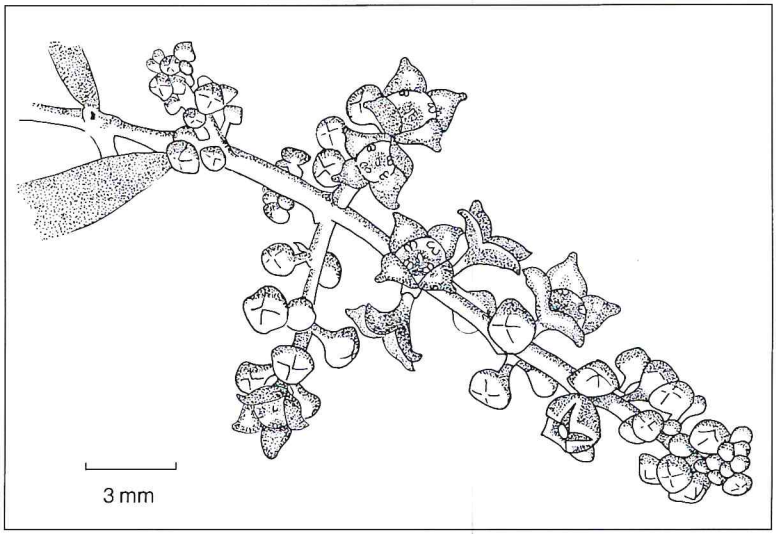
Fertiliser should not be used. Application of suitable fertiliser may be beneficial, but, as yet, there is insufficient knowledge on the subject.

Hazards

- **Herbivores** - Sandalwood, especially when young, is palatable to animals. It is essential to exclude herbivores such as rabbits, domestic and feral stock, and kangaroos from the planting site. Fencing may be required, particularly on stations and other grazed areas.
- **Fire** - Sandalwood is extremely fire-sensitive. Fire will kill or severely damage sandalwood, particularly in the early years.
- **Weeds** - Excess weed growth may offer too much competition and crowd out sandalwood seedlings. Weeds can be slashed or possibly controlled by limited, careful spraying with herbicides.

After care

Inspect the planting sites after the first and second years and fill in any gaps.

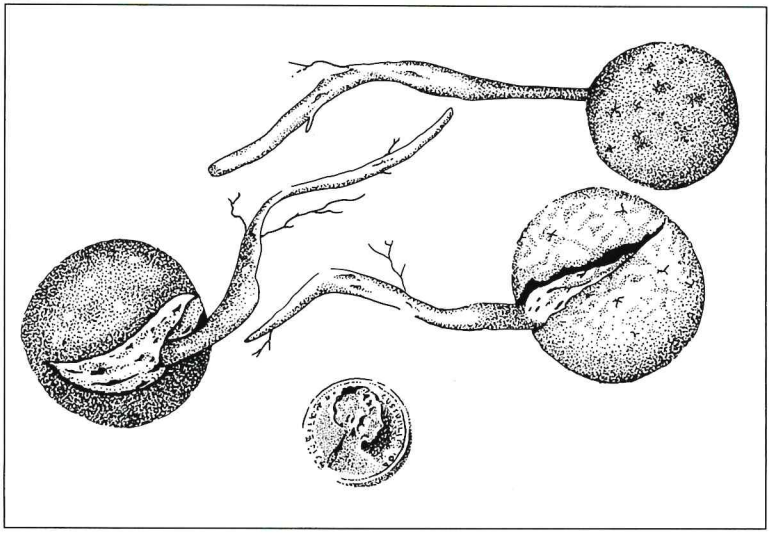


Sandalwood flowers.

DIRECT SEEDING - PLANTING ON THE LAND

Once sites have been selected and prepared, sow seeds directly into the ground in time for the first substantial rains (April-May) when soil temperatures are still relatively high. Seeds should be buried 15-30 mm deep. Between four and ten seeds should be planted per spot, because not all seeds will germinate and some deaths can be expected among young seedlings. Planting spots should be three to four metres apart. When planting in rip lines with one or two year old host trees, sandalwood seeds should be placed about a metre from the host on the most shady side.

Germination can be expected anything from two weeks to several months after the first good rains. Some seed may not germinate until the following year or even longer. Seedlings will appear above ground a few weeks after germination.

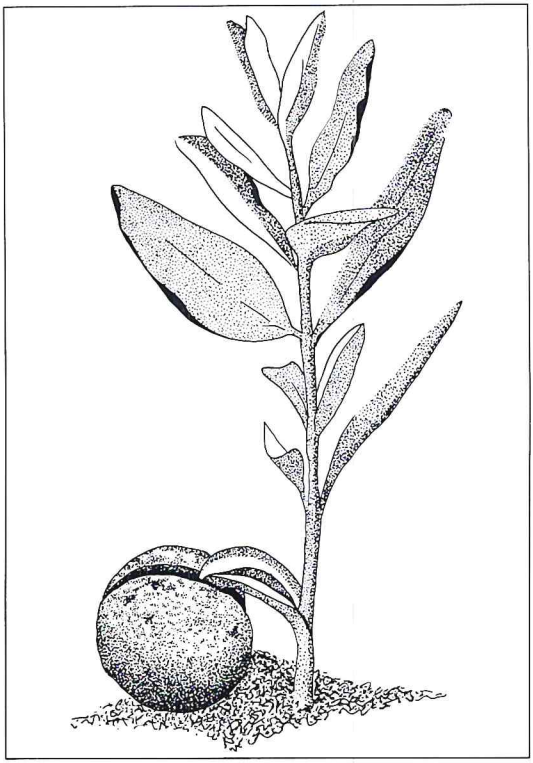


Germinating nuts (seeds). The emerging radicle (root) is brittle and would normally be making its way down into the soil.

RAISING POT PLANTS

Seeds (cracked or uncracked) can be germinated by burying them in a tray of moist, coarse sand, or placing them on a tray of vermiculite covered by hessian. They should not be allowed to dry out and are best kept in a shed, glass house or shade house. Plant at least four or five times as many seeds as will be needed to allow for mortalities at different stages.

Between two and six weeks or longer, a white root (radicle) will emerge from each germinating nut. Be very careful not to cause damage when looking for germinating seed. When the radicle is about 10 mm long each germinant should be planted into a pot. Use a fairly deep container (150 mm or more). The potting mix should be of good quality and firm enough to hold together when the seedlings are eventually planted out. This is particularly important for sandalwood since the radicles are brittle and break easily. A mix of one part fine sand, one part coarse sand and one part peat has been successfully used in many trials. Make a vertical hole the width of a pencil in the surface of the soil in the pot and gently poke the radicle down into it. Allow the nut to sit on the surface or cover it with soil. Firm the soil around the radicle and water in.



The young sandalwood seedling continues to draw nourishment from the kernel in the nut for many weeks.

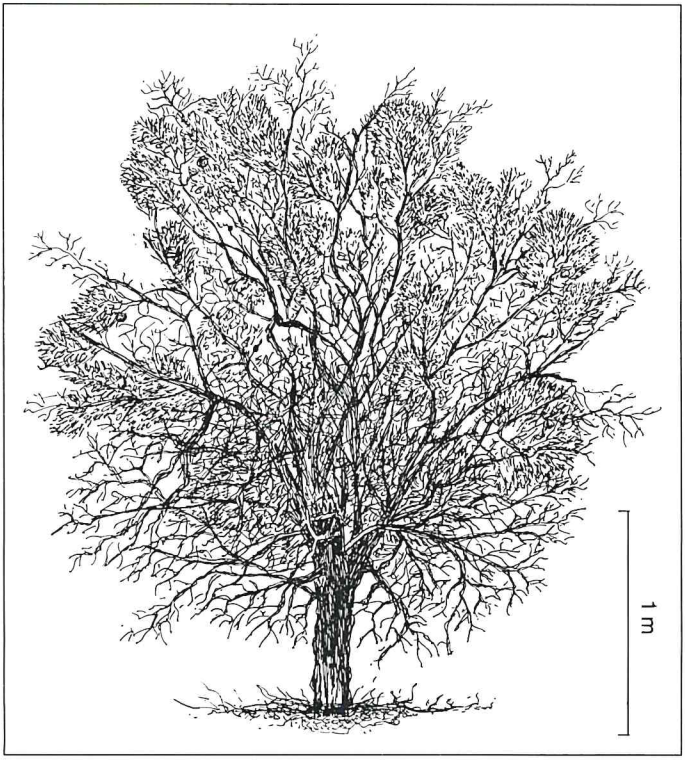
All seeds, germinants and seedlings should be kept watered and well drained, not sodden.

Previcur, Benlate, Rovral and Thiram have been successfully used to curb fungal and nematode infections.

Fertiliser, such as long life 'Osmocote' or Hortico 'Aquasol' applied according to the manufacturers' instructions, is recommended once leaves appear.

When the sandalwood is about a month old it is beneficial to introduce a temporary host to the pot (such as lucerne or a young *Acacia* seedling of a low growing species). The host may need to be trimmed if it begins to smother the sandalwood.

Sandalwood seedlings should be planted out with their pot hosts by the time they are about six months old. Older plants survive less well when transplanted. Planting out should be done at the start of the wet season, taking into account the 'Points to Consider When Planting in the Field' on pages 6-8 of this pamphlet.



Sandalwood tree.

FURTHER INFORMATION

Sandalwood depletion from clearing and harvesting, compounded by slow growth rates and low natural regeneration and survival, has prompted research into various aspects of the biology, regeneration and management of WA sandalwood. Since 1980, the Sandalwood Research Institute, with funds made available by the Australian Sandalwood Company, has played a major role in supporting and co-ordinating research. In 1988, the Sandalwood Conservation and Regeneration Project (SCARP) began, its objective being the improvement of the conservation status of sandalwood in WA: this includes providing research funds.

The Department of Conservation and Land Management's Wildlife Management Program No 8, *The Management of Sandalwood*, provides a detailed program for the conservation and management of sandalwood in WA for the ten-year period 1991-2001. This program aims to conserve sandalwood as a species and to maintain the industry by setting up a reserve system throughout the range of sandalwood, controlling herbivores, making inventories, continuing research, developing plantations, managing harvesting and sale of wood appropriately, and by promoting public awareness of the need for such a program.

Further information can be obtained from the following Department of Conservation and Land Management (CALM) offices:

- State Operational Headquarters
  PO Box 104, Como, WA 6152.
  Tel (09) 334 0333, Fax (09) 334 0466
- Mid-West Regional Office
  PO Box 72, Geraldton, WA 6430.
  Tel (099) 21 5955, Fax (099) 21 5713.
- Goldfields Regional Office
  PO Box 366, Kalgoorlie, WA 6430.
  Tel (090) 21 2677, Fax (090) 21 7831.
- Wheatbelt Regional Office
  PO Box 100, Narrogin, WA 6312.
  Tel (098) 81 1113, Fax (098) 81 1645.

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

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