

B3 at a glance

- More than 20 years of providing border biosecurity science to protect Aotearoa New Zealand's precious and productive plants
- Crucial new tools and knowledge developed to boost border biosecurity and better prepare for and manage incursions if they occur
- Projects based on what Government, industry, Crown Research Institutes, iwi and community partners need

Partners:



- Supported preparation and responses towards Lepidoptera, rapid 'ōhi'a death, *Phytophthora*, brown marmorated stink bug (BMSB) and *Xylella*, to name a few.
- More than 100 of the country's best biosecurity scientists are working on B3 projects at any one time.
- 27 projects in the 2023/24 financial year.
- Projects cover intentional introductions (biocontrol); unintentional introductions; pathway risk management; diagnostics; surveillance, response and eradication.
- Mātauranga Māori and extensive engagement with tangata and mana whenua are integral to all projects.

Visit [b3.nz](https://www.b3.nz) to find out more and see specific projects.

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NGĀ KUPU MĀORI

- Kaitiaki/Kaitiaki: guardian
- Kaupapa: approach, principle
- Mana whenua: people from the region / area
- Mātauranga: knowledge
- Ngā pūkenga o ngā take tāiao: environmentalist
- Rōpū: group
- Tangata whenua: people of the land
- Taonga: treasures/ keepsakes, not necessarily Māori
- Te Āo Māori: the Māori world view
- Wānanga: discussion forum/workshop

ABBREVIATIONS USED IN THIS REPORT

- AGR: AgResearch
- BCA: biological control agent
- BMSB: brown marmorated stink bug
- DOC: Department of Conservation
- EPA: Environmental Protection Authority
- FOA: Forest Owners Association
- LU: Lincoln University
- MPI: Ministry for Primary Industries
- MWLR: Manaaki Whenua Landcare Research
- OMB: Old man's beard
- PEQ: Post-entry quarantine
- PFR: The New Zealand Institute for Plant and Food Research Limited
- QFF: Queensland fruit fly
- ROD: Rapid 'ōhi'a death
- UAV: Unmanned aerial vehicle

From Chair and Director Māori

Tēnā koutou, tēnā koutou, tēnā koutou katoa.

Tēnei te mihi kau atu ki a koutou i roto i ngā āhuatanga o tēnei wā.

Ka rere ngā whakaaro ki ngā mate kua hinga i tēnei tau, haere atu rā, e okioki.

E ngā kanohi ora e kawē nei i te mātauranga me ngā moemoeā kia haumarū ai ngā taonga o te whenua nei, tēnā koutou katoa.

Aotearoa New Zealand's primary industries and global export reputation depend on a strong biosecurity system to prevent new plant pests and diseases from establishing. Better Border Biosecurity (B3) plays a vital role in safeguarding our borders, ensuring our environment and economy remain resilient against threats such as Lepidoptera, rapid 'ōhi'a death, *Phytophthora*, brown marmorated stink bug, and *Xylella*. By staying ahead of potential incursions, we help protect our productive landscapes, trade relationships, and the taonga species that define our unique biodiversity.



Celebrating Achievements

As we reflect on the past year, we are proud of B3's progress in strengthening Aotearoa's biosecurity framework through cutting-edge research and collaboration.

- 27 research projects have advanced our ability to assess risk, improve surveillance, and enhance diagnostic tools.
- New diagnostic tools are being developed to reduce testing time for *Phytophthora* from weeks to days, while work is underway to revolutionise eDNA sampling tools to identify and track unwanted plant pests and diseases across large areas.
- B3 initiated eight new research projects, bringing together over 100 of the country's top biosecurity scientists and publishing 10 peer-reviewed papers while delivering 18 invited presentations and 7 stakeholder briefings.

This report highlights the extensive work undertaken in collaboration with government, industry, Māori, end-users, and communities to strengthen New Zealand's biosecurity resilience.

Honouring Te Tiriti o Waitangi

B3 remains steadfast in its commitment to Te Tiriti o Waitangi, ensuring that biosecurity research and innovation are developed in genuine partnership with Māori. Mātauranga Māori continues to be woven into our work, strengthening our collective ability to protect Aotearoa's environment, primary industries, and cultural heritage.

All B3 partners remain dedicated to working alongside Māori as active collaborators, recognising the vital role of tangata whenua in safeguarding our natural and productive landscapes. Through shared knowledge, respect, and partnership, we will continue to enhance biosecurity solutions that reflect the values and priorities of all New Zealanders.

Transitions & Acknowledgments

This year, we farewelled valued colleagues who have made significant contributions to B3:

- **Theme Leaders:** Karen Armstrong (BPRC) and Barbara Barratt (AgResearch)
- **Collaboration Council Members:** Veronica Herrera (MPI), Travis Glare (LU) and Peter Millard (MWLR)
- **Science Advisory Group:** Anna Rathe (HortNZ) and Linda Johnson (AgR)
- **B3 Director:** Desi Ramoo (PFR)

Karen and Barbara have been part of B3 since it was established and have had significant impact on border biosecurity through their own research as well as their leadership within B3. Their contribution and guidance over this long period has been immense in helping forge the biosecurity research undertaken by B3. Veronica played a key role representing the Ministry for Primary Industries view and Peter for Manaaki Whenua Landcare Research, both connecting their people to research programmes and teams across the partnership. Although Travis has stepped down from the Collaboration Council, he continues to be a valued member of B3's Science Advisory Group. Their experience will be missed on the Collaboration Council. Desi's leadership as B3 Director has been pivotal in strengthening collaboration between government agencies, industry, research institutions, and Māori stakeholders. We acknowledge Karen, Barbara, Veronica, Peter, Travis, Anna, Linda and Desi's time and commitment, and sincerely thank them for their dedication in advancing border biosecurity in Aotearoa.

We welcome Dr. Beccy Ganley as incoming Acting Director, we look forward to her expertise in plant biosecurity research and leadership, her experience with Ngā Rākau Taketake, the Biological Heritage National Science Challenge, and Plant & Food Research supporting us to navigate new challenges and opportunities. We also welcome Dr Fleur Francois (MPI) and Dr Fiona Carswell (MWLR) to the Collaboration Council and Axel Heiser (AgR), Eve Pleydell (Hort NZ) and Aubanie Raynal (EPA) to the Science Advisory Group.

A full list of those contributing to the B3 programme in 2023-2024 can be found on page 23.

Looking Ahead

In these times of change across the science and environmental sectors, we call on our wider B3 whānau to stand strong, be resolute, and be courageous. B3 remains steadfast in its dedication to building robust partnerships, integrating mātauranga Māori, and pioneering research initiatives that bolster our border biosecurity preparedness. Our work is critical, and together, we will continue to strive to protect Aotearoa's environment, primary industries, and communities from the ever-evolving landscape of biosecurity threats. Afterall, when the land thrives, we all prosper.

Ngā mihi – Mel and Alby



Melanie Mark-Shadbolt
(B3 Collaboration Council Chair)



Alby Marsh
(B3 Director Māori)



Desi Ramoo
(B3 Director)



Beccy Ganley
(Incoming Kaihautū Tiriti)

Theme A: Risk Assessment (Intentional Introductions)

Improved tools and methodologies for assessing risk and predicting impacts for intentional introductions

Expanding our eradication toolbox in Aotearoa New Zealand: Is biocontrol a feasible tool to incorporate in a response?

The goal of this 2-year project was to explore the feasibility of using inundative biological control for eradication, either alone or alongside other methods. While classical biological control is a cost-effective long-term pest management strategy, it often suffers from delays in approval and implementation, allowing pest impacts to escalate. A timelier approach could involve pre-emptive approval or leveraging existing biological control agents (BCAs) through inundative biocontrol during incursion responses. However, no known successes have been recorded globally using this strategy for eradication.

To help fill this knowledge gap, we developed a mathematical model of the eradication process, parameterized using published data. The team focused on identifying key parameters for predicting the success or failure of various eradication tools, including BCAs, using brown marmorated stink bug (BMSB) and its egg parasitoid *Trissolcus japonicus* as the model system. By examining the potential of BCAs like *T. japonicus* (already approved for release in Aotearoa New Zealand for a BMSB incursion) and integrating other tactics such as insecticide treatments, the research has provided critical steps for a novel approach to invasive insect eradication.

Our research highlights how the egg parasitoid can be strategically used in combination with other tools for controlling the highly invasive BMSB. Additionally, the modelling approaches developed are transferable to other insect species, further enhancing the tool's potential for eradication efforts.



An adult samurai wasp lays eggs in a mass of brown marmorated stink bug eggs. Photo credit: Chris Hedstrom, Oregon Department of Agriculture.

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Research partners: PFR

Testing the Toolbox: Reducing uncertainty around non-target impacts

Over several years B3 scientists have developed tools and models to help predict the risk posed by new biological control agents (BCAs) to non-target species, before their introduction.

In a three-year project finishing in 2025, researchers are validating this B3-developed 'toolbox' for deployment by agencies such as the EPA, applicants, and DOC. Tools include a machine learning model (using Random Forest) that uses phylogenetic, phenological and morphological data to predict the likelihood of a BCA using non-target species as hosts. Another involves the construction of food webs to help with the highly challenging task of identifying potential indirect effects of BCAs.

The research team are applying four case studies to validate the tools, including the ability of the food web tool to predict indirect effects of the weed biocontrol agent, old man's beard (OMB) leaf miner, on natural enemies and other hosts of those enemies. Results show that native leaf miners on native *Clematis* spp. were slightly less likely to be parasitised when surrounded by OMB leaf miners,

despite high rates of parasitism of the OMB leaf miners. This suggests that the introduction of the OMB leaf miner has not had indirect effects on these related, non-target leaf miners. The Random Forest model is being tested using the codling moth BCA, *Mastrus ridens*. The model unexpectedly predicted that the forest semi-looper, *Declana floccosa*, could be a non-target host for *M. ridens*, so the team has collected *D. floccosa* from the field and laboratory testing with *M. ridens* is underway.

Researchers are also involved in wānanga to understand Māori perceptions of biocontrol introductions and to improve their understanding of the effects of BCA introductions on te taiao.



Leaf mine made by *Phytomyza vitalbae*, the biocontrol agent for old man's beard.



Hunting for *Declana floccosa*, a potential non-target host for *Mastrus ridens*, in the Tasman region.

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Project research partners: PFR, AGR, Scion and MWLR

He waka hourua: Mātauranga and Western science navigate a safe course for future biocontrol

The Environmental Protection Agency's (EPA) Mātauranga Māori Framework was designed to guide the inclusion of Māori knowledge in applications for using biological control agents (BCAs). It aims to help decision-makers assess mātauranga when presented as evidence.

In this project, researchers are supporting appropriate integration of mātauranga Māori into EPA's process and evaluating how Māori and scientists are using the Mātauranga Māori Framework. Researchers have been engaging with the EPA, scientists, industry and a select group of ngā pūkenga o ngā take tāiao through a series of wānanga.

These wānanga have provided an opportunity to discuss the introduction of BCAs and their safety, as well as gather critical feedback from mana whenua on the consultation process, the validation of mātauranga, and the perceived limited Māori involvement in the decision-making process. Findings from this project will be shared with the EPA to help improve the uptake and use of the Mātauranga Māori Framework.

The team is currently looking to consult with any groups that are using the EPA Mātauranga Māori Framework for their applications and would appreciate anyone who is, to get in contact with them.

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Project research partners: AGR and PFR

Get more details about current and completed Theme A projects at [B3.nz](https://www.b3.nz).

Theme B: Risk Assessment (Unintentional Introductions)

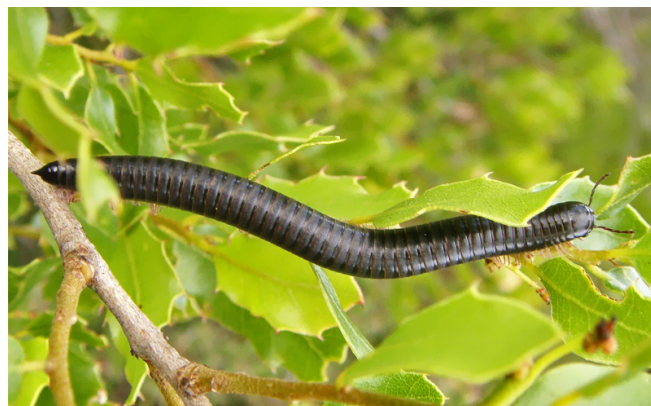
Improved tools and methodologies for identifying hazards, assessing risk, predicting impacts, and ascertaining where in the system mitigation measures are best targeted for unintentional introductions

Biosecurity over the horizon: identifying invasive agricultural pests in China

This project aimed to identify and understand the risks posed by invasive agricultural pests from China by testing a “Sentinel Plant Habitats” (SPH) approach. The SPH concept posits that threats to multi-species crops like pasture are best understood by investigating the habitat *in situ*, rather than looking at the component plants in isolation. We searched the Chinese language scientific literature and identified 739 invertebrate species that might have a negative impact on grassland habitats, and we collaborated with Chinese colleagues to summarise high-impact pests in Chinese lucerne and grasslands. Unfortunately, the COVID-19 pandemic prevented planned field work in Chinese pastures, so the project was partially refocused on Australia.

Sampling in Australian grasslands, augmented by primary literature sources, identified 129 invertebrate species that are not currently present in Aotearoa New Zealand. Twelve percent of these were assessed as having a high risk of dispersing to Aotearoa New Zealand, based on biology, flight capability and hitchhiking potential. From Australian research, climate suitability and host plant consumption, 11% of the species pose a high likelihood of causing substantial damage to Aotearoa New Zealand pastures if they were to establish. Our results complement an earlier MPI risk assessment that identified only 17 taxa that threaten Aotearoa New Zealand pastures.

A key finding from this project is that neither direct sampling (the SPH approach) nor conventional literature searches identified all potential hazard taxa. This work suggests that both sampling and literature searches are needed to compile a comprehensive list of hazard species in multi-host habitats like pastures.



The black Portuguese millipede *Ommatoiulus moreleti* was assessed by this project as having a high chance of entering and establishing in Aotearoa New Zealand. It was subsequently found to have already established in the Wellington area (Photo credit: J. Coelho, Flickr).

As part of a pilot study partially funded by UK researchers, this project also supported summer students to survey oak, Scots pine, beech and roses at Christchurch Botanic Gardens and Lincoln University Arboreta across three seasons. These surveys benefitted UK biosecurity by identifying new potential pests and diseases. It was also valuable biosecurity experience for the students, and also detected a new-to-New Zealand lady beetle *Scymnus suturalis* (Coleoptera: Coccinellidae).



Scymnus suturalis, a tiny ladybird beetle was first found in Aotearoa New Zealand by a B3 summer student. (Photo credit: Gilles San Martin, Flickr, CC-BY-SA 2.0)

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Research partners: AGR, LU, UK-based Botanic Gardens Conservation International (BGCI), FERA Science Limited, and the UK Department for Environment, Food and Rural Affairs (DEFRA)

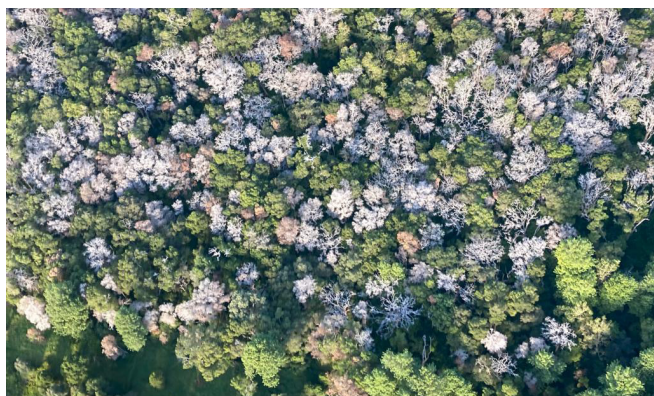
Assessing the risk of Rapid 'Ōhi'a Death to Aotearoa New Zealand and the South Pacific

Rapid 'ōhi'a death (ROD) pathogens are causing widespread mortality of *Metrosideros polymorpha* in Hawaii and pose a significant threat to Aotearoa New Zealand's rātā and pōhutukawa, among other species. A comprehensive literature review helped identify entry pathways and climatic conditions suitable for ROD establishment in Aotearoa New Zealand, ranking native *Metrosideros* species by infection risk and providing a framework for targeted surveillance.

Climate modelling identified key pathways and regions at risk, but much of the value of this project has accrued through our collaborative approach. We engaged with regulatory bodies such as MPI and DOC, industry partners, and Māori communities, ensuring a culturally sensitive approach. High-value collaboration with USDA Hawaii and international experts extended our network, enriching our research with global insights. Regular meetings and a newsletter, "Te Haere huihui tahi," kept all stakeholders informed and involved.

Practical measures included developing seed movement protocols, creating identification flip charts for field use, and establishing seed collection protocols. Through these, we were able to collect and export native seeds to Hawaii to be grown and challenged by the pathogens.

Susceptibility testing is ongoing, but the project has enhanced Aotearoa New Zealand's readiness and preparedness for ROD through targeted pathway management, informed surveillance, and robust stakeholder engagement. It has also laid a strong foundation for future biosecurity efforts, demonstrating how rigorous scientific processes and collaborative engagement can effectively predict and mitigate the risks of emerging pathogens.



Aerial view of *Metrosideros* trees killed in Hawaii from rapid 'ōhi'a death (ROD).



Cross sectional view of the trunk from one of the dead *Metrosideros polymorpha* trees.

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Research partners: PFR, AGR and MWLR

Predicting the spillover of pests and pathogens into natural ecosystems

Various end-users have expressed a need to understand which exotic pests and pathogens are most likely to affect Aotearoa New Zealand's natural ecosystems. However, predicting these threats remains exceptionally challenging owing to the often-limited baseline information available for natural ecosystems, which hinders risk assessments.

The goal of this project is to support risk assessments by accurately predicting the traits of exotic herbivore pests and pathogen species that establish themselves and adversely affect native ecosystems. This is being done by generating data for predictive modelling, understanding the role of phylogeny and determining whether risks and threats ultimately lead to impacts.

Our project team is currently analysing exotic species, representing most of the major plant pest and pathogen groups in Aotearoa New Zealand, with an aim to have evaluated more than 300 species by project conclusion. The data collected from this will create a globally unique and unparalleled resource, providing invaluable support for future biosecurity efforts.

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Research partners: MWLR and AGR

Get more details about current and completed Theme B projects at [B3.nz](https://www.b3.nz).

Theme C: Pathway Risk Management

Fit-for-purpose tools and methodologies for reducing risks along importation pathways

Novel sensor approaches to sniff out biosecurity threats

With an increase in global trade comes increased biosecurity risk from unwanted pest insect incursions via importation pathways. There is a need for new tools and technologies that can rapidly and confidently detect pests pre-border and en route.

This ambitious project combined expertise in insect chemosensory science and bioengineering to develop novel sniffer technologies for the real-time detection of pest insects based on their unique volatile fingerprints. Research focused on detection tools for two of Aotearoa New Zealand's top unwanted invasive pests—the Queensland fruit fly (QFF) and brown marmorated stink bug (BMSB)—using two different technologies.

The first technology comprised a nature-inspired sensor that could screen fresh produce and inanimate commodities arriving as cargo, using powerful insect odorant receptors (iORs) that detect volatile organic compounds (VOCs). A combination of iORs and various biosensor platforms were assessed for their ability to detect QFF-specific VOCs in liquids. The focus is now on transferring this technology into the gas phase.

The second sensor is a low-cost portable sensor system for detecting VOCs from hitchhiker pests in containers during shipment or post border. The research team have targeted tridecane, the major component of the BMSB alarm pheromone. A portable prototype BMSB sensor, combining a specialised polymer-coated sensor with a front-end selectivity filter, has been developed, capable of detecting tridecane at concentrations consistent with expected concentrations in shipping containers.

These novel biosensors have the potential to become essential biosecurity tools for MPI and other key stakeholders involved in the importation of goods into Aotearoa New Zealand.



Components of the laboratory-based prototype volatile sensor using insect odorant receptors (iORs). From left to right, atomic force microscopy image of carbon nanotubes functionalised with iOR nanodiscs, the volatile delivery system used to test the sensors, the field effect transistor (FET) sensor.

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Research partner: PFR

Automatic detection of contaminants on shipping container exteriors

Shipping containers have long been identified as pathways for invasive alien species (IAS), which include hitchhiker pests, soil and plant material such as seeds, on the external surfaces of sea containers. While onshore inspection protocols, risk-based profiling and visual inspection at seaports when containers are unloaded minimise the risk of unintended arrivals, the risk is not eliminated. Therefore, technologies that improve detection of IAS on the surfaces of sea containers while being unloaded, improve the biosecurity protection for Aotearoa New Zealand. This challenge is being addressed with research to develop semi-automated container scanning tools for seaports, based on two key technologies: a scanning system using cameras in conjunction with edge-applied neural networks; and a laser-based topology scanning system. Both systems are seen as complementary for 6-sided scanning and rapid detection of IAS as containers are unloaded at seaports.

An object detection algorithm (based on a convolutional neural network), with other supporting algorithms, was trained to identify a selection of potential biological threats including reptiles and insects. A 'proof-of-concept' camera system was

also tested at a seaport. The laser scanning system was developed using spectral features of different contaminants based on key infrared wavelengths of 1450 and 1550 nm. This system was tested using a supercontinuum laser in the laboratory with biological contaminants such as insects and soil on various shipping container sections.

The 'proof-of-concept' camera system was able to acquire images of container surfaces day and night and in full sunlight through to rain events, as each container was unloaded from the ship. While no reptiles or insects were detected, the quality of the images meant that small sized objects (e.g., stones) could be identified on container surfaces. The laser was able to detect contaminants such as insects and moist soil on shipping container surfaces with high rates of confidence. The ability to separate soil from rust was found to be an issue for both systems, especially for dry soil, and further training of both systems is required on object datasets.

There are clear benefits for a hybrid implementation of the two systems, with opportunities for improved robustness in detection approaches and better generalisation for the detection of IAS on shipping containers.



Port container crane with camera (circled), cockroaches on the underside of sea container (top right), soil contaminant on container rail (middle right bottom right), and image of sea container where the AI neural network has classified potential biosecurity risk on a sea container arriving at a port.

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Research partner: AGR and PFR

Biosecurity risks in imported seeds linked to herbicide resistance

Herbicide resistance in ryegrass and other seed contaminants poses significant challenges for New Zealand agriculture, impacting both crop management and biosecurity. Our study investigated resistance rates in ryegrass seed lines, focusing on haloxypop and iodosulfuron. We examined 56 cultivar lines from New Zealand, the USA, and Europe, finding that 79% exhibited resistance to one or both herbicides, though

resistance rates did not differ significantly between imported and domestic lines. Glyphosate resistance was absent. Most resistance appeared to be due to pre-existing genetic variation rather than recent selection pressures, with Italian ryegrass showing higher resistance rates than perennial ryegrass.

Separately, herbicide-resistant black-grass (*Alopecurus myosuroides*) was introduced to New Zealand through contaminated seed lots from the UK and France, despite rigorous border inspections. Resistance to Acetolactate synthase inhibitors (iodosulfuron + mesosulfuron) varied between the populations, underscoring the need for diversified herbicide strategies and the use of certified, locally multiplied seed to mitigate the introduction of new resistant weeds.

Additionally, *Poa annua* L. contaminants in ryegrass seed imported from Japan displayed significant resistance to iodosulfuron, complicating weed management. This population was 5.9 times more resistant than a susceptible local population, highlighting the potential for resistant biotypes to spread through international seed trade.

Finally, a comprehensive testing of various seed contaminants at the Ministry for Primary Industries revealed no resistance to tested herbicides among species such as *Amaranthus* spp., *Chenopodium album*, and *Panicum* sp. These findings stress the importance of stringent seed inspection and management practices to prevent the establishment and spread of herbicide-resistant weeds in New Zealand.



Growing black-grass to test against commercial herbicide mixtures.

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Research partners: AGR, Massey University, GTSeq wetland development

Get more details about current and completed Theme C projects at [B3.nz](https://www.b3.nz).

Theme D: Diagnostics

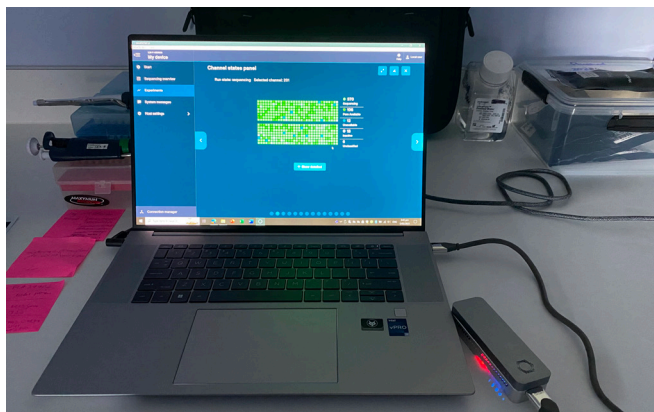
Theme aim: Fast, cost-effective, robust and accurate diagnostic methods and tools to enable informed biosecurity decisions

Metatranscriptomics informing the relevance of pathogen disease biomarkers in plants

Long-read nanopore DNA sequencing, such as that performed on portable MinION (Oxford Nanopore) devices, is an increasingly important tool for plant viral diagnostics at the Ministry for Primary Industries' Plant Health and Environment Laboratory (PHEL). A new challenge is to apply this technology to distinguish bacterial and fungal pathogens simultaneously infecting plant hosts.

Building on a previous B3 project, researchers are using nanopore DNA sequencing to identify the high-risk pathogen *Xylella* in taonga sentinel plants in California. This work is now being extended to diagnose other bacterial and fungal risk pathogens in the taonga plants, including species of *Pantoea* and *Fusarium*. These pathogens are considered high risk to New Zealand as they are frequently identified by MPI-PHEL in border interceptions and are known to be of high diagnostic uncertainty. Experiments with plant infection in New Zealand are an important component of the project; these are allowing the researchers to test parameters associated with nanopore RNA sequencing (metatranscriptomics). This RNA-based research is developing pipelines to identify markers of plant infection and to distinguish pathogenic from non-pathogenic bacteria and fungi.

The outcome of this project will be a diagnostic package that incorporates developments in nanopore sequencing, biological risk information, and mātauranga Māori of taonga plants growing overseas.



MinION sequencing in action. The MinION is the small, grey device to the right of the laptop.

The outcome of this project will be a diagnostic package that incorporates developments in nanopore sequencing, biological risk information, and mātauranga Māori from taonga plants.

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Research partners: PFR

Understanding the real risk of badnaviruses to the horticulture sector

Badnaviruses infect a wide range of plants across several horticultural sectors and can cause significant production losses. However, knowing the actual risk when detected in asymptomatic plants in post-entry quarantine (PEQ) presents a substantial challenge.

Badnaviruses transmitted by sapsucking insects are high risk and will cause disease, but their detection by molecular methods cannot distinguish them from a lower risk form of the virus spread between generations of plants by integrating its DNA into the host plant.

In this project researchers evaluated and developed three molecular methods to reliably distinguish the forms of badnavirus that present different degrees of risk on a large variety of host plants, with the aim to determine which methods could easily be incorporated into existing MPI systems to rapidly assess the hazard in PEQ.

Rolling circle amplification was the most reliable method for the detection of free form viruses but was unable to detect integrated forms. Semi-random two-step PCR could distinguish between the two virus forms; however, the procedure required significant additional effort to be developed into a standardised detection and differentiation method. The CRISPR/Cas-assisted detection method showed the greatest potential, and produced good quality, long reads on some samples. Further refinement of the CRISPR/Cas-assisted detection methodology is necessary to develop it into a reliable and universal assay for operational badnavirus identification and threat analysis.

This research progresses our understanding and ability to detect badnaviruses that could threaten our horticultural industries.

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Research partners: PFR

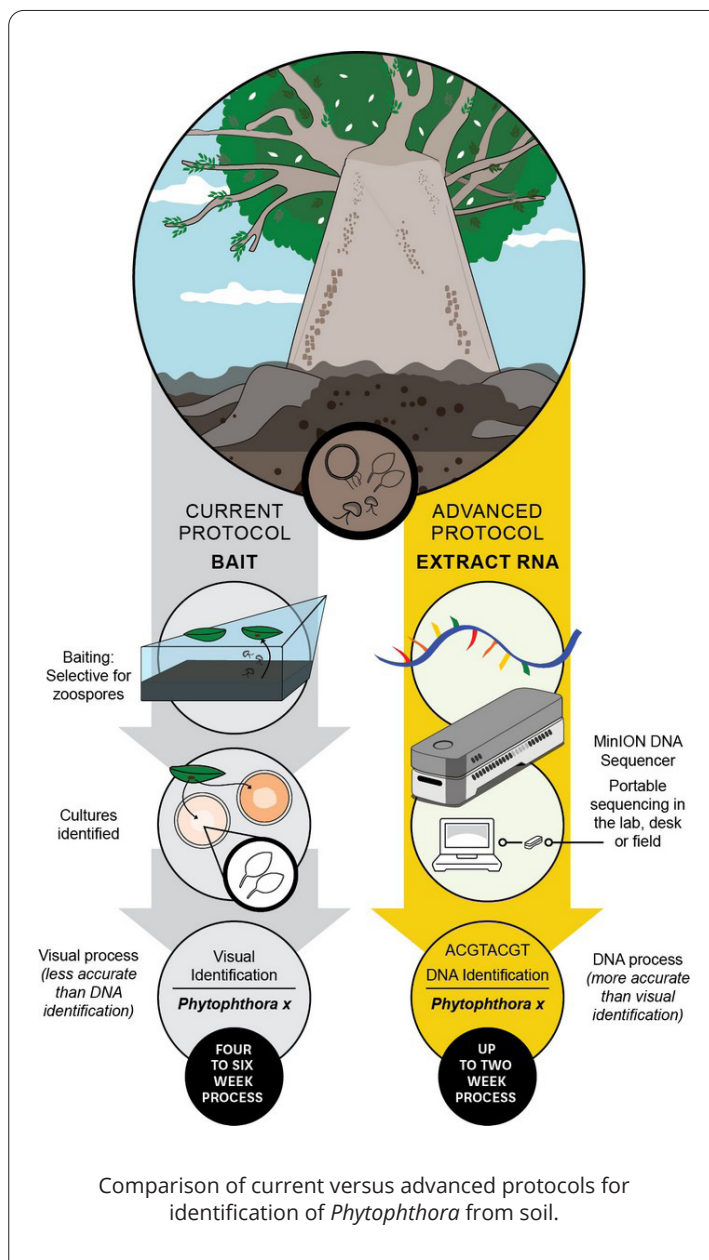
Beyond soil baiting: toward application of an eRNA diagnostic tool for *Phytophthora*

In this project, B3 scientists are leading the study to advance environmental RNA (eRNA) sequencing techniques for the rapid identification of live, soil-borne plant pathogens, particularly *Phytophthora* species.

Labelled the 'plant-destroyers', *Phytophthora* are water moulds that can cause severe disease in a number of important plant species, including kauri, pine, and avocados amongst others.

The project aims to develop a repeatable and reliable *Phytophthora* testing procedure as an alternative to soil-baiting, the current 'go-to' method for surveillance of *Phytophthora* in soil. Soil baiting is a time-consuming method and does not pick up *Phytophthora* that are not culturable, introducing the risk of missing some species with unknown biosecurity threat.

The testing procedure under development uses eRNA that can be directly extracted from soil and used to identify *Phytophthora* present. RNA is less stable than DNA, degrading more rapidly, in days or weeks compared with years for DNA. Therefore, its detection can give a more biologically relevant snapshot of 'viable' populations in an environment. It is expected to significantly reduce the time from weeks to days, improve throughput capability, and provide a better representation of the *Phytophthora* community.



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Research partners: Scion and PFR

Get more details about current and completed Theme D projects at [B3.nz](https://www.b3.nz).

Theme E: Surveillance and Eradication

Tools and strategies for preparedness for and response to incursions of invasive plant pest species, including determining their presence or absence

Improving UAV Effectiveness for Spot Applications of Btk During Incursion Responses

Species in the insect order Lepidoptera are key biosecurity risks for Aotearoa New Zealand's horticultural, arable and forestry industries. A previous B3-funded unmanned aerial vehicle (UAV) spot spraying trial for applications of insecticide for eradication during an incursion identified that the standard broadcast treatment for aerial spraying tall trees was highly susceptible to downwind displacement at wind speeds classed as light wind, compromising spot spraying targeting accuracy. This observation raised potential "social licence to operate" concerns from spray drift in sensitive areas.

To address these concerns, the researchers have identified a low-drift alternative spray methodology to improve UAV spot spraying targeting efficiency in non-calm wind conditions. This methodology would be expected to improve the licence to operate in sensitive urban areas by producing less off-target spray movement.

A workshop identified which *Bacillus thuringiensis* var. *kurstaki* (Btk) insecticide would be used in a lepidopteran incursion response. A spinning disc atomizer spray nozzle system was developed for a UAV, formulation properties were measured, and spray-dye-tracer compatibility was established. A UAV spot spray field trial was conducted on a ginkgo tree under calm wind conditions using characterisation by high-resolution LiDAR. Spray deposition and penetration were measured within the canopy and tree surrounds.

Findings showed that large-droplet, high-rate, dilute applications from a UAV are likely to be as efficacious targeting a tall tree canopy as small-droplet, low-rate neat applications in calm conditions, and they improved targeting in windy conditions. The hard-to-reach deepest parts of the canopy did not receive an efficacious dose from either treatment.

During an incursion response large-droplet aerial spot spraying could be employed when targeting

infestations of tall trees in sensitive environments to improve targeting accuracy, reduce drift, and widen suitable operational wind thresholds. Rates may need increasing to eradicate insects in hard-to-reach canopy areas.



Aerial view of the UAV, the three sampling towers holding samplers at different heights and location within the canopy, and the ground grid layout as the ginkgo tree is sprayed.

Contacts: Justin.Nairn@scionresearch.com

Research partners: Scion

Remote sensing to support surveillance, response, and eradication

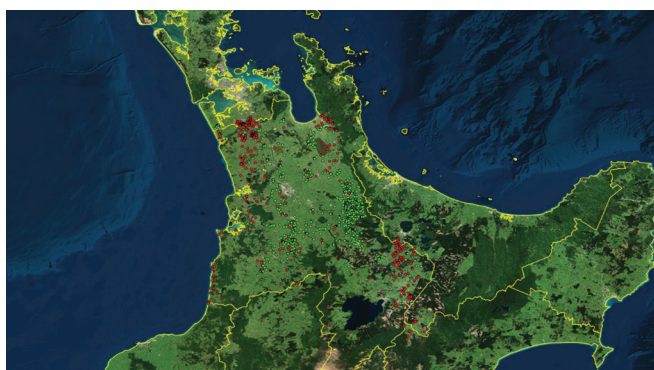
This project evaluated the potential of remote sensing technology for use in biosecurity surveillance. Its first aim was to identify crops that are at risk from new biosecurity incursions.

In the first two years of the project's three-year term, new methods to remotely identify maize crops were developed using time series data from satellite images integrated with semi-automatic labelling of

high-resolution aerial imagery. The aerial imagery was semi-automatically segmented over entire regions to collect training and validation data for the classification model. In the third year, Google Street View + LiDAR points + satellite images and drone images + PlantNet to automatically identify individual specimens of tree of heaven (TOH) was integrated.

The data were used to train machine-learning algorithms, which can now classify maize crops in several Aotearoa New Zealand regions with >85% accuracy, and identify individual TOH in Christchurch and Wellington public areas with high confidence values.

These methods can quickly and inexpensively define the spatial distributions of biosecurity hazards' host plants such as maize and TOH and are increasingly contributing to the national and international scientific community.



Example of artificial intelligence (AI) generated satellite mapping in the North Island of Aotearoa New Zealand.

Contacts: Federico.Tomasetto@agresearch.co.nz

Research partner: AGR

eDNA for terrestrial biosecurity monitoring

Environmental DNA (eDNA) is DNA found in an environment that has been shed from biological organisms present in that environment. It can provide a snapshot of the biological diversity present. This project focuses on advancing biosecurity through the use of eDNA technology, with a specific emphasis on terrestrial biosecurity monitoring. The goal is to develop and implement efficient eDNA methodologies for detecting plant pests and diseases, enhancing biosecurity decision-making.

While eDNA has been successfully used in marine pest detection, this project aims to extend its applications to terrestrial biosecurity. The project will collect eDNA from the air to potentially identify invasive taxa like weeds, pathogens, and insects.

The project's biosecurity outcomes include providing new tools for landscape-scale eDNA sampling, enabling confident confirmation and delimitation of plant pest and disease incursions.

From a scientific perspective, the project will develop new eDNA aggregation methods, purification techniques and species identification assays, while addressing detection limits and false positives.

Māori aspirations are integrated into the project through collaborations with Māori partners and stakeholders, ensuring the protection of indigenous species and active engagement as biosecurity partners.

A workshop with key stakeholders in the field of biosecurity was undertaken to address concerns related to sensitivity, false discovery rates, and optimal deployment settings for eDNA technology, ensuring its successful adoption and implementation. The project has also initiated work to evaluate air eDNA samplers to assess their efficiency and effectiveness in capturing terrestrial biosecurity-related DNA and to determine the sensitivity of detection.

This project is poised to significantly improve biosecurity by advancing eDNA technology, scientific knowledge, and fostering collaboration with Māori partners, and will contribute to more effective and efficient biosecurity measures for Aotearoa New Zealand.



Testing four eDNA collection methods for detecting pests and pathogens: UV light trap, Chux® cloth, battery-powered fan, modified Wilson and Cook sampler.

Contact: Andrew.Cridge@scionresearch.com

Research partners: Scion and PFR

Get more details about current and completed Theme E projects at [B3.nz](https://www.b3.nz).

Theme X

Projects that relate to all parts of border biosecurity activity, and those with a focus on mātauranga Māori

Empowering Te Āo Māori responses to biosecurity threats

The concept of biosecurity among tangata whenua is deeply rooted in cultural practices and roles as kaitieki. In this context, B3 biosecurity refers to methods taken to protect the environment, ecosystems and biodiversity from the introduction and spread of potential pests coming into Aotearoa that threaten taonga plant species.

Māori cultural authority should be recognised as an essential part of the biosecurity system where skilled kaitieki can work closely with government bodies to achieve positive outcomes.

In the final year of this 3-year project, the emphasis has been the integration of mātauranga Māori and scientific knowledge to strengthen biosecurity efforts, with a focus on the priorities of mana whenua (local Māori communities). Highlighting kaupapa Māori research principles, the project has explored how cultural values and traditional ecological knowledge can be incorporated into biosecurity, particularly within the B3 biosecurity framework, to address Māori-specific issues. Collaborative partnerships with mana whenua aim to deepen understanding of how traditional knowledge can enhance scientific practices, leading to more effective and sustainable biosecurity strategies and climate change adaptations. Ultimately, this approach seeks to ensure that both indigenous and scientific perspectives work together to protect the environment and communities across Aotearoa New Zealand and the South Pacific.

Contact: Waipaina.awarau-morris@agresearch.com

Project research partners: AGR and PFR

Prioritising social research for border biosecurity

Within the framework of biosecurity in Aotearoa New Zealand, understanding the awareness and motivations of the public (our putative citizen biosecurity officers) and tourists towards biosecurity is lacking. Social research is a priority for B3; however, there is limited appreciation for how social research might contribute to biosecurity outcomes. Past research has identified that uptake

of social research outcomes is limited by a lack of stakeholder capability and awareness of how individuals and communities can contribute to improved biosecurity.

Working together with stakeholders to identify research topics and evaluate them against stakeholder priorities is one way of ensuring a shared appreciation of how social research can be implemented. In this project, the prioritisation of social research was achieved by first scoping topics with social researchers, classifying these into research ideas and further developing these through online discussions with stakeholders associated with Auckland International Airport, the main gateway through which international visitors and returning New Zealanders arrive.

Areas were prioritised based on their relevance to stakeholders, the adaptability of potential outcomes, and whether impact could be measured. Stakeholder priorities highlighted the value of working with local communities and building on their motivations and initiatives to support collaboration in improved border biosecurity.

The research focused on three integrated areas for transformation: 1) benchmarking and evaluation framework development; 2) participatory research and engagement with different communities, i.e., businesses, mana whenua and migrant communities; and 3) Māori partnership and implementation pathways. The research has highlighted the need for strategies that engage the public to improve biosecurity outcomes in the Auckland region.



In 2024 Auckland International Airport handled 9.3 million international passengers.

Contact: Andrea.Grant@scionresearch.com

Project research partners: Scion, Lincoln University, AGR and PFR

New Projects

All new projects starting in 2024/25 involve high rates of engagement with mana whenua, communities, and industry, and will provide tools and knowledge gained to protect against potentially seriously damaging threats to primary industries and taonga plant species.

Tackling the threat of invasive *Ceratocystis* species to Aotearoa New Zealand

Rapid 'ōhi'a death (ROD), caused by two recently described fungal species, *Ceratocystis lukuohia* and *C. huliohia*, has caused widespread death of 'ōhi'a lehua (*Metrosideros polymorpha*) in Hawaii. Susceptibility testing has shown both kiwifruit and pōhutukawa can be infected by *C. lukuohia*. This project will see our knowledge of the threat posed by these *Ceratocystis* pathogens expanded through host testing of other native and commercially grown plant species, risk assessments of potential primary vectors for spread, and climate risk mapping.

Contact: Virginia.Marroni@plantandfood.co.nz

Automated sensing technologies to detect concealed invertebrates

Invertebrates concealed inside biological material such as seeds are difficult to detect without slow, labour-intensive, and often destructive sampling of imported products at the border. New technology that increases the probability of detection and/or reduces the time needed for screening reduces the risk of unwanted pest incursions and protects Aotearoa New Zealand's primary industries and natural ecosystems. This project will test new technologies and automated analytics for non-destructive detection of concealed pests, using pea weevil as a case study to demonstrate proof of concept. Technology developed in this project will have strong potential to be adapted for detection of other concealed pests in future, either at the border or on-farm.

Contact: Sarah.Mansfield@agresearch.co.nz

AI technology to improve biosecurity at seaports in Aotearoa New Zealand

Shipping containers with external contaminants, including soil, pose a significant risk to Aotearoa New Zealand's biological assets, as they act as vectors for a range of pests and diseases, some of which are invasive (e.g., insects, plant pathogens and weeds). While only a small percentage (c. 5%) of sea containers arriving into Aotearoa New Zealand are checked for external contaminants based on risk profiling, not all remaining containers are free of contaminants (e.g., soil) or exotic organisms. This research will provide a technology that will allow for rapid scanning and detection of external contaminants arriving on sea containers at Aotearoa New Zealand's sea ports, using camera imagery combined with AI-driven-automated detection and laser-based topology scanning.

Contact: Mark.Mcneill@agresearch.co.nz

The impact of heatwaves on surveillance programmes for high-risk pests in Aotearoa New Zealand

This research investigates the effects of varying heat and heatwave scenarios and how these increasingly common climate events could alter the chemical composition (including longevity and stability) and thus, the effectiveness of commercial pheromone-based lures. The project will also investigate the effects of heat and heatwaves on the corresponding olfactory perception of pheromone lures (via electrophysiological and behavioural responses) by males of selected high-risk pests or their surrogates.

Contact: Adriana.Najar-Rodriguez@plantandfood.co.nz

How big is the eDNA operability gap?

Environmental DNA (eDNA) technologies have revolutionised biomonitoring in some ecosystems and have the potential to enhance surveillance systems on Aotearoa New Zealand farms, but systematic testing is needed to understand their operability. Specifically, how big is the gap between current capabilities and on-farm implementation? This research will test where and how eDNA for biosecurity detection might be implemented on orchards/farms. Research will be split into two aspects, with substantial overlap: eDNA detection from fruit in postharvest, and eDNA detection from plant leaves in the orchard. This project will provide operational understanding of what aspects of eDNA technologies should be incorporated in ongoing biosecurity surveillance activities and what are unsuitable for implementation.

Contact: Simon.Bulman@plantandfood.co.nz

Improving Māori/Indigenous engagement within B3 programmes

An effective biosecurity system needs to operate cohesively and collaboratively to achieve specific social, cultural, economic, environmental, and biodiversity outcomes and should involve industry, community groups, Māori, the science community, central and local government, and all New Zealanders. There are opportunities to improve the representation of Māori interests, priorities, and perspectives within B3 and other related kaupapa, to promote more inclusive and positive indigenous collaborations. This project seeks to contribute to this by maintaining and strengthening relationships with mana whenua and communities developed from previous B3 investment, connecting new Māori roopū to this growing network, holding wānanga and initiatives to support indigenous knowledge exchange and connecting other B3 projects to this growing network.

Contact: Waipaina.Awarau-Morris@agresearch.co.nz

Building bridges to impact from biosecurity research

This 1-year scoping project aims to bridge the gap between scientific knowledge and practical application in both biosecurity preparedness and response. The research approach will emphasize interdisciplinary collaboration to gain an overview of potential models or tools already developed in B3 that are ready for implementation but not currently user-friendly or easy to access. Key contributors include biosecurity risk assessment researchers, computer scientists, government officials responsible for policy and response decision-making, and stakeholders representing industries, agriculture, public health, and environmental conservation. This approach will leverage the collaborative, interdisciplinary network fostered by B3 to extend the value of research from science to impact.

Contact: Murray Fea, mfea@doc.govt.nz;
Waka.Paul@plantandfood.co.nz

Bacterial metabolites as growth promoting agents to enhance detection of plant diseases.

Imported material may contain low titres or number of plant pathogens such as bacteria, fungi, viruses, and viroids and this is one of the reasons that long post-entry quarantine periods are required. This 1-year scoping project will investigate the use of metabolites to boost the growth of key plant pathogens and enhance expression of disease symptoms, especially when pathogens have low titres and are difficult to culture. This will enable more rapid detection of incipient pathogens and their disease symptoms, reducing the necessary quarantine period for plants before release.

Contact: Tanushree.Gupta@agresearch.co.nz

Building Biosecurity Capability: Students

Today's university students will be key to addressing the growing biosecurity challenges Aotearoa New Zealand faces. Fostering the next generation of biosecurity experts is an important focus for B3.

Rachael Horner

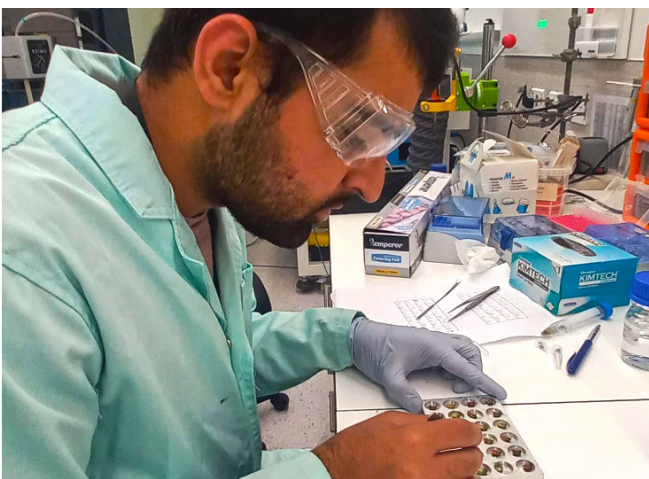
B3 has been supporting B3 Project Leader Rachael Horner, who has completed a MSc at the University of Canterbury. Her thesis focused on modelling the use of biological control in eradication efforts, and her B3 research has been instrumental in developing and refining computational biology skills, particularly in population modelling.

Yuhao Zheng

University of Auckland student Yuhao Zheng, supervised by Katerina Taskova (University of Auckland) and Darren Ward (MWLR), obtained a Master of Data Science. Zheng's thesis was on the "Integration of Few-Shot and Hierarchical Learning for Insect Classification". The thesis used images of fruit flies from B3 research along with two computer science techniques to improve the accuracy of predictions.

Muhammad Afaq Ahmed

Ahmed is working on using mass spectral fingerprinting to identify host plants in insects as part of the B3 project 'Use of mass spectral fingerprinting to solve tricky biosecurity diagnostics problems'. He is doing his PhD at the University of Canterbury, in collaboration with AgResearch and Plant & Food Research, and guidance from MPI.



Muhammad Afaq Ahmed processing samples.

Luna Hasna

Luna Hasna is completing a MSc at the University of Auckland. Luna's project focuses on modelling the risk of establishment of rapid 'ōhi'a death in New Zealand using global knowledge of *Ceratocystis* species. Luna's research has been a key component of the B3 project 'Assessing the risk of Rapid 'Ōhi'a Death to Aotearoa New Zealand and the South Pacific'.

Charlie Timperley

Charlie Timperley (Patukeha ki Rāwhiti Pewhairangi te hapū, Ngāpuhi te iwi) joined the "Testing the Toolbox: Reducing uncertainty around non-target impacts" project on a Pūhoro Summership. Her work involving placing sticky traps at sites in the Manawatu for the food web case study. The sticky traps collected parasitoids of the leaf miner (*Phytomyza vitalbae*) that was introduced to control old man's beard (*Clematis vitalbae*), and native leaf miners of puawānanga (*Clematis paniculata*).



Charlie Timperley collected parasitoids as part of the food web case study.

Research Publications and Outputs

Peer-reviewed publications

Avila GA, Seehausen L, Lesieur V, Chhagan A, Caron V, Down RE, Audsley N, Collatz J, Bukovinszki T, Peverieri GS, Tanner R, Maggini R, Milonas P, McGee CF, Horrocks K, Herz A, Lemanski K, Anfora G, Batistič L, Bohinc T, Borowiec N, Dinu M, Fatu A-C, Ferracini C, Giakoumaki M-V, Ioriatti C, Kenis M, Laznik Z, Malumphy C, Stacconi MVR, Roversi PF, Trdan S, Barratt BIP. 2023. Guidelines and framework to assess the feasibility of starting pre-emptive risk assessment of classical biological control agents. *Biological Control* 187: 105387

Clavijo McCormick A, Effah E, Najar-Rodriguez A. 2023. Ecological aspects of volatile organic compounds emitted by exotic invasive plants. *Frontiers in Ecology and Evolution* 11: DOI: 10.3389/fevo.2023.1059125

McNeill MR, Phillips CB, Richards NK, Aalders LT, van Koten C, James TK, Young SD, Bell NL, Laugraud A. 2023. Defining the biosecurity risk posed by soil found on sea freight. *Neobiota* 88: 103–133. doi: 10.3897/neobiota.88.98440

Starkie ML, Fowler EV, Piper AM, Zhu X, Wyatt P, Gopurenko D, Krosch MN, Strutt F, Armstrong KF, Patrick H, Schutze MK, Blacket MJ. 2023. A novel diagnostic gene region for distinguishing between two pest fruit flies: *Bactrocera tryoni* (Froggatt) and *Bactrocera neohumeralis* (Hardy) (Diptera: Tephritidae). *Insect Science* (2023) 0, 1–11, DOI 10.1111/1744-7917.13299

Reports

Avila G. 2023. co-author of Euphresco DROP - Factsheets of high-risk pests and their most promising natural enemies - Preparedness in biological control of priority biosecurity threats <https://drop.euphresco.net/data/eb8ae357-caee-4029-a3ed-46f48eeb7cd0>

Grant A, Wegner S, McNeill M, Sandanayaka M, Paul W, Conroy D, Gan I, Lin B, Graham S. March 2024. Prioritising social research. Co-design workshop summary. A collaborative Scion, Plant and Food Research, AgResearch report prepared for Better Border Biosecurity and further stakeholder engagement.

Phillips C, Yuijie H, Davies N, Kean J. 2023. New Zealand locations where *Spodoptera frugiperda* is expected to occur year-round. AgResearch & Better Border Biosecurity, Lincoln. 50 pp.

Rajkumar D, Sun J, McNeill M, Fitzgerald R, Welsh T. 2023. Automatic Detection of Contaminants on Shipping Container Exteriors - Laser Scanning System. An AgResearch report prepared for: Better Border Biosecurity. December 2023.

Stringer L, Phillips C, Vereijssen J, Turner R. 2023. BS22058: Pest risk analysis for kiwifruit. A Plant Food Research report prepared for: Zespri Group Limited. Milestone No. 94226. Contract No. 40242. Job code: P/363002/01. PFR SPTS No. 24658.

Wilson C. 2023. Subcontract 2324-22-002 C: St John's wort beetle survey. Ahika Consulting, Report for B3, Dunedin. 4pp.

Wilson C. 2024. Report on surveys two and three for St John's wort beetle larvae, feeding sign, and adults on *Hypericum involutum*, Macraes Flat. Ahika Consulting, Report for B3, Dunedin, New Zealand. 5pp.

Invited presentations (significant international/national meetings/seminars)

Avila G, Barratt BIP, Chhagan A, Audsley N. 2023. Pre-emptive classical biological control: a novel approach to increase preparedness for potential biosecurity threats. International Congress on Biological Invasions, Christchurch, New Zealand. 1-4 May 2023.

Avila G. 2024. Pre-emptive biological control: a new tool to maximise preparedness against high-risk biosecurity threats. PBRI Symposium, 8-9 May 2024, Cairns Convention Centre, Australia.

Awarau-Morris W. 2024. B3 – Better, Border, Biosecurity Aotearoa New Zealand– Integrating indigenous perspectives in biosecurity initiatives. PBRI Symposium, 8-9 May 2024, Cairns Convention Centre, Australia.

Barratt BIP, Meenken ED, Awarau-Morris W. 2023. Uncertainty in risk/benefit assessment for proposed biological control agents. Benefits and Risks of Exotic Biological Control Agents: 5th IOBC-WPRS working group meeting, Aviero, Portugal 11-14 Sep 2023.

Horner R. 2023. Expanding our eradication toolbox in NZ: Is biocontrol a feasible tool to incorporate in a response? Presentation at the University of Canterbury's School of Biological Sciences Annual Biology Conference (ABC), 26 October 2023, University of Canterbury, Christchurch, NZ.

Horner R. 2023. Expanding our eradication toolbox in NZ: Is biocontrol a feasible tool to incorporate in a response? Presentation at the B3 Science Partnership Forum, 19 October 2023, Wellington, NZ.

Jordan MD, Kralicek AV, Mitchell J, Treacher N, Khadka R, Cheema J, Mas F, Plank N, Carraher C, Colbert D. 2023. Novel sensor approaches to sniff out biosecurity threats. Presentation for the B3 Science Partnership Forum, 19 October, Wellington, NZ.

McDougal RL, Panda P, O'Neill R, Herron D, Bulman S. 2024. Detection of viable *Phytophthora* and other oomycetes from soil using eRNA and its potential use a diagnostic tool. IUFRO 26th World Congress: Forests and Society toward 2050. Stockholm, Sweden, 23-29 June 2024.

McDougal RL, Panda P, O'Neill R, Daley K, Herron D, Bulman S. 2024. Detection of viable *Phytophthora* and other oomycetes from soil using eRNA and its potential use a diagnostic tool. IUFRO Working Party 07.02.09 *Phytophthora* in Forests and Natural Ecosystems Conference. Paihia, New Zealand, 8-13 September 2024.

McNeill MR, Hardwick S, Ferguson C. 2023. Pest management and biosecurity to protect New Zealand grassland and forage agricultural systems. Global Forum of Leaders for Agricultural Science and Technology (GLAST). November 2023 in Sanya, China.

Poulton J, Vereijssen J, Watkins LM, Kean A, Drayton G, Nielsen M-C, Colhoun K. 2023. Assessing the risk of *Xylella fastidiosa*: Could native spittlebugs play a role in spreading the pathogen in New Zealand? 71st Entomological Society of New Zealand Conference, 30 August - 01 September 2023, Ellerslie Events Centre, Tāmaki Makaurau / Auckland.

Teulon D. 2023. Science and mātauranga in bioprotection in Aotearoa New Zealand – a Pākehā perspective. New Zealand Plant Protection Conference, Biocontrol Keynote Presentation, 8 August 2023, Sir Howard Morrison Centre, Rotorua.

Teulon DAJ. 2023. Border biosecurity research for plant health in NZ: Priorities and opportunities. Talk presented to CABI, Delemont, Switzerland, 12 December 2023.

Todd J. 2023. Update on Testing the Toolbox. Presentation at the B3 Science Partnership Forum, 19 October 2023, Wellington, NZ

Vereijssen J, Bulman S, Campbell R, Colhoun K, Drayton G, Groenteman R, Kean A, Nielsen M, Poulton J, Sharp J, Taylor T, Watkins L. April 2024. Assessing the risk of *Xylella fastidiosa*: Movement of spittlebugs between productive and natural areas in New Zealand. Plant Biosecurity Research Initiative Symposium in Cairns, 8-9 May 2024.

Waiariki T, Marroni V. 2023. Rapid 'ōhi'a death (ROD). Training and awareness workshop for forestry, quarantine personnel, and other selected participants. Suva, Fiji, 5 - 8 September 2023.

Withers T, Sopow S. 2023. An update on biological control projects against pest insects. TMBC Biological Control Workshop. 12 October 2023, Mercury Baypark, Tauranga.

Visnovsky S was invited to a virtual round table at the end of the seminar series "The Xylella Files 2023", together with researchers from USA, Italy, and Spain on the topic "Disease Control, Surveillance and Diagnostics of *Xylella fastidiosa*".

Visnovsky S. Sponsored by The National Plant Biosecurity Diagnostics Network (AU) attended at the Xylella Workshop at the University of Adelaide post-APPS 2023, 24th November.

Presentations to stakeholders

Kean JM, Meurisse N, Vereijssen J, Phillips C. 2023. Global change and biosecurity in Aotearoa New Zealand. Forest Biosecurity Committee meeting, 24 August 2023, Wellington, New Zealand.

Marroni MV. 2023. Update and progress on B3 project: The risk of rapid 'ōhi'a death (ROD)) to Aotearoa New Zealand and the South Pacific. Meeting with Department of Conservation, Kiwifruit Vine Health and the Ministry for Primary Industries, 30 November 2023.

Stringer L, Phillips C, Turner R, Vereijssen J. 2023. Pest risk analysis for kiwifruit (BS220588). Presentation to Kiwifruit Biosecurity Council, 24 August 2023.

Todd J, Page-Weir NEM, Brown S, Barratt BIP, Ferguson CM, Pugh A, Meurisse N, Fowler SV, Peterson P. 2023. Testing the Toolbox. Presentation at the Tauranga Moana wananga, Te Puna Marae, 28 July 2023

Todd J, Page-Weir NEM, Brown S, Barratt BIP, Ferguson CM, Pugh A, Meurisse N, Fowler SV, Peterson P. 2023. Testing the Toolbox. Presentation at wānanga with representatives of Papatuanuku Marae, 26 October 2023.

Visnovsky S was invited to talk at the Xylella Action Group meetings in February 2024. "*Xylella fastidiosa* and Sentinel Plants Network", research carried out with the participation of PFR, MPI, MWLR, and UC Berkeley.

Withers T, Avila G, Todd J, Awarau-Morris W, Barratt BIP. 2023. B3 Theme A –Risk of Intentional Introductions - Biological Control Research. Presentation at the Tauranga Moana wānanga, Te Puna Marae, 28 July 2023

Withers T, Avila G, Todd J, Awarau-Morris W, Barratt BIP. 2023. B3 Theme A: Intentional Introductions: Assessing the risks of Biological Control. EPA-B3-BMSB Wānanga, Te Whare Wananga o Awanuiarangi, Auckland, 26 Oct 2023

News & Media Release

Nairn J. 2024. UAVs for pest control take off. News & Media Release, 13 February 2024. <https://www.scionresearch.com/about-us/news-and-events/news/2024-news-and-media-releases/uavs-for-pest-control-take-off>; <https://www.nbr.co.nz/business/new-zealands-uav-revolution-precision-pest-control/>; <https://www.farmersweekly.co.nz/technology/scion-drones-take-aim-at-pest-control/>; <https://www.rnz.co.nz/national/programmes/ruralnews/audio/2018926827/midday-rural-news-for-20-february-2024>; <https://www.iheart.com/podcast/1049-the-country-sport-breakfa-84978536/episode/csb-justin-nairn-152022579/?embed=true>; <https://evsandbeyond.co.nz/uavs-for-pest-control/>

Contributions of parties to B3

Collaboration Council	Theme Leaders Group	End-user/Theme Representatives
<p>CHAIR (IND.) Melanie Mark-Shadbolt</p> <p>MEMBERS Jolon Dyer (PFR) Marie Bradley (AGR) Tara Strand (Scion) Fiona Carswell (MWLR) Chad Hewitt (LU) Veronica Herrera (MPI) Clare Stringer (DOC) Brendan Gould (FOA) Leanne Stewart (HortNZ) Holden Hohaia (Te Ara Pūtaiao) Chris Hill (EPA) (obs.)</p> <p>SCIENCE ADVISORY GROUP Richard Newcomb (PFR) Linda Johnson (AGR) Andrew Cridge (Scion) Geoff Ridley (MWLR) Travis Glare (LU) Jeremy Thompson (MPI) Murray Fea (DOC) Anna Rathe (HortNZ) Paul Adams (FOA) Simon Lambert (TTW)* * Supported by Te Tira Whakamātaki</p>	<p>DIRECTOR Desi Ramoo</p> <p>DIRECTOR MĀORI Alby Marsh</p> <p>THEME A Barbara Barratt (AGR) Toni Withers (Scion)</p> <p>THEME B John Kean (AGR) Simon Bulman (PFR)</p> <p>THEME C Nicolas Meurisse (Scion) Joy Tyson (PFR)</p> <p>THEME D Karen Armstrong (BPRC) Bevan Weir (MWLR)</p> <p>THEME E Jessica Vereijssen (PFR) Robin McDiarmid (PFR)</p> <p>MWLR REP Darren Ward</p>	<p>PROGRAMME LEVEL Andrea Clavijo McCormick (MPI) Sathish Puthigae (MPI) Waata Papali'i-Smith (MPI) Murray Fea (DOC)</p> <p>THEME A Miriam Robertson (EPA) Te Mauri Apiata (EPA) Andrea Clavijo McCormick (MPI)</p> <p>THEME B Jo Berry (MPI) Helen Harman (MPI) Madeline Marshall (MPI)</p> <p>THEME C Hoda Ghazalibiglar (MPI) Chris Denny (MPI) Sina Waghorn (MPI) Jessica Devitt (MPI)</p> <p>THEME D Luciano Rigano (MPI) Lia Liefing (MPI) Rebijith Kayattukandy Balan (MPI)</p> <p>THEME E George Gill (MPI) Scott Sinclair (MPI) Paul Stevens (MPI)</p>

Project leaders		
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