Ministry for Primary Industries
Manatū Ahu Matua

Project Completion Template

Project Title:
Minimising growth-strain in eucalypts to transform processing

Project Number:
407602

Date of Report:
June 2019

The information from Sections 2 – 5 and Section 11 will be published on the Ministry for Primary Industries (MPI) website unless you advise us otherwise.

1. Milestone Summary Table

Milestone Number	Milestone [As per SFF contract schedule]	Completion Date		Percent Complete
		Original	Actual	
M-3377	Pruned 1st trial at Woodville	30/01/2016	25/01/2016	100
M-3457	Establish 2nd trial at Woodville	30/04/2016	19/02/2016	100
M-3458	Establish 3rd trial at Harewood for G x E analysis with Woodville data	30/04/2016	30/03/2016	100
M-3456	Demonstration workshops on early selection	24/06/2016	23/06/2016	100
M-3459	Peeling trial at NPI (Richmond)	30/06/2016	30/06/2016	100
M-3460	Pruned 2nd trial at Woodville	30/01/2017	9/01/2017	100
M-3461	Harvesting of 1st trial at Woodville	30/04/2017	11/01/2017	100
M-3462	Measure and analyse 1st trial at Canterbury	30/06/2017	1/05/2017	100
M-3489	1st Propagation of improved *E. bosistoana* and *E. argophloia* at Amberley	30/06/2017	22/06/2017	100
M-3703	Workshop & advisory committee meeting	30/06/2017	22/06/2017	100
M-3704	Harvesting of 2nd trial at	30/04/2018	10/04/2018	100

	Woodville			
M-3707	2nd Propagation *E. bosistoana* and *E. argophloia* at Amberley	30/06/2018	3/06/2018	100
M-3708	Final workshop	30/06/2018	20/06/2018	100
M-3706	Measure 2nd trial at Canterbury	30/06/2018	30/05/2018	100
M-3705	Harvesting and analysis of G x E trial (Harewood and Canterbury)	30/06/2018	29/06/2018	100
407602-M16	Trial maintenance	30/09/2018	29/08/2018	100
407602-M17	Trial assessment	31/03/2019	13/03/2019	100
407602-M18	Propagation of selected individuals	30/06/2019	15/05/2019	100

2. Project Objectives

(Why did you do this project? What were your key objectives at the start of the project? Outline if any of these objectives changed during the course of the project.)

The main objective was to create a new 2nd generation breeding population of *E. bosistoana* and *E. argophloia* with low growth-strain.

Growth-strain is a main wood feature, restricting plantation grown eucalypts to lower value products like pulp and paper, as they cause splitting and deformation in higher value solid wood products.

The success of the work led to a one-year extension to screen two additional durable eucalypt species, namely *E. quadrangulata* and *E. tricarpa*.

3. Approach

(What did you do – how did you go about it?)

First, breeding trials of the four species totalling more than 19,000 trees were established and then destructively measured for growth-strain at age ~2 years old. This was only possible, at this internationally unique scale, by employing a newly developed technique called the 'splitting-test'. Essentially a ~500 mm long pruned stem section is cut along the pith and growth-strain can quickly be assessed by measuring the deflection of the half rounds and sample geometry.

Secondly, the superior (i.e. low growth-strain) genotypes were rescued by clonal propagation from cuttings, which were sourced from coppice shoots growing from the stumps left in the field. Clonal propagation had never been done before for these species. More than 25,000 cuttings were set resulting in more than 10,000 potted plants.

4. What were the main findings from this project?

Growth-strain in the tested eucalypts was under genetic control (heritability of ~0.25) and independent of diameter (growth) but positively correlated to stiffness. Therefore, it seems possible to select fast-growing and low-growth-strain genotypes. However, these will have slightly reduced stiffness, what is not a major concern given the fact that the young trees were with ~11 GPa three times stiffer than radiata pine at the same age.

A propagation protocol was successfully developed for these durable eucalypts, by modifying procedures used internationally for clonal propagation of other eucalyptus species. As commonly experienced, propagation success varied with genotype. The first improved clonal breeding stock for *E. bosistoana* has been established.

5. What difference has this project made to your group / community of interest / industry?

(Include intangible benefits where significant — e.g. “enabled us to develop a strong on-going working relationship with the scientists”).

The project delivered the basis for the first improved planting stock of durable eucalypts being available from 2021 and successfully established 2nd generation durable eucalypt breeding trials.

The project increased the interest in durable eucalypts of the NZ forest and wood processing sector, with continuing financial and in-kind support from industry and government in aligned projects.

The data generated by this project is essential for the durable eucalypt breeding programme and will be used for identifying future selections and quantifying genetic gains.

6. If you did the project again what would you do differently?

(i.e. what worked and what didn’t?).

The initial strategy for selecting a superior low growth-strain landrace was to choose the best individuals from all families. However, it was realised in course of the project, that due to the low precision of the destructive ‘splitting test’ caused by the inhomogeneous stress field in the stems, only accurate estimates of family means can be obtained. Therefore, the selection strategy needs to be changed to superior families rather than individuals. As a consequence, the genetic diversity of the 2nd generation breeding population will be reduced. The genetic diversity of top material for clonal production is not affected.

A side objective of the project, aiming to quantify GxE effects, failed. This was due to an unfortunate choice of the second site, being compromised by frost and the too small scale (only 2 sites) of the work programme.

Propagation and peeling were successful, but also highlighting further points for improvement.

Extension/outreach worked well, leading to continuing support for the durable eucalypt programme.

7. Is there anything the SFF could have done differently?

SFF project advisors were helpful and managed the numerous handovers at MPI well.

8. Is there anything that you have learnt that would be useful for new project teams?

Success of such a SFF project requires a group of highly motivated people, who are willing and able to commit significant amount of time. Apart from having personal or financial interests in the project outcomes, adequate resourcing/funding is necessary.

9. Where to from here – what are the next steps?

Superior genotypes with low growth-strain (and other beneficial traits) have been identified. These have been deployed in 2nd generation breeding trials, which need to maintained and assessed. Further, top selections are grown as mother plants in a commercial clonal propagation from cuttings, with first improved planting material scheduled to be available in 2021. Also, the breeding values for the families will be used to create the next generation breeding population by controlled out-crossing. Finally, the age-age correlation for growth-strain should be verified, i.e. is selection at young age improved wood products at harvesting age.

10. Financial summary

Provide a brief comment as to whether the project was completed on budget; whether there is any grant money left unspent. There is a separate Financial Summary sheet you are also required to submit. Please ask your Project Advisor for this.

The project was completed on budget as shown in the attached Financial Summary.

11. List and attach any major outputs from the project.

Examples could include:

- Scientific reports
- Code of Practice/ Best Practice Guide
- Publications (booklets, posters, links to websites)

1. Schroeder, P., & Altaner, C. (2016). Propagation - a bottleneck in tree breeding programmes? New Zealand Tree Grower, November, 35-36.
2. Altaner, C., Murray, T.J., & Morgenroth, J. (Eds.). (2017). Durable Eucalypts on Drylands: Protecting and Enhancing Value. Christchurch, NZ: New Zealand School of Forestry. 123pp
3. Guo, F., & Altaner, C.M. (2018). Properties of rotary peeled veneer and laminated veneer lumber (LVL) from New Zealand grown *Eucalyptus globoidea*. New Zealand Journal of Forestry Science, 48(1), 3. doi: 10.1186/s40490-018-0109-7
4. Millen, P., van Ballekom, S., Altaner, C., Apiolaza, L., Mason, E., McConnochie, R., Morgenroth, J., & Murray, T. (2018). Durable eucalypt forests – a multi-regional opportunity for investment in New Zealand drylands. New Zealand Journal of Forestry, 63, 11-23.

If appropriate, we would like to publish a copy of the above on our website: please provide an electronic copy for this purpose preferably in Word format.

Report Confirmation

Name [Project Manager]	Confirmation	Date
Clemens Altaner	I hereby confirm the above information is true and correct:	18/06/2019

Submission Notes:

1. **Project Completion forms should be sent electronically** to your Project Adviser or attached to your final milestone in the Portal. Also attach electronic versions of any resources developed.

   Please ensure you put your project number in the e-mail's subject line: e.g., 400000 Final report 2011.

2. **Hardcopies of any project resources** developed should be **posted** to your Project Adviser at the following address:

   Ministry for Primary Industries

   Investment Programmes

   Level 7, Charles Fergusson Building, 34 – 38 Bowen Street,

   Wellington 6011, New Zealand