

Rare genetic find delivers high-quality sandalwood oil

Sandalwood plantations that exploit genetically superior stocks could help to meet the growing global demand for the precious commodity, while generating a much-needed cash income for local communities in Vanuatu and Cape York Peninsula

BY SAMANTHA MURRAY

For centuries, ‘wooden gold’—sandalwood—has been cherished for its aromatic and therapeutic qualities. From Indian joss sticks to French perfume, the myriad cross-cultural uses of sandalwood may be surprising, but demand for sandalwood and its precious oil has led to a global shortage.

Concerned about the impact of over-harvesting as a result of growing demand, the Vanuatu Department of Forests approached ACIAR for assistance to understand the genetic diversity in sandalwood populations that affects oil production. In partnership with Australian researchers, the ACIAR-supported study made a remarkable discovery that is helping to boost production in ways that promote conservation efforts.

The ACIAR partnership found that for the sandalwood species in Vanuatu and Australia’s Cape York Peninsula, about 3–4% of trees in local populations produce very high quality oil. To take advantage of the genetic potential of these species, communities are being helped to implement breeding programs and conservation strategies that will build viable sandalwood industries that exploit the international shortage.

Sandalwood is a medium-sized hemiparasitic tree that can grow independently or by drawing nutrients from a host. It grows mostly in tropical countries, including India, Indonesia, Australia and the Pacific islands.

In Vanuatu, sandalwood export revolves around the local variety, *Santalum austrocaledonicum*, which contributes a substantial proportion of the country’s forestry revenue. About half of Vanuatu’s sandalwood is sent as powder to China and Taiwan for making incense, while the other half is

exported as oil to Europe for use in perfume and cosmetics. However, lack of information and poor management techniques have threatened to deplete Vanuatu’s wild stocks and compromised overall sandalwood quality.

As a principal forest officer with the Vanuatu Department of Forests, Hanington Tate is familiar with the problem. He has been instrumental in developing the national sandalwood policy that aims to improve management of the natural stock and build a sustainable industry.

“Sandalwood is a small tree crop that fits well with traditional farming systems, so everybody feels it is an important cash crop that needs to be promoted for planting by rural communities,” he says.

Included in the policy reforms is a requirement for the harvested sandalwood to be processed locally before export. It was as a result of this reform that Mr Tate made an important decision. After being informed by the distillery of variable oil yields, he came up with the idea of investigating genetic variability among natural sandalwood populations in Vanuatu.

He contacted ACIAR with the idea and was encouraged to jointly develop a project proposal with Australia’s Dr Tony Page from James Cook University (JCU). When the project received funding, Mr Tate took on the role of in-country project leader.

At the project’s outset, a series of workshops brought together Australian and Vanuatu collaborators—including local community members in both countries—to map the ensuing domestication and conservation programs. A survey of wild sandalwood stocks was undertaken, which identified the superior populations of the local species and the barriers to local communities managing this resource.

The surveys were conducted in regions



Sandalwood seedlings in a village nursery in west-coast Santo.



PARTNER COUNTRY: Vanuatu

PROJECT DESCRIPTION: FST/2002/097: Identification of optimum genetic resources for establishment of local species of sandalwood for plantations and agroforests in Vanuatu and Cape York Peninsula

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of known sandalwood populations on seven islands: Santo, Malekula, Moso (a small island north-west of Efate), Erromango, Aniwa, Tanna and Aneityum. They involved collecting several hundred woodcore samples from the superior tree populations. Oil quality of the samples was assessed and material from the trees was grafted onto rootstock in a centralised nursery at the Vanuatu Department of Forests in Port Vila.

Dr Tony Page, a research fellow from JCU's School of Marine and Tropical Biology, says the superior oil quality was identified by assessing the commercially important oil constituents—particularly the alpha-santalols and beta-santalols—against the international standard, which is based on the common Indian sandalwood (*S. album*).

Despite the important discovery, Dr Page was wary of the 'cash crop hype'. He offers copra as an example of the kind of development he was keen to avoid. By the time smallholders planted the copra crops, the value had already gone out of the market. However, he says that sandalwood—with increasing international demand and diminishing supplies—is a much safer option for the people of Vanuatu.

"This is a product that the ni-Vanuatu (indigenous population) are comfortable with, since it is part of their day-to-day existence and fits with their traditional agricultural practices," Dr Page says.

"Given the high value of sandalwood, villagers do not need to plant trees on a large scale like intensive cash crops. With raw sandalwood selling at approximately \$10 a kilo, the cash goes a long way to helping them access the services Australians take for granted, such as schooling, medical services and travel."

Sandalwood growers in Vanuatu range from small garden plantings, of between 5 and 10 trees, to smallholder plantings of 1–4 hectares. Even a family with a small garden that plants 20 trees each year would be well on their way to building a sustainable and profitable plantation.

The Vanuatu Department of Forests (VDoF) aims to replicate the grafted seed orchard cultivated in Port Vila across Vanuatu. This will provide smallholders on several islands with seed sources from which they can establish plantations, which will ultimately help to protect wild populations from over-harvesting.

The project's conservation program recognises that sandalwood populations on the northern islands are genetically distinct from those on the southern islands. To maintain their genetic diversity and distinctiveness, the



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project has two separate seed production programs to preserve the differences between the north and south, while simultaneously managing each population in order to avoid the deleterious effects of future inbreeding.

An equally important project stream is education, with VDoF and JCU running a workshop to share their findings and teach the communities about propagation and silviculture. The workshop was attended by approximately 15 farmers, one from each participating community. Dr Page says the attendees were the more progressive farmers who could be relied on to take the information back to their communities.

"We found that the information did get disseminated between the villages and that nursery and silviculture techniques, such as the role of a host tree, made a significant impact," Dr Page says. "The next step would be to deliver training in the actual villages to reach even more people."

The Vanuatu Department of Forests and JCU are now filling in some of the knowledge gaps, looking at growth rates to determine actual producer returns. In the future Vanuatu will need to consider the different sandalwood markets and how Vanuatu's industry could position itself as a premium brand to the international marketplace. There is also likely to be opportunities for plantings of the joint

venture investment type in collaboration with smallholder producers in Vanuatu.

"The project has been well received in Vanuatu," Mr Tate says. "Unlike a few forestry projects, this one jumps a few steps ahead by identifying the best available resource for germplasm improvement, bypassing the need for extensive trials. Resource owners like the project because it actually informs them of the quality of their sandalwood stands."

In contrast, in Australia a different sandalwood species, *S. lanceolatum*, has traditionally been valued by Aboriginal communities on Cape York Peninsula for oil, food, fibre and medicinal purposes.

One of the most exciting aspects of the Cape York studies was the discovery of an extremely high quality oil product. The studies indicated that the oil from some Cape York samples exhibits high concentrations of alpha-santalols and beta-santalols, and many of them meet international standard requirements. The result was most unexpected given that *S. lanceolatum* is considered the lowest quality of all sandalwood.

The scientific information offers the potential for the domestication of high-quality, drought-tolerant sandalwood by Indigenous communities in Far North Queensland, with the data serving as a platform to propagate the valuable strains in plantations and agroforests. ■