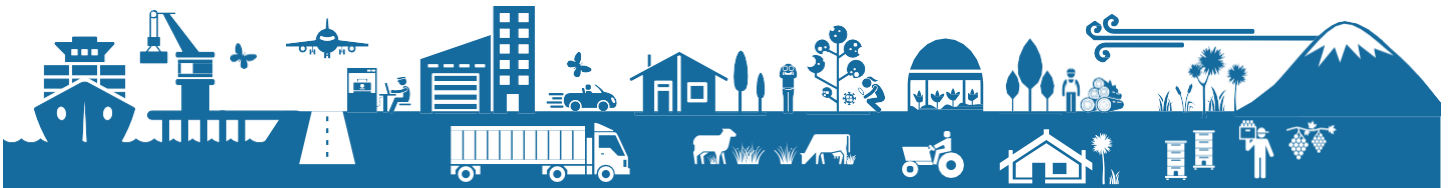




B3

Science Solutions for
Better Border Biosecurity
AOTEAROA NEW ZEALAND



B3 Annual Report

2023

(Reporting period July 2022 to June 2023)



Better Border Biosecurity (B3) at a glance

More than 20 years of providing border biosecurity science to protect Aotearoa New Zealand's precious and productive plants.

B3 research develops new tools and knowledge to boost border biosecurity and better prepare for and manage incursions if and when they occur.

Projects based on what government, industry, crown research institutes, Māori and community partners need.

Partners:



Supported myrtle rust, *Pseudomonas syringae* pv. *actinidiae* (Psa) kiwifruit vine canker, fall armyworm, brown marmorated stink bug (BMSB) and *Xylella fastidiosa* preparedness and response, to name a few.

More than 100 of the country's best biosecurity scientists, from across five research organisations, are working on B3 projects at any one time.

25 active projects in the 2022/23 financial year.

Projects cover intentional introductions (biocontrol); unintentional introductions; pathway risk management; diagnostics; surveillance, response and eradication.

Extensive engagement with and inclusion of tangata and mana whenua, and mātauranga Māori across multiple projects.

Visit b3.nz to find out more and see specific projects.

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ABBREVIATIONS USED IN THIS REPORT

AGR: AgResearch
 BCA: biological control agents
 BMSB: brown marmorated stink bug
 DOC: Department of Conservation
 EPA: Environmental Protection Authority
 FAR: Foundation for Arable Research
 FOA: Forest Owners Association
 FGR: Forest Growers Research
 LU: Lincoln University
 MPI: Ministry for Primary Industries
 MWLR: Manaaki Whenua Landcare Research
 PFR: Plant & Food Research
 QFF: Queensland fruit fly
 TTW: Te Tira Whakamātaki
 UC: University of Canterbury

NGĀ KUPU MĀORI

Hapū: subtribe
 He Awa Whiria: braided river
 Kaitiaki: guardian
 Kaitiaki: guardian (Ngāti Porou)
 Kaupapa Māori: Māori theme/subject/topic
 Kotahitanga: togetherness, unity
 Mahi: work
 Mana whenua: people from the region/area
 Mātauranga: knowledge
 Ngā pūkenga o ngā take tāiao: environmental kills
 Pono: to be true
 Pou: pillar
 Rangatiratanga: leadership with autonomy to make decisions
 Rōpū: group
 Tangata whenua: people of the land
 Taonga: treasure
 Te Āo Māori: the Māori world view
 Te Tai Tokerau: Northland
 Te Tiriti o Waitangi: The Treaty of Waitangi
 Tiakitanga: care, guardianship
 Tika: correct
 Tikanga: values and protocols
 Wānanga: discussion forum / workshop
 Whanaungatanga tikanga: relationships and connections and the values they support



From Director, Director Māori and Chair

Kia ora koutou

New Zealanders are well versed in understanding the importance of a robust biosecurity system, and the need for constant evolution to adapt to our changing world. Aotearoa New Zealand’s plant border biosecurity relies on knowing what threats are knocking at our door now and predicting biosecurity threats of the future and their potential entry pathways. B3 has been responding to this challenge for over 20 years.

Finally, 2023 saw B3 take the brave step into Tiriti-based leadership with the appointment of Alby Marsh as the B3 Co-Director Māori, transitioning from his previous role as the Pourangahau Māori Research Lead. As part of this transition, Alby introduced the B3 Māori Strategy (see page 18). This strategy provides B3 with a structure that will guide the weaving of mātauranga Māori into our research themes. The strategy presents an opportunity to develop mātauranga Māori-led research projects as part of the new focus to have more participation by Māori researchers and dedicated

funding to encourage more kaupapa Māori projects. Our work, in B3, delivers underpinning science to reduce the entry and establishment of new plant pests and pathogens that would threaten the economy and natural estate of Aotearoa New Zealand. A selection of research delivered by the B3 team, that responds to this threat, is described in the collection of articles compiled in this Annual Report. However, delivering current tools does not mean our job will be complete. A B3 strength is its agility to draw in research expertise from across the New Zealand system to complete

current research, whilst pre-empting and responding to future needs. This year B3 has invested in new projects and relationships and has seen some significant changes to its operating model. This includes reinvestment of approximately \$960,000 of funding being awarded across three new projects, which commenced in July 2023. They were: 1) De-risking the tissue culture import pathway; 2) Risks from pathogens, pests and weeds in a changing climate; and 3) Prioritising social research for border biosecurity (see page 20). These projects will see researchers engage with mana whenua, communities, government and

industry, in order to develop tools and share learnings, an approach that exemplifies our collaboration model. Our collaboration model has also seen B3 project teams working collaboratively with our Australian MOU partners the Plant Biosecurity Research Initiative (PBRI) and the Centre of Excellence for Biosecurity Risk Analysis (CEBRA). A new MOU with the Biosecurity Cluster at the University of Canterbury is a developing relationship and an opportunity for long-term collaboration. Our government agency stakeholders, MPI, DOC, EPA, MfE and MBIE, contributed alongside our MOU partners, to our work and the biennial B3 Conference. Our connections across the system ensure our research is focused on end-user needs, and the right impact

pathways. Significantly the 2023 biennial B3 Conference was an opportunity to farewell long-serving leaders, and welcome new ones. The conference was opened by outgoing B3 Collaboration Council Chair, James Buwalda, and closed by incoming Chair, Melanie Mark-Shadbolt. James served as B3 Chair for 15 years, and his biosecurity knowledge, as well as his strategic and governance skills have kept B3 focused on impact. Mel has broad experience as a researcher, senior government official, Co-Director of the Biological Heritage National Science Challenge, and as a co-founder and the CEO of Te Tira Whakamātaki. Mel’s experience adds a new dimension to the leadership of B3 going forward. We must also thank Philippa Stevens for

supporting B3 as the Acting Chair in James’ absence. We also farewelled Suvi Viljanen from the Collaboration Council, thanking her for her contribution to B3 Governance on PFR’s behalf. Finally, we welcomed Jolon Dyer to the Collaboration Council as PFR’s new governance representative. 2023 also saw David Teulon formally hand B3 over to Desi Ramoo. Under David’s 10 years of leadership, B3 has established a national and an international brand where B3’s research and collaborations are held in high esteem. We take this opportunity to specifically thank James and David not just for their service to B3, but for the impact of their contributions across the plant biosecurity system.



Melanie Mark-Shadbolt
(B3 Collaboration Council Chair)



Desi Ramoo
(B3 Director)



Alby Marsh
(B3 Co-Director Māori)

Theme A: Risk Assessment (Intentional Introductions)

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

Supporting agencies to safeguard our natural and productive environments

A key focus of Theme A is supporting agencies such as the Environmental Protection Authority (EPA) and Department of Conservation (DOC) with evidence to determine risk, reduce uncertainty in decision-making and more confidently predict the environmental safety of new organisms for biological control.



Searching for leafroller hosts of *Dolichogenidea tasmanica* in an abandoned apple orchard, Tasman.

In 2018 the EPA approved the conditional release of the Samurai wasp should a BMSB incursion occur in Aotearoa New Zealand – a huge milestone and probably a world first.

B3 evidence was used in this decision and researchers have since done work to determine the potential for further pre-emptive decisions.

One such project, done with Euphresco, has seen the team develop a set of guidelines and a decision-making framework for agencies to assess the feasibility of conducting pre-emptive biocontrol risk assessment. It defines the elements that need to be considered when selecting a suitable target pest for risk assessment. The project, and a recently published paper, also provide examples of biological control programmes against different high-risk pests.

As well as determining future risk, B3 retrospective studies help agencies see how decisions worked out.

A recently published paper summarised outcomes of the biological control agent (BCA) *Cotesia urubae* introduced in 2011 against the Eucalyptus defoliating lepidopteran pest *Uraba lugens*. It found the BCA parasitised less than 1 per cent of larvae of a native non-target species. The study also revealed that self-introduced generalist parasitoids had a greater impact on non-target species. The study provided invaluable data to calibrate non-target risk models.

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Research partners: PFR, AgR, Scion, MWLR

Read these publications on the B3 website under 'Outputs'.

Validating a toolbox to predict non-target species

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



PFR Te Rito summer student, Charlie Timperley, searching for native leafrollers on apple leaves to investigate off-target parasitism by biological control agents.

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 an ecologically based predictive Bayesian network model (BAIPA) to determine the probability non-target species will be negatively affected. 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 weed biocontrol agent, old man's beard leaf miner, on natural enemies and other hosts of those enemies. BAIPA is also being tested using the codling moth BCA, *Mastrus ridens*, and its potential to use the gorse pod moth as a non-target host in scrubland adjacent to apple orchards.

Researchers are also conducting wānanga to understand Māori perceptions of biocontrol introductions and the effect on te taiao as well as the usefulness of the toolbox for BCA applicants.

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Project research partners: PFR, AGR, Scion, MWLR

Biocontrol and its relationship to te āo Māori

A B3 project focused on supporting appropriate integration of mātauranga Māori into EPA processes

is bringing rōpū Māori and scientists together to discuss biocontrol and its relationship to Te Āo Māori.

EPA's Mātauranga Framework was developed to guide engagement and provide guidelines for consistency or pono and tika in the process of applications for the use of introduced BCAs.

Wānanga in Auckland and Tauranga were held during 2023 as part of the three-year He Waka Hourua project and involved the EPA, B3 scientists, the Government Industry Agreement BMSB Council and a select group of ngā pūkenga o ngā take tāiao.

The purpose of wānanga was to connect with tangata whenua to highlight the reason for introducing BCAs into Aotearoa New Zealand and explain latest science in risk assessment to ensure, as far as possible, they are safe in the environment. During wānanga, mana whenua gave robust and critical feedback on research projects and the Framework. Feedback included reservations regarding the consultation process and the perception of mātauranga in this context, the absence of wider Iwi/Māori involvement by EPA in procedures and decisions, and the potential for dissemination of mātauranga to unknown sources.

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Project research partners: AGR and PFR

Get more details about current and completed Theme A projects at B3.nz.



EPA, B3, BMSB Wānanga at Te Whare Wānanga o Awanuiarangi, Auckland, 26 October 2023.

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.

Identifying common threats to Aotearoa New Zealand and its Pacific neighbours

A database of insects and fungal threats to native trees in the Pacific has been established to underpin development of targeted pest lists and prioritisation of biosecurity activities in Aotearoa New Zealand and globally.

The project, completed in mid-2023, filled knowledge gaps on forest pests and pathogens present in the Pacific and their potential impact on culturally, environmentally, and economically valued plants.



Pests and diseases of Fiji's *Agathis macrophylla* could threaten NZ kauri. Photo credit: Tatiana Gerus.

The database contains threats to native trees in the Pacific to 14 host genera for fungi and 3 host genera for insects. It includes information such as geographic distribution, recorded and/or potential impacts, disease symptoms and known dispersal mechanisms.

The project raised awareness of significant threats – those already causing issues and future ones. Existing threats include *Ceratocystis lukuohia* and *C. huliohia*, responsible for mortality of native *Metrosideros* in Hawaii, and the brown root rot caused by *Pyrrhoderma noxium* on *Agathis* (kauri) in Fiji. Potential threats identified included 18 species of sap-sucking insects that are pests of *Pittosporum* species and 12 woodboring insects identified on kauri trees across the Pacific.

A Pacific indigenous biosecurity network was established as part of the project and included organisations from New Caledonia, French Polynesia, Fiji and Hawaii whose expertise can be drawn on in future.

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Project research partners: Scion and PFR

Preparing to protecting natives from a pathogen decimating trees in Hawaii

B3 researchers studying the threat to Aotearoa New Zealand native plants from the Rapid 'ōhi'a death (ROD) pathogens decimating trees in Hawaii are now part of an expert international community to boost preparedness in the event of an incursion.

A three-year project is assessing susceptibility of Aotearoa New Zealand *Metrosideros* species, such as pōhutukawa, to ROD pathogens by mapping climate risk and identifying pathways and potential disease vectors.



Rapid 'ōhi'a death in Hawaii. Photo credit: JB Friday, University of Hawaii.

In 2023 B3 scientists visited Hawaii to learn from researchers, park rangers, conservationists, cultural leaders, community and the indigenous Kanaka

Maoli, who were involved from the beginning of the incursion. They learnt about helicopter surveys to record the occurrence of potentially infected ROD trees and drone surveys to obtain GPS coordinates that allow ground teams to collect samples from suspected ROD-infected trees. Samples are sent to the lab and information, including samples from homeowners, contributes to up-to-date maps showing progression of the disease for management efforts. A nursery identifies disease-resistant 'ōhi'a plants with the objective of growing them and restoring native forests.

The 2023 International Congress of Biological Invasions was an opportunity for international experts to gather and share their experiences, strengthening the international network and understanding.

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Research partners: PFR, AGR, MWLR and Scion

Empowering citizen scientists to protect against Xylella

Researchers involved in the *Xylella fastidiosa* (Xf) and its insect vectors project have harnessed the power of citizen science to collect spittlebugs from across Aotearoa New Zealand.

Spittlebugs that spread the devastating pathogen overseas are currently not present in Aotearoa New Zealand

Field research in the five-year project that ends in 2025 found the exotic *Philaenus spumarius* (meadow spittlebug), a known vector of Xf in Europe, is widespread in Aotearoa New Zealand.

During 2022–2023 the project team sent more than 50 sample collection kits for exotic adult spittlebugs to a wide range of insect enthusiasts in Aotearoa New Zealand. Response was positive with, for example, 17 insects collected from just one area. PFR insect enthusiasts assisted with collection of the native spittlebug.

Project leader Jessica Vereijssen received a Margaret Hogg–Stec Memorial Scholarship to support women advance their careers within PFR. Jessica was able to apply morphological identification skills developed as a result of the scholarship funding to identify collected adult spittlebugs, which were then sequenced to build the molecular diagnostic tool that now complements an existing taxonomic tool.

When completed, the project will deliver new knowledge for incorporation into MPI and DOC risk assessments for productive and native estates, and support government and industry response plans in the event of an incursion.

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Research partners: PFR and MWLR

Get more details about current and completed Theme B projects at B3.nz.



Spittlebugs may spread the unwanted pathogen *Xylella fastidiosa* if it enters New Zealand. Photo credit: PFR.

Theme C: Pathway Risk Management

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

Understanding pathway risk of insects in suspended development

The journey of high-risk pest insects in diapause, or suspended development, is being simulated to better understand the biosecurity risks of this natural phenomenon.



The brown marmorated stink bug, *Halyomorpha halys*, is an example of a high-risk pest insect to New Zealand. If diapausing individuals on pathways to New Zealand are more likely to survive than their non-diapausing counterparts, this could increase the risk of future establishment of that species in New Zealand.

With input from stakeholders, researchers identified 17 high-risk pest insects, including the spotted lanternfly, spongy moth, and BMSB.

A national and international literature review canvassed diapause (suspended development) at different stages of insects' development, whether it affects pests being on the importation pathway

or surviving the journey, and climate matching information to understand pests' ability to establish.

Researchers found a lack of details on crucial factors such as what triggers particular species to go into diapause and climate conditions that make them viable biosecurity threats.

With key partners, researchers classified the risk of diapause as high because of these large knowledge gaps.

Researchers are now working with international collaborators to develop a real-world simulation of insects' importation journeys. It will cover insects hitch hiking on inanimate objects, on plants and food, and at the egg stage during transportation. Researchers will also develop climate models for high-risk pests where this information is not available.

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Research partner: PFR

Herbicide resistance high in imported and local seed lots

More than 40 per cent of Aotearoa New Zealand vineyards and arable farms contain herbicide-resistant plants, with resistant ryegrass particularly common, according to recent findings by B3 project leader Chris Buddenhagen and colleagues.

Herbicide-resistant plants become a problem in the next field rotation, be that of ryegrass or another crop, such as wheat.

A three-year project ending in 2024 focuses on risks of imported herbicide-resistant seeds to develop new border



Survival differences to different herbicides were investigated between seed lots sourced from New Zealand and other exporting countries.



Commercial ryegrass plots were treated to identify resistance to common herbicides haloxyfop, iodosulfuron and glyphosate.

biosecurity measures or voluntary seed industry mitigation measures.

Researchers planted out seed from 56 distinct lots from 52 varieties over two years. Plots were treated with haloxyfop, iodosulfuron and glyphosate at the highest recommended rate.

Eight weeks after treatment, up to 20 survivors were collected per variety and herbicide, grown in a glasshouse and tillered for respraying to confirm resistance to herbicide treatments.

Out of 56 seed-lots (11 from Aotearoa New Zealand, 45 imported), resistance was confirmed for 80 per cent or 44 lots, including some breeder's lines. There was no significant difference between seed lots sourced from Aotearoa New Zealand or overseas. No lots survived glyphosate.

In the final phase of this project, researchers are growing other weed contaminants to produce seed for resistance testing.

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Research partners: AGR, Massey University, GTSeq wetland development.

B3 treatments research opens up new export option for Samoa

B3 along with Samoan, Australian and Pacific funding agencies supported research into alternatives to the fumigant methyl bromide for killing insects, mites and pathogens on fresh taro, which has allowed Samoan exporters to access the valuable Aotearoa New Zealand market without fumigation and gain potential new access to the lucrative Australian market.

The B3 project, completed in 2021, identified a combination treatment of high-pressure washing and hot water treatment (HPW+HWT) to be effective against mites and nematodes while maintaining acceptable taro quality. With buy-in from the Samoan government, laboratory research later conducted at the Scientific Research Organisation of Samoa (SROS) showed that the combination treatment regime was also effective against the pathogen that causes taro leaf blight, a biosecurity organism restricting

taro access to Australia. Support from the Pacific Horticultural and Agricultural Market Access Plus program (PHAMA Plus, funded by DFAT in Australia and MFAT in New Zealand) subsequently enabled the successful testing of this combination treatment using PFR semi-commercial treatment facilities in Samoa. Ten successful export consignments of combination-treated taro from Samoa to New Zealand resulted in no fumigation required in New Zealand (most consignments usually require fumigation). A submission was tabled with Biosecurity Australia to consider reopening the fresh taro market from Samoa.



Taro being high pressure washed prior to hot water immersion – an environmentally friendly alternative to fumigation.



High-pressure washing and hot water treatment equipment used to treat taro for control of biosecurity pests to export to New Zealand, or to control leaf blight for export to Australia.

As a result of the project, Samoa's largest produce importer has purchased a combined HPW+HWT system, which will need to be approved by importing country regulators.

Alternatives to the fumigant methyl bromide remain a high priority for managing quarantine pests on imported goods in Aotearoa New Zealand and globally. The B3 project has demonstrated the importance of connecting with our Pacific Island nation researchers, regulators, and industry partners to progress research findings to actual biosecurity value.

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Research partner: PFR

Get more details about current and completed Theme C projects at B3.nz.

Theme D: Diagnostics

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

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.

The integrated badnavirus may only be capable of causing disease if it comprises the complete genome. It remains inactive until unpredictable stresses such as tissue culture or drought may trigger them start to replicate and cause disease.

In a project ending in 2024, researchers are developing a method to reliably distinguish the forms of badnavirus that present different levels of risk. The method will be easily incorporated into existing MPI systems to rapidly assess the hazard in PEQ and monitor the spread of a virus, or pre-screen material prior to plant breeding or tissue culture.

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Research partners: PFR

Mass spectral fingerprinting to solve tricky biosecurity issues

The increasing diversity of biosecurity threats makes diagnostics a complicated and evolving area, requiring moving beyond traditional taxonomic species identification.

Metabolomics is a novel approach being explored, where metabolites signify useful biological characteristics of intercepted organisms such as age, reproductive status, geographic origin, or pathogen status. Mass spectral fingerprinting (MSF) technology

substantially reduces time taken for metabolomic measurements from days to seconds.

In a one-year feasibility study, B3 researchers found clear signatures of *Liberibacter* infection in tomato plants and distinguished species of weevil and differences in their time since death.

A four-year project stemming from these positive findings is progressing MSF as a forensic tool to fill diagnostic gaps in both insect and pathogen systems.

Researchers are using substitutes for exotic pests, including house fly for Queensland fruit fly and green vegetable bug, *Nezara viridula*, for BMSB to explore factors such as age, sex and mating status. In pathogens, disease progression of *Pseudomonas syringae* in cherry trees is being studied for early detection of asymptomatic infection.

The project, ending in 2026, will investigate two MSF instrument types: rapid evaporative ionisation mass spectrometry (REIMS) and direct analysis in real time-mass spectrometry (DART-MS).

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Research partners: AGR, PFR, LU and UC



Queensland fruit fly, *Bactrocera tryoni*, is an example of a high-risk pest insect to New Zealand. If it were to establish, it could jeopardise our multi-billion-dollar horticulture industry. Photo credit: James Niland



Isotope ratio mass spectrometry for determining insect origins.

Isotopes can determine the geographic origins of insects

Understanding if an exotic insect belongs to a local breeding population in Aotearoa New Zealand is valuable information for informing operational responses and eradication campaigns in an incursion.

A series of B3 projects—built evidence to show ‘stable isotopes’ can determine the geographic origins of insects. Isotopes are natural variants of an atom with their ratios characteristic of different environments. They enter the food web so insects take on a chemically imprinted life history of what they eat and, therefore, where they grew up.

In a project ending in 2022, researchers analysed georeferenced leaves sampled from high-risk surveillance sites around New Zealand to create the first local ‘isoscape’ – a geographically referenced model that predicts isotope values across the country to determine the probability a specimen is from where it was found.

The method was trialled with Queensland fruit fly detected in New Zealand to support MPI conclusions on whether they were bred in the location they were found. Researchers have since developed Australian isotope data to improve confidence in distinguishing trans-Tasman breeding populations.

Further research is required for use of the method in a range of insects, especially those feeding on different plant parts besides fruit, such as sap.

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Research partner: LU

Get more details about current and completed Theme D projects at 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.

B3 tunnel trap used at high-risk sites in Aotearoa New Zealand and Australia

New traps developed by B3 to better detect and catch high-risk insects such as the brown marmorated stink bug (BMSB) and spotted lanternfly are being tested at sites in Aotearoa New Zealand and Australia. The project focused on giving biosecurity agencies a better tool for detection and surveillance of these high-risk insects.

The traps were developed as part of a three-year project that ended in mid-2023 and involved field trials in Italy where BMSB is present and B3 collaborations were already in place.

The research team found their tunnel trap prototypes greatly improved the catch of adult BMSB compared with sticky panel and pyramid traps, making them an

effective tool for surveillance and delimitation in an incursion. The traps' effectiveness was superior at both high and low population densities.

Researchers developed the traps using latest knowledge of pheromone plume dynamics to best attract and retain flying insects. Researchers also developed tailored information on trap placement in different environments to optimise performance.

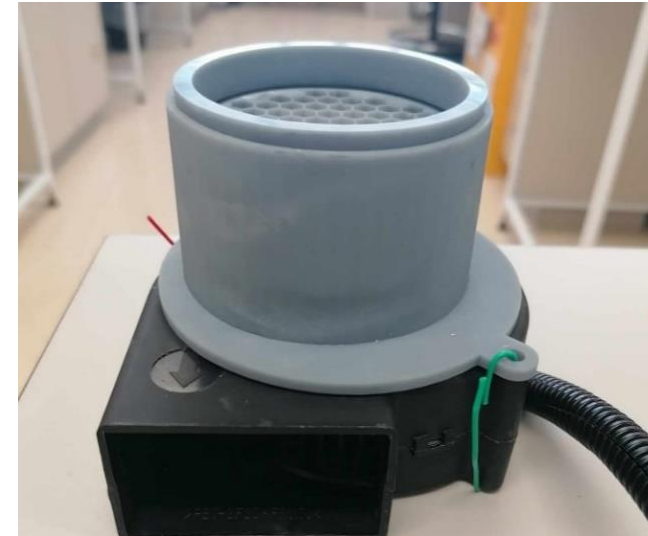
The optimal prototype is now being tested at 10 Ministry for Primary Industries surveillance sites in Aotearoa New Zealand, as well as high-risk sites in Australia.

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Research partners: PFR and Scion



A 150-mm diameter, 30-cm long tunnel trap prototype in the field for capture of brown marmorated stink bug.



3D-printed air filtering device for collection of eDNA samples.

Filling knowledge gaps on eDNA as a biosecurity tool

B3 researchers are filling knowledge gaps on the potential of environmental DNA (eDNA) as a biosecurity tool, including a project that quantified the period of exposure required before an insect is detected.

eDNA detection methods are rapidly changing how organisms are detected in the field. Recent studies have shown pests including the BMSB can be detected in the field using DNA collected from plant surfaces. But relatively little is known about the limits of detection and lifespan of insect DNA within the environment.

A three-year project completed in mid-2022 focused on quantifying the period of exposure required.

Researchers studied the green vegetable bug (GVB) as a surrogate for BMSB and conducted several assays. After allowing GVBs to walk and feed on apples for 30 minutes, researchers could detect insect DNA. There was little change in detection sensitivity up to 24 hours after exposure.

Researchers are continuing work with the GVB across a larger number of samples to develop a robust understanding of detection limits, degradation of insect DNA over time and DNA metacoding versus qPCR to detect a wider range of insects.

A current B3 project, ending in 2027, is collecting eDNA from the air to potentially identify invasive taxa like weeds, pathogens and insects to provide new tools for landscape-scale eDNA sampling.

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Research partners: PFR, MWLR, and Scion

Remote sensing of crops via satellite and aerial imagery

Researchers are testing the potential of remote sensing technology to identify crops at risk from new biosecurity incursions such as the BMSB and fall armyworm.

In the first part of the three-year project finishing in 2024 the team developed new methods to remotely identify maize crops using time series data from satellite images integrated with high-resolution aerial imagery. They used the data to train machine learning algorithms, which can now classify maize crops in several Aotearoa New Zealand regions with greater than 80 per cent accuracy. These methods could help biosecurity agencies and primary producers quickly and inexpensively define spatial distributions of biosecurity hazards' host plants such as maize and help target surveillance for new incursions.

In the final stage of the project, researchers are remotely sensing individual specimens of tree of heaven (TOH), which is invasive in Aotearoa New Zealand and a favoured host of the BMSB and spotted lanternfly. They are integrating Google Street View + Lidar points + satellite images + Pl@ntNet to automatically identify TOH.

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Research partner: AGR

Get more details about current and completed Theme E projects at B3.nz

Theme X:

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



Information sharing hui with Mana Whenua in Tauranga July 2023.

Theme X provides an opportunity for cross theme research to be housed under a single theme as well as a home for Māori-led and kaupapa Māori projects.

Using the He Awa Whiria (braided river) approach, Theme X acknowledges that multiple knowledge streams are needed to create solutions that work for everyone. Like a braided river, Theme X integrates streams of knowledge from across the B3 programme and partnership to create projects that aren't constrained by 'themes', 'disciplines' or 'worldviews', and do not advantage one source over another.

Theme X is the home for these integrated collaborative projects, particularly those that are Māori led and/or kaupapa driven. Theme X is also important for ensuring Māori are able to bring their mātauranga into B3 programmes in safe and appropriate ways.

Something B3 believes is vital for accelerating innovation in the protection of our plants.

Encouraging more Māori researchers into B3 is a key focus of the B3 Māori strategy. Theme X is the vehicle that encourages more Māori participation. It is also important for more integration of mātauranga into mainstream B3 science and contemporary science with mātauranga. If we can build familiarity into B3 science programmes of both knowledge systems through encouraging an integrated approach, then this type of research will be the way of the future in working with researchers from both Māoridom and Pasifika.

Empowering te āo Māori responses to biosecurity threats

The concept of biosecurity is not new to tangata whenua, it is deeply rooted in the cultural practices and role they have as kaitiaki of their lands and



Mana Whenua hui, Tāmaki Makaurau, October 2023.

waters. In this context, B3 biosecurity refers to tools and approaches that protect Aotearoa New Zealand's environment, ecosystems and biodiversity from the introduction and spread of pests coming into Aotearoa that threaten taonga plant species.

B3 acknowledges that Māori have cultural authority over their taonga, and that it should be recognised as an essential part of the biosecurity system. In part that means skilled kaitiaki must be empowered to work closely with scientists and government bodies to achieve positive outcomes for their taonga plant species.

A three-year kaupapa Māori research project ending in 2025 is supporting a range of activities built around ensuring Māori tikanga is included, where appropriate, into B3 programmes. It directly supports engagement following whanaungatanga tikanga relevant to each hapū researchers are working with.

Weaving together the complex web of biosecurity social networks

A project to analyse the evolution of B3 publications and collaborations has revealed a growth in co-authorship

and collaborations over time but these tended to be within existing B3 themes.

Researchers involved in a two-year project that ended mid-2023 used state of the art methods to analyse research outputs from B3 scientists published in international peer-reviewed journals. The aim was to understand how biosecurity science collaborations have evolved over time.

The analyses examined almost 300 peer reviewed articles from B3 researchers, published between 2010 and 2021 and produced by a community of more than 500 authors.

Results revealed males and females played similar roles in the biosecurity network. A handful of researchers played key roles in the network and given some may retire or leave B3 there is a need for planning to ensure this does not disrupt collaboration in future.

Co-authorship grew over time as more scientists joined B3 but there was little evidence of increased collaboration or crossover between researchers in different themes.

Māori Strategy

The B3 Māori Strategy has three Pou based on the principles of Te Tiriti o Waitangi.



A key focus of the new Māori strategy is continuity of relationships with mana whenua across the motu. Here B3 is supporting training in species and disease identification of myrtle rust for Tauranga Moana kaitiaki.

Kotahitanga

This pou focuses on partnerships and relationships. It requires B3 to establish and foster enduring relationships with iwi/Māori that extend beyond the life of a single project.

Rangatiratanga

This pou focuses on participation and co-innovation. To develop and lead kaupapa Māori projects and bring benefit to iwi/hapū/whanau participants in the project.

Tiakitanga

To be the protectors of our taiao and taonga. This pou focuses on protection and the mahi (work). Integration of mātauranga with science to create tools, opportunities and outcomes to deliver benefit to our kaitiaki, taiao and taonga.

B3 in 2024

- Te Tiriti training for B3 Researchers
- Filling the vacancies for Māori representatives to the Collaboration Council and Science Advisory Group
- Growing the number of kaupapa Māori projects supported by B3
- Ongoing support of Māori Summer Students
- Continued co-hosting of students with MPI/Biosecurity NZ
- Expanding into more partner organisations
- A concerted focus on developing a network of Biosecurity practitioners from across the Pacifica through deeper relationships and partnerships.

Māori Strategy

Vision

ki te tiaki wahi taonga –
to protect our treasured places.

Mission

To care, support and protect our taonga from invasive species threatening their existence through integrated research programmes that incorporate knowledge, both traditional and contemporary
and
To be a trusted research partner to iwi/Māori.
Based on honesty, integrity and reliability.

Our three Pou

1

Kotahitanga – Partnership

- Develop a network of Māori champions (Tangata Kokiri) from across the country.
- Strong trusted relationships based on honesty, integrity and reliability.
- Continuity of research partnerships.
- Integrated research programmes.

2

Rangatiratanga – Participation

- Joint summer studentships in partnership with end-user organisations.
- Co-innovation, co-development, co-led programmes of research.
- Lead organisation in the development of a Pacifica.
- Biosecurity Network.

3

Tiakitanga – Protection

- Kaupapa Māori-driven research programmes.
- Training programmes for mana whenua in pest and disease identification.
- Tiriti-based waananga.
- VM training.

Key alignment to:

The B3 Strategy | Te Tiriti | Māori Strategies of partner organisations

B3 in 2023

- Appointment of Co-Director
- Two Māori representatives on Collaboration Council
- Māori representative to SAG
- Two kaupapa Māori projects supported
- Ongoing support of Māori Summer Students
- Co-hosting of students with MPI/Biosecurity NZ
- Embedding tikanga as part of everyday activities
- Te Titiri and Vision Mātauranga education for B3 science leaders

Priorities to 2028

- Vision Mātauranga workshops
- Tiriti workshops
- Māori Research Co-Leads
- Kahui Māori
- Strong enduring relationships and partnerships
- Increase Summer Students numbers and co-hosting partnerships
- Participation at key events
- B3 Roadshow

Latest Projects

All new projects approved to commence July 2023 involve high levels of engagement with mana whenua, communities, and industry, and will provide tools and learnings to protect against potentially seriously damaging threats to primary industries and taonga plant species.

De-risking the tissue culture import pathway

The first project explores ways to safely increase importation of plant tissue culture and allow New Zealanders access to a greater number and wider range of species such as house plants. Plant material entering Aotearoa New Zealand, including tissue culture, must be quarantined and tested for the presence of pests or diseases. This three-year project will use latest and existing technology to examine different tissues and track how microbial communities persist or diminish during their growth and, ultimately, identify best methods to perform rapid and comprehensive screening of tissue culture.

Contact: hayley.ridgway@plantandfood.co.nz

Prioritising social research for border biosecurity

A second one-year scoping project involves social scientists working in partnership with key groups related to international air travel to explore whether travellers, airport workers and communities consider biosecurity important, and identify potential areas of vulnerability for unwanted pests or diseases to breach the border. The collaborative project will culminate in a plan for further research and activity to improve awareness and better engage the public in biosecurity surveillance and response efforts.

Contact: andrea.grant@scionresearch.com and simon.wegner@scionresearch.com

Risks from pathogens, pests and weeds in a changing climate

The third new project focuses on developing programmatic methods for analysing risks from foreign insects, weeds and pathogens to plant-based industries in changing climate conditions and designing ways to mitigate against their establishment and impact. This three-year project builds on previous work in collaboration with partners including MPI, DairyNZ, FOA / FGR, Zespri and FAR to develop a partly programmatic – or semi-automated – approach to pest risk analysis for use by stakeholders.

The new project will extend previous work that spanned insects and weeds to include plant pathogens; increase engagement with Māori; place a greater emphasis on climate warming; and for the first time include surveillance and response expertise to design mitigations for the greatest risks.

Contact: craig.phillips@agresearch.co.nz

Building biosecurity capability: Summer Students

In 2022/23 the B3 Summer Student programme evolved to include a studentship supported by MPI and PFR's Te Rito programme. The first student to experience this collaborative approach, Jordan Pickering, undertook a research project and spent time across MPI biosecurity units to understand real-world implications of research.

Jordan Pickering (Ngāpuhi)

Jordan made videos in English and Te Reo to support Te Tai Tokerau mana whenua to look for and recognise the FAW and understand the pest's potential impact on native taonga species.



Summer Studentship supported by PFR's Te Rito programme and MPI.

Olivia Mairs

Olivia captured a range of air samples containing pollen, insects and fungi as part of a wider B3 project, one of the first to study eDNA's potential as a biosecurity tool for surveillance of weeds, pathogens and insects.



Summer Studentship supported by B3 and Scion.

Te Matau O Te Rangi (Te Ati Haunui-a-Pāpārangi) and Joel Tregurtha

Te Matau and Joel 3D printed a model of the BMSB to help raise awareness of the potential for a costly invasion of the pest. The model could be used at events such as public awareness outreach programmes, children's activities and field days.



From left: Joel and Te Matau with their 3D printed brown marmorated stink bug.

Summer Studentship supported by the BMSB Council and the B3 through PFR's Te Rito programme.

Kelly-Anne Bentley (Ngāti Kahungunu ki Wairarapa and Ngāi Tahu)

Kelly-Anne looked at potential badnaviruses – part of the largest and most diverse group of viruses in plants indigenous to New Zealand. She worked as part of a wider B3 project studying exotic badnaviruses and developing new diagnostic methods for use in post-entry quarantine.



Summer Studentship supported by B3 through PFR's Te Rito programme.

Stacey Maki (Ngai Tūhoe & Te Whakatōhea)

Stacey developed a template to more rapidly evaluate the potential of new phytosanitary treatments for commodity items at the border. This will help narrow the list of potential treatments for New Zealand's biosecurity system and contribute to the search for alternatives to ozone-depleting fumigants and improve existing treatments.



Summer Studentship supported by B3 through PFR's Te Rito programme.

Julian Manti

Julian supported an International Plant Sentinel Network (ISPN) pilot study to understand the potential of sentinel gardens for exotic pests and pathogen horizon-scanning. He recorded examples of threats to plants considered iconic in the United Kingdom that are growing in the Christchurch Botanic Gardens.



Summer Studentship supported by the Christchurch Botanic Gardens.

B3 represented at the First International Conference on Plant Health

B3 Director, David Teulon, and B3 Pourangahau-Māori, Alby Marsh, joined more than 500 of world's leading authorities on plant health at the world's first ever International Plant Health Conference (IPHC) held in London in September 2023. The attendance reflected B3's on-going involvement with the Paris-based Euphresco network and New Zealand's leading role in the inclusion of indigenous knowledge in biosecurity research.

At a side-session, David presented B3/PFR research led by Gonzalo Avila on pre-emptive biosafety for biological control, illustrated by the example of the brown marmorated stink bug / Samurai wasp. At a pre-conference workshop, David led discussion on models for resourcing an effective global research co-ordination. PFR has joined an international, multiparter, research collaboration network on phytosanitary research funded by Horizon EU programme (Euphresco III), with David Teulon taking the role of Pacific Coordinator. This network is an opportunity to strengthen B3 collaborations in the Pacific Region.



See: <https://www.b3nz.org.nz/enhancing-international-research-co-ordination/>

David Teulon and Gonzalo Avila. 2023. Preparedness in biological control of priority biosecurity threats. International plant health research partnership to address global challenges. Side session at the International Plant Health Conference, London, 22 September 2022

The 4th International Congress on Biological Invasions (ICBI2023)

The 4th International Congress on Biological Invasions (ICBI2023) was hosted in Ōtautahi Christchurch, Aotearoa New Zealand, 1–4 May 2023. B3 was a key partner in securing the ICBI2023 conference for New Zealand, which attracted 440 delegates from 25 countries. ICBI2023 provided a science forum to share

knowledge on how to minimise the impact of invasive alien species (IAS) such as exotic pests, pathogens and weeds. This was the first time the Congress has been held outside of China and the strong attendance, particularly from participants from the Pacific countries, reinforced the relevance of this global challenge.

Themes of the Congress were Innovation, Collaboration and Partnership, and these were evident throughout as the science community working on invasive species management across terrestrial, freshwater and marine habitats and in tropical, sub-tropical, temperate and even polar regions intermingled and conversed.

ICBI2023 had its own distinctive Aotearoa New Zealand characteristics, highlighting New Zealand's role as a responsible partner within the Pacific community, it recognised the pivotal role of mana whenua and indigenous knowledge in the effective mitigation and management of invasive species, and the need for strong and broad-based social partnerships across government, industry, and community interests. The influence of climate change on the impact of invasive species and the need to build broad social partnerships were two other important areas highlighted.

B3 Conference

The B3 Conference was held 5 May following ICBI2023 and the timing secured attendance by Hawaiian and Australian delegates in addition to industry and government agency representation. The Conference saw farewells from James Buwalda B3 Chair of 15 years and David Teulon B3 Director of 10 years. Both James and David must be commended for the contribution to biosecurity science delivered through B3.

B3 Theme Leaders presented an overview of the breadth of B3 research. Government agencies MPI, DOC, EPA, MfE and MBIE provided an agency perspective on priorities and aligning effort. Stakeholder and end-user representatives from the Government Industry Agreement, Biological Heritage National Science Challenge and Te Tira Whakamātaki provided updates which help guide B3 direction.

MOU partners Plant Biosecurity Research Initiative, Centre of Excellence for Biosecurity Risk Analysis and University of Canterbury Biosecurity Innovations contributed presentations in support of B3's approach to collaboration. B3 will reciprocate support through contribution to the PBRI symposium May 2024.

The B3 conference demonstrated very strongly that its collaborative research model works as evidenced by system-wide attendance and contribution.

Peer reviewed publications

Avila GA, MacDonald F, Hun S, Santos K, Alavi M, Pugh AR, Gresham BA, Pierce B, Prache A, Withers TM (2023) Field assessment of parasitism on the New Zealand endemic *Nyctemera annulata* by *Cotesia urabae*: can non-target impacts be ruled out? *Biological Control* 178: 105136. DOI: 10.1016/j.biocontrol.2022.105136

Barratt BIP, Meenken ED, Withers TM (2023) Characterising uncertainty in risk assessments for biological control. *BioControl* DOI: 10.1007/s10526-023-10181-x

Bedoya CL, Nelson XJ, Brockerhoff EG, Pawson S, Hayes M (2022) Experimental characterisation and automatic identification of stridulatory sounds inside wood. *Royal Society of Open Science* 9: 220217. DOI: 10.1098/rsos.220217

Buddenhagen CE, Hackell D, Henderson HV, Wynne-Jones B (2023). Factors impacting the detection of weed seed contaminants in seed lots. *Pest Management Science* 79: 881–890. DOI: 10.1002/ps.7257.

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

Gonzatto Maciel C, Sidnei Fior C, Franco Cardozza Y, Visnovsky SB, Reichelt Alves K, Duarte V, Lazarotto M (2023) Bacterial Leaf Spot of *Ilex paraguariensis* caused by *Pseudomonas syringae*. *Journal of Phytopathology* 00, 1–2. DOI: 10.1111/jph.13170

Martoni F, Bulman SR, Piper AM, Pitman A, Taylor GS, Armstrong KF (2023) Insect phylogeny structures the bacterial communities in the microbiome of psyllids (Hemiptera: Psylloidea) in Aotearoa New Zealand. *PLoS ONE* 18(5): e0285587. DOI: 10.1371/journal.pone.0285587

Mason PG, Barratt BIP, Mc Kay F, McKay F, Klapwijk J, Silvestri LC, Hill M, Hinz HL, Weyl P, Sheppard A, Brodeur J, Vitorino MD, Hoelmer KA (2023) Impact of access and benefit-sharing implementation on biological control genetic resources. *BioControl*. DOI: 10.1007/s10526-023-10176-8

Mason PG, Mc Kay F, Silvestri LC, Hill M, Weyl P, Hinz HL, Brodeur J, Vitorino MD, Barratt BIP (2023) International agreement for the use and exchange of biological control genetic resources: a practical

proposal. *BioControl* DOI: 10.1007/s10526-023-10177-7

Mason PG, Barratt BIP (2023) special issue on access and benefit sharing and biological control genetic resources. *BioControl* 68 (3)

Nunes Leite L, Visnovsky SB, Wright P, Pitman AR (2023) Draft genome sequences of three *Candidatus* *Symbiopectobacterium* isolates collected from potato tubers grown in New Zealand. *Microbiology Resource Announcements* 12: e0114822. DOI: 10.1128/mra.01148-22

Payne PR, Finlay-Smits S, Small B, Cave V, Kean J (2022) What's that bug? Community participation in biosecurity in Mount Maunganui, New Zealand. *Biological Invasions* 25: 593–610. DOI: 10.1007/s10530-022-02937-w

Robinson AP, McNeill MR (2022) Biosecurity and post-arrival pathways in New Zealand: relating alien organism detections to tourism indicators. *Neobiota* 71: 51–69. DOI: 10.3897/neobiota.71.64618

Ross A, Muller H, Subbaraj A, Homewood I, Mas F, Hardwick S, Stringer L, Vereijssen J, Visnovsky S, Najar-Rodriguez A, Armstrong KF (2023) Metabolomics for plant health biosecurity diagnostics and response. *Sustainability* 15: 4654. DOI: 10.3390/su15054654

Voice DG, MacLellan R, Russell A, Goulden D, Lawrie I, Baker G, Teulon DAJ, Kean JM (2022). The eradication of pea weevil *Bruchus pisorum* (L.) (Coleoptera: Chrysomelidae) from New Zealand. *CABI Agriculture and Bioscience* 3: 31. DOI: 10.1186/s43170-022-00093-8.

Reports

Armstrong K, Holder P. 2023. Boosting Diagnostics: Determining the geographical origin of priority insect pest detections: Anthropogenic stable isotope signatures to improve resolution of high-risk environments. Final report to the Grains Research and Development Council. Research Report No. 9177864. 10th February 2023. 29 pp.

Horner R. February 2023. New aerodynamic design principles for effective insect traps — year three progress report. A Plant & Food Research report prepared for: Ministry for Primary Industries. Milestone No. 95435. Contract No. NA. Job code: P/321025/09. PFR SPTS No. 23593.

Marroni V, McNeill M, Campbell R, Johnston P, Smith G, Waiariki T, Puketapu A, Awarau–Morris W, Marsh A, Weir B, Beresford R, Tyson J, Padamsee M, McCarthy J, Etherington T, Ganley B, Keith L. 2022. The risk of rapid ‘ōhi-a death to Aotearoa New Zealand and the South Pacific. Plant & Food Research report prepared for Better Border Biosecurity (B3). Milestone No. 93859. Contract No. NA. Job code: P/321022/09. PFR SPTS No. 22708.

Marroni V et al. 2022. Te haere huihui tahu. B21.2 project newsletter, issue 1.

Marroni V et al. 2022. Te haere huihui tahu. B21.2 project newsletter, issue 2.

Marroni MV 2023. Travel report to Hawaii, 13–27 November 2022. PFR SPTS No. 23632 B21.2

McNeill MRM, Gibbs G, Armstrong K 2022. Protecting our plants by future proofing plant health. Report prepared for Christchurch Botanic Gardens and Better Border Biosecurity (B3).

Phillips CB, Buddenhagen CE, Han Y, Lamoureaux S, Noble A, Bourdot G 2023. Offshore weed risks to NZ forage seed production: Milestone 3 Weed hazard ranking. [AgResearch Client Report]. AgResearch Ltd, Lincoln. 20p.

Phillips CB, Han Y 2022. Offshore weed risks to NZ forage seed production: Milestone 2 Weed hazard identification. [Report AgResearch Client Report 12200]. AgResearch Ltd, Lincoln. 14p.

Turner R, Phillips CB 2023. Forestry biosecurity pest risk evaluation Phase 1. Presentation to Forest Growers Research Limited (virtual).

Turner R, Phillips CB 2023. Forestry biosecurity pest risk evaluation Phase 1. Report to Forest Growers Research Limited.

Invited presentations (significant international/national meetings/seminars)

Armstrong KF. 2022. Current research directions for Diagnostics in B3. Annual Diagnostics and Surveillance Workshop AgriBio, Melbourne, 30 August–1 September 2022.

Andow DA, Pires Paula D, van Lenteren JC, Barratt BIP, Pfannenstiel R. 2022. Integrating adverse effect analysis into environmental risk assessment for exotic generalist arthropod biological control agents: a three-tiered framework. Symposium Revisiting the biosafety of exotic generalist arthropod biological control agents, XXVI International Congress of Entomology, Helsinki, Finland. 17–22 July 2022. Book of Abstracts p. 42

Avila GA, Barratt BIP, Chhagan A, Audsley N. 2022. Pre-emptive biocontrol: a novel approach to increase preparedness against high-risk biosecurity threats. XXVI International Congress of Entomology, Helsinki, Finland. 17–22 July 2022

Avila GA, Hoelmer KA, MacDonald F, Charles JG, Hunt S, Davis V. 2022 A world first: What pre-emptive biocontrol might mean for BMSB? Symposium Proactive, Reactive and Accidental Biological Control of Invasive Species, XXVI International Congress of Entomology, Helsinki, Finland. Book of Abstracts p. 58, 17–22 July 2022

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

Awarua–Morris W, Paul W. 2023. Kaitiakitanga, science and better, border biosecurity. International Congress on Biological Invasions, Christchurch, New Zealand. 1–4 May 2023

Barratt BIP. 2023. Biological control: the risks, benefits and challenges. Presentation to the Wanaka Branch of the Royal Society of New Zealand, 24 May 2023, Wanaka.

Cridge A, Hyink O, Armstrong KF, Holder P, Harrop TWR, Wardhaugh C, Dearden PK. 2022. “Biosecurity Hide and Seek”. Plenary. 70th Annual Conference of the Entomological Society of New Zealand, Rotorua. 24 – 28 Oct 2022.

Cridge A, Hyink O, Armstrong K, Harrop T, Dearden P. 2023. Bees as Biosecurity Biomonitors: exotic plant detection and identification to monitor plant invasions. 1st Australian and New Zealand environmental DNA (eDNA) Conference: Innovation & Application. Hotel Grand Chancellor, Hobart 14–17 February.

Fitzgerald R, Sun J, Welsh T, Rajkumar D, McNeil M, Atlas J. 2023. Automatic detection of contaminants on sea container exteriors to improve detection of unwanted exotic organisms. International Congress of Biological Invasions (ICBI), 1–4 May 2023.

Hardwick S, Davies N, Harmer A, Heywood A, Lawrie I, Palmer R, Phillips C, Pitman A, Walker G. 2023. A cooperative response to fall armyworm in New Zealand: Government and Industry working together. International Congress of Biological Invasions, 1–4 May 2023, Christchurch, New Zealand.

Hasna L, Beresford R, Campbell R, Marroni V. 2022. Assessing the climatic risk of establishment of rapid ‘ōhi-a death (ROD) in Aotearoa New Zealand. NZ Plant Protection Society Conference, Christchurch, 9–11 August 2022. Poster.

Hasna L, Beresford R, Marroni V, Campbell R, Perry G. 2023. Assessing the risk of establishment of rapid 'ōhi 'a death: using knowledge of Ceratocystis species already in New Zealand. International Congress of Biological Invasions, 1–4 May 2023, Ōtautahi Christchurch, New Zealand.

Holder PW, Armstrong K, Murphy D, McComb K, Van Hale R. 2022. Using isotopes to determine provenance of biosecurity risk insect pests. Plenary. 70th Annual Conference of the Entomological Society of New Zealand, Rotorua. 24–28 October 2022.

Kean JM, Newfield M, Finlay–Smits S, Reed C, Phillips CB 2022. What makes a good risk-based decision in biosecurity? Society for Risk Analysis, Australia and New Zealand (SRA–ANZ) Conference, 26–27 October 2022, Melbourne, Australia.

Marroni V. 2022. Rapid ‘ōhi-a death, how substantial is the threat of this disease to Aotearoa New Zealand’s endemic and indigenous *Metrosideros* species? NZ Plant Protection Society Symposium, Plant pathogens that keep us awake: past, present and future threats to native species. Christchurch, 8 August 2022. Poster.

Marroni MV, Keenan S, Brill E, McNeill MRM, Waiariki T, Awarau–Morris W, Keith L. 2023. (Poster) Validation of a real-time PCR protocol to detect *Ceratocystis lukuohia* and *C. huihiohia* from Aotearoa New Zealand *Metrosideros* species. International Congress of Biological Invasions, 1–4 May 2023, Ōtautahi Christchurch, New Zealand.

Mason P, Barratt BIP. 2022. Biological control genetic resources and access and benefit-sharing. XXVI International Congress of Entomology, Helsinki, Finland. Book of Abstract p. 66, 17–22 July 2022

Phillips C, Yujie H, Davies N, Kean J. 2023. Where in Aotearoa can fall armyworm survive winter? International Congress of Biological Invasions, 1–4 May 2023, Christchurch, New Zealand.

Poulton J, Vereijssen J. 2022. Rapid ID guides – bringing insect identification to the non-taxonomist. NZ Plant Protection Society Conference, Christchurch, 9–11 August 2022. Poster.

Teulon DAJ, Boyd Wilson K, Visnovsky SB, Groenteman R, Ramos Romero L, Marsh A, and McNeill MR. 2022. Exploring the utility of sentinel plants for biosecurity risk assessment for New Zealand indigenous plants. in Proceedings of The NZ Plant Protection Society (NZPPS) Conference 2022. 8 – 11 August; Christchurch

Teulon DAJ, Groenteman R, Visnovsky S, McNeill MR. 2022. Exploring the utility of sentinel plants for biosecurity risk assessment for New Zealand indigenous plants. NZ Plant Protection Society Conference, Christchurch, 9–11 August 2022.

Todd JH, Tooman L, Barratt BIP. 2022. Assessment of *Polistes chinensis* as a biocontrol agent in kiwifruit orchards. XXVI International Congress of Entomology, Helsinki, Finland, 17–22 July 2022.

Todd JH, Lubanga U, Collinson NP, Mills P, Lefoe GK. 2023. Using the PRONTI tool to select non-target scale species for host-range testing with *Neoleucopis n. sp. B* (Diptera, Chamaemyiidae). Presentation at ICBI, Christchurch, 1–4 May 2023.

Turner R, Liebhold AM, Nahrung HF, Phillips C, Yamanaka T, Brockerhoff EG. 2023. The known unknowns in international border interceptions of insects (poster). 4th International Congress on Biological Invasions, 1–4 May 2023, Christchurch, New Zealand.

Vereijssen J, Bulman S, Campbell R, Colhoun K, Drayton G, Groenteman R, Kean A, Nielsen M, Poulton J, Sharp J, Taylor T, Watkins L. 2023. Preparing for a *Xylella* incursion: Presence and movement of spittlebugs in New Zealand landscapes. International Congress on Biological Invasions, 1–4 May 2023, Ōtautahi Christchurch, New Zealand.

Visnovsky SB. 2022. Rapid plant pathogen detection – a few examples. Nanopore Sequencing for Biosecurity workshop, Australian National University, Canberra 28–30 November.

Visnovsky SB, Nieto–Jacobso F, Panda P, Thompson S, Bojanini Molina I, Kahn A, Groenteman R, Rigano L, Taylor RK, Forbes H, Almeida R. 2022. Detection of *Xylella fastidiosa* in New Zealand indigenous plants growing overseas. in Proceedings of the NZ Plant Protection Society (NZPPS) Conference, 8–11 August 2022, Christchurch.

Waiariki T, Awarau–Morris W, Marsh A, McNeill MRM, Marroni V. 2023. Bringing tikanga Māori (Māori values) into biosecurity research: Te Haere huihui tahi (A journey gathering together). International Congress of Biological Invasions, 1–4 May 2023, Ōtautahi Christchurch, New Zealand.

Watkins L, Butler R, Colhoun K, Ellingham D, Groenteman R, Kean A, Nielsen M, Power M, Preddey J, Taylor T, Vereijssen J. 2022. Assessing Xylella risk: Movement of spittlebugs between productive and natural areas in New Zealand. Hemipteran Plant Interactions Symposium, Melbourne Australia, 7–9 December 2022.

Watkins LM, Preddey J, Vereijssen J. 2022. Spittlebug (Hemiptera: Aphrophoridae) occurrence and abundance in unmanaged areas neighbouring commercial vineyards in Waipara. NZ Plant Protection Society Conference, Christchurch, 9–11 August 2022. Poster.

Withers TM, Meurisse N, Gresham B, Davy M, Pugh A, Todd J, Barratt BIP. 2022. Bayesian Network Tool – expert opinions used to build predictions of probabilities of non–target attack. New Zealand Plant Protection Conference, Town Hall, Christchurch. 9–12 August 2022

Invited presentations (B3 Conference)

Awarua–Morris W, Paul W, Barratt BIP, Teulon D. 2022. He Waka Hourua: Mātauranga and western science navigate a safe course for future biocontrol. Presentation to B3 Science Partnership Forum, Wellington, 18 October 2022

Bulman S, Cridge A. 2022. eDNA for terrestrial biosecurity monitoring. Presentation at the B3 Science Partnership Forum, 18 October 2022, Brentwood Hotel, Wellington.

Esfandi K. 2022. Rapid screening method for optimising commodity treatments Presentation at the B3 Science Partnership Forum, Wellington, 18 October 2022.

Frampton R. 2022. Accelerated aging of plants to shorten post–entry quarantine testing period. Presentation at the B3 Science Partnership Forum, Wellington, 18 October 2022.

Herron D. 2022. Beyond soil baiting: toward application of an eRNA diagnostic tool for Phytophthora. SPF, Wellington, 18 October 2022.

Horner R. 2022. Expanding our eradication toolbox in NZ: Is biocontrol a feasible tool to incorporate in a response? Presentation at the B3 Science Partnership Forum, 18 October 2022, Brentwood Hotel, Wellington.

Ridgway H, Bulman S. 2022. De–risking the plant tissue culture pathway. Presentation at the B3 Science Partnership Forum, Wellington, 18 October 2022.

Todd J. 2022. Testing the Toolbox: Reducing uncertainty around non–target impacts from biocontrol agents by validating tool predictions. Presentation to B3 Science Partnership Forum, Wellington, 18 October 2022.

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Contributions of parties to B3

Collaboration Council	Theme Leader Group	End–user/Theme Representatives
CHAIR (Ind.) James Buwalda (up to March 2023) Melanie Mark–Shadbolt (from April 2023)	DIRECTOR David Teulon (up to March 2023) Desi Ramoo (from March 2023)	PROGRAMME LEVEL Aurélie Castinel (MPI) Andrea Clavijo McCormick (MPI) Sathish Puthigae (MPI) Waata Papali'i–Smith (MPI) Murray Fea (DOC)
MEMBERS Suvi Viljanen (PFR, up to April 2023) Jolon Dyer (PFR, from May 2023) Marie Bradley (AGR) Tara Strand (Scion) Peter Millard (MWLR) Travis Glare (LU) Chad Hewitt (LU) Veronica Herrera (MPI) Clare Stringer (DOC) Brendan Gould (FOA) Leanne Stewart (Hort NZ) Holden Hohaia (Te Ara Pūtaiao) Melanie Mark–Shadbolt (Ind. Up to April 2023)* Chris Hill (EPA) (obs.) Gavin Forrest (FFNZ) (obs.)	MĀORI RESEARCH LEAD/POURANGAHOU transitioned to CO–DIRECTOR MĀORI Alby Marsh THEME A Barbara Barratt (AGR) Toni Withers (Scion) THEME B John Kean (AGR) Simon Bulman (PFR) THEME C Nicolas Meurisse (Scion) Joy Tyson (PFR) THEME D Karen Armstrong (BPRC) Bevan Weir (MWLR) THEME E Jessica Vereijssen (PFR) Robin McDiarmid (PFR)	THEME A Miriam Robertson (EPA) Te Mauri Apiata (EPA) Andrea Clavijo McCormick (MPI) THEME B Jo Berry (MPI) Helen Harman (MPI) Ursula Torres (MPI) THEME C Hoda Ghazalibiglar (MPI) Chris Denny (MPI) Sina Waghorn (MPI) Jessica Devitt (MPI) THEME D Rob Taylor (MPI) (to April 2023) Luciano Rigano (MPI) (from May 2023) Lia Liefiting (MPI) Diane Anderson (MPI) (to March 2023) Rebijith Kayattukandy Balan (MPI) (from April 2023) THEME E George Gill (MPI) Rory MacLellan (MPI) (to March 2023) Scott Sinclair (MPI) (from July 2022)
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