B3 | Science Solutions for BETTER BORDER BIOSECURITY
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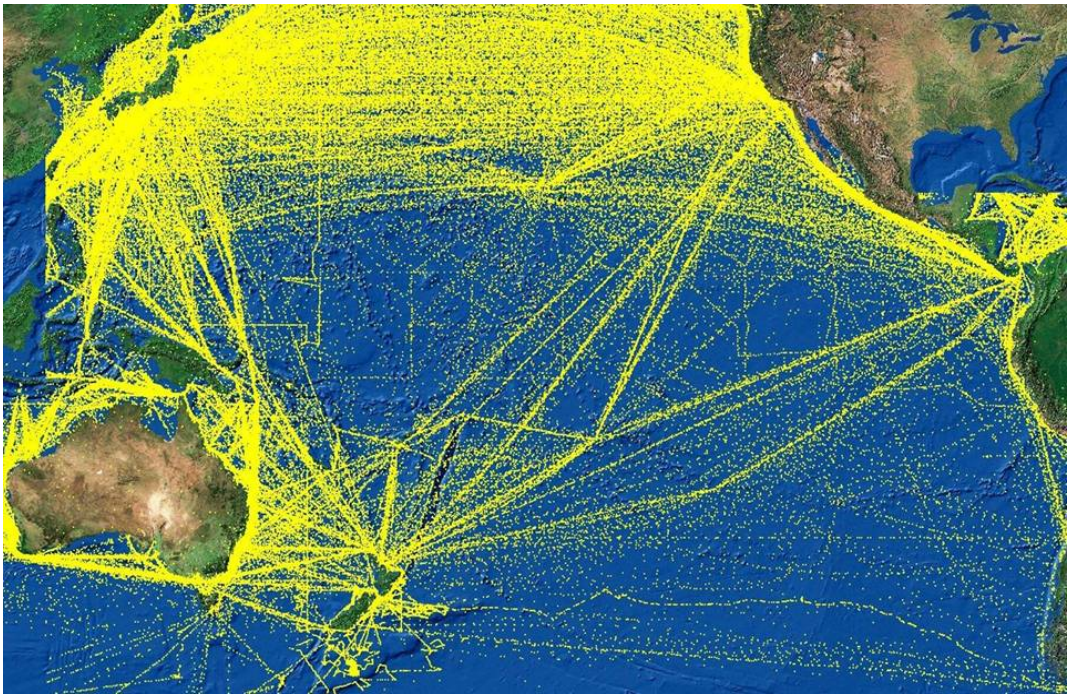

Better Border Biosecurity (B3)

Adding Value to New Zealand's Biosecurity System through Research

Annual Report 2012–13

B3's vision

… a world-leading source of science-based solutions for border biosecurity challenge by 2017, supporting and protecting the competitiveness of export industries and unique terrestrial ecosystems …

B3's strategic priority

Adding value to New Zealand's Biosecurity System through research

B3's critical objective areas

Leadership and Influence
Performance
Uptake
Capability
Investment

B3's research themes

Risk Assessment
Pathway Risk Management
Diagnostics
Surveillance
Eradication and Response

B3's partners

The Ministry for Primary Industries (MPI)
The Department of Conservation (DoC)
The New Zealand Forest Owners' Association (FOA)
The Environmental Protection Authority (EPA) (observer status)
Plant & Food Research (PFR)
AgResearch (AGR)
Scion
Bio-Protection Research Centre (BPRC)

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FOREWORD AND SUMMARY OF KEY ACTIVITIES

Biosecurity has never been more important to the economic prosperity and environmental health of New Zealand. The recent establishments of high impact pests and diseases have reinforced the importance of defending New Zealand's border from these and other invasive organisms. Both the Government and industry are in accord – biosecurity is now the number 1 priority for New Zealand. A secure border for New Zealand's biological industries will be the cornerstone for the Government's Business Growth Agenda.

This annual report summarises the activities of the Better Border Biosecurity (B3) research collaboration for 2012–13. B3 aims to add significant value to New Zealand's biosecurity system through fit-for-purpose and world leading science. The three CRI partners: Plant & Food Research (PFR), AgResearch, and Scion, invest their core funding into B3, with a sizable subcontract to the Bio-Protection Research Centre, and partner with the Ministry for Primary Industries (MPI), the Department of Conservation (DoC) and the Forest Owners Association (FOA) to achieve valuable biosecurity outcomes.

The report presents the highlights of the year in the context of B3's critical objective areas, the achievements and outcomes from each of the five research themes, and lists the programme's many outputs. In doing so it provides evidence of delivery of the vision, priority, critical objective areas, and research priorities outlined in the B3 Strategic and Business Plans.

Significant achievements in 2012–13, include:

- Science: 27 peer-reviewed publications; two plenary/keynote presentations, and nine invited presentations at important national and international conferences
- End-user engagement: Multiple constructive interactions between B3 researchers and end-users at a range of levels to ensure a co-oriented approach to achieve planned outcomes.
- International linkages: Connecting New Zealand biosecurity to the rest of the world, for example through the Plant Biosecurity CRC in Australia and the "luminaries" programme of key international expert visitors to New Zealand
- Incursion response: Considerable technical advice, expertise and operational assistance for at least two significant eradication programmes (Great white butterfly, Eucalyptus leaf beetle)
- A range of outcomes for MPI, DoC and FOA through key science deliverables.

Since joining B3 in April 2013, I have been impressed with the commitment of B3 researchers to improving outcomes for the New Zealand biosecurity system. Stephen Goldson (the former Director) and the theme leaders should be commended for their leadership. B3 is an exemplar for collaborative research in the New Zealand context, which will be enriched by the addition of Landcare Research expertise and capability in 2013–14.

In 2013–14, I intend to build on this foundation by continuing to drive B3 to achieve greater value for New Zealand biosecurity through science outcomes for MPI, DoC, FOA and EPA while maximising the opportunities for new developments such as the New Zealand Science Challenges and the Government Industry Agreements (GIAs).

Dr David AJ Teulon
Director, Better Border Biosecurity

30 September 2013

Dr Stephen Goldson steps down. The 2012–13 year saw the transition from the leadership of Dr Stephen Goldson, who stepped back after three years as Executive Director.

Stephen provided great leadership during this time, bringing the research teams together to focus on an integrated programme aligned to the interests of end-users. His significant experience in biosecurity research was a great asset, as he was quickly able to see key opportunities to galvanise the research teams across the partner organisations involved in the *Better Border Biosecurity* collaboration. Stephen's ability to communicate with a wide range of stakeholders – both end-users and researchers – helped enormously in building stakeholder confidence about the relevance and performance of the B3 collaboration.

Stephen also played a pivotal role in the transition of the B3 collaboration, from a FRST-funded 'outcome based investment' to a voluntary collaboration involving three CRIs committing core-purpose-funding to an integrated biosecurity research programme. The B3 collaboration now stands as an exemplar of a multi-organisation collaboration focused on a strategically important issue for New Zealand, wherein each of the participating parties enjoys contributing to outcomes greater than they could achieve individually (the 'whole is greater than the sum of its parts').

As Stephen resumes his own personal biosecurity research interests, the B3 collaboration continues to thrive, now under the leadership of Dr David Teulon. I want to thank Stephen for his leadership and wish David well as he continues the fine performance that the B3 collaboration now delivers for its partner organisations and wider New Zealand stakeholders.

Dr James Buwalda
Collaboration Council Chair, Better Border Biosecurity

30 September 2013

THE CONTEXT FOR BORDER BIOSECURITY RESEARCH IN NEW ZEALAND

Biosecurity remains an area of very high interest within New Zealand, affecting trade competitiveness, economic prosperity and the quality of our unique natural environments.

B3 research is carried out in the context of the current external influences.

- Agribusiness leaders rank “maintaining a world class biosecurity system” as their number 1 issue (KPMG Agribusiness Agenda 2012).
- The Hon. Nathan Guy, Minister for Primary Industries, has said, “Biosecurity is my top priority”.
- There are substantial ongoing endeavours across industry and research organisations to manage the recent *Pseudomonas syringae* pv. actinidiae (Psa) (kiwifruit) and Tomato potato psyllid (TPP) / *Liberibacter solanacearum* (Lso) (potato and related crops) incursions.
- New Zealand industries are showing much greater interest in biosecurity science as a result of these recent pest and disease incursions. Their developing involvement in the Government Industry Agreements (GIAs) with respect to “readiness and response” is a key driver.
- Eradication attempts are continuing for (at least) two species of insects (i.e. Great white butterfly, Eucalyptus leaf beetle).
- Establishment of new organisms in New Zealand from recent incursions continues at a rate above the historical average.
- “A Review of Import Requirements and Border Processes in Light of the Entry of Psa into New Zealand” found major shortcomings in the biosecurity system.
- The report from the Office of Auditor-General titled “MPI: Preparing For and Responding to Biosecurity Incursions” recognised that there was ‘still a lot to do’ and that ‘some serious weaknesses remain’ in the area of biosecurity incursions.
- The National Science Challenges identified “biosecurity” among the top ten science challenges for New Zealand.

B3 PROGRAMME HIGHLIGHTS BY CRITICAL OBJECTIVE AREA

1 Leadership and influence

Landcare joins B3. Landcare Research was accepted in principle into the B3 collaboration at the CC meeting in June 2013. This means that all land-focused CRIs are now represented in the B3 collaboration, to provide a more fully co-ordinated and integrated approach to New Zealand's terrestrial plant border biosecurity. Landcare strengthens B3's capacity, capability and expertise especially in a number of areas (esp. non-target risk assessment, molecular diagnosis of plant pathogens, applied mathematical modelling). Research projects maximising Landcare's investment in border biosecurity research will be actioned in 2013–14.

"Luminary" programme. Three "luminary" (international expert) visits were hosted by B3 during 2012–13: Separate visits from Dr Sandy Liebhold (USDA Forest Service), and Prof. Jerry Bromenshenk (Bee Alert Technologies) and a combined visit from Dr Susan Hester, Prof. Oscar Cacho (both Univ. of New England), and Dr Daniel Spring (Monash University). Each visit coincided with a number of meetings, including seminars throughout the country and, in one case, a field trip. All were well attended by staff from MPI and DoC and considered to be very successful. For example, Dr Barney Stephenson (MPI) noted that the visit of Prof. Jerry Bromenshenk resulted in "mindsets challenged" and "gratifying links for MPI developed".

International linkages. In addition to the "Luminary" Programme, B3 researchers maintain and develop connections with overseas researchers and organisations, providing a range of benefits to the New Zealand biosecurity system, including MPI and DoC. Quantifiable (e.g. funding sources) and non-quantifiable (e.g. expertise, access to facilities, reputation) outcomes result. Some of the most important international connections include:

- Plant Biosecurity Cooperative Research Centre (Australia) – collaborative research projects for PFR and BPRC (AGR subcontracts) building on B3 themes with significant co-funding
- Our relationship with CEBRA (Centre of Excellence for Biosecurity Risk Analysis) developing further with CEBRA's support for the Great White Butterfly surveillance programme
- The B3-developed Global Eradication and Response Database (GERDA) has generated interest (and data sets) from Australia (PBCRC), USA (USDA Forest Service, NCEAS), and Europe (IAEA PRATIQUE)
- B3 has initiated a Symposium on Plant Sentinels for Biosecurity Risk Assessment at the Global Botanic Gardens Congress in Dunedin in October 2013, which will host researchers from the International Plant Sentinels Network (IPSN).

2 Performance

Research projects. B3 had 19 high performing research projects in 2012–13, providing outputs and outcomes for science and end-users. A summary of some of these projects, their impact and the value created for MPI, DoC, FOA and EPA are outlined for each theme.

Some metrics of B3's research in the last year include:

- 27 peer-reviewed articles in national or international journals
- 2 book chapters accepted for publication
- 2 plenary or key note presentations at international conferences
- 9 invited presentations at significant national or international conferences or meetings
- 15 reports to stakeholders/end-users
- 6 new or modified products

Individual Achievements

- The New Zealand Plant Protection Society gave its highest honour to scientist **Margaret Dick** at its 2012 conference in Nelson. Margaret was presented with the Plant Protection Society medal to honour her extensive contribution to disease management and biosecurity in the forestry sector.
- The **CAUTHE Award for Best Full Paper** was awarded for:

  Moore K, McNeill M 2013. The research interface between biosecurity and tourist behaviour. 23rd Annual CAUTHE Conference, Lincoln University, Christchurch, New Zealand. Council for Australian University Tourism and Hospitality Education.

A Legacy of Achievement. Some of the more highly cited (Google Scholar) publications from B3 researchers are listed below. These provide evidence of the high esteem in which New Zealand biosecurity research is held by contemporaries throughout the world, and raise the profile of New Zealand biosecurity research.

- KF Armstrong, SL Ball. 2005. DNA barcodes for biosecurity: **invasive species identification**. Phil Trans R Soc B 360: 1813–1823. (205 citations)
- AR Clarke, KF Armstrong, AE Carmichael, JR Milne, S Raghu, GK. Roderick, DK Yeates. 2005. **Invasive phytophagous pests** arising through a recent tropical evolutionary radiation: The *Bactrocera dorsalis* complex of fruit flies. Ann Rev Ent 50: 293-319. (145 citations)
- AM El-Sayed, DM Suckling, CH Wearing, JA Byers. 2006. Potential of mass trapping for long-term pest management and **eradication of invasive species**. J Econ Ent 99: 1550-1564. (102 citations)
- SP Worner, M Gevrey. 2006. Modelling global insect pest species assemblages to determine **risk of invasion**. J Appl Ecol 43: 858–867. (79 citations)
- EG Brockerhoff, J Bain, M Kimberley, M Knížek. 2006. **Interception frequency** of exotic bark and ambrosia beetles (Coleoptera: Scolytinae) and relationship with establishment in New Zealand and worldwide. Can J For Res 36: 289-298. (74 citations)

Significantly, our key end-users frequently requests that B3 research is published in internationally peer-reviewed journals to add considerable credibility to decisions made based on the research.

3 Uptake

New pest and disease incursions. A number of B3 researchers have provided significant support to MPI and DoC in responding to new and ongoing pest and disease responses in the last year. These include (see stories below for more detail):

- DoC eradication response for the Great white butterfly
- MPI eradication response for the Eucalyptus leaf beetle
- Diagnostic expertise to MPI and FAR for the bacterial leaf streak

> *"B3 researchers have been very supportive of MPI in their response to new incursions during 2012–13"*
> PAUL STEVENS, SENIOR ADVISOR, MPI

Secondments. Two secondments were arranged between B3 researchers and B3 operational members to foster greater mutual understanding between researchers and end-users:

- John Kean (AGR/B3) visited the MPI Incursion and Response Team for a week in September 2012.
- Rory McLellan (MPI) visited B3 researchers at Lincoln for two weeks in January 2013.

Māori. B3's role in realising Māori aspirations in the area of biosecurity is still evolving. However, a highlight of 2012–13 was the successful application to the Australian Plant Biosecurity CRC for a project on '**Building resilience in indigenous communities through engagement – a focus on biosecurity threats'** – led by Alby Marsh. This has a strong element of engagement between biosecurity researchers, Māori, and aboriginal communities.

The B3 website Biocontrol Information Resource for EPA Applicants (BIREA) has a strong Māori engagement section to assist applicants to EPA to work through the process. Recently published research (Withers et al. 2013) was initiated as a result of potential risk to a New Zealand native taonga species, which required the applicant to carry out further biosafety testing and provide a more robust risk analysis.

4 Capability

New research capability. B3 aims to help CRIs gain and retain talent essential for border biosecurity research by creating an interesting and vibrant collaborative culture. In the last year, a number of new staff have joined the B3 collaboration, including some that provide unique capability. New faces include: Dr Peter Scott (Scion) (plant pathology), Dr Ela Sawicka (AGR) (molecular biology/biochemistry), Ashley Lu (PFR) (bioinformatics), Bruce Philip (AGR) (biosafety risk assessment), and Dr Rebekah Frampton (PFR) (molecular biology).

Students. Several PhDs students are closely linked to B3 either through direct funding or through B3 supervisors.

Peter Holder defended his PhD thesis in November 2012 at Lincoln University. Marie-Caroline LaFort (LU) is aiming to submit her PhD in August 2013. Hossein Khandan (Lincoln Univ.), Kevin Chase (Univ. of Canterbury) and Gonzalo Aviala (Auckland Univ.) continue their studies supervised or co-supervised by B3 researchers.

B3 researchers are also supporting biosecurity-related Masters projects for Johanna Voinopol-Sassu (Lincoln and Goettingen Univ.), and Denise Ford (Lincoln Univ.).

Several summer scholarship/studentships were also undertaken with strong B3 connections, including Joshua Thia (PFR) and Sarah Redlich (Scion).

Leaving B3. During the year we also said goodbye to Dr Geoff Ridley (EPA Representative), Dr Kirstin Wright (BPRC), Dr Cor Vink (AGR) and Margaret Dick (Scion).

5 Investment

Crown Research Institutes. Plant & Food Research, AgResearch and Scion have continued to invest in B3 at historical levels through their core funding. Plant & Food Research has continued to subcontract the Bio-Protection Research Institute at historical levels. During 2012–13 Landcare Research was accepted into B3 as a new member and is planning for a modest investment in B3 in 2013–14 but increasing considerably thereafter.

Plant Biosecurity Co-operative Research Centre (PBCRC) (Australia). During 2012–13 Plant & Food Research and the Bio-Protection Research Institute effectively increased investment in plant biosecurity research in New Zealand to the value of nearly $NZ1 M p.a. through successful negotiation of collaborative research projects and PhD studentships from the PBCRC.

Ministry of Primary Industries. B3 members were contracted to deliver nearly $200 K of mostly operational research for MPI in 2012–13.

B3 Theme Outcomes

B3 drives research under five themes – risk assessment, pathway risk management, diagnostics, surveillance, and eradication and response. Each of these themes involves teams comprising people from science and end-user organisations. These themes must contribute to five critical objectives of B3 and the projects within each theme are strongly informed by the end-user organisations.

This section highlights some of the impacts generated in the research themes.

THEME 1. RISK ASSESSMENT

Theme Leader:	Barbara Barratt
Theme Representatives:	Jo Berry MPI), Helen Harman (MPI), Chris Green (DoC), Geoff Ridley (EPA), Bill Dyck (FOA)
Project Leaders:	Lisa Jamieson, Sue Worner, Craig Phillips, Nigel Bell, John Charles, Toni Withers, Barbara Barratt

***Aim**: To develop and deliver improved methodologies for identifying hazards, assessing risk, predicting impacts and ascertaining where in the system mitigation measures are best targeted.*

New Mapping Tool Developed for Assessing Pest Establishment

An online ArcGIS mapping tool developed by B3 is now being used by MPI's risk analysis team to assess the likely establishment and spread of risk pests and pathogens in New Zealand's productive and natural plant systems. It is based on similarities between the climate in its current distribution and New Zealand's climate. The tool uses a spatial mapping approach that compares the similarities between the climate where the pests and diseases are currently located in the world, and the climate of New Zealand's important productive regions and its important natural plant systems regions. This allows MPI to target its resources on pests and diseases that are likely to spread rapidly within New Zealand.

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Insect Feeding Technology Appropriated for Biosecurity Risk Analysis

In a recently published article (Sandanayaka et al. 2012), B3 researchers explored the potential for using the Electrical Penetration Graph (EPG) technique as a tool to assess the host range of sap-sucking insect invaders rapidly. Information of this sort is very important when assessing the risk of a new incursion to plants in New Zealand's important productive and natural systems and whether MPI should attempt an eradication programme. A measure, comparing ingestion time with probing time, was developed that provided a useful first guide for this purpose.

In 2013–14, B3 researchers will be working closely with MPI to explore how this technique might be used by MPI in the event of a new incursion and how quickly it could provide critical information for decision making.

Contact: Manoharie.Sandanayaka@plantandfood.co.nz

Being prepared for the Glassy-winged Sharpshooter

Border officials closely monitor the progress of a number of pests and diseases as they creep closer and closer to New Zealand. One of these is the glassy-winged sharpshooter (GWSS), a vector of Pierce's disease of grapevines and a potentially serious pest of New Zealand's horticultural crops and native trees; this pest has now reached the Cook Islands.

If such important pests become established in New Zealand, it is vital that we have appropriate pest management solutions on hand as quickly as possible. One of these is biological control – in this case by a well-studied egg parasitoid. Recently published work carried out by B3 researchers (Charles 2012; Charles & Logan 2013), indicated that New Zealand's native fauna are so different from GWSS that the parasitoid could be safely released without undergoing host-testing in containment, although it should be sourced from populations that have adapted, as far as possible, to a cool-climate environment.

This research could significantly speed up the introduction of this biological control agent in the event of a GWSS incursion, and has important implications for biocontrol of other potential pests that are taxonomically and biologically different from our native fauna.

Contact: John.Charles@plantandfood.co.nz

International Plant Sentinel Researchers to Visit New Zealand

The idea of using New Zealand native plants in overseas botanical gardens or arboretums as indicators for potential pest and disease incursions has been an active area of research in B3.

Following on from a B3-funded visit by Richard Baker (FERA & PRATIQUE) to New Zealand in 2012, and Dr Baker's initiative to develop an International Plant Sentinels Network (IPSN), B3 is organising a Symposium on Plant Sentinels for Biosecurity Risk Assessment at the upcoming 5th Global Botanic Gardens Congress to be held in Dunedin in October 2013. The symposium will raise awareness of the value of botanic gardens and plant collections internationally to assist in the identification of potential plant pests and diseases that could threaten indigenous plants in their area of origin. The symposium will be opened by the newly appointed co-ordinator of the IPSN, Ellie Barham, who will also be visiting B3 researchers before the Symposium.

The B3 sentinels research is strongly supported by DoC and the symposium will bring together researchers in this area from all over the world to raise awareness of this unique opportunity to develop international linkages to support plant biosecurity.

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http://b3nz.org/news

Uncertainty in risk assessment: helping biological control applicants make a better case to the regulator

Host specificity testing to predict host range is one of the key steps to predicting the risk that a new biological control agent (BCA) will present to non-target organisms after release in New Zealand. For example, we do not want to introduce weed BCAs that attack our native plants. This is of special interest to Māori with respect to taonga species. When host specificity testing data contain discrepancies, or unacceptable degrees of uncertainty, it can be difficult for decision makers to evaluate this uncertainty accurately.

In recently published work (Withers et al. 2013), B3 researchers examined four different analytical approaches to better understand the uncertainty in host specificity testing. The results provide a framework for other researchers undertaking risk assessment work on weed BCAs and provide regulators, such as EPA and MPI, and key stakeholders such as DoC, with quantitative measures for evaluating the costs and benefits when considering applications for BCA importations and release into New Zealand.

Contact: Toni.Withers@scionresearch.com

Developing testing regimes for the importation of new microbial BCAs

While there has been considerable research on the non-target impacts of insect and weed BCAs, relatively little as been carried out on BCAs for plant pathogens.

A B3 research programme has recently been completed that will help regulatory agencies to assess the potential impacts of new microbial biocontrol agents on native ecosystems. In this case, the impacts of a commercialised microbial BCA (*Trichoderma atroviride*) on native plant health and soil microbial diversity were tested (McLean et al. 2013). No major effects were found.

This research underpins the EPA requirements for experimental data to develop an effective system to assess the risks of introducing new microbial BCAs into New Zealand.

Contact: Kirstin.Wright@lincoln.ac.nz

THEME 2. PATHWAY RISK MANAGEMENT

Theme Leader:	Ecki Brockerhoff
Theme Representatives:	Shane Olsen (MPI), Chris Denny (MPI), Chris Green (DoC), Geoff Ridley (EPA), Bill Dyck (FOA)
Project Leaders:	Lisa Jamieson, Mark McNeill, Craig Phillips, Ecki Brockerhoff

***Aim**: Develop and deliver 'fit for purpose' tools and methodologies for reducing risks along importation pathways*

Pushing the border beyond New Zealand's shores

Pushing the biosecurity focus for imported goods offshore is a critical aspect to New Zealand's biosecurity. For this to happen, we need a number of scientifically proven tools for disinfestations, often combined together in a systems approach, which are used in the country of origin.

New heat and low toxicity fumigant treatments for fresh imported produce have been developed with industry partners. Bayesian Networks are being used to assess the effectiveness of these treatments into a Systems Based Risk Management process, which is seen by MPI as the key to effective Import Health Standards that will minimise new biosecurity incursions into New Zealand.

Contact: Lisa.Jamieson@plantandfood.co.nz

Cost-benefit analysis of phytosanitary policy

Pathway risk management can reduce biosecurity risks for multiple pests and pathogens over entire pathways. International Standards for Phytosanitary Measures (ISPM) are multinational agreements that specify treatment standards and other measures for specific pathways however, no comprehensive assessment of their benefits and costs has been done. The ISPM for wood packaging materials (ISPM 15) was chosen for a cost-benefit analysis combining assessments of treatment efficacy, the resulting reduction in future establishments and associated benefits, as well as the direct and indirect costs of the Standard. The analysis by B3 scientists and their overseas colleagues via the National Center for Ecological Analysis and Synthesis (NCEAS) (University of California) showed that although ISPM 15 is unlikely to prevent future invasions entirely, it is expected to result in cumulative economic benefits of more than $10 billion (USD) by 2050. MPI and USDA APHIS contributed key information and reviewed draft manuscripts.

This analysis will be valuable for the International Forestry Quarantine Research Group (IFQRG), International Plant Protection Convention (IPPC) and MPI for the implementation of other phytosanitary measures and the evaluation of their net benefits.

Contact: Eckehard.Brockerhoff@scionresearch.com

A lot or a little? Soil on footwear and sea-freight

Research on the relative risk of soil associated with footwear and sea-freight as a pathway for pest and pathogen incursions into New Zealand indicates that the loading of risk organisms in soil on footwear is much higher than the loading in soil on sea-freight, but that the relative volume of soil on sea-freight is much greater. Additionally, soil that is protected has a much higher incidence of risk organisms than soil that is not protected.

The results of this research have been used by MPI to justify its ongoing focus on soil to prevent risk pests and diseases from entering New Zealand.

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The pollen pathway!

The role of pollen as a pathway for the incursion and establishment of new organisms in New Zealand is an area of considerable interest. B3 researchers have been shedding light on this debate with their expertise on bacterial infection processes and the development of preventative treatments.

Recently published B3 research (Everett et al. 2012) has highlighted the opportunities for heat treatments to control bacteria on pollen while minimising pollen viability.

Information supplied to MPI from B3 researchers has helped MPI to instigate appropriate measures to mitigate the threat from the pollen pathway.

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THEME 3. DIAGNOSTICS

Theme Leader: Karen Armstrong

Theme Representatives: Robert Taylor (MPI), Chris Green (DoC), Geoff Ridley (EPA), Bill Dyck (FOA)

Project Leaders: Andrew Pitman, Simon Bulman, Karen Armstrong

***Aim**: To investigate and deliver fast, cost effective, robust and accurate diagnostic methods and tools to enable informed biosecurity decisions.*

A new paradigm for determining pathogenicity?

When an organism is detected at the border, one of the first questions that needs to be asked is whether it is likely to pose a threat to our primary industries or native flora. The threat is often determined by taxonomic classification of the organism, pathogenicity testing, and scouring relevant literature. Recent high impact incursions have demonstrated, however, that finding answers to this question is very difficult and time consuming.

B3 researchers have carried out a series of comparisons between the genomes of pathogenic and non-pathogenic *Pseudomonas* strains and the analysis has led to a preliminary list of genes that are found in one group or the other. These are candidates for use in diagnostics for pathogenic versus non-pathogenic pseudomonads that would eliminate the need for laborious and unreliable pathogenicity tests.

This innovative and proof of concept work may help ultimately to identify risk organisms at the border without knowing what species they are or the need for pathogenicity assays, thus helping to reduce the rate of entry and establishment of these and other diseases in New Zealand.

Contact: Andrew.Pitman@plantandfood.co.nz

Biogeochemical markers help determine point of origin for insect pest incursions

“Has it just arrived?” and “Where is it from?” are questions often asked when an exotic insect invader is discovered in New Zealand. A B3 project is investigating naturally abundant stable isotopes and trace elements as point-of-origin markers. Key to this method is the assumption that the stable isotope ratios and trace element concentrations found in an insect reflect a ‘signature’ of the environment where the insect developed.

Recent developments with this method have shown its potential to identify an insect’s place of origin correctly about 75% of the time (within a country), and differentiate between insects of New Zealand and eastern Australian origins with 100% accuracy.

The current research aims to develop the technology further so that MPI can determine routinely and confidently the point of origin of new incursions, enabling more timely, appropriate and cost-effective biosecurity operational decisions. Point-of-origin information can also reassure our trading partners that a pest species intercepted in New Zealand is not established here, avoiding costly disruptions to our exports.

Contact: Karen.Armstrong@lincoln.ac.nz
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Assisting MPI to investigate bacterial leaf streak in wheat

B3 capability is used to assist industry partners and MPI diagnose the likely causal agents of disease outbreaks. In this instance, a B3 team responded to a recent occurrence of bacterial leaf streak in wheat and barley crops in the South Island. Bacterial leaf streak afflicts barley in New Zealand, but has yet to manifest itself on wheat in this country. The disease is caused by different pathovars of *Xanthomonas translucens*. Their host ranges are controversial, however, and therefore several remain regulated through import health standards for seed. The team used B3-developed protocols to differentiate regulated and non-regulated pathovars of the pathogen in both wheat and barley.

This information helped MPI to define a suitable response to this suspected outbreak, clarifying the importance of wheat seed imports as a likely pathway for regulated forms of the organism, and whether they should remain a barrier to trade.

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THEME 4. SURVEILLANCE

Theme Leader:	John Kean
Theme Representatives:	Paul Stevens (MPI), Rory MacLellan (MPI), Chris Green (DoC), Geoff Ridley (EPA), Bill Dyck (FOA)
Project Leaders:	Max Suckling, Scott Hardwick, Suvi Viljanen-Rollinson, John Kean

***Aim**: To deliver knowledge, strategies and tools for determining presence or absence of invasive pests of plants*

Surveillance to support DoC's eradication of the Great White Butterfly

The Great white butterfly (GWB) is considered to be "one of the greatest risks to our native plant species" because of its potential to bring about the extinction of many rare native cress species, including the iconic Cook's scurvy grass" says DoC scientific advisor Chris Green.

B3 researchers are supporting DoC with the eradication of this important pest of productive (vegetable and forage brassicas) and natural (native cress species) ecosystems. B3 scientists have provided expert advice on both the MPI and DoC Technical Advisory Groups. Passive surveillance by the Nelson public is a key part of the eradication programme, and B3 scientists have developed a model to predict the timing of the insect's flight peaks, allowing DoC to optimise the efficacy of their public awareness campaigns. Meanwhile, B3 scientists are also developing new surveillance traps and trialling them here and overseas.

As part of the "Luminaries" Programme, B3 funded a visit by three Australian biosecurity surveillance experts who participated with key stakeholders MPI, DoC and EntEcol Ltd in two surveillance workshops and a Nelson field day. B3 created an opportunity for DoC to work with the Centre for Excellence for Biosecurity Risk Analysis (CEBRA) (Australia), which has led to a collaboration analysing the costs and benefits of eradicating this insect.

"Support from all the contributing organisations and individuals has been vital in getting us to the stage we are at now, and will continue to be needed if the eradication is to be successful" Richard Toft (Planning and Intelligence Manager, GWB Eradication Programme).

In a related B3 activity, worked quantifying the threat of plant viruses to Cook's scurvy grass has led to DoC using seed for its plant propagation for its re-establishment programme rather than vegetable propagation.

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Optimising fruit fly surveillance

Fruit flies remain one of the largest threats to New Zealand's horticultural industries because of their potential to cause fruit and vegetable damage but, also, and perhaps more importantly, because if they become established in New Zealand they could severely restrict our trade with other countries. The current build-up of Queensland fruit fly populations in the former fly exclusion zone is a major concern in southern Australia, following the withdrawal of organophosphate insecticides as it may increase the likelihood of fruit fly incursions into New Zealand.

A package of fruit fly-related research projects is enabling MPI to review its surveillance programme for this group of key plant pests. MPI and B3 have together co-funded research to develop risk maps that illustrate where fruit fly are most likely to be introduced and establish, to quantify the optimal geographic placement of fruit fly traps, and to suggest appropriate dates for trap placement and removal each year.

This information will be used by MPI as it reviews its fruit fly surveillance programmes in light of the Government Industry Agreements for biosecurity readiness and response.

Contact: Lloyd.Stringer@plantandfood.co.nz, John.Kean@agresearch.co.nz

Surveillance for plant pathogens

Recent incursions of high impact plant pathogens (Psa, Lso) have highlighted the need for more effective surveillance technologies in this area. This is particularly challenging as plant pathogens may need to be detected earlier than other organisms to enable eradication.

B3 researchers are currently undertaking an extensive review of all national and international literature on the tools available for plant pathogen surveillance. To date this covers over 300 references and a range of technologies from simple ELISA tests to remote piloted vehicles. The primary aim of this review is to identify where B3 should prioritise its research, but the information will also enable MPI to develop strategies for plant pathogen surveillance in the future.

Meanwhile, other B3 researchers are using the finely tuned olfactory systems of honey bees to search for the odour signatures of plant pathogens. In this case, Psa is being used as the model system. Honey bees can pick up very low concentrations of odours and can be trained to respond to them to indicate their presence. In the long term, it is hoped that MPI will be able to use insects as electronic noses to detect infected plants on the landscape.

Contact: Suvi.Viljanen@plantandfood.co.nz, Max.Suckling@plantandfood.co.nz

THEME 5. ERADICATION AND RESPONSE

Theme Leader:	Max Suckling
Theme Representatives:	George Gill (MPI), Rory MacLellan (MPI), Chris Green (DoC), Geoff Ridley (EPA), Bill Dyck (FOA)
Project Leaders:	Max Suckling, Grant Smith, John Kean, Tara Strand

***Aim**: To increase preparedness for responses by providing knowledge, strategies and tools to support robust decision making*

Global Eradication and Response Database (GERDA)

The GERDA database summarises the responses for nearly 1000 pest and pathogen biosecurity incursions from around the world. Analysis of these data is providing a novel insight into the factors that led to a successful eradication programme, such as the organism involved, infestation sizes and potential eradication tools used. The scope of the B3 GERDA project has been expanded to include additional data (especially from the grey literature) through funding from the Australian Plant Biosecurity CRC. Max Suckling spent two weeks hosted by the International Atomic Energy Agency working on the international fruit fly eradication data, and will lead a multi-authored topic review.

GERDA provides MPI with a very useful decision-making tool to optimise their approach to current incursions. Additionally, the information found within GERDA is proving to be useful for risk analysis (e.g. distribution information) and also for general information about economic impacts and surveillance/eradication efforts.

Contact: John.Kean@agresearch.co.nz, Lloyd.Stringer@plantandfood.co.nz
http://b3.net.nz/gerda

Surveillance and eradication of the Eucalyptus Leaf Beetle

This Australian native was found in the Upper Hutt in mid-2012 and could become a serious pest on eucalypts in New Zealand if it becomes widespread and established. Because of its limited distribution, MPI believes that it can be eradicated and has sought B3 expertise to support this undertaking. B3 provided considerable support to MPI in this incursion.

George Gill (MPI) reported “B3 members made valuable contributions at short notice to the TAG that enabled MPI to progress quickly to a decision point. The expertise of the TAG members was useful in the choice of strategy, tools and execution of the response. The surveillance programme and delimitation of the infestation were informed by the work and expertise of B3. The surveillance strategy had a high degree of sensitivity and provided the confidence that the incursion is unlikely to be widespread.”

Moreover, B3 has continued to provide assistance to the response by undertaking research on an aerial spot-spraying technique as an alternative to boom spraying to reduce off-target application of insecticide in an urban area. The outcome of this research is promising and would play a key role in the eradication programme.

Contact: Tara.Strand@scionresearch.com

Improved aerial application through the SWATH calibration tool

Aerial pesticide application is often used in pest management and eradication programmes, particularly when the pest is widespread or located in the tops of tree canopies. Spray treatments are most effective when there is good spray coverage throughout the canopy.

A B3 research programme has focused on several ways of improving the effectiveness of aerial spraying while minimising the associated risks. This research has culminated in a new SWATH Calibration Tool that aims to streamline the complex calculations required to ensure effective coverage of the target area.

Tools like the SWATH web-tool and AGDISP, the spray deposition model developed by the US Forest Service and undergoing further development at Scion, were used to evaluate trade-offs between efficacy and spray drift in the recent eucalyptus leaf beetle eradication (see separate story). These tools are invaluable for eradication operations as they help to define the boom configuration and meteorological operation limits that satisfy sometimes conflicting management operations.

In related work, B3 Scion researchers worked with Zespri Group limited to test new aerial spray optimisation methods to assist with their battle against Psa in kiwifruit orchards. Data from the Zespri and Kiwifruit Vine Health trial are being applied to improve existing aerial spray models, especially for pergola-type canopies.

Contact: Tara.Strand@scionresearch.com
http://webapps.scionresearch.com/SwathCalibration

B3 People

Key people in the B3 collaboration include:

Collaboration Council	Operational Leadership	End-user and Theme Leader Representatives
James Buwalda (Chair)	**Director** Stephen Goldson David Teulon (from April 2013)	Barney Stephenson (MPI)
Philippa Stevens (PFR)	**Theme 1** Barbara Barratt (AGR)	Chris Green (DoC)
Glyn Francis (AGR)	**Theme 2** Ecki Brockerhoff (Scion)	Bill Dyck (FOA)
Brian Richardson (Scion)	**Theme 3** Karen Armstrong (BPRC)	Geoff Ridley (EPA)
Philip Hulme (BPRC)	**Theme 4** John Kean (AGR)	**Theme 1** Jo Berry (MPI) Helen Harman (MPI)
Veronica Herrera (MPI)	**Theme 5** Max Suckling (PFR)	**Theme 2** Shane Olsen (MPI) Chris Denny (MPI)
Geoff Hicks (DoC)	**Programme Co-ordinator** Margaret Hean	**Theme 3** Robert Taylor (MPI)
Liz Prendergast (EPA Observer)		**Theme 4** Paul Stevens (MPI) Rory MacLellan (MPI)
		Theme 5 George Gill(MPI) Rory MacLellan(MPI)

Knowledge transfer

Commissioned reports

Armstrong JW, Jamieson LE, Waddell BC 2012. A review of phosphine fumigation for use on perishables SPTS Report No 6468. Pp. 58. Auckland, New Zealand. The New Zealand Institute for Plant & Food Research Limited.

Brockerhoff E, Epanchin-Niell R, M. KJ, Turner JA 2012. Cost-benefit analysis of surveillance for wood borers and bark beetles. Scion Report for the Forest Owners Association Report No 49997. Pp. 68.

Dick MA, Williams D 2013. *Puccinia psidii*: selection of a disease for validation of the expatriate plants concept. Scion report for B3. Report No 19295.

Holder PW, Armstrong K 2012. Isotopes and trace elements as geographic origin markers for biosecurity pests. Final report to MPI for contract 10749/2007. Pp. 12.

Jamieson LE, Griffin M, Page-Weir NEM, Chhagan A, Connolly PG 2012. A review of generally recognised as safe compounds and food-safe compounds with potential for disinfesting horticultural products SPTS Report No 7200. Pp. 41. Auckland, New Zealand. The New Zealand Institute for Plant & Food Research Limited.

Kean JM, Stringer LD 2012. Optimising the timing of fruit fly surveillance in New Zealand. M4. Predicting fruit fly population trends in New Zealand. Report for Ministry for Primary Industries. RFP 15184 The New Zealand Institute for Plant & Food Research Limited.

Kean JM, Stringer LD 2012. Optimising the timing of fruit fly surveillance in New Zealand. M5. Optimising the timing of surveillance trapping. Report for Ministry for Primary Industries.RFP 15184. The New Zealand Institute for Plant & Food Research Limited.

Kean JM, Stringer LD, Suckling DM 2012. Optimising the timing of fruit fly surveillance in New Zealand. M3. Estimating the potential voltinism of fruit flies in New Zealand. Report for Ministry for Primary Industries RFP 15184. The New Zealand Institute for Plant & Food Research Limited.

Phillips C, Iline I, Novoselov M, McNeill MR, Richards N, van Koten C 2012. Time between methyl bromide fumigation and mortality of *Musca domestica* Linnaeus (house fly) eggs Ministry for Primary Industries Technical Paper No: 2012/02. Pp. 56.

Sandanayaka WRM 2012. Preliminary report on application of EPG technique for host testing of phloem feeding insects; tomato/potato psyllid *Bactericera cockerelli* as a model insect SPTS Report No. 7782. Auckland, New Zealand. The New Zealand Institute for Plant & Food Research Limited.

Strand T, Richardson B, Grace J, Brownlie RK, Gous SF, Coker GWR 2012. Optimisation of aerial application for Psa control: aircraft wake study. Scion Report No 18775.

Strand T, Richardson B, Grace J, Brownlie RK, Gous SF, Coker GWR 2012. Optimisation of aerial application for Psa control. Scion Report No 19000.

Suckling DM, El-Sayed AM, Stringer LD, Mas F, Stanbury M 2012. Assessment of fitness in irradiated Lepidoptera: progress report September 2011 to August 2012. Progress report to International Atomic Energy Agency. SPTS Report No. 7487. Auckland, New Zealand. The New Zealand Institute for Plant & Food Research Limited.

Suckling DM, El-Sayed AM, Stringer LD, Mas F, Stanbury M, Battisti A, Hardwick S 2012. Increasing the efficiency of Lepidoptera SIT by enhanced quality control. Technical report to International Atomic Energy Agency. SPTS Report No. 7519. Auckland, New Zealand. The New Zealand Institute for Plant & Food Research Limited.

Todd J, Berndt L, Gresham BA, Withers T, Barratt B 2013. Improvements in assessing host range of deliberate and accidental introductions: a test model for non-target test species selection. Case study 2: *Cotesia urabae*. SPTS Report No. 8568. Auckland, New Zealand. The New Zealand Institute for Plant & Food Research Limited.

Substantive information sharing or advice

- Collaboration Council (CC). Quarterly meetings involving Senior Management from MPI, DoC, FOA, EPA, PFR, AGR, Scion, LCR, BPRC and B3 (Chair Director)
- Science Partnership Forum (SPF). Twice-yearly meetings involving representatives from MPI, DoC, FOA, EPA, and B3 (Theme Leaders, Project Leaders)
- Theme Leaders Reports. Monthly. Available on B3 Website
- Theme Brief Updates. One meeting per theme (themes 4 and 5 combined). MPI, DoC, EPA, B3 Theme Leaders, B3 Project Leaders.
- 'Luminary' visits. See above
- Technical Advisory Group (TAG) for Great white butterfly. MPI, DoC, B3 experts (Phillips, Walker, Suckling)
- Technical Advisory Group (TAG) for Eucalyptus leaf beetle. MPI. B3 experts (Bulman, Kean, Teulon, Bain)
- Frequent informal B3 project updates. E.g. B3 camera project with MPI, Mi5
- Biosecurity Ministerial Advisory Committee (BMAC) meeting. August 2012 (Goldson)
- Biosecurity Ministerial Advisory Committee (BMAC) meeting. November 2012 (Goldson)
- NZ Institute of International Affairs (NZIIA) Canterbury. February 2013 (Goldson)
- MPI Science Series, Wellington. 2012. Phillips C, Iline I 2012. Ghosts haunt New Zealand's border
- MPI training course - Basic Surveillance for Biosecurity. 25 MPI staff, B3 (Kean)
- MPI Research Forum. November 2012 (Stringer, Kean)
- MPI Emerging Risks Workshop. Wellington. April 2013 (various B3)
- MPI CARIS Forum. Advanced Surveillance Design for Biosecurity – 7 MPI staff, B3. 2-day workshop. March 2013 (Kean, Stringer)
- EPA advisory Panel on generalist BCAs. Wellington. April 2013 (various B3)
- MPI QUADS/B3 Meeting. Christchurch. May 2013 (Teulon)
- GERMAC. Discussion re role of B3. July 2012 (Goldson)
- GERMAC. Report on B3 research. Wellington. June 2013 (Teulon)
- SWATH Calibration Tool. Workshop for MPI.
- Horticulture NZ conference. Invited talk and panel discussion. July 2012 (Goldson)
- PSA Forum. B3 Update. Te Puke. February 2013 (Teulon, Everett, Bulman)
- Horticulture and Arable Sector B3 Update. Hastings. April 2013 (Teulon, Charles, Jamieson, Viljanen-Rollinson, Suckling)

Significant International collaborations/linkages

B3 researchers provide considerable value to the New Zealand biosecurity system through their international connections. This value can be measured through early intelligence on emerging risks, being able to undertake research overseas on high impact pest and disease organisms not found in New Zealand, creating opportunities for MPI, DoC and FOA to link with key international expertise, research visits to New Zealand increasing our capability and capacity, joint publications and joint graduate students.

Name	Institution	B3 Contact	Context	Activity
Peter Mason	Agriculture and Agri-Food, Canada	Barratt	Non-target impacts	Additional case studies for B3 project
Hugh Evans	Forest Research & IFQRG, UK	Brockerhoff	Detection tools and issues of pathway risk management	Joint publication
Andrea Lucchi René Sforza	Pisa Univ., Italy USDA Montpellier, France	Suckling	Lures for surveillance	Field trials in Europe
Fabio Chinellato (Andrea Battisti)	Univ. Padova, Italy	Suckling	Camera traps for surveillance	Visited NZ for 6 months undertaking research
Alfredo Jimenez Perez	Académico y de Investigación del Centro de Desarrollo de Productos Bióticos (CEPROBI), Morelos, Mexico	Suckling, Stringer	Mass trapping	Visited NZ for 12 months undertaking research
Richard Baker	FERA, UK	Bell	Sentinel plants	Development of international network
Johanna Voinopol-Sassu	Goettingen Univ., Germany	Brockerhoff	Non-target impacts	MSc student
Tom Larsen Adam Wolf	Suterra	Suckling, Stringer	Trail disruption technology	Discussion for future application
Various	National Center for Ecological Analysis and Synthesis (NCEAS), USA	Brockerhoff	Improving phytosanitary measures	Joint manuscript
Patrick Tobin Fiona MacBeth	USDA Forest Service Ex. OCPPO, ex DAFF, Australia	Stringer	Eradication and response data base (GERDA)	Additional international data
Rene Eschen	CABI Switzerland (PERMIT EU COST)	Brockerhoff	Pathway Risk Management, EU Standards	Visit to NZ, Meetings/seminar with MPI
Various	Plant Biosecurity CRC, Australia	PFR, PBRC	Various aspects of biosecurity	Collaborative research projects including 3 PhD projects
Various	Tonga Fiji New Caledonia	Jamieson	Postharvest treatments	Off-shore trials
Various	QUADS (NZ, US, Canada & Australia)	Armstrong, Hardwick	Molecular diagnostics, Camera traps	Co-ordinated research
Various	Various Europe	Suckling	High impact invasive pests not found in NZ	Collaborative in EU programme on Brown Marmorated Stick Bug and *Drosophila suzuki*
Various	Centre for Plant Health Science & Technology, APHIS, USA	Suckling	Sterile Male Technique	Workshop in Phoenix, USA with participants from 14 countries
Andrew Robinson Ann Nicholson	Australian Centre of Excellence for Risk Analysis (ACERA), Australia Monash Univ., Australia	Jamieson, DeSilva, Walker J	Risk assessment, Bayesian Networks	Discussion on best approaches
Sandy Liebhold	US Forest Service	Brockerhoff	Effects on invading populations	Joint PhD supervision

Name	Institution	B3 Contact	Context	Activity
Various	Centre for Excellence for Biosecurity Risk Analysis (CEBRA), Australia	Phillips, Kean	Surveillance research plans (GWB)	Discussion and development of surveillance plans
Colin Henderson	Bee Alert Tech., Univ. of Montana, USA	Suckling	Honey bee pathogen detection	Visited NZ
Sandy Liebhold	USDA Forest Service	Brockerhoff	Forest pest invasions	Visit NZ, Seminars to Univ. Canterbury, FOA/MPI
Jerry Bromenshank	Bee Alert Tech., Univ. of Montana, USA	Suckling	Honey bee pathogen detection	Visit NZ, Seminar to MPI
Georgio Balestra	ISRIFE, Universita degli Studi della Tuscia, Italy	Worner	Innovative solutions to reduce invasive fruit pests	Invitation to join EU programme
Phil Berger Ken Bloem	US Department of Agriculture	Suckling	Surveillance	Discussion
Roger Magarey	US Department of Agriculture	Suckling	Risk modelling	Discussion
Bob van der Meer	US Department of Agriculture	Suckling Stringer	RIFA trail pheromone disruption	Trials in Florida
Andrew Parker	International Atomic Energy Agency (IAEA), Europe	Suckling	Eradication and response data base (GERDA)	Additional data
Rebecca Epanchin-Niell	SESYNC (National Socio-Environmental Synthesis Center, USA	Brockerhoff	Live plant trade	Invitation to join programme and workshop
Susan Hester Oscar Cacho Daniel Spring	Univ. New England, Australia Univ. New England, Australia Monash Univ., Australia	Kean, Phillips	Passive surveillance	Visit NZ, Workshops and field trip
Phil Welch	Bee Alert Tech., USA	Suckling	Honey bee pathogen detection	Visit to NZ

Popular articles

Anon. 2012. Paving the way for better collaboration between science and plants biosecurity: A research consumer's perspective on partnership and research (July 2012) http://b3nz.org/news

Anon. 2012. Project quantifies economic benefits of phytosanitary policy (August 2012)http://b3nz.org/news

Anon. 2012. Trap cameras could help early pest detection (October 2012) http://b3nz.org/news

Anon. 2012. B3 researchers present at 24th International Congress of Entomology (October 2012) http://b3nz.org/news

Anon. 2012. Advances in aerial spraying contribute to eradication of insect pests (November 2012) http://b3nz.org/news

Anon. 2012. International plant sentinel network helps identify potential invasive pests (November 2012 http://b3nz.org/news

Anon. 2013. Intensive effort to beat pest butterfly breeding (8 May 2013). http://www.hortidaily.com/article/2060/NZ-Intensive-effort-to-beat-pest-butterfly-breeding

Anon. 2013. Our changing world: training sniffer bees (20 May 2013). http://www.radionz.co.nz/national/programmes/afternoons/audio/2555713/our-changing-world-training-sniffer-bees

Lee F 2012. Sniffer bees for poorly trees (10 December 2012). http://www.stuff.co.nz/science/8057239/Sniffer-bees-for-poorly-trees

New products, processes and services

- Method for determining biological status. Iline I, Phillips C 2013. NZ584619, Patent.
- SWATH Calibration Tool. http://webapps.scionresearch.com/SwathCalibration
- Global Eradication Database. http://b3.net.nz/gerda
- Online ArcGIS climate matching mapping tool (http://www.arcgis.com/home/) (password protected)
- Updated – Biocontrol Information Resource for EPA Applicants (http://b3.net.nz/birea/index.html)
- Updated – Biological Control Agents introduced to New Zealand (http://b3.net.nz/bcanz)

Science quality

Science quality can be measured in a range of ways, including regular publication in higher impact journals, invitations to speak at international meetings, frequency and duration of international visitors. The following lists summarise outputs but not their impact.

Peer reviewed articles (published or accepted)

Brockerhoff EG, Suckling DM, Kimberley M, Richardson B, Coker G, Gous S, Kerr JL, Cowan DM, Lance DR, Strand T, Zhang A 2012. Aerial application of pheromones for mating disruption of an invasive moth as a potential eradication tool. PLoS ONE 7(8): e43767.

Brockerhoff EG, Suckling DM, Roques A, Jactel H, Branco M, Twidle AM, Mastro VC, Kimberley MO 2013. Improving the efficiency of Lepidopteran pest detection and surveillance: constraints and opportunities for multiple-species trapping. Journal of Chemical Ecology 39(1): 50–58.

Charles JG, Logan DP 2013. Predicting the distribution of *Gonatocerus ashmeadi*, an egg parasitoid of glassy winged sharpshooter, in New Zealand. New Zealand Entomologist 36(2): 73–81.

Davidson M, Skill S, Butler R, Nielsen M, Keenan S, Bulman S 2012. Virus status of western flower thrips (*Frankliniella occidentalis*) does not affect their response to a thrips lure or host plant volatiles in a Y-tube olfactometer. New Zealand Plant Protection 65: 120–125. Not reported in 2011–12

El-Sayed AM, Gibb AR, Mitchell VJ, Manning L-AM, Revell J, Thistleton B, Suckling DM 2013. Identification of the sex pheromone of *Conogethes pluto*: a pest of Alpinia. Chemoecology 23(2): 93–101.

Everett KR, Pushparajah IPS, Vergara MJ, Curtis CL, Larsen NJ 2012. Heat treatments to kil*/ Pseudomonas syringae* pv. actinidiae on contaminated pollen. New Zealand Plant Protection 65: 8–18. Not reported in 2011-12

Iline I, M Novoselov and C. Phillips. 2013. Proof of concept for a biochemical test that differentiates between heat-treated and non-heat-treated food products. New Zealand Plant Protection 66: 34–39.

Heath ACG 2013. Implications for New Zealand of potentially invasive ticks sympatric with *Haemaphysalis longicornis* Neumann, 1901 (Acari: Ixodidae). Systematic & Applied Acarology 18: 1–26.

Jamieson LE, Page-Weir NEM, Chhagan A, Brash DW, Klementz D, Bycroft BL, Connolly PG, Waddell BC, Gilbertson R, Bollen F 2012. Phosphine fumigation to disinfest kiwifruit. New Zealand Plant Protection 65: 35–43. Not reported in 2011–12

Jamieson LE, DeSilva HN, Worner SP, Rogers DJ, Hill MG, Walker JTS 2013. A review of methods for assessing and managing market access and biosecurity risks using systems approaches. New Zealand Plant Protection 66: 1–9.

Kean JM 2013. How accurate are thermal accumulation methods for predicting phenology in New Zealand? New Zealand Plant Protection 66: 124–131.

Kriticos DJ, Leriche A, Palmer DJ, Cook DC, Brockerhoff EG, Stephens AEA, Watt MS 2013. Linking climate suitability, spread rates and host-impact when estimating the potential costs of invasive pests. PLoS ONE 8(2): e54861.

Lefort MC, Barratt BIP, Marris JWM, Boyer S 2013. Combining molecular and morphological approaches to differentiate the pest *Costelytra zealandica* (White) (Coleoptera: Scarabeidae: Melolonthinae) from the non-pest *Costelytra brunneum* (Broun) at the larval stage. New Zealand Entomologist 36(1): 15–21

LeFort MC, Boyer S, Worner SP, Armstrong K 2012. Non-invasive molecular methods to identify live scarab larvae: an example of sympatric pest and non-pest species in New Zealand. Molecular Ecology Resources 12: 389–395.

McLean KL, Dodd SL, Minchin RF, Ohkura M, Bienkowski D, Stewart A 2013. Non-target impacts of the biocontrol agent *Trichoderma atroviride* on plant health and soil microbial communities in two native ecosystems in New Zealand. Australasian Plant Pathology: DOI 10.1007/s13313-013-0229-8.

Narouei Khandan HA, Worner SP, Jones EE, Villjanen-Rollinson SLH, Gallipoli L, Mazzaglia A, Balestra GM 2013. Predicting the potential global distribution of *Pseudomonas syringae* pv. actinidiae (Psa) New Zealand Plant Protection 66: 184–193.

Page-Weir NEM, Jamieson LE, Bell NL, Rohan C, Chhagan A, Clare GK, Kean AM, Davis VA, Griffin M, Connolly PG 2013. Interception and hot water treatment of mites and nematodes on root crops from the Pacific Islands. New Zealand Plant Protection 66: 17–28.

Phillips C, Iline I, Richards N, Novoselov M, and McNeill M. 2013. Development and validation of a quick easily used biochemical assay for evaluating the viability of small immobile arthropods. Journal of Economic Entomology. 106(5). Accepted for publication as of June 2013.

Richards, N., L. Winder, I. Iline, M. Novoselov, M. McNeill, and C. Phillips. 2013. A biochemical viability assay is compatible with molecular methods for species identification. New Zealand Plant Protection 66: 29–33.

Sandanayaka WRM, Jia Y, Charles JG 2013. EPG technique as a tool to reveal host plant acceptance by xylem sap-feeding insects. Journal of Applied Entomology 137(7): 519–529.

Smith HM, Vink C, Fitzgerald BM, Sirvid PJ 2012. Redescription and generic placement of the spider *Cryptachaea gigantipes* (Keyserling, 1890) (Araneae: Theridiidae) and notes on related synanthropic species in Australasia. Zootaxa 3507: 38–56.

Stringer LD, Sullivan NJ, Sullivan TES, Mitchell VJ, Manning L-AM, Mas F, Hood-Nowotny RC, Suckling DM 2013. Attractiveness and competitiveness of irradiated light brown apple moths. Entomologia Experimentalis et Applicata 148(3): 203–212.

Suckling DM 2013. Benefits from biological control of weeds in New Zealand range from negligible to massive: A retrospective analysis. Biological Control 66(1): 27–32.

Suckling DM, Brockerhoff EG, Stringer L, Butler R, Campbell D, Mosser LK, Cooperband MF. 2012 Communication disruption of *Epiphyas postvittana* (Lepidoptera: Tortricidae) by using two formulations at four point source densities in vineyards. Journal of Economic Entomology, 105, 1694–1701. http://dx.doi.org/10.1603/EC12130

Suckling DM, Stringer LD, Stephens AEA, Woods BW, Williams D, Baker G, El-Sayed AM 2013. From IPM to integrated pest eradication: technologies and future needs. Pest Management Science: Accepted for publication as of June 2013.

Teulon DAJ, Boyd Wilson KSH, Holton A, Ridley GS 2012. Research on invasive pests and diseases in New Zealand and the law. New Zealand Plant Protection 65: 281–288. Not reported in 2011–12

Teulon DAJ, Boyd Wilson KSH, Holton A, Ridley GS 2013. Research on invasive pests and diseases in New Zealand and the law. New Zealand Science Review 70 (2): 37-41 (Reprinted in full from New Zealand Plant Protection 65: 281–288)

Teulon DAJ, Stufkens MAW, Drayton GM, Maw HEL, Scott IAW, Bulman SR, Carver M, von Dohlen CD, Eastop VF, Foottit RG 2013. Native aphids of New Zealand—diversity and host associations. Zootaxa 3647: 501–517.

Wakelin SA, Barratt BIP, Gerard E, Gregg AL, Brodie EL, Andersen GL, DeSantis TZ, Zhou J, He Z, Kowalchuk GA, O'Callaghan M 2013. Shifts in the phylogenetic structure and functional capacity of soil microbial communities follow alteration of native tussock grassland ecosystems. Soil Biology and Biochemistry 57: 675–682.

Withers TM, Carlson CA, Gresham BA 2013. Statistical tools to interpret risks that arise from rare events in host specificity testing. Biological Control 64(3): 177–185.

Van Vianen J, Houliston G, Fletcher J, Heenan P, Chapman H 2013. New threats to endangered Cook's scurvy grass (*Lepidium oleraceum*; Brassicaceae): Introduced crop viruses and the extent of their spread. Australian Journal of Botany 61: 161–166.

Books or chapters (published or accepted)

Kean JM, Burnip GM, Pathan A 2013. Detection survey design for decision making during biosecurity incursions. In: Jarrad FC, Low-Choy SJ, Mengersen K eds. Biosecurity surveillance: quantitative approaches. Wallingford, U.K., CABI. Accepted for publication.

Suckling DM 2013. Monitoring for surveillance and management. In: Allison JD, Carde RT eds. Pheromone communication in moths: evolution, behaviour and application. Accepted for publication.

Keynote Addresses at Significant International or National Conferences or Meetings

Brockerhoff E 2013. Management of pest and disease risks in planted forests. 3rd International Congress on Planted Forests, 16–22 May, Bordeaux, France. Keynote.

Suckling DM 2012. Pheromones for pest management and eradication of invasive species. International Organisation of Biological Control WPRS Working Group on Pheromones and other Semiochemicals, 1-5th October 2012, Bursa, Turkey. Plenary.

Invited Addresses at Significant International or National Conferences or Meetings

Barratt B 2012. Host range testing for natural enemy introductions. Surrogate species selection for assessing potential adverse environmental impacts of genetically engineered plants on non-target organisms, 26–28 June 2012, Washington D.C. Center for Environmental Risk Assessment. [not reported in 2011–12]. Conference Proceedings. P. 2-4.

Barratt B, Oberprieler R, Barton D, Mouna M, Stevens M, Alonso-Zarazaga M, Vink C, Ferguson C 2012. Does knowledge of natural host range always help predict host range in new areas of introduction? A case study with the braconid parasitoid *Microctonus aethiopoides* loan. XXIV International Congress of Entomology, 19–25 August 2012, Daegu, South Korea. CD abstract number S1404TH10.

Barratt B, Oberprieler R, Barton D, Mouna M, Stevens M, Alonso-Zarazaga M, Vink C, Ferguson C 2013. Natural host range of *Microctonus aethopoides* Loan (Hymenoptera: Braconidae) in Morocco: could it help predict host range in new areas? 4th International Symposium on Biological Control of Arthropods, Pucon, Chile. ISBCA. 4–8 March 2013. Proceedings. P. 15–19.

Berndt L, Withers TM 2012. Host range testing for a new biocontrol agent for *Uraba lugens* (Lepidoptera: Noctuidae) in New Zealand. XXIV International Congress of Entomology, 19–25 August 2012, Daegu, South Korea. CD abstract number S1102M04.

Park KC 2012. Olfactory receptor neurons and host specificity in phytophagous insects. XXIV International Congress of Entomology, 19–25 August 2012, Daegu, South Korea. CD abstract number S603W07.

Suckling DM, Kean JM, Stringer LD, Tobin PC, Herms DA, Lee DC, McCullough DG, Pluess T, Yamanaka T 2012. Lessons from the global eradication and response database. 24th International Congress of Entomology, 12–17 August 2012, Daegu, South Korea. CD abstract number S1405TH15.

Suckling DM. Mobile mating disruption – the challenge of cross-species behavioural suppression. 4th International Symposium on Biological Control of Arthropods, Pucon, Chile. ISBCA. 4-8 March 2013. Proceedings. P. 107–108.

Teulon DAJ, Boyd Wilson KSH., Holton A and Ridley GS 2013. Bioscience Laws and Effects on Pest Research. NZ Bio National Conference. 19 March 2013. Auckland.

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Stringer LD, Kean JM, Armstrong JW, Stephens AEA, Kriticos DJ, Samietz J, Suckling DM 2012. Optimising the timing of fruit fly surveillance in New Zealand. MPI Research Forum, 21 November 2012, Wellington, New Zealand.

Co-funding for Border Biosecurity Research Amongst B3 Partners

Project	Funder	CRI	PI (or equivalent)	Amount
New approaches for diagnosing bacterial pathovars	PBCRC-2002	PFR	Smith G	A$152,994
Predicting the likelihood of eradication	PBCRC-1032	PFR/AGR	Stringer L / Kean J	A$33,179
Building resilience in indigenous communities	PBCRC-4041	PFR	Marsh A (Teulon D)	A$22,549
New tools for insect surveillance and eradication	PBCRC-2034	PFR/AGR	Suckling M / Kean J	A$103,240
Natural dispersal scoping study	PBCRC-1031	PFR	Dohmen-Vereijssen J	A$15,300
GWCB surveillance	MPI	PFR	Suckling M / Walker G	$22,225
Fruit Fly Surveillance	MPI	PFR/AGR	Stringer L / Kean J	$47,343
Combining lures	MPI	PFR/Scion	Stringer L / Brockerhoff E	$27,895
Laser vibrometer	IAEA	PFR	Suckling M	$16,343
Pheromone modelling	USDA-Forest Service	Scion	Strand T	US$8,000
Gypsy moth surveillance	MPI	Scion	Bulman L	$31,200
Eradication tools	MPI	Scion	Strand T	$11,400
Bark beetle surveillance trapping cost-benefit analysis	FBC	Scion	Brockerhoff E	$2,400
Pathway risk management, live plant trade	Univ. Maryland / Sesync (US)	Scion	Brockerhoff E	$4,000
Scenario tree analysis of fruit fly surveillance	MPI	AGR	Kean J	$11,445
Surveillance training	MPI	AGR	Kean J	$10,890
Tick training course	MPI	AGR	Hardwick S	$6,500
Phenology model for GWB	MPI	AGR	Phillips C	$15,000

About Better Border Biosecurity

Background. B3 is the pre-eminent research provider for science-based plant border biosecurity solutions in New Zealand. It has evolved from largely isolated (and sector-based) initiatives within the productive sector CRIs (pre 2003), through to the FRST-funded 'Improved Biosecurity' programme (2003–05), followed by the large MSI-contracted Outcome Based Investment (OBI) B3 programme (2005–11), to the current collaboration resourced primarily through CRI core funding.

Scope. The breath of research carried out within B3 encompasses threats to the pastoral, horticultural, arable and forestry productive sectors and natural systems, especially cross sectoral issues where pests and diseases do not respect the productive and natural system boundaries. Research on weeds and animal pests and diseases are not a focus.

Partners. All parties work towards a commonly developed and agreed-to Strategic Plan and Business Plan underpinned by a Partnership Agreement. The current members of B3 include:

Science providers: Plant & Food Research, AgResearch, Scion, and the Plant Bio-Protection Research Centre. Landcare Research joined B3 in June 2013

Stakeholders/end-users: Ministry for Primary Industries, Department of Conservation, Forest Owners Association. The Environmental Protection Authority has observer status.

Governance. The Collaboration Council (CC), led by an independent Chair and consisting of senior managers from the members listed above plus the Director, meets quarterly to provide a governance role for B3 and to provide a link between the executive arms of the members' organisations and the operational science programme.

Operational. The Director leads a group of five Theme Leaders (plus Landcare representative), who are also representative of the research providers. They provide operational leadership to the Project Leaders who make up the B3 science programme. The Theme Leaders are strongly influenced by theme representatives from the stakeholders, who provide input at the twice-yearly Science Partnership Forum (SPF) as well as a range of formal and informal meetings throughout the year. A central tenet of B3 is that it is the government operational agencies, MPI and DoC, create the value from B3's science and technology through their co-investment in the form of research uptake and application at the border. A corollary of this design is the need for frequent and effective communication among the various parties.

Staff are managed by their own organisations, with some advice from the B3 leadership, which has no direct line-control.

Essential documents. The Statements of Cooperate Intent (SCI) of all member CRIs identify biosecurity as core to their research investments. The B3 Strategic Plan (2010/11 to 2016/17) outlines the key drivers, critical objectives, scope, and aspirations for the research conducted within B3. The Collaboration Agreement outlines how the members intend to interact with one another to enable B3 to function. The Business Plan outlines the planned activities for a given year and the Annual Report provides an account of what was achieved. The Hosting Agreement with PFR provides the resources for the Collaboration's leadership and coordination.

Reporting. Monthly Theme Leader reports (to the Director), a monthly Director's report (to the CC), and an Annual Report, are placed on the B3 internet site (www.B3.org.nz) and are made available to the CRIs for their internal reporting requirements.

B3 Science Solutions for BETTER BORDER BIOSECURITY
www.b3nz.org