DIVERSIFIED SPECIES THEME UPDATE

Number: 01

Theme Leader: Patrick Milne

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SUMMARY

The power of cross pollination of ideas can be seen in the wood quality, LVL and embryogenesis work with Douglas-fir. The NIR scanning and site-mapping work have far wider application than just cypresses. The Diversified Species Theme – far from being a ragbag of bits and pieces – seems to be a hotbed of inter-disciplinary innovation. Its future looks bright.

How successful would it be – the first meeting of the Diversified Species Theme? Douglas-fir, redwoods, cypresses, eucalypts and natives. Would people specialising in sawing eucalypts, for example, be happy to sit through a session on embryogenesis techniques for Douglas-fir?

Indeed they were. Furthermore, the (very professional) presentations held more than just casual interest for most participants – discoveries and insights in one species often had startling implications for the entire forestry sector, as will be described below. This is "hybrid vigour" with a vengeance!

This article was written by:
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Background

The new Future Forests Research programme has four "themes": radiata pine, diversified species, harvesting and environment/social. The Radiata Theme has been functioning since October 2007, and the Diversified Species is the next one off the block. In terms of hectares of existing forest, active membership and financial support, Douglas-fir dominates – although there is general recognition of the need to continually explore and promote less popular alternatives.

Russell Dale and Phil Taylor were there to support the new theme. Heidi Dungey gave a very competent overview of the key research outcomes that are expected by the funding agencies (FRST, MAF, SFF, FIDA, etc) and overseen by the industry-focussed Technical Steering Groups. But minimal time was spent on such matters – participants were after research results, and were not disappointed.

Douglas-fir

In keeping with its role as the leading alternative to radiata pine, the technical presentations started with Douglas-fir. Charlie Low described a tree selection programme that was based on wood quality rather than just the traditional characteristics of growth rate and stem form. It seems that stiffness (as measured by sonic velocity) has an almost identical heritability to stem diameter, so this goal seems realistic.

Charlie Low then discussed the opportunity for growing Douglas-fir cuttings. Unlike radiata pine, seed supply is unreliable and sometimes scarce. One problem with cuttings is plagiotropism – the cuttings continue to grow like branches, not like stems. Another is that some clones could easily be grown from cuttings, but others could not. All clones seemed to show ageing, which implies that stool-beds would have a limited use-by date. This work is ongoing.

Douglas-fir trial stool beds

Cuttings growing on for planting

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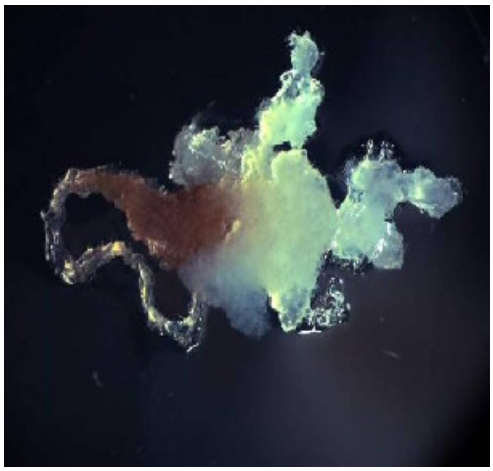
Cathy Hargreaves spoke with passion (not normally associated with a self-described "lab rat"!) about her work in embryogenesis. This is a way of multiplying up scarce seed and complements Charlie's work of propagation by cuttings. With embryogenesis, genetic material can be stored in liquid nitrogen – thus arresting ageing – while the plants are field-tested. Using technology pioneered with radiata pine, she has achieved a remarkable success rate with Douglas-fir. Perhaps one day this technology could be employed in other species?



New embryogenic callus of Douglas-fir

Doug Gaunt reported on the best way to measure and sample the MoE of standing trees. (The Modulus of Elasticity or stiffness is a vital consideration for structural wood, and of particular importance for Douglas-fir markets). Breast-height outerwood density combined with sonic measurements gave the best predictability. Although the relationship is not perfect, it can help identify trees that will comfortably meet specifications based on Machine Stress Grading. Fairly obviously, you get more precise results the closer you are to the final product (dry sawn timber).

Doug Gaunt then introduced those unfamiliar with modern timber processing to the concept of Laminated Veneer Lumber (LVL), whereby a highly predictable, dimensionally stable structural product can be made that would satisfy any architect or engineer. Doug examined the feasibility of using Douglas-fir thinnings and top-logs, for which there is currently a very limited market. He wanted to see how the stiffness of the original wood corresponded to the stiffness of LVL. It seems that you cannot make stiff LVL using weak wood from thinnings, although for some applications there may be a role for a weaker substrate combined with denser, stiffer wood on external laminations.

Douglas-fir sawlogs and sawn timber from MoE study

Redwoods

Paul Silcock described a redwood sawing study of pruned trees from Managtu Forest. The objective is to understand the log and tree features that relate to grade outturn, and to create a dataset for building future models (including, perhaps, ones similar to MARVL). It is difficult to estimate the economic viability of a species or a regime unless one can access such a model. So a range of trees were sampled – the good, the bad and the ugly – to see how the lumber literally stacked up. The Pruned Log Index (PLI) of this sample was very low, which could easily be explained: the tight initial stockings in the sampled stand suppressed diameters, and the intensive thinning resulted in a large burst of epicormics shoots – which could not be distinguished from ordinary branches at the time of grading. Good silviculture may mean avoidance of such a regime, which also resulted in loose knots and entry points for rot.

The eight grades used could have been improved with a factor that allowed for heartwood content – which comprised more than half of the sawn wood. The wood had a low and uniform density and shrinkage, but there was high variability between trees. This opens the possibility of tree breeding for improvement of wood quality.

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Milling Mangatu redwood logs

Paul went on to report progress on two redwood trials where silviculture is almost complete. His perceptive observations deserve a mention: he noted that follow-up treatments may be required with redwoods because, unlike nearly all other conifers, they mostly do not die if thinned – they coppice. Spring pruning generates a flush in epicormic growth (depending greatly on which clones are used) but if the epicormics are pruned sufficiently early, the pruning stubs may actually be extruded – as in some eucalypts. From these trials, it should be possible to retrospectively calculate the time for all knots to occlude.

The other trial series that Paul described were the "Redwood Benchmarking Trials". A wide range of genetic material would be planted on a number of sites for comparative purposes (although not for breeding).

Pruning redwoods

In the discussion, there was a clear divergence of views as to the choice of silviculture. Some favoured lower stockings to increase the proportion of clearwood and reduce the dead knots; while others argued that individual tree growth (in redwoods, as in cypresses) was not compromised by higher stockings, whereas a cool, mulch-rich forest floor was important. Higher stockings reduced wind and improved taper. Obviously, this debate needs to be settled in a subsequent trial series.

Cypresses

All the clones of Leyland cypresses in current use were the result of accidental hybrids between different genera, and have been vegetatively propagated for 100 years. Leylands are the fastest-growing tree in the United Kingdom and have good quality wood. But how do the various clones compare?

The 20-year old trees provided data on the extent of heartwood formation. Distinct latewood bands could be seen (unlike with pure cypresses), which simplified ageing the samples. Clones differed markedly in colour and smoothness. Leighton Green was the most vigorous clone while Green Spire had the most heartwood. The physical properties of each clone could be examined using Silviscan data yielding such things as density, Microfibril Angle and therefore stiffness.

Using cores for durability studies

For durability, clones on two different sites were examined using a combination Near Infra-Red (NIR) Spectroscopy and "accelerated fungal cellar testing". Fortunately, Scion's Trevor Jones is an expert on this technology. The NIR scan could identify the proportions of each chemical present, some of which are known to impart durability to the heartwood. The screening could be done very quickly, and the chemical composition calibrated against the more conventional decay test (and further confirmed by the even more traditional graveyard or shingle tests, with the full spectrum of fungi present). We are awaiting the final results.

The main opportunity here lies not in the small collection of existing Leyland clones, but in the hundreds that are about to be produced – including the canker-resistant *ovensii* clones. Screening at an early age could hugely short-circuit a selection programme.

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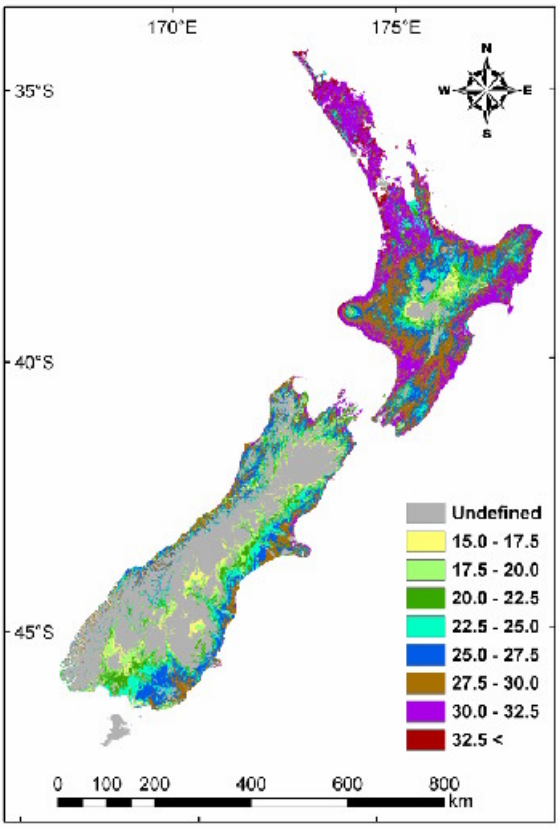
We could also unravel the importance of site factors in determining physical and chemical attributes.



Cupressus lusitanica productivity

Michael Watt gave a mind-boggling presentation, mapping the best place to grow *lusitanica*. This methodology has only recently been developed for radiata pine, with results that are not greatly superior, while the Douglas-fir equivalent is not due until March. The method involves interrogating the PSP database to build a multiple regression that predicts site index based on location, climate, soils and vegetation cover. The most important factor for *lusitanica* was shown to be mean minimum air temperature, followed by establishment date since 1900 and with minor contributions from potential root depth, levels of ground frost in summer and vegetation cover. The "establishment date since 1900" is a mystery, which some of the audience attributed to improved weed control, nursery practice or to climate change (there's been 10m gain in site index for stands established in 1999 compared with those established in 1931). But altogether, these factors explained an amazing 82% of the variation in site index. Obviously, the next step would be to develop a "400 Index" similar to that of redwoods or equivalents in radiata pine and Douglas-fir, so that volume growth and not merely height could be predicted.

Eucalypts

Of all the zillions of eucalypts that have been in fashion over the years, the front-runner for the widest range of sites now seems to be *E. fastigata*. Charlie Low described the seed collection plan for this species, including second generation progeny trials. He also discussed the breeding plan for *E. nitens*, including the key aspect of genetic fingerprinting. This allows breeders to use far cheaper and more convenient open pollination and then to work backwards from the performance of the progeny to deduce the best parents – male and female. Progeny would be assessed not just on the basis of growth but also on wood properties and tree health.

There is also a need for an extension of the PSP database. For example, *E. fastigata* has only two PSPs in the South Island. If ever "productivity maps" are going to be constructed (as previously described for *C. Lusitanica*), there will need to be data even from locations where we know the species is suboptimal.

It would be great to have a reliable and robust growth model for *E. fastigata*. And guess what? Subject to resolution of some IP issues, MAF will pay for it for carbon reasons! Results must be delivered in this calendar year. After the formal presentations there was a lot of debate regarding carbon forestry.

Eucalyptus fastigata

Which species is optimal?

Should a grower focus on carbon as an alternative or in addition to timber?

Needless to say, these questions were not resolved.

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Drying the sawing study timber

Trevor Jones described a sawing study of 25-year old *fastigata*, *globoidea*, *muelleriana* and *pilularis*. The reasons for the study were the same as for redwood (described earlier), but in addition the outturn of these four species could be contrasted. Comparisons were made of DBH, wood density, stiffness, volume, heartwood, end splitting, flitch movement, total board recovery, shrinkage after drying, crook and bow, and surface hardness. It is hard to draw many robust conclusions based on this one study, but suffice to say that all four have the potential to produce high-quality timber on a 25-year rotation, and that the main constraints are the presence of growth stress and also knots in unpruned stands.

PSP Review

Establishing plots and collecting data is a very time-consuming and expensive business, especially now that it has proven desirable to include wood quality and site attributes, but is essential to a silvicultural research programme. The huge cost means that there is a continuing need to rationalise the extent and frequency of plot measurements, and the review that is currently underway was well described by Paul Silcock.

Seed Collections

The forest sector has an obligation to maintain existing genetic material, particularly where we can no longer import seed (for example, with Douglas-fir). We need "fallback" species that we could use if radiata pine were to fail, for whatever reason. Some of these species have special qualities that could be useful even if radiata continues to dominate our resource. One such (recently popular) special quality might be the ability to accumulate and maintain very high quantities of carbon.

Charlie Low described seed collections of *muricata* pine, Mexican pines and *Eucalyptus regnans*. By adapting to New Zealand conditions, the seed may be quite different to material originally collected from its natural habitat.

Indigenous

Always the Cinderella branch of commercial forestry, indigenous forests hold a strong place in New Zealand hearts. But it is not only the natural ecosystems that we favour; it is also the native timber! How are we going to supply demand for such timber if our existing native forests are held to be sacrosanct and withheld from any form of exploitation? The answer, as David Bergin and Greg Steward have painstakingly pointed out for decades, is with plantations – of kauri, totara and beeches. They would like – if resources allow – to add rimu, matai, miro, tanekaha, kahikatea, puriri, kanuka, rewarewa, kohekohe, and pohutakawa (or rata). As Peter Berg explained in the discussion, there are some 16,000 ha of kauri and totara regeneration on private land in Northland. This is currently considered almost a weed, troublesome to the land managers, but with a bit of silviculture it could be transformed into an attractive and valuable asset.

Planted kauri stand

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