

Project Update - March 2013 to June 2012

Durable eucalypt trial assessments

From April to June 2013 there have been assessments undertaken of all the 2011 breeding population and demonstration trials located at nine sites in the North Island and four sites in the South Island. These trials were age 18 -20 months at the time of the assessment. Thanks to the many landowners and others that helped with the assessments.

These assessments recorded survival and tree health with the height measured of all surviving trees. All trials were measured although measurements of one demonstration trial site in Gisborne were not included as it had partially been damaged by deer and goats. Overall the initial survival following establishment of all 2011 trials was excellent and can be attributed to well-managed pre- and post-planting weed control, and nursery production of healthy, robust seedlings.

An initial analysis of some of the data collected from these trials has been completed including the results of the extensive breeding populations of *E. globoidea* that were planted at three sites. These results for first height measurement reflect the differences in the performance of this species at these different sites (Table 1.)

There are 160 open-pollinated families in the breeding populations, with 40 – 240 individuals of each family spread across the three sites. The family performance has been ranked across all sites and within each site to identify the best families. There was a low degree of genotype by environment interaction for tree height. This suggests that a family selected for good growth at one trial location is likely to perform equally well at other sites.

Table 1: Maximum height and average height of *E. globoidea* seedlings surviving in NZDFI 2011 breeding populations

Site	Max. Height (cm)	Average Height (cm)
Marlborough - Avery	260.0	85.1
Wairarapa - JNL	305.0	117.6
Wairarapa - Atkinson	475.0	233.0

Ongoing activities planned include:

- Complete analysis of assessments of all other breeding populations planted 2011.
- Identify the families that rank highly for the desired traits and select individuals within these best families for future seed collection and establish clonal seed orchards. This will be the future source of genetically improved seed to forest owners.
- Utilise genetic evaluation models to test for provenance effects in the genetic population. Seedlots collected from a particular locality in Australia may be performing better than others. These areas could then be highlighted for further seed collections.

Early prolific flower bud development was also observed in the *E.globoidea* breeding trial at Atkinson's Wharerata property in southern Wairarapa. This characteristic was specific to some families, indicating that flowering in young trees may be under strong genetic control. NZDFI has previously recorded *E.globoidea* flowering in 5-7 year old trees from July-November. This species (like many other eucalypts) produces excellent pollen with high protein content important to bees. A subset of these families may be selected for this trait so that they can be propagated and planted to provide a nectar source for the beekeeping industry from a young age. Links are being explored with the team leading the Trees for Bees programme that also has a new SFF 13 015 project titled 'Producing abundant bee pollinators for sustainable farming.'

In another three years NZDFI plan further analysis and assessment of all breeding populations that will provide genetic parameters for the key traits of interest – growth, stem form, and early heartwood production to understand the level of genetic control and opportunities for significant improvement.



Figure 1: Ruth McConnochie records height of 4.5 metre *E. globoidea* at 20 months old at ‘Wharerata’ in south Wairarapa.



Figure 2: Flower buds were recorded on some families of *E. globoidea* at ‘Wharerata’ in south Wairarapa.

NZDFI’s demonstration trials are located on sites with variable characteristics. Average species height across all sites ranged from 104.4 to 179.8cm (see Table 2), while survival among species was 8.2% to 93.3%.

Table 2: Mean height of species included in NZDFI 2011 demonstration trials

Species	Mean Height (cm) Across all sites	Species	Mean Height (cm) Across all sites
<i>E.camaldulensis</i>	179.8	<i>P.radiata</i>	131.6
<i>E.quadrangulata</i>	152.8	<i>E.bosistoana</i>	129.5
<i>E.cladocalyx</i>	144.3	<i>E.tricarpa</i>	121.9
<i>E.globoidea</i>	134.5	<i>E.eugenoides</i>	120.2
<i>E.notabilis</i>	132.4	<i>E.macrorhyncha</i>	117.1
<i>E.longifolia</i>	132.2	<i>E.argophloia</i>	104.4

These broad results for each species are not intended to pick an overall winner. Rather these preliminary assessments have revealed there are clear relationships between the height and survival for each species with specific site characteristics. Species blocks are replicated 2 -3 times at each site and the variation in growth and survival was often greater than the average value across sites.



Figure 3: View over demonstration trial plots planted 2011 at Birch Hill in northern Wairarapa by Craigmore Forests that were assessed in April.



Figure 4: View over some of the demonstration trial plots planted 2011 at 'Te Koawa' in central Gisborne by Bob Wishart and Meg Gaddum that were assessed in April.

Ongoing activities planned include:

- To capture and develop our understanding of site/tree performance relationships, the heights of each species will be mapped in relation to the site factors to define site adaptability. Individual site assessments and maps can then be sent to all landowners.
- A further set of trials will be established across new sites using a subset of species, increasing the plot size from 49 trees to 100 trees and increasing initial stocking for a pole crop regime.
- A programme of intensive *within* and *between* site soil sampling may be investigated to provide detailed soil mapping of all sites.

Sites being planted in 2013.

5,000 *E. cladocalyx* nursery stock have been propagated from ALRTIG/CSIRO seed orchard seed and are planned for planting in a mass selection trial with the NZ Redwood Co. site near Hunterville, later this year.

In addition, 10,000 *E. camaldulensis* nursery stock have been propagated from WA Forestry Products Commission seed orchard stock and are planned for planting in a mass selection trial by Juken NZ Ltd (JNL) at Ngaumu forest at a site alongside the existing NZDFI trials. These will complement the 5 hectare waste water irrigation area planted with 13,500 *E. camaldulensis* by JNL last year alongside their mill in Masterton.

Further, NZDFI are currently working with a small number of new landowners to establish additional species demonstration management trials this year. These include Greater Wellington Regional Council, Warwick Lissaman in south Marlborough and Tim Chamberlain in north Canterbury.

SoF Wood quality study at Harewood.

A pilot wood quality evaluation was undertaken using 160 *E. bosistoana* seedlings (16 families, 8 reps) and 40 *E. argophloia* seedlings (5 families, 8 reps) that were planted in September 2010 and grown at the Christchurch City Council's nursery in 100 litre bags under perfect growing conditions (fertilized, irrigated, etc). This accelerated growth produced trees with sufficient early stemwood for School of Forestry to cut down and assess for growth strain at age 2. This pilot study was planned to validate procedures for eucalypts that NZDFI wish to implement in 2013-2019. The School has developed these innovative techniques for radiata pine wood quality improvement.

The key, predictable, outcome was that the mean stiffness of these young trees was at least twice that of radiata pine of the same age – ca. 3 GPa for pine, 7 GPa for *E. bosistoana* and 9 GPa for *E. argophloia*. These results confirm that

as pine forms low stiffness/low strength corewood that results in high breakage rates of CCA-treated pine posts during mechanical harvesting in vineyards. In contrast, hardwoods do not form core wood in the sense used by NZ foresters; their issues are different, such as growth stresses.

In this study, growth stresses were calculated by the splitting test (akin to splitting a carrot or piece of celery along its length) and measuring the outward movement of the two half-rounds from the centre line. Once again the results were promising. Growth stresses are an aggravation when sawing some eucalypts, e.g. the ash group species such as *E. fastigata* and *E. regnans* as well as *E. nitens*. Here our results show much lower growth stresses with *E. bosistoana* and *E. argophloia*. School of Forestry intend publishing these results in the near future.

The stumps coppiced profusely: at the end of February 2013, only 17 of the 160 *E. bosistoana*; and 8 out of 40 *E. argophloia* failed to develop coppice. Cuttings taken from the coppicing stumps are being tested with reasonable success had in striking (propagating) these.

Climate stations established

Two more weather stations have been set up including one at Ngaumu, JNL's forest in Central Wairarapa and at Ben McNeill's Waimarama property in coastal Hawkes Bay. Proseed have given additional funding of \$5000 for a further weather station to be established at the *E. globoidea* breeding population planted in 2011 at Atkinson's 'Wharerata' property in south Wairarapa.

An additional 40 temperature sensors donated by UoC will be deployed to measure microsite temperature variations within some of NZDFI's sites. This will be linked to site maps and NIWA data to better understand microsite variations within sites.



Figure 5: Sean McBride of JNL beside the new weather station at the NZDFI breeding population site in Ngaumu forest.

NZDFI Regional Field Day/Workshops

On 25th May 2013, NZDFI held a regional workshop/field trip in conjunction with the University of Canterbury. This was at the NZ School of Forestry at the Ilam campus in Christchurch. There were 54 attendees.

The workshop presentations in the morning session gave an overview of NZDFI's programme since it was established in July 2008 at the Marlborough Research Centre. These included;

- Current markets for durable hardwood justify investment in planting new eucalypt forests. *Paul Millen, NZDFI Project Manager*
- Breeding tomorrow's trees today – an overview of NZDFI's durable eucalypt breeding programme. *Luis Apiolaza, School of Forestry, UC*
- Collecting the seed for a durable eucalypt tree breeding programme. *Shaf van Ballekom, Chairman NZDFI (Proseed)*
- The adaptability and early growth of durable eucalypt species in NZ drylands. *Ruth McConnochie, NZDFI Tree Breeder*

After lunch there was a further presentation on the early screening of individuals for low growth-stress, high stiffness and physical characteristics by Clemens Altaner, School of Forestry, UC. This was followed by another on selection for improved heartwood and durability by Justin Nijdam, Chemical & Process Engineering, UC.

After a look around the School of Forestry's Wood Technology Laboratory with Monika Sharma, those attending departed for a short trip to Harewood nursery to see trees that have been bagged and grown for piloting early wood property studies on durable eucalypts as well as coppicing. Some returned to UoC for drinks and nibbles sponsored by Proseed NZ Ltd.

Thanks to all those involved with co ordinating and presenting as well as to the enthusiastic interest shown by all those that attended.



Figure 6: Dr Clemens Altaner, University of Canterbury's School of Forestry, describes the simple 'splitting' test for characterising growth stresses at the NZDFI workshop in Christchurch, 25th May 2013.



Figure 7: Patrick Milne (FFR & Southern cypresses) on left at Harewood nursery with Shaf van Ballekom, (NZDFI & Proseed) discussing eucalypt coppice propagation at the NZDFI field trip in Christchurch, 25th May 2013.

Completion of SFF 10 034 project

The NZDFI SFF 10-034 R&D project was to establish large breeding populations for genetic improvement of five wild (unimproved) species in six NZ dryland regions and to establish demonstration species trials to provide a base for research and development of forest management systems for growing naturally-durable timbers that are adapted to NZ drylands. This was the final year of NZDFI's SFF 10 034 programme and a final report has been sent to MPI on the completion of this SFF project. This is available on request to info@nzdfi.org.nz

A key question within the report was 'What difference has this project made to your group/community of interest/ industry?'

NZDFI has made a difference as New Zealand now has internationally unique genetic resources of two durable eucalypts, *E. bosistoana* and *E. globoidea*. Also significant genetic resources of *E. argopholoia*, *E. tricarpa* and *E. quadrangulata*. Collectively, these species have the potential to establish new hardwood forests in NZ drylands that will diversify NZ forestry.

Best provenances and early clonal selections for growth and form are planned this year within the 2009 *E. bosistoana*. NZDFI's target is for the first commercial release of provenances and clonal selections to nurseries from 2014. These can be propagated for sale of tree stocks to growers in 2015 with seedling sale prices of improved selections to include a NZDFI royalty payable to MRCT to fund ongoing R & D on durable eucalypts.

Throughout this SFF project, NZDFI has been successful in leveraging off the increasing interest shown by potential growers and those seeking sustainable products for use in their business or communities – electrical network companies, winegrowers, organic farmers and regional government.

The key representatives of NZDFI's team have worked hard to ensure the project's success. Marlborough Research Centre Trust as a regional research agency has provided governance and an effective administration base to support this local industry driven research initiative. Excellent links have been forged with the University of Canterbury who provide guidance and advice to the NZDFI R&D programme. These organisations have developed collaborative management and science teams that include the staff and local science consultants engaged by MRCT alongside the professors and lecturers at UC.

Underpinning NZDFI's success have also been the east coast regional councils that were financial supporters during the last three years including:

- Bay of Plenty Regional Council
- Gisborne District Council
- Hawkes Bay Regional Council
- Greater Wellington Regional Council
- Marlborough District Council
- Environment Canterbury

Relationships have been developed by the NZDFI team with staff in these organisations. Some have provided active support through identifying local landowners with possible trial sites and with the planning and promotion of local field days.

Marlborough Lines approached NZDFI about their requirement for high quality durable hardwood for crossarms for the electrical transmission network as the international supplies are dwindling and increasing in cost. In addition to financially supporting NZDFI's R&D programme, they decided they wanted to secure their own long term supply. Therefore in 2011 they purchased a forest property in Marlborough and have established a 50 hectare plantation of durable eucalypts.

Additional financial supporters have included a number of farm forestry association groups that see the value of NZDFI's tree improvement and extension programmes. These include:

- Neil Barr Farm Forestry Foundation
- NZ Farm Forestry Association's Eucalypt Action Group.
- Marlborough Tree Growers Association
- Gisborne Farm Forestry Association

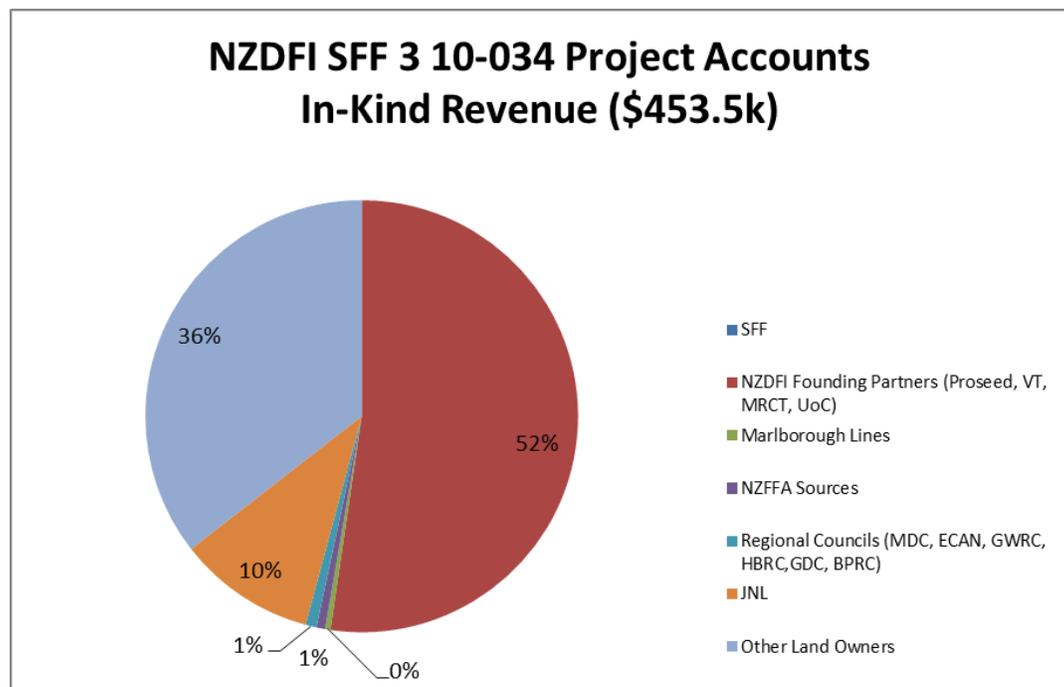
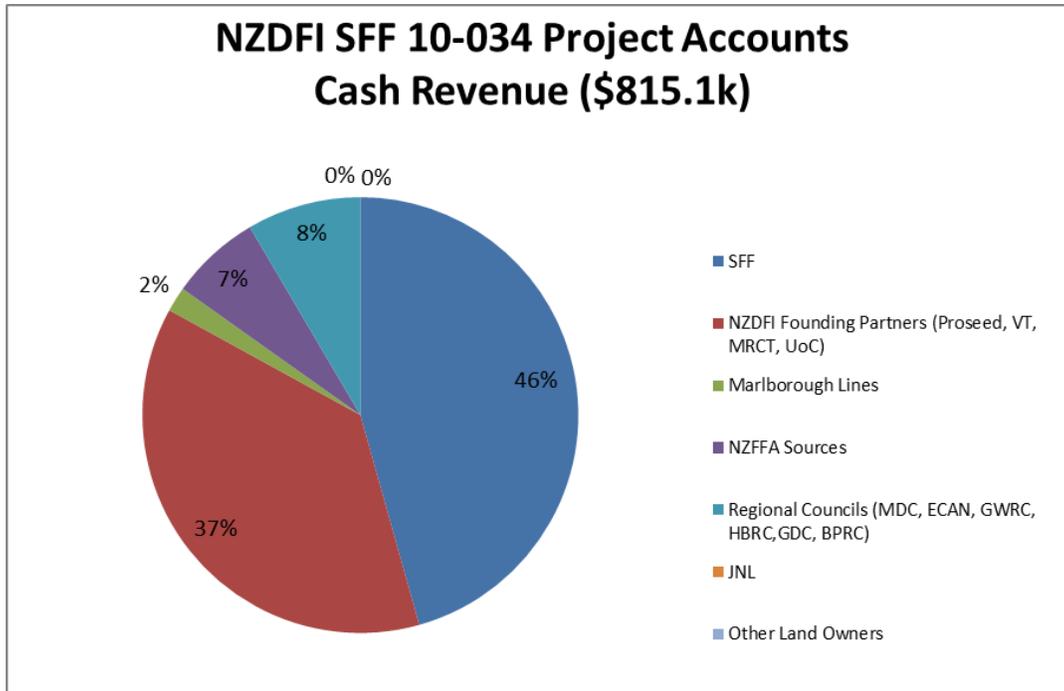
Other regional NZFFA branches have been active in helping identify local landowners with possible trial sites and the planning and promotion of local field days.

A total of 17 landowners from Bay of Plenty, Gisborne, Hawkes Bay, Wairapa, Marlborough and Canterbury have provided over 40 hectares of land for planting NZDFI eucalypt trials. These people are NZDFI's core 'community of interest'. Regional networks can now be developed with these landowners so that they can encourage and support others to start planting. New landowners have already been engaged to plant new trials with support through NZDFI's next SFF project.

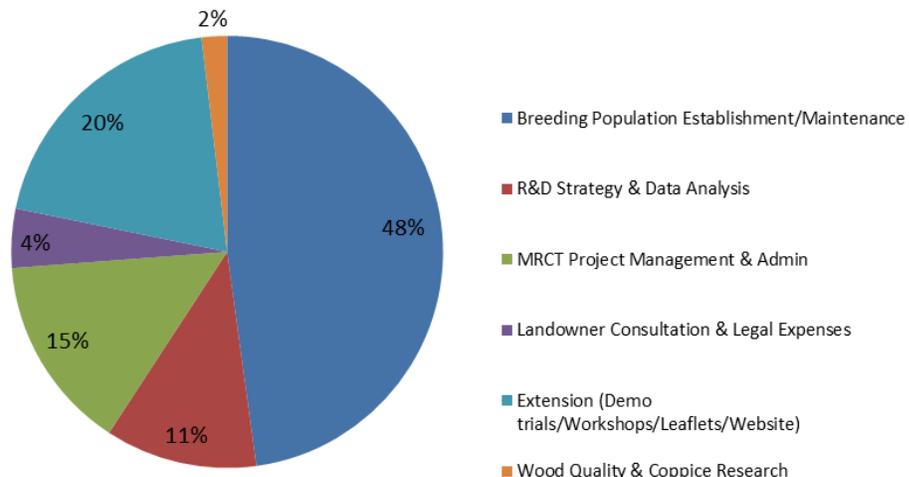
Over the three years of SFF 10-034, NZDFI attracted significant financial support with total revenue from cash contributions being \$815,108. This was \$174,664 more than the original project revenue budget of \$640,444. These additional cash contributions were largely given by the University of Canterbury and Proseed NZ Ltd as well as Bay of Plenty Regional Council.

This additional funding allowed for more extensive breeding populations and demonstration trials to be established. Actual total expenditure was \$815,617. This is \$509 over total revenue. This outstanding amount has been met by Proseed.

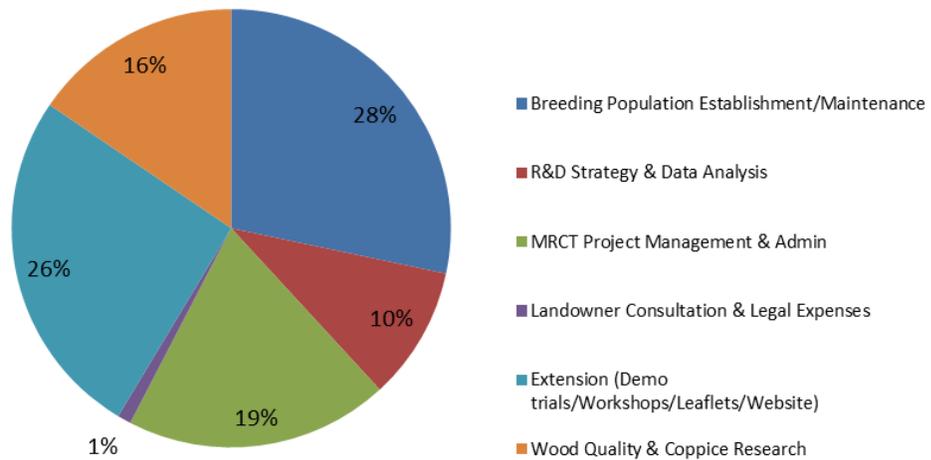
As with cash contributions, NZDFI's total in kind contributions exceeded the original budget. The total of \$552,975 is more than twice the \$256,440 originally budgeted.



NZDFI SFF 10-034 Project Accounts Cash Expenditure (\$815.6k)



NZDFI SFF 10-034 Project Accounts In-Kind Expenditure (\$453.5k)



Commencement of NZFI SFF 13 024 project

NZDFI's strategy for the next six years is to pursue two parallel research and development programmes for which funding was sought separately (see Table 3 in Appendix 1).

These two programmes are:

1. Forest Operational Research and Extension

NZDFI was advised by Ministry of Primary Industries (MPI) last month that our application to the Sustainable Farming Fund for our planned 2013-2016 programme was successful. This application had been submitted by Marlborough Research Centre Trust on behalf of NZDFI in October 2012. Our new three year SFF project will be funded \$213,000 by MPI. This has already been matched by \$84,000 of cash co-funding over the three years by other NZDFI supporters.

This new SFF funding allows us to continue our current extension work programme that is engaging growers in learning successful establishment and effective early silviculture to manage durable eucalypts to maximise crop value. This project has multi-regional participation and builds on the knowledge and interest created by NZDFI since 2008.

With this grant NZDFI plans to:

- Establish a NZDFI landowner lead extension team with professional support to co ordinate the programme; to promote NZDFI's work through their regional networks and to inform others on how to plant and manage durable eucalypts.
- Design new post and pole regimes for all the demonstration trials and work with landowners and others to teach them best silviculture practice through regional workshops.
- Develop web based videos on best practice establishment and silviculture for NZDFI durable eucalypt species for growers to view 'on line' via the NZDFI website and linked to other industry supporters web sites.
- Develop an integrated GPS/GIS mapping and remote data capture system for working with our landowners to set up and measure at least 20 Permanent Sample Plots (PSPs) for five species (100 total) in our 11 demonstration trials.
- Deliver workshops/field days/hui to organic growers and iwi forest growers and conference presentations to new sector interest groups.
- Engage new growers by supporting them to establish more demonstration trials.

NZDFI will also monitor planting rates in 2015 through repeating the nursery survey that was conducted in 2011.

2. Tree Improvement programme:

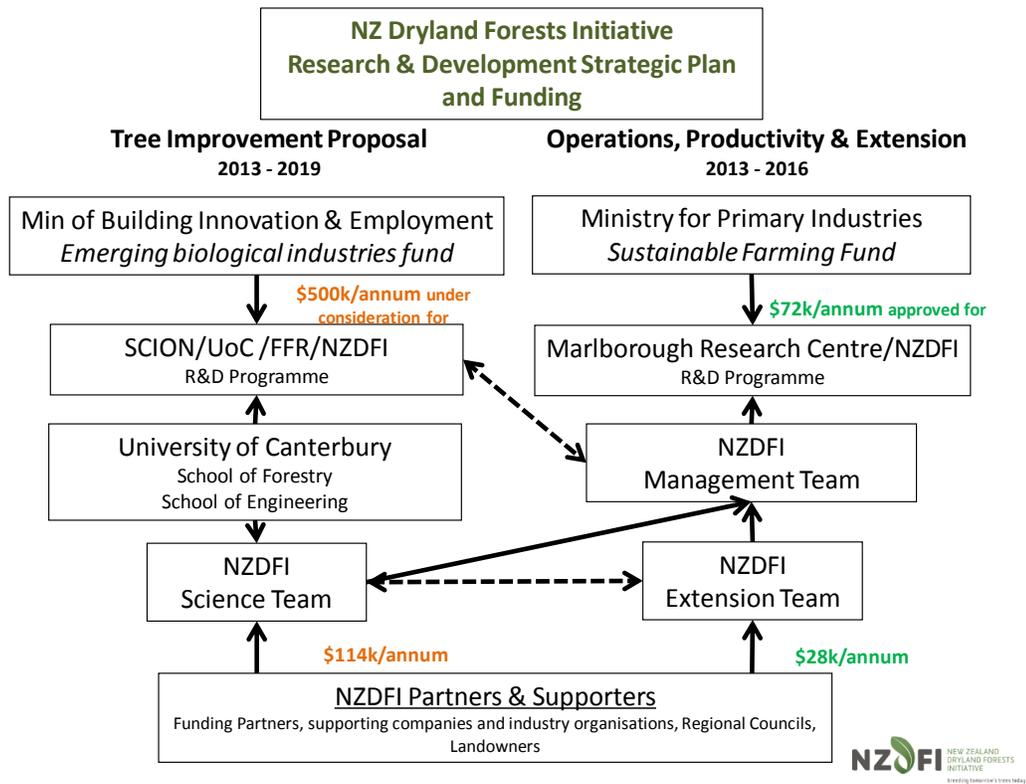
We plan a tree improvement programme led by University of Canterbury (UoC) that involves a novel large-scale sampling and selection strategy to enhance early heartwood formation, durability and intensity of colour, distinctive interlocked and straight-grain sub-populations, and improve wood properties. This programme attracted the interest of Future Forests Research (FFR). Following negotiation, early this year, we completed an agreement with Future Forests Research (FFR) and SCION to collaborate in seeking funding for our tree improvement programme as a part of SCION's wider research programme on diverse forestry species.

This agreement resulted in a collaborative FFR-SCION/NZDFI-UoC proposal being prepared and lodged by SCION in April 2013 with the Ministry of Building Innovation and Employment's (MBIE) for funding from its 'Emerging Biological Industries' portfolio. This proposal is for a 6 year R&D programme that, if successful, would deliver NZDFI \$610,000 per annum. A decision due in August 2013.

This funding will ensure that we can deliver genetically improved eucalypt planting stock to growers that will produce hardwood of superior durability and strength. NZDFI's R&D tree improvement programme has been included in SCION-FFR-UoC-NZDFI collaborative proposal for six year's funding under MBIE's Emerging Industries portfolio.

APPENDIX ONE:

NZDFI's Research and Development Strategic Plan



Anyone wanting further information should contact Paul Millen, NZDFI Project Manager 03 574 1001 or p.millen@xtra.co.nz

SUPPORTERS:

