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Growing sandalwood *(Santalum spicatum)* on farmland in Western Australia

Jonathan Brand and Peter Jones

Forest Products Commission
WESTERN AUSTRALIA

Forest Products Commission
Locked Bag 888, Perth Business Centre, Western Australia 6849

Introduction

The Western Australian sandalwood (*Santalum spicatum)* is a root hemiparasitic tree that contains fragrant timber. The distinctive sandalwood fragrance comes from oils contained in the heartwood. Sandalwood provides a valuable export industry in Western Australia, with logs shipped to many countries in southeast Asia. In these countries, sandalwood is commonly powdered and used to make joss sticks for the incense trade. Aromatic oils can also be extracted from the heartwood and used in the manufacture of perfumes, soaps and cosmetics.

Sandalwood is a small tree of 4 m (Figure 1) that occurs naturally in the southern half of Western Australia (Figure 2) and on the western border of South Australia. Natural stands of sandalwood were commonly harvested in the Wheatbelt before agricultural clearing, but today harvesting occurs mainly in the rangelands: the Goldfields and the Midwest. Harvesting is strictly controlled by the Forest Products Commission (FPC), in accordance with the provisions of the Sandalwood Act.

The potential exists to grow sandalwood on farmland and increase the resource base of this valuable industry. The most suitable areas to grow sandalwood are the medium rainfall (400–600 mm) regions of the Wheatbelt and Midwest. Since the early 1980s, the Department of Conservation and Land Management (CALM) and Curtin University have examined methods to grow sandalwood on farmland. Sandalwood trials have been established in many locations, including Narrogin, Katanning, Dandaragan and Northampton. These trials are examining the effects of host species, stocking rate, fertiliser and provenance on sandalwood performance. The results from these trials have been used to formulate this establishment guide.

Figure 1. Mature sandalwood tree, growing near Kalgoorlie. Photo by J. Brand.

Site selection

The preferred site to grow sandalwood is a loam over clay, duplex soil type. However, sandalwood will also grow on gravels, yellow sands and red sands. The site should be water-gaining but well drained. Saline, waterlogged or heavy clay soils are not suitable.

Host species

Sandalwood is dependent on nutrients and water from host plants to survive and grow. The best hosts are nitrogen-fixing trees, especially the wattles *(Acacia* species). Extensive trials have shown that jam *(Acacia acuminata)* is an excellent long-term host for sandalwood (Figures 3 & 4). A fast-growing, short-lived acacia, such as manna wattle *(A. microbotrya)*, is also a good host but may not live long enough for the sandalwood to reach commercial size. Planting either all jam, or a combination of jam and manna wattle, will provide the sandalwood with a good supply of nutrients and water.

Host establishment

The site should be ripped in rows spaced 4 m apart and to a depth of 0.5 m. In early winter, spray the rows with a knock-down and residual herbicide to control weeds for the first year. Two weeks after spraying, plant the host seedlings along the rows at 3 m intervals (833 stems ha^{-1}). Plant rows with either all jam or alternate between manna wattle and jam. A 50 g fertiliser pellet containing NPK can also be applied next to each host to promote growth.

Sandalwood establishment

The most economic and efficient method of establishing sandalwood is by direct seeding. Sow the sandalwood seeds when the host trees are 1-2 years of age. The host trees need to be approximately 1 m tall before introducing sandalwood. In April, plant four sandalwood seeds approximately 0.5-1.0 m from each host. Sandalwood germination rates are about 50%, therefore this sowing density should provide at least one sandalwood seedling per host. Sow the seeds along the rip line, because the host roots will be more concentrated in this region. At each sowing 'spot' loosen the soil with a spade and sow the seeds 2-3 cm below the surface. Sandalwood seeds are available from the FPC Manjimup Seed Centre (see sandalwood contacts), or from private seed suppliers.

Approximately two weeks after the break of the season (e.g. early June), spray each sandalwood 'spot', in a 0.5 m radius, with a knock-down herbicide. Ensure no spray touches the host plants. Weed control is very important before the sandalwood seedlings emerge. Weeds can smother the seedlings and reduce survival and growth. Sandalwood seeds take 4-8 weeks to germinate after good rains in late autumn or early winter. The sandalwood seedlings will emerge in July to August.

Sandalwood to host ratio

At age 5 years, the parasitic requirements of sandalwood trees greatly affect the survival and performance of the host. A ratio of one sandalwood to one host will place too much stress on the host. At age 3 years, the sandalwood to host ratio should be 1:2 or 1:3. Therefore an area with 800 jams ha^{-1} should have no more than 400 sandalwood ha^{-1}, at age 3 years. This may require selective thinning of sandalwood throughout the area to achieve the right balance.

Grazing & fire

Sandalwood is readily grazed by domestic and feral herbivores. Prevent sheep, cattle, goats, kangaroos and rabbits from grazing the sandalwood. Sheep can be introduced when the sandalwood are 10 years old. Parrot numbers also need to be monitored because they can ringbark seedlings. Sandalwood trees are not fire-tolerant and the plantation will need a fire break.

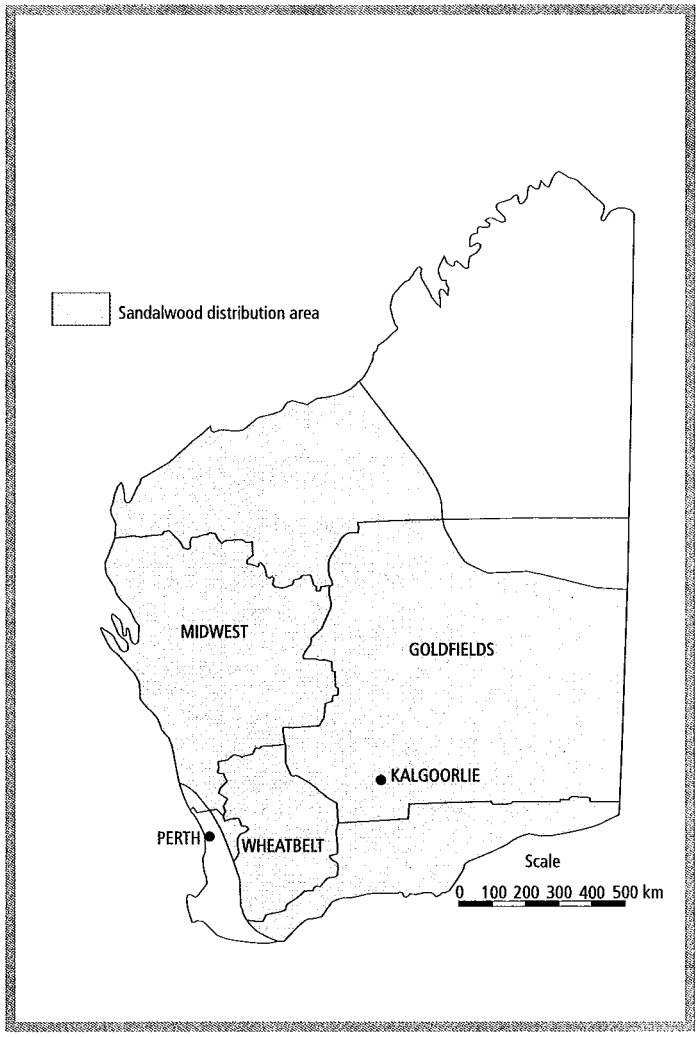

Figure 2. Sandalwood distribution in Western Australia.

Growth rate & fruit production

Sandalwood trees produce fragrant heartwood and oil at age 5-10 years, and the trees should reach a stem diameter of 125 mm (at 150 mm above the ground) at age 20 years. A stocking rate of 200-300 stems ha^{-1} should yield 2-3 tonnes of commercial timber at age 20 years.

After age 5 years, an individual sandalwood tree can produce up to 200 mature nuts per annum. Each nut is 2-3 cm in diameter and there are approximately 400 nuts kg^{-1}.

Sandalwood seeds from a plantation have a high rate of germination and are therefore a good seed source for further plantings. The sandalwood nuts also contain an edible kernel, similar in composition to commercial nut species, such as as almonds, peanuts and macadamias. Studies by Curtin University show that sandalwood kernels contain 60% fat, 18% protein and 16% carbohydrate. Therefore, the nuts have the potential to provide a source of income while waiting for the timber to reach commercial size. Sandalwood trees flower in March–May and the fruits mature in August–November.

Figure 3. Three-year-old sandalwood growing beneath an eight-year-old jam (A. acuminata). *Sandalwood trial near Katanning. Photo by J. Brand.*

Figure 4. Eight-year-old sandalwood (left) growing next to a nine-year-old jam (right). Sandalwood trial near Northampton. Photo by J. Brand.

Provenance selection

Provenance trials have been established by CALM and FPC to identify superior types of sandalwood, and its preferred host *A. acuminata*. The aim is to examine the range in sandalwood and select the trees that are fast growing and produce high quantities of fragrant oil.

The effect of different *A. acuminata* provenances on sandalwood growth is also being studied to identify the best type of *A. acuminata*. The seeds from the superior sandalwood and *A. acuminata* will be used in future plantings.

Further reading

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Sandalwood contacts

The information contained here is up to date at the time of printing. For the latest developments or for information on other sandalwood matters please contact the following FPC branches:

FPC Arid Forest Branch
Forest Products Commission
64 Weir Rd, Harvey, WA 6220
Ph: (08) 9729 2888, Fax: (08) 9729 2499

FPC Arid Forest Branch
Forest Products Commission
Hannan St, Kalgoolie, WA 6430
Ph: (08) 9021 8643, Fax: (08) 9021 5186

FPC Manjimup Seed Centre
Forest Products Commission
Burnside Rd, West Manjimup, WA 6258
Ph: (08) 9772 1288, Fax: (08) 9772 1305

FPC Sharefarms South Coast
Forest Products Commission
120 Albany Hwy, Albany, WA 6330
Ph: (08) 9842 4530, Fax: (08) 9842 5279

FPC Southwest Treefarms
Forest Products Commission
20 Throssell St, Collie, WA 6225
Ph: (08) 9734 1688, Fax: (08) 9734 5649

FPC Sharefarms Midwest
Forest Products Commission
260 Kalamunda Rd,
South Guildford, WA 6055
Ph: (08) 9279 4088, Fax: (08) 9279 5481

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