NZDFI NEW ZEALAND DRYLAND FORESTS INITIATIVE
breeding tomorrow's trees today

Project Update – January to June 2016

NEWS FROM THE PAST FEW MONTHS

June 2016 saw the completion of our three-year *'Enabling growers to maximise value from planting durable eucalypts'* MPI Sustainable Farming Fund project 13-024. We achieved all of our milestones through making good use of over $530,000 that was received in total funding for the project. We are grateful to all those who contributed in so many different ways.

The project's main achievements include:

- working alongside landowners to increase the network of NZDFI demonstration trials from 14 to 25, with a greatly extended geographical and site-type range.
- establishing and measuring over 200 Permanent Sample Plots, and analysis of the height data collected.
- generating demand for information, and confidence in the whole concept of growing durable eucalypts, via our workshops and seminars, videos, website, articles, and presentations.
- building firm foundations for the robust, innovative research programme now underway - the key to the long-term success of the NZDFI.

The NZDFI research programme is now funded under the MBIE/FFR Specialty Wood Products (SWP) partnership. This doesn't mean we will lose our identity; far from it. NZDFI's team will continue to work on a range of research projects both within and outside the SWP aimed at delivering our vision – for New Zealand to be home to a thriving sustainable hardwood industry by 2050.

RESEARCH UPDATE

NZDFI's Tree Improvement Programme
Wood Quality Research

New corer put to work: 2009 *E bosistoana* breeding populations core sampling

This autumn we completed our first major core sampling programme in two *E bosistoana* breeding populations, at the Lawsons and MDC Cravens Road trial sites, both in Marlborough. The trees are six years old and some were thinned at the beginning of the year; discs were cut from the stems of felled trees to study the bioactivity and chemistry of heartwood extractives.

The majority of remaining trees at both sites had large enough diameters to enable coring. At each trial a combination of random sampling (to cover population) and also selection of the top three trees from each family resulted in a selection of about 700 cores to be taken at Lawsons with a further 400 cores from the Cravens site.

Our new tree corer, designed and developed by Lan Le-Ngoc of Callaghan Innovation, was put to the test. It runs off a standard cordless power drill with minimal vibration and great precision. It was used to cut 14 mm diameter cores, at a stem height of 300 mm, through the centre of stems up to 200 mm in diameter.

Several prototypes of the core cutter were tested over the preceding 12 months. The optimal design was finalised in April and then fine-tuned over five weeks during May and early June when a total of 759 trees were core

sampled at Lawsons and 370 at Cravens Road. In early tests it took around 10 minutes to extract one core; PhD student and corer operator Yanjie Li was extracting cores in 1-2 minutes by the end of the period. The cores are now under analysis for extractives content at the UoC Wood Technology Centre. There is a 30 second video of the corer in operation on the NZDFI website (www.nzdfi.org.nz)

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>Corer used with a standard cordless drill.</td><td>Cores taken right through the centre of each tree.</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Cores labelled with their family code.</td><td>Freshly cut 14 mm diameter cores.</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Corer leaves a 19 mm hole right through the stem.</td><td>Cores stained with di methyl yellow that highlights heartwood by turning bright pink within minutes following application.</td></tr>
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Single tooth corer designed and developed by Lan Le-Ngoc of Callaghan Innovation.

Stump excavation to study lignotubers

Following the summer disc sampling operation at Cravens, a small excavator was hired to extract three *E. bosistoana* stumps to enable UC's researchers to study the trees' lignotubers. Lignotubers are the large, woody growths that develop at the base of the trunk of many eucalypt species. They consist of a mass of vegetative buds and associated vascular tissue that contains substantial food reserves. In their native Australian environment they are the trees' regeneration strategy in case of fire, but there has been little research on their development and cellular structure.

Excavated stump - *E. bosistoana*, age 6 years, for lignotuber analysis

Selection of *E globoidea* and *E quadrangulata* trees for grafted seed orchard establishment

Following some intensive analysis of form and growth traits, Ruth McConnochie, NZDFI's tree-breeding specialist, worked with Paul Schroeder of Proseed to collect scions from 'Plus Trees' - the best individual trees of top ranked families - of *E globoidea* and *E quadrangulata* within NZDFI's breeding populations at the Atkinson (Wairarapa) and Cuddon (Marlborough) trials respectively. The scions have now been grafted onto rootstock by staff at Proseed in Amberley for planting as a clonal seed orchard. The aim: production of our first genetically improved seed within the next 2-3 years.

New Katmandoo database introduced

Through until June 2016 NZDFI have been using Microsoft Excel as basic data base for recording all measurements. From July 2016 the transfer of all data will commence into a relational database called Katmandoo that has been developed specifically for forest research applications. This will allow data to be entered by and will deliver multi-accessibility to all NZDFI researchers in a format suited to rapid analysis and review.

Eucalypt insect pest research

(Dr. Tara Murray & Huimin Lin)

The first season of insect herbivore research in the NZDFI Marlborough plantings has gone well. PhD student Huimin Lin has been looking at the insect pests on *Eucalyptus bosistoana* at the Avery 2010 trial site, under particularly windy and dry conditions. One of the most labour intensive achievements was the successful establishment of our defoliation trial. The aim of study is to better understand the impacts of moderate and severe defoliation on tree growth, with a particular emphasis on the seasonality of the damage (spring or late summer). Huimin and her team of helpers simulated 50% and 90% defoliation by Paropsis beetle and Gum emperor moth by manually clipping leaves from > 140 trees in late October 2015 and March 2016.

		
Before defoliation	After 'severe' defoliation	Volunteers help out with defoliating the trees

DBH and height of all defoliated and also control trees have been measured monthly since October 2015 and this will be continued until 2017 to assess the impact of defoliation and ability of *E. bosistoana* to recover.

When not cutting leaves from trees herself, Huimin has been monitoring the natural pest abundance and defoliation caused by four different pests (Paropsis beetle, gum emperor moth, leaf blister sawfly and eucalyptus leaf roller) on 15 families of *E. bosistoana* to determine differences in pest resistance or tolerance. She has collected 5 months of data and is preparing to continue this work in the summer of 2016-2017 to produce a ranking of family susceptibility to these well-established insect pests. There are already some clear indications of families that are less susceptible but multi-season data will allow these to be ranked with greater confidence and accuracy.

In addition to monitoring the damage they cause, we have also been assessing the phenology of these four pests to develop an understanding of population dynamics in the field. Interestingly, only one generation of Paropsis was observed in the 2015-2016 season, in contrast to the two usually observed in North Island plantations. This will be a major focus of the next field season and aims to provide data that we can use to better predict pest outbreaks of damaging levels. The overall aim is to determine when it is worth controlling pests in eucalypt plantations while maintaining economically and ecologically sustainable management practices.

Huimin Lin has just returned from presenting a poster and presentation about her NZDFI work at the New Zealand Plant Protection Conference in Palmerston North where it was well received.

UC SFF Project 407602: Minimising growth-strain in eucalypts to transform processing

E argophloia breeding population sampled for growth strain testing

The five year old *E argophloia* breeding population at Cuddons in Marlborough was measured and thinned in April 2016, with stem samples collected and delivered for processing by UC's Wood Technology team. PhD student Nick Davies is using the results of the rapid splitting test used to measure the growth strain of these stems to provide a dataset for use in a Genetics x Environment analysis with the results from testing of younger trees of these same families being grown at Harewood (UoC, Christchurch) and Woodville sites. Stem lengths measuring 60cm were collected from 6 – 13 individuals per family. All 18 families planted in the trial, plus the control seedlot were sampled. Multiple samples were collected from trees with two or more leaders.

Thinned trees where early heartwood was evident had discs cut from the base of stem. These will provide extractives for the first chemical analysis of *E argophloia.* by PhD student, Gayatri Mishra. In total 68 samples were collected and delivered to UoC's Wood Technology Centre.

E argophloia heartwood formation - stem discs taken for extractives analysis

Stem samples collected for growth stress testing

SFF 13-024 project: Enabling growers to maximise value from planting durable eucalypts

Trial site measurement

Following an intensive summer measurement programme led UoC graduate Jack Burgess, a report: ***'Early Height Growth of Durable Eucalypt Species: The measurement and analysis of NZDFI demonstration trials planted 2010-2014'*** was produced**.**

This report outlines the development of the trial site network, and summarises the performance of different species across all trial sites using the parameter of mean annual height increment (MAHI) - the average height increase in a year for each species across all sites.

Measuring early height growth of young trees demonstrates their ability (or lack of) to be successfully established and provides a basis for comparative assessment to be made of early growth rates of each species across many sites. While not every NZDFI trial site/block planted was successfully established, there are a large number with partial or full success with some or all species surviving. Measurements from 25 sites were used to calculate MAHIs; the MAHI for each species is shown below and ranges from 0.98 m for *E. quadrangulata* down to 0.56m for *E. argophloia*.

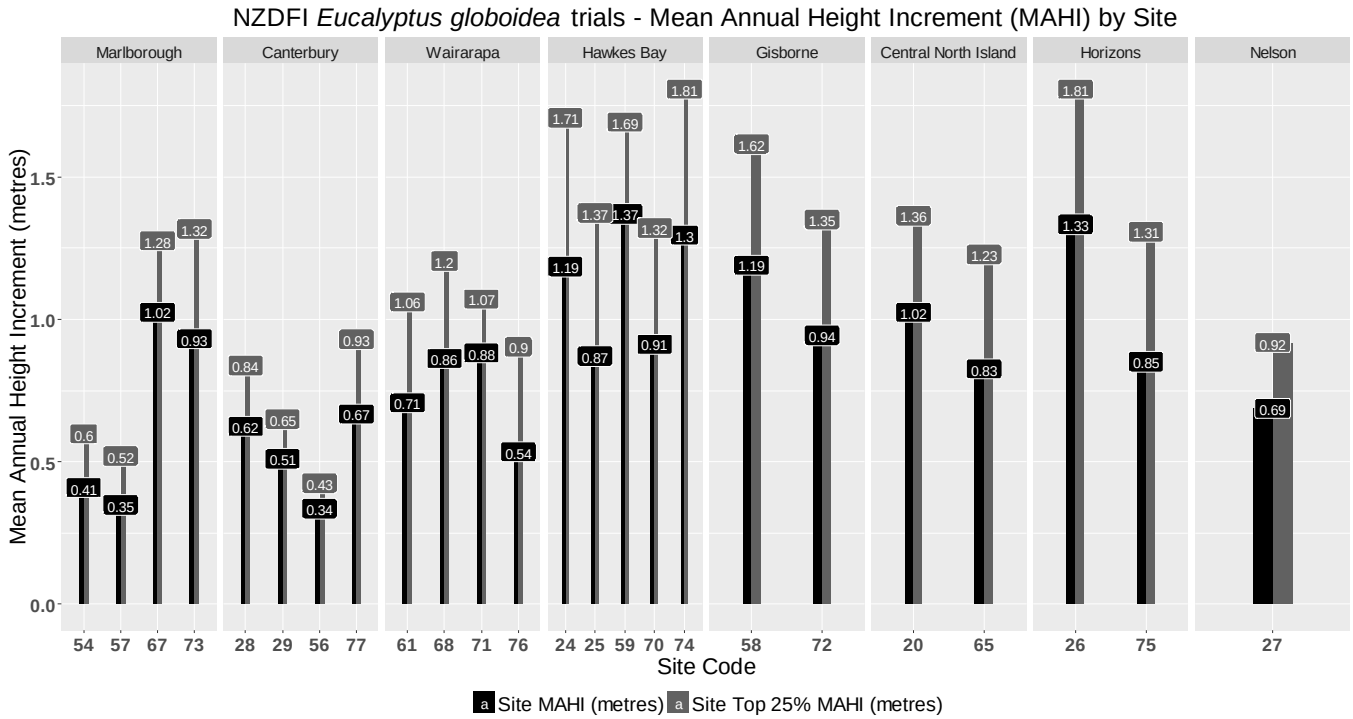
The mean annual height increment (MAHI) for all species based on all height data from 2010-2014 trials

Species	MAHI (metres) across all sites	Species	MAHI (metres) across all sites
E. quadrangulata	0.98	E. macrorhyncha	0.76
E. globoidea	0.91	E. longifolia	0.75
E. cladocalyx	0.87	E. tricarpa	0.66
E. camaldulensis	0.84	E. notabilis	0.62
E.bosistoana	0.80	E. argophloia	0.56
E. eugenioides	0.78		

In addition, we evaluated the potential effects of microsite and genetics for each species by calculating the MAHI for the tallest 25% of the trees at each site and then the percentage difference this is of the MAHI for all heights of all trees.

This analysis shows there is significant variation in early height growth between sites with the difference between the site with the fastest growth of most species (Site 26) having MAHIs that are up to three to four times greater than MAHIs of the same species at sites where early height growth has been slowest.

There is also significant microsite/genetic variation calculated from the heights of the MAHI of all trees of one species compared to that of the tallest 25%. There are a wide range of differences between species at one site including less than 20% difference for some while for others the difference could be over 50%. As an example, the MAHI data for *E globoidea* across all sites is illustrated in the graphic below:

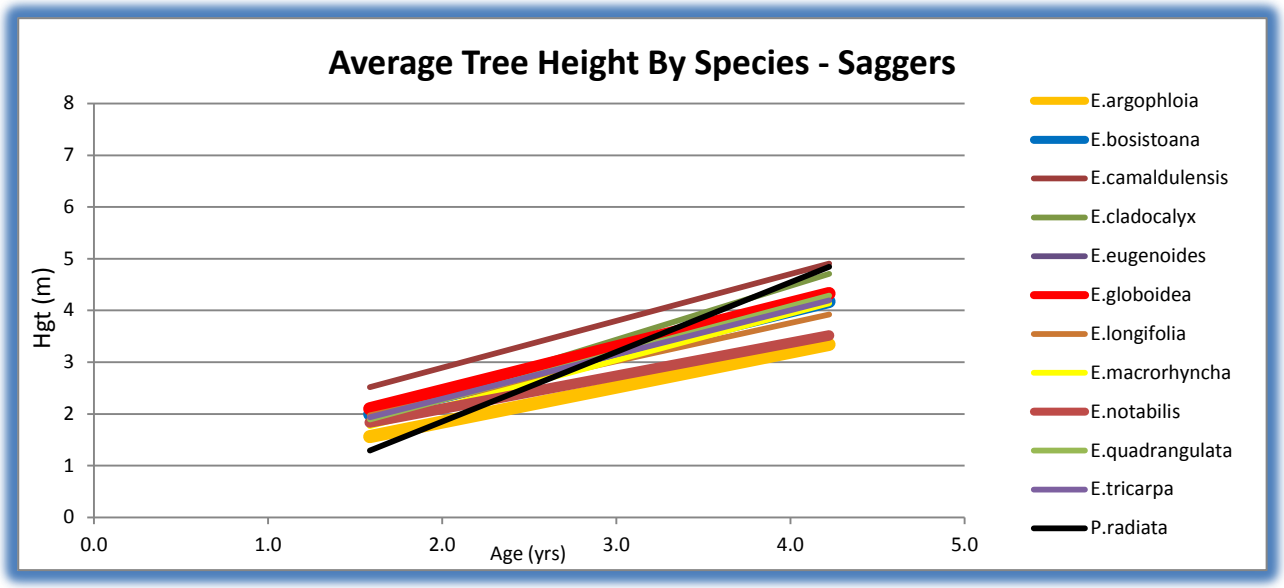


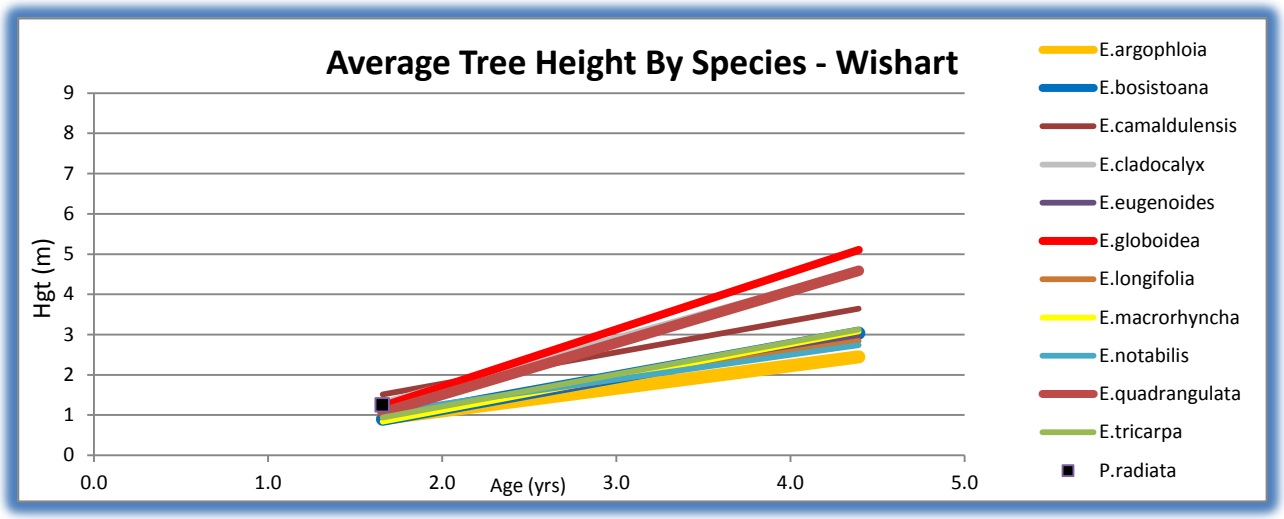
This demonstrates the importance of needing to learn where to match species to sites as well as the significant potential gains in growth for the species that have been selected for NZDFI's tree improvement programme.

Permanent Sample Plot measurement and analyses

The above report also provides summaries of data collected from the NZDFI's network of over 200 Permanent Sample Plots (PSPs). Trees in these plots have all been measured at least once, in the summers of 2013-14 and 2015-16. There have been two sets of measurements at Wisharts trial in Gisborne and Saggers trial in Marlborough (both planted in 2011) and the data analysed to review the differences between species survival and height growth at these sites.

The graphs below show the average heights of different species at the Saggers (Marlborough) and Wishart (Gisborne) sites respectively following the second round of PSP measurements and data analysis.





The ongoing measurement of PSPs is essential to capture productivity data that will support development of growth models. Thinning operations and then eventual harvest of the trials offer the opportunity to measure the real value which these high density species offer in terms of carbon sequestration under the Emissions Trading Scheme and to predict the potential value of merchantable posts, poles and saw logs at time of harvest.

Therefore, in the 2016/17 summer NZDFI plan to continue some re-measurement of PSPs with the University of Canterbury support by supporting summer scholarships for UoC forestry students. The extent of re-measurement

and any establishment of new PSPs will depend on the level of funding that NZDFI's partners, supporters and landowners can provide.

NZDFI wants to significantly expand on the success of research effort already completed by continuing to collaborate with our trial landowners to seek funding for a three year research project starting 1 July 2017. This new project will target development of decision support tools/system for new forest growers to successfully match species to site with models to predict productivity and thereby potential value.

The establishment of PSPs at NZDFI sites has been significantly assisted by the development and use of individual geo-referenced site maps that display the accurate layout of each NZDFI trial as well as map and number individual trees within each block. These maps have been completed across all NZDFI demonstration trials and breeding populations along with a location map to assist with return visits to continue measurement.

The use of a mini iPad ensures both maps can be viewed on screen and individual tree measurements recorded in a geo spatial format that aligns with the geo-referenced maps. This has significantly increased accuracy and reduced time required for data entry and processing. The mini iPad has mobile connectivity, so the data is directly for storage in NZDFI's site register.

Jack Burgess measuring tree diameters in an *E. quadrangulata* PSP at JNL's Steed Forest with Saturo Kuwabara measuring heights that he will record in the mini iPad he's holding.

SFF 13-024 project: Extension Programme: 2016 workshops and seminar programme completed

The final round of workshops and a seminar as part of the 13-024 SFF project were successfully completed during February and March: workshops were held in Marlborough, Gisborne, Bay of Plenty, and North Canterbury. The North Canterbury event included a visit to Proseed's new propagation facility at its Amberley site.

A seminar was held in conjunction with the Lake Taupo Forest Trust in Taupo, and two Extension Team members, Heather Atkinson and Harriet Palmer, gave a presentation at a 'Farming for the Future' conference in Carterton in March.

These events have been highly successful in creating awareness of the potential for durable eucalypts in different parts of our target area. In total over the three years of the SFF project, we have run thirteen field events with a total of 336 participants.

We are grateful to everyone who hosted one or more workshops, or contributed to the presentations. Lakewood Products was an excellent sponsor of the workshops, and gave demonstrations of their Pro-Pruner pruning equipment.

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Finally there sixteen presentations delivered about the NZDFI over the past three years to a wide range of rural sector interest groups. These presentations were delivered to rural sector meetings, conferences and field days and increased the awareness of and support for NZDFI's R&D programme.

A final word from Paul....

Close to one million ground-durable eucalypt seedlings have now been established in New Zealand, of which 90% are outside of the NZDFI trial network. In other words, landowners are impatient to embark on planting these trees, and are prepared to get underway despite only unimproved seedling stock being available.

This Project Update shows that we are now making significant progress towards our goal of genetic improvement of these durable species. Forest growers can then accelerate their planting with confidence that the trees will grow fast, straight and produce high quality durable timber.

Anyone wanting further information and you can encourage others to contact:

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