

Project Update – July to December 2016

RESEARCH HIGHLIGHTS FROM THE PAST FEW MONTHS

- The second half of 2016 has been a time to extend NZDFI's tree breeding programme with the establishment of three new *E. quadrangulata* trials.
- UC's Wood Technology Centre has made good progress on the analysis of the *E. bosistoana* cores collected last summer and on the study of the cellular processes of heartwood formation.
- Proseed has achieved some significant milestones in their durable eucalypt propagation work.
- However, a new environmental challenge has arrived in the form of a new eucalypt variegated beetle that has been found in Hawkes Bay.
- Our research on the soil, topographic, and climatic variables that affect the growth of durable eucalypts has expanded with the start of a new UC project.
- NZDFI's programme was included in the national Forest Growers Research conference held in Hawke's Bay.

NZDFI's Tree Improvement Programme update from Paul Millen

New breeding populations planted

Last summer Morgans Road Nursery was successful with propagation of 83 family seed lots of *E. quadrangulata*. These seed lots had been collected by Proseed NZ in 2013 from plus trees located across *E. quadrangulata*'s wide natural range - the tablelands of central and northern NSW - where rainfall ranges from 900 – 1700 mm per year.

The successful propagation meant there were plenty of seedlings to plant in UC's SFF 'growth strain' nursery field test project based at Woodville. Additional seedlings were deployed in three new NZDFI breeding populations.

These new *E. quadrangulata* breeding populations were planted in spring 2016. The three sites were chosen for their higher rainfall and for being generally sheltered, as this species is proving to grow best in these conditions. *E. quadrangulata*, along with *E. bosistoana* and *E. globoidea*, are proving to have potential to extend NZDFI's regional scope beyond NZ drylands.

The host landowners for these new breeding populations are:

- Dale Webb site, Tunakino Valley, north Marlborough
- Ket Bradshaw, Lamberts Valley, north Marlborough
- NZ Redwood Company, Paparoa forest, Taumaranui.

A small mass-selection trial of *E. sideroxylon* was also planted in collaboration with Ed Beetham, at Brancepeth in Wairarapa, with assistance from Andrew Turnbull of Greater Wellington Regional Council. This trial is to evaluate this species against earlier NZDFI trials of *E. tricarpa* to which it is closely related.

A big thanks to all these landowners for enabling NZDFI to increase the range and diversity of trial sites.



The new *E. quadrangulata* trial being planted at Dale Webb's property in Tunakino Valley, north Marlborough.



The new *E. quadrangulata* trial planted at Ket Bradshaw's property in Lamberts Valley, north Marlborough.

Wood Quality Research update from Clemens Altaner

Tree Corer

The light-weight battery-powered tree corer which was developed for the NZDFI programme has raised international interest. This corer is unique worldwide as it can rapidly extract (in 1-2 mins) large (~14mm) diameter cores from high density trees with little effort. We have already received orders for the coring system from international forest research institutions. Together with Callaghan Innovation we are now manufacturing these corers and are making them available for wood quality research worldwide.

Screening for Heartwood

Only heartwood can be naturally durable and have colour. The ~1100 cores collected by our post-grad student, Yanjie Li from the 2009 *E. bosistoana* breeding trials at Lawson's East, Lawson's North and Craven's Road were analysed for their heartwood content. Sixty seven families (that is seed lots from 1 mother tree) were replicated at these sites. The results showed genetic influence between families in the production of heartwood by the trees. The figure below shows that some families produce more heartwood than others, indicating the possibility to select trees for increased heartwood content. It needs to be noted that the largest trees do not necessarily have the most heartwood (R^2 only ~0.5).

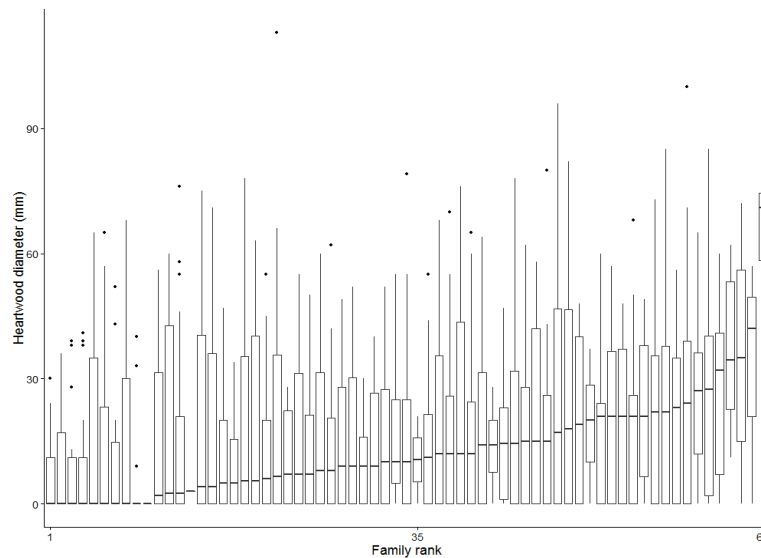


Figure 1: 67 families *E. bosistoana* ranked for heartwood diameter at age 7 on three sites

It was also interesting to see that tree size and heartwood content varied significantly between sites. The site with the largest trees was not the site where the trees had the largest heartwood diameter (table below).

Table 1: Median heartwood, sapwood and tree diameters on sites for 7 year old *E. bosistoana*

	Lawson's East	Lawson's North	Craven's Road
Heartwood diameter (mm)	5	32	16
Sapwood diameter (mm)	64	60	81
Core length (mm)	76	91	104
DBH (mm)	66.8	88	105

Coring of the NZDFI breeding populations will continue as trees reach the age when they form heartwood. More research is needed on the environmental influences on heartwood development, and to incorporate heartwood into growth models.

Heartwood formation

Little is known about heartwood formation in young trees. Most published literature reports on old trees. However, in the context of fast-growing short-rotation durable eucalyptus plantations, heartwood formation in young trees is important. There are indications that heartwood formation in young trees differs from that in old trees in the sense that the parenchyma cells (cells that stay alive in sapwood), which synthesise the heartwood extractives, remain active for a longer period. This would result in a wider zone which is not 'true heartwood' – the part of the stem in which all parenchyma cells have died. The implication would be that the extractive content (and consequently wood quality) at centre of the stem could improve over time in young trees.

The hypothesis of prolonged heartwood formation in young trees was being tested by our post-grad student, Gayatri Mishra by looking for living parenchyma cells in radial profiles of 6 year-old *E. bosistoana* trees. Unfortunately identifying living cells in wood is not straight forward. With a lot of persistence, we finally managed to visualise nuclei, the essential cell organ in a living cell, by microscopy using an antibody labelling

technique. The observations revealed that 6 year-old *E. bosistoana* trees contained 'true' heartwood (see figure below). Other tissue characteristics like the absence of vacuoles and reserve material (starch) or the presence of extractives and vessels blocked by tyloses confirmed this result.

As a consequence extractive content does not increase over time at the centre of 6 year-old *E. bosistoana* trees due to local synthesis and deposition of these compounds.

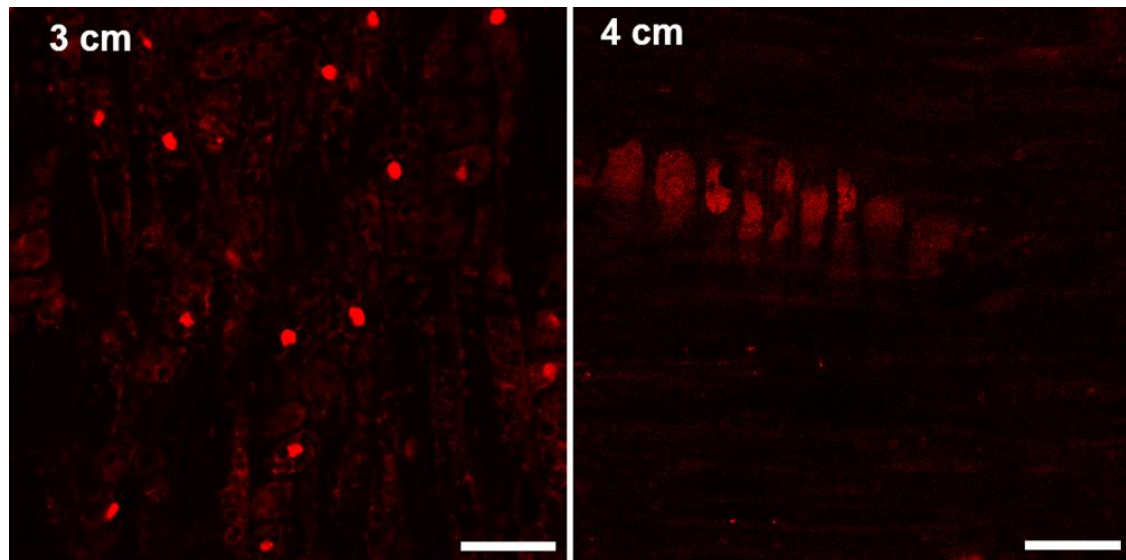


Figure 2: Radial sections from a 6 year-old *E. bosistoana* stem labelled for histone to visualise nuclei (bright red 'dots') in parenchyma cells. Nuclei were observed at the outside of the stem (left) but not at the centre (right). Scale bar 50 μ m.

Propagation research by Proseed from Paul Schroeder

In concert with first selection of superior individuals from NZDFI breeding programmes, we have been working on techniques to propagate superior individuals for (i) establishment of seed orchards producing improved seed lines and (ii) clonal material for trials and commercial planting.

Small grafted seed orchards have been established of *E. bosistoana* in 2015 and *E. quadrangulata* in 2016. Grafting *E. globoidea* has proved more difficult and limited material from 2016 selections has been put into an archive for bulking up.



Grafted *E. quadrangulata* seedlings established this spring at Proseed's orchard in Amberley.

In December 2015, we visited NSW, Australia to look at how eucalypt cuttings were being propagated. What we learned in Australia we copied in our new, climate controlled propagation house here at our Amberley site. From January to March around 750 *E. bosistoana* cuttings that were taken from coppiced trees from UC's growth strain trial were successfully rooted. Investigation of a technique to transplant stumps of selected trees for use as cutting stools was initially encouraging but later abandoned when stumps eventually collapsed.

Rooted *E. bosistoana* cuttings were planted into a pilot hydroponic stool system for production of further cutting material. The method is well established in eucalypt cutting programmes around the world. Growth of plants was spectacular but management requires refinement in respect of environment, nutrition and pruning.

Future work will focus on rooting cuttings from coppice off up to 2000 selections in the Wairarapa growth strain trial at Woodville, and on further refining a system for stool management at Amberley.



E. bosistoana cutting hydroponic growing system in Proseed's propagation house in Amberley.

New eucalypt insect pest alert from MPI

MPI needs your help to prevent Eucalyptus variegated beetles from spreading throughout New Zealand and damaging our developing eucalyptus forestry industry.

<https://www.mpi.govt.nz/protection-and-response/responding/alerts/eucalyptus-variegated-beetle/>

The Eucalyptus variegated beetle (*Paropsisterna variicollis*) is an Australian leaf beetle. Its larvae feed on the leaves of eucalyptus trees and can cause significant damage.

It was first found in New Zealand at Te Pohue, Hawkes Bay in March 2016.

They found it was relatively widespread in the Hawkes Bay. Surveillance in early October 2016 confirmed it is widespread across the Hawkes Bay hinterland – they were found in more than 20 surveyed locations.

from Paul Millen

NZDFI are keen to work on monitoring the impact of this new beetle as it has already been found at all our trial sites in Hawkes Bay.

We have been in discussion with UC's entomologist, Tara Murray and HBRC's Forestry Manager, James Powrie, on scoping a possible research project based at our large demonstration trial planted at Hawkes bay Regional Council's Waihapua property in 2014. This site also hosts SCION's trials of several non-durable eucalypts so they could also be involved.

I visited the Waihapua trial site with James in November and the new beetle was present on a number of species. Another Hawkes bay landowner hosting several NZDFI trials, Ben McNeill has also been monitoring the occurrence of the new beetle on his property as well as the large areas of eucalypts that he has planted himself. He has found it on most NZDFI species with *E. bosistoana* appearing to be favoured which is of concern.



The new Eucalyptus variegated beetle (*Paropsisterna variicollis*) on *E. quadrangulata* at HBRC's Waihapua site near Lake Tutira in Hawkes Bay.



The NZDFI Waihapua trial site planted in 2014 with a wide range of durable eucalypt species.

Site Species Matching and Productivity research from Justin Morgenroth

This summer PhD candidate Serajis Salekin will be re-measuring trees at the Lawson, Avery, and Dillon trials in Marlborough so as to complete his current UC site x species matching research project on *E. bosistoana* and *E. globoidea*. This project is funded by UC, AGMARDT and the SWP partnership.

These will be Serajis' final measurements and will allow him to produce his juvenile growth models for *E. bosistoana* and *E. globoidea*. In addition, he'll be using a high grade GNSS receiver (global navigation satellite system) to produce a high resolution digital elevation model for the Dillon trial. This work has already been completed for the Lawson and Avery trials. The GNSS receiver will be used to take positional measurements of latitude, longitude, and elevation at 3 – 5 m intervals across the trial, and to provide accurate positions of all trial corner pegs. The end result will be a high resolution digital terrain model for approximately two dozen NZDFI trials. These models will be used to incorporate topographic surfaces (e.g. aspect, slope, exposure) in subsequent growth and yield modelling.

Also this summer, a UC forestry Masters student, Jack Burgess plans to start his project to use environmental mapping to correlate soil, topographic, and climatic variables to the growth of three or more of the durable eucalypts growing within NZDFI trials.

His research will help solve the problems associated with correctly siting eucalypts on dryland sites. Eucalypt species in NZDFI trials can display large variation in growth across a site that is partly attributable to environmental effects (e.g. climate, soil, topography). By identifying the site conditions associated with greatest growth, this research will help growers and landowners identify the optimal species to match their site conditions.

This project is funded by UC Foundation, Marlborough Research Centre, Neil Barr Farm Forestry Foundation and Forest Growers Levy Trust. **The project aims to:**

(a) use existing LiDAR data or a hand-held GNSS receiver to develop high-resolution terrain models for a selection of our trial sites;

(b) use NIWA's virtual climate station network to estimate site-specific climatic conditions;

(c) use S-map or other relevant soil mapping data to estimate site-specific soil conditions;

(d) re-measure tree size at NZDFI permanent sample plots containing the three species of interest;

(e) model *Eucalyptus spp* growth as a function of the environmental characteristics described in (a) – (d); and

(f) use the model developed in (e) to develop decision support tools to match dryland sites with the optimal *Eucalyptus* species.



Serajis Selakin using a GNSS receiver to collect data for a high-resolution terrain model at Ben McNeill's Waimarama property in coastal Hawke's Bay.

NZFOA Forest Growers Research Conference

from Paul Millen

This conference, held 12th & 13th October in Napier, was primarily focused on delivering outcomes and updates on the sector's MBIE/Forest Grower Levy funded research programme on radiata pine, which focuses on 'Growing confidence in forestry's future'. <https://gcff.nz/>

In addition, there was a presentation given on the SWP the Programme Manager, Marco Lausberg that included outlining NZDFI's research of durable eucalypts for drylands. During the conference field trip the next day there was visit by about 70 delegates to a NZDFI durable eucalypt species trial planted in 2011 by Rick Alexander at his central Hawkes Bay property.

Rick's site is one of twenty five demonstration trial sites established by NZDFI from 2010-2014 to evaluate the potential adaptability, productivity and management of durable eucalypts. The establishment of these trials was supported by the Ministry of Primary Industries Sustainable Farming Fund.

The survival and growth rates demonstrated by all species at this site has been surprisingly good given that it's a north facing slope with an average rainfall of 800 mm. Several assessments of survival and height of all live trees within the trial have been completed since planting and most trial blocks are now being measured as Permanent Sample Plots.

The full report prepared for the visit to the Alexander site is available on <http://nzdfi.org.nz/wp-content/uploads/2016/10/AlexanderTrial-Notes-Final-for-ForestGrowersResearchConferenceFieldtrip-NZDFI.pdf>



Toni Withers, SCION's entomologist tells NZFOA Research conference delegates about the new EVB arrival at NZDFI trials at Alexander's property in central Hawke's Bay.

A final word from Paul

In April 2017 the University of Canterbury and NZDFI are planning a two-day workshop in Marlborough – see following page for details or visit <http://nzdfi.org.nz/wp-content/uploads/2016/12/Eucalypt-Workshop-Notice-final.pdf>

The workshop will feature national and international speakers, and will be a great way to keep up-to-date with all the research and other developments happening in the durable eucalypts scene. Book early as we expect a lot of interest and I look forward very much to seeing many of you here in Marlborough!

Best wishes for the holiday season.

Paul Millen

13th December 2016

DURABLE EUCALYPTS ON DRYLANDS: PROTECTING AND ENHANCING VALUE

Workshop

19th - 20th April 2017

Marlborough Research Centre, Blenheim

Advance notice: industry partners, scientists and growers

We are planning a workshop to update all those interested in the exciting and fast-moving developments in durable eucalypt research.

Wednesday 19th April:

A full-day indoor programme, with presentations by New Zealand and international research scientists and technical specialists. Topics will include:

- Siting and microclimates
- Eucalypt defoliation by insects: impacts and monitoring
- The NZDFI breeding plan
- Early selection for low growth-strain
- Propagation
- Early heartwood & extractives
- Heartwood and durability
- Down-stream opportunities: LVL requirements and markets.

Thursday 20th April:

We plan a visit to see some of our research in action in the field, followed by a tour of LVL producer Nelson Pine International, which is trialling durable eucalypts for its laminated products.

Mark these dates in your diary!

April 19th-20th 2017

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