

A composite background image. On the left, a close-up of a microscope's objective lens and eyepiece is visible. The rest of the background is a blurred image of a person in a white lab coat working in a laboratory, with green plants in the foreground.

Chapter 8

Plant biosecurity RD&E

An understanding of the biology of plant pests, the hosts that are susceptible to them, their effects on production and methods of control are fundamental to effective plant biosecurity.

Plant biosecurity RD&E is the research, development and extension that develops this understanding and how to apply it to situations to minimise negative impacts from plant pests.

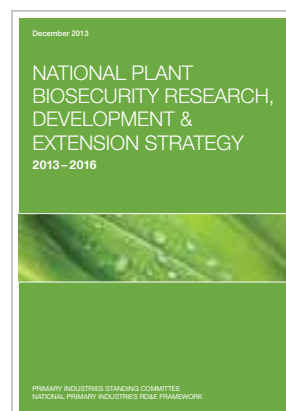
Industry and government often combine resources to invest in plant biosecurity RD&E. The research on pests and how to manage them is undertaken by research institutions across Australia, including CSIRO, Cooperative Research Centres, the Australian Government, state and territory agencies as well as universities, plant industries, PHA and private organisations.

The science underpinning Australia's plant biosecurity system takes many forms. It covers the topics of pest management, crop improvement, risk analysis, database management, surveillance, diagnostics, protecting the natural environment, and the basic biology of pests and crops. It involves the full range of crops grown in Australia as well as pollinators.

The pests investigated include bacteria, fungi, nematodes and viruses, along with the diseases they cause, and also weeds, insects and other invertebrates, such as mites.

The data for 2017 provides an overview of all plant, weed and pollinator RD&E in Australia, with a summary of where it was carried out, the size, the topic, pest and crop types*. Surveillance programs that include some research or extension activities are also included, as are some training and awareness programs.

National Plant Biosecurity RD&E Strategy



Plant biosecurity RD&E is conducted by dozens of research organisations across Australia, including universities, governments, botanic gardens, museums, plant industries, PHA and other private organisations.

There was no overarching framework coordinating research nationally until PHA devised the National Plant Biosecurity RD&E Strategy in 2013 in collaboration with stakeholders around Australia. It was developed under the National Primary Industries RD&E Framework.

The strategy was developed to guide plant biosecurity research to increase efficiency and effectiveness and enhance collaboration. It was developed along with other sector-specific and cross-sector strategies being implemented by the Agriculture Senior Officials' Committee (AGSOC).

The objective of the strategy is to enable effective management of economic, environmental and social risks posed by established pests as well as those that may enter, emerge, establish or spread within Australia, by strengthening biosecurity RD&E for Australia's plant industries and those dependent on them.

Since 2014, an Implementation Committee comprising a broad group of stakeholders has been bringing the strategy to life. The Committee includes representatives from the Australian Government, state governments, PHA, Hort Innovation, and the following research organisations: Council of Rural Research and Development Corporations, GRDC, CSIRO, PBCRC and the Plant Biosecurity Research Initiative.

The National Plant Biosecurity RD&E Strategy Implementation Committee is chaired by PHA and receives administrative support from PHA to drive the agenda and to host workshops focusing on particular biosecurity issues. It reports to the AGSOC Research and Innovation Committee.

It is funded by Hort Innovation, the Victorian Department of Economic Development, Jobs, Transport and Resources, Cotton Research and Development Corporation, Dairy Australia, Grains Research and Development Corporation, Meat and Livestock Australia, Sugar Research Australia, AgriFutures, Wine Australia and Forest and Wood Products Australia.

In 2017, the committee held a workshop at AgriBio in Melbourne. The workshop was attended by governments, industry and RDCs and covered the policy implications of plant pest diagnostics and RD&E. More workshops will be held in 2018.

* Every year, the methods used to collect data for this chapter improve incrementally. While every effort is made to secure accurate data for inclusion in this table, we acknowledge that it is not complete.



Australian Government agencies and statutory authorities

The Australian Government currently contributes to a variety of plant biosecurity related RD&E activities. This occurs predominantly through the Department of Agriculture and Water Resources but also through the Department of Industry, Innovation and Science, the Department of the Environment and Energy and the Department of Foreign Affairs and Trade.

AUSTRALIAN CENTRE FOR INTERNATIONAL AGRICULTURAL RESEARCH

aciarc.gov.au

The Australian Centre for International Agricultural Research (ACIAR) was established to help address agricultural problems in developing countries, and to commission collaborative research-for-development, focusing on fields where Australia has special research competence. Its mission is to achieve more productive and sustainable agricultural systems for the joint benefit of developing countries and Australia through international agricultural research partnerships, regional monitoring and management and the reduction of poverty, thereby enhancing regional security.

ACIAR's biosecurity projects adopt various approaches and are spread across several program areas, including horticulture, agricultural systems, crop improvement and management and forestry.

AUSTRALIAN RESEARCH COUNCIL

arc.gov.au

The Australian Research Council (ARC) is an independent agency within the Australian Government's Education and Training portfolio. The ARC's purpose is to grow knowledge and innovation for the benefit of the Australian community by funding the highest quality research, assessing the quality, engagement and impact of research and providing advice on research matters. The ARC plays a leading role in supporting and developing Australian research to benefit Australia across the full range of research disciplines with outcomes in the commercial, cultural, economic, environmental, health and societal fields.

The Centre for Fruit Fly Biosecurity Innovation

fruitflyitcc.edu.au

The Centre for Fruit Fly Biosecurity Innovation co-ordinates research and research training across three universities, Macquarie University, Queensland University of Technology, and Western Sydney University, and four Partner Organisations: New Zealand Institute for Plant & Food Research, CSIRO, NSW Department of Primary Industries, Queensland Department of Agriculture and Fisheries, and Ecogrow Environmental Ltd.

With a focus on research training, the Centre for Fruit Fly Biosecurity Innovation supports research fellows and PhD students, who are distributed across and move freely between participating organisations.

Research activities of the Centre are supported by a grant of \$3.7 m from the Australian Research Council's Industrial Transformation Training Centre program, with supplementary support from NSW Trade and Investment's Research Attraction and Acceleration Program.

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION

csiro.au

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) is Australia's preeminent scientific organisation and plays a crucial role in the Australian innovation system. It is one of the largest and most diverse research organisations in the world ranked in the top one per cent in 15 of 22 research fields, with over 5,000 experts holding more than 1,800 patents. CSIRO creates value for customers through innovation that delivers positive impacts for Australia. CSIRO feeds into the plant biosecurity system via its Health and Biosecurity, and Agriculture and Food business units together with its National Research Collections.

CSIRO's successes include:

- Developing solutions to reduce the impact of invasive pests and diseases in plants.
- Delivering counter measures to detect, control and mitigate biosecurity threats.
- Designing integrated strategies to manage invasive pests in agriculture.
- Developing knowledge and tools around rigorous risk analysis protocols.
- Delivering biological control for many exotic weeds that are found in production landscapes and the wider environment.

PLANT INNOVATION CENTRE

In November 2017, a new Plant Innovation Centre was launched at the Mickleham Post-Entry Quarantine facility near Melbourne's Tullamarine Airport.

The purpose of the new facility, known as PIC@PEQ, is to develop innovations that improve Australia's capacity to address current and anticipated plant biosecurity risks, ensuring the nation has modern, effective plant biosecurity systems in place to combat any incursion.

The centre's research team consists of a steering board, which will determine priority operational projects based on operational challenges, and departmental scientists, who will collaborate with various external scientists and other biosecurity stakeholders to deliver on the agreed projects.

State and territory governments

Most of Australia's state and territory departments of agriculture have dedicated RD&E divisions that undertake research, including aspects of plant biosecurity that are a priority for that jurisdiction. These organisations carry out a significant proportion of Australia's agricultural RD&E. A smaller proportion of projects are undertaken by botanic gardens in some states. Research projects are done to meet state and territory government needs, as well as projects commissioned by commercial clients.



Doctor Sarah Collins, nematologist, in a sterile working environment in the Plant Pathology Laboratory in South Perth. Image courtesy of the Department of Primary Industries and Regional Development



Seed analysts conducting tests. Image courtesy of the Department of Primary Industries and Regional Development





Cooperative Research Centres

CRCs are formed through a collaboration of businesses, the community, government organisations and researchers. Essential participants within a CRC must include at least one Australian end user (from either the private, public or community sector) and one Australian higher education institution (or a research institution affiliated with a university). The CRC program is an Australian Government funded initiative.

PLANT BIOSECURITY CRC

pbccr.com.au

The PBCRC undertakes research to develop and deploy scientific knowledge, tools, resources and capacity to safeguard Australia, its plant industries and regional communities from the economic, environmental and social consequences of damaging invasive plant pests and diseases.

PBCRC's objectives are achieved through its four research programs – Early Warning, Effective Detection and Response, Safeguarding Trade and Secure Future – with education and delivery embedded throughout the programs.

Areas of expertise within PBCRC include plant biosecurity risk, pest pathway analysis, incursion impact management, insect resistance, plant health policy, economic and social analysis, modelling and agricultural engineering.

PBCRC is a collaborative venture with 27 government, industry and research participants from: the Department of Agriculture and Water Resources; the Bio-Protection Research Centre New Zealand; CAB International; CBH Group; Charles Darwin University; CSIRO; the Department of Primary Industries and Regional Development, Western Australia; the Department of Economic Development, Jobs, Transport and Resources, Victoria; GrainCorp Operations Limited; the Grains Research and Development Corporation; Hort Innovation; Kansas State University; La Trobe University; Murdoch University; Museum Victoria; the NSW Department of Primary Industries; the Pacific Institute for Sustainable Development, Indonesia; Vinehealth Australia; Plant and Food Research New Zealand; PHA; the Queensland Department of Agriculture and Fisheries; the Queensland University of Technology; the South Australian Research and Development Institute; the University of Adelaide; the University of Queensland; the University of Western Australia; and Viterro Ltd.

PBCRC engages in international collaborative research with organisations in China, Timor-Leste, Indonesia, Laos, Malaysia, New Zealand, Thailand, United Kingdom, the United States and Vietnam, and has international linkages with east African nations including Burundi, Ethiopia, Kenya, Malawi, Mozambique, Rwanda, Uganda, Tanzania, Zambia and Zimbabwe.

A key strength of the PBCRC is the involvement of the above participants who are, in many cases, end-users of the research. This ensures maximum benefit and impact in the delivery of project outputs, development of new products and services and capture of intellectual property. Visit pbrcr.com.au for more information on where and how the research has benefited national and international biosecurity objectives.

PBCRC concludes in July 2018 after a six-year term. It followed on from the Cooperative Research Centre for National Plant Biosecurity, which began operating in November 2005.



Image courtesy of Damian Herde, Plant Biosecurity CRC

Detecting phosphine resistant insects

The Plant Biosecurity Cooperative Research Centre with Kansas State University undertook research to find out which insects in Australia are becoming resistant to phosphine, a pesticide used extensively in grain silos. Phosphine resistance is a critical issue for the grains industry and represents a major threat to lucrative export markets.

The research has delivered a range of improvements for the grains industry including the development of a world-first molecular test and a re-structuring of the national insect resistance survey based on new diagnostic tools. This places Australia as world leaders in understanding the genetic basis of resistance. Additionally, a 'quick-test' developed by the team provides same-day advice to industry enabling a rapid response and eradication of pests with a high level of resistance.

The recommendations from this research form the basis of major pest and resistance management strategies across Australia, including the nationally agreed 'Phosphine Resistance Management Strategy'.

Due to the strategy the frequency of strong resistance to phosphine in key pests in Australian grain is, by global standards very low at 10 per cent, a level necessary for Australia to remain globally competitive. This success supports Australia's efforts to maintain a nil tolerance for live insect exports, the highest standard in the world.

Discussions with key end-users (GRDC and bulk handlers) with regards to a formal agreement are ongoing with the potential to transition the resistance monitoring to a self-sustaining model beyond the life of the CRC.



PBCRC research is helping the grains industry to monitor for and manage insect resistance in grain storages. Image courtesy of the Department of Agriculture and Fisheries Queensland

Research and development corporations

Research and development corporations (RDCs) bring together industry and researchers to establish the strategic directions for RD&E and to fund projects that provide industries with the innovation and productivity tools needed to compete in global markets. In 2017, 15 rural RDCs covered most Australian agricultural industries, with seven focusing on plant production.

RDCs provide funding and support to research providers including state governments, universities, CSIRO industry associations and research organisations in the private sector.

RDCs of particular relevance to Australia's plant industries are described in this section. They include a mixture of industry owned companies and statutory corporations. The industry owned RDCs have statutory funding agreements with the Australian Government that lay out the general principles that must be observed when investing levy funds as well as reporting obligations to levy payers and the Australian Government.

AGRIFUTURES AUSTRALIA

agrifutures.com.au

The vision of AgriFutures Australia is to grow the long-term prosperity of Australian agriculture through research and development, knowledge and understanding that fosters innovative, adaptive and valuable rural industries.

AgriFutures Australia invests in biosecurity RD&E activities, including:

- Incursion risk analysis.
- Biosecurity planning.
- Pest management.
- Weed management.
- Resistance breeding.
- Adoption of knowledge.

COTTON RESEARCH AND DEVELOPMENT CORPORATION

crdc.com.au

The Cotton Research and Development Corporation (CRDC) is a partnership between the Australian Government and the Australian cotton industry. CRDC's role is to invest in RD&E on behalf of cotton growers and the government, with the outcomes boosting the productivity and profitability of the Australian cotton industry. RD&E, and its resulting innovations, are a key driving force behind the cotton industry's continued success.

In 2016–17, the CRDC invested \$24.1 million into 350 RD&E projects in collaboration with 122 research partners, across five key program areas: farmers, industry, customers, people and performance. Biosecurity is a key focus of the CRDC's investment under the industry program, with a key goal being a cotton industry capable of managing its biosecurity responsibilities. CRDC supports RD&E that contributes to improved biosecurity surveillance, preparedness and awareness throughout the cotton industry.

FOREST AND WOOD PRODUCTS AUSTRALIA

fwpa.com.au

Forest and Wood Products Australia (FWPA) is an industry service company that provides a nationally integrated strategy to increase demand for forest and wood products and reduce the impediments to their supply. Owned by industry, FWPA is committed to helping industry grow through targeted RD&E investments, generic promotion and other services as requested by members.

These services include direct and collaborative investment in RD&E to provide innovative solutions for the industry and promotion of the industry's products, services and values. FWPA provides services to the industry that are designed to increase the sustainability and international competitiveness of forest and wood products. FWPA is funded by private companies and government agencies within the Australian forest and wood products sector, except for pulp and paper manufacturers.

GRAINS RESEARCH AND DEVELOPMENT CORPORATION

grdc.com.au

The Grains Research and Development Corporation (GRDC) is a corporate Commonwealth entity established to plan and invest in RD&E for the Australian grains industry. The GRDC's aim is to create enduring profit for Australian grain growers. GRDC's activities drive the discovery, development and delivery of world class innovation to the benefit of grain growers, the grains industry value chain and the wider community.

GRDC's primary source of income is through a levy on grain growers, which is matched (up to a specified limit) by the Australian Government.

The GRDC's research portfolio covers 25 leviable crops, spanning temperate and tropical cereals, oilseeds and pulses, which are worth over \$13 billion a year in farm production. The GRDC investment scheme, Protecting Your Crop, is identified as part of the GRDC's five year RD&E plan. This five-year plan targets genetic, cultural management and pesticide options for root and foliar crop diseases; increased farmer awareness and adoption of invertebrate and weed integrated management practices; and biosecurity and stewardship of genetic and pesticide technologies.

HORTICULTURE INNOVATION AUSTRALIA

horticulture.com.au

Horticulture Innovation Australia (Hort Innovation) is a not-for-profit, grower-owned RDC for Australia's \$9.5 billion horticulture industry. It invests more than \$100 million in research, development and marketing programs annually.

Hort Innovation's key functions include:

- Providing leadership to and promoting the development of the Australian horticulture sector.
- Increasing the productivity, farm gate profitability and global competitiveness of the horticultural industries by investing grower levies and Australian government contributions in RD&E.
- Marketing funds, programs and services.
- Providing information, services and products related to project outcomes.
- Promoting the interests of horticultural industries overseas including the export of Australian horticultural products.

SUGAR RESEARCH AUSTRALIA

sugarresearch.com.au

Sugar Research Australia (SRA) was launched in August 2013 bringing together the assets of BSES Limited and the Sugar RDC. SRA invests in and manages a portfolio of RD&E projects that drive the productivity, profitability and sustainability of its levy payers and the Australian sugarcane industry.

In its role as the industry services body, SRA is entitled to receive the statutory levies paid by growers and milling businesses, and matching funds from the Australian Government. SRA's own team of in-house researchers conducts research in the areas of plant breeding, trait development, biosecurity and farming systems.

The SRA Breeding Program and SRA Biosecurity Program collaborate to breed disease and pest-resistant crop varieties and support quarantine and disease-free seed cane programs. Cooperating with government departments to prevent entry of these pests and to prepare for possible incursions is also a high priority.

WINE AUSTRALIA

wineaustralia.com/research

Wine Australia supports a competitive wine sector by investing in RD&E, marketing, disseminating knowledge, encouraging adoption and protecting the reputation of Australian wine. Wine Australia's revenue comes from levies on the annual wine grape harvest with contributions matched by the Australian Government. Wine Australia collaborates with key stakeholders to coordinate and direct investments to best address the RD&E priorities of the wine industry.



THE PLANT BIOSECURITY RESEARCH INITIATIVE

pbri.com.au

The Plant Biosecurity Research Initiative (PBRI) is a partnership between the nation's seven plant RDCs, working collaboratively with the Department of Agriculture and Water Resources, industry, state and federal biosecurity stakeholders and PHA. It was established in 2017 to minimise the damaging consequences of established and exotic pests, diseases and weeds that affect Australia's plant industries, community and the environment.

In 2015–16, the plant RDCs collectively invested \$62.9 million into biosecurity research, development and extension. A coordinated approach ensures that this effort is aligned to broader national goals and delivered with increased efficiency, avoiding duplication of effort.

The aim of the initiative is to support cross-sectoral RD&E, deliver vital projects and attract further co-investment. Cross-sectoral collaborative RD&E refers to activities that are relevant to two or more RDCs, which may include research on pests that affect a broad range of plants and platform technologies or areas of research that are applicable to multiple industries.

The Plant Biosecurity Research Initiative was established for three years, with a mid-term review and option to renew. Research is developed to contract by a single lead RDC with co-investment from others.

Six key focus areas have been agreed for the initiative, taking into consideration:

- Seven RDC priorities and strategies
- National Biosecurity Committee priorities
- RD&E priorities from a 2016 AGSOC Research and Innovation (R&I) Forum
- The National Plant Biosecurity Strategy and the National Plant Biosecurity RD&E Strategy
- The Department of Agriculture and Water Resources Plant Biosecurity priorities
- The 2017 Intergovernmental Agreement on Biosecurity review and the Australian Academy of Science Decadal Plan for Australian Agricultural Sciences 2017–26.

The six key focus areas are:

- Preparedness
- Diagnostics
- Surveillance
- Sustainable management of pests, diseases and weeds
- Capability building
- Industry resilience.

More information, including freely available reports arising from the majority of PBRI projects can be found at pbri.com.au.

University and private research institutes

Many universities across Australia provide biosecurity research and education services for the community, often in partnership with other organisations. Research is funded by governments, industries and domestic or international sources, often in partnership arrangements.

Private research institutions commonly collaborate with universities to provide research facilities and services in specific subject areas. They contribute specialist knowledge and research skills in areas of significance to the Australian community and plant production industries.



CENTRE OF EXCELLENCE FOR BIOSECURITY RISK ANALYSIS

cebra.unimelb.edu.au

Centre of Excellence for Biosecurity Risk Analysis (CEBRA) is a group of quantitative scientists housed in the School of BioSciences at the University of Melbourne. CEBRA focuses its research effort on the general theme of improving the management of biosecurity risk, working closely with Australia and New Zealand's peak biosecurity regulatory bodies.

CEBRA's remit covers animal, plant, and environmental biosecurity, as well as protecting social amenity, and its scientific output spans the biosecurity continuum. Areas of expertise within CEBRA include pest pathway analysis, incursion impact assessment, mathematical and statistical modelling and agricultural economics.

The key point of difference between CEBRA and other academically focused research providers is the close engagement with stakeholders from conception through implementation to review. CEBRA researchers have learned that the traditional arm's length server-client relationship leads to shallow and sometimes impractical outcomes. CEBRA's outcomes are almost always in the public domain, and freely available.

CEBRA engages in international collaborative research with organisations in New Zealand and the United States, and has international linkages with other nations, including Canada and the United Kingdom. CEBRA has collaborated with a wide range of state and national organisations, including the NSW Department of Primary Industries; the Victorian Department of Economic Development, Jobs, Transport and Resources; the Office of Transport Security; the Clean Energy Regulator; Energy Safe Victoria; Chevron; the Department of Home Affairs; the Department of Primary Industries and Regions, South Australia; the Northern Territory Department of Primary Industry and Resources; the West Australian Department of Primary Industries and Regional Development; AgResearch New Zealand; Plant and Food Research New Zealand; the Cawthron Institute; and Scion.

CEBRA was created in 2013 by deeds between the Australian Government Department of Agriculture and Water Resources, New Zealand's Ministry for Primary Industries and the University of Melbourne. The CEBRA deeds will expire in 2021. CEBRA's predecessor was ACERA, the Australian Centre of Excellence for Risk Analysis, which ran from 2006–13.

Plant biosecurity RD&E projects in 2017

In 2017, a substantial amount of RD&E that benefits plant biosecurity occurred across Australia.

PHA was able to access data from additional research organisations this year. This chapter contains details of over 700 projects, more than in previous years.

Figures 93–97 present the research projects by pest type, research type, project value, biosecurity area and affected crop type to give some indication of how research budgets are spent in Australia.

Research projects covered the spectrum of crops and pest types relevant to Australian plant production industries and the natural environment. The highest proportion of projects were categorised as pest management.

Table 58 gives a complete listing of plant biosecurity related research projects that were active during 2017.

Figure 93. RD&E projects by pest type

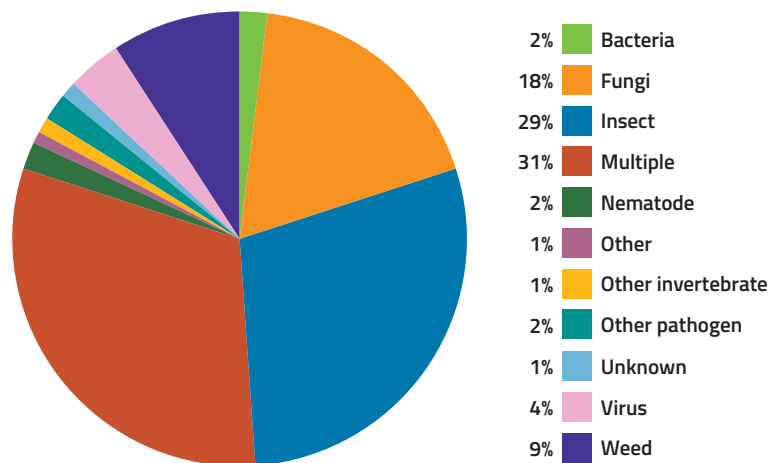


Figure 94. RD&E projects by research type or location

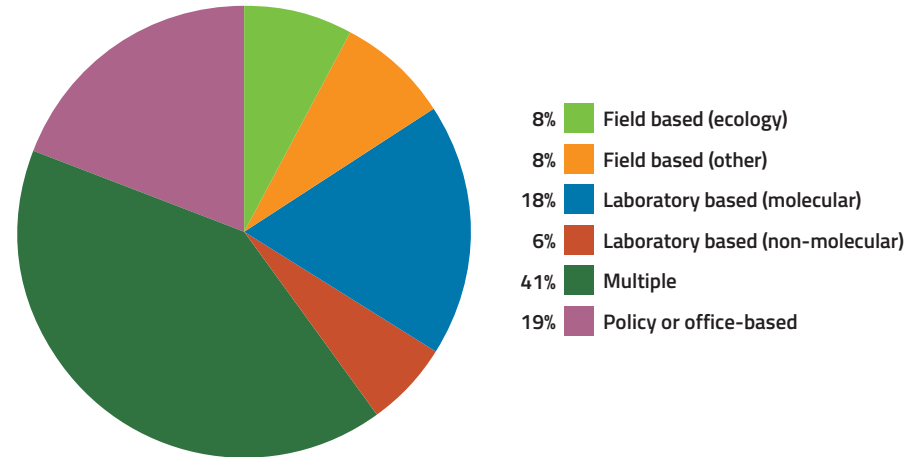


Figure 95. RD&E projects by project value

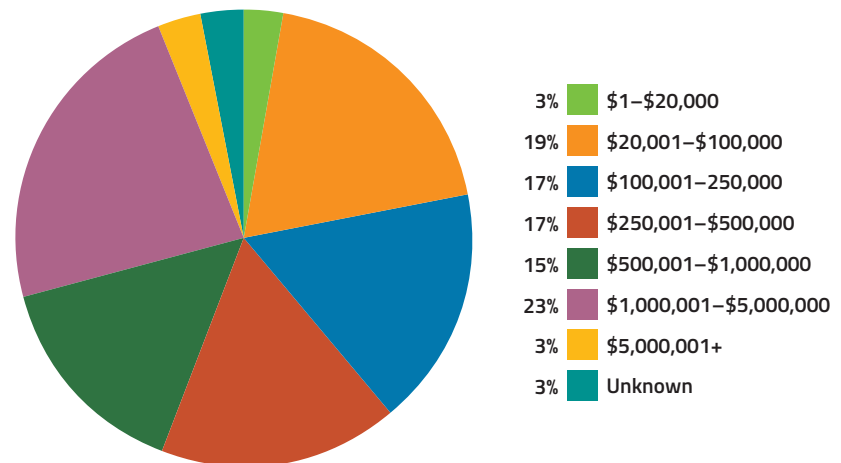


Figure 96. RD&E projects by biosecurity areas

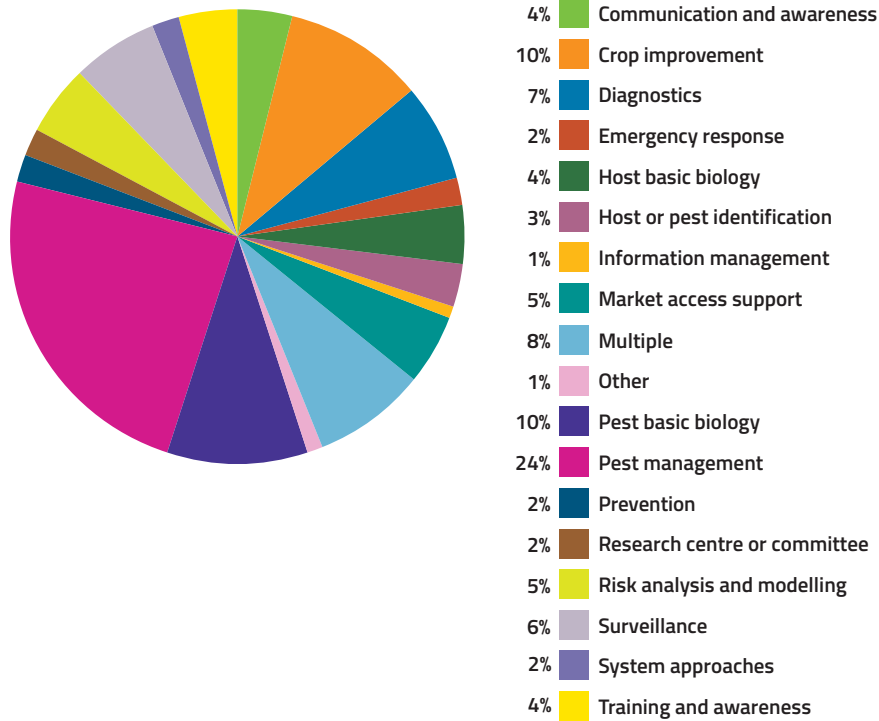


Figure 97. RD&E projects by crop type

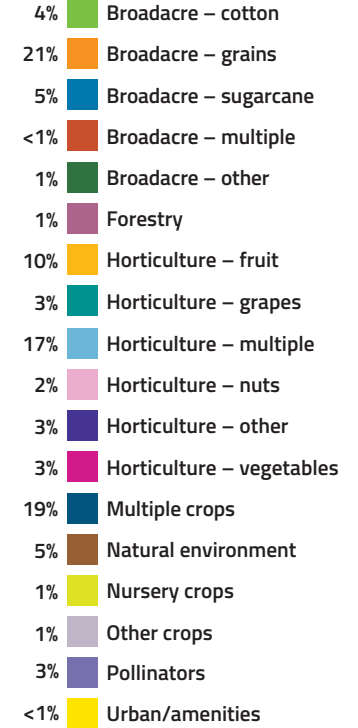




Table 58. Plant biosecurity RD&E projects

Project title	Organisation undertaking the research	Funding source
Broadacre – cotton		
Application of molecular tools to monitoring for resistance alleles in <i>Helicoverpa</i>	CSIRO	CRDC, Monsanto
Biology of <i>Amarathus hybridus</i> , <i>A. mitchelli</i> and <i>A. powellii</i> (PhD)	University of Queensland	CRDC
Biosecurity training scenario	PHA	CRDC
Crop protection development specialist	QDAF	CRDC, QDAF
Developing the weed control threshold (PhD)	NSW DPI	CRDC, NSW DPI
Electrophysiological and molecular identification of novel biopesticides (PhD)	Western Sydney University	CRDC
Enhancing integrated pest management in cotton systems	CSIRO	CRDC, CSIRO
Establishing southern cotton – integrated pest management	NSW DPI	CRDC, NSW DPI
Hard to control weeds in northern farming systems – understanding key processes to improve control methods	NSW DPI	CRDC, NSW DPI
<i>Helicoverpa punctigera</i> in inland Australia – what has changed?	University of New England	CRDC, University of New England
Host plant relationships of green mirids – is alternative control possible? (PhD)	University of Queensland	CRDC
Improving the management of cotton diseases in Australian cotton farming systems	QDAF	CRDC, Wine Australia, QDAF
Innovative solutions to cotton diseases	NSW DPI	CRDC, NSW DPI
Management of mirids, stinkbugs and <i>Solenopsis mealybug</i>	QDAF	CRDC, QDAF
Managing <i>Bt</i> resistance and induced tolerance in Bollgard III using refuge crops	CSIRO	CRDC
Managing <i>Verticillium</i> risk for cotton	NSW DPI	Wine Australia, CRDC

Table 58. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source
Mirid and mealybug management best practice	QDAF	CRDC, QDAF
Monitoring to manage resistance to <i>Bt</i> toxins	CSIRO	CRDC, CSIRO
Multiple host use and gene-flow in green vegetable bug relative to cotton crop (PhD)	University of Queensland	CRDC
National biosecurity/disease extension and central Queensland regional extension	QDAF	CRDC, QDAF
National cotton extension development and delivery – stewardship of biotechnologies	CRDC	CRDC
Novel approaches to silverleaf whitefly	University of Queensland	CRDC
Professor of soil biology	University of New England	CRDC
Regional weed management workshops for growers and advisors	Independent Consultant Australia Network	CRDC
Silverleaf whitefly resistance monitoring	QDAF	CRDC, QDAF
Surveillance and monitoring for endemic and exotic virus diseases of cotton	QDAF	CRDC, QDAF
Sustainable resistance management of mites, aphids and mirids in Australian cotton	NSW DPI	CRDC
The sustainable chemical control and resistance management of aphids, mites and mirids in Australian cotton	NSW DPI	CRDC
Understanding the ecology of reniform nematodes in cotton	QDAF	CRDC, QDAF
Verticillium wilt assessments using drones	WA Aerial Mapping	CRDC
Viruses, vectors and endosymbionts – exploring interactions for control	University of Queensland	CRDC, Greenwich University (England), University of Queensland

Project title	Organisation undertaking the research	Funding source
Broadacre – grains		
Accelerating the utilisation and deployment of durable adult plant resistance to leaf rust in barley	University of Sydney	GRDC
Advancement of new stem genes for stem and leaf rust resistance from uncultivated relatives of wheat	University of Adelaide	GRDC
An integrated approach to manage pests and resistance to phosphine in stored grain	QDAF, NSW DPI, GrainCorp	PBCRC
Aphid and insecticide resistance management in oil seed and pulse crops	cesar	GRDC
Ascochyta blight of pulses – integrating development of novel selection methods, mining germplasm for resistance and pathogen surveillance	Curtin University, Griffith University	GRDC
Assessing collections of wild chickpea relatives for resistance to root-lesion nematodes	University of Southern Queensland, CSIRO, University of California, Davis (USA), University of Cukurova (Turkey)	GRDC
Australian Cereal Rust Control Program – towards 2019 and a century of monitoring cereal rust pathogens in Australia	University of Sydney	GRDC
Australian Cereal Rust Control Program 3 – durable genes	University of Sydney	GRDC
Australian Cereal Rust Control Program 3 – molecular genetics	CSIRO	GRDC
Australian Cereal Rust Control Program 3 – national breeding support	University of Sydney	GRDC
Australian Cereal Rust Control Program 3 – rust surveillance	University of Sydney	GRDC
Australian herbicide resistance initiative – phase 5	University of Western Australia, QDAF	GRDC
Australian wheat and barley molecular marker program	DEDJTR	University of Adelaide, GRDC

Table 58. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source
Broadacre – grains (continued)		
Australian wheat and barley molecular marker program – genetic analysis	University of Adelaide	GRDC
Barley rust genetics	University of Sydney	AusAID
Beneficial microbes program 2 – progressing new microbial products for Australian grain production to commercialisation	Flinders University	GRDC
Cell wall structure and dynamics in emerging fungal pathogens of crops	University of Adelaide	ARC
Cereal and pulse cultivar resistance ratings for the southern region	DEDJTR	GRDC, DEDJTR
Characterising structural variation in the canola genome	University of Western Australia	ARC
Chemical residues of stored grain	Murdoch University	PBCRC
Combining monitoring and incursion surveillance for grains	NSW DPI	PBCRC
Comparison of biological and physiological behaviour of phosphine resistant and susceptible strains of two species of stored product insects (PhD)	Murdoch University	Government of Iraq
Control of chickpea pathogens	Flinders University	Flinders University
CSIRO snail biocontrol revisited – phase 2	CSIRO	GRDC
Delivering a collaborative monitoring program with industry to manage and facilitate trade	NSW DPI, QDAF, WA DPIRD	PBCRC
Delivery and adoption of nitrogen/ low-oxygen and nitrogen plus phosphine technology for the management of grain storage pests and grain quality	Murdoch University	PBCRC, Chinese Academy of Grain, Cytec Industries (USA)
Developing new diagnostic tools for <i>Trogoderma</i> spp. by using solid phase micro extraction, gas chromatography, mass spectrometry and visible near infrared hyperspectral imaging (PhD)	Murdoch University	Government of Iraq
Developing tools for in-field surveillance of pathogens	SARDI	PBCRC

Project title	Organisation undertaking the research	Funding source
Developing whole genome sequence resources for fungal pathogens of lupin	University of Western Australia	Curtin University
Development and implementation of biosensors for botrytis grey mould causal species affecting temperate legumes	Griffith University	NSW DPI, GRDC
Development of gene deployment strategies – using evolutionary principles to optimise the deployment of genetic resistance in crops	CSIRO	GRDC
Development of genetic tools for Australian barley crops against leaf rust	University of Sydney	GRDC
Development of rapid phenotyping and genotyping tools for selection of key agronomic and quality traits in the Australian peanut breeding program	University of Southern Queensland, Peanut Company of Australia	Peanut Company of Australia
Development of tools to accelerate nematode resistance gene deployment	University of Adelaide, University of Southern Queensland	GRDC
Diagnostic services for pulse germplasm enhancement and breeding program	DEDJTR	GRDC, DEDJTR
Disease screening service	DEDJTR	Fee for Services
DNA marker development and their use in monitoring and eradication of phosphine resistance in stored grain pests (PhD)	University of Queensland	PBCRC
Effective control of barley yellow dwarf virus in wheat	University of Tasmania	GRDC
Effective genetic control of <i>Septoria tritici</i> blotch	NSW DPI	GRDC
Effective genetic control of <i>Stagonospora nodorum</i> blotch	WA DPIRD	GRDC
Emerging foliar diseases of canola	University of Western Australia	GRDC
Enhancing resistance to wheat stripe rust disease	Australian National University	ARC

Table 58. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source
Establishing the international mungbean improvement network	Asian Vegetable Research and Development Centre, QDAF	ACIAR
Evaluating chlorine dioxide (PhD)	Kansas State University (USA)	PBCRC
Expanding the Brassica germplasm base through collaboration with China and India	University of Melbourne	GRDC
Extending biosecurity preparedness and surveillance strategies and developing a chemical supply framework for pest incursions	PHA	GRDC, PBCRC
Extension and engagement	Curtin University	GRDC
Fungal pathogenomics and bioinformatics	Curtin University	GRDC
Fungicide resistance group	Curtin University	GRDC
Fungicide resistance management strategy and communications	Curtin University	GRDC
Fungus and rust red flour beetles – identifying the fungal volatiles attractive to <i>Tribolium castaneum</i> (PhD)	University of Queensland	PBCRC
Future national invertebrate pest initiative forums – towards more sustainable pest management practices	CSIRO	GRDC
Genetic control of nematode species affecting major crops – germplasm enhancement for nematode control in cereals and pulses	University of Southern Queensland, GRDC	GRDC
Genetic control of nematode species affecting major crops grown within the Australian farming system and quantification of the effects rotational crops have on nematode numbers in the soil	University of Adelaide, University of Southern Queensland	GRDC
Germplasm enhancement for yellow spot resistance	DEDJTR	GRDC, WA DPIRD, NSW DPI, SARDI, QDAF, University of Western Australia, DEDJTR



Table 58. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source
Broadacre – grains (continued)		
Get tough, get toxic and get a bodyguard – using silicon to augment direct and indirect anti-herbivore defences in cereals	Western Sydney University	Western Sydney University, Australian Steel Mill Services
Grain crop disease management in Victoria	DEDJTR	GRDC, DEDJTR
Grain e-surveillance project	WA DPIRD	Royalties for Regions, WA DPIRD
Grain storage extension	QDAF	GRDC
Grain weeds advisory committee	Rural Directions Pty Ltd	GRDC
Grains farm biosecurity program	PHA	Grain Producers Australia
Harnessing wheat plant microbiome for drought tolerance and improved productivity in Australian and Indian environments	Flinders University	Department of Industry, Innovation and Science (Australia–India Strategic Research Fund)
Harvest weed seed control for the southern region	Southern Farming Systems	GRDC
How do effector proteins from necrotrophic fungi cause disease in plants?	Australian National University	ARC
Identification and utilisation of novel sources of resistance to crown rot and the root lesion nematodes in adapted spring and durum wheat	CIMMYT	GRDC
Identification of sources of resistance to wheat blast and their deployment in wheat varieties adapted to Bangladesh	CIMMYT	ACIAR
Impacts of host resistance on disease-induced yield loss	DEDJTR	GRDC, WA DPIRD, NSW DPI, SARDI, QDAF, University of Western Australia, DEDJTR
Improved diagnostic methods for khapra beetle	WA DPIRD, Murdoch University	WA DPIRD
Improved farming systems	Curtin University	GRDC

Project title	Organisation undertaking the research	Funding source
Improved fungicide use for cereal rust control	Foundation for Arable Research (NZ)	GRDC
Improved resistance to oat pathogens and abiotic stress management	SARDI	GRDC
Improve genetic solutions management of yellow spot in wheat	WA DPIRD, University of Southern Queensland	GRDC
Improving grower surveillance management, epidemiology knowledge and tools to manage crop disease	University of Southern Queensland, GRDC, QDAF	GRDC
Improving grower surveillance, management, epidemiology knowledge and tools to manage crop disease in South Australia	SARDI	GRDC
Improving grower surveillance, management, epidemiology knowledge and tools to manage crop disease in southern NSW	NSW DPI	GRDC
Improving grower surveillance, management, epidemiology knowledge and tools to manage crop disease in Victoria	DEDJTR	GRDC
Improving integrated weed management practice on emerging weeds in the southern and western regions	University of Adelaide	GRDC
Improving on-farm grain storage management through technical training	QDAF	GRDC
Improving weed management in pulse crops through herbicide tolerance – part A	SARDI	GRDC
Improving weed management in pulse crops through herbicide tolerance – part B	SARDI	GRDC
Insect tolerant chickpea for Bangladesh	CSIRO	ACIAR
Integrated genetic solutions to crown rot in wheat	University of Sydney, QDAF, CSIRO, University of Southern Queensland	GRDC

Table 58. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source
Investigation of new control options for phosphine resistant pests of stored grain	University of Queensland, QDAF, DEDJTR	PBCRC, University of Queensland, QDAF, DEDJTR
Linking crop protection, weeds and native vegetation management – on the ground, natural resource management action to benefit grain growers	CSIRO	GRDC
Maintaining a barley pre-breeding capability in Queensland	QDAF	GRDC
Managing crop disease – improving chickpea pathogen resistance	NSW DPI	GRDC
Managing crop disease – improving crown rot resistance in durum	University of Southern Queensland, NSW DPI, SARDI	GRDC
Managing on-farm biosecurity risk through pre-emptive breeding – the case of rust in field pea and lentil	Curtin University	GRDC
Mechanisms, evolution and inheritance of resistance	University of Adelaide	GRDC
Mitigating the effects of stripe rust on wheat production in south Asia and eastern Africa	University of Sydney	ACIAR
Mitigating the effects of wheat blast in Bangladesh and beyond	CIMMYT	ACIAR
National barley foliar pathogen variety improvement program	QDAF, Australian National University, SARDI, DEDJTR, WA DPIRD, NSW DPI, University of Adelaide, University of Southern Queensland, University of Tasmania	GRDC, WA DPIRD, NSW DPI, SARDI, QDAF, University of Western Australia, DEDJTR
National Brassica germplasm improvement program – phase II	NSW DPI	GRDC
National chickpea pathology program (<i>Ascochyta blight</i>)	Griffith University	GRDC
National coordination of invertebrate pest research and insecticide resistance management	University of Melbourne	GRDC

Project title	Organisation undertaking the research	Funding source
National crown rot epidemiology and management program	NSW DPI, University of Southern Queensland, SARDI, DEJTER, WA DPIRD	GRDC, WA DPIRD, NSW DPI, SARDI, QDAF, University of Western Australia, DEDJTR
National improved molecular diagnostics for disease management	GRDC, SARDI, WA DPIRD, NSW DPI, DEDJTR, University of Southern Queensland	GRDC, WA DPIRD, NSW DPI, SARDI, QDAF, University of Western Australia, DEDJTR
National nematode epidemiology and management program	GRDC, DEDJTR, NSW DPI, SARDI, WA DPIRD, University of Southern Queensland	GRDC, DEDJTR
National pathogen management modelling and delivery of decision support	GRDC, WA DPIRD, Marcroft Grains Pathology Pty Ltd, NSW DPI, SARDI, DEDJTR, University of Southern Queensland, QDAF	GRDC, WA DPIRD, NSW DPI, SARDI, QDAF, University of Western Australia, DEDJTR
National variety trials – disease screening	DEDJTR	GRDC
National variety trials – service agreement	GRDC, University of Southern Queensland, QDAF	GRDC
Net blotch of barley	Curtin University	GRDC
Network analysis of post-border pest spread (PhD)	Lincoln University (NZ)	PBCRC
New discriminatory diagnostic protocols for exotic khapra beetle (<i>Trogoderma granarium</i>) to aid early detection and future-proof market access	WA DPIRD	Royalties for Regions
New knowledge to improve the timing of pest management decisions in grain crops	CSIRO	GRDC
New technology for stored grain pest management – phase 2	Queensland University of Technology	GRDC
New tools and germplasm for Australian pulse and oilseeds breeding programs to respond to changing virus threats	QDAF, NSW DPI	GRDC

Table 58. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source
Broadacre – grains (continued)		
New tools for field grains surveillance and diagnostics of high priority exotic pests	SARDI, QDAF, DEDJTR	GRDC, PBCRC
New uses for existing chemistry	Southern Farming Systems	GRDC
New Zealand rust pathotype survey	NSW DPI	PBCRC
Non-chemical method for stored grain (PhD)	Murdoch University	PBCRC
Non-chemical technologies to protect grain (PhD)	Kansas State University (USA)	PBCRC
Northern NSW integrated disease management	NSW DPI	GRDC
Northern pulse and grains integrated pest management	QDAF	GRDC
Pathways to registration – minor use	AKC Consulting Pty Ltd	GRDC
Phosphine distribution modelling (PhD)	Kansas State University (USA), WA DPIRD	PBCRC
Phosphine resistance	Murdoch University	WA DPIRD
Powdery mildew of barley	Curtin University	GRDC
Pre-emptive APVMA emergency permit development for grains industry	PHA	GRDC
Pre-emptive chickpea pre-breeding for biotic stresses and germplasm enhancement for abiotic stresses	International Centre for Agricultural Research in the Dry Areas	GRDC
Proof of concept for approaches designed at increasing disease resistance to fungal pathogens of canola	University of Melbourne	GRDC
Protecting stored grains against pests	PBCRC	ACIAR
Protein trafficking pathways in fungal rust pathogens of plants	Australian National University	ARC
Pulse breeding Australian faba bean breeding	University of Adelaide, SARDI, University of Sydney, NSW DPI	GRDC
Pulse pathology and genetics	Curtin University	GRDC

Project title	Organisation undertaking the research	Funding source
Rapid detection and diagnosis of plant pathogens	Australian National University	Hermon Slade Foundation
Registration of minor use chemicals for the grain industry	AKC Consulting Pty Ltd	GRDC
Reverse genetics for the development of wheat cultivars with improved resistance to necrotrophic pathogens	CSIRO	GRDC
Russian wheat aphid incursion	DEDJTR	SARDI, GRDC
Sclerotinia stem rot of canola	Curtin University	GRDC
<i>Septoria nodorum</i> blotch of wheat	Curtin University	GRDC
Smart-trap design and deployment strategies (PhD)	Kansas State University (USA)	PBCRC
Smart use of fertilisers to minimise and manage the risk of pest infestations in growing canola	University of Western Australia	GRDC
Surveillance of herbicide resistant weeds in Australian grain cropping	Charles Sturt University, University of Western Australia	GRDC
Sustainable wheat and maize production in Afghanistan	CIMMYT	ACIAR, DFAT
The evolution of stripe rust virulence	Australian National University	ARC
The facilitation of category 25 submissions in the Australian grain industry	PHA	GRDC
The role of weedy hosts in disease incidence and emergence in barley	QDAF	GRDC
Triple rust resistance 1	CSIRO	GRDC
Triple rust resistance 2	CSIRO	2Blades Foundation (USA)
Two new phytotoxins in <i>Septoria nodorum</i> blotch – biosynthesis and functions	University of Western Australia	ARC
Understanding disease resistance mechanisms across the Brassicaceae	University of Queensland	ARC
Understanding the mechanisms of dust-induced insect death and biological effect (PhD)	Murdoch University	PBCRC

Table 58. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source
Virus threats – new tools and germplasm for Australian pulse and oil seeds breeding programs	DEDJTR	GRDC, WA DPIRD, NSW DPI, SARDI, QDAF, University of Western Australia, DEDJTR
Weed surveillance	QDAF	GRDC
White grain disorder in wheat	SARDI	GRDC
Yellow spot of wheat	Curtin University	GRDC
Yield loss response curves for host resistance to leaf, crown and root diseases in wheat and barley	WA DPIRD, QDAF	GRDC
<i>Zea mays</i> model and <i>Phytophthora cinnamomi</i>	Deakin University	Australian Government



Image courtesy of Barry Large, Grain Producers Australia

Project title	Organisation undertaking the research	Funding source
Broadacre – sugarcane		
Advancing yield, disease resistance and ratooning by exploiting new sources of genetic variability from wild relatives of sugarcane	SRA	SRA, QDAF
A novel polyphasic framework to resolve the yellow canopy syndrome paradox	Western Sydney University	SRA, QDAF
Bioprospecting for beneficial endophytes of sugarcane	AgResearch Ltd (NZ)	SRA
Delivering solutions for chlorotic streak disease	SRA	SRA
Delivery of remote sensing technology to combat canegrubs in Queensland cane fields	SRA	SRA, QDAF
Developing cytogenetic and molecular tools to improve selection for soil-borne pathogen resistance in wild hybrids	SRA	SRA, QDAF
Diagnostic laboratory for ratoon stunting disease	SRA	SRA
Exploiting soil microbe associations with sugar cane roots for resistance to canegrubs (PhD)	Western Sydney University	SRA
General pathology, diagnostics, training and technical advice – Tully	SRA	SRA
General pathology, diagnostics, training and technical advice – Woodford	SRA	SRA
General pest management – central Queensland	SRA	SRA
General pest management – north Queensland	SRA	SRA
General pest management – south Queensland	SRA	SRA
Identifying new-generation insecticides for canegrub control as contingency for loss of amenity with existing product	SRA	SRA, QDAF

Table 58. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source
Broadacre – sugarcane (continued)		
Improving sugarcane pest management through cross industry deployment of smart sensors, diagnostics and forecasting	SRA	SRA, DAWR
Innovative approaches to identifying the cause of chlorotic streak and new management strategies	SRA	SRA, QDAF
Integrated disease management of sugarcane streak mosaic in Indonesia	SRA	ACIAR
International and domestic quarantine for sugarcane germplasm	SRA	SRA
Investigation of biotic causes of yellow canopy syndrome	University of Queensland	SRA
Keeping our chemicals in their place – in the field	James Cook University	SRA
Leaf sucrose – the link to diseases, physiological disorders such as yellow canopy syndrome and sugarcane productivity	SRA	SRA, QDAF
Management of sugarcane soldier flies	SRA	SRA
Managing threats from exotic borers through accurate identification	SRA	SRA
Mesostigmatid mites as predators of nematodes in sugarcane soils – ecology, food preferences and biocontrol potential (PhD)	University of the Sunshine Coast	SRA
Molecular assay of major soil-borne pathogens for better exploitation of commercial varieties	SRA	SRA
New approaches to identify and integrate Pachymetra resistance genes from Erianthus into SRA breeding program	SRA	SRA
Regenerating a soil food web capable of improving soil health and reducing losses from soil-borne pests and pathogens of sugarcane	Biological Crop Protection Pty Ltd	SRA
Review of the sugarcane industry biosecurity plan and development of a biosecurity manual	PHA	SRA

Project title	Organisation undertaking the research	Funding source
Screening clones for disease resistance for the SRA breeding program – Tully	SRA	SRA
Screening clones for disease resistance for the SRA breeding program – Woodford	SRA	SRA
Securing Australia from Paupa New Guinea biosecurity threats	SRA	SRA, QDAF, Ramu–AI
Soil diagnostic assay laboratory – nematodes and Pachymetra root rot	SRA	SRA
Solving the yellow canopy syndrome	SRA	SRA, QDAF
Strategies to manage soil-borne fungi and mitigate sugarcane yield decline	CSIRO	SRA
Validation of leaf sheath biopsy PCR diagnostics for ratoon stunting disease and characterisation of non-Lxx strains of Leifsonia associated with sugarcane	University of Southern Queensland, SRA, University of the Sunshine Coast	SRA
Broadacre – multiple		
Benchmarking and managing soil herbicide residues for improved crop production – developing antigen for Clorpyralid	Monash University	GRDC
Validating the use of Bacillus for biocontrol	University of Southern Queensland, New Edge Microbials	New Edge Microbials, Department of Industry, Innovation and Science
Broadacre – other		
Herbicide resistance in rice	Charles Sturt University	AgriFutures Australia
Hydrophobin proteins on the fungal frontline	University of Sydney	ARC
Improved subterranean clover seed production from multiple disease resistance	University of Western Australia	AgriFutures Australia
Knowledge transfer and uptake of new practices for pest management in irrigated rice	Charles Darwin University	PBCRC
Potential exotic virus threats to lucerne seed production in Australia	University of Queensland	AgriFutures Australia, University of Queensland
Rice pest and disease biosecurity II	NSW DPI	AgriFutures Australia, NSW DPI

Table 58. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source
Forestry		
A model system for the discovery and development of biocontrol agents against forest pests	University of the Sunshine Coast	FWPA, DAWR, University of the Sunshine Coast, NSW DPI, Forestry Tasmania
Asian gypsy moth – national surveillance program	QDAF	QDAF
Biological control of galling pests of eucalypt plantations in the Mekong region	University of the Sunshine Coast, QDAF	ACIAR
Dispersal modelling of invasive forestry pest species	DEDJTR	DEDJTR
Ethanedinitrile – a potential replacement for the fumigant methyl bromide for eradication of pests in <i>Pinus radiata</i> export logs	Stakeholders in Methyl Bromide Reduction Incorporated (NZ)	PBCRC
Evaluating the costs and benefits of managing new and existing biosecurity threats to Australia's plantation industry	University of the Sunshine Coast	FWPA, University of the Sunshine Coast, NSW DPI, Forestry Tasmania
Management strategies for Acacia plantation diseases in Indonesia and Vietnam	University of Tasmania, University of the Sunshine Coast, NSW DPI, VAFS, Gadjah Mada University (Indonesia), Forest Research and Development Agency (Indonesian government)	ACIAR
National Forest Biosecurity Surveillance Strategy	Forest Health and Biosecurity Subcommittee, PHA	DAWR (Agricultural Competitiveness White Paper)
National Forestry Biosecurity Surveillance Program	PHA	DAWR (Agricultural Competitiveness White Paper)

Project title	Organisation undertaking the research	Funding source
Horticulture – fruit		
Adapting integrated crop management technologies to commercial citrus enterprises in Bhutan and Australia	NSW DPI	ACIAR
Agrichemical residue monitoring program for Australian citrus exports – stage 2	Citrus Australia	Hort Innovation
Alternative quarantine treatment for bananas infested with coffee bean weevil	QDAF	Hort Innovation
An inventory of <i>Colletotrichum</i> species infecting tropical and subtropical fruit crops in Australia based on molecular phylogenetics	QDAF	DEE (Australian Biological Resources Study)
Auscitrus horticultural project	NSW DPI	Collaborative Research
Australian lychee industry communication program	Australian Lychee Growers Association	Hort Innovation
Avocado industry biosecurity capacity building	University of Queensland	Hort Innovation
Banana blood disease	NT DPIR	Modern Diagnostic
Banana strategic industry development	Australian Banana Growers' Council	Hort Innovation
Biological control of yellow scale insect <i>Aonidiella orientalis</i> (Newstead)	Murdoch University	Government of Iraq
Breeding tools for enhanced fruit quality for the Australian papaya industry	Griffith University	Hort Innovation
Building a resilient mango industry in Cambodia and Australia through improved production and supply chain practices	NSW DPI	ACIAR
Cherry export readiness and market access	Cherry Growers Australia	Hort Innovation
Coordination of banana industry R&D – Panama TR4	Australian Banana Growers' Council	Hort Innovation
Data packages to support market access for additional citrus varieties to Japan	SARDI	Hort Innovation

Table 58. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source
Horticulture – fruit (continued)		
Detection and prevention of scab disease in Asian and European pears (PhD)	La Trobe University	PBCRC, La Trobe University
Developing US market access based on irradiation and methyl bromide	NSW DPI	Hort Innovation
Development of effective and sustainable disease management for blueberry production in Australia	NSW DPI	Hort Innovation
Diagnosis and control of <i>Botrytis cinerea</i> on postharvest blueberry fruit (PhD)	Murdoch University	Government of Iraq
Disinfestation of blueberries against Mediterranean fruit fly for market access to Japan	Kalang Consultancy Services Pty Limited, Murdoch University	Hort Innovation
Enhancing Australia's capability and capacity to diagnose <i>Fusarium oxysporum</i> f. sp. <i>cubense</i> tropical race 4	NSW DPI	PBCRC
Exploring alternatives for managing Phytophthora root rot in avocado	University of Queensland	Hort Innovation
Facing Fusarium – better banana biosecurity	QDAF	Hort Innovation
Feasibility of biocontrol of European blackberry with the sawfly	DEDJTR, CSIRO	Australian Government, Meat and Livestock Australia, DEDJTR
Fusarium wilt of watermelon in Australia – biology and management	Royal Botanic Garden Sydney, University of Sydney, NT DPIR, NSW DPI	Royal Botanic Garden Sydney, Hort Innovation
Fusarium wilt tropical race 4 – biosecurity and sustainable solutions	QDAF	Hort Innovation
Fusarium wilt tropical race 4 research program – 1	QDAF	Hort Innovation
Fusarium wilt tropical race 4 research program – 2	University of Queensland	QDAF, Hort Innovation
Host-pathogen interactions in the Venturia–Pyrus pathosystem	La Trobe University	PFRNZ
Implementation of recommendations from the avocado industry nursery voluntary accreditation scheme review	Nursery and Garden Industry Australia	Hort Innovation

Project title	Organisation undertaking the research	Funding source
Improved management of charcoal rot strawberry	QDAF	Hort Innovation
Improved plant protection for the banana industry	QDAF	Hort Innovation
Improvement of banana for small holder farmers in the Great Lakes region of Africa	University of Queensland	International Institute for Tropical Agriculture (Nigeria)
Improving avocado orchard productivity through disease management	Murdoch University	Hort Innovation
Improving avocado orchard productivity through disease management	University of Queensland	Hort Innovation
Improving biosecurity preparedness of the Australian citrus industry	PHA, Citrus Australia	Hort Innovation
Integrated crop management strategies for papaya in the Philippines and Australia	QDAF	ACIAR
Integrated disease management strategies for the productive, profitable and sustainable production of high quality papaya fruit in the southern Philippines and Australia	QDAF	ACIAR
Integrated management of Fusarium wilt of bananas in the Philippines and Australia	QDAF	ACIAR
Integrated management of yellow sigatoka	Australian Banana Growers' Council	Hort Innovation
Integrated pest management of redberry mite, <i>Acalitus essigi</i> , on blackberries	University of Tasmania	Hort Innovation
Investigating tree mortality during early field establishment	University of Queensland	Hort Innovation
Joint Florida and Australia citrus black spot initiative	University of Queensland	Hort Innovation
Maximum residue limit risk analyses and risk management options for major citrus export markets	AKC Consulting Pty Ltd	Hort Innovation
Melon industry biosecurity	Dianne Fullelove & Associates Pty Ltd	PHA

Table 58. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source
Mid-term review of banana bunchy top program	Murdoch University	Hort Innovation
Monitoring mangoes through the supply chain to the United States	NT DPIR	Hort Innovation
Multi-scale monitoring tools for managing Australian tree crops – industry meets innovation	QDAF	University of Queensland, University of Central Queensland, University of New England, University of Sydney, Avocados Australia, Simpson Farms, Australian Mango Industry Association, Australian Macadamia Society, QDAF, AGTRIX Ltd, Hort Innovation
National banana bunchy top virus program phase 3 – NSW	The Trustee for The Lagom Trading Trust	Hort Innovation
National banana bunchy top virus program phase 3 – Queensland	Barry Sullivan	Hort Innovation
National citrus biosecurity surveillance program	PHA, Citrus Australia	DAWR (Agricultural Competitiveness White Paper)
National passionfruit breeding program	Southern Cross University	Hort Innovation
Panama disease – longitudinal analysis of community wellbeing	CSIRO	CSIRO
Pest status and management of six spotted mite, <i>Eotetranychus sexmaculatus</i> , in WA avocado orchards	Western Australian Agriculture Authority	Hort Innovation
Pineapple model and <i>Phytophthora cinnamomi</i>	Deakin University	Deakin University
Precise recognition for automated harvesting and grading of strawberries	Griffith University	ARC
Protecting Australia's citrus industry from biosecurity threats	PHA, Citrus Australia	Hort Innovation
Protecting Australian citrus germplasm through improved diagnostic tools	NSW DPI	Hort Innovation
Protecting Australia's citrus genetic material	Auscitrus, NSW DPI	Hort Innovation

Project title	Organisation undertaking the research	Funding source
Review host status of cherries for codling moth	Applied Horticultural Research Pty Ltd	Hort Innovation
Review of the national biosecurity plan for the banana industry	PHA	Hort Innovation
Review of the national biosecurity plan for the cherry industry and development of a biosecurity manual for cherry producers	PHA	Hort Innovation
Strengthening the banana industry diagnostic capacity	University of Queensland	Hort Innovation
Testing the potential of incompatible insect technique for a haplodiploid insect species, Kelly's citrus thrips, a significant citrus pest originating from Australia and invasive in New Zealand	Western Sydney University	Australia Pacific Science Foundation
The cause and management of crown rot of banana	QDAF	Hort Innovation
The influence of soil physicochemical conditions on growth and infectivity of the banana disease-causing fungus <i>Fusarium oxysporum</i> f. sp. <i>cubense</i>	James Cook University	Hort Innovation, QDAF
Treatment for mites on lychee fruit after irradiation for improved market access	QDAF	Hort Innovation
United States market access project continuation	Australian Lychee Growers Association	Hort Innovation



Table 58. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source
Horticulture – grapes		
Adaptive area-wide management of Queensland fruit fly using SIT – guidelines for efficient and effective pest suppression and stakeholder adoption	CSIRO, DEDJTR	Hort Innovation, RDCs, CSIRO, DAWR (Rural Research and Development for Profit)
A generic approach to improving spray coverage	University of Queensland	Wine Australia
Biosecurity management activities for the wine grape industry	Australian Wine Research Institute	Australian Vignerons
Cold disinfestation verification trials for table grape access to Japan	WA DPIRD	Hort Innovation
Coonawarra rootstock trial	Vinehealth Australia, Treasury Wine Estates, Coonawarra Vignerons	Vinehealth Australia, Treasury Wine Estates, Coonawarra Vignerons
Desktop review to inform a national approach to grape phylloxera management	Australian Vignerons, Retallack Viticulture	DAWR
Developing a threat-specific contingency plan for the exotic pest angular leaf scorch	SARDI, Cornell University (USA)	Wine Australia
Evaluating and demonstrating new resistant varieties for warm irrigated regions	CSIRO	Wine Australia
Grapes e-surveillance project	WA DPIRD	Royalties for Regions, WA DPIRD
Identification and marker-assisted selection of genes for reducing the susceptibility of new wine grape cultivars to fungal pathogens	CSIRO	Wine Australia
Integrated management of established grapevine phylloxera	DEDJTR	Wine Australia
New rootstocks for Australian conditions	CSIRO	Wine Australia
Phylloxera rootstock screening	DEDJTR	CSIRO
Project boundary rider	Vinehealth Australia	Vinehealth Australia, PIRSA

Project title	Organisation undertaking the research	Funding source
Responsible visitation campaign	Vinehealth Australia	PIRSA, South Australian Wine Industry Association, Winemakers Federation of Australia, Vinehealth
Risks and management of exotic and endemic Phylloxera	DEDJTR	Wine Australia, DEDJTR
Sampling strategies for sensitive, accurate and cost effective detections of Phylloxera for quantifying area freedom status	Vinehealth Australia, SARDI, University of Adelaide, PIRSA, DEDJTR, NSW DPI, PFRNZ, Rho Environmetrics	PBCRC, Wine Australia, Vinehealth Australia, SARDI
Scoping study – development of a biosecurity IT platform for the wine industry	Vinehealth Australia	Vinehealth Australia
Spore trapping technologies for botrytis and powdery mildew DNA testing	SARDI, Australian Wine Research Institute	Wine Australia
Surveillance of South Australia for Phylloxera	Vinehealth Australia	Vinehealth Australia
Towards elite mildew resistant selections suitable for industry use	CSIRO	Wine Australia
Understanding factors leading to sooty mould	Australian Wine Research Institute	Wine Australia
Understanding fungicide resistance in powdery and downy mildew	SARDI	Wine Australia
Understanding the basis of agrochemical resistance in biotrophic grapevine pathogens	Australian Wine Research Institute	Wine Australia



Table 58. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source
Horticulture – multiple crops		
Alternaria on tomato	University of Queensland	University of Queensland
A multi-faceted approach to soil-borne disease management	Applied Horticultural Research Pty Ltd	Hort Innovation
An integrated pest, disease and weed management program for the Australian apple and pear industry	University of Tasmania, DEDJTR	Hort Innovation, DEDJTR, WA DPIRD, University of Tasmania, NSW DPI, QDAF
A novel regulator of growth signalling in <i>Drosophila</i>	Monash University	ARC
A strategic approach to weed management for the Australian vegetable industry	University of New England	Hort Innovation
Biochemistry of ejaculate-mediated sexual inhibition in Queensland fruit flies (PhD)	Macquarie University	Hort Innovation
Biology, behaviour and population structure of <i>Fopius arisanus</i>	NSW DPI	Charles Sturt University
Blends versus pure chemicals – understanding the mechanisms of host fruit location by Queensland fruit fly (Masters)	Queensland University of Technology	PBCRC
Chemical relationships between Queensland fruit flies and their natural enemies (PhD)	Macquarie University	ARC
Cold storage of Queensland fruit fly for mass-rearing programs (PhD)	Macquarie University	Hort Innovation
Combining sterile insect technique in Queensland fruit fly integrated pest management programs (PhD)	Macquarie University	Hort Innovation
Comparisons of new sexing strains of Queensland fruit fly	Macquarie University	International Atomic Energy Agency Cooperative Research Program
Continuation of pilot systems to validate pest free place of production for Queensland fruit fly in the Yarra Valley	DEDJTR	Hort Innovation

Project title	Organisation undertaking the research	Funding source
Creating a novel lure and kill device for Queensland fruit fly	Queensland University of Technology, QDAF, DEDJTR	PBCRC, DEDJTR
Crop hygiene – hort indexing	DEDJTR	Fee for Services
Decision intelligence determining pest natal origin	NSW DPI, Lincoln University (Bio-Protection Research Centre, NZ), Queensland University of Technology, SARDI, WA DPIRD	PBCRC, PFRNZ
Design and evaluation of targeted biosecurity surveillance systems	University of Western Australia, University of Adelaide, DEDJTR, WA DPIRD, Vinehealth Australia, PFRNZ	PBCRC
Developing an emergency response and longterm management strategy for <i>Cassava mosaic virus</i> in Cambodia and Vietnam	International Center for Tropical Agriculture (Colombia)	ACIAR
Development and production optimisation of a male-only selecting, temperature sensitive lethal strain of Queensland fruit fly	University of Adelaide	SARDI
Development of plant biosecurity surveillance protocols for the citrus and mango industries in northern Australia	PHA	DAWR
Diet medicated RNAi sterile insect technology	CSIRO	Hort Innovation
Dynamics of the Queensland fruit fly microbiome under mass-rearing (PhD)	Macquarie University	Hort Innovation
Efficacy of combined female lures for Mediterranean and Queensland fruit fly trapping	DEDJTR	DEDJTR
Essential market access data packages	QDAF	Hort Innovation
Establishment of systems to validate pest free place of productions for Queensland fruit fly in the Yarra Valley	DEDJTR	Hort Innovation
Establishment of the Queensland fruit fly SITplus facility in southern Australia	SARDI	Hort Innovation

Table 58. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source
Horticulture – multiple crops (continued)		
Evaluating volatiles from the infected insects as indicators for diagnostic insect health (PhD)	Murdoch University	Government of Iraq
Evaluation of fumigation and cold treatment for fruit fly on post harvest citrus	Murdoch University	Government of Korea (quarantine department)
Evaluation of mating, dispersion and migration between different treated fruit flies by using stable isotope technology (PhD)	Murdoch University	Government of Iraq
Evaluation of natural product extracts for control of vegetable pests (PhD)	Murdoch University	Government of Iraq
Genetic consequences of domestication in the Queensland fruit fly (PhD)	Macquarie University	Hort Innovation
Genomic tools to improve molecular diagnostics and control of fruit fly pests	DEDJTR, La Trobe University	DEDJTR
Gut bacteria-mediated physiology in Queensland fruit fly (PhD)	Macquarie University	Hort Innovation
Heritability of stress tolerance in Queensland fruit fly (PhD)	Macquarie University	Hort Innovation
Identification and taxonomy of economic crop diseases and their management using biological approaches	University of Queensland	Government of Korea (rural development administration)
Implementing brown sugar flotation for assuring freedom in fruit fly	Applied Horticultural Research Pty Ltd	Hort Innovation
Improved detection and identification of xanthomonads affecting vegetable crops (PhD)	La Trobe University, DEDJTR	PBCRC
Improved larval diets for mass rearing of Queensland fruit fly (PhD)	Macquarie University	Hort Innovation
Improved post harvest market access treatment for horticultural commodities	PFRNZ, QDAF, NSW DPI	PBCRC, PFRNZ, NSW DPI, QDAF

Project title	Organisation undertaking the research	Funding source
Improved soil-borne disease diagnostic capacity for the Australian vegetable industry	SARDI	Hort Innovation
Increasing yield and quality in tropical horticulture with better pollination, fruit retention and nutrient distribution	University of the Sunshine Coast	Hort Innovation
Industrial transformation training centre – Centre for Fruit Fly Biosecurity Innovation	Macquarie University, Western Sydney University, Queensland University of Technology	ARC
Integrated crop management strategies for root and tuber crops – strengthening national and regional capacities in Papua New Guinea, Fiji, Samoa, Solomon Islands and Tonga	University of Queensland	ACIAR
Integrated crop management to enhance vegetable profitability and food security	NSW DPI, QDAF	ACIAR
Integrated pest and disease management – productivity, irrigation pests and soils II	DEDJTR	Hort Innovation, DEDJTR
International acceptance of Australian solanaceous and cucurbit seed tests	DEDJTR	PBCRC
Investigation into deployment, dispersal and transformation of fruit fly lures (PhD)	Macquarie University	Hort Innovation
Irradiation doses for mites and thrips on fresh produce	NSW DPI	New Zealand Ministry for Primary Industries
LAMP assay for the detection of fruit flies	DEDJTR	DEDJTR
Male-only sterile Queensland fruit fly, SITplus	SARDI	Hort Innovation
Management and detection of bacterial leaf spot in capsicum and chilli crops	QDAF	Hort Innovation
Mating frequency of Queensland fruit fly – a potential constraint on sterile insect technique (PhD)	Macquarie University	Hort Innovation

Table 58. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source
Maximum residue limit risk analyses for major export markets of the pome fruit industry	AKC Consulting Pty Ltd	Hort Innovation
Mediterranean fruit fly eradication from Carnarvon using area wide management and sterile insect technique	WA DPIRD	Hort Innovation, Royalties for Regions
Mediterranean fruit fly, <i>Ceratitis capitata</i> , responses to lethal stressors (PhD)	Murdoch University	Government of Iraq
Methoprene and dietary yeast as pre-release supplements for Queensland fruit fly sterile insect technique (PhD)	Macquarie University	Hort Innovation
Methyl bromide disinfection of Queensland fruit fly	NSW DPI	Hort Innovation
Molecular basis of response to sub-lethal stresses	Murdoch University	PBCRC
Molecular basis of sexual performance in Queensland fruit fly (PhD)	Macquarie University	ARC
Molecular characterisation of specimens in the Victorian Plant Pathogen Herbarium to support market access into Asian markets – powdery mildews	DEDJTR, La Trobe University	DEDJTR
Mypolonga fruit fly monitoring – market access program	RDA Murraylands & Riverland Inc	Hort Innovation
National biosecurity plan for the summerfruit industry	PHA	Hort Innovation
National centre for post-harvest disinfestation research on Mediterranean fruit fly	Murdoch University	AgriFutures Australia, Hort Innovation, Kalang Consultancy Services Pty Ltd, QDAF, WA DPIRD
National Fruit Fly Council	PHA	Hort Innovation
National fruit fly RD&E plan	PBCRC	PBCRC
National Mediterranean fruit fly R&D centre	Murdoch University	Hort Innovation

Project title	Organisation undertaking the research	Funding source
National tomato potato psyllid program coordinator	AUSVEG	Hort Innovation
New and improved fruit fly lures for border security and management	Macquarie University	Hort Innovation
New end-point treatment solutions to control fruit fly	QDAF, NSW DPI	Hort Innovation
New end-point treatment solutions to control fruit fly 1	NSW DPI	Hort Innovation
New end-point treatment solutions to control fruit fly 2	QDAF	Hort Innovation
New in-field treatment solutions to control fruit fly 1	QDAF	Hort Innovation
New in-field treatment solutions to control fruit fly 2	Applied Horticultural Research Pty Ltd	Hort Innovation
Next generation national fruit fly diagnostics and handbook	Queensland University of Technology, QDAF, WA DPIRD, PHA	PBCRC
Non-host status and detection methods for Queensland fruit flies	DEDJTR	DEDJTR
Nutritional immunology of Queensland fruit flies (PhD)	Macquarie University	Hort Innovation
Olfactory relationship between fruit flies and associated bacteria (PhD)	Macquarie University	ARC
Olfactory switch as a mechanisms of Queensland fruit fly sexual inhibition	Macquarie University	Australian Government Department of Education and Training
Perceptions towards biosecurity threats across Vietnamese farming communities in Australia (PhD)	Charles Darwin University	PBCRC
Pheromones as potential fruit fly lures (PhD)	Macquarie University	ARC
Piloting new techniques to control and eradicate Mediterranean fruit fly	WA DPIRD	Royalties for Regions, WA DPIRD
Pilot testing efficacy of post-harvest disinfestation treatments	DEDJTR	DEDJTR
Plant biosecurity diagnostic and surveillance web-based bioinformatics toolkit	Murdoch University	PBCRC

Table 58. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source
Horticulture – multiple crops (continued)		
Plant pest surveillance project	DEDJTR	Hort Innovation
Potential impacts of climate change on habitat suitability for the Queensland fruit fly (PhD)	Macquarie University	Hort Innovation
Predator–prey interactions in Queensland fruit flies (PhD)	Macquarie University	Hort Innovation
Preparedness for exotic fruit flies	PHA	DAWR
Probiotic diets to increase Queensland fruit fly male performance as part of the sterile insect technique (PhD)	Western Sydney University, NSW DPI	PBCRC
Psyllid microflora – implications for Liberibacter disease surveillance and pest control (PhD)	La Trobe University, DEDJTR	PBCRC
Quality control procedures for Queensland fruit fly mass rearing (PhD)	Macquarie University	Hort Innovation
Queensland fruit fly behaviour (PhD)	Macquarie University	Hort Innovation
Raspberry ketone as a pre-release supplement for Queensland fruit fly sterile insect technology (PhD)	Macquarie University	Hort Innovation
Research and development of integrated crop management for mango production in the southern Philippines and Australia	QDAF	ACIAR
Review of national biosecurity plans for avocados and mangoes	PHA	Hort Innovation
Review of principles and current practices in determination of quarantine exclusion zones	DEDJTR	PBCRC, DEDJTR
Review of the biosecurity plan for the apple and pear industry	PHA	Hort Innovation
Review of the biosecurity plan for the vegetable industry	PHA	Hort Innovation
Risk evaluation and improvements to diagnostics of south eastern Australian fruit flies	DEDJTR	DEDJTR

Project title	Organisation undertaking the research	Funding source
Scoping for the requirements of a national surveillance strategy for temperate fruit industries	PHA	DAWR (Agricultural Competitiveness White Paper)
Scoping report into the potential biosecurity risks associated with powdery mildews on citrus and mango in northern Australia	University of Southern Queensland	DAWR
Semiochemical-mediated enhancement of sterile male Queensland fruit fly	NSW DPI	Universities
SITplus – area-wide integrated pest management using the sterile insect technique to control the Queensland fruit fly	NSW DPI	Hort Innovation
SITplus – developing and optimising production of a male-only, temperature sensitive, lethal strain of Queensland fruit fly	SARDI	Hort Innovation
SITplus – dietary sterilisation of male Queensland fruit fly	CSIRO	Hort Innovation
SITplus – improved population management system for Queensland fruit fly	PFRNZ	Hort Innovation
SITplus – larval diets for high productivity mass rearing of Queensland fruit fly	Macquarie University	Hort Innovation
SITplus – Port Augusta Queensland fruit fly sterile insect technique factory pilot operation	PIRSA	Hort Innovation
SITplus – raising Queensland fruit fly sterile insect technology to world standard	Macquarie University	Hort Innovation
Social and institutional aspects of grower participation in area-wide fruit fly management programs in Australian horticultural industries (PhD)	Charles Darwin University	PBCRC
Strengthened biosecurity for the vegetable industry – phase 2	AUSVEG	Hort Innovation
Suppressing repression of plant defence through viral micro RNA	University of Queensland	University of Queensland (UniQuest)

Table 58. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source
Surveillance and management of horticultural crop diseases	NSW DPI	Applied Horticultural Technology Ltd
Synthesis and analysis of zingerone analogues as fruit fly attractants (PhD)	Macquarie University	Hort Innovation
The diversity of Ilarviruses infecting Australian Prunus species (PhD)	DEDJTR	Hort Innovation, DEDJTR, La Trobe University
The phenology of fruit fly in subtropical Australia	Queensland University of Technology	Queensland University of Technology
The science underpinning ISPM 37	Queensland University of Technology	Queensland University of Technology
Tomato potato psyllid and Liberibacter ecology	PFRNZ	PBCRC
Training in the development and application of biological control technologies for insect pests and fungal diseases in tropical tree plantations	University of Tasmania	Crawford Fund Limited
Vegetable and potato biosecurity officer program	PHA	AUSVEG
Viruses of national importance to the vegetable industry	QDAF	Hort Innovation



Project title	Organisation undertaking the research	Funding source
Horticulture – nuts		
An integrated disease management program for the Australian almond industry	DEDJTR	Hort Innovation
An integrated pest management program for the Australian almond industry	DEDJTR	Hort Innovation
Biological husk spot research	Biocontrol Australia	Hort Innovation
Biology, species, and genetic diversity of macadamia lace bugs (<i>Ulonemia</i> spp.)	University of New South Wales	Australian Macadamia Society, Hort Innovation
Communication and adoption program for the Australian chestnut industry	Chestnuts Australia	Hort Innovation, Chestnuts Australia
Control of Carpophilus beetle in almonds using attract and kill system	DEDJTR	Hort Innovation, DEDJTR
Disease management in the macadamia industry	University of Queensland	Hort Innovation
Generation of residue and efficacy data for pesticide minor use permit applications in chestnuts in 2016	Chestnuts Australia	Hort Innovation, Chestnuts Australia
Macadamia integrated disease management	University of Queensland	Hort Innovation
Pathogens and other factors contributing to dark staining on pistachio shells	Ag Etc Pty Ltd	Hort Innovation
Technology transfer to pistachio growers utilising regional grower groups	Pistachio Growers' Association	Hort Innovation, Pistachio Growers' Association
Understanding and managing insects on pistachio orchards	Ag Dynamics Pty Ltd	Hort Innovation



Table 58. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source
Horticulture – other		
An integrated pest and disease management extension program for the olive industry	University of Western Sydney	Hort Innovation
A trial of Vapormate® fumigant for the disinfection of Australian wildflowers	Cedar Hill Flowers	DAWR
Biology, epidemiology and management of <i>Elsinoe</i> leaf spot in tea tree	NSW DPI	AgriFutures Australia, NSW DPI, Australian Tea Tree Industry Association
Bogia coconut syndrome in Papua New Guinea and related phytoplasma syndromes – developing biological knowledge and a risk management strategy	Charles Sturt University, University of Southern Queensland	ACIAR
Determining pathogenicity and methyl bromide control of ginger nematodes	QDAF	AgriFutures Australia
Development of a biosecurity plan for the Australian coffee industry	PHA	AgriFutures Australia
Development of a biosecurity plan for the tea tree industry	PHA	Australian Tea Tree Industry Association
Development of a pilot mushroom farm disease monitoring scheme	Australian Mushroom Growers' Association	Hort Innovation
Development of a risk management system for systemic downy mildew of poppy	University of Tasmania	ARC
Effective management of summer root rot of parsley	NSW DPI	Hort Innovation
Epidemiology, impact and management of myrtle rust in lemon myrtle plantations (PhD)	University of Queensland	PBCRC
<i>Fusarium oxysporum</i> on ginger	University of Queensland	AgriFutures Australia, QDAF
Improved management strategies for cocoa in Papua New Guinea	University of Sydney	ACIAR
Improved tissue culture production of ginger clean planting material	QDAF	AgriFutures Australia, QDAF

Project title	Organisation undertaking the research	Funding source
Pest and disease management and research services	University of Tasmania	Hort Innovation
Pests and diseases of truffles and their tree hosts in Australia	WA DPIRD	AgriFutures Australia, Australian Truffle Growers' Association, WA DPIRD, Truffle Producers Western Australia, Australian National University, Truffle and Wine Co.
RD&E for the truffle industry	Australian Truffle Growers' Association	AgriFutures Australia, Australian Truffle Growers' Association
Technical support, extension and minor use development for the ginger industry	Australian Ginger Industry Association	AgriFutures Australia



Image courtesy of the Australian Ginger Industry Association

Table 58. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source
Horticulture – vegetables		
Characterisation of a Carlavirus of French bean	QDAF	Hort Innovation
Cucumber green mottle mosaic virus – next generation sequencing	NT DPIR	Subcommittee for Plant Health Diagnostics
Detection and management of bacterial diseases in Australian Allium crops	QDAF	Hort Innovation
Developing improved crop protection options in support of intensification of sweetpotato production in Papua New Guinea	Charles Sturt University, University of Southern Queensland	ACIAR
Development of an onion white root rot forecasting model for Tasmania	University of Tasmania	Hort Innovation
Diagnostic capability to detect <i>Candidatus Liberibacter solanacearum</i>	DEDJTR, PFRNZ	Hort Innovation
Disinfestation of tomatoes against Mediterranean fruit fly for interstate market access	WA DPIRD	Hort Innovation
Extension of the Predicta Pt potato diagnostic service	SARDI	Hort Innovation
Fungus resistant crop development	Australian National University	ARC
Improved certification for certified seed potatoes	DEDJTR	DEDJTR
Improved knowledge of factors contributing to carrot rot	Peracto Pty Ltd	Hort Innovation
Improved management of pumpkin brown etch	Applied Horticultural Research Pty Ltd	Hort Innovation
Improving productivity of fruiting solanaceous crops through area wide management of insect vectored viruses in Bowen	QDAF	Hort Innovation, Bowen Gumlu Growers Association
Innovating new virus diagnostics and planting bed management in the Australian sweetpotato industry	Australian Sweetpotato Growers, QDAF	Hort Innovation
Managing soil-borne diseases of onions	SARDI	Hort Innovation

Project title	Organisation undertaking the research	Funding source
Minor use permits for the onion industry	Hort Innovation	Onions Australia
Novel approaches for root knot nematodes control	Central Queensland University, QDAF, Henderson RDE, Australian Sweetpotato Growers	QDAF, Australian Sweetpotato Growers
Plant viral messenger RNA project – nexgen plants (Syngenta)	University of Queensland	University of Queensland (UniQuest)
Potato virus resistance discovery project	University of Queensland	University of Queensland (UniQuest)
Resolving the critical disease threat to the Western Australian cucurbit industry	WA DPIRD	Royalties for Regions
Review of the national biosecurity plan for the onion industry and development of a biosecurity manual for onion producers	PHA	Hort Innovation
Review of the national biosecurity plan for the potato industry and development of a biosecurity manual for potato producers	PHA	Hort Innovation
<i>Spongospora</i> infection of potato roots – ecology epidemiology and control	University of Tasmania	Hort Innovation
Supporting commercial sweetpotato production and marketing in the Papua New Guinea highlands	Central Queensland University, QDAF, Australian National University, Enterprises, Fresh Produce Development Agency (PNG), National Agricultural Research Institute (PNG), Henderson RDE, Australian Sweetpotato Growers	ACIAR

Table 58. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source
Multiple crops		
Access to industry priority uses of agvet chemicals	AgAware Consulting Pty Ltd	AgriFutures Australia, DAWR
Advancing collaborative knowledge systems for plant biosecurity surveillance	CSIRO, Charles Darwin University	PBCRC
Agriculture weed surveillance in the south west to protect industry profitability	WA DPIRD	Royalties for Regions, WA DPIRD
Air inversion modelling to manage spray drift	MicroMeteorology Research and Educational Services	GRDC
Anthraxnose diseases (taxonomy)	DEDJTR	University of Melbourne
Anticipating, combating and exploiting the evolution of pesticide resistance in Australian agricultural pests and disease vectors	Australian National University	ARC
Area freedom	PHA	DAWR
A scientific trial to measure the in-paddock and economic benefits of biofumigation on soil health and on disease, pest and weed levels on a range of annual crops under Tasmanian conditions	University of Tasmania	DPIPWE
Assessing the progress against the national plant biosecurity surveillance strategy	PBCRC	DAWR
Australia–Africa plant biosecurity partnership	PBCRC	PBCRC, ACIAR
Australian psyllids – implications for conservation and biosecurity	University of Adelaide	DEE (Australian Biological Resources Study)
Biocontrol feasibility for giant pine scale	DEDJTR	DEDJTR
Biological control of silverleaf nightshade	DEDJTR	DAWR (Rural Research and Development for Profit), AgriFutures Australia, PIRSA, GRDC

Project title	Organisation undertaking the research	Funding source
Biopesticide use and insect resistance in Australian agriculture	University of Adelaide	ARC
Biosecurity planning	PHA	DAWR (Stronger Biosecurity and Quarantine Initiative)
Biosecurity risk management in Torres Strait and the northern peninsula area	QDAF	DAWR (Stronger Biosecurity and Quarantine Initiative)
Biotic mortality factors of Australian fruit fly across different regions	Western Sydney University	ARC
Black spot of field peas and native legumes in Australia	University of Adelaide, Royal Botanic Garden Sydney	University of Adelaide, Royal Botanic Garden Sydney
Centre for Biopesticides and Semiochemicals – novel insecticides and synergists from endemic and exotic flora	Western Sydney University	CRDC
Characterisation of soil microbial interactions for increased efficacy of herbicides using novel fertiliser management practices	University of Western Australia	ARC
Collaborative planning and shared decision making amongst stakeholders	QDAF	PBCRC
Commercial development and evaluation of a machine vision-based weed spot sprayer	University of Southern Queensland	CRDC, University of Southern Queensland, SRA, Hort Innovation
Compliance based inspection scheme – continuous sampling plan sensitivity analysis	University of Melbourne (CEBRA), University of New England	DAWR
Conventional insecticide resistance in Helicoverpa	NSW DPI	CRDC, NSW DPI
CSIRO innovative technologies project – remote sensing for presence or absence	CSIRO	DAWR
Curtailling exotic fungal spore incursions into Australia (PhD)	University of Western Australia	PBCRC
Decision making for eradication and quarantine zones	Queensland University of Technology, QDAF, NSW DPI	PBCRC

Table 58. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source
Defensible resource allocation for plant health surveillance	University of Melbourne (CEBRA)	DAWR
Delivery of an integrated internet based bioinformatics toolkit for plant biosecurity diagnosis and surveillance of viruses and viroids	Murdoch University	PBCRC, Murdoch University, PFRNZ
Deployment of validated, genome-informed bacterial diagnostics	NSW DPI	PBCRC
Determining the value of surveillance in biosecurity risk management	Deloitte Access Economics	DAWR (Agricultural Competitiveness White Paper)
Develop diagnostic keys to genera of Australian Cerambycidae and subfamily Prioninae	CSIRO	DAWR (Agricultural Competitiveness White Paper)
Developing an alternative herbicide management strategy to replace photosystem II herbicides in the Wet Tropics area	SRA, James Cook University	SRA, QDAF
Developing models for the spread and management of national priority plant pests	University of Melbourne (CEBRA)	DAWR
Developing scientifically robust risk maps for priority plant pests	University of Melbourne (CEBRA)	DAWR
Development of a generic sample size tool for the importation of small seed lots into New Zealand	University of Melbourne (CEBRA)	New Zealand Ministry for Primary Industries
Development of a remote pest identification system in Indonesia	PBCRC	PBCRC, RedClaw
Development of effective insect surveillance plans utilising economic portfolio theory	Murdoch University	Murdoch University, Chevron (USA)
Development of new tools and strategies for integrated pest management – biopesticides and semiochemicals	NSW DPI	CRDC, NSW DPI
Diagnosis of emerging pathogens	NSW DPI	Private Industry
Diagnosis of water samples for Phytophthora species	DEDJTR	DEDJTR

Project title	Organisation undertaking the research	Funding source
Discovering the pathways and mechanisms underlying bioinsecticide control of the global migratory pest, diamondback moth, <i>Plutella xylostella</i>	University of Adelaide	ARC
DITA regulation – West Indian drywood termite	QDAF	QDAF
Down to earth defence – unlocking soil-derived defences for plant protection	Western Sydney University	ARC
Ecological impact of myrtle rust, <i>Puccinia psidii</i> , in native and managed ecosystems (PhD)	NSW DPI, Macquarie University	NSW DP&E, PBCRC, DEE
Embedding GERDA (global eradication and response database) into the biosecurity landscape – phase 2, uptake and legacy	PFRNZ	PBCRC
Emerging viruses in agriculture – development of a network for biosecurity and biosurveillance to support food security	La Trobe University, DEDJTR	Innovative research universities (IRU) – Malaysian university research network
Emerging weeds – seed bank biology of emerging weeds	University of Adelaide	GRDC
Enabling improved plant biosecurity practices in Cambodia, Laos and Thailand	PBCRC, RedClaw	ACIAR
Engagement in resilience in indigenous communities	PFRNZ	PBCRC
Enhanced surveillance strategies in horticultural industries based on knowledge of natural dispersal pathways – phase 2	DEDJTR, DPIPWE	PBCRC, DEDJTR, DAWR, PHA
Establishment of the Australia–Indonesia bilateral plant biosecurity initiative	PBCRC	PBCRC, Crawford Fund
Evaluation of stressed weeds with herbicide, adjuvant and biostimulant blends	Monash University	Axieo Operations Pty Ltd
Evolution of multiple herbicide resistance is widespread in <i>Lolium rigidum</i> in Australia	University of Western Australia	ARC

Table 58. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source
Multiple crops (continued)		
Evolution of viral diversity and virus ecology in the management of resistance to biopesticides (PhD)	Queensland University of Technology	CRDC
Evolutionary aerial robotics	CSIRO	CSIRO
From individuals to mass organisation – aggregation, synchronisation and collective movement in locusts	University of Adelaide	ARC
Gene identification and functional characterisation for metabolism based herbicide resistance in <i>Lolium rigidum</i>	University of Western Australia	Bayer Crop Science
Genes of biosecurity importance	CSIRO	CSIRO
Historical pest genomes inform debate about how rapid evolution proceeds	Australian National University	ARC
Horticulture funding for the PBCRC	PBCRC	Hort Innovation
Identification of immune receptor and signalling proteins from plants	Australian National University	ARC
Identification of the molecular targets on filamentous fungi that lead to specific recognition and killing by an antifungal plant defensin	La Trobe University	ARC
Identifying the biochemical and molecular bases of 2,4-D herbicide resistance in the economically important weed wild radish, <i>Raphanus raphanistrum</i>	University of Western Australia	ARC, Nufarm Australia
Implementation of a multi target surveillance system	Murdoch University	Chevron (USA)
Improved management options for cucumber green mottle mosaic virus	NT DPIR	Hort Innovation
Improving the efficacy of pseudomonad biocontrol bacteria	Macquarie University	ARC
Industry liaison officer	PHA	DAWR
Interactions of entomopathogens and Australian fruit fly	Western Sydney University	ARC
Invasion pathway analysis for Australia – insects	Monash University	Invasive Species Council

Project title	Organisation undertaking the research	Funding source
Invasive grass LAMP platform	NSW DPI	DAWR
iSCOUT – sentinel surveillance systems for agriculture	Eight service providers (one for each subproject) – PHA, AUSVEG, SRA, University of Queensland (via CRDC), SARDI, DEDJTR, CSIRO and WA DPIRD	Hort Innovation, PHA, SRA, GRDC, Agrifutures Australia, Wine Australia, FWPA, CRDC, SARDI, DEDJTR, CSIRO, PFRNZ, Rothamsted Research (England), Burkard Manufacturing Company (England), Nursery and Garden Industry Australia, DAWR (Rural Research and Development for Profit) and WA DPIRD
Making Green Guard® greener – enhancing the efficacy of a biopesticide	University of Sydney, University of Adelaide	ARC
Manipulation of regulatory microRNAs to suppress insecticide resistance in the diamondback moth	University of Queensland	Hort Innovation
Mechanically transmitted DNA virus control of Botrytis	PFRNZ	PBCRC
Molecular mechanism of action of plant immune receptors	University of Queensland	ARC
Myrtle rust genetics	University of Sydney	
National diagnostic capability assessment	CSIRO	DAWR (Stronger Biosecurity and Quarantine Initiative)
National plant biosecurity RD&E strategy implementation committee	CSIRO, Council of Rural RDCs, DAWR, DEDJTR, GRDC, Hort Innovation, NSW DPI, PBCRC, PBRI, PHA, QDAF, WA DPIRD, Wine Australia	Hort Innovation, DEDJTR, CRDC, Dairy Australia, GRDC, Meat and Livestock Australia, Wine Australia, SRA, AgriFutures Australia, FWPA, PHA, state governments
National surveillance program for tramp ants	PBCRC	DAWR (Agricultural Competitiveness White Paper)

Table 58. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source
National weed biological control project	DEDJTR	DEE, Meat and Livestock Australia, DEDJTR, NSW DPI, CSIRO, QDAF
National working party on pesticide applications	PHA	CropLife Australia, GRDC, Hort Innovation, Wine Australia, CRDC, SRA
Natural dispersal subproject – metabarcoding of trapped insects	DEDJTR	PBCRC, Hort Innovation
New tools for insect surveillance and eradication	PFRNZ	PBCRC
New Zealand psyllids (PhD)	Lincoln University (NZ), University of Adelaide	PBCRC
Novel community engagement in plant biosecurity	NSW DPI	PBCRC
Novel insecticides and synergists from endemic and exotic flora (PhD)	Western Sydney University	CRDC
National Plant Health Surveillance Program – AUSPestCheck trial	PHA	DAWR
Odorant recognition in insect olfactory system to control insect behaviour	Murdoch University	ARC
Optimising surveillance protocols using unmanned aerial systems	Kansas State University (USA), QDAF, DEDJTR	PBCRC, Kansas State University (USA), Queensland University of Technology, DEDJTR, QDAF
Pantry Blitz – surveillance and reporting of pantry pests via citizen science	WA DPIRD	QDAF, WA DPIRD
Pathways and risk assessment framework for high impact species	CSIRO, QDAF, PFRNZ, WA DPIRD, Lincoln University	PBCRC
Pest and Disease Image Library (PaDIL)	PBCRC	PBCRC
Pestpoint	PBCRC	PBCRC
Physical management options for herbicide resistant weeds – targeted tillage	University of Western Australia, University of Sydney	University of Sydney
<i>Phytophthora cinnamomi</i> and native vegetation	Deakin University	DEE, Parks Victoria



Table 58. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source
Multiple crops (continued)		
Plant and associated microbiome responses to indoleamines and potential applications in agriculture	La Trobe University	La Trobe University
Plant Biosecurity Research Initiative	Projects led by individual RDCs	Hort Innovation, CRDC, GRDC, Wine Australia, SRA, Agrifutures Australia, FWPA
Plant biosecurity surveillance symposium	PBCRC	DAWR
Planthoppers in Cixiidae	NSW DPI	DEE (Australian Biological Resources Study)
Quantifying evidence of a plant pest's absence	University of Melbourne (CEBRA)	DAWR
RD&E program for control, eradication and preparedness for vegetable leafminer	AUSVEG, CESAR, NAQS, University of Melbourne, PHA	Hort Innovation
Real-time plant discrimination and weed detection platform	Edith Cowan University	ARC
Reduced herbicide usage through application technology	Edith Cowan University	GRDC
Reducing the impact of Nosema and viruses by improving honeybee nutrition	CSIRO	AgriFutures Australia
Reliable identification of downy mildews	University of Queensland	DAWR (Agricultural Competitiveness White Paper)
Research to inform yellow crazy ant management in the Wet Tropics	James Cook University	Wet Tropics Management Authority
Revision of bristle fly genus <i>Rutilia</i>	CSIRO	DEE (Australian Biological Resources Study)
Risk assessment and evaluation for plant pest disease pathways in northern Australia	QDAF	DAWR
Risk-mapping import pathways for risk-return opportunities	University of Melbourne (CEBRA)	DAWR

Project title	Organisation undertaking the research	Funding source
Risks associated with the spread of myrtle rust spores, through the movement of bees and beehives in New Zealand	PFRNZ	New Zealand Ministry of Primary Industries, PFRNZ
Semiochemical management for occasional pests of cotton and grains	University of New England	CRDC
Social attitudes and understanding of plant health surveillance	Instinct and Reason	DAWR (Agricultural Competitiveness White Paper)
Streamlining plant pest contingency plans	DEDJTR	DAWR (Stronger Biosecurity and Quarantine Initiative)
Strengthening integrated crop management research in the Pacific islands in support of sustainable intensification of high-value crop production	University of Queensland	ACIAR
Structural basis of host-pathogen interactions	La Trobe University	ARC
Surveillance of tomato potato psyllid in the eastern states and South Australia	University of Tasmania	Hort Innovation
Systematics, biodiversity and host associations of Australian psyllids – implications for conservation and biosecurity	University of Adelaide	University of Adelaide
Targeting metabolic resistance to the new herbicide pyroxasulfone in the global grass weed <i>Lolium rigidum</i>	University of Western Australia	Bayer Crop Science
Testing an iterative approach to selecting successful biological control agents	University of Queensland	CSIRO
Testing incentive-based drivers for importer compliance	University of Melbourne (CEBRA), University of New England	DAWR
The effects of damage and repair of fungal DNA on animal and plant diseases	University of Melbourne	ARC
The more the merrier – investigating copy number variation in Brassicas	University of Western Australia	ARC

Table 58. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source
The role of reproductive parasites in the biology of invasive pest thrips (PhD)	Western Sydney University	Western Sydney University
Time to prime – using silicon to activate grass resistance under higher CO ₂	Western Sydney University	ARC
Tomato potato psyllid transition to management research project	WA DPIRD	Costs shared under the EPPRD
TraitCapture – genomic modelling for plant phenomics under environmental stress	Australian National University	ARC
Treatment of stressed weeds with herbicide, adjuvant and oxidative hydrothermal dissolution liquor blends	Monash University	Greenpower Energy Limited
Weed biocontrol	DEDJTR	Goulburn Murray Water, Murrumbidgee Irrigation, Coleambally Irrigation Cooperative, Goulburn Broken CMA, Wyong Shire, OEH NPWS, Central Murray Council, NQ Dry Tropics, Murray Local Land Services, Murrumbidgee Landcare, PIRSA, GRDC
What are the roles of disturbance and biotic resistance in the establishment of <i>Solenopsis geminata</i> ?	James Cook University	Ecological Society of Australia
Wind spread of plant viral pathogens into northern Australia (PhD)	University of Western Australia, WA DPIRD, CSIRO	PBCRC
With the benefit of hindsight – a bioeconomic analysis of past pest incursions	University of Western Australia	PBCRC
Yellow crazy ant biology and novel control methodologies	James Cook University	Kuranda Envirocare Inc
Yellow crazy ant eradication in and next to the Wet Tropics World Heritage Area	James Cook University	Wet Tropics Management Authority

Project title	Organisation undertaking the research	Funding source
Natural environment		
A lucid key to the genera of Australian psyllids and lerp insects	University of Adelaide	University of Adelaide
Application of advanced molecular tools for identification of non indigenous invertebrates	Murdoch University	Chevron (USA)
A predictive framework for invaded communities	Monash University	ARC
Biocontrol solutions for sustainable management of weed impacts to agriculture	CSIRO, DEDJTR, NSW DPI, QDAF	GRDC, CSIRO, DEDJTR, NSW DPI, QDAF, PIRSA, Seqwater, Shire of Ravensthorpe, NSW Weed Biocontrol Taskforce, North West Local Land Services, NSW DP&E, Bundaberg Regional Council, Gladstone Regional Council, HQPlantations, Goulburn–Murray Water Corporation, Murrumbidgee Irrigation Ltd, Coleambally Irrigation Cooperative, Goulburn Broken Catchment Management Authority, Murray Local Land Services, USDA Agricultural Research Service, Australian Biological Control Laboratory, Wyong Shire Council, NSW National Parks Service, Central Murray County Council, Murrumbidgee Landcare Inc, NQ Dry Tropics

Table 58. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source
Natural environment (continued)		
Biological control of <i>Sagittaria</i> (Phase 2)	DEDJTR	Goulburn Murray Water Corporation, Goulburn Broken catchment management authority, Coleambally Irrigation Cooperative, Murrumbidgee Irrigation, Murray Irrigation
Biological control of <i>Tradescantia</i>	DEDJTR, CSIRO	DEE
Changes in the ecology and control of introduced non-native plants following pest herbivore eradication in the sub-Antarctic (<i>Stellaria media</i>)	University of New England	Australian Antarctic Division
Development of a bioherbicide for control of prickly acacia	University of Queensland, BioHerbicides Australia	Meat and Livestock Australia, BioHerbicides Australia
Development of a biosecurity plan for <i>Acacia</i> species	PHA	DAWR
Development of a protocol to enable in-transit fumigation with ethyl formate	Murdoch University	Chevron (USA)
Development of Davren™ technology for control of red imported fire ant	Murdoch University, QDAF	PBCRC
Development of surveillance and a pre-border data management system	Murdoch University	Chevron (USA)
Eradication of inkweed, a new priority weed incursion on King Island	King Island Natural Resource Management Group	National Landcare Program
Evaluating the deployment of autonomous vehicles for weed eradication	Murdoch University	Chevron (USA)
Fungus trials to control <i>Parkinsonia</i> weeds along the De Grey River in the Pilbara Region	De Grey Land Conservation District Committee	National Landcare Program
Habitat enhancement to support the endangered coastal emu	National Landcare Program	National Landcare Program
Improving and developing tools to manage <i>Parkinsonia</i> and mesquite in the Pilbara Region	Pilbara Mesquite Management Committee	DAWR

Project title	Organisation undertaking the research	Funding source
Info gap theory as a tool to assist biosecurity decision making	Murdoch University	Murdoch University, Chevron (USA)
Integrating emerging <i>Parkinsonia</i> biocontrol technologies on the Barkly Lakes	Australian Agricultural Company Ltd	[Northern] Territory Natural Resource Management
Invasion and impact – predicting the causes and consequences of plant invasions	University of Canberra	ARC
Linking flow, nutrients, seagrass and fish – an integrated approach to estuary management	Monash University	ARC
Maximising the net benefits of Barrow Island biosecurity	University of Melbourne (CEBRA)	PBCRC, Chevron (USA)
Mixed models to analyse pre-border and border surveillance to assist with decision making	Murdoch University	Murdoch University, Chevron (USA)
Multi-scale seed dispersal models for improved regional weed management	Monash University	ARC
National review and proposed action plan for myrtle rust	PBCRC	PBCRC, DEE
Psyllid resistant <i>Leucaena</i> to market	University of Queensland	Meat and Livestock Australia
Promoting conservation and future regeneration of Wollemi pine through manipulation of microbial communities (PhD)	Western Sydney University	DET (Research Training Program)
Phosphonate bark painting of Wollemi pine	Royal Botanic Garden Sydney, NSW DP&E	NSW DP&E, Royal Botanic Garden Sydney
Plant ecophysiology, prospecting for weed control using a native parasitic plant – from laboratory to field implementation	University of Adelaide	ARC, SA Water, Forestry SA, Department for Environment and Water SA, PIRSA, Nature Foundation SA, Lirabenda Endowment Fund, Adelaide and Mount Lofty Ranges and South Australian Murray Darling Basin Natural Resources Management Boards

Table 58. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source
Rehabilitation of corridors to connect significant areas of remnant vegetation	Wellstead Community Resource Centre	National Landcare Program
Resolving the reproductive mode of the invasive yellow crazy ant, <i>Anoplolepis gracilipes</i>	James Cook University	Skyrail Rainforest Foundation
Role of mycorrhizae in invasion	University of Wollongong	University of Wollongong
Susceptibility of Australian alpine species to <i>Phytophthora cinnamomi</i>	Royal Botanic Garden Sydney, NSW DP&E	NSW DP&E, Royal Botanic Garden Sydney
To determine the mechanism for dieback in the invasive tree <i>Parkinsonia aculeata</i> (PhD)	Western Sydney University	DET (Research Training Program)
Understanding the mechanisms underpinning range expansion in exotic plant species	Macquarie University	Macquarie University
Understanding the drivers of aquatic weed success	Macquarie University	Macquarie University
Weed control for soil handling practices associated with native ecosystem rehabilitation	Charles Darwin University	NT DPIR
Nursery crops		
A review of diagnostic technologies to benefit the Australian nursery industry	DEDJTR	Hort Innovation, DEDJTR
Building the resilience and on-farm biosecurity capacity of the Australian production nursery industry	QDAF	Hort Innovation
Integrated disease management in pyrethrum	University of Tasmania	Hort Innovation
National nursery industry biosecurity program	Nursery and Garden Industry Australia	Hort Innovation
Nursery production visual training resources	EHR Consultants	PHA



Table 58. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source
Other crops		
AgWhite – aquatic weed control tools for maintaining water flow in irrigation channels	DEDJTR	DAWR, United Phosphorus Ltd, Goulburn–Murray Water, Murrumbidgee Irrigation, Ord Irrigation, Coleambally Irrigation Cooperative, Sun Water Ltd
Best practice management of Sagittaria	DEDJTR	DAWR (Rural Research and Development for Profit), AgriFutures Australia, Goulburn Murray Water Corporation, Goulburn Broken CMA, Coleambally Irrigation Cooperative, Murrumbidgee Irrigation
Developing a foundation for the long-term management of basal stem rot of oil palm in Papua New Guinea and Solomon Islands	University of Queensland	ACIAR
Generation of efficacy and crop safety data with various pesticides in carobs	WA DPIRD	AgriFutures Australia
Solutions and understanding African whitefly (PhD)	CSIRO	DET (Research Training Program)
Systematic gene silencing and relevance to plant biology	University of Queensland	ARC
Transcriptome analysis of Phytophthora–plant interactions – characterisation of plant inhibitor proteins targeting Phytophthora extracellular effectors	Australian National University	ARC

Project title	Organisation undertaking the research	Funding source
Pollinators		
Asexual reproduction and social parasitism in honey bee invaders	University of Sydney	ARC
Assessing pathogen risks to honeybees and native bees in NSW (PhD)	Western Sydney University	Western Sydney University
A world without bees – simulating important agricultural insect pollinators	Monash University	ARC
Developing the use of sensors to model bee colony dynamics and to monitor bee health productivity and performance	Macquarie University, USDA Agricultural Research Service	USDA Agricultural Research Service
Enhanced national bee pest surveillance program	PHA	Hort Innovation, Australian Honey Bee Industry Council, Grain Producers Australia, DAWR
Enhancing bee research with collections specimen data	CSIRO	Bush Blitz
External attractant trap for small hive beetle	QDAF	AgriFutures Australia, QDAF, Queensland Beekeepers' Association, When Bee Foundation
Healthy bee populations for horticultural pollination services	Western Sydney University	Hort Innovation
Improving biosecurity resources and better understanding bee health in Australia	PHA	AgriFutures Australia
Improving honey bee diagnostics in Australia	CSIRO	DAWR
National bee biosecurity program	PHA	Australian Honey Bee Industry Council
National bee pest surveillance program enhancements	PHA	DAWR
Quantifying the role of wild insect pollinator biodiversity in the provision of pollination ecosystem services	University of New England	Ian Potter Foundation
Quantifying the use of pesticides on Nosema	University of Western Australia	ARC

Table 58. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source
RNA viruses of native bees	University of Adelaide	Holsworth Foundation
Securing pollination for more productive agriculture – guidelines for effective pollinator management and stakeholder adoption	University of New England, University of Sydney, University of Adelaide, Australian National University, AgriFutures	DAWR (Rural Research and Development for Profit), Hort Innovation, University of Sydney, University of Adelaide, University of New England, Adelaide and Mount Lofty Ranges Natural Resources Management Board, Almond Board of Australia, Apple and Pear Growers Association (SA), Australian Mango Industry Association, Australian Melon Association, Australian National University, Costa Group, Department of Environment Water and Natural Resources SA, Greening Australia, Lucerne Australia, Native Vegetation Council, Natural Resources Northern and Yorke, O'Connor NRM, PIRSA, Raspberries and Blackberries Australia, South Australian Apiarist Association, Terrestrial Ecosystems Research Network Eco-informatics, Trees For Life
Selection and development of Australian hygienic honey bee lines	Bee Scientifics	AgriFutures Australia, When Bee Foundation, Bee Scientifics
Stingless bees as effective managed pollinators for Australian horticulture	University of Western Sydney	Hort Innovation

Project title	Organisation undertaking the research	Funding source
Strengthening and enabling effective pollination for Australia	PFRNZ, PHA	Hort Innovation, PFRNZ
Systematics and biology of braconid wasps	University of Adelaide	DEE (Australian Biological Resources Study)
The mechanisms underlying crop pollinator effectiveness in agro-ecosystems	University of New England	ARC
Varroa mite host switch	Australian National University	ARC
Urban, amenities		
A risk-return prioritisation tool for global trade inspections	CSIRO	PBCRC
Improved disinfection protocols for the Torres Strait – Qantas airways	Qantas, DAWR	Qantas, DAWR
Improving biodiversity through restoration of habitat at Westgate Park using community volunteers	Friends of Westgate Park	National Landcare Program



Image courtesy of Trevor Monson, Australian Pollination Services