

Growing durable hardwoods – a research strategy

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Summary

The Special Purpose Species research group of the NZ Forest Research Institute is undertaking a project to investigate timber tree species that have naturally durable heartwood in contact with the ground.

Trees have been planted on farms to produce material for posts and other exterior uses, occasionally with success, but farmers are still faced with uncertainties in choice of species, seed source, siting and silvicultural management. Hardwood tree species with suitable wood properties that have been considered for this purpose include *Eucalyptus muelleriana*, *E. globoidea*, *E. pilularis*, *E. microcorys*, *Syncarpia glomulifera*, *Catalpa speciosa*, *Robinia pseudoacacia*, and *Castanea sativa*.

This paper gives a brief history on the growing and use of these species, summarises the information available and presents a strategy for future research. Until now, there has not been a research programme to compare the species, identify the best seed sources, describe the siting requirements, test spacing regimes or to measure growth of naturally durable hardwoods.

The economic prospects for some of these species may improve if concern about the depletion of tropical rainforests has an effect in the market and pressure from environmental groups leads to a re-evaluation of naturally durable timbers for use as posts and poles.

The research strategy outlined includes:

- collection of growth data from existing stands throughout NZ;
- species trials on different sites for all eight species;
- provenance trials for *E. muelleriana*;
- silvicultural trials for *R. pseudoacacia*.

Introduction

Trees which can produce heartwood that is sufficiently durable to use without chemical treatment for posts or for other farm purposes have always been of interest to farmers. In the past trees have been planted on farms to produce material for posts and other exterior uses, occasionally with success. However, despite years of experience, farmers are still uncertain as to choice of species, seed source, siting and silvicultural management. Hardwood tree species with suitable wood properties that have been considered for this purpose include the group of eucalypts known in New Zealand as stringybarks. These are usually given as *Eucalyptus muelleriana*, *E. globoidea*, *E. pilularis* and *E. microcorys*, although in the strict botanical terms only the first two are stringybarks. Turpentine (*Syncarpia glomulifera*), a close relative of eucalypts, has also been of interest for its very high natural durability, particularly as marine piling. Farmers have also been interested in traditionally durable timber species from the northern hemisphere including *Catalpa speciosa* and *Robinia pseudoacacia* from North America, and sweet chestnut (*Castanea sativa*) from Europe. In order to assess the potential for wider use of naturally durable trees for farm forestry, the Special Purpose Species research group at NZ Forest Research Institute (NZFRI) is undertaking a research project on these species. Close links have been

established in the project between NZFRI and the NZ Farm Forestry Association, particularly the NZFFA Stringybark Action Group.

New Zealand History of Ground-durable Hardwoods

Previously authors such as Matthews (1905) and Maxwell (1924) have summarised New Zealand experience with introduced timber species and advised on species choice and siting. In recent years articles in magazines such as "The NZ Farmer" and "NZ Tree Grower" have included articles by authors such as Fred McWhannell and Neil Barr, which have provided a little guidance to the selection and siting of some naturally durable species. However, these species have been of minor interest to forest growers, and have therefore received only limited attention in the research programmes of the NZFRI. The NZ Forest Service, formerly a principal provider of advice on timber-producing trees on farms for much of this century, had little experience of growing naturally durable hardwoods in its plantations.

Weston (1957) reviewed the history of growing forest trees in New Zealand. At that time eucalypts had been more widely used on farms than in forests, and much of the experience was not well documented. The following are the main points he noted about the naturally durable species. *Eucalyptus muelleriana* was recorded as a relatively late introduction at Whakarewarewa Forest in 1905, and at Greendale, Canterbury, in 1909. It was considered to have grown well "on suitable sites" in Northland, Waikato, Taranaki and Hawkes Bay, but it was only "fairly" tolerant of frost. The timber was used for posts, battens and poles and by 1957 had been sawn with satisfactory results. Weston concluded that it was an excellent species for warmer North Island areas.

He noted the longer history of growing *E. pilularis*, which was first recorded at Auckland in 1864. By 1900 it was established in Auckland, Waikato, Hawkes Bay and as far south as Wellington, although the New Zealand Forest Service showed little interest until a few hectares were planted at Riverhead in the 1920s. It appeared to do best north of Auckland and to do fairly well in Taranaki, and was thought to be very tolerant of poor soils in North Auckland. It sawed well, and dried without difficulty. It had been used for posts and battens and heartwood formation was rapid. Weston concluded that it should be planted more widely in the warmer parts of the North Island.

E. globoidea was also first recorded in New Zealand in 1864, at Clevedon near Auckland. By 1900 it had been planted in the Waikato and Canterbury. In the early 1900s it was also planted in Hawkes Bay. The species was tried in a wide range of State forests during this time, ranging from Mahinapua in Westland to Puhipuhi in Northland. The largest area planted was by NZ Railways at Athenree in the 1930s. Weston concluded that it had done well in the Waikato, Bay of Plenty, Taranaki and Banks Peninsula. Northland was considered too warm. It had been found to require moist, well-drained, free soils. The timber had been used for posts, poles and piles and sawn for farm use as well as cross-arms and flooring. It was recommended for planting on farms and also in forests on a small scale.

Weston made no comment on *E. microcorys*, but McWhan-

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nell (1960) noted that *E. microcorys* had been planted 20 years earlier, and that numerous good trees were established in the North Island with particularly good results in Poverty Bay, Bay of Plenty and Waikato.

Weston recorded that *Catalpa speciosa* was introduced in the 1880s and tried by Adams at Greendale, Canterbury. The State enthusiastically planted two million trees in the Rotorua region, but although it could stand -9°C frosts in winter, out-of-season frosts were fatal. By 1913 the Rotorua plantations had failed and the species was condemned for afforestation.

Robinia pseudoacacia seedlings were sold in Christchurch in 1863. By 1870 it was recorded as growing wild in Auckland and Waikato districts, but its generally poor form has discouraged planting. Kraayenoord and Hathaway (1986) noted its particularly poor form in the Waikato. It was reported as growing best on deep, light, moderately rich soil but it could also thrive on poor and sandy soils, and it became known for its use for soil conservation. In 1945 the "Shipmast" variety was imported by the Soil Conservation Council from the US Conservation Service, but contrary to expectations it did not give the hoped-for tall straight bole and small side branches. However, it was reported to produce excellent posts, strainers and sleepers, as well as tool handles, but it seems probable that some poor strains were distributed in some areas. Weston concluded that there was considerable scope for improvement by importing tested, dependable varieties.

Castanea sativa and *Syncarpia glomulifera* were noted by Weston as merely having been tried in New Zealand.

Developments since 1960

At NZFRI, early work on eucalypt tree breeding by I.J. Thulin and G.B. Sweet temporarily concentrated on durable species such

as *E. pilularis* and *E. muelleriana*. Also stringybarks were included in establishment trials and trials related to "enrichment" planting of scrub on the initiative of E.H. Bunn. However, the longest-running research programme at NZFRI has been the assessment of natural ground durability in field tests. A summary (NZ Forest Service, 1982) places *E. globoidea*, *E. muelleriana*, *E. pilularis* in the "durable" category (15-25 years) while *Robinia* is placed in the "very durable" category (more than 25 years).

Eucalyptus pilularis, *E. muelleriana* and *E. globoidea* have been included in ongoing service tests of crossarms, and *E. muelleriana* in decking trials, but as many of these tests are less than 10 years old, only interim unpublished reports have been written to date. The most recent summary of wood properties has been by Haslett (1990), who contends that, from a wood processor's point of view, *E. muelleriana* would be the most preferred of the eastern blue gums and stringybarks because of its fine texture and light colour. The stringybarks have only slight growth stresses, a feature which has little adverse effect on their utilisation, and among them *E. muelleriana* is the easiest to dry.

New introductions of *Robinia pseudoacacia* have been made from USA (1960) and from Hungary (1980s) where the most extensive plantations of the species exist (Kraayenoord and Hathaway 1986; Krijgsman, 1989). Experience in conservation plantings suggest that the Hungarian clone 'Zalai' and clone '46' are the most promising (B. Bulloch pers. comm. 1992).

Material from a chestnut stand in Whakarewarewa Forest has been marketed to furniture manufacturers (Treeby, 1986).

Although the NZ Forest Service policy on Special Purpose Species produced in 1981 (NZ Forest Service, 1981) recommended that *E. muelleriana*, *E. globoidea* and *E. pilularis* be eligible for consideration for establishment under Forestry Encouragement schemes (on appropriate sites, to enable limited



NZ Farm Forestry Association member John Pederson helps establish a *Eucalyptus muelleriana* trial on his, and wife Christine's, farm at Parakao, Northland.

production of naturally durable timbers for farm use), silvicultural trials established by NZFRI to support this policy, concentrated on the seven other hardwood species which had been identified as suitable for decorative uses, such as furniture and veneers, and on *Cupressus macrocarpa* for its potential for exterior joinery. Thus, although farmers have been encouraged to grow the stringybark eucalypts, and have expressed interest in *Robinia* and chestnut, until now there has been no programme of research to evaluate the growth of naturally durable hardwoods, including the identification of the best seed sources, siting requirements and to test spacing regimes.

Prospects for Durable Hardwood Species

While the Special Purpose Species Policy was formulated in response to the decline in supply of indigenous timbers, the depletion of tropical rainforests has led to an even greater supply problem which is having a significant effect in the market. For example, conservation groups in New Zealand have successfully negotiated with major timber retailers to implement a voluntary ban on advertising rainforest timbers. Stringybark eucalypts, at least, are now being regarded as having wider potential uses than just fence posts on the farm. M.D. Wilcox (see commentary, page 9) contends that eucalypts have a potential market in New Zealand for flooring and exterior decking and as decorative veneer and he includes *E. pilularis* and *E. muelleriana* and other stringybarks as being suitable for these uses.

Pressure from some environmental groups may lead to a re-evaluation of the place of naturally durable timbers. Greenpeace are launching a "Green Forestry" campaign which encompasses a wide range of issues including timber treatment.

Research Strategy

In 1991 NZFRI successfully obtained funding from the Foundation for Research, Science and Technology and the Agricultural and Marketing Research and Development Trust for trials to include the eight species of interest. The strategy for the research is to investigate siting and growth rates of all eight species through multi-species plots and surveys of existing stands, and to target the species with the greatest potential for inclusion in genetic and silvicultural trials.

Siting and Species Selection

The first stage of the research programme has included two trials with all eight species (*Eucalyptus muelleriana*, *E. globoides*, *E. pilularis*, *E. microcorys*, *Syncarpia glomulifera*, *Catalpa speciosa*, *Robinia pseudoacacia*, and *Castanea sativa*) planted out at each of two sites in replicated plots to gain information on comparative growth rates. For each species different seed sources were used: a range of provenances for the eucalypts and *Syncarpia*, different clones for *Robinia* and different parent trees for chestnut and *Catalpa*. One trial was planted last year on a farm in Northland and the second was planted this winter on a farm in the Bay of Plenty. Expansion of this series of trials to other sites is planned if funding and sites are available.

The next step will be to establish sample plots to measure growth and yield in existing stands in the North and South Islands. This will include describing the health of the trees in a consistent manner. A survey of this nature is inclined to highlight the successes rather than the failures, but an effort will be made to record the disappointments, because they are a good source of information in identifying siting requirements.

Provenance Trials

Eucalyptus muelleriana appears to be the most promising stringybark eucalypt for warm New Zealand sites. Trials to compare the performance of progenies of approximately 60 selected parents, representing seven provenances within the natural range of the

species in Australia, are being planted this year on a farm in Northland and on a Bay of Plenty forest site. Sites in the lower North Island and Marlborough will be sought for subsequent trials. Establishing trials at several sites will allow growth of the different provenances to be tested in different climates and soils.

Seed is imported from Australia at present, because it is not readily produced in local stands. If seed production is adequate, provenance trials may be converted to seed stands in future. All trials will be sampled in the future so that wood properties and durability can be assessed. When the provenance trials are four years old it should be possible to use the data gathered as a guide to seed selection for silvicultural trials.

It is proposed that the next species to be assessed in genetic trials be *E. pilularis*.

Silvicultural Trials

Well-formed *Robinia pseudoacacia* cultivars imported from Hungary are regarded as having the most promise for producing material for posts. The extremely durable nature of the species makes it an attractive option, and it can be grown on a wider range of sites than the stringybark eucalypts. One-hectare trials of the clone "Zalai" were planted this winter near Rotorua and Taihape on farm sites to test two different spacings and to provide stands in which to test silvicultural treatments. Further work on the species will depend on the performance of these stands.

Silvicultural trials of *E. muelleriana* and *E. pilularis* will not be established until the survey of existing stands is complete and some information is available from provenance trials. This information will assist in selection of seed source and the design of trials.

Sweet chestnut, *Castanea sativa*, demands a good site. The interest from farmers may partly arise from the versatile nature of the species. It not only produces durable heartwood, but also nuts and is an ornamental tree with pleasing autumn colouring. The decision to proceed with a silvicultural trial will depend to a large extent on grower interest, but a better understanding of the hybrids that exist in New Zealand, their growth rates and durability should be investigated first.

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