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Producing posts and veneer from durable eucalypt timber

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Producing a naturally durable timber alternative to treated radiata pine, and a high-stiffness component for engineered wood products, have been driving forces behind the New Zealand Dryland Forests Initiative. Wood quality research has also been an important part of this programme from day one. Growers need to be confident that the durable eucalypts they plant will grow fast and straight, and will also produce large, consistent volumes of durable, stiff and strong timber.

The aim of the New Zealand Dryland Forests Initiative is to establish a sustainable multi-regional hardwood industry based on ground-durable eucalypts grown in wood supply catchments in the North Island and north-eastern South Island. The target is to steadily improve the growth, form and timber characteristics of selected species by breeding from seed collected mainly from natural, unimproved trees in Australia.

Two main product types have been identified as having strong market potential in New Zealand –

- Naturally ground-durable posts and poles for the primary sector, a market currently dominated by treated radiata pine
- Engineered wood products such as laminated veneer lumber using the exceptional stiffness of eucalypt timbers.

Early research testing durable posts

Work on growing durable eucalypts was begun by Paul Millen in Marlborough in 2003 when the area of vineyards was expanding rapidly and posts in their thousands appeared in what had been a farming landscape. The vineyard industry has continued to grow, not just in Marlborough, and now covers over 45,000 hectares nationwide. Vineyards use 500 to 600 posts on each hectare, making a total of over 20 million, the vast majority of which are copper-chrome-arsenic treated pine.

Many vineyard owners dislike using treated posts because of the toxic nature of copper, chrome and arsenic, and because of the high breakage rates of pine posts when grapes are mechanically harvested. An estimated five per cent of posts break, which would be around a million every year. These have to be disposed of, creating a problem for growers because treated posts cannot be burned and approved disposal in council landfill sites is expensive.

Durable eucalypt posts are much stronger than radiata pine so are less likely to break when hit with harvesting machinery. In addition, they can be chipped or used for firewood at the end of their vineyard use.

Initial research

Between 2006 and 2009, Vineyard Timbers produced 1,400 durable eucalypt sawn posts 70 mm by 70 mm which six Marlborough vineyards agreed to test on site. In 2017, a survey of the six vineyards found over 1,000 of the posts still in service. The posts were performing well, with low levels of decay and breakage. Vineyard owners were generally positive about the posts, and provided some useful feedback. This included one comment that posts may need to be pre-drilled because the timber was too hard for easy nailing or fastening wire hangers.

The plan is to repeat the survey in due course. This small research project was the start of what is now a steadily accumulating bank of theoretical and applied research knowledge about posts being compiled at the School of Forestry.

Timber properties of selected species

Species	Density at 12 per cent moisture content kg per cubic metre	Stiffness in gigapascals	Strength in megapascals	Life expectancy in the ground in years
E. bosistoana	1100	21	163	Greater than 25
E. globoidea	880	17	133	15 to 25
E. quadrangulata	1030	18	163	15 to 25
E. cladocalyx	1105	16	110	Greater than 25
E. argophloia age 13	1055	-	150	15 to 25
E. tricarpa	1130	17	135	Greater than 25
Radiata pine untreated	**480**	**9.1**	**76**	**0 to 5**

Timber properties of selected species

In the early days, a number of durable eucalypt species were identified to form the base resource of the project. The species all met the following criteria –

- Established timber potential using experience from Australian markets
- Class 1 or 2 durability
- Good stiffness and strength
- Good growth in dry New Zealand conditions
- Relatively good frost tolerance.

The table above shows that the selected species are much denser, stiffer and stronger than radiata pine, with durability suitable for in-ground use as alternative to copper-chrome-arsenic treated pine. The first two species selected for intensive genetic improvement were *Eucalyptus bosistoana* and *E. globoidea*. Since 2015, research at the School of Forestry has focused on these two species while work is now starting on the others.

The trial network

By the end of spring 2021, over 40 sites will have been established with a mix of breeding and demonstration trials. These sites are provided by farmers, forest owners and other land owners. The genetic origin of every breeding trial tree is known. Selecting trees for improvement relies on identifying elite families – plants grown from the seed of one tree – with superior genetic traits. The trials are crucial to the wood quality research being undertaken.

The School of Forestry wood quality research team, which consists of PhD candidates helped by skilled technicians and often other students, have extracted thousands of cores from trial trees over the past six years

Extracting cores from trial trees

Cores stained, ready for heartwood analysis

to assess hundreds of eucalypt families. The extracted cores are taken back to the lab, where their heartwood quality and quantity is measured.

A new near-infrared imaging technique has recently been developed which provides a fast, contactless way of analysing the cores. It has been shown that durability is mainly determined by the levels of extractives – a range of chemical compounds laid down in the heartwood. The technique enables rapid assessment of heartwood diameter as well as extractive content and how this varies across the stem. It also has the potential to be the basis of a technique to grade for natural durability, a quality control measure not available before.

The post market

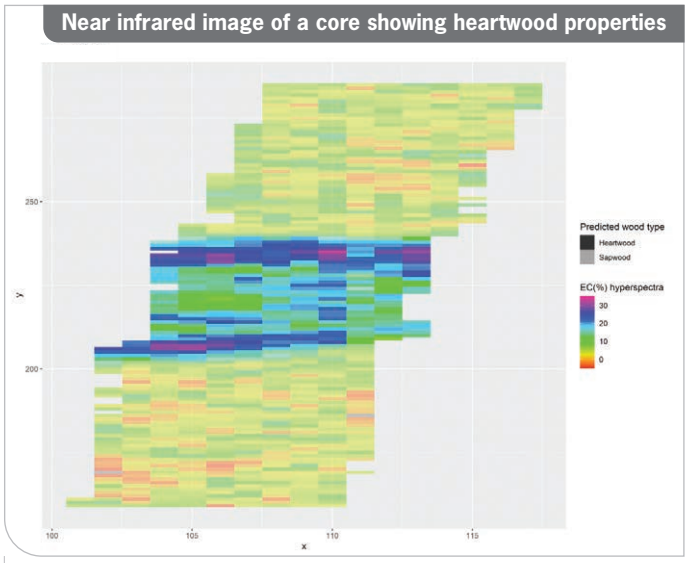
Very little has been published on wooden post manufacturing, despite them being a common product with a well-established process. Following a 2019 report on the potential for producing posts from *E. bosistoana* a comprehensive review on wooden posts was made. The review covers the New Zealand post market, technology for manufacturing, the potential production capacity of small and large-scale post-producing sawmills and an initial economic analysis of post production.

Some examples were included from Europe, the USA and Australia of forest systems which produce fencing timber, and how fencing material is produced. Naturally durable timbers are used as a traditional fencing product in some countries, and because of restrictions on the use of chemical treatment

The review confirmed that there is currently little, if any, use of naturally durable timbers for posts in the New Zealand. It also identifies knowledge gaps around the whole area of producing posts from durable eucalypts, several of which are now being addressed.

***E. cladocalyx* posts in use at Ata Rangi vineyard**

Near infrared image of a core showing heartwood properties



The domestic market for posts

Early investigations revealed that very little information existed about the scale and value of the market for posts and poles. The domestic market is dominated by demand from agriculture and horticulture, including viticulture, kiwifruit and apples. To find out more about the scale and characteristics of the domestic treated wood market, detailed data was gathered to produce an estimate of the size and value of the treated wood market. The findings included –

- The estimated demand for posts from farming, viticulture and the apple and kiwifruit sectors is 300,000 cubic metres each year
- The annual value of this market is estimated at $210 to $240 million based on retail value of $700 to $800 a cubic metre.

The study revealed new information about the demand for posts from the primary production sector. It is acknowledged that durable timbers will only take a proportion of the total post market in the near future, but the magnitude of the opportunity has become clearer. Organic producers and those with an environmentally responsible brand around their production are likely to be first in line when a sustainable supply of naturally durable posts becomes a reality.


Measuring posts during a peeling trial


Morbark post peeler and an *E globoidea* log, Dashwood Timber, Marlborough


Peeled posts ready for use

In 2010, Organics Aotearoa assessed the potential for alternatives to copper-chrome-arsenic-treated radiata pine posts and concluded that naturally durable timbers compared favourably to steel and plastic. There are several examples of New Zealand eucalypt enthusiasts already growing, manufacturing and using naturally durable eucalypt posts and other durable products on a small scale.

De-barking logs to make posts

One of the gaps identified was around whether machinery already available can be used to manufacture posts from high-density durable eucalypt logs. Removing bark and ideally some non-durable sapwood is the typical process for pole wood being converted into posts. A small-scale sawmill or post-producer could convert woodlot-grown eucalypt logs into posts for local agricultural and horticultural markets.

Tractor-mounted post-peeling machines used for peeling softwood logs before they are treated with preservatives are not uncommon, and a recent School of Forestry project investigated how well two such machines handled eucalypt logs. The two machines tested were Posch Schälprofi 500 and a Morbark post peeler.

The trial compared the performance of the two machines peeling *E. bosistoana, E. globiodea* and *E. quadrangulata* logs. The machines had no problem with the high-density eucalypt timber. However, there were mixed results with the removal of the thick fibrous eucalypt bark. Debarking technology for eucalypts is available and needs to be available before post manufacturing in the forest or at the milling site. The two machines had different strengths and weaknesses. Full results of these trials are available in a technical report and videos made of each peeling trial are available on the New Zealand Dryland Forests Initiative website.

Post stapling trial

If current fencing techniques and hardware can be applied to durable eucalypt posts this could make market access considerably easier. Generally, the wire or netting on rural fences is fixed to the posts by means of a staple.

A trial tested whether staples could be driven into durable eucalypt posts using a Stockade ST 400 fencing staple gun. The batten staples 30 mm by 3 mm were


Durable eucalypt posts on a spindle-less lathe

driven in fully. Larger staples 50 mm by 4 mm were also driven in past the barbs although not always fully. Hardwood 40 mm by 4 mm staples are commercially available from Australia.

Posts and veneer

An alternative technology for the production of a post product is to use rotary veneer peeling lathes. Small-scale spindle-less lathes can be used to manufacture round heartwood posts from small diameter logs. These lathes are widely used in China for veneer production and at least one Australian business is using them. It is especially suited to small diameter logs for manufacturing eucalypt posts. Larger diameter logs can be rotary peeled to produce veneer and a post, with the veneer going into laminated veneer lumber production and the remaining central core of each log forming a round post.

The School of Forestry has worked with Nelson Pine Industries Ltd to assess the suitability of different species for veneer. Incorporating a eucalypt component will increase the strength and value because of the high stiffness properties of eucalypt timber.

The amount of veneer produced in the peeling trials was reduced due to the release of growth stresses in the logs, causing the veneer sheets to split. Poor tree form also reduced veneer yields. An economic analysis showed that tree form and wood properties have a greater effect on tree value than product prices. Reducing growth stress and improving tree form are therefore both important selection traits for *E. bosistoana* in the breeding programme.

Technical and economic analyses

Scion were commissioned to investigate the technical and economic feasibility of producing posts in New Zealand. Using the Woodscape model, scientists undertook two analyses.

One was the potential for making durable eucalypt posts and veneers from *E. globoidea* in a combined process under three regime options of 15, 20 and 25-year rotations. The conclusion was that this could be technically and financially viable at a scale suitable to supply the domestic agricultural demand for naturally durable posts and to supply high stiffness veneer.

The other investigation was into the potential for producing posts from durable eucalypt species compared with the well-established treated radiata post market, as well as posts made from other materials. There is a wide range of non-wooden posts on the market, made from concrete, steel, recycled plastic and hybrids from a mix of materials. Generally, these non-wooden posts have retail prices which are higher than the copper-chrome-arsenic treated wooden posts.

The report concluded that durable eucalypt posts would be cost-competitive with posts made from other materials. This includes the treated radiata pine posts when the disposal cost of these posts is taken into account.

Linking wood quality research

In its work on durable eucalypts, the New Zealand Dryland Forests Initiative are building on techniques and knowledge developed over decades of international tree breeding work with radiata pine and other forestry species. Research results, including calculations of the heritability of desirable wood properties, are fed into the breeding programme, leading to the identification of the highest performing individuals and families across multiple traits. These trees form the core of the breeding population and collection of improved seed from our breeding trials in 2020 enabled planting of the first XyloGene branded trees this year.

Associate Professor Clemens Altaner leads wood quality research and development work at the University of Canterbury School of Forestry, and also heads the science team of the New Zealand Dryland Forests Initiative.

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