LINCOLN AGRITECH LTD

Annual Review 2024

Next-generation Innovators

LINCOLN AGRITECH LTD

Engineering and Science for Agriculture, Industry and the Environment

Contents

Our Ambition

We deliver innovative research and development of responsive, sustainable solutions that enable industries and communities to thrive globally in a healthy environment.

Our Expertise

Lincoln Agritech is a multidisciplinary, independent research and development company and is a 100% subsidiary of Lincoln University. We have a long track record of delivering leading-edge science and engineering solutions for primary industries and the environmental sector.

We have expertise in several important areas:

- **Environmental Research:** We provide expertise in water-related research, focused on understanding and measuring groundwater systems. As part of this expertise, we supply tools to regional and central government and water users, to manage groundwater quality, nitrogen impacts, and water allocation, enabling a sustainable future for water resources. This includes design and deployment of novel sensors.
- **New Materials:** We develop new high-value materials from biological sources, including coarse wool and plant-derived cellulose. We partner with industry, including the Wool Research Organisation of New Zealand, and focus on commercial applications of new materials.
- **Biotechnology:** We develop novel biologically based solutions for replacing fertilisers and pesticides to enhance plant growth. We also develop microbial-based solutions to improve product yields from plant-based material through novel enzyme applications.
- **Green Futures:** We develop engineering-based methane mitigation and CO_2 removal technologies and smart sensing machine vision approaches. We also have AI and digital agriculture expertise and strength in electromagnetics. These technical solutions target agricultural productivity improvements and climate change mitigation, realise new revenue streams, and improve decision-making across the primary industries.

Our commercial initiatives and partnerships include:

- IRRICAD™: A world-leading computer software system for designing pressurised irrigation systems, which we sell in more than 90 countries, and which is available in eight languages. It is used by the world's largest irrigation company, Netafim, Nelson Irrigation in the USA, and other leading irrigation design companies.
- Wool Source: a company formed by the Wool Research Organisation of New Zealand to commercialise transformative wool fibre research developed in partnership with Lincoln Agritech.
- Hydro-Metrics: a business providing ground- and surface-water assessment of nitrate and other pollutants, selling in nine countries.
- Autonomous Pivot: an overseas company licensing our technology for sensing soil properties from irrigation pivots and providing real-time control.
- TDRI: a New Zealand company licensing our technology for sensing sub-surface moisture to measure infiltration under road surfaces and provide valuable predictive maintenance data.

Chairman & CEO's Report

Lincoln Agritech Chairman, Bruce Gemmell.

Lincoln Agritech CEO, Travis Glare.

Welcome to Lincoln Agritech's 2024 Annual Review. This past year has been one of change and challenges in the research and development landscape and wider ecosystem.

Despite the many challenges, Lincoln Agritech staff have delivered some groundbreaking research and projects, contributing to our aim of delivering cutting-edge solutions for New Zealand's primary industries.

In this publication you can read about our many successful projects, but also you will see a focus on our world-class innovators. Our teams have worked tirelessly to develop innovations that address real-world issues, enhancing crop yields, improving resource efficiency, and contributing to a more sustainable future.

The staff of Lincoln Agritech are our greatest asset, and it is good to see some of our younger staff receiving accolades for their efforts. Two of our emerging researchers, Alice Sai Louie and Jeff Lang, received significant honours this year, and you can read about their achievements on page 5. We attracted several new staff bringing years of experience to our teams. It is encouraging to see the science teams grow, even in the face of significant financial challenges across the sector.

In 2024 Lincoln Agritech, largely under the leadership of our interim CEO Richard Gordon, reorganised to increase focus on our clients and their needs. That increased focus led to an internal restructure to three highly motivated teams, New Materials and Biotechnology, Green Futures, and Environmental Research. These groups better reflect Lincoln Agritech's strengths.

We have also expanded our reach through key partnerships and collaborations with industry leaders, research institutions, and government bodies.

Our Environmental Research Group has initiated a large study on understanding how long-term changes in climate are affecting water quality, using the Waikato River as the test ground. This five-year research project is an example of our commitment to New Zealand's sustainability in the face of climate pressures. The group is also doing important work on defining and delineating the sub-surface component of New Zealand's braided rivers. This research includes establishing a nationally consistent methodology for delineating braided rivers, empowering more informed land-use planning and infrastructure development.

The Green Futures Group has been active in atmospheric methane conversion, investigating cost-effective catalysts for converting methane to carbon dioxide or value-added products under ambient conditions. This research is crucial for helping New Zealand achieve its 2050 methane reduction goal.

Our research project to find more sustainable, cheaper, longer-lasting, and better-performing

battery materials is ongoing and showing great promise. The goal is to develop a large database of new compounds suitable for battery use, with simulations showing promising accuracy.

The Biotechnology team is reporting success in using microbial consortia to accelerate the hemp retting process. Our preliminary research has demonstrated the potential of microbial consortia to significantly accelerate hemp retting, providing a foundation for further work to develop the consortia for commercial application. As well, a Smart Idea project to manipulate fungi-associated bacterial communities to combat plant fungal diseases has been developing novel fungal biocontrol agents for pathogenic fungi afflicting New Zealand's high-value export crops. You will also find a case study explaining how we helped Sealord to turn fish waste to fertiliser.

The New Materials Group is building on its success in developing new materials from wool to create smart, functional, high-performing keratin structures for biologically derived export products. This also builds on the strong relationship with Wool Research Organisation of New Zealand (WRONZ). And the group has also been extracting valuable proteins from sheepskin waste, another fascinating case study you can read in this review.

As an organisation we continue to look for opportunities to develop our and our clients' IP into new products and even companies. Hydro-Metrics, a new start-up based on nitrate sensors developed by Lincoln Agritech, is now operating and doing great things. Our own in-house irrigation software product IRRICAD™ added a new capability in centre-point pivot design in 2024. There are opportunities to keep more of the IP in New Zealand and establish companies, an area where Lincoln Agritech has knowledge and a dedicated business development team to assist.

We are grateful to our dedicated team, valued partners, and loyal clients for their steadfast support and trust. Together, we have accomplished great things, and together, we will continue to shape the future of our primary industries.

LINCOLN UNIVERSITY
TE WHARE WĀNAKA O AORAKI

Lincoln Agritech is a wholly owned subsidiary of Lincoln University.

Next-Generation Innovators

Groundbreaking research from next-generation scientists

Lincoln Agritech has a history of nurturing young scientists and engineers to grow into the innovation leaders of tomorrow – and 2024 was no exception.

We hosted interns from New Zealand and the Netherlands, all at different stages of their science and engineering studies. We also celebrated the successes of two of our own early-career scientists.

In September Research Scientist Alice Sai Louie and Postdoctoral Researcher Jeff Lang were among just 19 finalists in Falling Walls Lab Aotearoa New Zealand.

Falling Walls Lab is a global search for world-changing ideas from students or early-career scientists. They each have three minutes to pitch their concept, with each national winner competing in a global grand finale.

Alice Sai Louie

Alice, who is also a PhD candidate at the University Canterbury, won second place in the national competition for her concept "Breaking the Wall of Hidden Water". She proposes repurposing existing fibre optic telecoms networks to measure groundwater in real time, which could be a game-changer for flood prediction and monitoring, especially in low-lying cities.

"Traditional methods for measuring groundwater rely on sparsely distributed sensors, which often miss the complexity of groundwater flow," says Alice. "Using distributed fibre optic sensing lets us monitor along the length of the cable, which is kilometres long. This gives a far more detailed picture of how water is moving underground."

Lincoln Agritech is pursuing this idea, proposing a research project to develop technology that characterises and predicts shallow groundwater dynamics and risks. Such technology will help to manage the placement and protection of important infrastructure and prevent flooding and water contamination.

While Jeff was not placed in Falling Walls, he later won an Aotearoa New Zealand Tāwhia te Mana Research Fellowship, worth $820,000 over four years, to research his concept for improving our understanding of New Zealand's earthquake history.

"In young countries such as Aotearoa New Zealand, our knowledge of the long-term recurrence of large earthquakes is limited because our written records are short," says Jeff. "This affects our ability to assess earthquake risk."

In caves, stalagmites record changes in groundwater chemistry, often over millennia. For his PhD at the University of Auckland, Jeff worked with a research team that hypothesised that when earthquakes fracture cave rocks this briefly raises magnesium in the groundwater above them. The stalagmites should record that as a magnesium pulse.

"By analysing and dating stalagmites near major historic earthquakes we can test this hypothesis which, if true, could help to greatly extend our country's seismic record," he says.

Jeff Lang

Jeff is focusing his research on caves in Hawkes Bay, which is on the Hikurangi Subduction Margin, Aotearoa New Zealand's largest and least understood source of earthquake risk.

Collaborating with local kaitiaki, Jeff will analyse samples from selected caves to identify the magnesium signatures of historic earthquakes.

He will then develop a tool for determining earthquake intensity from measured magnesium. It will be calibrated against the shaking intensity of known past earthquakes, based on mātauranga Māori and records from 1840 on.

The aim is to produce a continuous earthquake record for Hawkes Bay for the Holocene – the period since the last ice age.

Ultimately, the method Jeff develops in this research could be used to uncover the record of past earthquakes held in caves worldwide.

Next-generation water insights – expanding understanding

Expanding understanding of water has been a cornerstone of Lincoln Agritech's research for many years, and 2024 was no exception.

We revealed world-first insights into how braided rivers work; began a five-year study into how increasing CO_2 is affecting the Waikato River; collaborated on national maps indicating where groundwater nitrate contamination is or is not likely to be problematic; and asked new questions about the problems shallow groundwater is likely to cause with climate change.

Braided rivers

This final year of our five-year MBIE-funded research, leading a team of national and international scientists, developed new insights into how braided rivers and regional aquifers interact. The findings highlight the key role of 'braidplain aquifers' and the need to consider the entire river system, not just active channels.

Braidplain aquifers are thin deposits of loose gravel with less fine material than the surrounding sediments. They can be below and/or beside the wetted channels and act as a shallow storage system. The river transfers water to the braidplain aquifer, which then transfers water to the regional aquifer.

In some settings the braidplain width controls how much water leaks into the regional aquifer, while in other settings, bed-level elevation controls leakage. So, the way we manage rivers can decrease or increase the amount of water recharging our aquifers.

"This work has important implications for understanding how changes in river management, such as extracting surface water,

bank training and gravel extraction may impact groundwater recharge," says project lead Scott Wilson.

Climate change and freshwater

This $10 million, five-year, MBIE-funded project is investigating how increasing CO_2 is changing the Waikato River's water quality, the hypothesis being that increasing CO_2 is driving incremental acidification of the Waikato River, which affects freshwater quality. Researchers aim to develop a model that predicts harmful algal blooms in freshwater systems and the effectiveness of preventative measures.

In 2024 researchers laid the groundwork, including commissioning and building the Waikato River monitoring infrastructure. This was no mean feat, as Lake Karapiro is one of the busiest hydro lakes in the country.

The team is now looking forward to the teasing out what the incoming data is telling us.

National maps show nitrate risk

In partnership with ESR, our scientists produced new national maps showing where groundwater nitrate contamination may exist – even in untested areas.

Nitrate contamination varies because of differences in land use, but also because of differences in groundwater's natural denitrification potential.

The new model uses information on variables such as soil, geology, and hydrology linked to wells where the redox (oxidation and reduction) state is known, to predict the groundwater redox state in areas without existing data. This indicates the denitrification potential.

The maps, based on a modelling methodology developed and refined over the past decade, are available on the Data Supermarket developed by the National Science Challenge Our Land and Water.

Ongoing engagement

Our Environmental Research team engages with many stakeholders about the impact and importance of our work, including fellow researchers and regulators.

In 2024, we presented to conferences including the New Zealand Hydrological Society and the Water NZ Stormwater conference. We also presented to regulators such as the Hawkes Bay Regional Council, Marlborough District Council, and Environment Canterbury, and to the wider community through webinars.

Our researchers continue to expand knowledge on the complex interactions between water, human activity, and the environment.

Next-generation batteries – lowering the impact

As the world moves to more sustainable forms of energy, efficient rechargeable batteries are becoming more and more important.

Now a three-year search to find more sustainable, cheaper, longer-lasting and better-performing battery materials is showing promising results, one year into the project.

In late 2023 Lincoln Agritech Research Scientist Joseph Nelson (Ngāti Tūwharetoa, Ngāti Raukawa) received a $360,000 grant from the Marsden Fund to search for new lithium-ion battery compounds, using high-performance computing.

Lithium-ion batteries are used for everything from mobile phones to EVs. But the materials needed for those batteries – such as cobalt and nickel – can be rare, environmentally damaging to extract, and subject to fluctuating availability and price because of geopolitical instability.

"We need to sever our dependence on those materials," says Joseph.

Several research teams around the world are investigating the potential of a few selected compounds, but Joseph is taking a different approach.

"Finding new, improved materials that hopefully lead to more efficient batteries and lower environmental impact can happen in one of two ways," he says.

"In the past, we've used mainly lab-based experiments, but that takes a lot of time and a lot of labour, so it is quite expensive."

Joseph's trying the second way – using high-performance computing to investigate hundreds of thousands of possible compounds.

That computing power comes from NeSI – New Zealand eScience Infrastructure, which offers high-performance computing capability to researchers. By March 2025, this project had used more than 2,287,455 core hours, which is equivalent to 65 laptops running 24 hours a day for a year.

"We're looking at different relative ratios of these compounds and running programs to predict their crystal structure and stability," Joseph says.

"Since setting up and starting, I've focused largely on the oxide metals. There are already some compounds that show potential."

While the past year has been about setting up and testing a small number of elements, the data generated will be used to train machine learning so that over the next two years it can search even more quickly and efficiently.

NeSI's computing power means that very large numbers of possible compounds – hundreds of thousands to millions – can be tested in parallel, rather than having to run the calculations sequentially.

The aim, by the end of the three-year project, is to have a large database of new compounds that are likely to be suitable for battery use.

"The computer simulations have pretty good accuracy," says Joseph. "So, if a particular compound looks promising in simulations, there's more than a 90% chance that its properties in real life will turn out to be exactly what the simulations say."

Next-generation keratin – growing a new export market

A new five-year, $10.4 million research project aims to grow a new wool-based manufacturing export sector.

In 2024 Lincoln Agritech was awarded MBIE Endeavour Research funding for the project, *Smart, functional, high-performing keratin structures for new biologically derived export products.*

The aim is to develop keratin biopolymer products that capitalise on wool keratin's unique structure, including reversible shape and volume change and controlled breakdown.

"There is a lot of global interest in biological-based materials that have the functionality to replace synthetics and are environmentally sustainable," says project leader Rob Kelly.

"We aim to develop products for diverse market areas, such as products that control the release of microbes in soil, textile fibres with silk-like properties, garments that respond to the environment to control wearer comfort and ruminant boluses for controlling greenhouse gas emissions."

The project has been established with the strong support of the Wool Research Organisation of New Zealand (WRONZ).

It also builds on Lincoln Agritech's established wool-science capability, developed while working with WRONZ over the past nine years to establish new, profitable markets for the wool industry. Together they have developed products that offer sustainable, innovative solutions for the print, textile and personal care industries, and have received a strong positive response nationally and internationally.

"Developing new, innovative uses for New Zealand crossbred wool through rigorous research programmes with commercial applications is consistent with WRONZ's strategy to support growers," says Andrew Morrison, WRONZ Chairman.

"It also adds a long-term product pipeline to the first generation of new wool-based products currently being introduced to the market by WRONZ subsidiary Wool Source," he says. "Developing innovative new uses for wool, alongside the increasing popularity of wool-based products like carpets, will provide a much-needed boost to farmers and the industry."

This new project brings together the world's leading scientists in the field to focus on solving industry challenges and creating export opportunities for New Zealand.

Project research collaborators include bioengineering Professor Kit Parker of Harvard University, biointerfaces scientist Associate Professor Dr Jenny Malmstrom of the University of Auckland and keratin structural scientist Dr Duane Harland from AgResearch.

Initial progress is promising, with researchers having identified methods of maintaining the structural hierarchy that naturally occurs in keratins.

"Establishing a substantial and rigorous science-based programme to develop long-term market opportunities is one step towards establishing a secure long-term future for the sector," says Rob.

Key Research

Our Outcomes

When working with partners, Lincoln Agritech aims for its research to contribute meaningfully to one of six outcomes. They are:

1. Growers can increase productivity sustainably
2. Businesses can extract higher value from natural materials
3. Growers and industry have tools for managing greenhouse gas emissions
4. Climate change impacts are predicted and mitigated
5. Government and industry can develop strategies for managing clean, accessible and efficiently used water
6. Industry has access to novel sensing for animal and plant health, crop and stock management.

In the following pages we outline some of our work, and how it is helping to achieve these outcomes.

Fish waste to soil fertiliser

2

Working with: Sealord

Overview: Industrial processing of fish frames creates a high-protein waste product. With Sealord, our Biotechnology team determined whether this waste could be used as a fertiliser to promote plant growth and support soil microbial communities.

We performed plant trials to identify the optimal dilution factor for plant growth promotion and to benchmark the product's performance against competitor offerings. We also worked to fortify the product with additional nutrient sources, including seaweed, to improve growth promotion.

We assessed the product's impact on soil microbial communities through microbiome analysis of bacteria and fungal communities over a nine-week period. We also monitored shelf-life stability, which included monitoring proliferation of naturally present microbes to support the selection of suitable preservatives.

Impact: Our research scientifically demonstrated the positive impacts of the fish waste when used as a fertiliser, supporting Sealord in the launch of a commercial fertiliser product, Sealord Naked.

Emerging climatic pressures on freshwater

4

Working with: Universities of Waikato, Auckland and Otago, Lincoln University, Victoria University of Wellington, Waikato Regional Council, Waikato River Authority, Waikato River Iwi (Waikato Tainui, Ngāti Maniapoto, Ngāti Korokī Kahukura), Mercury Energy, WaterCare, and Ministry for the Environment.

Overview: Our understanding of change in freshwater systems is evolving to see freshwater as a biogeochemical system, influenced by more than just changes on the land (e.g. nitrate leaching or erosion). Rather, we are investigating the effects of globally rising air temperatures and increasing atmospheric CO_2 levels. We believe these trends are changing the boundary conditions of surface waters and driving metabolic shifts in these ecosystems.

The Emerging Climatic Pressures project is an MBIE Endeavour Programme, which takes a holistic view of freshwater systems and seeks to understand how long-term changes in Earth's climate, and in particular rising CO_2 pressures, are influencing water quality, particularly in terms of algal growth patterns in the iconic Waikato River.

In our first year, we have developed an extensive monitoring infrastructure in the Waikato River, including three fixed monitoring stations, and a profiler buoy on Lake Karapiro, which continuously records CO_2 pressure and related water quality variables within the water column.

We have also completed fortnightly water sampling and analysis to develop a well-rounded dataset from which to develop computational models and test our study's overarching hypotheses. Additionally, we welcomed five PhD candidates into the programme across our partner universities and are excited to integrate their work alongside our research partners to generate new scientific understanding and impact for New Zealand.

Impact: Our Environmental Research team is leading this multi-institutional project and generating novel insights into previously hidden processes. By revealing the climatic drivers of changing water quality in the Waikato River, we are assisting in future-proofing ecosystem health, and the water supply to around one-third of New Zealanders.

Braided river mapping

5

Working with: Waterways Centre at the University of Canterbury

Overview: New Zealand's braided rivers are poorly defined in the Resource Management Act (RMA) because they contain land, water, gravel and sediments simultaneously. This has contributed to poor outcomes when braided rivers are managed for various purposes.

The Natural and Built Environments Act (NBEA 2023) expanded the definition of a "river bed", however the Ministry for the Environment identified that further work was still needed to delineate the bed of a braided river.

With the Waterways Centre at the University of Canterbury, which has been working on the visible portion of braided rivers, Lincoln Agritech has been working on methods to define and delineate the sub-surface component of braided rivers. This is work that has led on from our Sub-Surface Processes in Braided Rivers MBIE Endeavour research programme completed in 2024.

The team has delivered phase one of this programme and is currently working on delivering phase two in June 2025. Our work has required collaboration and open discussions with regional councils, central Government, NIWA and collaborators from North America and Europe.

Impact: Our goal is to establish a nationally consistent methodology for delineating braided rivers, empowering more informed land-use planning and infrastructure development. This will reduce flood exposure and strengthen our resilience to the growing risks posed by climate change.

Extracting valuable proteins from sheepskin waste

2

Working with: 3EO

Overview: Working with Christchurch-based biotech startup 3EO, Lincoln Agritech tackled the complex problem of extracting valuable proteins from whole sheepskins, a significant waste issue for the New Zealand red meat industry.

With an applied focus and targeting a product outcome from the outset, the project spanned research and development on the extraction and characterisation of the complex protein mixtures present in the waste material, through to the chemical engineering and pilot-scale operation of the process developed and culminated in commissioning trials at full manufacturing scale.

The Lincoln Agritech team worked closely with 3EO staff at the company manufacturing site to ensure maximum success and impact of the protein extraction process developed. We had commercial operation of the process in mind from the outset, and this ensured rapid uptake of the new biological extraction process at scale.

Impact: As a direct result of the Lincoln Agritech work, 3EO subsidiary Tertiary Extracts Ōtautahi launched the branded ingredient Ovitage®, "the world's most complete collagen", as well as Everee Women®, a consumer brand of collagen supplement women's health products "for every age and every stage of a woman's life". The technology is a finalist in the 2025 Fieldays Innovation awards.

Characterising sea ice using novel radar technology

4

Working with: University of Canterbury, University of Otago

Overview: How much sea ice is there, how does it drive climate change, how is it affected by climate change, and what does that mean for the future of our planet?

Lincoln Agritech is part of a team led by the University of Canterbury aiming to measure the largest stretches of Antarctic sea ice in history and shed light on its role in a warming climate.

In previous years we developed a snow radar, one of three parts of an aerial device known as an "EM-bird", with which we hope to assess the characteristics and thickness of pack ice in the Western Ross Sea. This work is funded by the Marsden Fund.

In 2024, we developed new algorithms to more precisely extract snow depths from pack ice measurements and explored measuring the brine layer intrusion on McMurdo Ice Shelf from the air.

We also made several improvements to the snow radar, updating the software safeguard codes to deal with intermittent instrument failures, and introducing new operating procedures.

However, our season on the ice was frustrated by logistical problems, including aeroplane unavailability and equipment failure, which meant we had to cancel the airborne field work.

But by collaborating with the University of Otago, we ran a ground-based measurement campaign on sea ice at McMurdo Sound, including snow radar and electromagnetic induction surveys, together with ground truth validations.

With the preferred aeroplane not available in 2025, we are now assessing the practicalities of an alternative approach in 2026.

Impact: The data produced from this multi-year project will greatly help in measuring the impacts of climate change. The project aims to provide the basis for developing a satellite-derived measure of coastal sea ice thickness and data sets that can be used to develop robust computer simulations.

Hemp retting

1

Working with: Rubisco

Overview: Extracting hemp fibres involves a retting (rotting) process that helps to separate the fibres from the hurd on the hemp stem. Field retting of hemp prevents the productive use of land for up to six weeks and presents challenges in maintaining consistent fibre quality.

Our research involved adding microbes with specific enzymatic activity (pectinase, ligninase, cellulase) to accelerate the retting process, so land could be available for productive use sooner. We isolated a collection of bacteria and fungi with desired enzymatic activity. We then assembled various consortia consisting of microbes with complementary enzymatic activity and assessed them for their effectiveness in hemp retting assays.

Lab-based assays identified an optimal consortia that significantly accelerated the hemp retting process. The effectiveness of this consortia was further demonstrated in a preliminary field trial.

Impact: Our research demonstrated the potential of microbial consortia to significantly accelerate hemp retting. This preliminary research provides a foundation for further work to develop the consortia for commercial application.

Field trials of hemp retting at days 0, 14, and 28.

Spin-out of Hydro-Metrics from Lincoln Agritech

5

Who is involved: Lincoln Agritech developed HydroMetrics nitrate-sensing technology over several years, using our deep expertise in environmental sensing. In July 2024 a new independent commercial entity, Hydro-Metrics Ltd, was established to advance New Zealand's only 'home grown' optical nitrate monitoring business. Lincoln Agritech continues to offer technical, research, and business support.

Overview: Rapidly growing demand for precision nitrate monitoring technologies was, in 2016, behind the creation of HydroMetrics sensors. Lincoln Agritech's researchers identified a critical gap in the market: the need for a robust, affordable, and highly accurate nitrate sensor that did not require specialist technical skills to use. The result was the HydroMetrics GW50™ optical nitrate sensor, which has since become well-established in the environmental monitoring field.

This spin-out reflects the technology's maturity and growth potential.

Hydro-Metrics' flagship product, the GW50™ sensor, stands out for its slim-line design, ease of use, exceptional accuracy, automated cleaning system, and ability to operate in demanding environments with minimal maintenance. The sensors are deployed in a wide range of applications, from groundwater monitoring on farms to wastewater compliance and large-scale water supply systems.

Impact: Elevated nitrates in water systems are a pressing issue worldwide, impacting everything from agricultural runoff to the health of aquatic life and drinking water supplies. HydroMetrics sensors mitigate these risks, arming communities and industries with the ability to safeguard precious water resources.

By empowering industries, governments, and environmental organisations with precise, real-time data on nitrate levels, the company aims to support these communities to make a lasting contribution to environmental sustainability.

Hydro-Metrics Managing Director Andy Matheson (left) seals the spin-out deal with Lincoln Agritech Interim CEO Richard Gordon.

Manipulation of fungi-associated bacterial communities to combat plant fungal disease

1

Working with: Scion, Utrecht University (Netherlands)

Overview: More than 19,000 fungi are known to cause disease in plants worldwide, resulting in an estimated 10-15% reduction in global crop yields, annually. But the eco-toxicity of synthetic fungicides means we need biological alternatives to control plant diseases.

Lincoln Agritech is leading this project, which is funded by the Ministry of Business, Innovation and Employment's Endeavour Fund. Our novel approach to biocontrol of pathogenic fungi is to manipulate bacterial communities (add or remove bacteria strains) associated with the fungi to develop fungal derivatives that reduce disease symptoms and prime the plant's defence response.

We have proved that associated bacterial communities can increase fungal virulence, as disease symptoms decrease after removing the bacterial community. We have also found that one bacterial species reduces disease severity when added to the fungal pathogen. Most importantly, the phenotype (symptoms, pattern of infection etc) we saw on our model plant Arabidopsis also occurs on commercial brassica.

At the end of the year Dani Joy, a third-year student at the University of Canterbury, became involved in the project as an intern through the Pūhoro STEMM Academy. She actively participated in our science programmes, helping us to transfer the methodology we had learned from the Arabidopsis and its fungal pathogen Alternaria to wheat and its fungal pathogen *Zymoseptoria*.

Impact: To develop novel fungal biocontrol agents for pathogenic fungi afflicting New Zealand's high-value export crops (e.g. white rot on onions, scab on apples and pears, and grey mould on grapes), we need to successfully manipulate associated bacterial communities. We believe the new knowledge we develop will have broad applications, including combating fungal diseases in animals and humans. And by engaging Pūhoro STEMM Academy students through internships we can support iwi aspirations to upskill and build the capability of next-generation leaders.

Research Scientist Jin-Hua Li (centre) with Pūhoro STEMM interns Dani Joy (left) and Lani Rotzler Purewa.

Adding centre pivot design capability to IRRICAD

5

Working with: Nelson Irrigation Corp., local industry

Overview: Approximately 11.5 million hectares of cropland worldwide are irrigated by centre pivot irrigation systems, making their design and installation a crucial component of efficient water use in the modern irrigation landscape.

In 2024 we updated IRRICAD™, our world-leading irrigation design software, focused on the rigorous, yet streamlined, theoretical design of pivots.

Working with our industry partners, and consulting with local industry experts, we identified the primary needs of both designers and clients. The resulting new pivot module allows for the fast layout, analysis, and modification of centre pivots in IRRICAD designs. We also included various graphical summaries, such as elevation and wheel gradient variation under the pivot, to analyse performance.

Impact: The centre pivot module was added to IRRICAD v21, making it significantly quicker and easier for designers to model pivot pressure and flow demands within the IRRICAD system. In the future, there is significant scope to enhance the pivot module to further improve accuracy and usability for our clients.

Digital technologies for plant health, early detection, territory surveillance and phytosanitary measures (STELLA)

6

Working with: Agricultural University of Athens (project lead), and 12 other European universities and research institutions, including seven sensing and risk assessment companies. In New Zealand the project works closely with the apple industry, namely in its "Smart & Sustainable" project, co-funded by MPI's Sustainable Food and Fibre Futures programme (SFFF).

Overview: The Horizon Europe STELLA project aims to develop a holistic digital system (STELLA PSS) to help implement early warning and detection of regulated pests by using modern sensing technology and artificial intelligence.

STELLA's New Zealand research on bull's eye rot *(Neofabraea alba)* is a use-case study collaborating with the "Smart & Sustainable" (S&S) project to explore infection drivers and collect data. In 2024, Lincoln Agritech investigated the New Zealand industry's *N. alba* risk assessment through interviews.

Plant & Food Research trials in the S&S project, supported by two Hawkes Bay orchards (Mr Apple and Johnny Appleseed) provide a base for studying *N. alba*. In 2024, Lincoln Agritech collected sensor-based data for the PSS risk modelling, using Eden Core's (Greece) canopy sensor for fruit counts and crop density, and Metos' (Austria) spore samplers for droplet splash transport. We are planning PCR analysis for *N. alba* spore counts.

New Zealand's counter-seasonal timing made its use-case study the first to collect data. This was an exemplar for STELLA's other five use cases, presenting in a webinar details of our orchard exploration, setup, and data collection.

Impact: Policy recommendations generated through the STELLA PSS findings will be targeted to policy and decision makers, aiming to support the European Commission's goals of reducing pesticide use, managing priority plant pest outbreaks, and promoting digitalisation of European Union agriculture and forestry.

Atmospheric methane conversion using cost-effective catalysts under ambient conditions

3

Working with: Tsinghua University, Zhejiang University (both China), and the University of Canterbury

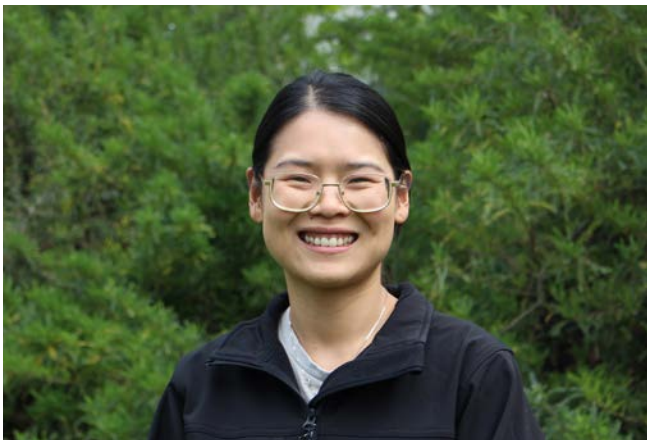
Overview: With methane recognised as the main contributor to agricultural greenhouse gas emissions in Aotearoa New Zealand, effective technologies are urgently required to help the country reach its 2050 methane reduction goal.

We have employed an electrochemical method to convert methane to carbon dioxide or, alternatively, value-added products such as formic acid. But to optimise this approach, it is crucial we understand the methane conversion mechanisms.

Supported by the Catalyst: Leaders Fund from Royal Society Te Apārangi, we have established new collaborations with outstanding electrochemistry researchers from Tsinghua University and Zhejiang University, both in China, to investigate the reaction mechanisms using cutting-edge instruments.

We also collaborated with the University of Canterbury to further explore the reaction mechanisms by working in the Australian Synchrotron facility.

Impact: These strong new collaborations have enabled us to bridge fundamental research with agricultural business needs, as we work on providing advanced tools to help Aotearoa New Zealand achieve its 2050 goal of reducing biogenic methane emissions by 24 to 47% below 2017 emissions.



Research Scientist Ting Wu established important collaborations with Chinese universities.

Our Ecosystem

High-value bio-resource inspired products

WOOLSOURCE

FAR

TEO
TERTIARY EXTRACTS ŌTAUTAHI

Waterways science and predictive modelling tools

Waikato Regional Council
Te Kaunihera ā Rohe o Waikato

Waterways Centre

Marlborough District Council

Farm productivity and green energy solutions

Bluelab

DairyNZ

Ballance agri-nutrients

New Zealand Apples & Pears

Irrigation design and nitrate management

Autonomous Pivot

Central Plains Water Ltd
Sustainable water growing our world.
Mā te tauwhiro wai ka fipu tō tātou ao.

IRRICAD™
IRRIGATION DESIGN SOFTWARE

Mātauranga Māori relationships

PŪHORO
He Waka Eke Noa

Whanaketia te Mātaurana

International partners

Funded by the European Union

STELLA

AgriFutures® Australia

NZ Research and network partners and government

Lincoln University
Te Whare Wānaka o Aoraki

NIWA
Taihoro Nukurangi

Victoria University of Wellington
Te Herenga Waka

Ministry for Primary Industries
Manatū Ahu Matua

Ministry for the Environment
Manatū Mō Te Taiao

Ministry of Business, Innovation & Employment
Hīkina Whakatutuki

SEALORD

And confidential commercial companies

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

aqualinc

HAWKES BAY REGIONAL COUNCIL
TE KAUNIHERA Ā-ROHE O TE MATAU-A-MĀUI

Zespri KIWIFRUIT

DairyNZ

Zespri KIWIFRUIT

GROUNDSPREADNZ
Excellence in Nutrient Placement

FOREST GROWERS RESEARCH

PREDATOR FREE 2050

ravensdown

And confidential commercial companies

HydroMetrics

Utrecht University

TECHNISCHE UNIVERSITÄT DRESDEN

GRIFFITH UNIVERSITY
QUEENSLAND AUSTRALIA

LA TROBE UNIVERSITY
AUSTRALIA

AARHUS UNIVERSITY

CAWTHRON

UC UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

SCION
FORESTS • PRODUCTS • INNOVATION

AgriTech NEW ZEALAND

KiwiNet
Kiwi Innovation Network

University of Otago
ŌTĀKOU WHAKAIHU WAKA

iRANZ

NZ Product Accelerator

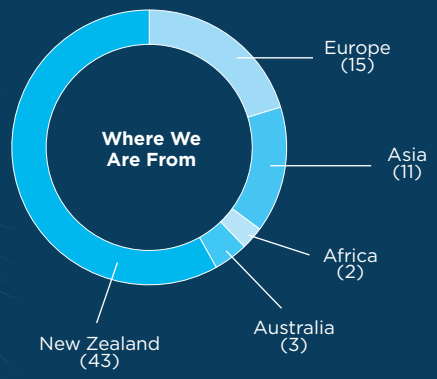
agresearch
āta mātai, mātai whetū

ROYAL SOCIETY TE APĀRANGI
EXPLORE | DISCOVER | SHARE

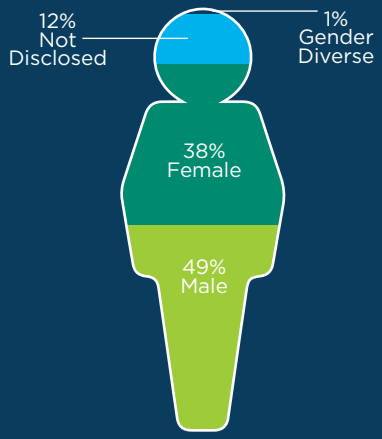
Our People

What We Look Like

LAL Staff Profile as at the 31st December 2024

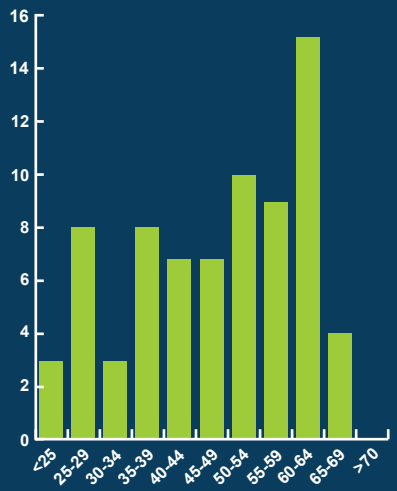


Staff Gender Ratio



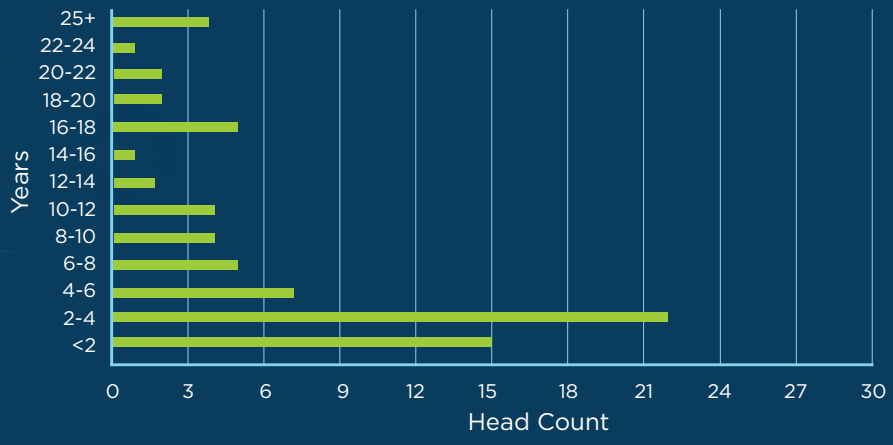
Total Staff: 74

Age Profile



Our Gender Equality Plan has been established to enable us to deliver on our commitment to create an environment where our people are treated equally, regardless of their gender identity. This plan includes leadership, career progression, awareness, sexual harassment, and organisational culture.

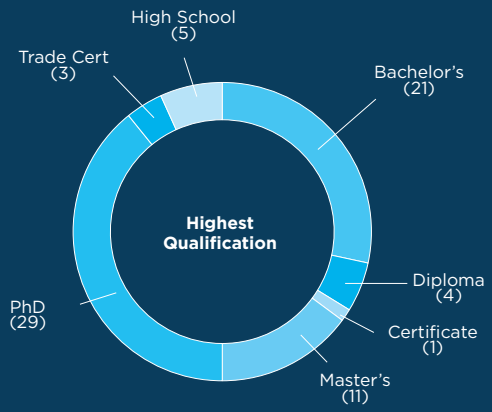
Length of Service

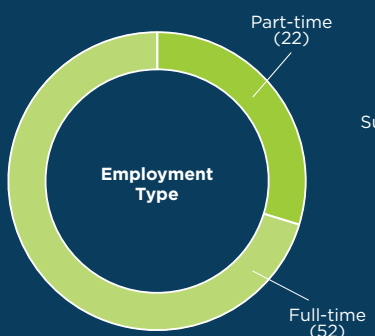


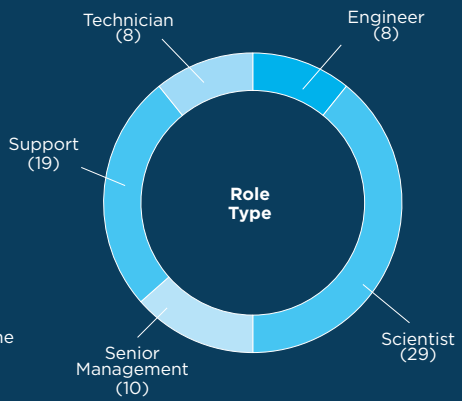
Turnover

Appointments 11
Departures (Voluntary) 8

Turnover for 2024 was 10.19%







NB: Short fixed-term, casuals, and students omitted.

Board

Bruce Gemmell
Chair

Bruce was appointed Chancellor of Lincoln University in January 2019 and joined the Lincoln Agritech Board in June 2019. He is a chartered accountant and former senior partner at international accounting firm EY.

Julia (Jules) Chambers

Jules has spent over 30 years working in the DeepTech space internationally, initially with corporates such as Eli Lilly (UK) and Genzyme (US). She has significant experience in commercialisation at the intersection of science, technology and market opportunity, working with Kiwi start-ups and entrepreneurs.

Olivia Egerton

Olivia is an experienced manager with a track record for professionally delivering strategic projects, partnerships and events in primary industry, master-planned property development, and arts, heritage, and culture.

Prof Grant Edwards

Professor Grant Edwards is the Vice-Chancellor of Te Whare Wanaka o Aoraki, Lincoln University. He holds a Bachelor of Agricultural Sciences (Hons) from Lincoln University and a DPhil from Oxford University. Professor Edwards has worked in both the UK and New Zealand as a researcher, academic, and university leader.

Senior Leadership

Travis Glare
Chief Executive

Professor Travis Glare joined Lincoln Agritech as Chief Executive in November 2024. He is also Professor of Applied Entomology at Lincoln University and co-founder and Chief Science Officer of the contract manufacturing company Biosouth Ltd and Managing Director of Agroceutical Products NZ Ltd. Travis has a background in insect pathology, molecular biology and biopesticide development (including fermentation), as well as commercialisation of research.

Richard Gordon
Interim Chief Executive

Richard joined Lincoln Agritech as interim Chief Executive in January 2024, leaving in November. His career had been dedicated to research and science. Between 2011 and 2022 Richard was CEO at Manaaki Whenua. He was also a director of Toitū Envirocare, New Zealand's largest carbon emissions certifier. Richard is a governance group member of the New Zealand Agricultural Greenhouse Gas Research Centre and is on the Pāmu Board's Sustainability Advisory Panel.

Anya Hornsey
Group Manager, Business Development & Marketing

Anya has an academic background in intellectual property and business administration and a long history of working with researchers and innovators to secure funding and commercialise technology across a range of sectors.

Armin Werner
Group Manager, Precision Agriculture / Principal Science Advisor

Armin has a background in agronomy, crop modelling and sustainable land use development. He specialises in novel agricultural production systems, with a strong focus on digitising and automating agriculture and forestry and the impacts of new technologies on primary industries. At the end of 2024 he took up the new role of Principal Science Advisor.

Senior Leadership

Ian Woodhead
Chief Scientist/Emeritus Research Fellow

Ian has more than 40 years' experience in sensor development. He is a member of the Institute of Electrical and Electronics Engineers (IEEE) and board member of Lincoln University's Centre for Soil and Environmental Quality. Ian was awarded the Royal Society Te Aparangi's Scott Medal in 2017. Ian stepped down in 2024 and became our first Lincoln Agritech Emeritus Research Fellow.

Jane Carr
Financial Controller

Jane has a Bachelor of Management Studies (Hons) from the University of Waikato. She is a Chartered Accountant with membership of Chartered Accountants Australia & New Zealand and the Institute of Directors. She has worked in a variety of finance roles in both Auckland and Christchurch.

Joanne Hay
Group Manager, Sensing & Biotechnology / Research Office Manager

Jo has a PhD from the University of Canterbury and completed a postdoctoral fellowship at the John Innes Institute (UK). She has a background in molecular biology, plant viruses and biosensor development, as well as R&D project management. She led the Sensing & Biotechnology Group until December 2024 when she became Research Office Manager.

Kirsty Macdonald
Human Resources Manager

Kirsty has a Bachelor in Business Management, with a major in employment relations. She has extensive human resource management experience in New Zealand and the United Kingdom.

Phil Dewar
Group Manager, IT

Phil has over 30 years' experience in the design and development of specialised engineering software. Phil has worked at Lincoln Agritech since 1982. He has extensive irrigation industry knowledge and is an expert in theoretical and practical irrigation solutions.

Rob Kelly
Group Manager New Materials /New Materials & Biotechnology

Rob studied chemistry at the University of Cambridge (UK), completed a PhD at the University of Otago and then a postdoctoral fellowship at Lincoln University. He has managed R&D teams in New Zealand science institutes, including the Wool Research Organisation of New Zealand. At the end of 2024 Rob also became responsible for the biotechnology team.

Simon Pollock
Group Manager, Environmental Research

Simon has an MSc from the University of Otago and is a Certified Environmental Practitioner. Simon is focused on working with collaborators and partner organisations to advance scientific knowledge, particularly in the areas of water resources and environmental science.

David Rankin
GreenTech Team Leader/ Group Manager Green Futures

David has a Bachelor of Engineering and PhD in Electrical and Electronic Engineering from the University of Canterbury. He joined Lincoln Agritech as a Senior Research Scientist, before becoming the leader of the GreenTech team, focusing on greenhouse gas mitigation. He is now leader of the Green Futures Group, which encompasses our GreenTech, Sensors, and Digital Ag teams.

New Arrivals

Julie Beer

Julie Beer joined Lincoln Agritech as an Executive Assistant, to provide support for the Chief Executive, Financial Controller, and Business Development & Marketing Group Manager. Julie has previously worked in the science and research, education, agriculture, and commercial sectors. She is an experienced executive assistant who enjoys optimising workflow and enhancing efficiency.

Nevan Ofsoski

Nevan Ofsoski joined Lincoln Agritech's Hamilton office in the new role of Key Account Manager. He has a Bachelor of Horticulture Science, NZ Certificate in Biology, and Diploma in Tertiary Teaching. Since Nevan's first role as a Science Technician for DSIR Soil Bureau, he has always enjoyed working with scientists who are making innovations and solving industry problems.

Ash Hyland

Ash Hyland joined Lincoln Agritech as a Human Resources Advisor. Ash has a Bachelor of Business from Massey University, majoring in human resource management and employment relations. She has worked in areas of HR including recruitment, process improvement, employee engagement and culture as well as generalist HR support. At Lincoln Agritech she undertakes a generalist role supporting our kaimahi (employees) in all people-related matters.

Helen Rutter

Helen Rutter joined Lincoln Agritech as a Senior Research Scientist. She has worked as a hydrogeologist for more than 30 years, including 16 years with the British Geological Survey in the UK and Botswana, followed by another 16 with Aqualinc Research. Her areas of interest include groundwater and freshwater quality (particularly nitrates), transport processes in groundwater, drinking water quality and protection, climate change impacts on water resources, ground source heat pump systems, shallow groundwater hazards, and earthquake impacts on aquifer systems.

Alice Sai Louie

Alice Sai Louie joined Lincoln Agritech as a Research Scientist in the Environmental Research team. Alice's research focuses on surface water/groundwater interaction in braided rivers, investigating how river loss varies seasonally at a high spatial resolution. Her research uses heat as a tracer using novel Active-Distributed Temperature Sensing (A-DTS) methods.

Awards & Achievements

In September two young Lincoln Agritech Scientists, Alice Sai Louie and Jeff Lang, presented in the finals of Falling Walls Lab Aotearoa New Zealand.

Each had three minutes to pitch their world-changing new ideas. Alice's concept, "Breaking the Wall of Hidden Waters", proposed a solution to the difficulty of measuring shallow groundwater across large areas, such as cities, in real time. Jeff's concept was titled "Breaking the Wall of Earthquake Forecasting" and proposed a new way of measuring prehistoric earthquakes. Alice won second prize in the event.

In November Senior Research Scientist Helen Rutter was awarded the Services to the New Zealand Hydrological Society Award at the society's annual conference. Dr Rutter served as a member of the society's executive committee for around 10 years. She was chosen for the award, which recognises past and ongoing contributions to the society and the promotion of the science of hydrology, by the current executive committee.

In December, Joseph Nelson, who is an Associate Investigator with the MacDiarmid Institute received a Mātauranga Māori Research Programme Award to advance the Institute's goals of developing innovative science approaches and techniques based on Mātauranga Māori.

Joseph was also involved in one of two successful proposals in the 2024 e-ASIA Joint Research Programme scheme organised by MBIE, in the field of alternative energy. As part of an international consortium consisting of the MacDiarmid Institute, Kyoto University in Japan, and the Vidyasirimedhi Institute of Science and Technology in Thailand, he has this year started on a three-year project titled 'Interface Materials Informatics platform for virtual screening of next generation organic solar cell devices'.

Clockwise from top left: Helen Rutter, Jeff Lang, Joseph Nelson and Alice Sai Louie

Retirement the end of an era

In 2024, after more than 40 years with Lincoln Agritech, Professor Ian Woodhead, or Woody as he is known to those who work with him, retired.

Ian's last fulltime role was as Lincoln Agritech's Chief Scientist. His main research interests are in broadband dielectric properties of composite materials including water content, physical measurements using microwave and mm waves, and high-speed electronics. However, he worked in multi-disciplinary teams on projects across the company and played a crucial role in concept development and preparing research proposals.

Ian has held many external roles, including being an advisor to and assessor for MBIE Science and an assessor for the French National Research Agency. He was awarded the Royal Society Te Aparangi's Scott Medal in 2017 in recognition of the wide range of sensors he has developed for the agricultural and environmental sectors.

Ian still works part-time on a contract basis and is Lincoln Agritech's first Emeritus Fellow.

Sharing Knowledge

Non-Financial Highlights

80
Popular Press & Trade Journals
(excluding social media)

5
Videos

36
Conference Contributions

42
Client Reports

37
Journal Publications

LINCOLN AGRITECH LTD

X
1225 followers
.16% increase

LinkedIn
4059 followers
22.4% increase

Facebook
229 followers
38.8% increase

Newsletter Circulation
683 subscribers, 45.5% open rate
2.8% increase

IRRICAD™ IRRIGATION DESIGN SOFTWARE

LinkedIn
4723 followers
5.4% increase

Youtube
Watch Time: 473.1 hours
15% increase

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Business Development Manager,
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The research & development team are fantastic to work with, very dedicated and flexible to change direction if needed to get the best science outcome. Staff are very good at explaining the science to science & policy staff.

Thomas Wilding,
Team Leader, Hydrology & Groundwater,
Waikato Regional Council

Lincoln Agritech has worked well with NZAPI for many years, they are professional to work with, meeting deadlines and providing good research reports.

Rachel Kilmister,
Research & Development Programme Manager,
New Zealand Apples & Pears Inc

Lincoln Agritech were quick and efficient when it came to developing research contracts. Their work was always delivered on schedule, and they were available to respond promptly to any questions that arose.

Owen Solomon,
Innovation Leader Environmental Sustainability,
Zespri

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Throughout this publication the use of geometrical patterns represents the borders or edges of domains. The patterns indicate movement where spaces cross over and go back and forth – a space held to meet and greet, a space to navigate and negotiate. For us this pattern is symbolic of the fusion of cultures that seeks to develop and evolve, to grow its critical thinking, its shared learning systems. It supports a culture of science/mātauranga unique to this part of the world.