Growing confidence in forestry's future
Research Programme 2013-2019

Newsletter

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Welcome to the latest update of the six-year 'Growing Confidence in Forestry's Future' (GCFF) research programme (Oct 2013 - Sep 2019). The programme is now half way through its time and several research projects are producing significant results that will ultimately lead to changes in the tools being used and assessments being made, and the types of management interventions for increasing forest productivity. In this edition of the newsletter, several items are covered to highlight the progress to date.

Excellent support and a vote of confidence in the research programme and team was given by the Forest Growers Levy Trust as they recently funded four extra projects aligned to the GCFF programme for the next two years (July 2016 - June 2018) to the value of $1,990,000. These projects will accelerate and extend existing research within the GCFF programme. The projects are: Quantifying the impacts of genetics, silviculture and site on growth and quality; Fast tracking new foliar spray treatments; NuBalM in precision nutrient management; and Extension and further development of the phenotyping platform.

The research team has been very active in the field. Six silviculture breeds trials were assessed and a large number of new field trials were established, including two new accelerator trials (a cutover site in Kaingaroa forest and an ex-pasture site in Rangipo). New trials testing optimised nursery management strategies have been established at 46 sites along with other trials testing the response of mid rotation stands to new fertiliser treatments. These new trials will be major assets for the programme and will also form the basis for future research programmes.

Peter Clinton *(Programme Leader)* and the research team.

Research updates

Optimisation of chemical use in the nursery increased seedling growth by up to 7.5% compared with current practice at no additional cost.

Growth benefits from nursery management trials at Tokoroa ArborGen

Operational scale trials established in partnership with ArborGen Australasia have produced significant growth benefits for seedlings in the nursery. Root collar growth was increased by up to 7.5% through the optimisation of chemical use, with no negative effects for seedling health in the nursery. Further testing is now underway to determine the impact of the treatments on seedling nutrient content when leaving the nursery gate, and the effect on the beneficial mycorrhiza that grow on the seedling roots. To investigate the potential benefits for forest performance, 46 new plantation trial sites have been established around New Zealand with seedlings from this study, allowing post-nursery growth rates to be measured. Based on past studies, the extent of the benefits for plantation growth should be apparent within two to four years.

For more information, please contact *simeon.smaill@scionresearch.com*

The pathway to sustainable, cost-effective fertiliser use

Identifying options to make better use of existing and new nutritional amendments is one of the key aims of the GCFF programme. To help identify the current limitations and pressures on fertiliser use in New Zealand forests, Scion scientists recently reviewed past and current rationales for fertiliser

application, and the issues that are likely to influence application rates in the future. Fertiliser use to address critical nutrient deficiencies has been shown to be cost effective in various cases, but concerns around changes to wood properties and variable growth responses have largely limited the use of fertiliser as a productivity enhancement option.

Various projects within the GCFF programme are addressing these barriers by developing new systems to improve the efficiency of conventional fertilisers, testing the suitability of new nutritional products, and assessing the wider environmental impacts of fertiliser use in planted forests.

To read the full article, please see *http:// www.nzjf.org/new_issues/NJF61_ 2_2016/0A1B9406-B44A-448b-B77C- 32615B5BE00B.pdf*

For more information, contact *simeon.smaill@scionresearch.com*
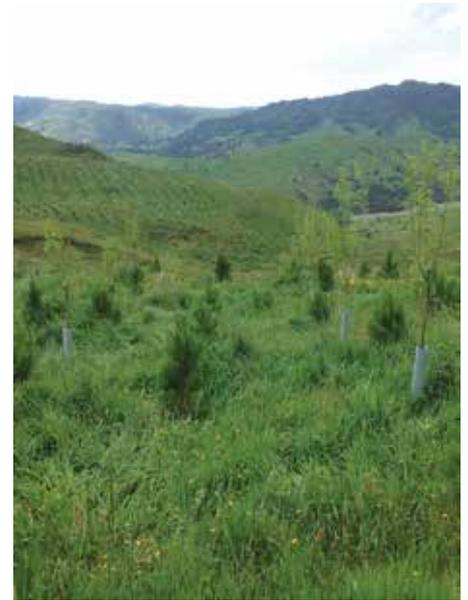
The second accelerator trial is on a fertile pasture site.

The third accelerator trial is on a cut-over site in Kaingaroa Forest.

Accelerator trials update

The second and third accelerator trials were established in the 2016 winter. The second accelerator trial is on a fertile ex-pasture site. The challenge with this site is to see if we can increase the productivity over and above what would be expected for an ex-pasture site and what will be the consequences for wood quality as a result.

The third accelerator trial is on a cut-over site in Kaingaroa Forest where the productivity gap is predicted (using Cabala) to be 13%, owing primarily to soil N/organic matter limitations to growth. This third trial is at a significantly lower elevation than the pilot/1st accelerator trial that was installed in southern end of Kaingaroa Forest in 2015. The focus of the experimental treatments will involve improving nitrogen availability, and the specific experimental treatments to be implemented there are still being determined.

Waikura Valley pine and willow trial update

Sustainable methods for preserving soil quality and preventing debris flows post-harvest on steep slopes are being explored in Waikura Valley. In steep country, post-harvest sites are vulnerable to intense weather events where the risk of erosion and debris flows are increased. There is a period of eight years post planting, ('window of vulnerability'), where the land remains vulnerable until canopy closure. The Whangaparaoa 2L Trust farm in the Waikura Valley has been granted East Coast Forestry Project funding to restore a large gully erosion site. This trial was incorporated into the restoration site with the Whangaparaoa 2L Trust providing in kind support.

The Waikura Valley trial on the East Coast of the North Island (112 km northeast of Gisborne) is trialling willow species Tangoio (*Salix matsudana x alba*) alongside *Pinus radiata* to measure performance of willows at slope stabilisation post planting. The aim of this trial is to measure the productivity of *Pinus radiata* planted in mixtures with willow to determine if there is any impact on growth of the pine. The trial has been designed to consider species and stocking effects. The site preparation was carried out in June/July 2015, tree planting occurred in August/September 2015 and in November 2016 the trial was measured for height, form, and survival.

Initial results show that the trial is now well established and has over 92% survival in both species. Mortality amongst the willows is predominantly due to browsing by deer. The trial runs for four years and will be remeasured in September 2017 and 2018.

Four newly funded FGLT projects to extend and accelerate existing GCFF research

The four new projects include:
1. The assessment of 17 additional silviculture breeds trials;
2. Fast tracking new foliar spray treatments by screening more products and establishing five additional field trials;
3. Extension and further development of the phenotyping platform with a focus on tree level and area based phenotyping, and;
4. Further development of the Nutrient

Balance Model (NuBalM) for use in precision nutrient management.

The fourth project includes two streams of research aimed to improve precision nutrient management through addressing the site specific application Nutrient Balance Model (NuBalM) and understanding onsite soil productivity drivers. The site specific application of NuBalM involves the collection of an independent validation data set that covers a range of soil nutrient

types. The validation data set will enable the model to be applied to a range of sites outside of the data set that has been used to parameterise and test NuBalM. The updated NuBalM will then enable a simple on site nutrient test (e.g. soil sample) to be used to calibrate the model without having to measure all forest ecosystem nutrient pools. Understanding of onsite soil productivity drivers involves using existing data and archived soil samples from the MfE LUCAS plots to improve confidence in soil productivity drivers. The findings will be used to further support site precision nutrient management.

Soil sampling video available soon

Following on from the two practical soil sampling workshops held last year there will be a set of short video clips made to support *'How to soil sample a forest'*. The short video clips will demonstrate the steps outlined on the three soil sampling flyers on how to:
1. identify the mineral soil surface,
2. chemistry sampling using a Hoffer,
3. bulk density sampling.

These video clips will be available at the end of this calendar year at *https://gcff.nz*

Engagement

Forest Genetics 101 workshop, LiDAR cluster meeting and the 3rd GCFF annual conference

These three events were held in May in Auckland and were attended by about 75 participants in total and included members from industry, government and research organisations.

The Forest Genetics 101 Workshop "What is it and why should I care?" consisted of both talks and hands on activities - covering the basics within forestry and beyond to understand some of the tools that gene technology can bring to the forestry industry. The topics of the four sessions were: introduction to DNA, quantitative genetics, molecular genetics, and genetic engineering.

The LiDAR / phenotyping cluster meeting included presentations on: area based

and tree phenotyping; prediction of leaf area index from LiDAR; national LiDAR acquisition (through LINZ) and potential uses; recent examples of the benefits of working with multiple parties to reduce LiDAR acquisition costs; and future research directions, moving towards precision forestry.

The annual GCFF research programme conference theme was 'Management of Risk in Forestry' and included a field trip to Riverhead and Woodhill forests. Keynote presentations included: Productivity, risk, and the environment: Trends in the US and broader over the last 25 Years by W Hyde, USA; A European perspective on risk management in forestry, with a particular focus on wind by Barry Gardiner, France; Sustainable intensification: how far can we go? by Tim Payn, New Zealand; and, the value of the industry Licence to Operate by Kit Richards, New Zealand.

The conference presentations are available at *https://gcff.nz/news-andevents/gcff-2016-conference-presentations/*

Phenotyping Platform workshop, 11 October, Napier

This workshop was held prior to the FOA Research meeting in Napier in October and provided a forum to discuss with industry members the proposed form of the phenotyping platform and how industry might use the platform. The workshop provided very useful feedback and highlighted the importance of good inventory and record keeping as the basis for developing and using the phenotyping approach. The results of the workshop will help us to deliver a framework for the next three years in order to deliver a useful outcome for industry.

Annual Forest Growers Research Conference, 12-13 October 2016, Napier

Selected results from the GCFF programme were presented to the Forest Growers Research Conference in Napier. They had a focus on the interactions of GxExS on wood properties (John Moore), intensification and wood properties (Dean Meason) and the long term impacts of intensive organic matter management (Loretta Garrett). Peter Clinton gave an overview of these three presentations highlighting the value of long term research and the contribution that existing long term trials were making to the programme as evidence in presentations of John, Dean and Loretta. The current investment in new trial series is sowing the seed for future research programmes and on-going investment in capability and infrastructure will ensure that the GCFF programme fully capitalises on existing and new long term trials.

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Other events

The GCFF research team presented ongoing work at a meeting with the Lake Taupō and Lake Rotoaira Forest Trusts in Taupō on February 2016 including 'Sustainable production over multiple rotations' by Loretta Garrett and other GCFF related work. This interaction led to the establishment of one of the new accelerator trials.

The fifth Forest Ecosystem Services (FES) Forum was held in Wellington and again was well supported by the forest industry, local and central government and several members of the GCFF research team presented their research. The presentations of the FES forum are available at *http://www.scionresearch.com/general/news-and-events/events/past-events/forest-ecosystem-servicesforum-2016*.

Planning is underway for the 2017 forum so watch this space.

Collaboration and international linkages

World forestry congress

The World Forestry Congress (WFC), managed by the Food and Agriculture Organization of the United Nations (FAO), is held every six years and brings together the largest gathering of the world's forestry sector to share their expertise and experiences. In 2015, the XIV WFC was held in Durban, South Africa from 7-11 September, attracting just under 4000 participants from 142 countries. The theme for the congress was 'Forests and people: Investing in a sustainable future'. This was the first time the WFC was held on African soil. Attending from Scion were Tim Barnard, Tim Payn and Brenda Baillie.

Forests and water were an integral component of the Congress programme with a two day side session dedicated to an International Forests and Water Dialogue. The session provided the opportunity to hear from key world presenters on issues relating forests and water, participate in discussion groups and to present Scion's work in this area via a conference paper and poster session. The Forests and Water session was used as a platform to launch the Forest and Water – a five-year action plan, and, as a result of contacts made during this time Brenda Baillie was invited onto the IUFRO soils and water task force.

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Brian Strahm, Virginia Tech, Visitor based in Christchurch

Nitrogen in the ecosystem and the productivity responses to nitrogen fertiliser is a key research area in the GCFF program. Brian Strahm from Virginia Tech will be visiting Scion for six months from January to June 2017 to become part of the research team and boost the capability in this area. Brian is an associate professor in the forest resources and environmental conservation department of Virginia Tech and his research focus is highly relevant to current issues in New Zealand regarding forest productivity, land use intensification/change, and water quality.

Bernadette Nanayakkara was successful with her application to the Royal Society Catalyst Fund to work with Dr Cyrille Rathgeber at INRA in France to study the intra-annual dynamics of cambial activity and wood formation. This fund allows for scientific exchanges that will provide access to world class facilities in France. This collaboration will significantly enhance the work on understanding the process of wood formation, which in turn will help us to predict what the impacts of future change might be on the wood quality of radiata pine.

Dr Scott Leavengood, Director of the Center for Wood Innovation at Oregon State University visited Scion for a short sabbatical. He is working on developing a better understanding of intra-ring checking in radiata pine which is of interest to many Oregon wood processing companies who work with this species. He is also sharing his knowledge and experiences around linking end product performance back to forest management.

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Looking ahead

Innovation cluster meetings

- **Product Quality Improvement innovation cluster** – on issues related to wood quality and resource characterisation. Workshop, 29 November 2016, Rotorua. For general enquiries email John Moore at *john.moore@scionresearch.com* or phone 07 343 5425.

- **Puruki field trip 2017**
- **Phenotyping/LiDAR Innovation Cluster Meeting**, March 2017, Dunedin. For general enquiries email Mike Watt at michael.watt@scionresearch.com or phone 03 364 2987 ext 7823.
- **Sustainability workshop** on steep land erosion and debris flow mitigation experiences, mid-2017 (TBC).

Fourth Annual GCFF conference, 28-30 March 2017, Dunedin.

National Forest Ecosystem Services (FES) Forum, May 2017 (TBC).

Selected recent publications related to the GCFF programme

1. Dickson, A., Nanayakkara, B., Sellier, D., Meason, D., Donaldson, L., Brownlie, R. 2016. Fluorescence imaging of cambial zones to study wood formation in Pinus radiata D. Don. *Trees – Structure and Function*. Available on line 28th September 2016. DOI: 10.1007/s00468-016-1469-3

2. Smaill, S.J.; Garrett, L.G. 2016. Multi-rotation impacts of increased organic matter removal in planted forests. *J. Soil Sci. Plant Nutrition* **16**, 287-293.

3. Coker G, et al (2016). *Track-sprayer screening trials for testing mid-rotation treatment options*. Technical note of the 'Growing Confidence in Forestry's Future (GCFF) research programme, RA1.2, GCFF TN-12, 12 pp.

4. Moore J et al (2016). *The potential of in-forest segregation using an acoustic tool on a harvester head*. Technical note of the 'Growing Confidence in Forestry's Future (GCFF) research programme, RA1.1, GCFF TN-11, 5 pp.

5. Pearse G, Watt SM, Morgenroth J. (2016). *Refined models of leaf area index from LiDAR*. Technical note of the 'Growing Confidence in Forestry's Future (GCFF) research programme, RA2.1, GCFF TN-09, 7 pp.

6. Smaill S et al (2016). *Interim report on the results of N response trials outlining the best combination of foliar, soil and climatic predictors of fertiliser response (LTSPII)*. Report of the 'Growing Confidence in Forestry's Future (GCFF) research programme, RA2.1, GCFF, 16 pp.

7. Watt MS, Kimberley MO, Dash JP, Harrison D. (2016). *Use of productivity indices to spatially predict optimal final stand density, value and the economic feasibility of pruning'*. Technical note of the 'Growing Confidence in Forestry's Future (GCFF) research programme, RA2.1, GCFF TN-10, 5 pp.

8. Yao, R. T., Harrison, D. R., Velarde, S. J., & Barry, L. E. (2016). Validation and enhancement of a spatial economic tool for assessing ecosystem services provided by planted forests. *Forest Policy and Economics*, **72**, 122-131

To learn more about the research projects in the programme:

Contact Dr Peter Clinton at *peter.clinton@scionresearch.com*

Visit the programme website http://gcff.nz/

To receive our newsletter and information on upcoming GCFF events go to *www.scionresearch.com/subscribe* and sign up.

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