

Durable Eucalypt Leaflet Series
Eucalyptus quadrangulata

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Why grow durable eucalypts?

New Zealand's agricultural landscapes need sustainable land use options adapted to droughts and floods which complement pastoral farming while reducing soil erosion, improving water quality and habitat for native biodiversity.

Eucalypts are renowned for their adaptability to droughty and eroding landscapes. They also provide excellent habitat for nectar-feeding birds and insects. With over 400 eucalypt species to select from there is a great opportunity to select appropriate species for the planting objective.

With CCA (copper chrome arsenic)-treated wood now banned for many uses by the USA and several European countries, there are significant international and domestic markets for naturally-durable hardwoods. The wood properties of New Zealand grown durable eucalypts ensure they can replace CCA treated material for many uses and are also ideal for a wide range of agricultural and land-based industrial applications, particularly for posts, poles and utility cross-arms as well as heavy structural timbers.

NZDFI (New Zealand Dryland Forests Initiative) has selected eucalypt species which can be sawn to produce durable hardwood. Using these species, NZDFI is committed to developing viable best-practice forest management systems to complement livestock farming. NZDFI wants to encourage planting durable hardwood forests and woodlots to protect steeplands and waterways, for shade and shelter, and to generate income from carbon credits and sustainable timber harvesting.

Why NZDFI have selected *E. quadrangulata*?

NZDFI have selected species that:

- Produce highly durable timber (Class 1 and 2 Australian Standard, AS5606-2005)
- Are drought tolerant
- Coppice vigorously after fire and harvesting
- Do not appear to spread as wildings
- Have the potential to sequester carbon faster than pine on drylands
- Provide nectar/pollen for native biodiversity.

NZDFI have selected *E. quadrangulata* as one of its suite of species because of its high durability (Class 2) and its fast growth rates reported from recent plantings.



Figure 1: Ten year old *E. quadrangulata* Northland

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Natural distribution in Australia

Known as White-topped box, *E. quadrangulata* is a medium to large hardwood of the better soils of the coast and adjacent ranges in New South Wales and southern Queensland and is considered a common commercial species from native stands in its areas of occurrence (Bootle 1983).

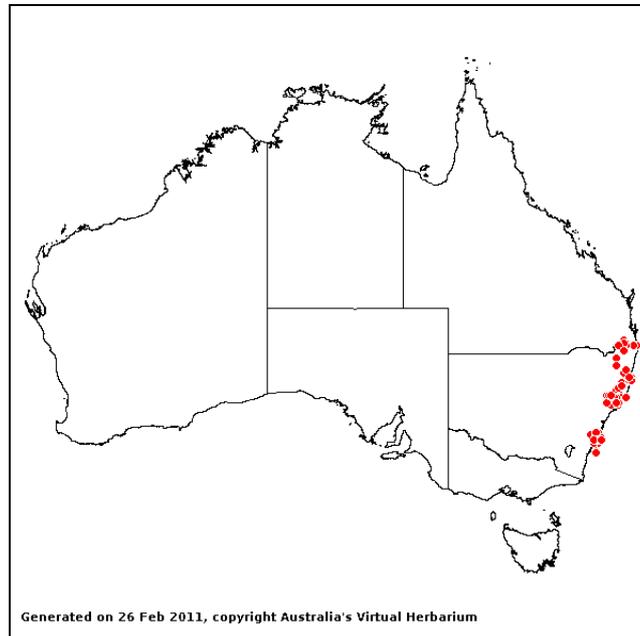


Figure 2: Map of Australia showing the natural distribution of *E. quadrangulata* (source Australia's Virtual Herbarium)

Australian and New Zealand grown wood features

The inclusion of *E. quadrangulata* in the list of species to grow in New Zealand is a surprise to many as it has not been widely planted in New Zealand. Its uses in Australia are described as heavy engineering construction, poles, piles, sleepers, flooring and cladding (Bootle 1983).

Table 1: Strength and density values for core DFI eucalypt timbers

Origin/species	Modulus of Rupture (MPa)		Modulus of Elasticity (GPa)		Compression Parallel (MPa)		Hardness (kN)		Density (kg/m ³)		
	Green	12%	Green	12%	Green	12%	Green	12%	Green	Air-Dry	Basic
Australia											
<i>E. bosistoana</i>	103	163	17	21	50	73	10	13	1180	1100	880
<i>E. globoidea</i>	92	133	14	17	43	68	6.8	8.8	1100	880	680
<i>E. camaldulensis</i>	64	101	8	11	33	55	5.3	7.5	1130	900	710
<i>E. quadrangulata</i>	98	163	17	18	47	71	8.2	14	1230	1030	800
New Zealand											
<i>E. bosistoana</i>	na	na	na	na	na	na	na	na	na	na	na
<i>E. globoidea</i>	81	132	7.7	15	38	67	4.5	6.9	na	805	635
<i>E. camaldulensis</i>	na	na	na	na	na	na	na	na	na	na	na
<i>E. quadrangulata</i>	na	na	na	na	na	na	na	na	na	na	na
<i>Pinus radiata</i>	40	89	6.2	8.5	16	38	2.4	5.0	960	500	420

SUPPORTERS:



Market opportunities

Currently New Zealand relies on radiata pine which makes up 90% of our plantation estate. Eucalypts account for only 1% of timber production yet New Zealand imports over \$30 million of hardwood sawn timber and \$240 million of wooden furniture annually. New Zealand has nearly 25,000 ha of eucalypt plantations mostly of low durable species for short fibre pulp.

The banning of CCA-treated wood for many uses in the USA and parts of Europe opens up new opportunities for naturally-durable hardwoods. The substitution of CCA-treated pine with naturally durable hardwood will also reduce the production of hazardous timber waste. For example, in Marlborough broken posts from vineyard harvesting create up to 24,000 cubic metres of hazardous waste every year. There are no acceptable disposal facilities for this waste other than secure landfill, which in Marlborough costs \$21 per cubic metre. Although more benign treatment methods are being actively researched to replace CCA, another advantage of the chemical free durable eucalypt posts is their high strength.

NZDFI eucalypt hardwoods will match elite species like mahogany, rosewood and teak. They are highly durable and very stiff and strong. These properties ensure they are also ideal for a wide range of agricultural and land-based industrial applications, particularly for posts, poles and utility cross-arms as well as heavy structural timbers. Other applications include wharves, jetties, bridges and rail sleepers.

A further application for selected durable eucalypt species could be for land-based wastewater disposal to produce post and pole wood with biofuel produced from residues. Durable eucalypts also have potential for bio-fuel due to their high wood densities.

Another advantage of durable eucalypts is a high rate of carbon sequestration because of their very high wood densities. The rapid growth rates of some species combined with their wood being almost twice as dense, age for age as radiata pine makes them suitable as species for NZ's Emissions Trading Scheme.

New Zealand experience:

The only one of the traditional books describing eucalypt forestry in New Zealand, that makes any mention of *E. quadrangulata* is McWhannell (1960) who states it is "a hardy box which yields a good ground-durable timber but it has proved exceedingly difficult to grow". However, Nicholas (2008) puts *E. quadrangulata* in the same group of eucalypts that can tolerate mid to sharp frosts (-7 to -3° C).

Research trials:

The only formal trial that includes *E. quadrangulata* is a 2009 planting of durable eucalypts in a land treatment trial at Masterton. Trees in this trial have reached 5 metres tall in just over two years.



Figure 3: Masterton land treatment trial (photo credit D. Bell)



Although not planted in any formal trials *E. quadrangulata* has performed very well in farm forestry plantings since 2000 in Northland, Hawkes Bay and Marlborough (Figure 4).



Figure 4: 7 year old *E. quadrangulata* plantation in Hawkes Bay

Growth and form

Although there is limited experience with *E. quadrangulata*, where it has been thinned and pruned the trees have grown well (Figure 5).



Figure 5: 10 year old *E. quadrangulata* plantation in Northland

Health

Without large plantations to inspect it is difficult to assess the health of *E. quadrangulata* although the 2004 pilot study of Blackbutt Leafminer (*Acrocercops laciniella*) damage on eucalypts in Northland identified *E. quadrangulata* as quite susceptible to the insect (Figure 6).



In other stands damage from both leaf roller (*Strepsicrates macropetana*), sawfly (*Phylacteophaga froggatti*) and eucalyptus tortoise beetle (*Paropsis charybdis*) have been noted. This suggests that *E. quadrangulata* is a eucalypt species that is relatively susceptible to leaf chewing insects.

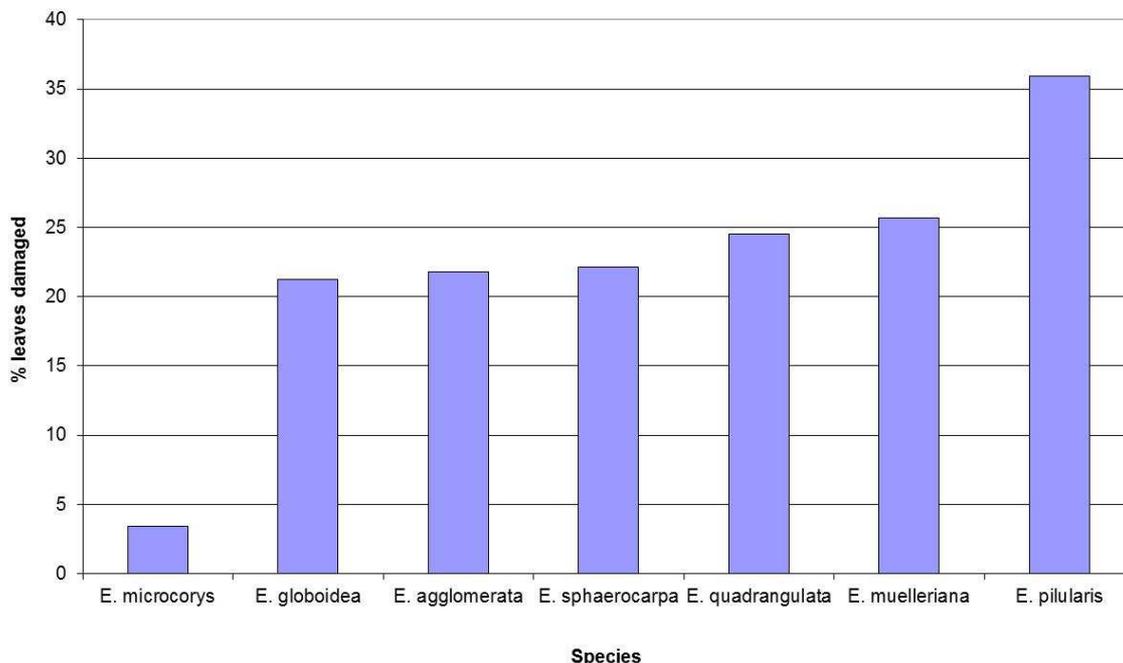


Figure 6: Health assessment of a sample of eucalypt trees in Northland (www.nzffa.org.nz)

Flowering

The flowering of eucalypts can be influenced by season and probably more importantly by seed source. Blakely (1934) suggests that the flowering period for *E. quadrangulata* is February to March. Recent observations have been made of 7 year old trees flowering in Marlborough in September.

NZDFI *E. quadrangulata* research programme

E. quadrangulata was selected for possible tree improvement development in 2008 following its success in extensive small plantings in 2004/07 in Marlborough and Canterbury.

Since then, NZDFI has established large base breeding populations of several naturally-durable eucalypt species including *E. quadrangulata* in dryland regions from which to select improved germplasm for commercial release. Individual provenances and trees with superior traits including wood properties, rapid growth and improved form will be selected at an early age for deployment. In collaboration with NZFFA members and regional land managers, NZDFI has planted breeding populations within Marlborough, Canterbury, Gisborne, Hawke's Bay and Wairarapa. Diverse sites will test the species across a range of environments and provide comparative data for screening individual families. Early screening for growth and form with selection of the best provenances and individuals will be completed in 2015. Plans are for these to be available progressively to commercial nurseries from 2017.

Since 2008 Proseed has co-ordinated seed collection within Australia and NZ and donated this to the NZDFI. The target for each species is to collect seed from a minimum of 100 individual seed trees for each species from these remaining stands. Trees are very variable in their wild state therefore seed collections are made across a wide range of wild families in different areas to sample the full genetic diversity across climates and soil types. NZDFI seed collection sites extend across southern Queensland, New South Wales and Victoria. For some species, seed has been collected from NZ eucalypt plantations where the original provenance is known.

Successfully establishing large breeding populations of each species is critical to capture a broad range of genetic diversity from which to select multiple-traits and perhaps develop hybrids. For each species a target of 225 seedlings per family are grown. These have been planted to establish base populations of 7500 trees/species across three separate sites in the NZDFI regions. This will provide the broadest affordable genetic base to create elite breeding populations of the very best individual trees. For example, to have trees in the top 20% for growth, form, disease resistance, natural



durability and drying, only one tree in up to 3000 is selected. Individual provenances and trees with superior traits including adaption to dryland conditions, fast growth, good form, early heartwood formation and ability to coppice can then be selected at an early age.

Seed of 20 plus trees of *E. quadrangulata* collected from native stands in Australia were acquired from CSIRO by Proseed NZ and donated in 2010. These were propagated to establish breeding populations at four locations in NZ. 6,000 seedlings were planted with the four sites chosen being McNeill's farm at Waimarama, Hawkes Bay; Rewanui Farm Park in Central Wairarapa; Cuddon's property at Marlborough Ridge and the Martin's property in north Canterbury.

NZDFI plan to extend these breeding populations once further seed has been collected and funding is available so as to ensure the basis for significant genetic improvement of *E. quadrangulata*.

New Zealand management recommendations

Siting

There is insufficient information to define the best *E. quadrangulata* sites, but it has been established on sites from Northland to Marlborough and has shown excellent early growth.

Establishment

Eucalypts will perform best when cultivation, weed control and fertiliser are used for establishment. **Effective cultivation** can be achieved by deep ripping, rotary hoeing or mounding. Mounding can also provide some protection from ground frosts. If mechanical cultivation is not possible, soil in the planting spot should be loosened thoroughly with a spade.

Eucalypts require **weed free sites** in the first year of growth. This is critical to achieving good survival and growth. It is preferable to use a pre-plant spray such as glyphosate, to kill existing ground cover two to eight weeks before cultivation and/or planting. Hormone sprays should not be used.

Eucalypts can be damaged by some standard forestry herbicides, their sensitivity can be influenced by species, the soil type temperature and whether plants are flushing. Gardoprim, Gallant and Versatill have been used successfully over eucalypts but care is needed in hot conditions and sandy soils. Spraying directly over plants is not recommended.

Planting stock options vary from bare-rooted stock to container grown plants. Either is acceptable if the plants are well-grown and robust for their growing season. Bare-rooted seedlings should be lightly branched, about 45 cm tall, have a root collar of at least 7 mm in diameter.

Ideally, container-grown stock should be planted out when the plants are 15-25 cm tall and have 6-8 pairs of leaves. Large plants receive a considerable check at transplanting, and the root system is often deformed and constricted in the container.

Eucalypt seedlings generally **respond to fertiliser** applied to individual seedlings about one month after planting on weed-free sites. A general recommendation is apply 60 grams of urea or 80 grams of diammonium phosphate (DAP), in a spade slit 20 centimetres to one side of the seedling.

Spacing

Although there are no specific post/pole trials with eucalypts in New Zealand, evaluation of a eucalypt planting comparing close spaced trees with standard forestry spacing indicated a much higher proportion of post quality material in the closer spacing. Therefore until further research data are available, it is recommended that pole crops be established at 3 m x 1.5 m (2222 stems/ha).

Silviculture

No clearwood pruning or thinning is anticipated in post stands, but a standard form pruning to remove double leaders and or heavy branches is recommended between ages two and three years, but not earlier.

Acknowledgement

Comments on earlier drafts from Heidi Dungey (Scion) are most appreciated. Input from a number of farm foresters has also been helpful to help understand the performance of *E. quadrangulata* plantings in New Zealand.



Reference material

- Blakely, W. F. 1934. A key to the Eucalypts. With descriptions of 500 species and 138 varieties, and a companion to J.H. Maiden's critical revision of the genus *Eucalyptus*. The Worker Trustees, St Andrews place, Sydney.
- Bootle, K.R. 1983. Wood in Australia: types, properties and uses. McGraw-Hill Book Company, Sydney.
- McWhannell, F. B. 1960. Eucalypts for New Zealand Farms, Parks and Gardens. Pauls Book Arcade.
- Nicholas, I. 2008: Best Practice with Farm Forestry Timber Species, No. 2: **Eucalypts** - NZFFA electronic handbook series No. 2. www.nzffa.org.nz SFF Project (04/106)

Web links

- www.nzdfi.org.nz
- www.proseed.co.nz
- www.fore.canterbury.ac.nz
- www.scionresearch.com
- www.nzffa.org.nz
- www.ersa.edu.au/avh
- www.vineyardtimbers.co.nz
- www.iannicholasconsulting.com
- www.thewoodexplorer.com

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