

**PROCEEDINGS OF THE AUSTRALIAN RANGELAND SOCIETY BIENNIAL CONFERENCE**  
**Official publication of The Australian Rangeland Society**

**Copyright and Photocopying**

© The Australian Rangeland Society 2014. All rights reserved.

For non-personal use, no part of this item may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without prior permission of the Australian Rangeland Society and of the author (or the organisation they work or have worked for). Permission of the Australian Rangeland Society for photocopying of articles for non-personal use may be obtained from the Secretary who can be contacted at the email address, [rangelands.exec@gmail.com](mailto:rangelands.exec@gmail.com)

For personal use, temporary copies necessary to browse this site on screen may be made and a single copy of an article may be downloaded or printed for research or personal use, but no changes are to be made to any of the material. This copyright notice is not to be removed from the front of the article.

All efforts have been made by the Australian Rangeland Society to contact the authors. If you believe your copyright has been breached please notify us immediately and we will remove the offending material from our website.

**Form of Reference**

The reference for this article should be in this general form;

Author family name, initials (year). Title. *In*: Proceedings of the nth Australian Rangeland Society Biennial Conference. Pages. (Australian Rangeland Society: Australia).

For example:

Anderson, L., van Klinken, R. D., and Shepherd, D. (2008). Aerially surveying Mesquite (*Prosopis* spp.) in the Pilbara. *In*: 'A Climate of Change in the Rangelands. Proceedings of the 15<sup>th</sup> Australian Rangeland Society Biennial Conference'. (Ed. D. Orr) 4 pages. (Australian Rangeland Society: Australia).

**Disclaimer**

The Australian Rangeland Society and Editors cannot be held responsible for errors or any consequences arising from the use of information obtained in this article or in the Proceedings of the Australian Rangeland Society Biennial Conferences. The views and opinions expressed do not necessarily reflect those of the Australian Rangeland Society and Editors, neither does the publication of advertisements constitute any endorsement by the Australian Rangeland Society and Editors of the products advertised.



*The Australian Rangeland Society*

# A SILVICULTURAL SYSTEM FOR SANDALWOOD: A SEMI-PARASITIC SPECIES FOR FARM AND COMMUNITY ENTERPRISES IN SEMI-ARID TO ARID AUSTRALIA

*J.E.D. Fox, T.M. Luong, M.C. Cox and T. Carlino*

Mulga Research Centre, Department of Environmental Biology,  
Curtin University of Technology, GPO Box U1987, Perth WA 6845

## ABSTRACT

Declining and irregular supplies of naturally occurring sandalwood have led to increased interest in planting sandalwood either in small lots on farms, or as investment holdings in larger schemes. *Santalum spicatum* (West Australian sandalwood) is an autotrophic, obligatory parasite. Sandalwood seedlings have an early requirement for attachment to hosts that provide nutrition and shade. Survival and growth of sandalwood are related to the success of haustorial connections. It is probable that small holders growing trees for a variety of purposes will have a more suitable base for adding sandalwood than would large enterprises concentrating on single species plantations. Species selected as hosts should be intrinsically useful as well as being able to promote sandalwood growth. In WA, the native, nitrogen fixing species, *Acacia acuminata* has demonstrated the best sandalwood response.

## INTRODUCTION

The aromatic heartwood of sandalwood is a valuable internationally traded commodity. It has a wide range of uses such as wood for carvings; wood dust for the manufacture of joss sticks, which are used for religious purposes; and the oil distilled from heartwood that is used in the perfume, medicinal and pharmaceutical industries. *Santalum spicatum* (R.Br.) A.D.C (West Australian sandalwood) occurs in central to southern Western Australia. There is considerable interest in planting WA sandalwood in small lots on farms or as private investment holdings in large schemes. WA sandalwood can be grown in higher rainfall areas on farms to supplement the declining natural stands. The wheatbelt region of WA is ideal as it receives 350-500 mm of rainfall a year (Fox, in press). It is suitable for catchment protection in saline areas, in partially cleared areas, or for enrichment of remnant vegetation. Establishing WA sandalwood on farms has the potential to enhance future value, enable nut crop yields and it adds endemic species to the land (Fox *et al.*, 1996).

WA sandalwood is a slow growing shrub or small tree that can reach 7-8 m in height, but is usually shorter. After 3-4 years of age, it begins to flower and fruit. Mature fruits are 15-20 mm in diameter, with a leathery red-brown exocarp 1 mm thick (Fox, 2000). The kernel is edible and has potential in the speciality nut trade. WA sandalwood is an obligate root hemi-parasite, therefore its distribution is dependent on the presence of potential hosts, with *Acacia* species being the most suitable. Sandalwood can attach to many host roots at the same time and those species growing nearby are most likely to be used as hosts. Sandalwood can produce fragrant heartwood and oil at nine years, when stem diameters can reach 125 mm (at 150 mm aboveground), under summer irrigation.

## SILVICULTURE PROTOCOL

### Site selection

Sites should be well-drained and water gaining. Waterlogged or heavy clay soils are not suitable. WA sandalwood can be grown in remnant bush areas, reclamation areas, previously cleared land with planted hosts, and along accessways. Sandalwood thrives in loam to sandy loam soils. In the Perth area, it can be grown in sandy soils with irrigation.

## Seed collection

Establishment of WA sandalwood is best achieved with directly sown seed. A local seed source is preferred. Mature fruits can be collected around December, when the fleshy mesocarp has dried and is brown in colour. Seeds gradually lose viability, so are best used when one to two years of age. Recently produced seeds do not germinate well until three or four months later.

## Establishment

The easiest planting technique is to use open land with regenerating *Acacia* species present. Seeding sites should be prepared in advance; selected areas ripped to a depth of a least 250 mm into contoured furrows (4-5 m or more apart) (Fox *et al.*, 1996). If hosts have been established for less than a year, plant seeds at least 1 m away; if the host is already established, plant seeds 2 m away. This provides shade and shelter for seedlings for the first year or so. Planting two hosts to one sandalwood is recommended. May is the most favourable month to plant host species. It is best to have new hosts established for 1-2 years, before directly sowing sandalwood (Fox, in press).

Multiple host plants for sandalwood have the potential to enhance plantation growth. A host plant should ideally promote sandalwood growth, and also be a useful species in its own right (fuelwood, fodder, timber or fruit). Hosts that extract large amounts of nitrogen from the soil, such as legumes, are generally good hosts for sandalwood in the field (Fox, 2001). *Acacia acuminata* Benth. (jam) and *Acacia aneura* Benth. (mulga) are the most efficient host plants for WA sandalwood. If these species are not available, many other *Acacia* species are satisfactory (Fox, in press). She-oaks (*Allocasuarina* species) may also be good hosts (Fox *et al.*, 1996).

## Seed sowing and germination

No pre-sowing treatment is necessary. Direct sowing of individual WA sandalwood nuts next to roots of the host plant is recommended. WA sandalwood is best sown between February to May. Plant single nuts 1 m apart allowing for selective removal of seedlings if necessary to aim for 5 m between plants. If many seeds germinate, the least vigorous can be removed. Sow seeds 15-30 mm below the soil surface. In nature, seedlings begin to emerge 3-6 weeks after the opening winter rains of April or May. Any planting spots without seedlings may be resown the following year.

## Maintenance

Young sandalwood seedlings grow better in light shade (about 50%) for the first three years, later thriving in more light. Providing seedlings with slow release fertiliser may be beneficial. Fencing against herbivores, fire control, and weed control are essential, especially when sandalwood is young (Fox *et al.*, 1996). Repeated pruning of sandalwood in its early growth stages to give one stem is likely to improve the value of the tree (Fox, in press). Pruning and trimming of hosts after 4-5 years may be necessary if they are crowding the sandalwood (Fox *et al.*, 1996).

## REFERENCES

- Fox, J.E.D. (2000). Sandalwood: the royal tree. *Biologist* 47: 31-34.
- Fox, J.E.D. (2001). Sandalwood: the prospects and advantages of cultivation of a semi-parasitic species by landowners. In 'Forests in a Changing Landscape. Proceedings Commonwealth Forestry Conference'. (Ed Promaco). Promaco Conventions, Canning Bridge, Perth, pp. 537-543.
- Fox, J.E.D. (in press). Silviculture of sandalwood: a semi-parasitic species for family farm enterprises in Western Australia. Paper presented at the IUFRO International Symposium in the Black Forest: Contributions of Family Farm Enterprises to Sustainable Rural Development. Gengenbach, Germany, 29 July-1 August 2002.
- Fox, J.E.D., Barrett, D.R. and Gentle, R. (1996). Sandalwood for saline sites. In 'Proceedings 4<sup>th</sup> National Conference and Workshop on the Productive Use and Rehabilitation of Saline Lands'. Albany, pp. 335-343.