

Eucalyptus oil

Richard Davis

Australia is the home of the eucalypt. All the commercial oil-bearing species of *Eucalyptus* are indigenous. Therefore, the raw material for the production of eucalyptus oil is available, and the soil and climate are suitable for the establishment of plantations of oil-bearing species.

Eucalyptus oil has been produced and traded for over 140 years. Although several different types of oil can be produced, it is only the oils rich in cineole that are now produced in quantity. Eucalyptus oil is used in a wide range of pharmaceuticals, cleansers, flavours, and to a small extent, as an insect repellent. Demand for the oil is currently stable.

The oil is easily produced, but the cost of production in Australia is high compared with other countries, even when produced from natural stands thereby avoiding the cost of establishing the crop.

While the demand is static, the production of eucalyptus oil in other countries, particularly China, has increased to a point where the world demand can be met by countries where labour is cheaper. Furthermore, in China

the oil is produced as a by-product of the timber industry, thus also avoiding the cost of establishing the crop.

Markets

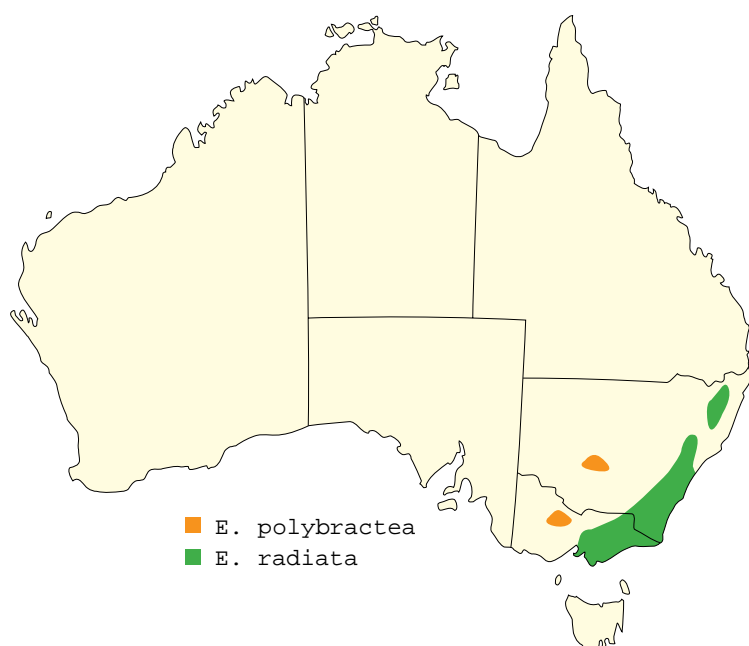
There are two market categories for eucalyptus oil:

- one for supply of straight oil to the ultimate consumer; and
- one for oil that will be incorporated in other products.

Eucalyptus oil is sold worldwide. Most oil sold in Europe and North America is used in products such as 'Vicks Vaporub',

cough and cold remedies, confectionery, etc. Much of the oil sold in Australia and Asia, is used as a pure oil in household products, in inhalations, to alleviate cold symptoms, and as a cleaner, spot remover, massage oil, etc.

The crude oil produced on the farm or in the forest, is sent or sold to a refiner, who redistils, blends to customers requirements, packages and ships to manufacturers or bottlers. The oil is then exported or distributed through the appropriate chain to the retailer. Nowadays, the straight oil is retailed through pharmacies and supermarkets.



Estimated global demand for cineole-type eucalyptus oil is 2500–3000 t/year. Australian production is about 120 t. However, the Australian production is from *E. polybractea* and *E. radiata* var. 'Australiana', while almost all the cineole-type oil produced in other countries is from *E. globulus*. While all the oils conform to the same standards, there is a difference in their character, and this difference allows Australia to retain a share of the world market.

World market price for the standard grade *E. globulus* oil is now about US\$3.50/kg in container lots (15 t). The price, while varying to some extent, is now fairly stable after a steady decline. The price is now less than it was 15 years ago. Because of static demand and over-production in China, the price is likely to stay low in the foreseeable future, unless a new large-scale use for the oil is found. Although the higher quality Australian oil commands a higher price, the demand is strictly limited.

Production requirements

Oil-bearing eucalypts will grow well in many parts of Australia, but work to date shows that *E. polybractea*, the major source of oil, thrives best on the light sandy soils of the western plains of NSW and just west of Bendigo in Victoria.. It grows quite well in rainfall down to 350 mm/year, but would probably do better in slightly higher rainfall areas.

While irrigation would enhance growth, the potential return does not warrant the cost.

E. radiata grows naturally on the Great Dividing Range and the south coast of NSW. It thrives in steep country on a wide range of soil types.

Because it is now essential to mechanise production to be able to produce oil at a saleable price, production from natural stands of *E. radiata* is unlikely. For mechanical harvesting, level to no more than gently sloping land is necessary. Natural forest areas of this type, with good oil-bearing trees as the dominant species, are now rare, which means that plantations are required, or trees planted for soil desalinisation, as in Western Australia, are required.

Varieties/species

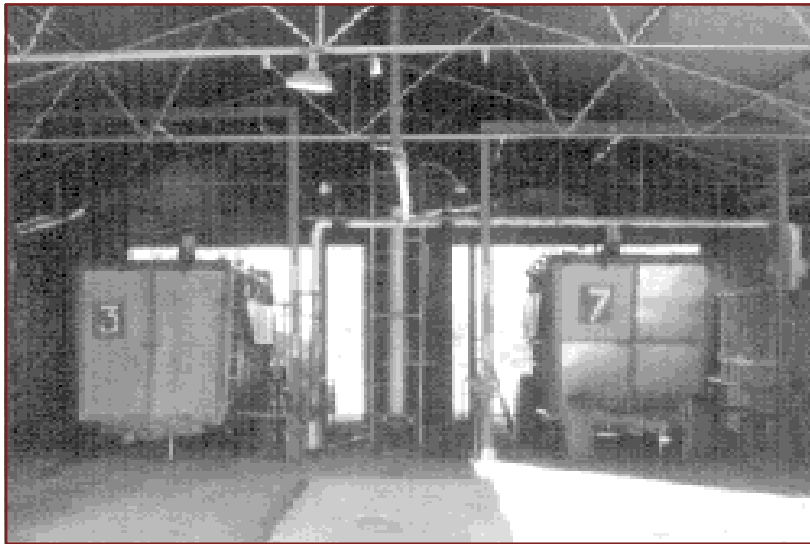
The most commonly traded eucalyptus oil is that obtained from *E. globulus*. This oil is readily available because of large-scale planting of *E. globulus* primarily for wood. These trees now also produce oil in commercial quantities.



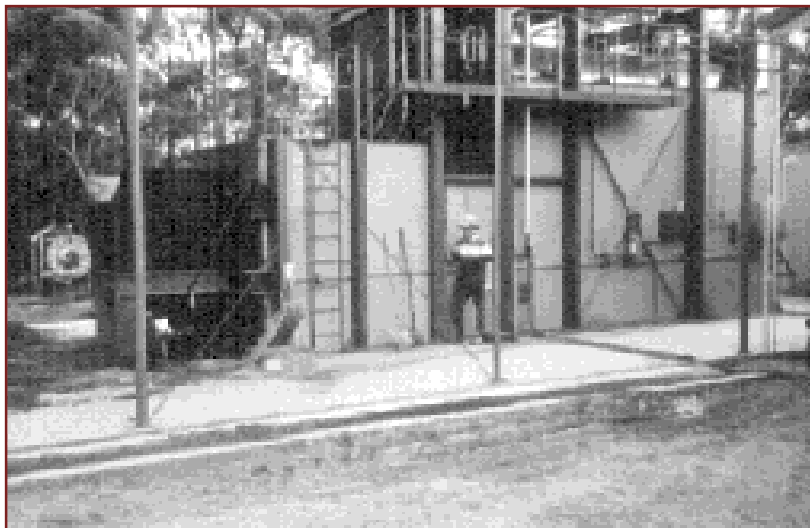
Plantation establishment of *Eucalyptus polybractea*



Harvesting eucalyptus into a mobile still



Simultaneous distillation of two mobile stills



A 300 hp colonial boiler with Dutch oven for burning extracted leaves

Oil of more character is obtained from *E. polybractea*, which also gives better yields and is suitable for mechanical harvesting. The strong lignotuber developed by this species allows coppice growth to be harvested frequently—at about 18-month intervals. This growth can be harvested at ground level.

Several species are being planted for soil desalination. Periodic harvesting of the leaves of these trees will stimulate growth, and therefore

transpiration, further helping to lower the saline water table. Species being tried for this purpose include: *E. kochii* ssp. *kochii*; *E. kochii* ssp. *plenissima*; *E. horistes*; and *E. loxophleba* ssp. *lissophloia*. All of these eucalypts are native to Western Australian.

CSIRO's Forestry and Forest Products Seed Centre in Canberra, and the Department of Conservation and Land Management (CALM) in Perth are likely sources of seed for all species.

Agronomy

Although all the oil-bearing eucalypts occur naturally in Australia, there are now virtually no remaining areas of natural bush suitable for development for oil production. Therefore, future production must be based on plantations of the desired species, or on harvesting of the leaves of trees grown for other purposes, such as soil desalination.

Since it is essential to mechanically harvest plantations, planting in straight rows is desirable. For ease of pest and weed control, sufficient space should be left between the rows for machinery access. Thus, site preparation calls for clearing land that slopes no more than gently, and laying out straight rows, across the slope where possible. The rows should then be ripped as deeply as is practicable and, just before planting, the surface layer to about 25 cm on both sides of the rip broken down to allow the use of planting machines. One or two passes with a rotary hoe should be sufficient to achieve this. Into this ground, 10–20 cm seedlings are planted.

To protect the young seedlings from dehydration, watering at or immediately after planting is essential and watering must continue until the first effective rainfall. In the first few months, the seedlings also need to be protected from livestock.

The equipment required for planting and establishing the young trees is thus:

- a powerful tractor, or preferably bulldozer, with a ripper;

- a cultivator;
- a planting machine; and
- either an irrigation system, or a water tanker with an appropriate water delivery and pump and motor filling systems.

A good source of water is essential.

Seedlings can be bought from a commercial nursery, but unless the scale of operation is quite small this will be too costly. Seedlings therefore generally need to be raised on site, and this calls for the usual nursery facilities of tubes, trays, watering bays, plastic greenhouses and a watering system.

Once planted the trees need to be kept weed free for at least 12 months and protected from insect attack.

Most of the oil-bearing eucalypts do not respond well to fertiliser and thrive in reasonable weather conditions without additional nutrients.

First harvest will depend on time of planting and weather, but except during drought the first harvest can be made 18–24 months after planting. Thereafter harvests are at about 18-month intervals. Over-frequent harvesting will adversely affect the trees.

Because the trees are harvested at ground level, soil will be prone to water and wind erosion. This can be prevented by planting pasture or a crop of some sort between the rows but not close to the trees, or by mulching with leaves from which the oil has been extracted. A machine will be needed to spread the leaves.

Pest and disease control

Control of weeds in the early planting and regrowth phases is essential. Cultivation is effective in a well laid out plantation where implements can be used very close to the trees. There are also effective herbicides which can be applied close to, or in some cases over, the trees and which do not suppress tree growth.

Livestock, feral pigs and kangaroos can cause damage in the early stages of plantations.

The main insect pests of the mallee species such as *E. polybractea* are sawflies and case moths. Case moths in particular can spread very rapidly and defoliate the trees. This tends to occur when there is a substantial amount of leaf, but not in the early stages of growth or regrowth. A good means of control is to harvest the affected area even if it is not due for harvest.

About the author

Richard Davis is Managing Director of G.R. Davis Pty Ltd (see Key contacts for address), the major producer of eucalyptus oil in Australia.

Experience from trial plots indicates that insects and diseases may be a greater problem in establishing plantations in higher rainfall

areas, than in the dry areas where *E. polybractea* and other oil-bearing mallees occur naturally.

E. polybractea has not responded well to more fertile soil in higher rainfall areas. Although it is likely that some suitable areas could be found, improved leaf growth would be offset to some extent by the increased cost of insect and disease control.

Key statistics

- E World demand for cineole-rich eucalyptus oil—approx. 3000 t/year
- E World production potential from existing trees—over 4000 t/year
- E Australian production—approx. 120 t/year
- E Australian potential—200 t/year

Harvest and processing

Eucalyptus oil is extracted by steam distillation. While there are other methods of extracting the oil, this is the accepted method, stipulated by national and international standards. It is a simple and cheap method.

The oil is confined to the leaves which, after harvest, are placed in a container (still) through which steam can be passed. To produce oil economically, these processes must be mechanised. The mallee type eucalypts, with their capacity to coppice vigorously,

are ideal for mechanised harvesting as the whole of the aerial part of the tree can be cut off and placed in the still. The amount of non-oil-bearing stem so harvested is insufficient to warrant separation of leaf and stem and so harvesting requires only simple machinery.

Key messages

- E Eucalyptus oil is overproduced
- E China can supply world demand
- E New use for oil essential

By passing steam through the leaf mass in the still, the oil is vaporised; oil and water vapour are ducted to a condenser and there condensed to liquid oil and water which can be separated by flotation. The oil, being of lower density and, for practical purposes, immiscible with water, floats on the top of the water from which it can be separated easily.

The oil can be stored in drums made of high density plastic or steel (preferably but not necessarily galvanised). Although the oil is 'wet' at this stage, it can be stored without deterioration for several weeks before further processing.

For most uses, the oil needs to be refined, and this is best done by redistillation under reduced pressure. Thus vacuum stills and pumps will be needed.

The initial steam distillation of the oil from the leaves needs to

be done close to the harvest area as the cost of transporting leaf more than a few kilometres is too high. Vacuum redistillation is generally not carried out on farm as the cost of the apparatus needed will be too high, unless production on the farm is large or a number of farms share the equipment.

If the crude oil is to be sent on for refining, all that is necessary is to pack it into suitable containers for transport to the refinery. If the crude oil is to be sold as crude oil it should first be dried and filtered.

Steam has to be generated for the distillation of oil from the leaf and because of the low value of the oil at present, the cost of steam production must be kept low. The leaf, after the oil has been extracted, is suitable for this purpose. About 20% of extracted leaf is required as fuel, the rest should be returned to the harvested area to minimise erosion and to retain moisture.

Most oil entering the market must conform to the appropriate national standard. Refining ensures that this is so.

Economies of production and processing

At this stage of the industry's development it is not feasible to set up a viable operation if land and all equipment has to be purchased. However, if land and some standard items of agricultural equipment are already owned, and the cost of establishment of trees is covered

by some other project, e.g. trees planted for desalination, a profitable operation might eventually be possible. The key to success is the market price. If it remains at its present level it will be impossible to produce oil in Australia at competitive prices.

Establishment costs on cleared land, assuming a heavy tractor or bulldozer is already owned, consists of cost of laying out the plantation, deep ripping and surface cultivation of the rows, planting, watering and weed control. If as suggested above, these costs are not borne by the eucalyptus oil production, then the specific costs to be covered to enable production are: acquisition of a heavy forage harvester, at least three mobile distilling vessels, a boiler, lids, a condenser and oil separator, a pump and motor for circulating the cooling water plus housing for the apparatus if it is not already there. A good water supply is essential. The cost of these items, not new, would exceed \$50,000 for a modest plant capable of producing about 15 t of oil per annum. This quantity of oil at present prices would not cover the cost of wages, maintenance and machinery running costs. There can, therefore, be no gross margin for a typical production unit in 1997.

The world market price is set by China. China is moving towards a market economy and the availability of extremely cheap labour might end. However, unless a substantial new use is found for eucalyptus oil, China can more than supply the world demand, and consequently a dramatic price rise is unlikely.

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