

# Australian Essential Oil Woody-plant Species Profile

# Broad-leaved paperbark (Australia), niaouli (New Caledonia) and several others (Melaleuca quinquenervia)

- Species: *Melaleuca quinquenervia* (Cav.) S.T. Blake (E-nerolidol (60–95%) and linalool (tr–40%) form know commercially as Nerolina)
- Common name: Broad-leaved paperbark (Australia), niaouli (New Caledonia) and several others
- Principal source of oil: Australian provenances, in natural stands or plantations in northern New South Wales either rich in E-nerolidol with little linalool or a balance of both compounds are the commercial sources of Nerolina which is the primary focus of this leaflet.

#### Species description

Erect, small to large tree, 8–25 m tall.

Features:

- bark papery, white or greyish in colour.
- young shoots densely hairy, silvery
- adult leaves alternate, stiff, leathery, lanceolateelliptic, 55–120 mm long, 10–31 mm wide, dull green and glabrescent, veins longitudinal, 5 (rarely 3 or 7), oil glands dense and scattered (see Figures 1 and 2).

(many botanical texts are available describing this species, see selection under 'Further Reading' below).

### Natural occurrence

*M. quinquenervia* is a native of the coastal region in eastern Australia, from near Sydney (New South Wales) to Cape York (northern Queensland). It occurs mainly in a belt within 40 km of the sea (Figure 3). This species extends into southern Papua New Guinea and southern Papua province, Indonesia, and has an extensive distribution in New Caledonia, especially on the western coast of the main island. In Australia, Papua New Guinea and Indonesia, *M. quinquenervia* is generally confined to the lowlands (below 100 m), but in New Caledonia it forms extensive stands in uplands to an altitude of 900–1000 m.



Figure 1: Photo of a *M. quinquenervia* stand taken near Coffs Harbour, NSW (Fagg 1984).



Figure 2: Botanical specimen of *M. quinquenervia* (Everist 1959).

### Climate

In southern regions, *M. quinquenervia* occurs in warm subhumid and humid climates. In the northern regions it is found in the hot humid zone. The following data pertain to the species' natural range in Australia, The mean maximum temperature of the hottest month ranges from 26°C in the south, to about 34°C in the north. The corresponding minimum temperatures of the coolest month are 4°C and 20°C. There are few days over 38°C in coastal areas, temperatures over 32°C varies from about 20 days in the south, to 100 days or more in the north. Heavy frosts are absent in northern coastal areas, but a few kilometres inland, in southern Australia, frosts occur 1–5 times a year. The 50<sup>th</sup> percentile rainfall is 900–1250 mm, the 10 percentile 550-775 mm, and the lowest on record 400-650 mm. The seasonal incidence varies from a moderate summer-autumn maximum in the south, to a strong monsoonal pattern in the north. The number of wet days is in the range 105–140.

Marcar and Crawford (2004) give climatic indicators for the successful cultivation of the species combining information from both natural and planted occurrences.

#### Topography, soils and vegetation

Broad-leaved paperbark mostly occurs on level or gently undulating coastal lowlands often near streams, fringes of tidal estuaries and freshwater swamps where it frequently occurs in more or less pure stands. It is also found on hill slopes in New Caledonia. The best-developed stands of *M. quinquenervia* occur as open forest or woodland but, on less favourable sites, are reduced to low woodland or tall shrubland. Tree associates in mixed stands include various *Eucalyptus* species and *Lophostemon suaveolens*. Acid to neutral soils are preferred by this species. They are often peaty, humid gleys, sandy at the surface but silty or clayey below with high organic matter content. The watertable is near or above the surface for most of the year. It has proven moderately salt tolerant in cultivation (Marcar and Crawford 2004).



Figure 3: Natural distribution of *M. quinquenervia* in Australia (hatched area) based on edited points taken from Atlas of Living Australia (<u>www.ala.org.au</u>). The distribution map focusses on Australia and not the whole species distribution as that is the focus of this leaflet.

### Importance of biodiversity

Ireland *et al.* (2002) in an examination of the leaf oils of *M. quinquenervia* over its geographical range in Australia and Papua New Guinea demonstrated wide variation in chemical composition but only two major chemotypes. They described Chemotype 2 as containing 1,8-cineole (10–75%), viridiflorol (13–66%),  $\alpha$ -terpineol (0.5–14%) and  $\beta$ -caryophyllene (0.5–28%) in varying proportions and order of dominance in the oils. Commercially this oil is

called Niaouli and it is found throughout the distribution of the species, from Sydney to Papua New Guinea, Indonesia and New Caledonia. It was once produced commercially in New Caledonia and Madagascar (Trilles *et al.* 1999).

Ireland and co-worker's Chemotype 1, known commercially as Nerolina, is the focus of this Fact Sheet. Chemotype 1 is comprised of E-nerolidol (60–95%) and linalool (tr - 40%) and is found from Sydney, north along the east coast of Australia to far northern New South Wales, with an isolated occurrence near Maryborough, Queensland (25°S Lat). Two divisions (A & B, see following datasheet) occur in this chemotype based on the relative proportions of linalool to E-nerolidol: A in which Enerolidol is dominant with only a small presence of linalool and B where there is a significant proportion of linalool. Dowell and Hardwick (2023 unpublished cited in Dowell 2023) in a more recent study confirmed the presence of two distinct subtypes of the nerolidol chemotype.

Provenances including trees representative of Chemotype 1, Division A in Ireland's 2002 study, and from subsequent work undertaken by ATSC are all from NSW and include Selection Flat, Candole, Port Macquarie, Coopernook, E of Bulladelah, Long Jetty, Bateau Bay, Hawks Nest, Narrabeen and Centennial Park, Sydney. The Dowell and Hardwick study adds Fingal, Cabarita and Brunswick Heads to this list. Most of these provenances contained some trees (up to 20%) that tested as Chemotype 2 (Niaouli) so some segregation of chemotypes can be expected when propagating by open pollinated seed. Provenances representative of Chemotype 1, Division B were all from east or south of Maryborough, Qld.

Analyses have shown that *M. quinquenervia* trees that occur at latitudes south of 25°S have high oil yields (1-3% w/w%, fresh leaves) and comprise chemotypes 1 and 2. North of 25°S, however, chemotype 1 does not occur and oil yields amongst the Australian populations are uniformly low (0.1-0.2% w/w%, fresh leaves).

#### **Essential oils**

The light yellow to pale green oil is sourced by steam distillation of leafy biomass of Nerolina trees from coastal NSW and Maryborough Qld provenances. It is valued for its soft, floral and woody aroma.

Leaf oil concentration is in the range of 1.0–2.5% (Fresh Weight) (Brophy *et al.* 2013).

The following datasheet gives the range of compounds and their percentages in two typical commercial Nerolina oils distilled from central coast of NSW provenances of *M. quinquenervia*.

#### Uses

Nerolina oil is noted for providing a wide range of aromatherapy and pharmaceutical products based on antimicrobial, antifungal, skin-soothing and antinflammatory effects.

### **Oil Quality**

No International standards exist for Nerolina oil from *M. quinquenervia*. It is traded on the basis of sample assessment, mainly on the relative proportions of linalool to E-nerolidol as determined using gas-liquid chromatography.

The Essential Oil Producers Association of Australia (EOPAA) has prepared an essential oil database. This database features quality standards, International Fragrance Association (IFRA) rules and safety statements for selected Australian native essential oils, to serve as a reference for buyers, sellers, producers and regulators. The database includes *M. quinquenervia* (Nerolidol type) (Dowell 2023). Anyone considering growing this species for oil production is encouraged to refer to this publication and contact EOPAA for more information.

#### Production and markets

Production by independent growers of Nerolina oil from *M. quinquenervia* plantations in northern NSW is neither substantial nor regular. Growers interested in entering this market are advised to do a thorough business plan beforehand.

### Plantations for oil production

Growers of this species in northern NSW have usually adopted similar silviculture to that used with *M. alternifolia*. Propagation is from seed collected from mature trees (Gunn [2001] gives the average laboratory germination rate for *M. quinquenervia* as 2600 germinants per gram) and, when planting for oil production, special care is needed to source seed from populations that produce the required oil type. It might also be necessary to select for resistance to the rust fungus *Austropuccinia psidii* (syn *Puccinia psidii*). This introduced and highly invasive fungal disease of plants of the family Myrtaceae which was first discovered in Australia in 2010, can severely damage *M. quinquenervia* populations with susceptibility varying within and between populations (Makinson 2018).

A spacing of 1.2 m between rows and 0.66 m between trees down the row (12,626 trees per ha), was used successfully for trials of this species for oil production in northern Queensland (Doran *et al.* 2007). Fertilizer is applied six months after planting and following

subsequent harvests. Weed and insect control is intensive and the same as for *M. alternifolia* (Colton *et al.* 2000).

# Harvesting, average yields and distillation times

First harvest is at 15–18 months and every 12 months thereafter with the trees cut to near ground level. Average oil yields are about 100 kg/ha. Each distillation takes about 5 hours to complete.

### Trials in Australia

In trials of several Myrtaceae species established in 2001 in northern Queensland, Australia, *M. quinquenervia* (Nerolina type) showed potential for the commercial production of trans-nerolidol. At 15.5 months after planting (Figure 4) and again 12 months after harvesting, tree survival was high (96%) and average foliar oil yield was 100 kg/ha per harvest. Increases in oil yield were predicted through selection and breeding (Doran *et al.* 2007).



Figure 4: *M. quinquenervia* in an irrigated trial in northern Queensland at 15.5 months since planting and ready for harvest for oil production.

## *Melaleuca quinquenervia* Essentail Oil Data Sheet

1. The range of compounds and their percentages in two typical commercial Nerolina oils, one (Chemotype 1A) distilled from a central coast of NSW (Bulladelah) provenance of *M. quinquenervia* and the other (Chemotype 1B) from a provenance near Maryborough in SE Queensland (Ireland 1999).

Compound	Chemotype 1A	Chemotype 1B
	%	%
a-pinene	0.1	
limonene	0.4	
g-terpinene	trace	
linalool	0.2	28.3
b-caryophyllene	0.1	
aromadendrene	0.1	
a-terpineol	0.2	0.2
bicyclogermacrene		0.1
geraniol		0.1
palustrol	0.1	
Z-nerolidol	0.8	0.8
caryophyllene oxide	1.3	
E-nerolidol	95.2	66.3
cubebol	trace	
viridiflorol	0.3	0.7
g-eudesmol		0.2
b-eudesmol	0.1	0.1
E,E-farnesol	0.3	0.3
S	99.2%	97%

For the specifications of physical parameters for the essential oil of *M. quinquenervia* (Chemotype 1B) refer Dowell (2023).

#### References

Brophy JJ, Craven LA and Doran JC (2013). Melaleucas: their botany, essential oils and uses. ACIAR Monograph No. 156. Australian Centre for International Agricultural Research: Canberra.

Colton B, Murtagh J, Drinnan J and Clarke B (2000). Tea tree oil: best practice management for sustainable production. Agfact P6.4.6 (second edition). NSW Agriculture: Orange, New South Wales.

Doran JC, Drinnan JE, Macdonell PF and Aken KM (2007). Screening selected myrtaceous tree species for production of essential oils in northern Queensland. Australian Journal of Experimental Agriculture 47: 755-761.

Dowell A (2023). Developing industry standards for Australian native oils. Publication No. 23-164. Agrifutures Australia: Wagga Wagga, NSW.

Everist, S.L. (1959). Preserved specimen of Preserved specimen of *Melaleuca quinquenervia* (Cav.) S.T.Blake | Swamp Paperbark. Australia's Virtual Herbarium, Queensland Herbarium.

urn:catalog:BRI:Herbrecs:0043451.

https://biocache.ala.org.au/occurrences/5b40f9b4-3b07-4d51-abf1-7fa66fb0fc53.

Fagg M (April 1984), Taken near Coffs Harbour, NSW. Image source: Australian Plant Image Index (<u>APII</u>) - Photo No.: <u>a.36611</u>). Copyright: ANBG.

Gunn B (2001). Australian Tree Seed Centre Operations Manual. CSIRO Forestry and Forest Products: Canberra, Australia.

Ireland BF (1999). Essential Oils of *Eucalyptus miniata* and *Melaleuca quinquenervia*. BSc (Hons) thesis, UNSW.

Ireland BF, Hibbert DB, Goldsack RJ, Doran JC and Brophy JJ (2002). Chemical variation in the leaf essential oil of *Melaleuca quinquenervia* (Cav.) S. T. Blake. Biochemical Systematics and Ecology 30: 457-470.

Makinson RO (2018). Myrtle Rust reviewed: the impacts of the invasive pathogen *Austropuccinia psidii* on the Australian environment. Plant Biosecurity Cooperative Research Centre, Canberra.

Marcar NE and Crawford DF (2004). Trees for Saline Landscapes. RIRDC Publication No 03/108. Rural

Industries Research and Development Corporation: Canberra, Australia.

Trilles B, Bouraima-Majebi S and Valet G (1999). *Melaleuca quinquenervia* (Cavanilles) S.T. Blake, Niaouli. Pp 237-245 in Southwell I and Lowe R (eds). Tea Tree: The Genus *Melaleuca*. Medicinal and Aromatic Plants: Industrial Profiles V. 9. Harwood Academic Publishers: Australia.

#### Further reading

Boland DJ, Brooker MIH, Chippendale GM, Hall N, Hyland BPM, Johnston RD, Kleinig DA, McDonald MW and Turner JD (2006). Forest Trees of Australia (5th ed.). CSIRO Publishing: Victoria, Australia.

Doran J and Le Dinh Kha (2018). *Melaleuca quinquenervia*. Pp 159-161 in L Thomson, J Doran and B Clarke (eds). Trees for Life in Oceania: Conservation and utilisation of genetic diversity. ACIAR Monograph No.201. Australian Centre for International Agricultural Research: Canberra, Australia.

Doran JC and Turnbull JW (1999). *Melaleuca quinquenervia* (Cav.) S.T. Blake. Pp 131-135 in LPA Oyen and Nguyen Xuan Dung (eds). Plant Resources of South-East Asia No 19. Essential-oil plants. Backhuys Publishers: Leiden.

Doran JC and Turnbull JW (1997). Australian Trees and Shrubs: Species for land rehabilitation and farm planting in the tropics. ACIAR Monograph No. 24. Australian Centre for International Agricultural Research: Canberra.

Webb MA (2000). Bush Sense: Australian essential oils and aromatic compounds. Mark A. Webb: Australia.

Wrigley JW and Fagg M (1993). Bottlebrushes, Paperbarks and Tea Trees and all other Plants in the Leptospermum Alliance. Angus and Robertson: Sydney.

#### Authors

Prepared by J. Doran<sup>1</sup>, J. Brophy<sup>2</sup> and R. Ahlers<sup>1</sup> (February 2025).

<sup>1</sup>CSIRO Australian Tree Seed Centre, Canberra <sup>2</sup>School of Chemistry, University of NSW, Sydney

As Australia's national science agency and innovation catalyst, CSIRO is solving the greatest challenges through innovative science and technology.

CSIRO. Unlocking a better future for everyone.

Contact us | 1300 363 400 | csiro.au/contact | csiro.au

#### For further information

National Collections & Marine Infrastructure Riko Ahlers (02) 6218 3679 <u>riko.ahlers@csiro.au</u> <u>https://www.csiro.au/en/about/facilities-collections/Collections/ATSC</u>