DIVERSIFIED SPECIES THEME UPDATE

Number: 07

Theme Leader: Patrick Milne

Date: May 2012

Meeting held in Gisborne, 15th March 2012

Summary

If New Zealand's forest estate is going to expand significantly as advocated by both government and opposition parties, then it is unlikely to consist of 'more of the same' - alternative species will be the key. For this is to happen industry needs evidence that the risks of alternative species can be managed, and that the expected returns can equal or exceed that of radiata pine. Members attending the recent Theme meeting in Gisborne were presented with new research results which are continuing to add to the body of evidence that these species can be grown and managed successfully.

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

Introduction

The field day at the Gisborne meeting looked at three things: the effects of storm damage; the problems associated with roading and harvesting; and the port operation. The following day was a workshop entirely dedicated to the risks of erosion on steeplands. This was very well attended. The technical meetings of harvesting, diversified species and radiata pine took place simultaneously on the final day. The Diversified Species Theme meeting is summarised in this report.

How does stiffness in Douglas-fir vary with site?

Douglas-fir is sold mainly for structural timber, so with this species stiffness is particularly important. But it was often marginalised to upland sites where radiata doesn't do so well. As Stuart Kennedy said, if we could understand how stiffness varies with site, it would help us segregate out the worst locations and thus maintain the good reputation of this excellent species.

But the environment is not the only influence on stiffness. Tree age, silviculture and genotype are also important, so we must account for these effects. How best to do this? By a careful comparison of 18 sample plots from throughout the country, tempered with measurements from 6 provenance trials and one transect at Craigieburn – where the only variable was altitude. In the Craigieburn trial, the altitudinal differences are quite striking – the higher altitude trees are considerable smaller and more malformed, with larger and more steep-angled branching. In addition, the wood density drops from 420 kg/m^3 (at 800 m) to 366 (at 1080m).

The variation around the country is also quite pronounced, ranging from 505 kg/m^3 at Golden Downs to 318 at Castledowns. What causes this? Tree age, the temperature in March, tree slenderness and acoustic velocity squared can explain 91% of the variation. But acoustic velocity and density have a close relationship throughout the data range (after all, they both measure the same thing: the quantity of woody material present as opposed to air). "Slenderness" can be associated with silviculture (ie high relative spacings), but is also closely related to exposure, because wind tends to create shorter trees with more taper. So slenderness could be another way of describing exposure.

"Exposure" is a word that is easy to understand, but difficult to measure. We could use digital terrain models and TOPEX, but this is not ideal. Wind speed models may be better, but is still problematic. The speed, direction, duration, frequency, temperature and seasonal occurrence of the wind may or may not all be critical.

The definite conclusion is that increasing altitude and/or exposure decreases stiffness. Further work is required: to standardise the results to a common age (say, 20 years); to incorporate the impact of Swiss needlecast on growth, density and velocity; and to translate the results in terms of grade recovery, taking account the altitudinal effect of branching and density/velocity.

Future Forests Research Ltd, PO Box 1127, Rotorua. Ph: 07 921 1883 Email: info@ffr.co.nz Web: www.ffr.co.nz

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Cypress hybrids, how did the 2008 plantings perform?

To refresh memories, cypress crosses were made in 2005 using combinations that would almost guarantee canker resistance: *lusitanica* and *guadalupensis*, *lusitanica* and *nootkatensis*, *macrocarpa* and *nootkatensis*. The cones ripened, the seed was extracted and sown in 2007 (although if the seed had *nootkatensis* ancestry there was low viability). These hybrids were planted in rows of 5 trees in Kaingaroa and Ruatoria on July 2008, with controls of pure *lusitanica* and *macrocarpa*. There were also 100-tree blocks of pure species and *guadalupensis* hybrids.

The sites were not unusual, therefore any lessons we learn could be widely applicable. The Kaingaroa site is 530m asl and has had two previous rotations of radiata pine, and the Ruatoria site (Whakaangiangi block) is at 320m asl and has had one previous pine crop.

The trees were assessed for height, foliage type (fluffy or flattened), acceptability rating (bad, good or excellent) and for canker symptoms. Of course these are early days, but it is interesting that the *lusitanica/guadalupensis* cross was the tallest (2.8m) significantly above the macrocarpa (2.32m). Other hybrids were in between. All the crosses and pure species were about 80% “acceptable” (except for one strange *lusitanica* x *nootkatensis* family with some mutant plants). It is still too soon to consistently identify canker symptoms, but – predictably – stem canker was seen on pure *macrocarpa*, and only on the *macrocarpa*.

As regards flattened or fluffy foliage, *nootkatensis* has the characteristic flattened leaves as opposed to fluffy *macrocarpa* or *lusitanica*. So how do the hybrids appear? It seems that *macrocarpa* x *nootkatensis* takes the flattened form of the latter, but this is not always the case with *lusitanica* x *nootkatensis*. Perhaps this implies some pollen contamination?

To summarise, the hybrid growth is better than expected and their form looks very good. It is too early to evaluate canker resistance, but we will need to check for pollen contamination. Where to now? Some young hybrids were stimulated to flower and will be tested for sterility. It will be most interesting to discover if the new hybrids are fertile – opening up the possibility of cheaper deployment as seedlings, or more critically the development of a tree breeding programme based on these fertile hybrids.

A new trial is planned for winter 2013, with new seedlings from various hybrid combinations plus some cuttings from the existing trial. This is very exciting work! It promises to challenge the monopoly of radiata pine and Douglas-fir on our landscapes, and within a generation to make a home-grown high-quality appearance wood available to New Zealand consumers.

Working out the origins of our *E. nitens*

Our breeding population of *nitens* was open pollinated. In other words, we know the background of the mums but the dads could have come from anywhere. We assume that the dads were from seed orchards, so they were probably good stock, but it would be useful to know exactly which tree produced the pollen so that we don’t get in-breeding in the next generation. For a start, this would mean a cheaper breeding strategy – because you can capture the whole genetic range in a population with fewer trees.

The way to work out your true parents is to use DNA markers. These are certain sequences of base pairs sandwiched between sections of DNA that remain the same for all individuals. Some 14 markers were selected as developed by Shaun Wynard for the Eucalyptus Coop between 2005 and 2007.

When each marker is identified in the chosen tree, the true mother is confirmed (cones may have been accidentally mixed up) and any markers associated with the mother-tree are eliminated. Then if new markers are found that are not present in the mother-tree, this points the way to identifying the pollen parent. This technology is likely to be world leading, and will create a lot of international interest.

Sampling eucalypt leaves for DNA analysis

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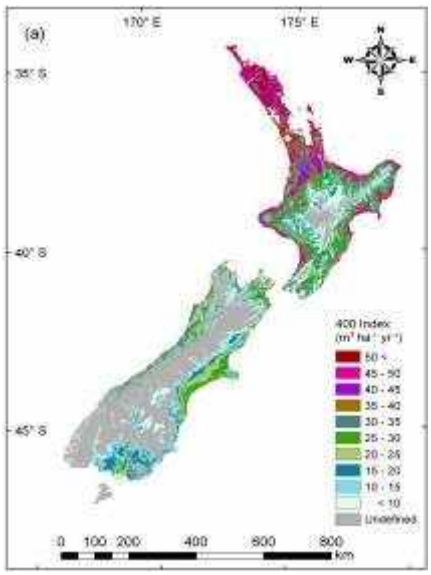
Where's the best place to grow redwoods?

There is a lot of interest in redwoods, as most of the old-growth resource in the US is now protected, but redwood growth in New Zealand varies from poor to impressive. So where does this species grow best, and why?

The research team looked at the PSP data and quantified the growth rate. Height was defined in terms of site index (the MTH at age 40) and volume was defined in terms of 400 Index (volume at age 40 for a final stocking of 400 sph). These growth data were then compared against climatic records, environmental data and biophysical data, using regression modelling. Starting with the strongest relationship, variables were added until further additions were not significant or didn't improve R^2.

Mean spring air temperature was the most important determinant of volume productivity, explaining 55% of the variation around the country. This was followed by acid soluble phosphorus (16%) and mean summer Vapour Pressure Deficit (5%). For site index, the phosphorus level was unimportant but mean annual air temperature explained a whopping 71%m followed by VPD with 11%.



Redwood Site Productivity Map

A general rule of science is that it is easy to get remarkably good correlations between a group of variables from a wide choice of possibilities – with any given set of data. First, there has to be some mechanical cause as to why those particular variables should be important, and second there has to be a validation using an independent dataset. If the general rule that you have devised works well for your data, does it work elsewhere? Fortunately, these models easily passed the test.

Two uses are immediately obvious for this work: first, great nationwide maps have been produced so you see at a glance where redwood is likely to grow well or poorly. Second, we have identified the site factors that are critical for height and volume. The problem is that the PSP dataset is limited and there may be many potentially good sites that are not represented. Let's hope that redwoods will become more popular (as well they should) and we can improve this map. In the meantime, the models can be used within a given region for identifying the best sites.

The Kauri Calculator

Greg Steward presented a kauri model for the change of stocking, MTH, BA, and volume against age. This will be incorporated into a delivery system which will soon be available on the website, and which can be used for analysing the profitability of this species.

In a very simple and intuitive interface, the user inputs the starting conditions, including initial stocking, site index, land value, the various costs, and discount rate. The model will then grow the crop up to the specified age and calculate the various indices for profitability. As with similar programs for other species, this is a very valuable learning tool. At the touch of the keypad, a user can investigate the merits of different options (what final stocking? what rotation age?) before any great expense is incurred.

This delivery system is a very useful weapon in FFR's arsenal, which includes similar products for radiata pine, Douglas-fir, the cypresses, *E. fastigata*, redwood, and poplar. With this variety of tools, we can start to quantify the old but important question "which species should I plant?" Each species added to the list becomes easier to construct because we are building on work for other species. For example, Greg is now going to obtain kauri increment cores to add wood density to the outputs.

Summary

Due to its smaller budget, the Diversified Forests Theme has restricted research opportunities compared with the Radiata Management Theme, but it still manages to chalk up some impressive achievements. The steady trickle of research results for a carefully chosen range of worthy species is inexorably accumulating to form a large pool of knowledge.

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