

The Avon Sandalwooder

Welcome to the third issue of the Avon Sandalwooder, a newsletter produced by the Avon Sandalwood Network

From the Chair

Bruce Storer, Chairman, Avon Sandalwooder Network Inc.



Cunderdin Farmer and ASN Inc. Chairman Bruce Storer has a break from host planting at his east Koorda property June 2004

NOW that the Avon Sandalwood Network Inc. officially exists, I would like to thank all those who attended our last workshop and assisted us through out inaugural AGM. I think we have a very valuable group of people in the association and it was great to see so many attend. The network will provide a great range of benefits and I encourage anyone interested to become a member.

Sandalwood is a long term venture; hence I believe that there are real advantages in sharing information via the ASN Inc. Anyone wishing to establish commercial stands of sandalwood will save time and money through accessing information produced by researchers, and from experiences shared by growers in regards to plantation establishment and management. A lot of frustration and unnecessary cost can be avoided if we can cut out the trial and error phase and start your plantation off on the right foot. Projects already underway have allowed us to see what does and does not work.

Seed is another aspect of the network I see as valuable at this time. Some members will have seed for sale while others will be looking to purchase seed for the 2005 planting season. Via the association we may put these people in touch with one another and endeavour to have seed sourced from as close to home as possible. Local provenance is something that comes to the fore again and again.

Sandalwood seed begins to ripen around November, so if you are looking for, or have seed, contact secretary Tim Emmott and we may be able to coordinate distribution within the group. It is likely growers will soon be seeking information on seed harvesting, so the network will be focusing on this in the future. Products, marketing, packaging and storage are also going to be issues to be addressed in the future.

I trust you all have gained something from being part of the network, and I look forward to seeing you all at our next workshop.

Wishing you all the best for the festive season.

Bruce Storer

Membership & ASN Update

Tim Emmott, Farm Forestry Coordinator Greening Australia (WA) and Secretary Avon Sandalwooder Network Inc.

THANK you all for your prompt payment of membership fees, this is most appreciated. The Avon Sandalwood Network Inc now has 52 paid members, providing the ASN with the operating budget required to function throughout 2005. Our membership base is diverse, consisting mainly of growers, as well as researchers, farm tree nurseries, natural research management professionals and interested people.

There is now an email discussion network for the ASN, allowing members with any questions, comments or issues to seek feedback from the group. To participate in the email network, contact temmott@gawa.org.au.

The inaugural AGM and combined workshop/field trip held on the 3rd of September in Beverly was a great success, with the election of an enthusiastic executive committee. The workshop included presentations by Jerome Ryan (Australian Sandalwood Oil Company) discussing current markets and future potential of WA sandalwood oil, Geoff Woodall (CENRM) provided an update on same day establishment of hosts and sandalwood and Jon Brand (FPC) expanded on sandalwood ecology in the rangelands. The afternoon field trip focussed on Felicity and Tony Ednie-Brown's impressive plantation east of Beverley, with a quick look at Ron Mulder's irrigated plantation. Thank you to Felicity and Tony for hosting the field trip.

The next AGM, workshop and field trip is planned for March 2005, and at this stage will be held in Narrogin, as there are several very interesting trial plantations in the area. Confirmation of the date and location will be advised early next year.

I would like to take the opportunity to thank the executive committee for their contribution to the ASN Inc, and acknowledge all of the presenters who have kindly delivered presentations at workshops, and provided articles for the newsletter, with special thanks to Geoff Woodall, Jon Brand and Peter Jones. I would also like to acknowledge the Avon Catchment Council and the Australian Government, Department of Agriculture, Fisheries and Forestry, National Landcare Program for provided funding to assist with the development of the ASN Inc.



Avon Sandalwood Network members at the 3rd workshop and field trip, East Beverley, September 2004

If you have any questions regarding the ASN, require information or would like to join, please contact the secretary:

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Australian Government
 Department of Agriculture, Fisheries and Forestry
 National Landcare Program



Greening Australia
 Western Australia Inc.

Harvesting Sandalwood in the Rangelands

Grant Pronk, Manager Arid Forest, Forest Products Commission

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THE commercial harvesting of natural stands of Western Australian Sandalwood has occurred over a long period of time. The salvaging of sandalwood ahead of land clearing in the emerging Wheatbelt gave rise to sandalwood being the State's primary export earner in the 1840's.

Harvesting continued beyond the Wheatbelt and into the outer reaches of sandalwood's vast distribution including the Rangelands and desert areas. By the late 1920's four Western Australian export companies were competing for markets in China, and large amounts of sandalwood were harvested throughout the Wheatbelt and Rangelands with no restriction on quantities. In 1929 the Sandalwood Act was passed and in 1932 the Sandalwood Export Committee was formed.

Today sandalwood harvesting is managed by the Forest Products Commission (FPC) according to the provisions of the Sandalwood Act and Forest Products Act 2000. The FPC ensures the long-term viability of the sandalwood industry and the principles of ecological sustainable forest management are applied.

At present an average harvest of around 2000 tonnes is produced from Crown Land each year, approximately 35% of this amount being dead sandalwood. The fragrant oil associated with sandalwood is retained in the heartwood of the tree, therefore dead trees and sticks have a commercial value.

Living trees are harvested to a specific sandalwood harvesting and regeneration silvicultural prescription. The prescription stipulates a minimum harvestable stem diameter of 127mm at 150mm above ground level. Living sandalwood trees below this size are not harvested.

To promote sandalwood regeneration and recruitment no less than 12 fresh sandalwood seeds are planted nearby on selected host trees for each sandalwood tree harvested. This regeneration work is carried out by contracted harvesters during the harvesting process. Contractors have been trained to identify fresh viable seed, select appropriate host trees and maintain a seed planting depth and technique.

Regular inspections by FPC Foresters ensure the required standards are met, thus promoting the long term viability of the species and industry. Continuous improvement in the management of sandalwood is enabled through the FPC Sandalwood Enrichment Programme (SEP), dedicated sandalwood researchers and collaborative research projects with local universities and other government agencies.

The role of sandalwood plantations has been identified as a crucial component in the future supply of sandalwood into expanding markets. Because of its long trade history, Western Australian Sandalwood is very well established in the global market. It is estimated that Western Australian Sandalwood supplies around 40% of the world demand. The continuance of this strong market position enjoyed by Western Australians is reliant on the ongoing consistent supply of quality sandalwood from both our managed native resource and future plantations.



Sandalwood regeneration resulting from an FPC harvest/regeneration operation (Image: D.Evans FPC); Water debarked sandalwood second grade product (sandalwood branches) (Image: G.Pronk FPC)

Grant Pronk is the Arid Forest Manager within the Forest Products Commission. Further information can be obtained by contacting Grant at the FPC office in Harvey on 08 9729 2888.

How Sociable is Your Plantation?

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RENEW Environmental Services can provide key services to sandalwood growers that will assist in achieving profitable returns through environmentally sustainable systems, based on our extensive knowledge of all aspects of the industry.

It is very easy to concentrate on the technical aspects of growing trees. The best propagation methods, soil type, rainfall, placement in the topography, nutrition, weed control and many other innumerable factors. The end result of growing a commercial plantation, which is hopefully earning more money than you've spent, can also consume endless hours of thought.

But have you considered the social impacts of your plantation?

Many growers consider the impact of their plantation ends at their boundary fence. However this is far from the truth and growers who ignore the impacts that large (and small scale) tree planting can have on the communities in which they are located, do so at their own peril.

The rural community is constantly assailed by seminars, pamphlets, articles, radio and the web articulating all the benefits and reasons why trees should be planted. I will assume you are all on board with these concepts. Enough said.

However the negative social aspects should also be considered and managed in order to save you money and remain on good terms with all.

These include, but are not limited to:

- Fire Hazard – Large plantings of trees can greatly increase the both the risk of fires starting and the severity of fire impact due to the increased fuel loads within a plantation. Fire fighting in most rural communities involves the wider community, the majority of who are volunteers. Active involvement with local brigades and prior planning for fire prevention and control is essential for any plantation;
- Transport Impacts – For the majority of a tree crop rotation there will be minimal impact on transport corridors. However once harvesting commences, things can get interesting. Will cartage of your harvest interfere with school bus routes and other road users by increasing hazards? Have you thought about entry and exit points from the plantation onto public roads and are all the bridges you intend to cross rated for the tonnage you anticipate being carted?;
- Weed and Pest Control – If you intend to use chemical control methods for weeds and pests the impact beyond your boundary must be assessed and acted upon. If you're unsure check with the EPA;
- Visual Amenity – How will your plantation affect the broader visual landscape values both as it matures and when it is finally harvested? Planning for this impact and developing strategies to manage the impact may prevent negative community attitudes to your plantation in the future.

Many of these factors may not seem important at the initial establishment phase of your plantation. However they need to be considered as early as possible in the planning process to avoid future problems and unnecessary disputes with neighbours and local councils. In some instances they may even assist in reducing insurance premiums.

Don Moir's Case Study

Don and Dianne Moir, ASN Inc. Members, Narrogin

Background

DON and Dianne Moir run an intensive cut flower enterprise that supplies overseas markets. Don has planted about 3 hectares of sandalwood and sees the wood providing a return in the long term, with nut collection providing income along the way.

When this site was established in 1999 the current establishment method promoted at the time involved the planting of host seedlings at 833 stems per hectare, usually *Acacia acuminata* as the sole host species, during winter of the first year and in the second or third year, four untreated sandalwood seeds are sown around each Acacia host tree during April or May.

This trial plantation aimed to determine whether:

- 1) Hosts could be established by direct seeding
- 2) Plantations could be productive when they contained more than one host species,
- 3) Plantations could be productive when they contained high densities of host species.

Plantation establishment

In preparing the site, Don had the site dozer ripped at 4m spacing (2.5km of rip line per hectare) before the break of season. The site was sprayed a knockdown herbicide 10 days prior to establishment.

In July of 1999 Don direct seeded a mix of species that were intended to be host plants for the sandalwood. The mix of seed that was used in is table 1. A few Hakea seedlings were also planted.

Table 1. Species, seeding rate and cost of sandalwood host establishment at Moir's property.

Species	Rate (g/ha)	Seeds/ha	Seeds/m in rip line	Cost/ha
	280	15,000	6	\$44
<i>A. acuminata</i> (jam)				
<i>A. pulchella</i> var. <i>glaberrima</i> (prickly moses)	40	14,000	6	\$6
<i>A. saligna</i> (golden wreath wattle)	100	5,000	2	\$9
<i>A. redolens</i>	48	6,000	2	\$12
<i>A. rostellifera</i> (summer scented wattle)	30	2,000?	1	\$8
<i>Allocasuarina huegeliana</i> (rock sheoak)	24	13,000	4	\$5
<i>Allocasuarina humulis</i> (dwarf sheoak)	20	13,000	5	\$6
<i>Kennedia prostrata</i> (running postman)	60	3,000	1	\$8
Seed preparation + delivery				\$8
TOTAL	602g/ha	71,000	27	\$106

A Chatfield tree planter (hired for \$100 per day) was used to scalp, mound and sow the host seed in a one-pass operation. The seed was bulked up with weed (seed) free soil from the site (400g of seed mixed with 6 litres of soil), and this was scattered by hand from the back of the tree planter (the seeding box was not working).

In mid may 2000, Don planted cracked sandalwood nuts. When planting (2 nuts every 5m), a small hollow was made in an attempt to collect moisture and maximize the germination and survival of the sandalwood. Although germination rate was 75%, emergence and establishment were low (30%). Many seeds that had germinated did not emerge due to a lack of moisture. The break of season didn't occur until early June and the last rainfall of the growing season was in early August. In subsequent years Don has filled in the gaps and the site has an adequate (or perhaps a few too many) number of sandalwood that are 2-4 years of age.

Table 2. Cost of site preparation, weed control and sandalwood nuts

Operation	Rate	Cost/ha
Ripping of site	\$140/ha	\$140/ha
Hire of Chatfield tree planter	\$100/day	\$33
Weed control	3.2l/ha	\$20
Sandalwood nuts	1.3kg/ha	\$55
Fencing cost	nil	nil
Total cost per hectare		\$248

On some areas of the site there have been minor problems with weeds, highlighting to Don the importance of weed control. "Weed control is crucial, otherwise the growth and survival of the hosts and germinating sandalwood can be reduced."

Another aspect of the enterprise was the cost. To plant the site with seedlings would have cost \$1000 for the seedlings alone yet a fantastic result was achieved by direct sowing the hosts for a cost of \$320.



Beverley farmer and ASN member Patt Butterworth inspecting seed ripening in the Moir's direct sown, multi host sandalwood plantation

Key Observations

- Excellent establishment of hosts via direct seeding (which was cost effective – approx. three times cheaper than seedlings)
- Seed mixes need to include a better balance of large fast-growing/short-lived Acacias and longer-lived/slower-growing hosts.
- Good sandalwood growth at this site. The average growth rate on this site is about 12-15mm pa (diameter at 150mm above ground) with the largest trees being about 85-90mm at year 4.
- Some hosts have a growth form that is complementary to that of the sandalwoods.
- Some sandalwood trees have very good form due to competition, however too much competition can be a problem and is being managed by pruning.
- Possible need to increase the distance between rows for access.
- Establishment of hosts and sandalwood is greatly affected by soil type (as is sandalwood growth rate).
- Plantations containing high host densities can support good sandalwood growth.
- In this system the parasitic load of the sandalwood is spread amongst numerous host plants.

Sandalwood Nuts

Geoff Woodall, Centre of Excellence in Resource Management
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SANTALUM spicatum produces a large nut – a true seed (kernel) enclosed by a woody endocarp (see image, right). Although sandalwood is commercially grown for its heartwood, there is renewed interest in developing sandalwood nut products and markets. This article summarises our current knowledge of the sandalwood nut, its production and potential products/markets.

Sandalwood nuts

The nut kernel is edible and similar in composition to the kernels of other nuts (e.g. walnut)¹. While some people enjoy the sandalwood kernels subtle taste, critics often comment that it has limited potential as a food because it is essentially tasteless. There is some evidence that the kernels were consumed by aboriginal people but the kernels do not appear to have been a major food. The macerated kernels of some *Santalum* species were used for medicinal purposes by aboriginal people (as a liniment)². A botanical collector who lodged sandalwood voucher specimens at the South Australian herbarium (approx. 1970) noted at the base of one specimen that the seeds were consumed by aboriginal children and that they shared them with local European children.

Nut size is variable, with some sandalwood provenances producing larger nuts than others. When cultivated, some large fruited selections produce nuts of greater than 30mm diameter.

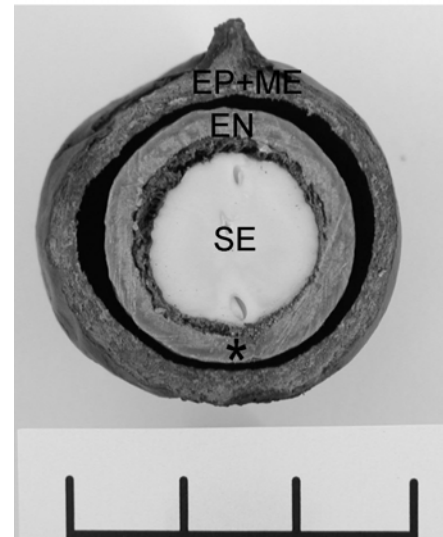
The kernel has a high oil content, approximately 50-60% (w/w)³. Kernel oil is viscous and non fragrant (cf. wood). All fats and oils when broken up into their constituent's yield glycerol and a diverse mix of fatty acids. Sandalwood nuts contain an unusual fatty acid ximenynic acid (also referred to as santalbic acid) and which accounts for approximately 30-35% of total fatty acids in the nuts³. Santalbic acid (and its salts) has strong antimicrobial activity against some bacteria (eg the chloramphenicol and cotrimoxazole resistant strains of *Staphylococcus aureus*) and various pathogenic fungi⁴. The oil itself has not been shown to have antimicrobial activity⁴.

Nut Production

Remnant sandalwood exhibits large annual fluctuations in fruit yield. Five remnant trees at Wagin produced an average of 300 nuts per tree in 1999 (1.2 kg/tree,) and less than 30 seeds per tree in 2000 and 2001. A small population of remnant trees at Borden produced 4, 14, 2, 41 and 11kg between 1999 and 2003 respectively.

Nut production from cultivated trees (<10 year old) ranged from 0.34-0.62kg per tree⁵. Cultivated trees usually start to produce seed when aged 3-5 years and may also display considerable variation in annual seed production. A plantation in the Narrogin region produced 194, 154, 265, 138 and 662kg of nuts between 1999 and 2003. Irrigation during strategic periods has been observed to have improved seed production and reduce annual yield variability.

By 2009 annual nut production from non-irrigated plantation sandalwood in WA is expected to reach 250t, assuming that cultivated trees (300/ha) will produce on average 0.35kg/tree pa after year 4.



Section through a *S. spicatum* fruit. EP = Epicarp, ME = mesocarp, EN = endocarp, SE = seed (kernel). Scale bar increments are 10mm

Products

Most seed/nuts currently produced are used to establish new plantations. Within a few years the supply of nuts will exceed the demand created by ongoing plantation establishment.

Although the nut kernel is edible, only a small amount is used for human consumption (anecdotal evidence suggests that annual consumption is less than 100kg of nuts). The current nut price of \$50/kg prohibits utilization by the food industry. Price is expected to fall as nut production exceeds the demand created by further plantation establishment. Given that macadamia nuts (in shell) currently sell for \$3/kg⁶ (total Australian production approx 37,000t⁶) it is likely in the longer term that the price of sandalwood nuts (in shell) for human consumption may reach a similar price.

The seed constituents are well understood but there has been little or no R & D to develop products and markets for the seed/fruit or any of its constituents. In Albany, we are currently developing methods to produce various food and industrial products from the seed/fruit and will soon be appraising these products in various markets. The sandalwood nut resource provides an opportunity to generate revenue while trees grow and mature. For this opportunity to be realised, products and markets need to be developed.

References

- ¹Barrett and Flanagan, 1993 *Mulga Res. Cen. J.* 11:21-26
- ²Lassak and McCarthy, 1983 *Australian Medicinal Plants* p 69
- ³Liu et al, 1997 *J. Sci. Food Agric.* **75**:27-30
- ⁴GP Jones et al, 1995 *J of Pharmacognosy* 33:120-123
- ⁵Brand et al, 2004 *Sandalwood Res. Newsletter* 19:4-7
- ⁶Australian Macadamia Society 2004

Letters to the ASN

Graham and Iris Herde, South Australia
Email: gherde@centralonline.com.au

WE looked at the potential of Sandalwood as a managed woodlot crop and as an alternative crop for dryland farmers and graziers in 1992 and decided to set up an experiment with sufficient trees from as many locations as we could find showing a cultivar difference to see how they grew on our water and soils.

Over a period of five years we planted 1000 Sandalwood from nine locations that showed a distinct difference in appearance. Nine cultivars were selected from the Pilbara to Port Pirie. All of these on drip irrigation, ground water of 2300ppm, in a clay loam soil with a ph of 9.5.

We had little knowledge of the Sandalwood's needs with regard to host plants, but a steep learning curve was soon started. A contact was made with Dianna Barrett and CALM and we obtained much of the printed material from the last twelve years.

We see from the Avon Sandalwooder that the WA growers are facing up to some of the same problems we had to solve when we established Nectarbrook Discovery Plantation. Some of these we can answer for you.

Bruce and Bev Storer.

Poor seed crops: There are two crop limiting factors. One is rainfall Oct/Nov/Dec. Little rain in these months is followed by a poor crop in the following season. This is true even for trees on irrigation. The other factor is The Quandong Moth *Paraepermenia santaliella* (*Lepidoptera: Epermeniidae*). The first generation of the moth during the season attacks the flowers, the second the just set fruit etc. If the early infestation is high it is possible for no fruit to reach maturity. Yes it is called the Quandong moth but if you take the ripening Sandalwood fruit and find a brown gritty material between the skin and the stone you have the moth. Have a look at www.aqia.com.au and the research results of Kaye Ferguson and Peter Bailey.

Germination: We started cracking our seed by soaking and then drying about ten years ago. For two years this worked fine with a 90% germination rate and then, when we had orders for over 1000 seedlings, 15 kilos of plantation grown seed and 8 kilos of wild collected resulted in only 200 germinants. Everything was done in exactly the same manner as the year before. Eventually we looked at our rainfall records

and realised we had collected these seeds and stored them away without it raining on them. In the previous years, good spring and summer rains were recorded the following year, and every year since, we have collected the seed and put the seed on a large piece of shade cloth out in the weather. If the late spring and early summers are dry the seed is occasionally squirted with water. We are back to a germination rate of over 80%. The seed is not as pretty. It is discoloured and often naturally cracked. We suspect the husk may contain something that breaks dormancy.

A potential area for the future prosperity of Sandalwood plantations is in the nuts. Not as a food crop, but for the pharmaceuticals in the kernel. We refer you again to the Australian Quandong Industry Association web site, (www.aqia.com.au), to the research pages. Published here is some work done at Curtin by Yandi Liu and Robert Longmore. More research is needed but we have a gut feeling the nuts will be too valuable in the future to pull your trees for timber.

Another area worthy of Sandalwood experimentation consists in the trialing of *Santalum album* in frost free temperate climates. We have seen tropical Sandalwood growing well in Perth Backyards. We have a small planting at Nectarbrook but they do suffer from the occasional frosts we have. However the couple of trees that have *Acacia victoriae* as the host plant resist the cold and have outgrown the same aged *S.spicatum*. Difficult growing circumstances appear to make *S.album* higher oil producers. The near perfect growing conditions for *S.album* at Kununurra have, in the timber sections we have seen, produced little heart wood.

In South Australia there is no Government Department interest whatsoever in Sandalwood as a crop for the future. Sandalwood, common in the marginal areas, was pulled almost to extinction by 1935 and then forgotten. Private interest in Sandalwood is growing. We have supplied several thousand seedlings to growers around SA and quantities of seed for propagation.

Nectarbrook Discovery Plantation is an experiment in "is it possible" and a way of us learning "how to do it". The plantation is a series of mistakes, each one learnt from until we can now say with some confidence to others looking to plant Sandalwood for a commercial future "this way works"

Any readers of the Sandalwooder travelling by road to the Eastern states are invited to call in and have a look. 30km South of Port Augusta and look for the road sign NECTAR BROOK 2km. Our web site is www.nectarbrook.com.

Graham and Iris Herde

ASN Inc. Member Photos



Above: East Northam farmer, Graham Storer inspecting his 3.5 year old sandalwood growing on 7 year old Tagasaste. The sandalwood has received some irrigation during summer months

Below: Five year old sandalwood growing near seven year old jam, plantation near Narrogin



Left: Avon Sandalwood Network members at the 3rd workshop and field trip, East Beverley, September 3 2004

Right: East Koorda farmer and ASN Member Bob Huxley inspecting his 4 year old sandalwood trees. Bob has set up a low cost, low maintenance irrigation system, providing water to the trees during the summer months

Below: Bolgart farmer and ASN member Matt Edmonds is happy with the early growth of his mixed species hosts, planted as seedlings in July 04. Matt plans to direct seed 3kg/ha of sandalwood nuts in March 05



Expressions of Interest

Strengthening the developing sandalwood industry across regions to achieve biodiversity, profitability and social targets

GREENING Australia (WA), in partnership with the Centre of Excellence in Natural Resource Management and regional NRM groups, has received funding from the Australian Government, Department of Agriculture, Fisheries and Forestry, National Landcare Program to implement the first stage of the above named project.

The project is focusing on the South Coast, South West and Avon River Basin Catchment areas.

This aims of the project are to:

- Encourage broad scale (cross regional) strategically placed revegetation of agricultural land with a biodiverse mix of local species including sandalwood;
- Ensure continued development toward a sustainable new sandalwood industry in southern Western Australia;
- Protect and enhance local plant biodiversity assets;
- Protect and enhance land and water assets;
- Increase the uptake of sustainable new industries using native plants

This will be achieved through:

1. Development of regionally specific host species data in the Avon and Blackwood regions and participative research;
2. On ground works: The establishment of 100 ha of biodiverse sandalwood plantations in the Avon and Blackwood regions in 2005 with a focus on direct seeding a range of native host species;
3. Technical support and Communication

Expressions of interest are now being sought from landowners located in the Avon River Basin and Blackwood catchment areas interested in participating in the on-ground component of the project, involving the establishment of 100ha of biodiverse sandalwood plantations in 2005. The Program will fund the cost of host seedlings and seed, half the cost of sandalwood seed and will provide a fencing subsidy. Landowners who participate in this project retain full ownership of the trees and any products from the trees.



Remnant sandalwood growing in a low proteaceous shrub land East of Northam. The NLP project will assist in firming up the range of native species that can be used as hosts in biodiverse plantations; 3 year old direct sown biodiverse host mix in the North Stirlings. The NLP project will involve the establishment of 100ha of biodiverse plantations in the Avon and Blackwood regions in the first year

To obtain an expression of interest form, or for more information, contact:

Tim Emmott from Greening Australia (WA)
Ph: 08 9621 2400 or 0429 106 289; or
Geoff Woodall from the Centre of Excellence in NRM
Ph: 08 9892 8427

Sandalwood Tips

A summary of cultivation tips from info delivered at ASN workshops

A range native legume species can be used as host plants for sandalwood, however some research has shown that sandalwood does not perform well on several species when they are used as the **sole host** species. Examples include *Acacia microbotrya* (Manna wattle) and *Allocasurina huegeliana* (Rock sheoak). These species are good sandalwood hosts when used with a mixture of other species. As a general rule, Manna wattle and Rock sheoak should only be used at low densities in a host species mix.

Small, prickly acacias are particularly good at protecting young sandalwood seedlings from grazing animals and parrots, and can be used as a component of a host species mixture. Examples of small prickly acacias from the western Avon region are:

- *Acacia erinacea*;
- *Acacia multispicata*; and
- *Acacia pulchella*

Successful germination and establishment of sandalwood is dependant on a range of factors:

- Seed quality;
- Competition (e.g. weeds);
- Soil temperature;
- Moisture availability (amount and duration); and
- Physical restriction by endocarp
- Availability of host roots;
- Planting technique;
- Secondary dormancy

When sourcing sandalwood seed for plantation in the wheatbelt, try to obtain seeds from plantation stock, derived from wheatbelt trees. Sandalwood seeds from plantations generally have a higher germination/growth rate than those growing in the wild. Within plantations, there are higher levels of outcrossing between trees, and there is generally more water/nutrients available to the sandalwood to develop good seeds.

If you are growing sandalwood in the eastern wheatbelt (300-350 mm annual rainfall), then you should try to obtain seed from this region. The sandalwood from this region will be better adapted to the drier conditions (e.g smaller leaves) than those from the western wheatbelt.

Plantation seed generally performs better than natural populations due to higher levels of outcrossing between trees, water, nutrition etc... However, you can still source good seed from the wild, if the seed is collected where there are groupings of trees. Try not to source sandalwood seeds from isolated trees, where all of the seed is self fertilized.

If direct seeding sandalwood nuts next to established host trees, the preferred time of the year is March/April. Ensure weeds are controlled in June at each spot where a nut has been seeded, before emergence of the sandalwood. A knockdown herbicide can be used, however ensure no herbicide comes in contact of the foliage of the host plants

Prior to direct seedling sandalwood nuts, you can check to see if the nuts are "cracked". If the seed has been collected early in the season and has not been on the ground long, the seed will most likely not be cracked. Sandalwood nuts can be cracked by soaking in water for 8 hours, and then put out in the sun on a tarp or black shade cloth for 1-2 days. Refer to Woodall GS (2004) "Cracking the woody endocarp of *Santalum spicatum* nuts be wetting and rapid drying improves germination", *Australian Journal of Botany*.

Before seeding nuts next to established host trees, dig a hole in the rip line next to a couple of host trees to ensure there are host roots present. This will assist with determining the distance to sow the sandalwood nut from the host tree.

Giving consideration to plantation design to allow for vehicle access and for fire control is important. This may involve keeping the distance between riplines to no less than 4-5 metres, and leaving gaps in the plantation at regular intervals.

This newsletter is a compendium of articles written by many different people. The views expressed are those of the authors, not necessarily those of the Australian Government, the Avon Catchment Council or Greening Australia (WA).