Update on research and development programmes managed by Forest Growers Research Ltd

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Figure 1: Biomass chipping at G.J. Hunger Contracting Ltd, Taranaki

Abstract

Forest Growers Research Ltd is an industry-owned research management company that facilitates and delivers R&D programmes for the benefit of the New Zealand forest growing sector. More than 20 programmes and projects are supported by co-funding from the Forest Growers Levy, industry, government and universities. These projects include genetic improvement, nurseries and propagation, silviculture, biosecurity, harvesting and transport, and environmental projects. The science and innovation facilitated by Forest Growers Research is critical for improving and future-proofing the industry. This paper includes an update on three of the key research programmes – Automation and Robotics, Specialty Wood Products and Precision Silviculture – and comments on the challenges and opportunities ahead.

Introduction

In the mid-1980s, the funding and management of forest research moved from being largely state-funded to a user-pays model, with industry creating research cooperatives covering radiata and eucalypt breeding, seed orchard management, site management, plantation management and growth modelling. This system provided the main means of engagement between industry and researchers for more than 20 years.

Then in 2007, following a review by forest owners, it was recommended that the funding and organisation of forest growing research be put on a more professional and commercial footing, with industry investing more in the upfront scoping and identification of research needs and priorities. This resulted in the formation of an industry-owned company, Future Forests Research Ltd, to coordinate and manage forest growing research on behalf of those providing the funding. Under this model, control over the research programmes lay with those providing the industry funding via a trustee shareholding arrangement.

In 2013, forest growers voted to introduce a compulsory commodity levy from 2014 to more fairly share the load of industry-good activities, such

as research, biosecurity and promotions. This meant that the industry had to organise itself differently and, most importantly, improve communications across a broader range of stakeholders. Future Forests Research was renamed Forest Growers Research to better align with its purpose and the levy trust funding, and the shareholding was transferred and held in trust for the broader industry. A Board – Forest Growers Levy Trust (FGLT) – was established to govern the levy collection and investment process along with evaluating research outcomes. An industry Forest Research Committee (FRC) was also installed to make recommendations to the FGLT on proposals for funding support.

A strong science and innovation sector is considered critical for future-proofing the industry and its ongoing success. The Forest Growing Science and Innovation Strategy 2020–2035 states that industry needs to be more agile and future-focused, with the following three key drivers:

- Continued changes in forest ownership and the potential for non-traditional investment
- Changing markets in response to pressure for circular bio-economies
- The need for our forests to be more resilient to deal with future threats.

The Science and Innovation Strategy also provides the overarching strategic framework for R&D investment, with three core themes and suggested levy allocation:

- The sustainable profitability of our core plantation forest resource (50–60%)
- Other trees species, contingency species and other forest systems (10–20%)
- Protecting and future-proofing our industry and growing community support (25–35%).

Currently, the Forest Growers Levy Trust invests 60% of the levy Work Programme costs each year in research, and in the 2022 calendar year this amounted to $5.4 million across about 20 projects/programmes. Forest Growers Research works hard to leverage that funding, and total support for the overall research portfolio was close to $20 million. The extensive range of research initiatives extend right across the value chain from advanced biotechnology through to harvesting and supply chain logistics.

Figure 2 shows the allocation of funds across the Research and Development portfolio. The red box highlights the five main programmes. Three of these programmes are now discussed in more detail –Automation and Robotics (A&R), Specialty Wood Products (SWP) and the Precision Silviculture Programme (PSP). The A&R programme has been operating for four years, SWP finished at the end of 2022 and the PSP commenced in 2022. The paper is rounded off with some comments on strategic issues, challenges and opportunities ahead.

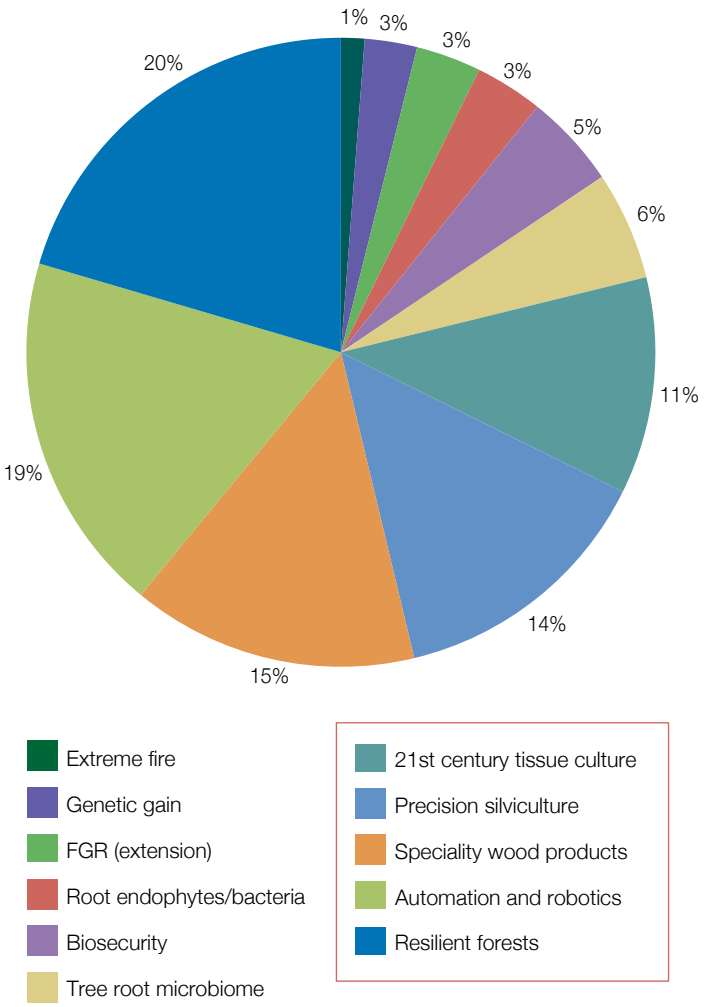

Figure 2: Percentage allocation of the $5.4 million levy funds across the Research and Development portfolio in 2022

Automation and Robotics (A&R) – Te Mahi Ngahere i te Ao Hurihuri

This seven-year Primary Growth Partnership programme with the Ministry for Primary Industries commenced in 2019 and follows the successful Steepland Harvesting Programme (2010–2017). The goal is to optimise the forestry supply chain by creating more value, improving profitability and enhancing sustainability through the design, development and commercialisation of innovative harvesting and log sort yard technology. There is a strong emphasis on increased automation and robotics.

The programme involves a consortium of leading forestry companies and 10 machinery manufacturing/engineering partners. There are three main project areas (with more than 20 individual projects underway):

- New automated technology
- Human factors in automation
- Commercialisation and deployment.

To date, specific achievements in the A&R programme include:

- An Automated Tower Hauler and Grapple to increase cable-logging automation and efficiency. Rosewarne and May Ltd has developed an integrated carriage and hauler and this is undergoing trials.
- In the Improved Residual Biomass Management project, several current chipping and biomass processing operations have been studied in Otago, Taranaki and Canterbury (Figure 1).
- In the Automated Log Tagging and Tag Reading project, automated log marking will improve log tracking and traceability, and reduce bottlenecks at log-scaling stations and at ports. Otmetka AB, the Swedish technology developer, has completed the technical design and build of the log marker, and it is now being installed on a Woodsman processor (Figure 3). Pocket Solutions Ltd, who are developing technology to read the log mark, will undertake further punch code readability trials when the log marker is installed and tested under New Zealand logging conditions.
- The Automatic Quick Coupler, manufactured by Steelwrist in Sweden, enables rapid change-over of machine attachments, so the same base machine can be used for multiple operations without lengthy delays while attachments are switched. The coupler has been installed on a Sumitomo 300 base machine and is currently undergoing field tests with a local harvesting contractor in the Waikato region. (Figure 4)

Figure 4: Steelwrist SQ80 coupler with Waratah 624 processor attached (note processor cradle)

Figure 3: Otmetka log marker prototype ready for installation on Woodsman processor

Figure 5: Trinder Engineering auto tensioner mounted on a log trailer

- The Automated Log Load Securing project has developed an automated log truck load securing system suitable for all logs, including debarked and slippery logs. The system developed by Trinder Engineering Ltd includes: a chain placer mechanism to eliminate manual chain throwing; an auto tensioner (Figure 5) to eliminate manual chain tensioning and maintain chain tensions automatically throughout the trip; and a real-time load monitoring system, including in-cab monitoring.

Specialty Wood Products Partnership (SWP)

The SWP is a seven-year partnership between Forest Growers Research, the Ministry for Business Innovation and Employment (MBIE), research providers and industry partners and officially finished in December 2022. The programme focused on:

- Developing improved breeding stock to overcome current wood quality and forest health issues (Figure 6)
- Transforming processing options for species other than radiata pine, namely, Douglas-fir, eucalypts and cypresses (Figure 7)
- Developing a new naturally durable eucalypt resource.

The long-term vision is to encourage regional investment in specialty species and four regional business cases or strategies have been developed to identify implementation pathways for the key outputs from the SWP.

The SWP has identified and developed market sectors, including naturally durable timbers, engineered timbers (such as LVL and CLT), and high-value applications that make the most of the attractive colours and grain of some specialty species. Over 150 technical reports have been produced, reporting on the clear wins that are beginning to emerge for all the species in the programme, and both small- and large-scale growers stand to benefit.

Figure 6: Assessing genetically improved eucalyptus seedlots in the Dryland Forestry Initiative

Cypresses and Douglas-fir

A 20-year Cypress Strategy has been produced to encourage investment in the Cypress industry.

Figure 7: Strength testing of Douglas-fir CLT element

Thermal modification technology of both Cypress and Douglas-fir improves durability and creates more product options for these species.

A structurally efficiency and cost-effective wall joint for Douglas-fir CLT has been proven, with the wall-hold down joints successfully repaired after testing. This would make building remediation after an earthquake event much faster and cheaper. These connection results provide valuable technical information for engineers to design mass timber structures utilising Douglas-fir CLT to resist seismic loads.

Non-durable eucalypts

Eucalyptus fastigata LVL (laminated veneer lumber) was shown to have significantly higher stiffness than typical radiata LVL and it is believed that this species could be commercially bonded with standard phenolic formulations to make plywood or LVL.

Eucalyptus nitens flooring product produced from trees grown for pulp showed very good performance when compared to a commercially available oak flooring product.

Eucalyptus nitens OEL (optimised engineered lumber) achieved stiffness levels of SG12, providing an opportunity to upgrade some of the *E. nitens* resources to higher value products.

Durable eucalypts

Peeling of young (15 years) durable *E. bosistoana* showed very high stiffness values for the veneer (16.6 GPa).

A vineyard post survey in Marlborough found the rate of breakage of *E. bosistoana* and *E. globoidea* posts had been a fraction of the breakage rate of radiata posts (0.3% compared to 5%).

Significant plantings have been established to demonstrate the growth and performance of durable eucalypts and annual sales of seedlings are rapidly increasing.

With the completion of the SWP in December 2022, work is progressing on developing a new long-term research programme with industry and government support. The aim is to realise the potential that alternative species have in diversifying the forest industry and the broader bioeconomy, and also their role in helping New Zealand meet its emissions reduction targets.

Precision silviculture for the 21st century (PSP)

The PSP is the latest in the Forest Growers Research portfolio and was formally launched in May 2022. This $25.5 million, seven-year programme aims to transform commercial forestry by adopting mechanisation, automation, digital technologies and robotics throughout the silviculture value chain. There are five main workstreams:

1. Nursery Automation
2. Precision Planting
3. Mechanised Pruning
4. Mechanised Thinning
5. Management of Digital Data.

The programme is being co-funded by Forest Growers Levy, the Ministry for Primary Industries' Sustainable Food and Fibre Futures (SFF Futures) fund and the industry.

Early work has focused on establishing the Programme Governance Group (PGG) and leadership teams for each of the workstreams, along with the development of workplans and contractor engagement.

Technology scans have been completed on developments overseas, to check for relevance to New Zealand conditions. Work is underway to develop automation solutions for forest nurseries and trials have been done on automated post-planting spot spraying with an unmanned aerial vehicle (UAV). Pruning trials have been undertaken to evaluate improved hand-held tools, and also test a new mechanised pruning machine developed by Hudson Clearwood Ltd (Figure 8).

The programme is also developing data standards to ensure the interoperability and consistency between different machines that are used for different silvicultural operations.

This programme is attracting much interest and support from across industry, government and communities. It has the potential to significantly transform the way silvicultural operations are implemented, managed and monitored.

Key strategic issues

The Forest Growers Levy is successfully funding collaborative research for industry, enhancing partnerships, with shared goals and the common vision of improving the productivity, profitability and sustainability of forests and forestry in New Zealand. Forest Growers Research Ltd manages that part of the levy allocated to annual forestry research programmes and is recognised as an experienced research management company with a good track record for delivering industry-good research outcomes.

These outcomes are aligned with, and guided by the vision of, the Forestry Roadmap to 2050 and the Forest Growers Science and Innovation Strategy. A key feature of Forest Growers Research's success has been the ability to leverage co-funding, partnerships and collaboration with forestry-aligned research providers, well connected to today's challenges and future opportunities. Scion, University of Canterbury, Lincoln University and the Marlborough Research Centre are some of the key research providers in this group, and they contribute to the successful delivery

Figure 8: Hudson Clearwood pruning machine undergoing field trials

of research and results that are applicable to small, medium and large forest growers.

This forest research funding and management model operates within the wider New Zealand science system, which is centred on National Science Challenges and Crown Research Institutes (CRI's). To many, however, the system is considered no longer 'fit for purpose', with structural and funding challenges making it difficult for funding to be more future-focused on big challenges such as climate change and environmental degradation.

It has also been difficult to secure long-term funding and support for high-quality applied research and, for research providers like Scion, this has been a significant problem with impacts on recruitment and retention of staff, critical mass, viability and capability of research programmes and teams. Many of these issues are widely recognised and are being considered in the current government review of the science system (Te Ara Paerangi – Future Pathways White Paper).

There are also initiatives, such as the Climate Emergency Response Plan (CERF) and the Forestry and Wood Processing Industry Transformation Plan (ITP), which are expected to enhance research funding and collaboration. Industry is already actively engaged in these processes through direct partnerships and a range of committees and advisory groups. The SFF Futures fund is also supporting a range of initiatives across the primary sector and is currently co-funding the Precision Silviculture Programme.

The science system review, initiatives and funding sources can be expected to lead to increased investment in forestry research. The time is right, as we see increasing awareness by society that forests and forestry are well positioned to respond to many economic, environmental, social and cultural challenges in New Zealand. This includes the increasing interest in more species diversification and the significant opportunities that could flow from a fully functioning circular bio-economy. More proactive strategies, greater engagement with stakeholders and new iwi owners, better training and education, and much larger financial investment, collaborations and partnerships will be required.

The industry needs to adapt to changes in societal expectations and be committed to continual improvement. The global transition to bio, and circular, economies represents a massive opportunity for fibre producers, but one that will only be properly capitalised on with a comparable investment in research.Sustainability, social licence and kaitiakitanga are ever-evolving terms and forestry, from cone to customer, needs to adapt in parallel. To do this, it will rely on research results to provide the ways and means.

The future is exciting, the challenges are real and the opportunities are huge. Science and innovation are critical for future-proofing the industry, addressing the challenges and making the most of the opportunities. Forest Growers Research is looking forward to playing its role in managing and delivering outcomes that help move the industry forward for the benefit of the nation, regions and communities in New Zealand.

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