# SPECIALTY WOOD PRODUCTS PROGRAMME UPDATE

Programme Manager: Marco Lausberg

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## Summary

Now that we are 3 years into the programme we are starting to see some results across a range of projects. Highlights included:

- Opportunity to improve Douglas-fir and *E. fastigata* properties through breeding has been identified.
- Testing of Douglas-fir CLT showed comparable properties with Radiata pine – these results will help enable Douglas-fir CLT to be specified for use in building.
- *E. nitens* drying trials showed air-drying to lower degrade than kiln drying, however the prediction of drying degrade from log measures was unsuccessful.
- Screening eucalypts for natural durability, at a relative young age, should be possible, based on variation in *E globoidea* extractive content and the relationship between the extractive content and levels of decay observed.
- A new tool to non-destructively measure the size of sapwood and heartwood in standing trees is showing good preliminary results.
- A series of demonstration plots will be established to help boost confidence to plant our species.

## RESEARCH PROGRESS: Q4 Year 3

### Douglas-fir

Douglas-fir open-pollinated progeny trials established on two New Zealand sites (Gowan Hill and Tramway), using seedlots from three Oregon (US) seed zones were assessed. Genetic improvement through breeding and selection can potentially be achieved as significant estimates of heritability were found. It was noted in the analysis that there was a negative impact of fast growth on stem defects such as forks and ramicorns. Therefore, the selection of fast growing individuals will result in an increased incidence of stem defects and the trade-off between productivity and stem form should be considered.

Scion's aligned Strategic Science Investment Fund (SSIF) funding milestone for Douglas-fir genomics is progressing with the first milestone describing the genotyping of the first training population set of 1,152 samples. The second set of the training data for 960 samples will be genotyped in 2018/19. The theoretical main advantage of genomic selection is enhanced gain by more accurate selections. Another advantage is that, when adequately robust genomic based models are available, selection can be based solely on markers. This enables selection without phenotypes, and the progeny testing phase can be skipped, leading to a shorter generation interval and increased genetic gains per unit of time.

There is a need to establish a comprehensive database of the mechanical properties and connection behaviour of Douglas-fir CLT in order for designers to specify Douglas-fir CLT in building design. Douglas-fir CLT panels were constructed at Xlam and tested at the University of Canterbury. The test results revealed that the Douglas-fir CLT specimens had comparable properties with radiata pine CLT. The dowelled connections also demonstrated reliable connection behaviour with high strength and stiffness and superior ductility.

### Non-durable eucalypts

Progeny trials for *Eucalyptus fastigata,* in the third cycle, were assessed for growth, form and adaptability. Results from this study indicate that there is great potential for genetic improvement in productivity and tree form. Wood stiffness was measured for the first time in this breeding population, with an average modulus of elasticity of ~12 GPA (MOE in gigapascal) and a moderate estimate of heritability.

*E. nitens* logs were selected to have low degrade during drying (good logs) and high levels of degrade during drying (bad logs) using four different prediction models. Air-drying led to less degrade than kiln drying and the thinner boards has less degrade than thicker boards (although this was not significant). As with previous studies, some logs consistently produced boards with low levels of degrade, and some logs consistently produced boards with high levels of degrade, irrespective of drying method. No significant difference in levels of degrade were seen between boards cut from the 'good' and 'bad' logs. This suggests that the underlying mechanisms



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causing checking and collapse propensity are not well correlated to the tree properties that were measured in this study.

Veneer from short rotation *E. fastigata* logs were tested to establish a correlation between the sonic (UPT) test values and stiffness (MoE) for the LVL veneer stiffness model. It was found that, without density values, the relationship between UPT and MoE was weak. As this relationship is affected by density, there will be different relationships between UPT and stiffness for different species.

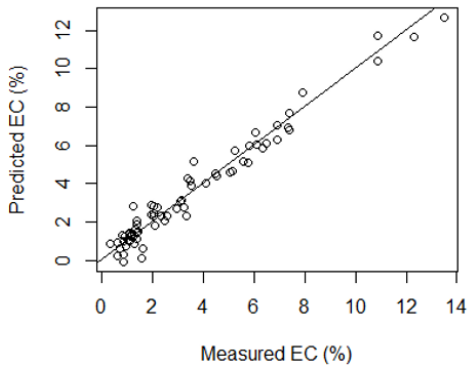
The veneer stiffness model that has been developed is intended to be used as a decision tool that enables questions to be asked about the potential suitability of a wood resource being able to supply a range of LVL grades. The output of the model indicates possible LVL layup grades and options.

Using lab-scale super critical $CO_2$ to dewater E. nitens timber, before traditional drying, was shown to reduce the levels of collapse. $CO_2$ is forced into the green wood at high pressure, and when the pressure is subsequently released some of the wood sap is released along with the $CO_2$. Collapse occurs during the initial stages of drying at high moisture contents, so removing some of this moisture prior to air drying would be expected to reduce levels of collapse. The economics of this process will be examined in the coming year.

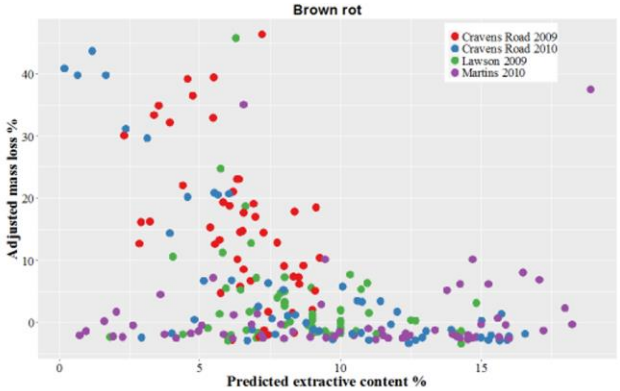
Thermal modification of *E. nitens* timber showed that the durability and stability were increased (but durability is unlikely to reach H3.1 level) and the colour darkened (but faded on exposure to sunlight). Stiffness was unchanged and the strength was significantly reduced, but still likely to be acceptable. Small demonstration samples have been shown to a number of potential end users as a product suitable for interior use, and feedback has been positive. A more formal market assessment of thermally modified *E. nitens* for interior use will be undertaken in the coming year.

## Naturally durable eucalypts

It was found that there is a large range in extractive content in 5 year-old *E. globoidea* samples, ranging from <1% to >10%. The figure below shows the strong correlation of measured and predicted (using NIR) extractive content for *E. globoidea heartwood*. This, along with variation in heartwood diameter, suggests that screening trees for natural durability at a relative early stage of growth should be possible.




Tests were undertaken at two sites to understand the correlation between NIR predicted extractive content and fungal decay levels. The figure below shows the relationship between predicted extractive content and mass loss. Generally the samples with the high extractives had low mass loss.




Heartwood of 7 year-old NZ grown *E. bosistoana,* on average, met the performance of a class 2 (above-ground) rated species. This can be interpreted as supporting data to include *E. bosistoana* for applications like decking. Additionally some trees had no significant mass-loss (<3%), indicating that by genetic selection class 1 durable timber from short rotations should be possible.

Chemical components of the extractives of durable eucalypts were analysed for their impact on fungal growth. Preliminary results suggest that the type of compounds present may also be a deciding factor in decay rates, along with the overall level of extractives present in the wood.

A method (gas chromatography) has been developed to analyse the foliar chemistry of durable eucalypts. If the method proves useful, the aim will be to link chemical profiles with observed pest defoliation and



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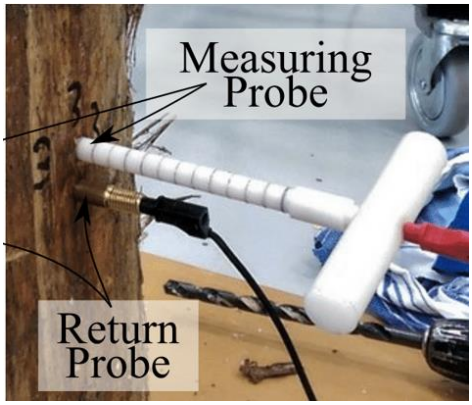
oviposition in field trials. This would provide the basis of a screening tool to determine pest-tolerance.

Two stands, of young *E. bosistoana* and *E. quadrangulata*, were measured in preparation for a LVL peeling study. Both stands will yield approximately 90 logs of peeler grade suitable for the proposed LVL study.

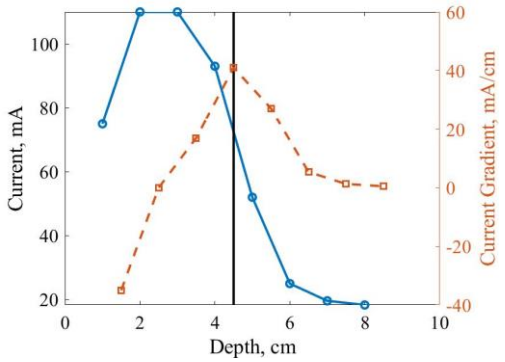
A biosecurity risk management plan was developed specifically to address concerns about the spreading of myrtle rust and EVB. Procedures are recommended for dealing with both foliage and wood samples. Recommendations for site visits and detection protocols are outlined.

A regional strategy process is being developed for the NZDFI with a range of feedback received from the interested parties. The positives included: diverse land uses in drier regions, reduced risk of only having one species (pine), control soil erosion and store carbon. The potential negatives included: shortage of planting stock, uncertainty around timber properties & performance, risk of pest & disease and potential fire implications.

In order to speed up the assessment of heartwood in standing trees a new tool is being developed using electrical resistance. Image below shows the two probes used. The measuring probe is inserted into the tree in 1cm increments to give a profile of electrical resistance and hence determine the size of the heartwood.




The figure below shows the electrical resistance in blue and the current gradient in orange. The point at which the gradient changes direction (at just over 4cm) corresponds to the heartwood/sapwood boundary in the tree.




## Cypresses

A survey of cypress growers in NZ was undertaken. The results show cypress is being grown across a number of sites, with little commonality in altitude or climate, although many stands have a North or South facing aspect.

The most critical siting factors appear to be:

- Moderate to well-sheltered (except in Hawke's Bay where wind was thought to reduce canker from forming)
- Deeper, fertile and moist soils
- Moderate to high rainfall
- South facing (in all regions except Otago-Southland where respondents recommend siting north facing).

A range of sites were identified for potential trial planting.

*Cupressus macrocarpa* genotypes located at the Proseed seed orchard were assessed for canker and a list of available seed for testing was provided. A set of cuttings was taken from the seed orchard and was set in the Scion nursery. This material will be planted out on a wide range of sites (including those identified in the survey) to evaluate the level of tolerance to canker.

The thermal modification of *C. lusitanica* showed improved durability of the sapwood and maintained durability of heartwood. The improved durability of modified lusitanica sapwood would allow sapwood-containing boards to be used in outdoor applications where boards must currently only contain heartwood. This would increase grade recoveries, as boards containing sapwood or intermediate wood could be used for higher value products.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## Pest management

A pre-application consultation process has begun for a new potential biological control introduction to control *Eucalyptus* tortoise beetle, *Paropsis charybdis*. The agent that can target the feeding larval life stage of paropsis is the Australian native parasitoid *Eadya daenerys* (photo below). Scion has been conducting laboratory host-range safety tests with female parasitoids each summer for the last four years to determine risk of release.

It was found that the ability of *Eadya daenerys* to internally parasitise non-target species (the broom and tutsan leaf beetle larvae) is likely to equate to minimal or nil impact in the field. Therefore it is considered that there is minimal risk to native beetles in New Zealand from the introduction of *Eadya*.

## Site species matching

Following recommendations from a workshop, a set of demonstration trial plantings will be established to show locally how the individual tree species can perform. Scion's first series, to be planted out 2018/19, will include *Eucalyptus fastigata*, *Cupressus macrocarpa*, and cypress hybrids. The NZDFI are establishing *E. bosistoana, E. cladocalyx, E. globoidea, E. macrorhyncha, E. quadrangulata & E. tricarpa* in the nursery for a series of demonstration plots.

## Other

Our annual nursery survey has been completed. Since 2015 (data prior to the start of the SWP programme) we have seen an increase in seedlings of all species being produced. The table below shows the number of seedlings produced and the area planted (assuming a 900 stems per hectare stocking rate) since 2015.

| Species | Seedlings produced since 2015 | Area planted since 2015 |
|---|---|---|
| *P. menziesii* | 3,951,164 | 4,390 |
| *E. nitens* | 552,339 | 614 |
| *E. fastigata* | 436,135 | 485 |
| Naturally durable eucalypts | 807,674 | 897 |
| Cypresses | 231,490 | 257 |

It is assumed (but we have no data to confirm) that these seedlings will be replanting for the Douglas-fir and ash eucalypts (*E. nitens* and *E. fastigata*) and new planting for the naturally durable eucalypts and cypresses.

An SWP programme description document was produced to outline the vision through to the R&D plan and funding allocations within the programme. This document can be used publically to lift awareness of the work and encourage new investors to join. Please contact me if you would like a hard copy of this document.

The SWP website has a new section which lists the key resources for forest growers for each of our species as well as redwoods– see links here:
https://fgr.nz/douglas-fir-information-growers/
https://fgr.nz/durable-eucalypts/
https://fgr.nz/non-durable-eucalypts-information-growers/
https://fgr.nz/cypresses-information-growers/
https://fgr.nz/redwoods-information-for-growers/

It is intended to have the key documents in one place so they are easier and faster to access. Documents include manuals, bulletins and other publications.


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## Reports completed

| Report No. | Document Title |
|---|---|
| SWP-040 | Prediction of Extractive Content of E. globoidea Heartwood Using NIR Spectroscopy |
| SWP-041 | NZDFI Regional Strategic Plan consultation document |
| SWP-042 | LVL Trial: Pre-Harvest Stand Assessment |
| SWP-043 | SWP Programme description document |
| SWP-T044 | Durable eucalypt forests – a multi-regional opportunity for investment in NZ drylands |
| SWP-T045 | Natural durability: Correlation between extractive content and fungal assay |
| SWP-T046 | Heartwood in *Eucalyptus bosistoana* (2010 plantings) |
| SWP-T047 | Thermal Modification of Douglas-fir for Improved Durability |
| SWP-T048 | Fastigata Veneer Stiffness |
| SWP-T049 | Evaluation of the Ernslaw One Douglas-fir progeny tests |
| SWP-T050 | Genetic analysis of *Eucalyptus fastigata* progeny trials and implications to selection |
| SWP-T051 | NZDFI Biosecurity Risk Management Plan |
| SWP-T052 | Developing GC methods for analysing the foliar chemistry of durable eucalypts: a potential pest-tolerance screening tool |
| SWP-T053 | Experimental studies on rolling shear strength properties of Douglas-fir CLT and monotonic behaviour of dowelled connections |
| SWP-T054 | Sapwood depth tool – proof of principle |
| SWP-T055 | Improved Drying of Eucalyptus nitens: Screening standing trees and drying thin boards |
| SWP-T056 | Eucalyptus variegated beetle creates concern for eucalypt growers |
| SWP-T057 | Pre application consultation has begun for a new potential biological control introduction to control Eucalyptus tortoise beetle, Paropsis charybdis |
| SWP-T058 | Douglas-fir breeding and genomics |
| SWP-T059 | LVL stiffness calculator user guide |
| SWP-T060 | Bioactivity of Heartwood Compounds |
| SWP-T061 | Research on insects and fungi on species other than radiata |
| SWP-T062 | Supercritical $CO_2$ dewatering of E. nitens. |
| SWP-T063 | Thermal modification of specialty species. |


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