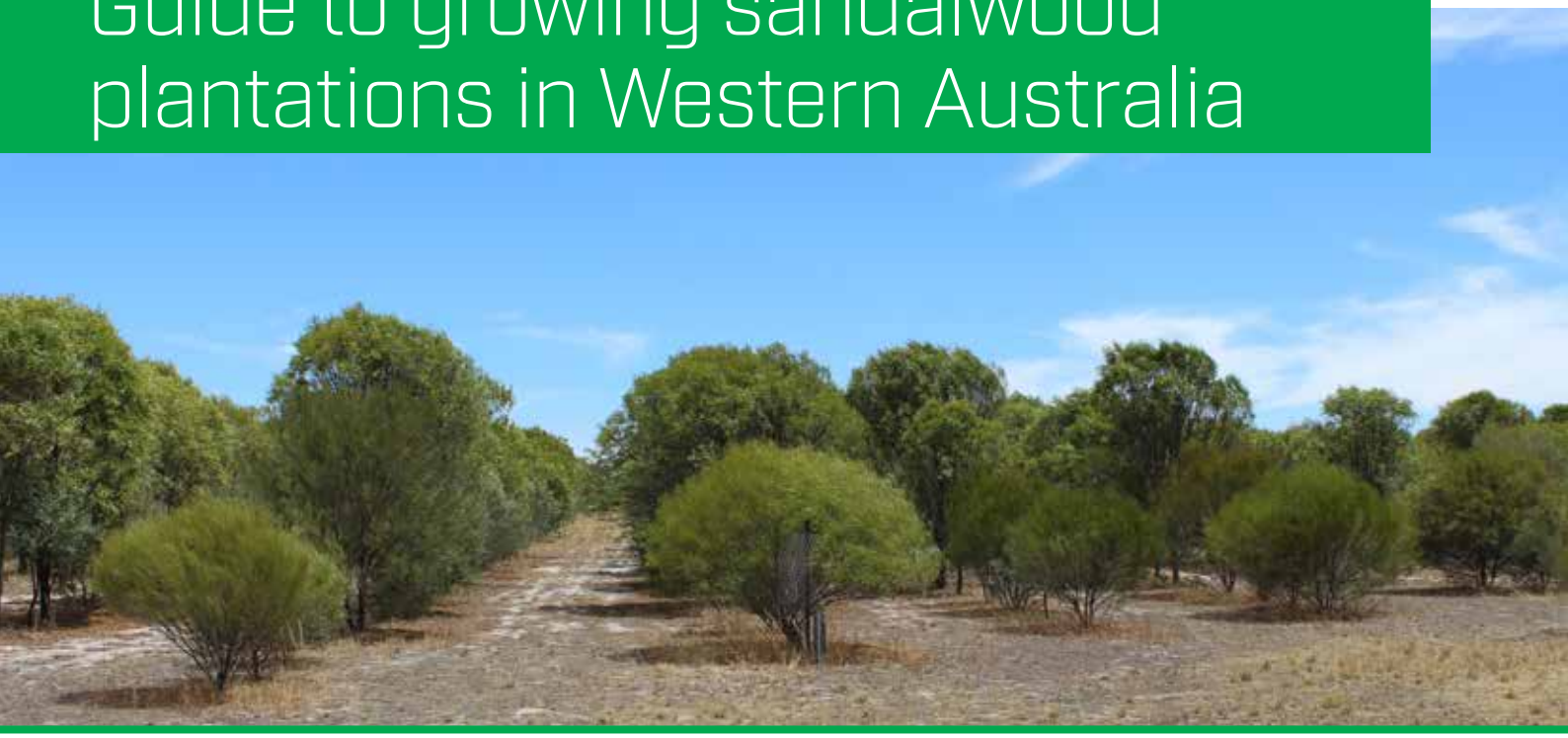
Guide to growing sandalwood plantations in Western Australia



There are around 25 species of sandalwood found globally. Western Australia's naturally growing species is *Santalum spicatum*, more commonly known as WA sandalwood.

WA sandalwood is one of Western Australia's oldest export industries, with the wood first leaving the State in 1845.

Today the oils produced within the heartwood of sandalwood trees are highly valued internationally and are used in a range of products, including perfumes, soaps and cosmetics. The scented wood is also prized and is often powdered to make incense sticks or carved to create ornaments.

This guide has been developed to help landowners understand the key considerations when establishing a WA sandalwood plantation.

Growing sandalwood in plantations is complex, because it is a root hemiparasite. Sandalwood trees photosynthesize, but are also dependent on host trees for water and certain nutrients. Sandalwood can be successfully grown near a range of host species, but performs well when near nitrogen-fixing trees, especially within the genus *Acacia*.

WA sandalwood can be grown using a variety of methods but the aim of this grower's guide is to describe one commonly used approach that has been successful in a range of locations in the Wheatbelt and south west of Western Australia. It will include site selection, host species, establishment, thinning, host-to-sandalwood ratio, grazing, fire, seed production and rotation length.

Site selection

Soil type and climatic conditions are important considerations for sandalwood plantations.

The site conditions need to be suitable for both the host species and sandalwood. Since a range of host species can be used, each potential host needs to be individually assessed to determine if it is suited to the area.

Soil type

Sandalwood can grow on a variety of soil types, including duplex soils like sandy-loam over clay, loams, sandy-gravels, loamy-gravels, red sands and yellow sands.

The best sandalwood growth rates are generally found in soil types with a soft surface, like sandy-loams, of 10 to 20 cm, which are water-gaining but well drained.

Soil types that are generally not suitable include deep-white sands, saline soils, water-logged or heavy-clay soils.

Climatic conditions

Sandalwood will grow in a range of climatic conditions, but growth rates will generally be higher in the western part of the Wheatbelt and South West, where the average annual rainfall is above 400 mm.

Host species

Jam wattle (*Acacia acuminata*) is a suitable host because it supports good sandalwood growth, grows in a range of soil types and can live for approximately 10 to 40 years.

Longevity of the host is an important consideration because sandalwood trees may take 20 to 30 years to reach harvestable age. Therefore, it is important to have a sufficient number of long-lived hosts to support the sandalwood through its full rotation.

Within the *A. acuminata* species, there are also a number of different variants, including *A. acuminata* typical variant and *A. acuminata* narrow-phyllode variant.

The typical variant has more of a tree-shape form and appears to be better suited to the regions with 400 to 600 mm annual rainfall in the western Wheatbelt and the South West. The narrow-phyllode variant has more of a shrub-like form and appears to be better suited to the regions of the Eastern Wheatbelt with 300 to 400 mm annual rainfall. As a general rule, the *A. acuminata* variant that grows locally is normally the best option.

Alternative host species

A number of other relatively long-lived species can also be used as hosts, including mulga (*Acacia aneura*) and wodjil (*Acacia resinimarginea*).

Acacia aneura is a suitable sandalwood host and will grow in a range of soil types and climatic conditions. However, it can be slow growing, especially in the first few years.

Acacia resinimarginea can also be slow growing and appears to be better suited to yellow acidic sandy soils, known as wodjil soils, in the low rainfall areas of the eastern Wheatbelt.

As a general rule, it is recommended that the sandalwood plantation contains at least 50 per cent *A. acuminata*. If using a mixture of host species, also ensure that the different hosts are spread evenly across the plantation.

Host establishment

In October to November, in the year before planting, it is recommended that host seedlings be ordered from a tree nursery or equivalent.

During March to May in the year of planting, it is recommended that the site be mechanically ripped to a depth of approximately 40 cm using a single-tyned ripper in rows spaced five metres apart.

Row spacing is an important consideration to allow future access to the plantation. If the rows are spaced at least five metres apart, they should allow sufficient room to harvest mature sandalwood trees in the future.

On many soil types drawing soil back onto the rip-line, known as a mound, approximately 10 to 20 cm in height, is also useful in promoting good root development of the seedlings. On very sandy soils, removing approximately 10 cm of top soil may be used instead to enable the seedlings to establish below the non-wetting top layer of the soil.

After the weeds have grown in early winter, approximately June, spray the rows with a knock-down and a residual herbicide to control the weeds in the first year.

Approximately two weeks after spraying, plant the seedlings along the rip lines at approximately 2.0 - 2.5 m intervals for rows spaced five metres apart. This will provide 800 to 1000 host trees per hectare. Ensure the hosts are planted firmly in the lines.

Host-to-sandalwood ratio

In a sandalwood plantation it is desirable to start with a high host-to-sandalwood ratio of approximately 3:1. Therefore, a plantation with 900 hosts per hectare, should have no more than about 300 sandalwood per hectare. Sometimes, selective thinning is required to achieve the right balance.

Over time, it is likely that some of the host trees will die due to the stresses of being parasitized by the sandalwood, as well as disease and drought.

By initially having up to three hosts per sandalwood, it provides insurance that even if some hosts perish, there will still be a sufficient number of host trees alive to support the sandalwood trees through the full rotation.

At age 10 to 15 years, if there is still a host-to-sandalwood ratio of 2:1, it should be enough to see the sandalwood through to age 20 to 30 years.

Sandalwood establishment

Preparations

Before planting the sandalwood, the host plants need to be aged at least one year and generally at least 1.0 m in height. The host trees may take one to two years to reach a height suitable to introduce the sandalwood.

The sandalwood seeds or nuts are established by direct seeding in April near the hosts.

It is important to seed early, preferably around April, because it allows the sandalwood the maximum time to germinate during winter and then establish well before summer.

It is also important to use seeds collected within one year, or seeds aged up to two years that have been stored in dry, cool conditions.

The fresher the seeds, the greater the viability. Seeds can be obtained from plantation trees or from naturally growing wild trees.

However, sandalwood seeds obtained from plantation trees generally have a higher viability, partly due to the higher likelihood of cross-fertilisation occurring between parent trees growing near one another.

Planting

Once hosts have matured to a satisfactory level, plant four sandalwood seeds 2 - 4 cm below the surface at each sowing spot, approximately 40 cm from every third host plant, so that you have 270 to 330 sandalwood sowing spots per hectare.

Sow the seeds along the rip-lines, because the host roots will be more concentrated in this region. If the host trees are taller, then plant the seeds further away from the host. For example, if the host tree is 2.0 m in height, plant the sandalwood seeds 80 cm from base of host stem.

At each sowing spot, also place the four sandalwood seeds approximately 10 cm apart from each other. Four seeds are sown at each sowing spot because not all of the seeds will germinate.

By planting the four seeds slightly apart from one another, it also enables excess seedlings to be thinned without damaging the remaining seedlings. For more information see *Thinning the sandalwood seedlings* on the following page.

Weed control

In early June of the sandalwood planting year or approximately two weeks after the weeds have emerged, spray each sandalwood sowing spot in a 50 cm radius with a knock-down herbicide.

During spraying, ensure no spray touches the host plant's stem or foliage.

It is important to control the weeds before the sandalwood seedlings emerge, because competition from weeds can significantly reduce sandalwood survival and growth.

The sandalwood seeds normally take four to eight weeks to germinate after sufficient rain in late autumn or early winter, and then the seedlings normally emerge during July to September.

Grazing and fire

Sheep, goats, cattle, rabbits and kangaroos can damage the sandalwood seedlings and young hosts.

Therefore, the plantation may need to be fenced to exclude stock, especially during the first five to seven years. When the sandalwood trees and hosts are above 1.6 m in height, controlled grazing by sheep during winter can be beneficial to help control weeds and reduce the fire risk.

If the plantation is a near a reserve, grazing by kangaroos may also be a problem. Parrots, including *Barnardius zonarius* or ringnecks, can also ring-bark young seedlings, causing significant damage, and may need to be controlled.

Both the sandalwood trees and hosts are susceptible to fire, and measures should be taken to reduce the fire risk. The plantation should have fire breaks around the perimeter plus turning areas for fire trucks.

Thinning the sandalwood seedlings

As the sandalwood seedlings reach one year, approximately around June to August, it is important to thin each sowing spot that contains multiple sandalwood seedlings. If more than one seedling emerged per spot, then thin to only one sandalwood seedling per spot.

Choose the tallest or strongest seedling to retain. Thinning sandalwood is normally best done in winter when the soil is moist, which enables the one year old seedlings to be easily removed by hand. It needs to be noted that after one year, the seedlings can become more firmly established and become more difficult to remove.

In sowing spots where no sandalwood seedlings have emerged, seeds can also be re-sown, and then thinned again after one year, to have an approximate host-to-sandalwood ratio of 3:1.

Rotation length

The value of sandalwood is normally determined by the proportion and quality of oil in the wood. Oil quality is related to the concentrations or percentages of key aromatic compounds, including alpha and beta santalol, within the oil.

In WA sandalwood trees, heartwood starts developing from about age 5 to 10 years but at this age the oil content and quality are both generally low.

Recent research indicates that high grade sandalwood, containing both high oil content and oil quality, does not develop until approximately 25 years.

Sandalwood oil will continue to develop and improve with the age of the tree.

Due to the time required to produce aromatic wood, growing WA sandalwood is generally considered a long-term proposition, with a rotation length of approximately 20 to 30 years. As such, it is vitally important that the sandalwood trees have a sufficient number of long-lived host plants to support them throughout their full rotation.

It also needs to be noted that the wild sandalwood harvested in Western Australia will generally have a higher oil content and oil quality than plantation wood, due to differences in age. The wild trees are typically harvested around 100 years of age, which is much older than the young plantation trees.

Seed production

At age two to five years, sandalwood trees produce clusters of small flowers, which have a sweet but carrion-like smell. The flowers are produced during January to May, and are pollinated by a range of insects including flies, bees, wasps and ants.

During September to December, the flowers can form into a single fruit, which has a brown leather-like skin enclosing a hard smooth round nut.

The sandalwood nut contains a white edible kernel, about the same size as a macadamia nut. Oils can also be extracted from the sandalwood kernels and can be used in products such as hand washes and skin creams.

Further information

The information contained in this establishment guide is up-to-date at the time of printing.

For further information please contact the Australian Sandalwood Network or the Forest Products Commission:

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