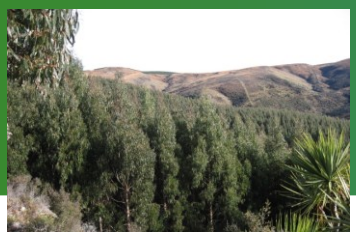

DIVERSIFIED SPECIES THEME UPDATE

Number: 09

Theme Leader: Patrick Milne

Date: September 2013

Introduction

Patrick Milne titled his introductory slide "The Last Rites", because this was the final meeting of the Theme. Not only is FFR being disbanded in its entirety to be replaced by an unknown research organisation, but on 1 October 2013 the funding for Diverse Species will totally cease. Key staff may lose their jobs, exciting research projects may be abandoned in mid-stream, and – heaven forbid – many not-inconsiderable achievements may be lost forever.

You would think, therefore, that the meeting would be infected by despair, and that it would be an unpleasant place to linger. Not so. The turnout of members may have been a record, and the interesting meeting ran smoothly, thanks to the professionalism of the organisers (Russell Dale, Veronica Bennett, Patrick Milne and Heidi Dungey). After every session, Patrick would ask members for their top priority – in the hope that there would be a trickle of rescue money from the forest levy or elsewhere.

The meeting could be seen as a celebration of what has been achieved. From an unpromising start five years ago, an amazing amount of useful information has been obtained about a wide number of tree species. This report summarises and honours the work of all those responsible.

This article was written by:
Piers Maclaren, Piers Maclaren & Associates Ltd for FFR Diverse Species Theme Members

Achievements

Patrick repeated the reason for the existence of the Theme: to move away from "once size fits all" approach, to increase market opportunities, to develop contingency species and to retain forestry's "licence to operate". Mainstream growers of radiata pine may think that they can ignore other species, but there is a rumbling of discontent from the general public about the radiata monopoly. The least one could say is that other species were being researched elsewhere. No longer true.

Under Heidi's inspired leadership, in a mere 5 years the few dedicated scientific staff have chalked up 21 scientific publications, a large number of Tree Grower and magazine articles, and over 200 technical reports, notes and workplans. The following is a review of the achievements of our scientists in this Theme, one species at a time..

Douglas-fir

This is New Zealand's Number Two forest crop, with most of the major Douglas-fir growers participating in and contributing to the research as described in the next paragraphs. The foundation of the Theme was the wisdom and energy of the old Douglas-fir Cooperative under the leadership of Phil de la Mare and the late Leith Knowles. If Leith is looking down from the clouds, he would be most impressed by the achievements of his successor organisation.

Given the species' importance as a structural timber, there has been a special emphasis on wood stiffness. A sawing study confirmed that acoustic measurements on standing trees reliably predict the stiffness in sawn wood. The interaction between the genetics of trees and the characteristics of the site and the way in which these impact on stiffness is now more clearly understood. We now know that wood stiffness is lower in the cooler sites of New Zealand; both mean annual temperature and C/N ratio in the soil are important in this respect.

What are the implications of this? Do we cease planting Douglas-fir in the most suitable and obvious sites – upland Otago, Southland and Canterbury? These sites have the cheapest land, good growth rates, and a low incidence of Swiss needlecast (SNC), even under a scenario of increased global warming. A partial solution may lie in the excellent progress we have made in the breeding programme for enhanced wood stiffness. We have identified "correlation breakers" – trees that grow stiff wood with a high level of diameter growth.

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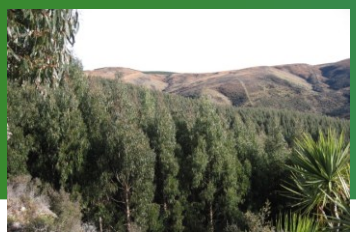

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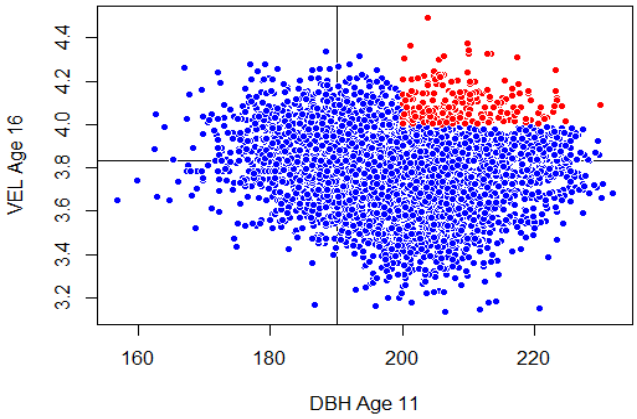

The 'correlation breakers' in red

But, for a time anyway, it seemed that being able to grow a tree that produced good wood at a profit was insufficient. The economic viability of Douglas-fir as a building material was threatened by a political move that demanded H1.2 treatment for all wood, regardless of species, in residential buildings. Key work by the late Mick Hedley and others showed that Douglas-fir wood was hard to wet and would substantially resist rotting: thanks to their efforts it can now be used without treatment in low-risk domestic situations.

To overcome the high cost of waste thinning (Douglas-fir trees hang up easily), the expensive production thinning option was considered. To make it pay, the Theme assessed the possibility of using such thinnings for Laminated Veneer Lumber. Unfortunately, the thinnings proved to be of insufficient diameter and straightness, but the basic idea was sound and should not be casually abandoned.

In the last 5 years a simplified breeding plan has been formulated, with new selections and trials. Trees will be screened for stiffness, growth, form and SNC resistance. Two new progeny tests (2nd generation) have been established and are growing well. Genetic enhancement has occupied much of the Theme's energy over the entire period.

A Douglas-fir manual has been written, summarising the state of knowledge in an easy-to-read form. For more sophisticated growers, the latest research has been distilled into equations which are the building blocks of an integrated model incorporated into both the Calculator and Forecaster. Individual case-studies are no longer of great interest – except perhaps to validate such models. Users can now assess, from their desks in a matter of minutes, the implications (in terms of quantity and quality of wood) of any combination of site and silviculture.

Mark Dean from Ernslaw One then spoke from the perspective of a major forestry company. He reiterated the achievements outlined above, and added the following aspirational goal: to produce products that were 10% stiffer from a similar volume – with a rotation length of only 35 years! He believes that, with the current breeding programme, this can easily be achieved. He thought that any future research should attempt to overcome another major hurdle: the high growing costs. Currently fashionable high discount rates disproportionately penalise up-front costs, particularly in long rotations. We also need cost-effective production thinning systems and pragmatic solutions to control wilding spread. The groundwork to enable a sterile forest has already been done by this Theme (thank you, Cathy Hargreaves), but there are political stumbling blocks to the use of GE technology.

In summary a lot of knowledge has been gained and reported, and we hope that the hard-won discoveries will not be lost in the funding hassles of the next year. Read www.douglasfir.co.nz to contact the Douglas-fir Association and find out more about this species.

Eucalyptus

This genus is capable of producing some excellent types of wood, including those with beautiful colours and natural durability. Some species grow at rates that leave radiata behind. Despite their wonderful attributes, their history in New Zealand has been plagued by pests and diseases. Toby Stovold spoke about de-risking eucalypts.

Funding restrictions have always forced scientists to focus on the "industrial" eucalypts, and even then only on two ash species plus *E. nitens*. Enthusiasts have been fickle in their preferences, and *E. regnans* has lost its former popularity because of a very serious leaf problem (Barron Road syndrome). It seems, however, that healthy trees selected from areas where there is a high level of leaf disease should be able to pass on their resistance to their offspring. Third generation trials were established in 2009/2010 on two sites, one of which was assessed in 2011. It seems we could achieve an almost unbelievable 900 m^3/ha from 20-year old stands (yes, you read that right). Sawing problems have been overcome, thanks to work by Dean Satchell and Christine Todoroki, and the future of this species is very bright. Or, it would be if there was sufficient research funding.

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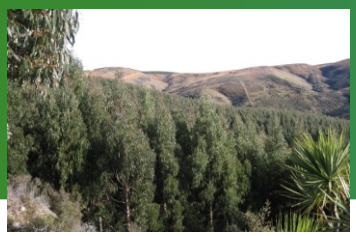

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High quality flooring cut for 18-year-old E. regnans

E.fastigata is the other ash-group species discussed by Toby. This species is like radiata pine, in being very tolerant of a wide variety of sites. For a long time it has been identified as one of the healthiest eucalypts, but had a bad name because of coarse branching and forking. It seems that this handicap is easily solved by good breeding. The 2nd generation trials on four sites have shown forking to be present in only 10% of trees. Predicted volume growth is not as good as *regnans* – only a miserable 800 m^3 at age 20! As often experienced, the New Zealand seedlots outperform the introduced ones, in this case by about 30% in terms of volume.

E. nitens was very popular for a while, until devastated by *Paropsis* beetle. It is now grown for pulp in cooler climates where the beetle is less prolific. There is a breeding programme which makes use of modern DNA technology to identify the fathers in a given tree, thus obviated the need for expensive controlled pollination. Emily Telfer has been responsible for this development.

Toni Withers then spoke about the latest attempt to control *Paropsis* beetle. For a time, biological control using *Enoggerra* seemed to have overcome the pest, but since then a hyperparasite has negated the benefit. Another parasitoid has been located and research is underway to raise it in the laboratory. As a casual throwaway comment, Toni mentioned the Myrtle rust which has now been discovered in Australia and might easily blow over to New Zealand. This has the potential to devastate members of the Myrtaceae family, which includes eucalypts. Also feijoa, rata, manuka, kamahi, pukatea.... Yikes!

Contingency Species

There are two categories of such species: those that could replace radiata pine were it to fail, and those that complement pine by growing a different sort of wood. Charlie Low tried to cover both types in one short talk. (Perhaps we need Contingency Scientists to replace Charlie should he fail!)

A list of 80 such species was compiled by Gerry Vincent and has been updated. It gives the species and its location (forest, compartment, and owner). If needed, seed could be collected from there. As far as real contingency species are concerned, *Pinus muricata* is the closest replacement for radiata pine, but it got a bad name from use of undesirable provenances. There are some excellent seed stands of the blue strain from good provenances. *P.attenuata* is also of interest for colder, drier parts of the country. Trials have also been established for this.

Regarding complementary species, some of which outperform radiata pine on exposed sites, Charlie mentioned trials of Sitka and Norway spruce, *Pinus ayacahuite*, various *Abies* species, and *Acacia dealbata*.

Charlie summarised by saying that it is important to maintain the existing New Zealand genetic resource now that we can no longer import pine seed from California or Mexico (due to pine pitch canker).

Indigenous Species

Greg Steward started off with his work on riparian revegetation, where the objective is to establish indigenous species for production. This involved poisoning crack and grey willows, even though some locals thought these were native!

The next topic was hybridisation among the four species of totara. This may be a cause for concern (because we may have been planting hybrids) or it may be an advantage (we might use the best features of each). *Podocarpus totara*, for example, is the fastest grower, whereas *P. hallii* is the straightest. A way has been developed using ten DNA markers to differentiate between them, even in the nursery.

Thirdly, Greg discussed the cost of native seedlings. As with Douglas-fir, economic analysis never favours high up-front costs combined with long rotations. The goal is reduce the cost to less than one dollar a seedling. So, together with Tane's Tree Trust, comparisons were made for ten native species between trees planted as bare-rooted stock, in PB3 bags, and in root-trainers. Bare-rooted stock were at

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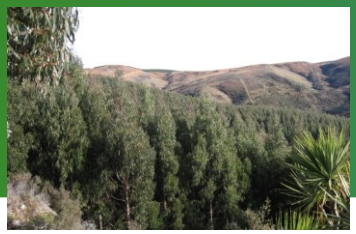

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least 50% cheaper, had similar survival and growth, and were more efficient to transport and plant.

Lastly, Greg talked about kauri. He has analysed data from 25 planted forests and seven natural forests, and has built models with which we can now confidently predict height, basal area and volume. From this data we have a basis for a breeding programme, and can compare planted stands with natural ones. Planted stands are a staggering 12-20 times more productive! Such stands yield an average of 16.1 m^3/ha/yr. (By way of comparison, average productivity for radiata pine is 25.2 for a forest site). This work has been coalesced into a kauri calculator, from which we can calculated such things as profitability. Kauri yields an impressive Internal Rate of Return of 6-7%. Greg has looked at the wood density and heartwood content from stands 14-240 years old, and while the levels of heartwood are not high in these "younger" stands, the density averages an enviable 452 kg/m^3 even in fast-growing plantations

Coast Redwood

Toby Stovold discussed Dean Meason's work (he is overseas). The state of knowledge before the formation of FFR was summarised in an electronic publication "Redwoods" by the late Ian Nicholas. The main problem in evaluation of this species has been the almost random genetic origin. Since then, two older Kuser trials have been analysed to identify the interaction between genotype and environment and the degree of genetic control for key characteristics has been estimated: DBH, wood density, heartwood and the propensity to throw epicormic shoots. This work is an essential underpinning to a rational breeding strategy. There has been (occasionally heated) debate about the merits of various clones now being deployed, and we will soon be able to compare these in an objective way, and also to establish a breeding population.

With about 30 new PSPs we now know a lot more about the regions and locations that are more suitable for Coast redwood. We have a 400 Index, in keeping with those of other species, and a productivity map of the country. Silvicultural trials have investigated the efficacy of thinning and pruning, and their impacts on growth and timber quality. Results indicate that redwood does indeed respond to thinning but only at stockings higher than currently planted (>800 sph). Epicormics can be controlled, particularly by good breeding. Pruning does not appear to have a long-term impact on growth and will certainly increase the potential value of the timber.
Some work has been done on wood quality: density, heartwood, log grade recovery, and durability. It is no longer necessary to wait for harvest and then a protracted decay test to test for the latter trait, because there is a good relationship with NIR (near infrared) scanning. This can be used even with seedlings. Toby's opinion was that it is important to purge the species of non-durable clones.

Sadly, there has been insufficient time to investigate such important matters as erosion mitigation and marketing, but in Patrick's view the redwood programme has almost over-achieved and is to be congratulated. The Mangatu study proved that New Zealand can grow redwoods of adequate quality and it has a bright future.

Simon Rapley, speaking from the industry perspective, discussed the cooperative approach that has been used among redwood growers. They have volunteered their clones for testing at relatively low cost. From this work has come an understanding that most of the variation in durability is within the stem of an individual tree, rather than between clones, so that segregation of sawn timber is the obvious way forward.

The South American Experience

Dave Hilliard spoke of his trip to Brazil and Chile, as part of the Radiata Pine Breeding Company visit. In Brazil, *Pinus taeda* yields an average of 38 m^3/ha/yr and hardwoods achieve 50, but Brazilians are aiming at increasing this to 70. Much of the harvest is for pulpwood or charcoal (for steel making). Eucalypts were *grandis, urograndis, urophylla, saligna, globulus* and *dunnii*. *Acacia mearnsii* was also widely grown. These trees are felled at age eight, but sometimes only six years old! Indigenous forest continues to be lost but the main culprits are palm-oil and demand for food production.

In Chile, there is a move away from radiata pine into hardwoods (*Eucalyptus nitens* and *globulus*). Perhaps half the pine harvest is replanted in eucalypts. Their pines are grown on a rotation of only 23 years, and pruning is more extensive than in New Zealand. They also use their indigenous beech forest (*Nothofagus alpina*). *Nectria* is a worse problem in Chile than New Zealand, and it is a worry that it occurs at latitudes warmer than Rotorua. They also have problems with red needlecast and pine tip moth.

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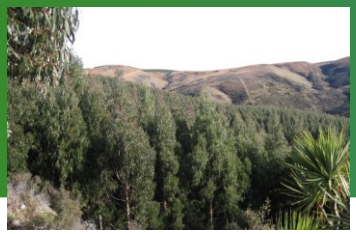

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Date: September 2013

Cypresses

There are more than 30 species in the *Cupressus* and *Chamaecyparis* genera, with durable and attractive heartwood. Their productivity is almost as high as radiata pine, although better soils and climate are required. Cypress Canker is the weak link.

Historically, research was intermittent and unfocussed, but since the first FFR there has been a continuous, prioritised effort. The top concern has been the sophisticated breeding programme. There are complex arrays of seed orchards, breeding programmes for the pure species, and hybrid archives for the clones with the best characteristics. One great strength of the cypresses is the ease with which they hybridise (for example, in the naturally occurring Leyland clones). This promises future plantations, within very few years, of suitable clones guaranteed for such attributes as heartwood colour and durability. NIR scanning has again proved a shortcut way of assessing the latter.

As with other species, incorporating growth models into a Calculator created an easy way to address fundamental questions of silviculture, yield and, ultimately, value. The genus could easily become a contender for the title of third most import commercial tree.

Dryland Forest Initiative

Although not a member of FFR as such, there are obvious links between the NZDFI and FFR. It was a clever move to schedule Paul Millen as final speaker, because his energy and enthusiasm could not fail to reinvigorate a room possibly somewhat dispirited by lack of institutional support. Although NZDFI will undergo some degree of trimming, independent funding sources ensure its survival.

Paul explained that vineyards require about 350,000 replacement posts per year, because weak low-dimension radiata pine is very susceptible to breakage. There is also continuing demand for cross-arms for telephones and power poles, bridge piles and other waterfront infrastructure, and railway sleepers. We currently import some $51 million worth of tropical hardwoods from a decreasing resource. Moreover, there is a backlash (rightly or wrongly) against CCA and residues of that treatment appearing in wines that advertise themselves as Clean and Green.
"Drylands" are areas with a rainfall of only 600-900 mm/yr and they have the following advantages: land-use alternatives are few; there is a huge area of such land outside New Zealand (think of the opportunities for exporting our technology); there is a link with adjacent vineyards; and most importantly, insects and fungi are less of a problem in environments with lower humidity. Paul's ambition is to plant an eventual estate of 100,000 ha, from New Zealand's dryland total of 13 million ha.

His work has investigated species such as *Eucalyptus bosistoana* some of which are virtually unknown as plantation crops even in Australia – but the same could once have been said of radiata pine. So far, trials have indicated good survival and reasonable growth, as was seen on the field day. Let's keep an open mind on the commercial potential of these new species. It would be truly wonderful if the enterprise succeeded.

Summary

The Diversified Species Theme has achieved almost miraculous results in a short 5 years. We have pulled ourselves up by our bootstraps, only to have those straps cut by short-term thinkers.

It takes many decades to grow a tree, but once the resource is mature many wonders can be achieved with modern processing technology. When that time comes, accountants may preen and strut about the stage expounding on the advantages of fashionable modern products in boutique markets. But without the prior existence of the forestry resource such thoughts are just a pipedream. Forestry may not be sufficiently sexy for funding agencies, but trees can't spontaneously appear without exhaustive background research to provide the economic justification for a planting programme. The government funders wanted us to show that we could generate $200 million by 2030 – from trees that have not yet been planted, let alone researched! How stupid is that?

Take heart, the foibles of politicians and administrators are soon forgotten. By contrast, the achievement of scientists in furthering human knowledge is noble and enduring. Kia Kaha!

At the end FFR was very well supported by its members

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