Strengthening Biosecurity Through Science

20 Years of Better Border Biosecurity (B3) Impact on Plant Protection

Impact Case Study

AgResearch Group - Bioeconomy Science Institute | June 2025

Science Solutions for Better Border Biosecurity
AOTEAROA NEW ZEALAND

B3 Partners

BIOECONOMY SCIENCE INSTITUTE

agresearch *āta mātai, mātai whetū*

Manaaki Whenua Landcare Research

Plant & Food Research Rangahau Ahumāra Kai

scion FORESTS • PRODUCTS • INNOVATION

LINCOLN UNIVERSITY TE WHARE WĀNAKA O AORAKI

Project Contributors

Department of Conservation *Te Papa Atawhai*

FOREST OWNERS ASSOCIATION

Ministry for Primary Industries Manatū Ahu Matua

Horticulture New Zealand Ahumāra Kai Aotearoa

FEDERATED FARMERS OF NEW ZEALAND

Environmental Protection Authority *Te Mana Rauhī Taiao*

Introduction

For twenty years, Better Border Biosecurity (B3) has contributed to the network of protection that safeguards Aotearoa New Zealand from invasive threats to our valued plant systems. As part of our broad biosecurity ecosystem, our research strengthens the connection between science, practice, and policy that helps preserve the taonga species and productive landscapes that make our country unique.

B3's collaborative approach reflects these interconnections: our researchers work with industry, government, iwi and local communities to create practical and effective biosecurity solutions. From developing world-leading risk assessment tools to supporting the eradication of invasive species, B3's work has prevented billions of dollars in potential productivity losses while protecting our natural taonga.

The evidence in the following pages shows how B3 has delivered an estimated return on investment of $4.80 for every dollar invested and, even more importantly, has helped ensure future generations inherit an Aotearoa New Zealand that retains its ecological integrity and productive potential.

The biosecurity challenges ahead will require continued ingenuity and resolve, delivered through the same collaborative spirit that has made B3 successful. When people work together with shared purpose we can achieve extraordinary outcomes. With continued investment in this partnership approach, Aotearoa New Zealand can remain a place where native species can flourish, productive systems thrive, and our unique identity endures.

This report highlights a small selection of what B3 has achieved over 20 years. We are proud to present this evidence of B3's impact, and grateful to all who have contributed to our shared mission of protecting what makes Aotearoa New Zealand special.

Melanie Mark-Shadbolt
(B3 Collaboration Council Chair)

Beccy Ganley
(B3 Kaihautū Tiriti)

Alby Marsh
(B3 Kaihautū Māori)

Impact Overview

Invasive pests, pathogens and weeds (hereafter pests) pose one of the greatest threats to Aotearoa New Zealand's unique ecosystems, taonga species, and the $59.9 billion annual value of food and fibre exports. Over the past 20 years, Better Border Biosecurity (B3) has led the science that helps minimise these threats to plant systems.

B3 is a science, industry and government partnership conducting research to improve Aotearoa New Zealand's plant biosecurity. B3's success is the result of collaboration between all its biosecurity research partners and stakeholders who ensure that cutting-edge science translates into practical protection for our environment and economy.

B3's research addresses biosecurity challenges at every stage, from predicting which pests pose the greatest risk, to developing early detection systems and supporting rapid responses when incursions occur.

B3 science helps decision-makers assess risks, prioritise resources, and respond effectively to emerging threats.

The 20-year contribution of B3 funding to Aotearoa New Zealand's biosecurity system has delivered an estimated return on investment of **$4.80 for every research dollar invested**. In addition to preventing billion-dollar losses, our biosecurity defences underpin investor confidence and maintain international market access for our food and fibre exports, while protecting our irreplaceable native species and ecosystems.

Among many other impacts, B3's research has contributed to:

- **Predicting and preventing invasions** through tools that help focus surveillance efforts where they're needed most, such as the climate-matching tool used by the Ministry for Primary Industries (MPI) (see page 10) and risk maps to keep Aotearoa New Zealand fruit-fly-free (see page 17)
- **World-leading approaches for safe biological control** that manages pests while protecting indigenous species, with economic benefits of up to $9.8 million annually from just one successful programme (see page 12)
- **Rapid response capabilities** that underpinned the world's first successful eradication of an invasive butterfly, delivering $37.5 million in economic benefits (see page 20)
- **Strengthened border defences** through research identifying high-risk pathways for harmful organisms, such as passenger footwear (see page 11) and the importance of urban entryways (see page 15), informing screening and surveillance protocols that protect against future incursions
- **Innovative diagnostic tools** that enable targeted and cost-effective defences, such as rapid DNA testing to protect horticulture from Psa-family bacteria (see page 22)
- **Multi-layered protection** against brown marmorated stink bug, preventing potential losses of up to $3.6 billion annually through better identification of risks, improved traps, safer fumigation methods, and pre-approved biological control (see page 18)
- **Community engagement** that increases biosecurity awareness among millions of visitors to botanic gardens (see page 27) and port communities (see page 24), creating a network of informed guardians
- **Te Tiriti partnerships** that strengthen biosecurity decision-making through genuine consultation and inclusion, ensuring culturally appropriate responses to invasive threats (see page 28)
- **Developing future research capability** by fostering the next generation of biosecurity experts (see page 30)
- **Building knowledge of biosecurity science relevant to Aotearoa New Zealand** through almost 900 research outputs to date including presentations, abstracts, reports and peer-reviewed publications which provide a provide a foundation for further research.

Evidence in this report is drawn from selected B3 research; the full record of our research is published on B3's website (b3nz.org.nz).

With continued investment and collaboration, B3's research will continue to play a vital role in keeping Aotearoa New Zealand's unique biological heritage safe for future generations.

20 YEARS OF B3

$134 million
of Strategic Science Investment Fund invested by Crown Research Institutes over 20 years

We've supported
33 DOCTORAL & 11 MASTERS OF SCIENCE RESEARCHERS
SEE PAGE 30

Our research has helped to identify practical ways to remove more than
94%
of microbial contaminants from footwear
SEE PAGE 11

We've contributed to the introduction of parasitic wasps as biocontrol agents!
SEE PAGE 12

BIOSECURITY TRAILS

setup at Auckland, Wellington and Christchurch botanic gardens play a vital role in communicating the challenges of biosecurity to the public
SEE PAGE 27

500+
B3 led projects in collaboration with the government and industry

5 Research organisations collaborating

Te Tiriti partnerships have strengthened biosecurity decision-making through genuine consultation and inclusion
SEE PAGE 28

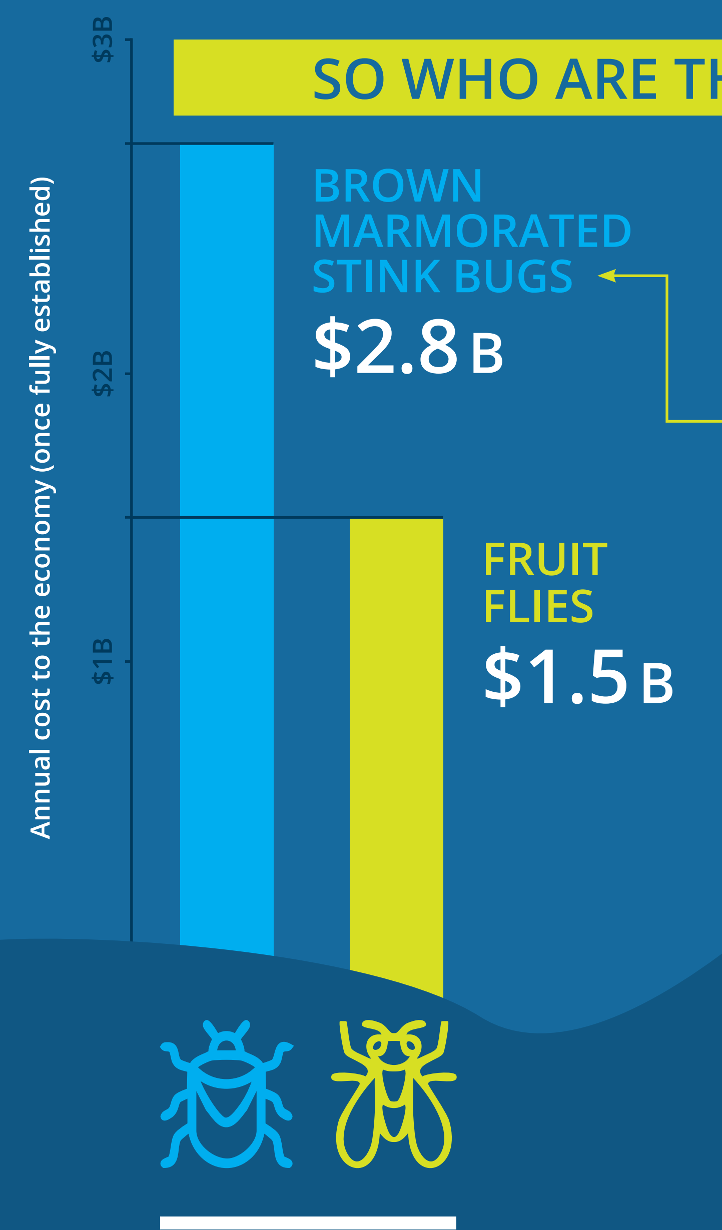
We're working hard to prevent the economic impact of New Zealand's most invasive pests

EVERY $1 INVESTED = A $4.80 RETURN

$9.2 BILLION PER YEAR
is the current total economic impact of pests, pathogens and weeds, primarily through losses to our primary industries. *(Nimmo-Bell 2021)*

We estimate a
$768 MILLION economic benefit from B3 science
SEE PAGE 32

SO WHO ARE THE MAIN CULPRITS?



Find out how we're combating the highest economic threat of any invasive pest, with the potential to damage more than 50 specialty crops and cause GDP to drop by as much as $3.6 billion by 2038
SEE PAGE 18

A $4.9 million benefit!
Read about our direct contribution to the eradication of the great white butterfly
SEE PAGE 20

20 YEARS OF B3

2003
Improved Biosecurity programme contracted with $2.25 million per year for five years ($11.2 million total) with CRI partners AgResearch, Crop and Food Research, and HortResearch

2005
Improved Biosecurity becomes Better Border Biosecurity (B3), contracted as an outcome-based investment (OBI) with $6.2 million per year for 12 years ($74 million total), joined by new partners Forest Research (Scion) and Lincoln University

2009
Independent review of the first four years of B3 recommends increased investment concluding: "Benchmarked internationally, the quality of the science in three of the five B3 Themes was above average and in Theme 5 [Eradication & Response] is world-leading"

2009
B3 partners develop theme briefs that improve strategic direction and strengthen relationships between researchers and stakeholders

2011
B3 core funding agreement with CRI partners removes dependence on government OBI funding

2012
Government Industry Agreement (GIA) for Biosecurity Readiness and Response deed establishes a biosecurity partnership between government and industry

2013
Manaaki Whenua – Landcare Research joins B3 as a CRI partner

2014
First B3 Conference, held in Wellington, to strengthen relationships with government and industry stakeholders

2014
Biological Heritage National Science Challenge established with considerable aligned co-funding from B3

2015
B3 holds it first national hui with iwi reflecting its growing commitment to te Tiriti partnerships

2016
Government shifts to Strategic Science Investment Funding (SSIF), and B3's five research partners commit to continue the collaboration, recognising B3's impact and value

2016
B3 Operational Refresh instigated providing a step-change for strategic annual re-investment with oversight from a newly formed Science Advisory Group

2016
Scientific expertise from B3 helps achieve the world-first eradication of the invasive great white butterfly *(Pieris brassicae)*

SEE PAGE 20

2016
B3's CLIMENZ maps the potential distribution of myrtle rust to inform MPI's response

SEE PAGE 10

2018
EPA approves 'with conditions' the samurai wasp *(Trissolcus japonicus)* as a biological control agent for a brown marmorated stink bug *(Halyomorpha halys)* incursion response

SEE PAGE 12

2019
Collaborative MOU signed with Australian Plant Biosecurity Research Initiative

2019
EPA approves *Eadya daenerys* as a biological control agent for eucalyptus tortoise beetle *(Paropsis charybdis)*

SEE PAGE 12

2019
Biosecurity NZ issues a new priority list which included brown marmorated stink bug, bacterial leaf scorch, fruit fly and myrtle rust, all species found in B3's research priorities

2020
EPA approves *Pauesia nigrovaria* as a biological control agent for giant willow aphid *(Tuberolachnus salignus)*

SEE PAGE 12

2021
Defences against brown marmorated stink bug are strengthened with approval of ethyl formate for fumigation treatment

SEE PAGE 12
SEE PAGE 18

2021
A B3 initiated 'sentinel / expatriate' plant concept is incorporated into European Union policy

2021
B3's novel approach to diagnostic testing for disease-causing *Pseudomonas* bacteria implemented by MPI

SEE PAGE 22

2022
Fall armyworm discovered in Aotearoa New Zealand, B3 research intensifies to support the response until other sources of funding became available

2023
B3 research contributes to the improvement of early warning surveillance for the brown marmorated stink bug with advanced aerodynamic traps deployed in 14 sites

SEE PAGE 18

2023
B3 adopts Tiriti-based leadership, appointing a co-director Māori and developing a Māori strategy

View B3's Māori Strategy

SEE PAGE 8

2025
B3 celebrates 20 years of impact!

B3's Māori Strategy

Vision

Tiaki wahi taonga.
To protect our treasured places.

Mission

To care for and protect Aotearoa New Zealand's treasures, plant species, and ecosystems from invasive threats, through research that draws on both traditional and contemporary knowledge. To be a reliable and respectful research partner to iwi and Māori communities, underpinned by honesty, integrity and trust.

Strategic Alignment

This strategic approach aligns with B3's overall vision and strategy, the Māori strategies of our partner organisations, and the collaborative intent of national and regional biosecurity efforts.

Our Commitment

B3 is committed to working in partnership with Māori across all areas of our programme.

Our approach is grounded in the principles of Te Tiriti o Waitangi and reflects the shared responsibility to care for the natural environment. We recognise the unique knowledge, values, and aspirations that Māori bring to biosecurity, and are committed to integrating mātauranga Māori and Māori-led priorities into our research in a manner that gives effect to Māori conservation and bioeconomic aspirations.

B3 champions a collaborative, inclusive model of science that respects Māori perspectives and supports Māori aspirations for conservation, innovation, and environmental stewardship.

The Three Pou of the B3 Māori Strategy

POU	FOCUS
Kotahitanga *(Partnership)*	Build and support a national network of Māori biosecurity champions. Strengthen existing research relationships and ensure mātauranga Māori is included across our programmes
Rangatiratanga *(Participation)*	Promote Māori leadership and shared governance in research. Co-develop and co-lead projects. Support the development of a Pasifika Biosecurity Network
Tiakitanga *(Protection)*	Support kaupapa Māori-led research. Provide training for mana whenua in pest and disease identification to protect taonga species and places

IMPACT STORIES

Targeted Protection Tools

Risk assessment tools created by B3 increase our understanding of the threats posed by pests, pathogens and weeds to Aotearoa New Zealand's environment and primary industries. A representative selection of these many tools is presented in this document.

This knowledge improves biosecurity by informing MPI decisions, preventing incursions, and optimising surveillance and response strategies.

B3's surveillance and detection tools have evolved how MPI and industry councils conduct biosecurity monitoring, creating more targeted and cost-effective defences. Being better prepared helps keep new pests out, reduces their impacts when they do arrive, and maintains our competitive advantage of having relatively low pest burdens compared to other countries.

This protection safeguards billions in export earnings while preserving our unique ecosystems, delivering economic, environmental and social benefits that reinforce each other.

Climate-matching map helps predict invasions

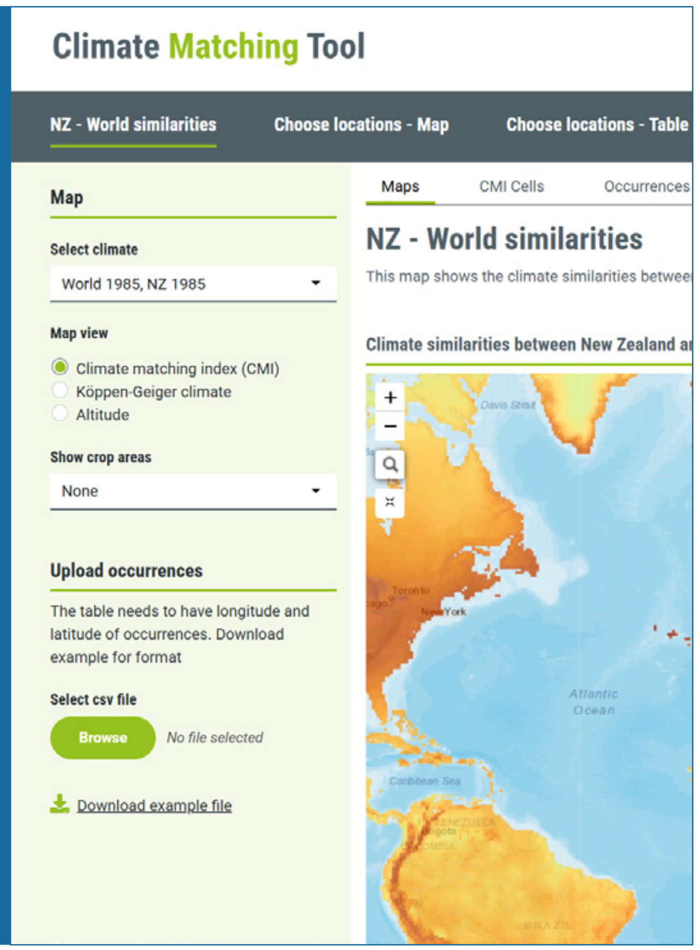
MPI uses B3's climate-matching tools to inform its biosecurity risk assessment, pathway management and surveillance strategies, helping prevent invasions by non-native species.

B3 researchers developed CLIMENZ (b3.net.nz/climenz) to map out the likely areas of high climate suitability for damaging pests that might establish in Aotearoa New Zealand.

CLIMENZ enables MPI to target resources effectively by focusing on the species and regions at greatest risk of pest invasion. For example, during the myrtle rust incursion in 2017, CLIMENZ was used to map its potential distribution to inform MPI's risk assessment and management response.

A related ArcGIS Climate Matching tool (climate.b3nz.org.nz) identifies areas of Aotearoa New Zealand where local conditions could meet the biological and climatic requirements of pests from around the world, either now or in future climate scenarios. This helps anticipate emerging biosecurity threats, as shifting conditions alter species' viable range, habitat and ecosystems.

> "We have been using the ArcGIS Climate Match software to improve consistency in risk analyses, and have recently incorporated it as part of the Emerging Risk System for quick assessments of large numbers of organisms."
>
> - Dr Jo Berry, MPI



Screening footwear at airports reduces biosecurity risks

Passenger footwear has been a focus for biosecurity checks at airports for the past decade and B3 research has identified shoes as being one of the most likely ways harmful organisms can enter Aotearoa New Zealand. This research informed screening and cleaning protocols at our international arrival ports, helping Biosecurity New Zealand reduce the risk of incursions while minimising costs and disruption.

The personal items of arriving travellers can harbour organisms that present a major biosecurity threat. Soil stuck in the tread of a shoe can harbour dozens of tiny stowaways, like insect larvae, invasive weed seeds or fungal spores.

It's impossible to inspect and clean every item entering Aotearoa New Zealand, so we need effective biosecurity strategies based on excellent science. B3's research has increased knowledge about relative risks and the effectiveness of interventions (including cost-effectiveness), which has strengthened risk management at our border.

B3 researchers compared organism survival in protected environments like luggage, versus more exposed environments like shipping containers. This identified the highest-risk ways that harmful organisms enter Aotearoa New Zealand, which is critical knowledge for focusing biosecurity efforts where they're most needed.

Researchers found that soil carried on passengers' footwear was one high-risk pathway for the entry of harmful species regulated by Biosecurity New Zealand (McNeill et al, 2011). An average gram of soil was found to contain two seeds, 41 nematodes, and high counts of bacteria and fungi, more than half of which contained harmful, biosecurity-regulated species. Further research tested different cleaning methods for contaminated footwear and identified practical ways to remove more than 94% of microbial contaminants from footwear (Young et al, 2008).

Researchers were then able to offer practical guidance on biosecurity interventions, sharing their findings with MPI to inorm biosecurity policy and helping prevent future incursions.

The research also gained international attention and local interest from the forestry sector, showing its wider value in reducing biosecurity risks and supporting behaviour change (NZ Farm Forestry Association, 2021; Speare & O'Sullivan, 2022).

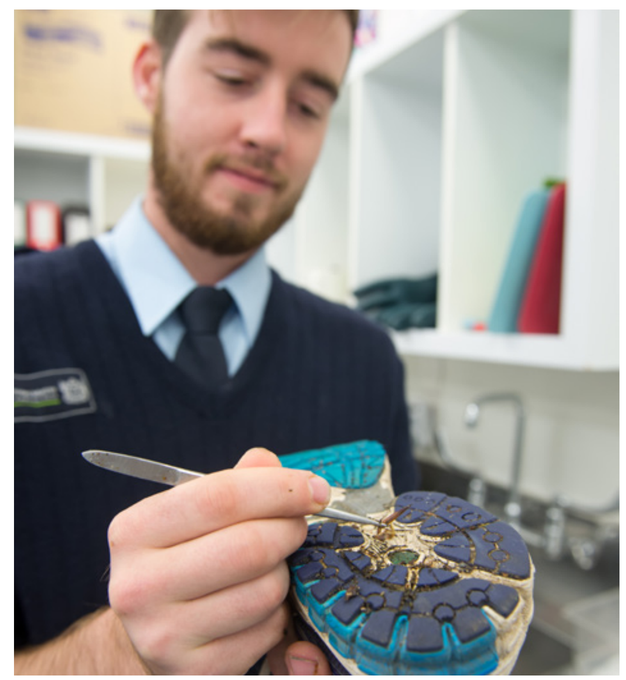


Photo: Lance Lawson

Global leadership in bio-control risk assessment and reduction

Non-native species are sometimes deliberately introduced to Aotearoa New Zealand as biological control agents (BCAs) to manage agricultural and horticultural pests that cost millions annually in crop losses and control measures. BCAs reduce chemical pesticide use while protecting our unique ecosystems, with introductions occurring infrequently and only after rigorous risk assessment.

B3's pioneering methods for assessing the potential effects of BCAs have enabled approvals for the safe introduction of species that will prevent catastrophic crop losses.

B3's risk assessment tools have established Aotearoa New Zealand as a world-leader in environmentally safe pest control, raising the international standard for biological control risk assessment. B3 assessment models have been implemented by biosecurity agencies and researchers around the world, improving global biosecurity.

In Aotearoa New Zealand, B3's risk assessment tools help ensure all proposed BCA introductions identify and minimise potential risks, supporting robust applications to the Environmental Protection Authority (EPA) for approval. This helps ensure that only species which will not harm Aotearoa New Zealand's native flora and fauna are used as BCAs.

The EPA has drawn on B3 expertise for decisions regarding three different wasps:

- *Trissolcus japonicus* as a BCA for the brown marmorated stink bug (*Halyomorpha halys*)
- *Pauesia nigrovaria* as a BCA for the giant willow aphid (*Tuberolachnus salignus*)
- *Eadya daenerys* as a BCA for the eucalyptus tortoise beetle (*Paropsis charybdis*)

For the latter, the eucalyptus tortoise beetle costs the forestry industry $7.2 million per year in lost yields and $1–$2.6 million per year in chemical control. Effective biocontrol by *Eadya daenerys* could therefore have an economic impact of $8.2–$9.8 million per year.

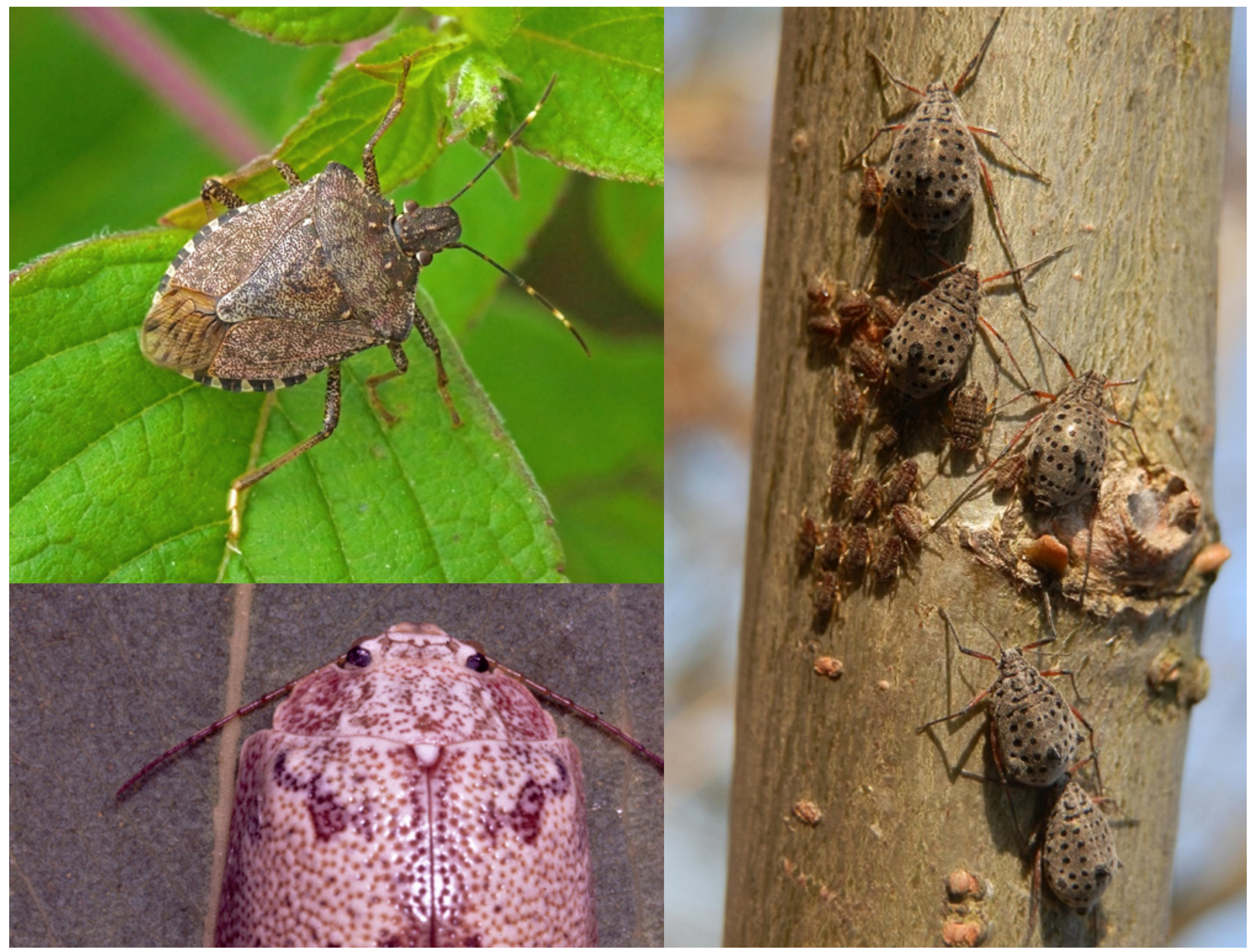
BCAs are important and effective components of Aotearoa New Zealand's biosecurity strategy. While they target harmful species, BCAs can also pose risks to non-target species. B3's research underscores the need for rigorous assessment of risks before any BCA is released, providing the scientific assurance needed to maintain public trust and social license for deliberate species introductions.

B3 researchers have developed several tools and innovations that improve risk assessment, including methods to assess the potential impact on non-target species (see Table 1). All have been adopted by other biosecurity researchers. These tools have improved the EPA's ability to assess and manage risks, and to inform decisions associated with the introduction of BCAs.

One innovation, Priority Ranking of Non-Target Invertebrates (PRONTI), enables quantifiable ecological assessments that are invaluable to the EPA when considering new BCAs. PRONTI allows researchers to predict which of Aotearoa New Zealand's unique invertebrates might be at risk from a new BCA. It ranks hundreds of non-target species, allowing them to be prioritised for testing.

For example, PRONTI was used in the assessment of the parasitic wasp *Eadya daenerys* as a BCA for the eucalyptus tortoise beetle. It helped demonstrate that testing had been carried out to precise safety standards, including the consideration of potentially at-risk endemic flightless weevils. Subsequent testing confirmed that these weevils were unlikely to be affected, providing further reassurance around the BCA's safety. The EPA staff assessment of the application to use *Eadya daenerys* as a BCA stated, 'we consider that PRONTI provided additional confidence in the selection process' (EPA, 2018).

Dr Barbara Barratt was awarded honorary membership of the International Organisation for Biological Control for the international importance of this B3 work, which was described as "heroic" (IOBC, 2024). Dr Stephen Goldson was awarded the New Zealand Order of Merit for his contribution.



Top, left: The brown marmorated stink bug *(Halyomorpha halys). Photo: Marco Uliana;* Right: the giant willow aphid *(Tuberolachnus salignus). Photo: Mariusz Sobieski, Bugwood.org;* Bottom, left: The tortoise beetle *(Paropsis charybdis). Photo: Pest and Diseases Image Library*

CONTINUED OVERLEAF

Table 1. Examples of new tools for BCA biosafety developed by B3

RESEARCH AREA	TOOL	DESCRIPTION
Biocontrol Agents	Biocontrol Adverse Impact Probability Assessment (BAIPA)	The *BAIPA* gauges the likelihood of a BCA spreading to new habitats, interacting with non-target species, and having a negative impact on those species. It is a key tool for decision making regarding deployment of BCAs
	Priority Ranking of Non-Target Invertebrates (PRONTI)	*PRONTI* enables researchers to rank the potential risk posed to non-target invertebrates by new BCAs. This enables prioritisation of testing to inform decisions about releasing BCAs, optimising resource use and the protection of our unique fauna
	Scale of Risk Tool (SORT)	The *SORT* uses a scoring system to assess the impact of BCAs by comparing assessments of ecosystems before and after their release. The *SORT* also allows the predicted effect of new BCAs to be compared with the known effects of current BCAs
	Threshold tool	The *threshold tool* assigns risk scores to determine the potential impact of BCAs on non-target species
Pest and Disease Incursions	Electrical Penetration Graph (EPG)	*EPG's* have been developed to assess the host range of invasive sap feeding species, measuring the way they feed on different plants
	CLIMENZ	CLIMENZ (b3.net.nz/climenz) is a climate-matching tool allowing users to map the suitability of Aotearoa New Zealand's climate for pests and diseases now and in the future (under predicted climate scenarios). This facilitates risk analysis regarding the pests most likely to enter, most likely to become established, and likely to cause the most damage to Aotearoa New Zealand's environment, informing biosecurity surveillance strategies
	Integrated Biosecurity Risk Assessment Model (IBRAM) and Spatial Pest Entry Analysis Runner (SPEAR)	*IBRAM* and *SPEAR* inform the design of biosecurity surveillance systems by tracking infestation risk along trade pathways from pre-entry to endpoints, including identifying the locations where pests are likely to be detected
	Weed hazard model	The *weed hazard model* predicts the likelihood of a plant becoming a weed based on geographical distribution, climate conditions and the plant's weediness score

Expanding forestry surveillance to urban risk points

Aotearoa New Zealand's forest biosecurity surveillance systems prevent millions of dollars in potential losses while providing crucial trade assurances to international partners that our plantation forests remain free of unwanted organisms.

From 2013, B3 helped identify important urban biosecurity risk locations that had not previously been prioritised by the forest industry. This led to surveillance coverage expanding beyond forests to previously under-monitored areas.

B3 researchers played a key role in developing a new national Forest Biosecurity Surveillance system that targets eight high-risk entry pathways: sea vessels, sea containers, used vehicles, used machinery, wood packaging, wooden furniture, returning residents, and international travellers. For example, risk modelling (Scion, 2018) revealed that spongy moth egg masses, regularly intercepted at our borders, are most likely to hatch and escape at ports and places related to containers and imported cars. These urban locations represented a surveillance gap that B3 helped to close.

B3 developed two innovations: a risk mapping tool identifying high-risk areas for forest pest introductions, and a model to optimise cost-effective use of surveillance tools according to regional risks. Integrating these into a single biosecurity surveillance framework was world-leading at the time.

The Forest Biosecurity Surveillance system became operational nationwide from 2018. In 2024 alone, biosecurity surveillance offiicers had inspected over 15,000 radiata pines, 1,000 Douglas firs, 10,000 other conifers, and 2,000 eucalypts.

Investment in surveillance has economic benefits to both the forestry sector and urban trees, with estimated avoided costs of between $370 million and $610 million over 30 years (Scion, 2025).

The Forest Biosecurity Surveillance system expanded rather than replaced existing surveillance, extending the reach of the 50-year-old Forest Health Surveillance system (which continues to monitor tree health within plantation forests) and complementing MPI's High Risk Site Surveillance (which targets all woody plants across high-risk sites). Together, these systems enhance early detection and optimise incursion response for forest biosecurity.

> "Forest pathologists are helping to preserve a huge, long-lived standing crop. We have to protect it – we can't just pull it up and resow."
>
> - Dyck & Hickling (2021)

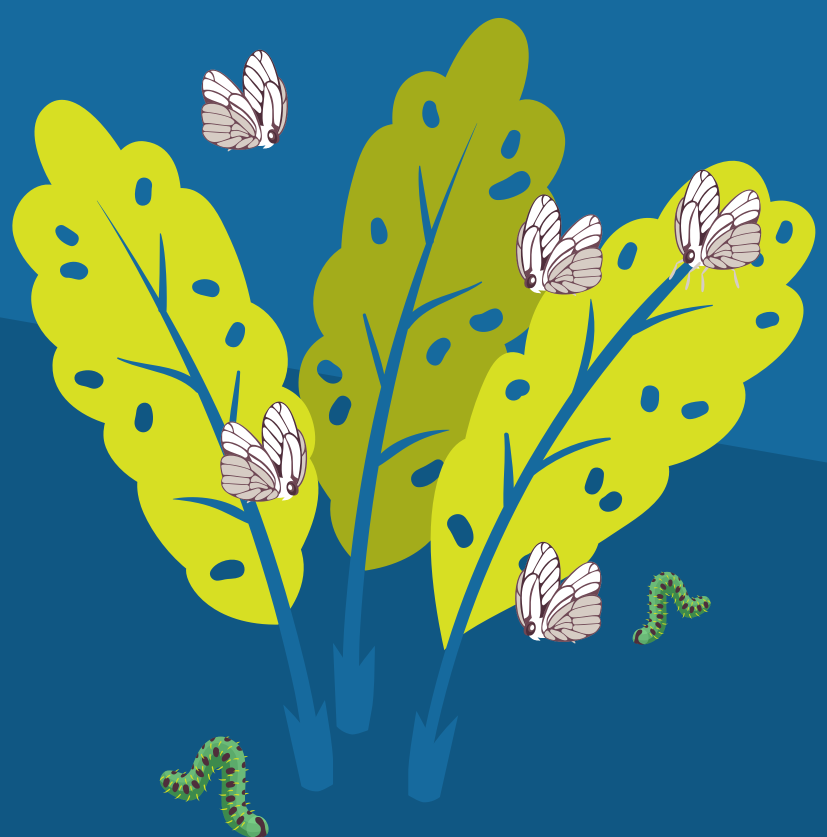
IMPACT STORIES

Specific Pests & Diseases

Some biosecurity threats demand targeted responses that combine cutting-edge science with coordinated national action. The stakes couldn't be higher – fruit fly establishment could slash horticultural exports by $1.5 billion annually, brown marmorated stink bug could cause GDP to drop $3.6 billion by 2038, and Psa has already stripped $1 billion from kiwifruit exports.

B3's species-specific research forms the scientific foundation of coordinated responses led by MPI, industry councils, and regional partnerships. B3 provides risk assessments, surveillance strategies, and rapid diagnostic tools that help keep these economic and ecological disasters at bay. When threats do arrive, B3's rapid-response capability helps translate science into action through collaborative partnerships.

These targeted interventions, a selection of which are presented here, demonstrate how strategic research investment prevents catastrophic losses and maintains Aotearoa New Zealand's position as a trusted food and fibre producer.



Aotearoa New Zealand remains fruit fly-free with science-optimised surveillance

Fruit flies are one of the largest threats to Aotearoa New Zealand's horticultural industries because of their potential to cause damage to fruits and vegetables. Our current status as 'fruit fly free' protects our fruit and vegetable exports, enabling unfettered access to premium export markets that contribute around 0.5% of national GDP (Rolls et al, 2024). If allowed to establish and spread, the annual cost of fruit flies would be around $1.5 billion.

B3 researchers collaborate with MPI and the Fruit Fly Councils of Australia and Aotearoa New Zealand to update our highly effective National Fruit Fly Surveillance Programme, which has contributed to keeping our country fruit-fly-free since it was initiated 50 years ago, despite increasing risk. B3's expertise contributed to successful fruit fly incursion responses in 2012, 2014, 2015, 2016, 2019 and 2025, and ensures that surveillance and trapping systems are underpinned by current science and best practices (Kean et al 2024).

Risk maps developed through this collaboration illustrate where fruit fly incursions are most likely to establish, and surveillance models identify areas where trapping can be improved (Kean 2017). As a result, MPI updated its placement of fruit fly traps and their seasonal timing (Kean & Stringer 2019).

Aotearoa New Zealand now has the world's only optimised fruit fly trapping programme, ensuring that we will detect incursions early and respond to them quickly. As changes in pesticide use and climate are increasing the risk of fruit fly incursions to Aotearoa New Zealand, ongoing and continually optimised surveillance measures are more important than ever.

"The horticulture industries greatly value the fruit fly-related research undertaken, and specialist advice provided, under the auspices of B3, and continue to see this as important to ensure that biosecurity system arrangements for fruit flies are continually updated to provide greater protection for New Zealand's important horticultural crops and their market access."

- Andrew Harrison, Kiwifruit Vine Health

> "Fruit flies continue to be one of the biggest biosecurity threats facing horticulture. An unmanaged fruit fly incursion would cost the horticulture industry billions of dollars, and would have significant negative impacts on the economy, the community and NZ's trade relationships."
>
> - Summerfruit NZ, Annual Report (2023)

Multi-layered stink bug defences prevent $3.6 billion GDP loss

B3's research has significantly strengthened Aotearoa New Zealand's defences against brown marmorated stink bug (BMSB, *Halyomorpha halys*), an invasive pest that could reduce fruit yields by one-quarter. B3 research contributed to international collaboration, risk analysis, more effective traps, safer fumigation methods, and enabled regulatory pre-approval of a biological control agent.

This contribution supports the coordinated national response led by MPI and the BMSB Council, which has reduced the risk of BMSB incursion, protected exports and the environment, and avoided multi-billion-dollar losses.

BMSB is a major horticultural threat that can cause serious damage to kiwifruit, apples, grapes and more than 50 other specialist crops. An incursion could cause GDP to fall up to $3.6 billion by 2038, through production declines, increased control costs, and loss of key export markets (Ballingall & Pambudi, 2017).

> "Symposium such as [B3's BMSB Symposium] lead to a more integrated and ultimately successful approach to combating the important biosecurity challenges facing New Zealand."
>
> - Nicola Robertson, Biosecurity Manager, NZ Apples and Pears

Reducing this threat requires several lines of defence, many of which are informed by B3 research:

- Advanced aerodynamic traps developed by B3 researchers catch five times more BMSB than other traps. They are now used across Aotearoa New Zealand as part of our early warning system for BMSBs and other pests.
- Fumigation defences were informed by B3's research on fumigation chemicals. Aotearoa New Zealand was the first country to approve ethyl formate for BMSB fumigation, replacing toxic, ozone-depleting methyl bromide.
- High-risk cargo bound for Aotearoa New Zealand is also treated pre-export from BMSB-affected countries, an MPI requirement

Biological control agents (BCAs, see page 12) are another potential response. B3 research identified the samurai wasp (*Trissolcus japonicus*) as an appropriate BCA for BMSB. In a world first, the release of the samurai wasp has been pre-approved with conditions by the Environmental Protection Authority (EPA), so that if a BMSB incursion occurs, the samurai wasp can be released as part of the response.

This pre-approval significantly improves our response speed in case of an incursion, giving Aotearoa New Zealand a five-year 'head start', worth $352 million in avoided losses. Previously, BCAs have been approved after pests had already established, a research and approval process that typically takes at least five years (Environmental Protection Authority, n.d.).

Australia's preparations for BMSB incursion include drawing on Aotearoa New Zealand's approach to approving the samurai wasp as a BCA, strengthening trans-Tasman biosecurity cooperation.

B3 also had an important role in communicating the BMSB threat, engaging industry and catalysing responses. The risk of BMSB to Aotearoa New Zealand was first raised in a 2012 MPI risk assessment, but a keynote address by Dr Tracy Leskey at the inaugural B3 Conference in 2014 brought wider attention to the substantial issues associated with BMSB.

B3 analysed Chinese-language scientific literature to understand BMSB's impact on kiwifruit, identifying it as a major threat. This contributed to a greater focus on BMSB by MPI and industry groups, and to the formation of the BMSB Council, formed under the Government Industry Agreement for Biosecurity Readiness and Response partnership.

B3 work confirmed that Aotearoa New Zealand's climate is very suitable for BMSB to establish (Kriticos et al, 2017) and identified where entry is most likely to occur (Jamieson et al, 2022). In 2021, B3 ran a BMSB symposium where international speakers and B3 researchers informed MPI and industry on the latest research developments.

> **"Not only will these bugs invade your homes and cars, they will have a devastating effect on New Zealand's food supply for years to come and have the potential to wipe out most of a crop in bad years. BMSB is horticulture's number one concern.... As an industry we support all measures to keep the BMSB out of New Zealand and were encouraged to hear the Biosecurity Minister say, 'We will shut down the pathways wherever we find them'."**
>
> - Julian Raine in 2018, speaking as President of Horticulture New Zealand

RESEARCH IN ACTION

Used vehicles were identified by B3 as a high-risk urban entry point for invasive threats. This had a temporary effect on used car sales in Auckland in early 2018, after around 6000 car imports were delayed entry following the identification of brown marmorated stink bugs on four bulk carrier ships from Japan.

The vessels were directed to leave Aotearoa New Zealand waters, with an Auckland used car salesman reporting he was running low on stock as a result.

Nearly 600 stink bugs, 12 of them alive, were found on the fourth ship, the Glovis Caravel. **"Even though the vessel was sealed, we assessed the risk was too high for it to remain in New Zealand waters,"** says Steve Gilbert, MPI border clearance services director.

Source: NZ Herald, 2018; Stuff, 2018

World-first eradication of the great white butterfly

The great white butterfly (GWB, *Pieris brassicae*) was totally eradicated from Aotearoa New Zealand within six years of it being identified. This was the world's first eradication of an invasive butterfly.

This collaborative effort protected numerous brassica crops and around 80 native cresses, of which 57 are at risk of extinction. We estimate B3's contribution to the rapid and successful eradication delivered benefits of around $4.9 million, based on a cost-benefit analysis by East (2014).

The GWB was found in Nelson in 2010. The caterpillars of this invasive pest can completely strip brassica plants, and the butterflies are strong fliers, capable of spreading to new areas rapidly. This presented a serious threat to Aotearoa New Zealand's agriculture and biodiversity. Brassicas include foods like broccoli, cauliflower, and cabbage, and forage brassicas used to feed livestock. Aotearoa New Zealand's native cresses, many of which are endemic, are closely related to brassicas. If GWB established here, long term control costs alone would amount to $43–$133 million per year (Department of Conservation, 2016).

Large white butterfly *(Pieris brassicae Linnaeus)* larvae
Photo: Mariusz Sobieski, Bugwood.org

Preventing the spread and establishment of the GWB was a matter of urgency. The Department of Conservation (DOC), in collaboration with MPI and local groups, launched a programme to eradicate the butterfly before it could spread beyond the Nelson area.

B3 researchers were embedded in the response team as part of the technical advisory group to provide scientific advice to inform the eradication strategy and support efficient use of resources, saving time and money. Close collaboration ensured that cutting-edge science was rapidly transferred to on-the-ground decision-making.

B3 had built-in capability to respond to a GWB incursion: it had equipment and expertise ready before the incursion started, enabling effective eradication efforts to begin upon detection, limiting agricultural, environmental and economic harm.

The contribution from B3 experts included modelling the GWB's life cycle in Nelson's climate, tracking how the population was spreading, and mapping the likelihood of movement through the region. This helped direct field teams to the right places at the right times. As a result, monitoring and control efforts could be focused on the most critical areas, improving efficiency and maximising the chances of success.

B3 also identified biocontrol agents. Researchers bred a parasitic wasp that would target the GWB and identified wild insects that were also parasitic to the butterfly. Thousands of these natural enemies were released into the infestation zone to help suppress the population.

Intensive monitoring around Nelson by B3 verified that the GWB had not spread beyond the core infestation zone. White butterflies reported outside of the infestation zone were investigated to determine their species, avoiding costly responses to false alarms. B3's 'proof of freedom' model then determined when the GWB population had been eradicated, so that DOC could judge when to cease control activities.

B3 had previously supported successful species eradications including two invasive moth species in Auckland (fall webworm and painted apple moth). B3 later supported the eradication of pea bruchid in Wairarapa. B3's comprehensive global database of biosecurity eradications (b3.net.nz/gerda) is used all over the world and has contributed to dozens of research papers.

"Huge thanks from the GWB team at DOC for B3's outstanding support. So grateful for all the groundwork you performed in the lab during the early days of GWB so that you were poised to go straight into action when a scenario like this came up. I get goose bumps when I come across that kind of professionalism."

- Mike Shepherd, DOC GWB Eradication Project Leader

RESEARCH IN ACTION

A $10 bounty for dead butterflies was a powerful incentive during the spring school holidays in 2013, with children netting 134 invasive great white butterflies, contributing to their successful eradication.

The Department of Conservation offered the reward to encourage community participation in the eradication effort.

"We are pleased so many in the community have joined in the butterfly hunt and we are grateful for their help. Each great white butterfly caught and killed is helping us in trying to beat a spring butterfly breeding peak," says project manager Bruce Vander Lee.

"The $10 reward for each of the dead great white butterflies is for us money well spent. The butterfly bounty hunters are also providing useful information on where butterflies occur in Nelson."

Source: Motueka Online, 2013

Rapid test protects horticulture from Psa-family bacteria

World-first diagnostic approaches taken by B3 researchers led to the development of a new test for disease-causing *Pseudomonas* bacteria, including the Psa strain that caused a catastrophic billion-dollar loss for our kiwifruit sector.

The test was adopted by MPI to reduce the risk of plant diseases and is used by Biosecurity New Zealand as part of its routine screening processes, speeding up pre-border quarantine and testing for imported plants. This has saved time and money, while protecting Aotearoa New Zealand's horticultural crops.

Pseudomonas is a group of bacteria, some strains of which cause serious disease in a wide range of plants. In 2010, the kiwifruit bacterium Psa *(Pseudomonas syringae pv. actinidiae)* became Aotearoa New Zealand's most costly biosecurity incursion, estimated to have resulted in the loss of around $1 billion of kiwifruit exports over a 10-year period. Psa is still a persistent economic drain of nearly $100 million every year, destroying 5% of all kiwifruit production (Birnie and Livesey 2014).

> "Fast, accurate detection and identification of pests and pathogens is fundamental to New Zealand's biosecurity, protecting our primary industries and environment, and reassuring our trading partners we are free of unwanted pests and diseases."
>
> \- Rob Taylor, Plant Health and Environment Laboratory Principal Scientist

Testing for Psa and other *Pseudomonas*-related pathogens was previously time-consuming and complex, because there are many bacteria in the *Pseudomonas* family. Some have no harmful effect on plants, and others may even be beneficial to them.

B3 researchers identified specific DNA sequences strongly associated with disease-causing *Pseudomonas* strains. This enabled the development of a rapid test to screen horticultural crops so that only those with pathogenic bacteria are tested further. This increases the speed and accuracy of diagnosis, reducing the incidence of *Pseudomonas*-related disease in Aotearoa New Zealand.

IMPACT STORIES

Community Capability

Strong biosecurity depends on more than science: it requires engaged communities, skilled people, and effective partnerships. B3's capability-building work has created a network of biosecurity-aware individuals and organisations across Aotearoa New Zealand, from port workers who can spot invasive threats to school children who understand why biosecurity matters.

Collaborations with te Tiriti partners have created more culturally appropriate and effective responses. Training the next generation of biosecurity experts ensures Aotearoa New Zealand will have the skilled workforce needed to tackle future challenges.

This capability investment multiplies the impact of B3's technical research, creating a resilient and responsive biosecurity system that engages all New Zealanders as guardians of our unique environment.

Biosecurity vigilance boosted at our largest port

Biosecurity-conscious behaviour, like reporting unusual insects, increased among Port of Tauranga community members and port staff with the support of evidence-based interventions.

B3 provided science support to the Port of Tauranga Biosecurity Excellence Initiative, a collaboration between the port, local primary sector groups and government. The initiative improved the early detection of pests at Aotearoa New Zealand's largest and busiest port, a critical entry point to defend against biosecurity incursions. Early detection depends on the port community's biosecurity awareness and behaviours, so the initiative included public engagement activities, such as awareness campaigns about potential pests, as well as internal activities, such as biosecurity inductions for all port workers.

> "This project has proven fundamental to our success. We have been able to make changes and improvements that have resulted in an increase in the behaviours we are looking for."
>
> - Lisa Gibbison, Kiwifruit Vine Health, 2022

B3's role in the collaboration began with baseline research into the biosecurity awareness and practices of different community groups (port staff, school children, residents, and local growers of kiwifruit, avocados, passionfruit and forestry), then identified opportunities to build awareness and change behaviour. B3 researchers supported local partners to develop and deliver interventions to help fill these gaps, ranging from education to practical tools:

- Biosecurity tools and protocols, including optimised insect traps.
- Evidence-based advice and recommendations.
- Biosecurity knowledge resources for port staff, such as playing cards and insect collection kits, which improved learning outcomes.
- Relevant training materials for port staff that featured their own workplaces and colleagues, which improved engagement.
- Training port staff in peer-to-peer education, which increased information-sharing among colleagues, decreasing the need for external training providers.
- Encouraging reporting of suspicious insects via a new local telephone number and closer relationships with the local MPI office.
- Establishment of portable 'sentinel gardens' in local schools, where children regularly check for unwanted species.
- Developing *Invasion Busters*, an educational science kit and board game used by thousands of children each year, increasing their understanding of biosecurity. The kit is used by over 300 schools and is available at all 19 hubs of the House of Science charitable trust across Aotearoa New Zealand, and the board game is used to teach biosecurity at Massey University and University of Canterbury.

Together, these efforts contributed to the Biosecurity Excellence Initiative's success in increasing biosecurity awareness and promoting biosecurity-conscious behaviour within the community (Kiwifruit Vine Health, 2019).

B3 scientists at the Port of Tauranga Biosecurity Week

CONTINUED OVERLEAF

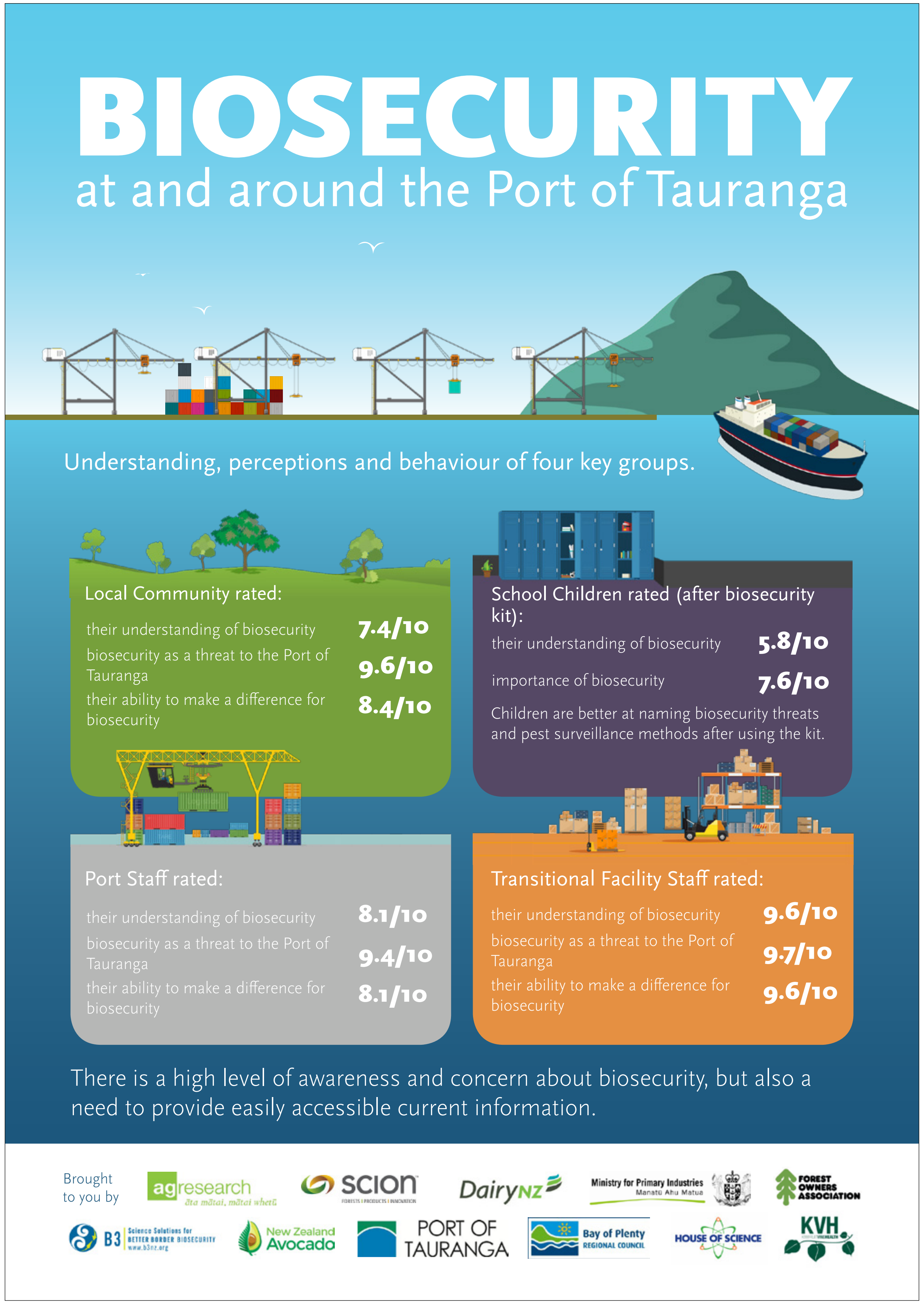
RESEARCH IN ACTION

Ten days before Christmas in 2018, a Mount Maunganui resident found an unwelcome visitor: a single live male brown marmorated stink bug on a side table just inside the main entrance of their house. The resident promptly reported it to Biosecurity New Zealand.

At the time, Biosecurity New Zealand and industry were running an active education campaign asking people to look out for stink bugs to enable early detection.

"It is due to this publicity that a member of the public reported this pest to us, and we thank them for doing so," says Dr Catherine Duthie, Biosecurity New Zealand spokesperson. **"Alerts from the public are an important part of the system, allowing us to act quickly to eliminate any biosecurity threats."**

Source: MPI, 2018



Infographics to support Port of Tauranga biosecurity efforts

Botanic Garden trails increase tourist biosecurity knowledge

Biosecurity walking trails in popular public botanic gardens have increased visitor confidence in recognising invasive species, reporting biosecurity concerns and understanding biosecurity.

The first biosecurity trail was developed as a collaboration between the Auckland Botanic Garden and B3. The success of this trail, which opened in 2019, led to collaborations with the Christchurch and Wellington Botanic Gardens. Collectively, these trails are accessible to millions of visitors every year, increasing knowledge and leading to changes in biosecurity attitudes and behaviours among international visitors and our own 'team of 5 million'.

Biosecurity risks can be hard to communicate because the damage cannot always be seen. Biosecurity walking trails make the risks more visible and meaningful by placing information checkpoints beside plants that would be affected.

The Auckland Botanic Garden biosecurity trail is 1.8km long with 12 checkpoints, each highlighting a pest or disease that threatens Aotearoa New Zealand's flora and primary industries, including the brown marmorated stink bug, myrtle rust and kauri dieback. Signs include Biosecurity New Zealand's 0800 number, and QR codes and leaflet offer information on preventative action, such as cleaning shoes before and after forest walks, and how to report biosecurity concerns.

Human activity and behaviour are big challenges for biosecurity. Visitors to Aotearoa New Zealand, the cruise ships or aeroplanes they arrive on, and tourism activities all have potential to introduce and distribute pests. Increasing visitor numbers increase risk.

International and domestic tourists therefore play a significant role in preventing the entry and spread of invasive threats – and tourist education presents a real opportunity to enhance Aotearoa New Zealand's biosecurity.

"It is important for all of us to understand the role we can all play in protecting our environment and economy. Helping people learn to recognise those biosecurity risks that may have crept into the country means we can move quickly to eradicate the pests and diseases before they take hold. That's great for our environment and our agricultural sector."

- Councillor Alf Filipaina, chair of Auckland Council's Parks, Arts, Community and Events Committee

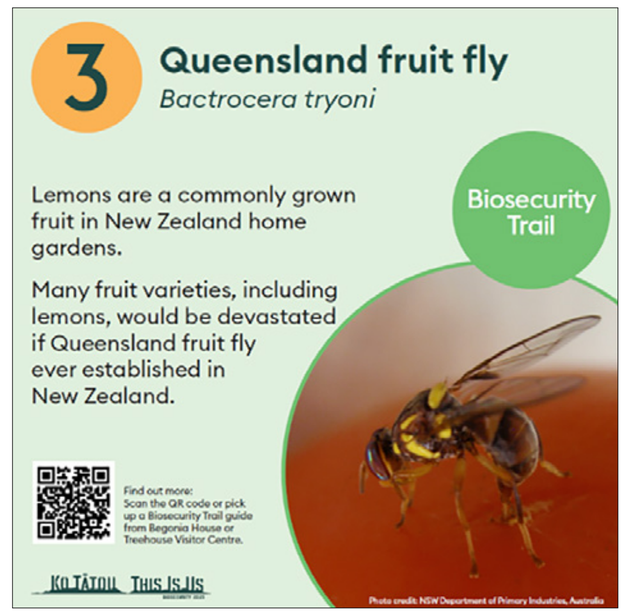


Image from the Biosecurity Trail Guide

Te Tiriti partnerships create a more connected biosecurity community

By engaging with te Tiriti partners, working with Māori entities across the country, B3 researchers are helping to build a more connected, inclusive and robust biosecurity system, leading to better biosecurity.

B3 has a firm, ongoing commitment to working with Māori experts and other te Tiriti partners on matters relating to Aotearoa New Zealand's biosecurity, outlined in its Māori strategy (see page 8). This requires genuine consultation and inclusion, particularly in research that has implications for Aotearoa New Zealand's indigenous flora.

> "The samurai wasp (*Trissolcus japonicus*) is one of the tools that can be used to prevent the brown marmorated stink bug from establishing in Aotearoa New Zealand. B3 has been key in enhancing engagement opportunities for the Brown Marmorated Stink Bug Council with mana whenua. This valuable relationship with B3 is one we will continue to foster over the coming years"
>
> \- Sophie Badland, chair of the BMSB Council

One example of such a partnership focused on the potential introduction of the samurai wasp to help manage the devastating effects of brown marmorated stink bug (BMSB) should it arrive (see page 18).

B3 researchers facilitated engagement between iwi, the BMSB Council and the EPA to improve consultation with and inclusion of Māori in the samurai wasp approval process. This led to ongoing hui with mana whenua across Aotearoa New Zealand to improve consultative processes for considering the introduction of biological control agents (BCAs) to help control invasive pests.

These hui are improving the process of assessing and approving BCAs. They allow researchers, industry, and biosecurity practitioners to deepen their understanding of Māori perspectives on BCAs, and allow Māori to gain a deeper understanding of the science that informs BCA applications, which may include the effects of BCAs on taonga species.

The initiative is improving the consultation process for future BCA proposals. One outcome is the EPA's mātauranga framework to guide iwi in assessing applications. It has also led to new engagement and relationship-building opportunities between the BMSB Council, the EPA, iwi and scientists.

A samurai wasp *(Trissolcus japonicus)* emerging from a parasitised brown marmorated stink bug egg.
Photo: Chris Hedstrom, Oregon Department of Agriculture

RESEARCH IN ACTION

B3 researchers have formed a close working relationship with the Tauranga Moana Biosecurity Capital Māori Caucus. This relationship is crucial since biosecurity is a major concern to iwi from around the Tauranga Moana and Bay of Plenty region. The region has high biosecurity risks, due to its large agriculture and horticulture industry, popularity as a tourist destination, and the busy Port of Tauranga.

"Māori practitioners, iwi and hapu alike have benefitted immensely through the leadership of B3 and their enhanced engagement practices," says Carlton Bidois, co-chair of Tauranga Moana Biosecurity Capital. **"This leads to better-resourced partnerships in cross-cultural research, and development in the biosecurity system."**

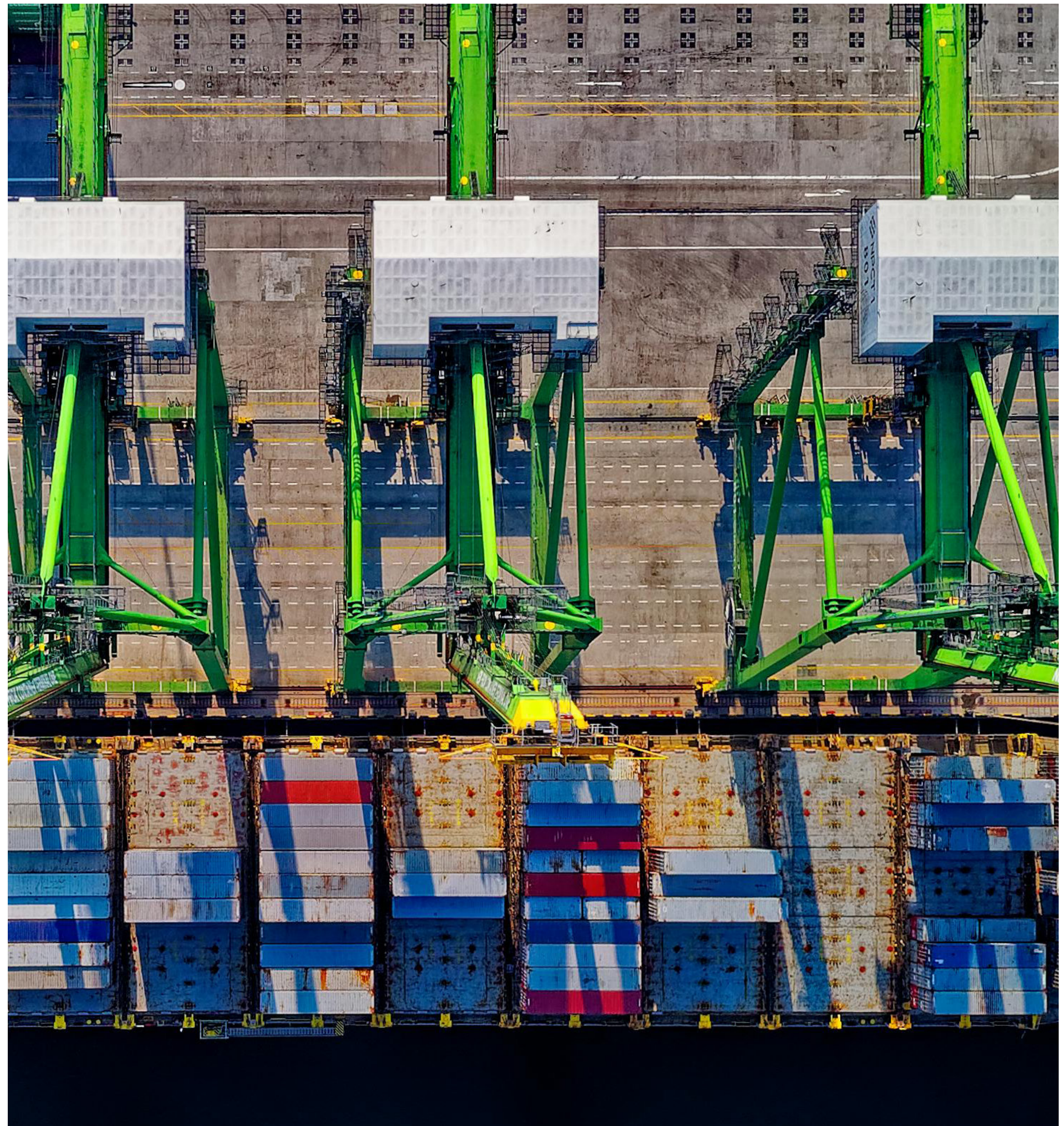
Developing future research capability

The growing biosecurity challenges Aotearoa New Zealand will face in future will be managed by the students of today. Fostering the next generation of biosecurity experts is therefore an important focus for B3.

B3 has supported 33 doctoral and 11 Masters of Science students, who have gone on to undertake research at CRIs or international institutes, teach biosecurity-related issues at universities, and work as experts in Government organisations, including the Ministry for Primary Industries and the Ministry for the Environment.

Lincoln University is a pivotal B3 research partner in the development of future biosecurity capability. B3 researchers also contribute to tertiary courses at many other institutions, including Massey University, University of Canterbury, University of Auckland and Toi-Ohomai Institute of Technology.

Photo: © Lincoln University



> "B3 is helping develop a generation of scientists who are thinking beyond the management of current pest problems. It links scientists with MPI's policy and operational thinkers to ensure cross-pollination of knowledge and understanding which will improve New Zealand's biosecurity system. These links have already demonstrated their worth."
>
> \- Nathan Guy, speaking in 2014 as Minister for Primary Industries

Photo: Tom Fisk

Economic Return on Investment

Context

B3 is deeply embedded within Aotearoa New Zealand's wider biosecurity system, which closely integrates science, industry and government. This approach is relatively rare internationally, with Australia perhaps the only country adopting a similar system. As a result of the integrated system, isolating benefits directly attributable to B3 is not easy. B3's research would have limited effect without being implemented within the biosecurity system by government and industry, while the biosecurity system itself would be less effective without the science, tools, and risk assessment frameworks that B3 and other biosecurity research provides.

Summary of Economic Analysis

A calculation of benefits divided by costs over 20 years gives a simple indication of the value of B3, with a return on investment of approximately **$4.80 per dollar** of research investment.

We focus on two main areas of B3's science: species-specific research, and general research into biosecurity factors affecting all invasive species. Adding the benefits from specific species work ($501.9 million) to benefits as a result of general research ($266.4 million), we value B3's work over its 20-year history at **$768.3 million.**

We calculate investment in B3's research based on estimates for different time periods. This gives total funding of **$158.4 million** for B3 research over 20 years. Note that not all research investment comes from Aotearoa New Zealand sources.

Net benefits after subtracting research costs are approximately **$610 million.**

Our overall benefit-cost ratio (BCR) of ~4.8:1 aligns with an impact evaluation of the Plant Biosecurity CRC in Australia (BCR 5.1:1), which is probably the closest parallel research programme in another country, albeit only operating for six years (CIE 2018).

The choice of counterfactual against which to compare is crucial in evaluating B3's contribution to impact: the counterfactual is the absence of B3's research. We can take a broader or narrower view of this counterfactual. This report aims for a 'medium' counterfactual. It focuses on the additional impact that B3 research generated, such as new tools, improved risk assessments, and earlier detection of incursions.

The full economic analysis, including detailed assumptions will be published separately as a peer reviewed journal article.

Limitations

B3 is a cooperative science collaboration between four CRIs and one university. It is not a distinct business entity and does not maintain detailed accounts of funding from all different sources. In particular, co-funding from outside sources is inconsistently reported in annual reports, captured in 10 out of 20 years. Therefore, we use approximate figures, gathered from interviews with B3 staff and annual reports where available.

This is a simple analysis that does not encompass all research performed by B3.

Likewise, the 'general research' assumes a simple linear relationship between research and biosecurity operations being made more effective and efficient – a more complex model might include diminishing returns in biosecurity operations (for instance when ramping up surveillance to high levels) modified by step-changes coming from research breakthroughs (such as new surveillance tools, or biocontrol).

Research Not Included

It was not possible to include all B3 projects in this impact case study. Numerous notable research projects and impacts are not covered in this report but can be found on the B3's website or in its Annual Reports (b3nz.org).

Top, left: Hanging a fruit fly trap. *Photo: Michael Craig*; Top, right: Forest surveillance *Photo: SPS Biota*; Bottom: The Biosecurity Response team in action. *Photo: Alden Williams*

Acknowledgements

This impact case study celebrates 20 years of collaborative excellence in plant biosecurity research that has strengthened Aotearoa New Zealand's defences against invasive threats. We extend our deepest gratitude to the many dedicated individuals and organisations whose expertise, commitment and partnership have made B3's success possible and who have moved our research insights into action.

Thank you to our research team members, past and present. You have made an invaluable contribution to advancing the frontiers of biosecurity science. Your dedication, rigour and innovation have been instrumental in developing the tools, technologies and knowledge that protect our unique flora and ecosystems. This includes our international collaborators and MOU partners who ensure our work is connected and contributes to improving global biosecurity.

We are profoundly grateful for the sustained collaboration, investment and support from B3's science partners: Plant & Food Research, AgResearch, Scion, Manaaki Whenua Landcare Research, and Lincoln University. Your shared commitment to biosecurity has enabled us to tackle complex challenges no single organisation could address alone.

We acknowledge the enormous contribution to biosecurity of B3's collaboration partners, who ensure our research is applied and delivers real-world impact: the Ministry for Primary Industries, Department of Conservation, Forest Owners' Association, Horticulture New Zealand, Kiwifruit Vine Health, Federated Farmers, and the Environmental Protection Authority.

We recognise the critical role of te Tiriti partnerships in strengthening our biosecurity community. Our collaboration with mana whenua, iwi, and Māori researchers has enriched our understanding and approaches.

We are grateful to the many plant industry organisations and government agencies whose commitment to evidence-based decision-making has helped turn our science into practical biosecurity action. We also thank the regional and district councils whose investment in biosecurity initiatives demonstrates the importance of coordinated responses across all levels of government. Your leadership in coordinating defences and applying research, tools, and readiness strategies plays a vital role in protecting Aotearoa New Zealand from unwanted organisms.

We thank the communities, farmers, growers, and land managers who have engaged with our research. Your participation is invaluable, because effective biosecurity truly requires a team effort from all New Zealanders. Your vigilance and commitment to protecting our unique ecosystems and productive landscapes underpins the success of our biosecurity system.

The success of B3 over the past 20 years reflects the power of collaboration, the strength of partnerships, and the shared commitment to protecting what makes Aotearoa New Zealand special. Together, we will continue to safeguard our nation's biological heritage for future generations.

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