

### Conserving sandalwood (*Santalum spicatum*) in the rangelands, Western Australia

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#### Introduction

Within Asia, sandalwood (*Santalum spicatum*) powder is commonly used to make incense (joss) sticks. Sandalwood oil, contained in the heartwood, is also a desirable product in the perfume industry. The sandalwood tree grows to 4 m, and occurs naturally in the southern half of Western Australia and the western border of South Australia. It is a root hemi-parasite that grows with a range of vegetation types, including many wattle (*Acacia*) species.



Figure 1. One year old sandalwood seedling established by direct seeding. CALM sandalwood trial at Ninghan station. Photo by J. Brand.

The harvesting and export of sandalwood have a long history in Western Australia. During the 1840s, sandalwood was the state's primary export earner. The majority of sandalwood was cut at places close to Perth, such as Northam, York and Beverley. Gradually sandalwood harvesting moved further inland, into the Wheatbelt and then into the semi-arid regions of the Goldfields and Midwest. Today, the industry is much smaller, and harvesting occurs mainly in the pastoral regions. However, it is possible that the harvest from natural stands will be reduced and supplemented with sandalwood grown in plantations. Sandalwood plantations are currently being established in the medium rainfall (400-600 mm) farming regions of the Wheatbelt and Midwest (see Sandalwood Information Sheet 1).

Besides growing sandalwood on farmland, CALM also manages sandalwood in the rangelands (Figure 1). On many grazed pastoral leases, the majority of natural stands contain only old trees, with very little recruitment for at least 50 years. Recruitment failure has been partly due to grazing by domestic and feral herbivores, such as goats, sheep and rabbits. Low sandalwood survival is also due to drought and the low annual rainfall (200-300 mm) in these regions. To improve recruitment of sandalwood and other species, CALM has obtained and de-stocked a number of stations over the past ten years. Two stations managed by CALM are Burnerbinmah (near Paynes Find) and Goongarrie (near Menzies) - Figure 2. Sandalwood recruitment trials have been established on these stations since 1996, as well as on three grazed pastoral leases: Thundelarra, Ninghan and Jeedamya. The results from these trials have been used to formulate this guide.



## Landforms

Sandalwood will grow on a range of soil and land types in the rangelands. The highest stocking rates of sandalwood occur in the hills, washplains and plains. The deep red sandplains and saline plains generally have a lower stocking rate. The best sandalwood growth will occur on a water gaining site that is not saline.

## Parasitic relationship

A mature sandalwood tree has an extensive lateral root system that can extend over 20 m from the stem. Along the length of the lateral roots are fine feeder roots that search for suitable host roots. The fine feeder roots make cup-like connections (called haustoria) to host roots. Sandalwood haustoria can be up to 20 mm long, and enable the parasite to draw water and nutrients from the host. Generally, the best host species are the nitrogen-fixing plants, especially the wattles (*Acacia* species, Figure 3) and the cassias (*Senna* species).

Sandalwood will grow with a variety of host species in the rangelands, including: jam (*A. acuminata*), Burkitt's jam (*A. burkittii*), mulga (*A. aneura*), curara (*A. tetragonophylla*), miniritchie (*A. grasbyi*), wanyu (*A. ramulosa*), tan wattle (*A. hemiteles*) and desert cassia (*Senna artemisioides* subsp. *filifolia*).

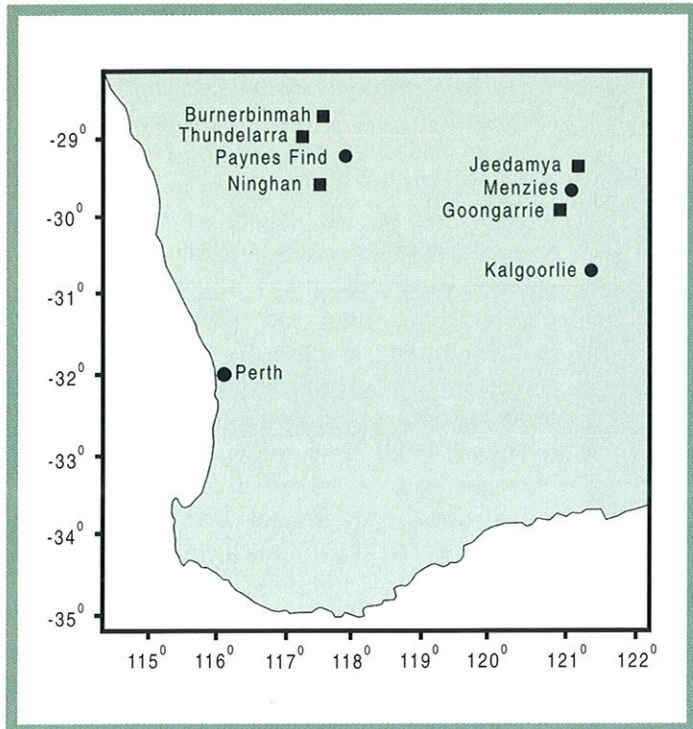
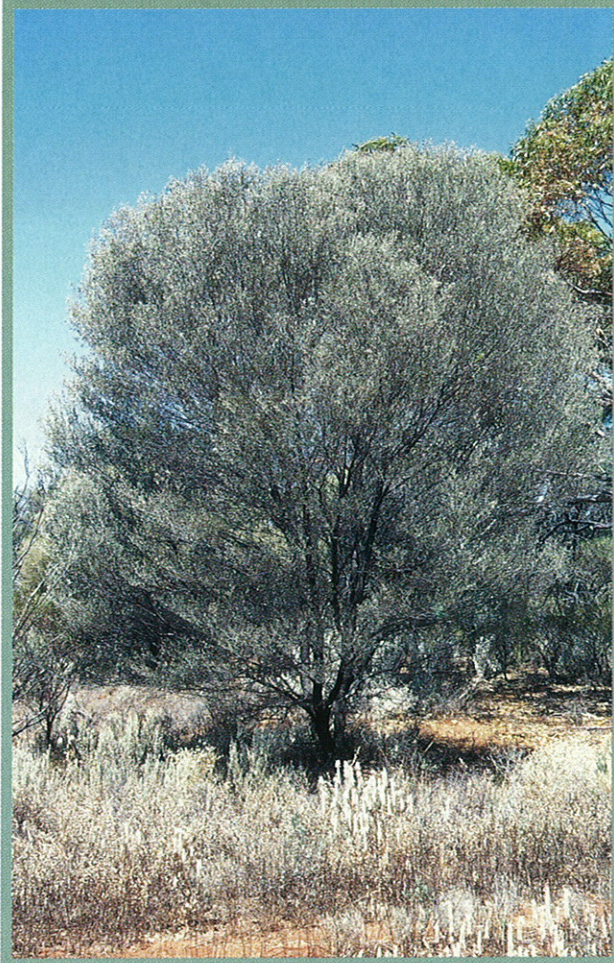
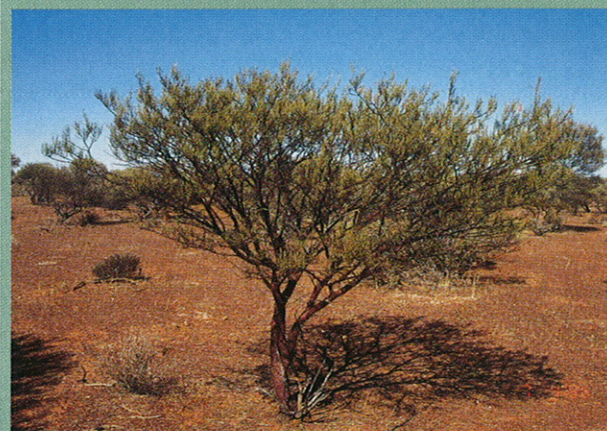


Figure 2. The location of pastoral leases (■) used to study sandalwood recruitment in Western Australia.

Figure 3. Three suitable host species for sandalwood in the rangelands: Burkitt's jam (top), miniritchie (middle) and mulga (bottom). Photos by J. Brand.



## Sandalwood establishment

Direct seeding is a very effective method of establishing sandalwood in the rangelands. Select suitable host species that are 1-2 m in height and sow four sandalwood seeds approximately 1 m from the base of the stem. At each sowing 'spot' loosen the soil with a spade and bury the seeds 2-3 cm below the surface, in April-May. The seeds require no pre-treatment, apart from removing the leather-like fruit that encloses the hard smooth nut. Use fresh sandalwood seeds from the previous season or seeds that have been stored in a dry, cool place. Wherever possible, use sandalwood seeds from local populations. Sandalwood seeds can also be purchased from the Manjimup Seed Centre (see sandalwood contacts) or from private seed suppliers. Germination rates in the rangelands vary from 5 to 50 % and depend on winter rainfall. The sandalwood seedlings normally emerge in July-September.

Annual grass and weeds are generally not a problem in the rangelands and no herbicide spraying is required.

## Growth rate & fruit production

The nutrients contained within the sandalwood seed enable the newly emerged seedling to reach a height of 10-30 cm by late November (Figure 4). Survival and further growth are then dependent on successful attachments to suitable host plants. Drought and grazing can also have a large impact on sandalwood survival. Sandalwood growth rates in the low rainfall (200-300 mm) regions of the rangelands are generally slow, with trees requiring 50-100 years to reach a stem diameter of 125 mm (at 150 mm).

Sandalwood trees flower in March-May and produce mature fruit in August-November. Fruit production can occur from age 5-10 years, but is dependent on good autumn and winter rainfall. The sandalwood fruit contains a round nut, that is 15-25 mm in diameter. Within the nut is a kernel, and studies by Curtin University show that the kernel consists of approximately 60 % fat, 18 % protein and 16 % carbohydrate.

## Grazing & fire

The sandalwood seedlings need to be protected from grazing for up to 40 years. Although a range of herbivores graze on sandalwood, goats appear to cause the most damage. Goats are capable of stripping foliage to a height of 2 m, and can kill mature sandalwood trees. Sandalwood trees are poor resprouters and therefore susceptible to fire.

## Managing natural stands

Areas where sandalwood grow naturally can be fenced to reduce grazing pressure and improve sandalwood recruitment. This will also reduce pressure on sandalwood parent trees (Figure 5) and enable their crowns to expand and produce more seeds. Seed enrichment within the stand will also enhance natural recruitment. Other plant species should also benefit from de-stocking, and therefore provide more young host seedlings for sandalwood. If de-stocking is not a viable option, reducing stock numbers when feed is limited, will enhance sandalwood recruitment.



Figure 4. Three month old sandalwood seedlings established by direct seeding. CALM sandalwood trial at Ninghan station. Photo by J. Brand.

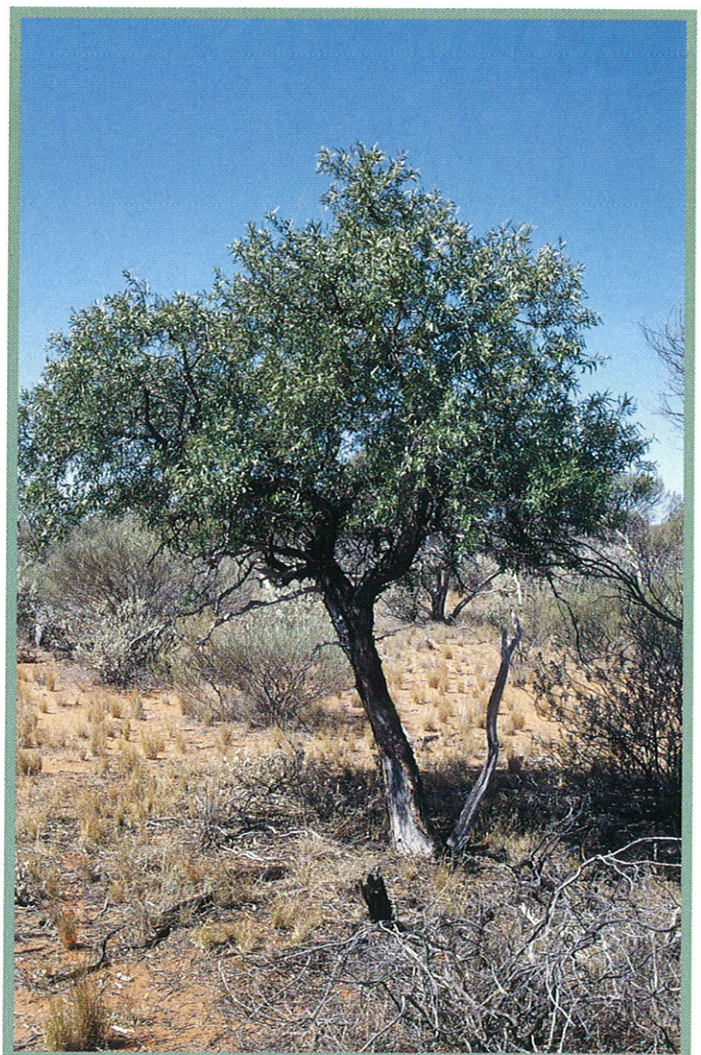


Figure 5. Mature sandalwood tree growing at Burnerbinmah station. Photo by J. Brand.

## Further reading

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Talbot, L. (1983). Wooden Gold. Early Days of the Sandalwood Industry. W.A. Forests Department. Forest Focus 30: 21-31.

## 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 CALM branches:

### **CALM Science Division**

Conservation and Land Management  
50 Hayman Rd, Como, WA 6152  
Ph: (08) 9334 0299, Fax: (08) 9334 0327

### **Sandalwood Business Unit**

Conservation and Land Management  
50 Hayman Rd, Como, WA 6152  
Ph: (08) 9334 0419, Fax: (08) 9334 0550

### **Midwest Region**

Conservation and Land Management  
193 Marine Tce, Geraldton, WA 6530  
Ph: (08) 9921 5955, Fax: (08) 9921 5713

### **Goldfields Region**

Conservation and Land Management  
Hannan St, Kalgoorlie, WA 6430  
Ph: (08) 9021 2677, Fax: (08) 9021 7831

### **Manjimup Seed Centre**

Conservation and Land Management  
Burnside Rd, West Manjimup, WA 6258  
Ph: (08) 9772 1288, Fax: (08) 9772 1305

