SPECIALTY WOOD PRODUCTS PROGRAMME UPDATE

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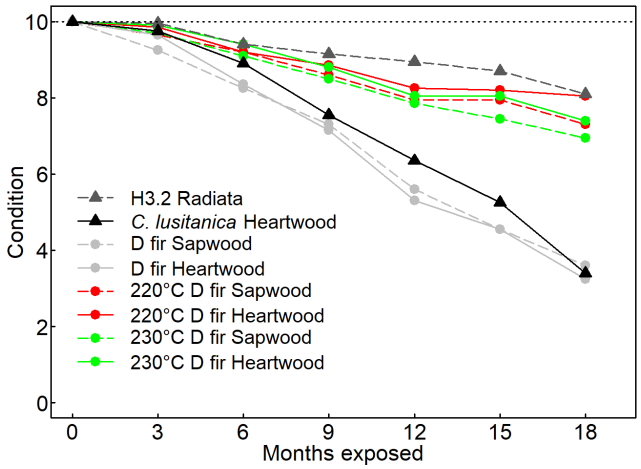
Summary

Thermal modification of both *Cupressus lusitanica* and Douglas-fir show significant improvement in durability and stability (this impact was seen in sapwood and heartwood of both species).
Preliminary results for *E. fastigata* veneer are indicating high stiffness.
Superior genotypes of durable eucalypts species with lower growth-strain have been identified. *Eucalyptus bosistoana* clones from top-performing families are now established as stool material for commercial clonal propagation.

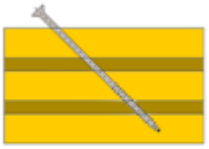
RESEARCH PROGRESS: Q2 Year 5

Douglas-fir

The thermal modification of Douglas-fir has shown very good increases in durability (see figure below) with both the sapwood and heartwood performing almost as well as H3.2 treated radiata pine after 18 months.



Fastener withdrawal and small scale connections are being tested on Douglas-fir CLT. Image below shows testing rig and one of the test cases being examined.



(a) Partially threaded

Non-durable eucalypts

Interim (33 month) fungus cellar results for *E. nitens* modified at Scion using an atmospheric steam process are not looking promising (see figure below). The durability of the modified wood is greater than that of the unmodified controls, but not as great as H3.2 CCA-treated radiata pine. A more severe level of modification is not possible for this modification process, as the existing modification process is already producing excessive levels of degrade in the wood.

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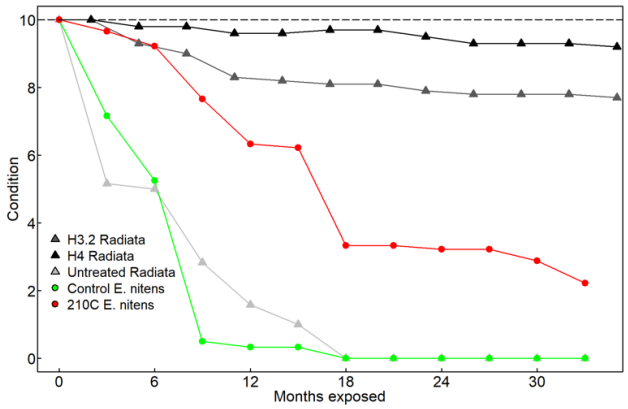
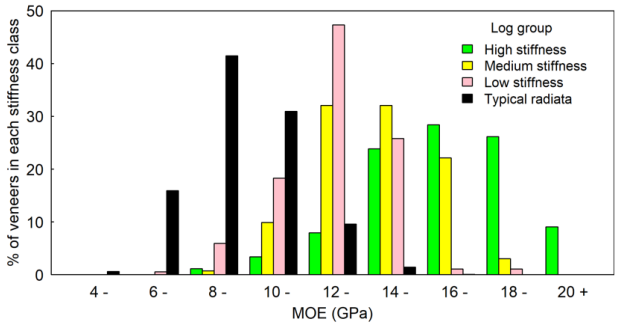


Figure: Fungus cellar stakelet results following 33 months of exposure. A condition of 10 indicates no sign of decay, and 0 indicates complete failure from decay.

An alternative pressure steam modification has achieved a similar degree of modification to the atmospheric steam process, while producing no degrade in the wood. This means there is an opportunity to trial a more severe pressure steam modification to increase the degree of durability.

A peeling and sawing study of 24 year-old *E. fastigata* logs was undertaken at JNL Masterton. The logs were split into 3 stiffness classes. There was some log end splitting which dropped some logs from peelers to sawlogs. The veneer produced showed very promising Metriguard stiffness values compared to radiata (see figure below) with even the low stiffness *E. fastigata* logs producing a higher average stiffness than radiata.



The levels of splitting in the veneer were high (observations by mill staff). This will need to be tackled to make peeling E. fastigata commercially viable. The sawn timber is currently being dried.

Naturally durable eucalypts

Growth strain assessments (see image below) in a set of NZDFI species enabled the selection of the most promising families in terms of low growth strain and other properties.

Cuttings were then harvested from the coppicing stumps of the top-performing families. Superior genotypes with lower growth-strain have been identified and will soon be made commercially available through clonal propagation from coppice.

A population-genomic and taxonomic study of *E. argophloia* and *E. bosistoana* has been initiated. It aims to address the following: 1) what is the taxonomic identity of a morphologically deviating population of E. bosistoana, 2) what is the patterns of genetic diversity and structure of *E. argophloia* and *E. bosistoana*, and 3) what is the mating system of *E. bosistoana*. This information will then be used in the breeding programme to a) calculate accurate breeding values and determine if further collections are required and b) identify the levels of outcrossing and inbreeding depression.

144 families of *E. globoidea* were assessed at age 8 years old for heartwood quantity, extractive content (i.e. natural durability), drying defects (i.e. collapse) and stiffness (i.e. acoustic velocity). All traits were heritable and having a degree of variation enabling potential improvements to be made through a breeding programme. An unfavourable genetic correlation was found between heartwood quantity and extractive content, indicating the need for compromise between growth and natural durability. Collapse was seen in some of the cores (see image below) which will need to be monitored to ensure that collapse in the timber is kept to acceptable levels.

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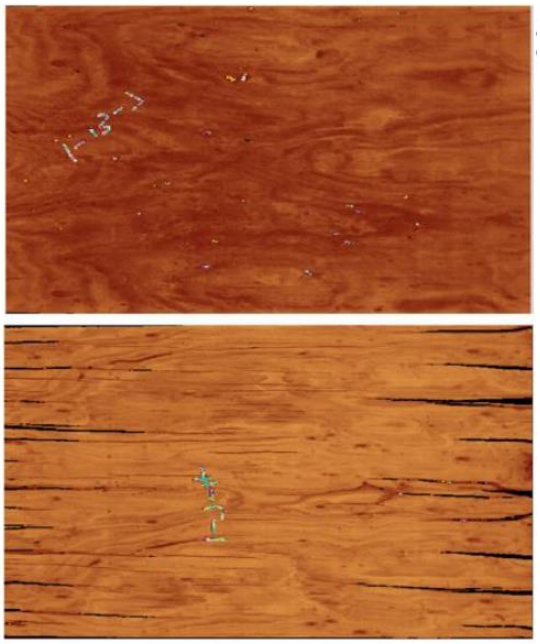
Peeling trials using 30-year-old E. globoidea were undertaken in collaboration with Nelson Pine Industries Ltd. The trials demonstrated that veneers of suitable quality could be obtained from the trees, and also demonstrated the importance of low growth strain to maximise veneer yields. Image below shows a high quality veneer sheet (top) and a sheet with severe splitting (bottom).



Glue bond trials were undertaken on young *E. bosistoana* and *E. quadrangulata* peeled at NPI. Results indicate that the standard phenolic resins used to bond radiata pine are likely to need to be modified to bond the *E. bosistoana* and *E. quadrangulata* veneer. Image below shows the veneer sheets that were supplied for the testing.

The New Zealand Dryland Forests Initiative (NZDFI) envisages to establish a naturally durable eucalyptus resource with agricultural posts as a key product. A review has been completed that looks at markets, processing technology, production capacity/plantation estate and economics of post production. Posts are a high value product for a small log resource.

Cypresses

Interim (12 month) fungus cellar results for *C. lusitanica* are very promising with modified heartwood and sapwood both showing increased durability over unmodified heartwood, and showing similar durability to H3.2 CCA treated radiata pine (see figure below).

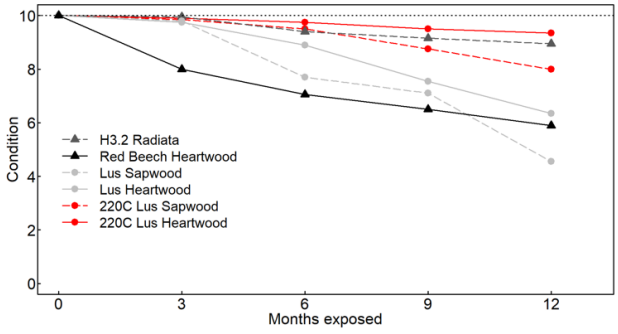


Figure: Fungus cellar stakelet results for modified *C. lusitanica* following 12 months exposure.

Further testing, including outdoor durability testing are planned.
Mechanical testing results are in line with what we would expect for a severe level of modification - a slight (5%) decrease in MOE and a substantial (40%) decrease in MOR.

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Pest management

Scion has obtained permission from the EPA to release the larval parasitoid *Eadya daenerys* in New Zealand. This species is another biological control agent but this time to specifically target the first-generation larvae of *Paropsis charybdis*. *E. daenerys* a larval parasitoid from Tasmania will be released in 2020. This financial year the team returned to Tasmania to recollect the correct species of parasitoid, imported it back into Scion's insect transitional facility. It will pass through one full generation from adult to adult within a puparium, in order to obtain MPI clearance for release into New Zealand Eucalyptus forests. Image below shows *E. daenerys* stinging a *P. charybdis* larva.

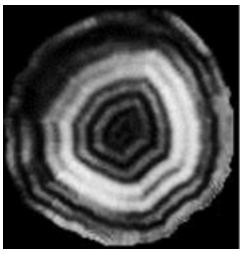
Site species matching

Preliminary juvenile height yield models were developed from very limited data sources by including site-specific variables for three durable Eucalyptus species, namely *E. argophloia, E. quadrangulata*, and *E. tricarpa*. The findings show that *E. quadrangulata, E. tricarpa*, and *E. argophloia* grew taller in relatively less moist soils and sites with higher maximum monthly temperatures. Moreover, *E. argophloia* also needed wind shelter and deeper potential rooting depth to grow taller at the juvenile stage. This study will provide a first-hand indication of how to handle the management and silviculture of these species, specifically with regard to planting them on appropriate sites.

Other

Changes in the moisture content of wood changes its dimensions. The magnitude of these changes (dimensional stability) can have a large impact on how the wood performs in service. Poor dimensional stability can lead to cracking, poor paint adhesion and problems with clearances in moving parts like doors and windows. To better understand how wood will behave in service, the dimensional stability of 16 different wood types were compared (8 species, plus variations such as modified wood, or different tree ages). The softwoods tended to swell relatively quickly, and the hardwoods much more slowly. For the three species investigated (radiata pine, *C. lusitanica, E. nitens*) thermal modification tended to increase the dimensional stability in all species tested. The cypresses, Douglas-fir, and two eucalypts (E. nitens and E. regnans) swelled less than the radiata pine.

A study examined the feasibility of using synthetic aperture radar (SAR) imaging to identify the Heartwood/sapwood barrier in trees (*E. globoidea, E. bosistoana* and *C. ovensii)*. This parameter is specifically measured in our programme for the durable eucalypts as large early forming heartwood is a desirable trait.
Preliminary results indicate that the heartwood boundary could be detected in cypress and potentially in a couple of eucalypt species. Images below show an ovensii disc and the corresponding scan showing the heartwood zone as black in the centre.



The following reports can be found on www.fgr.nz

Reports completed

Report No.	Document Title
SWP-T086	Thermal Modification of Specialty Species Results of Scion's SSIF-funded experiments
SWP-T087	Minimising growth-strain in eucalypts to transform processing
SWP-T088	Non-destructive Detection of the Heartwood-Sapwood Barrier

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SWP-T089	A population-genomic and taxonomic study of *Eucalyptus argophloia* and *E. bosistoana.*
SWP-T090	Dimensional Stability of Specialty Species
SWP-T091	Bonding of *E. bosistoana* and *E. quadrangulata* veneer
SWP-T092	Assessment of *E. globoidea* wood properties at Atkinson
SWP-T093	Peeling pruned *E. fastigata* for high-stiffness veneers: Part 1. Green grade recoveries
SWP-T094	Preliminary juvenile height yield models for three durable Eucalyptus species by integrating site-specific factors
SWP-T095	Wooden posts - A review

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