SPECIALTY WOOD PRODUCTS PROGRAMME UPDATE

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Summary

- Douglas-fir CLT connection system performed very well and could be efficiently repaired after a simulated earthquake.
- *Eucalyptus fastigata* seed orchard has been established.
- Thermal modification did not produce excessive degrade in cypress timber but there was some star checking following treatment (but the proportion of timber downgraded due to knot checking was quite small). The thermally modified Douglas-fir and *C. lusitanica* are showing improved durability in both the heartwood and the sapwood after 4 years of stakelet testing.
- The latest biological control agent *Eadya daenerys* (a Braconid wasp) first released in December 2022 to control the eucalyptus tortoise beetle (Paropsis charybdis).
- The annual nursery survey is complete. Approximately 22M seedlings of exotic species other than radiata pine are estimated to have been produced since the start of the SWP programme in 2015.
- Large variability was seen in the growth of durable eucalypts across NZ sites. Forest growers can use this information to optimally match species to sites and maximise the productivity and value of the tree crop.

RESEARCH PROGRESS: Q4 Year 8

Douglas-fir

As an engineered timber product, cross-laminated timber (CLT) is currently gaining popularity in New Zealand and globally. A two-year project aimed to develop high-capacity Douglas-fir CLT shear wall structures that are suitable for multi-storey mass timber buildings constructed in high seismic countries like New Zealand.

The results showed all the wall specimens exhibited significantly higher strength and stiffness than conventional CLT shear walls in literature. In particular, the coupled wall with steel link beams and mixed angle screwed hold-downs achieved high capacity and high ductility. The coupled wall was also repaired and re-tested. The repaired wall showed comparable performance to the original wall, indicating the feasibility of the repair strategy developed by this study. The images below shows a sequence from damaged screws removed through to hole repair and new screws installed.

(a) DAMAGED SCREWS REMOVED | (b) LOOSE FIBRE REMOVED | (c) EPOXY INJECTED

(d) SURFACE SANDED | (e) INSTALL NEW SCREWS IN ADJACENT TIMBER

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SPECIALITY WOOD PRODUCTS PROGRAMME UPDATE

Non-durable eucalypts

Progeny trials of *Eucalyptus fastigata* in their third breeding cycle, planted in 2009 and 2012 in Kaingaroa (compartment 333 and 605), Waihaha and Waihapua were assessed at age of 8 for growth and form characteristics. As these trials have now reached an age when selections for the next generation can be made, they were measured for genetic evaluation and selection purposes prior to thinning.

The favourable correlation structure makes it possible to simultaneously select productive individuals that have high wood stiffness (approximated by acoustic velocity) and a favoured branching pattern.

It is recommended to implement multi-generational evaluation to increase the genetic connectivity of the trials with the rest of the breeding programme to improve the quantification of GxE.

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In the one of the trials above, several potential thinning plans were evaluated, and genetic gains calculated. Based on one thinning plan, the best trees in each family were marked to stay, allowing them to be available for any future selection for 4th generation progeny trials, and the rest of the trial was available to thin at the Forest owner's discretion. The forest managers targeted removing around 50% of the trees, whilst trying to get an even stocking over the site. Post thinning all remaining trees where recorded and actual gains versus theoretical were calculated for the new seed stands. Simulations of seed harvests from the trees selected to remain revealed that selective seed harvesting had a bigger impact on the total genetic gain than thinning. The most intensive selection of Eucalyptus fastigata mother trees for seed harvest led to increases in genetic gain of 11.5% in diameter at breast height (DBH) and 4.7% in acoustic velocity.

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E. fastigata has potential to be processed into veneers that can improve stiffness of LVL products, and to be manufactured in flooring products. One of the limiting factors in overall wood recovery is the tendency of *E. fastigata* logs to end-split after felling. A pilot study of end splitting of *E. Fastigata* was undertaken on the above trial prior to thinning.

Log end splits were not severe overall (under 3mm wide) and appeared as small/fine cracks. Six percent of logs showed no defects over the life of the trial. At the end of the trial, 74% of the trees hadn't developed any visible cracking up the stem.

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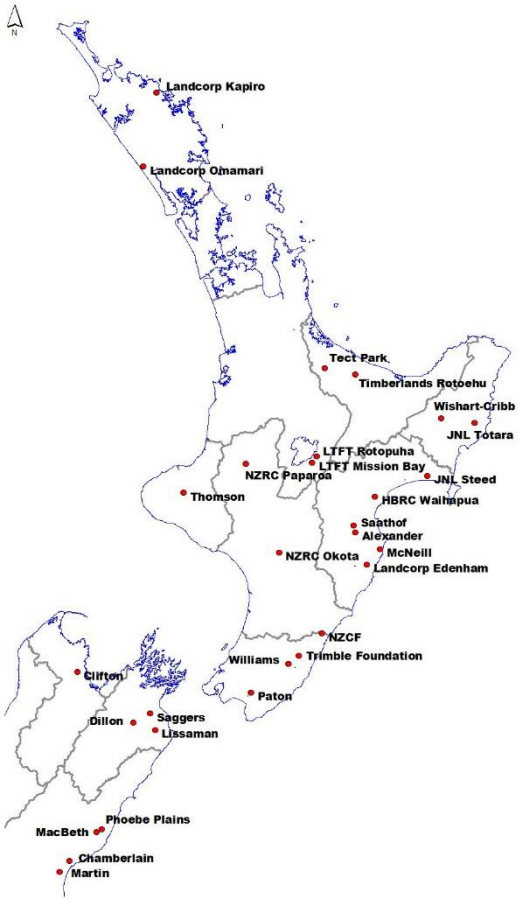
SPECIALITY WOOD PRODUCTS PROGRAMME UPDATE

Recutting of the logs appeared to slightly increase the mean index of the cut logs, however there was no statistical difference observed. The new logs (3-6m) all had some face checking and similar amounts of logs with no cracking or splitting.

Naturally durable eucalypts

Breeding families of *E. bosistoana* were genotyped and, despite the initial suspicion on the morphologically deviating plants that might be hybrids between *E. argophloia* and *E. bosistoana*, genetic structure study showed that plants of *E. argophloia* within the NZDFI breeding trials were apparently different from *E. bosistoana* identified individuals. Some populations of *E. bosistoana* labelled individuals within the breeding programme were instead identified as *E. melliodora*.

A report summarising early growth results from a total of 14 demonstration trials implemented by the NZDFI established across North Island regions and those in Marlborough, Nelson and North Canterbury has been produced. Map below shows the NZDFI demonstration trial sites planted 2010 - 2018.



Results presented for each species clearly demonstrate there is significant opportunity to select adaptable species that can be very productive in some New Zealand regions. There are also species that have been less productive or have failed at some sites, significant variability in performance seen for all species across sites. Forest growers can use this information to optimally match species to sites and maximise the productivity and value of the tree crop.

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SPECIALITY WOOD PRODUCTS PROGRAMME UPDATE

Cypresses

Thermal modification then grading of Ovensii lumber was undertaken. See image below of board post thermal modification.

Overall the thermal modification process did not produce excessive degrade in *C. lusitanica* and *C. x ovensii*. It was known that tight knots are prone to star checking following thermal modification, but the proportion of timber downgraded due to knot checking was quite small. The effect of knot checks could be further reduced by filling the knots following modification.

Pest management

Revenge against Paropsis - *Eadya daenerys* is in the field.
The eucalyptus tortoise beetle (*Paropsis charybdis*) remains one of the most serious insect pests in New Zealand causing defoliation of several eucalyptus species in particular, the fast growing, short fibre species *Eucalyptus nitens*. The cumulative effect of growing tips being removed by the adult beetles as well as the young larvae feeding on the flush, has a significant impact upon tree form, height, and stem volume potential of the tree.

Scion scientists have unleashed a torrent of revenge upon this pest, with the latest biological control agent *Eadya daenerys* (a Braconid wasp) first released in December 2022. This achievement has taken nearly ten years, spanned three separate MPI and industry-funded Sustainable Food and Fibre Futures grants, and overcome numerous scientific hurdles, such as the parasitoid being infected with a microsporidian from its home in Tasmania. The biocontrol agent is much more challenging to rear than the pest it attacks. A small number of adult female wasps, and over 10,000 eucalyptus tortoise beetle larvae with the parasitoids living inside their bodies, were released in December 2022 and January this year. The release locations, one in Central North Island and two in Southland, were chosen by our commercial co-funding partners Southwood Exports Ltd and Oji Fibre Solutions Ltd. There were strict criteria for selecting the suitable planted forests, including not having been sprayed for the previous two years, having sufficient populations of the pest in the planted forest, but not so many that they had already removed all the flush foliage. See link for more information - https://www.scionresearch.com/?a=87398

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Durability

Stakes of *Cupressus x ovensii* grown in Rotoehu and Riverhead, and *Cupressus x leylandii* (Leyland cypress) were installed in the Whakarewarewa outdoor test area in April 2021. After two years in-ground exposure, the first Rotoehu *Cupressus x ovensii* stake failed. This is an ongoing trial.

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Flat panel samples of untreated *Cupressus macrocarpa, Cupressus lusitanica, Cupressus x ovensi* and Douglas-fir were installed and after one year there was no decay in any of the panels. This is an ongoing trial.

Decking trial - After one year exposure, there was no decay on any of the untreated *Cupressus macrocarpa, Cupressus lusitanica, Cupressus x ovensi* and Douglas-fir decking samples. No decay was observed on any of the thermally modified *Cupressus lusitanica* and Douglas-fir decking samples. No decay was observed on any of the commercial benchmark decking samples (Accoya and Kebony). This is an ongoing trial.

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L-joint trial - After one year's exposure, there was no decay on any of the untreated *Cupressus lusitanica* L-joint samples. No decay was observed on any of the thermally modified *Cupressus lusitanica*, L-joint samples. No decay was observed on any of the commercial benchmark decking samples (Accoya).

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The thermally modified Douglas-fir and *C. lusitanica* are showing improved durability in both the heartwood and the sapwood after 4 years of stakelet testing. Longer term durability testing is underway to evaluate the suitability of these types of thermally modified wood.

Other

The annual nursery survey has been undertaken and the table below shows the number of seedling produced for each species/group since the programme began in 2015.

Species	**Seedlings produced since 2015**
P. menziesii	10,124,158
E. nitens	4,201,860
E. fastigata	1,510,289
E. regnans	97,362
Naturally durable eucalypts*	2,949,867
Redwoods	2,542,165
Cypresses**	851,475
Total	22,277,176

* Naturally durable eucalypts consist of E. bosistoana, E. globoidea, E. quadrangulata and some other minor species.

** Cypresses consist of C. macrocarpa, C. lusitanica, C. nootkatensis and Ovens/Leyland hybrids.

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Reports and other outputs completed

Report No.	Document Title
SWP-T163	Fastigata Breeding Trials Report
SWP-T164	Variation in adaptability and productivity between durable eucalypt species in different NZ environments.
SWP-T167	Decay rate of Cypress stakes after two year's exposure at the Whakarewarewa test site
SWP-T168	Genetic structure and diversity in the NZDFI Eucalyptus bosistoana and E. argophloia breeding populations
SWP-T169	Experimental Studies on Single and Coupled Douglas-fir CLT Shear Walls with High-Capacity Connections
SWP-T171	The condition of thermally modified cypress and Douglas fir flat panels after one year's field exposure
SWP-T172	The condition of thermally modified cypress and Douglas fir decking after one year's field exposure
SWP-T173	The condition of thermally modified cypress and Douglas L-joints after one year's field exposure
SWP-FN145	Converting E. Fastigata breeding trials to Seed Stands
SWP-FN146	Eucalyptus fastigata Growth Strain
SWP-FN147	2023 Nursery survey
SWP-FN148	Grade recoveries of thermally modified cypress timber
SWP-FN149	Interim fungus cellar results - Dfir and Cypress TM

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