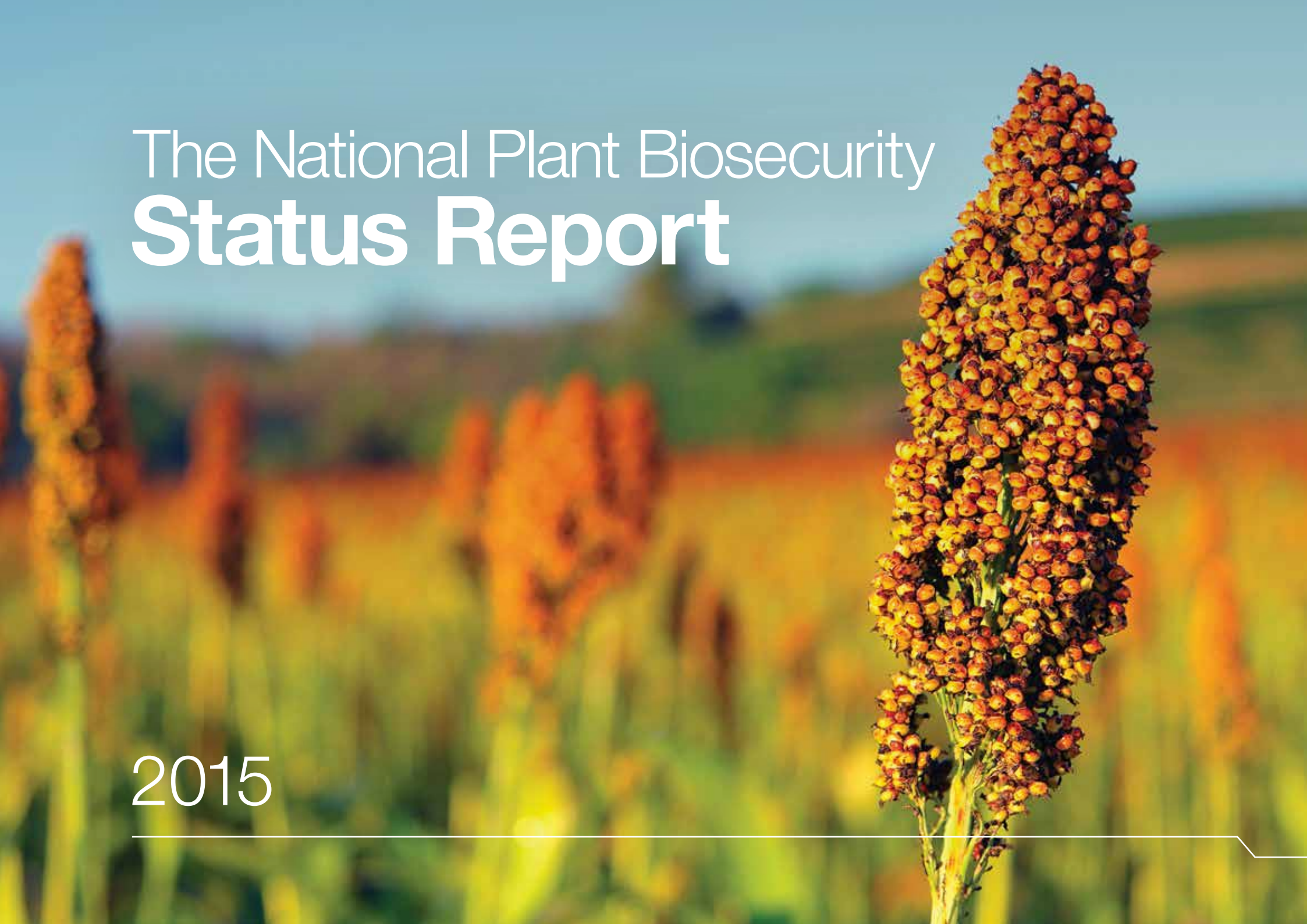

The National Plant Biosecurity **Status Report**

2015

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Image courtesy of Australian Lychee Growers' Association.

Image courtesy of Jenny Shanks.

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Image courtesy of Cotton Australia.

Foreword

This 8th edition of the National Plant Biosecurity Status Report provides a comprehensive picture of the plant biosecurity system in Australia in 2015. Each year Plant Health Australia (PHA) produces a new edition to showcase the plant biosecurity system and the series allows trend analysis of any changes in the system over time.

The report is only made possible by the contributions of over 60 stakeholders from industry, government, research institutions and research funders and PHA is grateful for their cooperation.

Chapter 1 presents the architecture of the system, explains the roles played by all the major stakeholders and shows how industry and government work together to protect our plant industries and unique natural environment.

Chapter 2 features plant pests of significance which includes a listing of exotic pests which would pose the greatest risk to production of food and fibre should they establish in Australia. Pests that are actively being contained in regions of the country and those that prompted some response activity under the terms of the Emergency Plant Pest Response Deed are also catalogued here.

The workings of the system are brought to life in Chapter 3, Managing Australia's plant biosecurity status. This chapter describes activities to combat plant pests along the plant biosecurity continuum—activities in Australia as well as those at the border and internationally (pre-border). It reveals a complexity that is often underappreciated.

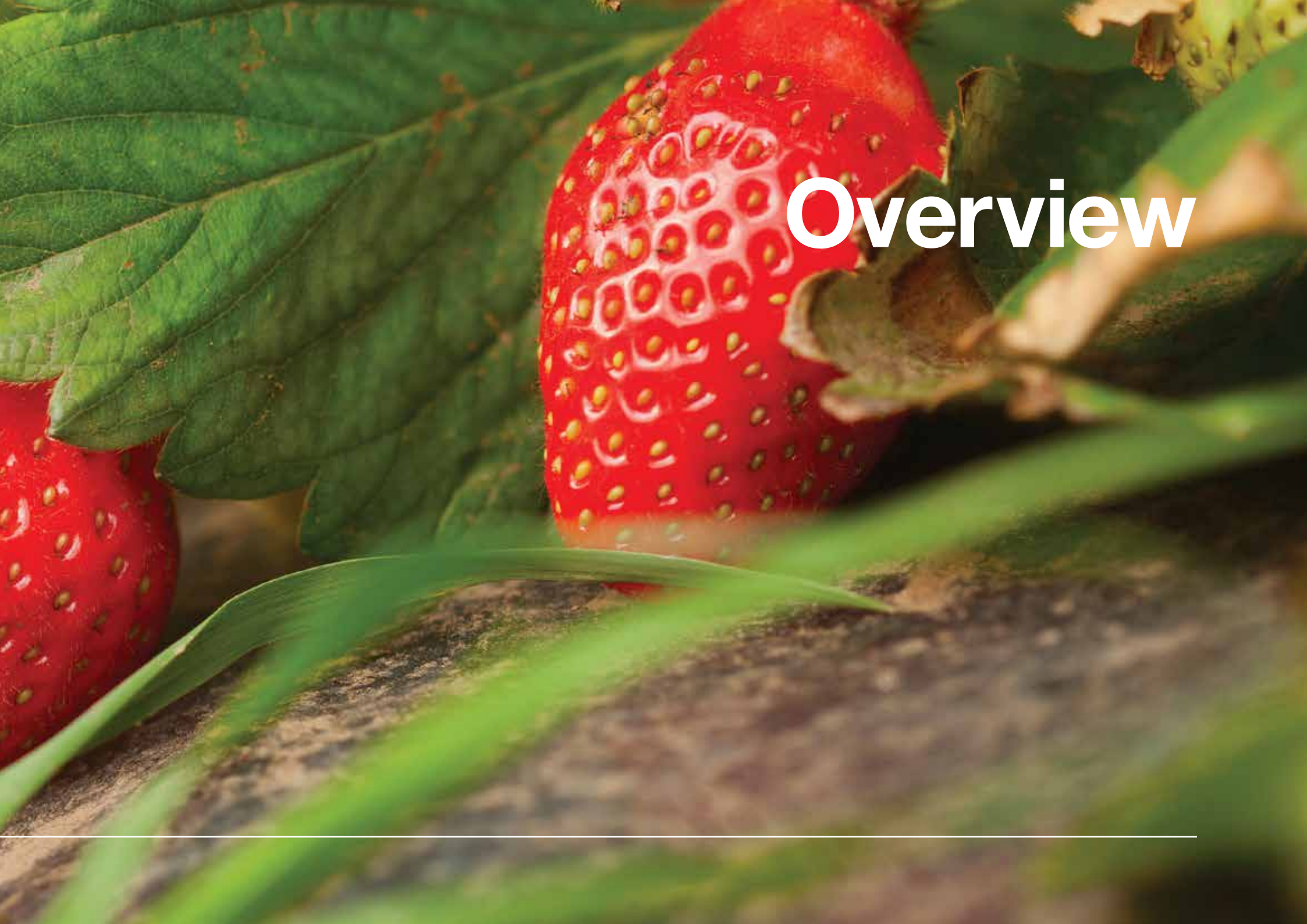
Australia has a unique emergency plant pest response system that is poised to swing into action in the event of a suspected exotic pest incursion of significance. The arrangements, which provide the best chance of preventing the establishment of new exotic pests, are set out in the Emergency Plant Pest Response Deed (of which PHA is custodian). Chapter 4 explains the arrangements, and lists existing contingency plans for exotic pests—preemptive plans that set out how each pest can be dealt with in the event of an incursion.

The report concludes with Chapter 5, which provides an updated catalogue of all the plant biosecurity research projects that were underway in Australia during the year, some 570 projects in all.

As always, case studies throughout illustrate aspects of the system.

Overall, the report leaves the reader in no doubt of the immense amount of effort that goes into Australia's biosecurity system. It serves as a tribute to the numerous Australians who strive to protect our unique environment, agricultural industries, regional economies and communities from plant pests.

Darral Ashton
Chairman
Plant Health Australia



Overview

Australia's plant production industries are in the enviable position of being free from many of the serious pests that negatively impact industries overseas. This relatively pest-free status is due to Australia's geographic isolation and more than a century of effective quarantine measures.

This enviable plant pest status confers significant benefits to Australians. It supports rural communities, boosts Australia's economy, contributes to food security and reduces the use of pesticides as well as the cost of food and fibre.

To maintain this favourable situation, Australia places a high priority on plant biosecurity and has developed an internationally recognised system to protect our crops and the environment.

Everyone has to do their part to keep Australia free from new pests. This includes industry bodies, governments, research organisations, travellers, gardeners, individual farmers and their visitors and staff.

The plant biosecurity system is only as strong as its weakest link.

The definition of a **pest** used in this report (except in Chapter 4) covers insects, mites, snails, nematodes, pathogens (diseases) and weeds that are injurious to plants, plant products or bees. **Exotic** pests are those not currently present in Australia. **Established** or **endemic** pests are those currently present within Australia.

The importance of plant biosecurity

Plant pests are a significant problem worldwide. It is estimated that every year between 20 and 40 per cent of crops are lost to plant pests and weeds globally.[1] Fortunately, Australia is free from many of the pests that contribute to losses overseas, due to our geographic isolation and a world class border protection system.

This freedom from many of the worst plant pests provides many benefits to producers, plant industries and our economy, including high yields, lower production costs, less pesticide use and access to premium markets for our produce.

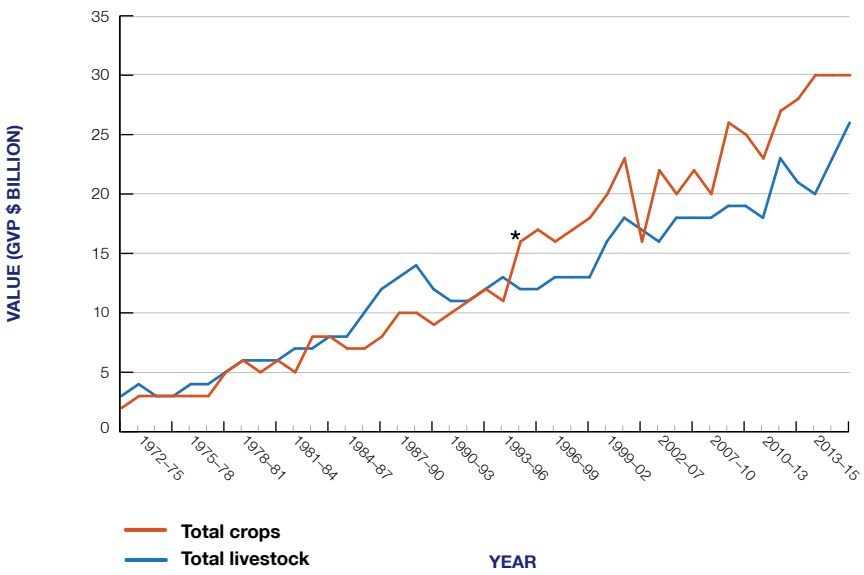
It takes a great amount of effort to keep this status. International trade, people movements and natural means of entry such as wind and water currents means that Australia's pest status advantage is always at risk.

Australian producers grow a wide variety of crops including sugarcane, bananas and ginger in the tropical north, pome and stone fruits, nuts, vegetables and potatoes in the southern temperate zones, as well as broadacre production of pulses, cotton, forestry, pasture and grains. Each of these crops need protection from a specific set of pests that pose a threat to production.

Together, plant production industries make a significant contribution to the Australian economy, with a gross value of $29.1 billion in 2014–15 (see Figure 1). This is more than the value of animal production industries, a situation that has existed for a decade. In addition to the economic contribution it makes, plant production also supports livestock industries, Australian families and rural communities and supports global food security.

1 Savary, S, Ficke, A, Aubertot, J-N and Hollier, C (2012). Crop losses due to diseases and their implications for global food production losses and food security. Food Security, 4(4): 519-537

Figure 1. Value of plant and animal production industries in Australia, 1972–2015*



* Includes forestry from 1995–96
Source: ABS 7503 data series, ABARES Agricultural Commodities: March quarter 2016

Our unique ecosystems also need protection from invasive exotic plant pests, some of which could change the face of the landscape and threaten native species. There is much to protect—Australia has a high level of species richness including a large number of native plants and animals that occur nowhere else on Earth. Parklands and other public amenities could also be threatened by the introduction of particular exotic plant pests.

With a total coastline stretching almost 60,000 km, Australia's borders are protected from plant pests by a collaborative partnership, and by coordinated activities that occur pre-border (overseas), at the border and within Australia. The plant biosecurity partnership includes plant industries and their growers, the Australian Government, state and territory governments, local governments, researchers, Plant Health Australia (PHA) and the wider community including home gardeners.

Chapter 1 provides an overview of the different roles and responsibilities of the key committees and organisations within Australia's plant biosecurity system including the individual industries. It shows how the partnerships have kept pace with the new challenges and demands of Australia in an increasingly globalised marketplace.

Chapter 1

The plant biosecurity system in Australia

Australia's plant biosecurity system involves efforts along the whole biosecurity continuum—pre-border, at the border and post-border—not simply restrictions at international entry points. Risk mitigation activities pre-border prevent pests reaching Australia, border restrictions aim to intercept pests and post-border initiatives focus on regional and interstate restrictions, preparedness and emergency responses within Australia. These activities across the continuum are carried out by a range of stakeholders including a cooperative government-industry partnership.

1.1 Plant biosecurity policy and legislation

The framework for managing the cooperative partnership that underpins Australia's effective plant biosecurity system consists of a suite of strategies, policies and legislation. These not only provide the current structure, but provide a vision of how the plant biosecurity system should operate into the future.

Australia's biosecurity system has been reviewed several times. The resulting recommendations have seen the Australian Government Department of Agriculture and Water Resources recognise that a future focused approach is vital to maintain a strong and resilient biosecurity system that will protect Australia from new biosecurity challenges, whatever they may be.

Key themes underpinning continuous improvement to Australia's biosecurity system include:

- Targeting what matters most, including risk-based decision making and managing biosecurity risk across the continuum (pre-border, at the border and post-border).
- Good regulation, including effective legislation and reduced regulatory burden.
- Better processes, including service delivery modernisation and streamlined systems.
- Sharing the responsibility, including maintaining productive relationships with all levels of government, primary industries and the wider Australian public.
- Maintaining a capable workforce.

The benefits of the modern biosecurity system are realised by industry, government and the community, with positive flow-through effects to the economy more generally. Benefits include streamlined business processes, productivity improvements and reduced regulatory burden in a seamless and lower cost business environment. The system is characterised by risk-based decision making, the use of intelligence, a single point of regulatory contact and robust partnerships.

INTERGOVERNMENTAL AGREEMENT ON BIOSECURITY

Within government, Australia's partnership approach to biosecurity is underpinned by the Intergovernmental Agreement on Biosecurity (IGAB), which came into effect on 13 January 2012. The IGAB was developed under the Council of Australian Governments and signed by ministers. The IGAB strengthens the working partnership between the Australian Government and state and territory governments by defining the roles and responsibilities of governments, and outlining priority areas for collaboration and improving the national biosecurity system.

Under the IGAB, key aspects of Australia's biosecurity system are becoming better coordinated. Areas addressed include mechanisms to allow emergency response information to be shared between governments, an improved model for managing nationally significant established pests, measures to improve the transparency and rigour of national decision making and investment and a national biosecurity research, development and extension strategy. A public information and stakeholder engagement framework with standardised tools for all jurisdictions has also been developed.

As responsibility for biosecurity management is shared, the agreement also provides opportunities for industries, natural resource managers and the community to work together to achieve some of the reforms outlined in the IGAB. PHA has been an active contributor to this process, and has aligned the National Plant Biosecurity Strategy (see next section) with the goals and objectives of the agreement.

In November 2015, Australian agriculture ministers agreed that the IGAB will be formally reviewed in 2016.

The National Plant Biosecurity Strategy (NPBS) outlines a set of aims and activities to strengthen Australia's plant biosecurity system by 2020. PHA developed the strategy by drawing together the views of stakeholders across Australia.

The NPBS was finalised in December 2010 with endorsement from PHA members, and in 2011 the process of implementing the recommendations began. With the benefits of many of the recommendations cutting across both industry and governments, responsibility for guiding the implementation process is shared among organisations and committees, based on their expertise.

Toward the end of 2014, halfway through its lifespan, PHA reviewed the NPBS and assessed progress against each of the recommended activities. An implementation plan listing the remaining tasks to be completed was published in 2015. All plant biosecurity stakeholders have a role to play in achieving the vision set out for 2020 (see box on page 21).

The government aspects of implementation are overseen by the Plant Health Committee (PHC), with specific input from the Subcommittee on Plant Health Diagnostics (SPHD) and the Subcommittee on National Plant Health Surveillance (SNPHS) on implementing the diagnostic and surveillance aspects, respectively. The Subcommittee on Domestic Quarantine and Market Access (SDQMA) works to ensure consistency of biosecurity requirements across states and internationally.

Plant industries, PHA and research and development corporations are contributing to NPBS implementation through biosecurity preparedness activities such as developing contingency plans and prioritising threats through the industry biosecurity planning process.

The NPBS continues to provide the focus and strategic direction for national plant biosecurity activities and, through its implementation, will strengthen the plant biosecurity system.

BIOSECURITY LEGISLATION

Australia's biosecurity system operates under Commonwealth, state and territory legislation administered and managed by the respective government agricultural and environmental agencies. Legislation current at 31 December 2015 is listed in Table 1.

Legislation covers a range of activities involving the international movement of people and goods into Australia, movement of goods within the country and exporting agricultural commodities. There are also laws covering related aspects such as the collection of primary industry levies to cover the costs of biosecurity activities, reporting of suspicious pests and biosecurity incident responses.

The Biosecurity Act 2015 and *Biosecurity (Consequential Amendments and Transitional Provisions) Act 2015* were introduced in 2015 to update current federal laws from 2016.

The NSW Biosecurity Act 2015 was assented to in September 2015 and is expected to come into effect in 2017. Queensland also has new legislation, *Biosecurity Act 2014*, which comes into effect 1 July 2016.

Table 1. Plant biosecurity related legislation

Jurisdiction	Administering authority	Legislation
Commonwealth	Department of Agriculture and Water Resources	*Biological Control Act 1984* *Quarantine Act 1908* *Quarantine Regulations 2000* *Quarantine Proclamation 1998*
Commonwealth	Department of Environment, Water, Heritage and the Arts	*Environment Protection and Biodiversity Conservation Act 1999* *Environment Protection and Biodiversity Conservation Regulations 2000*
ACT	Territory and Municipal Services Directorate	*Plant Disease Act 2002* *Pest Plants and Animals Act 2005*
NSW	Department of Primary Industries	*Plant Diseases Act 1924* *Plant Diseases Regulation 2008* *Noxious Weeds Act 1993* *Noxious Weeds Regulation 2008* *Apiaries Act 1985* *Stock Diseases Act 1923* *Animal diseases and Animal Pests (Emergency Outbreaks) Act 1992*
NT	Department of Primary Industry and Fisheries	*Plant Health Act 2008* *Plant Health Regulations 2011*
Qld	Department of Agriculture and Fisheries	*Plant Protection Act 1989* *Plant Protection Regulation 2002*
SA	Primary Industries and Regions	*Plant Health Act 2009* *Plant Health Regulations 2010*
Tas	Department of Primary Industries, Parks, Water and Environment	*Plant Quarantine Act 1997* *Weed Management Act 1999*
Vic	Department of Economic Development, Jobs, Transport and Resources	*Plant Biosecurity Act 2010* *Plant Biosecurity Regulations 2012*
WA	Department of Agriculture and Food	*Biosecurity and Agricultural Management Act 2007*

1.2 National committees

National committees provide a mechanism for developing and coordinating key plant biosecurity policy and procedures across jurisdictions. As a representative or observer at meetings, PHA is able to provide a link back to other members, particularly peak industry bodies, and other organisations with a stake in biosecurity. Figure 2 shows the structure of Australian plant related committees that are tasked with national coordination. PHA has observer status at National Biosecurity Committee (NBC), and is a member of Plant Health Committee (PHC) and the three PHC subcommittees, as well as the majority of emergency response committees.

The Agriculture Senior Officials Committee (AGSOC) is responsible for primary industries policy issues. AGSOC comprises the heads of primary industry government departments from the Australian Government, Australian states and territories and the New Zealand government. AGSOC is supported by the NBC.

NATIONAL BIOSECURITY COMMITTEE

The National Biosecurity Committee is responsible for managing a national, strategic approach to biosecurity issues relating to plant and animal pests and diseases, marine pests and aquatics, and the impact of these on agriculture production, the environment, community wellbeing and social amenity. A core objective of the committee is to promote cooperation, coordination, consistency, and synergies across and between Australian governments. The NBC has reporting responsibilities to ministers responsible for biosecurity through relevant Chief Executive Officers.

The Secretary of the Department of Agriculture and Water Resources chairs the NBC as a member of the AGSOC. The Australian Government is also represented by the Department of Agriculture and Water Resources Deputy Secretary responsible for biosecurity, and a Deputy Secretary from the Department of the Environment (or delegate). PHA and Animal Health Australia are observers.

Remaining members are senior representatives from primary industry or environment departments for each state and territory. Jurisdictions may have up to two representatives.

PLANT HEALTH COMMITTEE

Plant Health Committee (PHC) is the peak government plant biosecurity policy forum. Its role is to maintain or improve plant health in Australia in support of the economy, environment and community. PHC provides strategic policy, technical and regulatory advice, and national leadership on plant biosecurity matters. It has responsibility for overseeing the implementation of the government aspects of the National Plant Biosecurity Strategy (NPBS) and the Intergovernmental Agreement on Biosecurity (IGAB) with respect to plant health. PHA attends PHC meetings and the Committee reports to the National Biosecurity Committee (NBC).

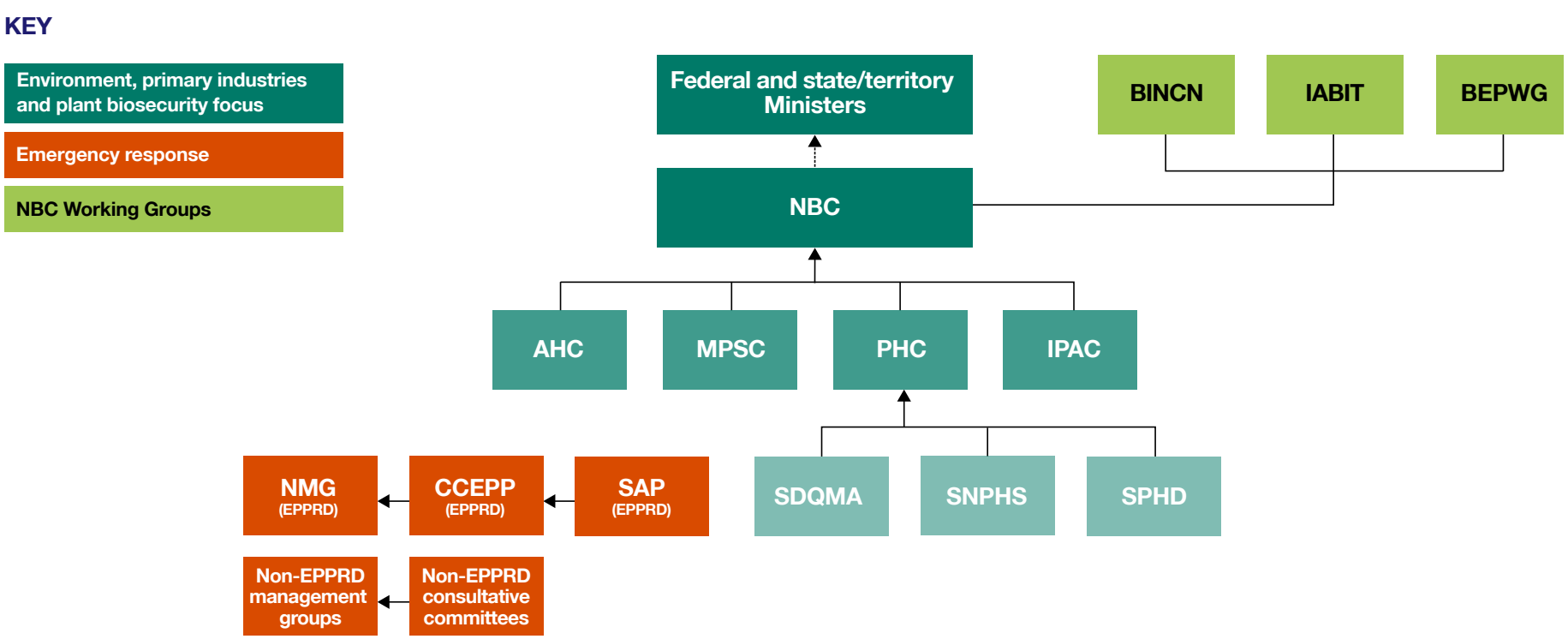
Through its subcommittees, currently the Subcommittee on Plant Health Diagnostics (SPHD), Subcommittee on National Plant Health Surveillance (SNPHS) and Subcommittee on Domestic Quarantine and Market Access (SDQMA), PHC also facilitates a consistent national approach to legislative outcomes and standards within the plant biosecurity sector. PHC's membership comprises representatives from the Australian, state and territory governments. PHA and subcommittee chairs have observer status.

In 2015 PHC continued implementation of the NPBS, using the document as one of the main guiding principles when determining work area priorities. PHC also continued to progress various lines of work to support and maintain trade and market access, both domestically and internationally.

Further information on PHC can be found at **www.agriculture.gov.au/plant/health/committees/phc.**

The Subcommittee on Plant Health Diagnostics meets twice a year to maintain an effective diagnostic system in Australia.

Figure 2. National biosecurity committees and the associated working groups with a plant focus



Abbreviations	
AHC	Animal Health Committee
BEPWG	Biosecurity Emergency Preparedness Working Group
BINCN	Biosecurity Incident National Communication Network
CCEPP	Consultative Committee on Emergency Plant Pests
IABIT	Intergovernmental Agreement on Biosecurity Implementation Taskforce

Abbreviations	
IPAC	Invasive Plants and Animals Committee
MPSC	Marine Pest Sectoral Committee
NBC	National Biosecurity Committee
NMG	National Management Group
PHC	Plant Health Committee
SAP	Scientific Advisory Panel

Abbreviations	
SDQMA	Subcommittee on Domestic Quarantine and Market Access
SNPHS	Subcommittee on National Plant Health Surveillance
SPHD	Subcommittee on Plant Health Diagnostics

1.3 Australian Government plant health services

Australian Government plant biosecurity responsibilities are delivered principally through the Agriculture portfolio, in collaboration with other agencies described below.

DEPARTMENT OF AGRICULTURE AND WATER RESOURCES

Australia's approach to managing the risk of incursions of exotic pests is multi-layered, involving complementary measures applied along the biosecurity continuum: pre-border, at the border and post-border. The Department of Agriculture and Water Resources' core priorities in managing biosecurity are to:

- Effectively identify risks and target resources to the areas of greatest return from a risk management perspective.
- Partner with other governments, industry, clients and stakeholders to manage Australia's biosecurity.
- Deliver biosecurity services to support access to overseas markets and protect the economy and the environment from the impacts of unwanted pests.
- Support Australia's reputation as a competitive exporter of agricultural goods and products.

Pre-border activities seek to prevent biosecurity risks reaching Australia by understanding global risks, working with international trading partners and the private sector, and informing travellers about Australia's biosecurity requirements. Specific activities include cooperation in multilateral forums, import risk analyses, collaborative plant health surveys in partnership with Australia's nearest neighbours, and capacity development audit activities, all aimed at managing plant health risks prior to reaching Australia.

Border activities seek to intercept biosecurity risks at airports, seaports, mail centres and along Australia's coastline. Border activities include import permit requirements, inspection of passengers, goods, vessels and mail, audit activities, monitoring and surveillance activities for exotic animal and plant pests, and post-entry quarantine. Rather than being based on state and territory boundaries, these activities are carried out in five consolidated regions as shown in Figure 3.

Post-border, the Department of Agriculture and Water Resources works cooperatively with other Australian Government agencies, state and territory governments and industry partners to detect and respond to plant pest emergencies that may adversely impact on Australia's agriculture, fisheries and forestry industries and the environment. Examples of post-border activities include national policy development, enhancing surveillance and diagnostic capability, and facilitating emergency preparedness and emergency responses. Formal national arrangements exist for managing responses to Emergency Plant Pests (see Chapters 2 and 4).

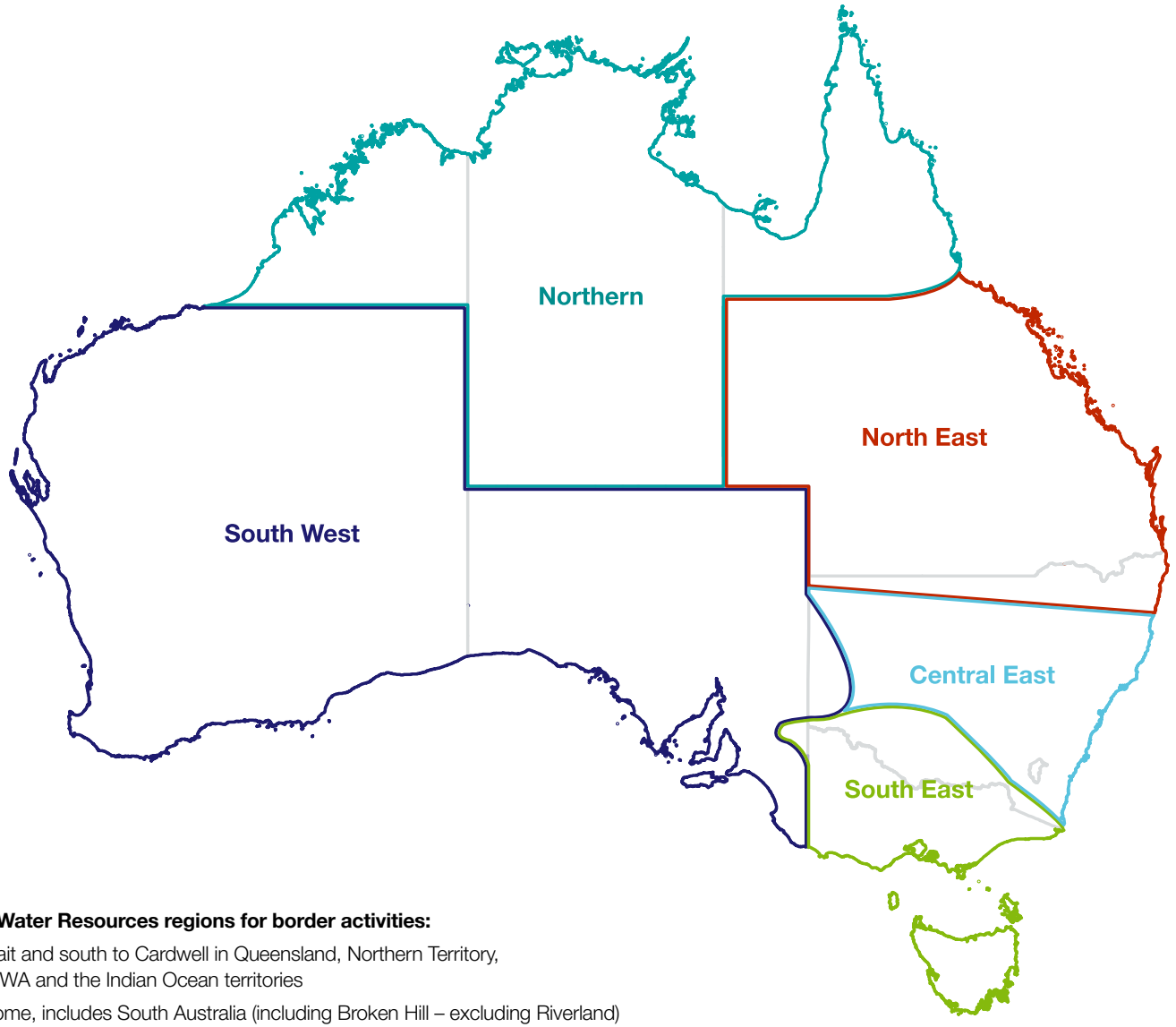
The Department of Agriculture and Water Resources also pursues international market access for Australia's industries and access to the Australian market for our trading partners through bilateral, regional and multilateral engagement. Priority is given to:

- Working to remove impediments to international trade.
- Progressing and resolving market access issues for portfolio industries.
- Facilitating targeted technical assistance and agricultural cooperation in support of portfolio interests.
- Assisting the development of international standards for portfolio products and industries.

The market access work of the Department of Agriculture and Water Resources is supported and enhanced by a network of agricultural counsellors located in China, Europe, India, Indonesia, Japan, Korea, the Middle East, Thailand and the United States. At each stage of the continuum, success is dependent on partnerships between governments, industry and the community.

Border activities are the more apparent biosecurity activities. Image courtesy of DAWR.

Figure 3. Regional boundaries for Department of Agriculture and Water Resources border biosecurity operations



Department of Agriculture and Water Resources regions for border activities:

Northern	Includes Torres Strait and south to Cardwell in Queensland, Northern Territory, west to Broome in WA and the Indian Ocean territories
South West	From south of Broome, includes South Australia (including Broken Hill – excluding Riverland)
South East	Includes Tasmania, Riverland and extends north to Riverina and east coast NSW to Eden
Central East	Includes NSW with the exception of Eden and areas south, Riverina and far north coast
North East	Extends from Cardwell in Queensland to far north coast NSW, south to Grafton

DEPARTMENT OF FOREIGN AFFAIRS AND TRADE

The purpose of the Department of Foreign Affairs and Trade (DFAT) is to help make Australia stronger, safer and more prosperous by promoting and protecting our interests internationally and contributing to global stability and economic growth. The department provides foreign, trade and development policy advice to the government and works with other government agencies to coordinate Australia's global, regional and bilateral interests.

DEPARTMENT OF THE ENVIRONMENT

The Department of the Environment is responsible for contributing to the development of national policies on pests and invasive plants that cause harm to the environment.

The Department of the Environment is also responsible under the *Environment Protection and Biodiversity Conservation Act 1999* for assessing the environmental impact associated with proposals to import live species (except plants, the approvals of which are done in accordance with the *Quarantine Act 1908*) and ensuring that Australia complies with its obligations under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

It also provides advice to the Department of Agriculture and Water Resources on environmental issues in relation to risk assessments.

DEPARTMENT OF IMMIGRATION AND BORDER PROTECTION

The Department of Immigration and Border Protection manages the security and integrity of Australia's borders. It works closely with other government and international agencies, in particular the Australian Federal Police, the Department of Agriculture and Water Resources and the Department of Defence, to regulate and control the movement of goods and people across the Australian border.

OTHER GOVERNMENT ORGANISATIONS

Within the Department of Agriculture and Water Resources, the Australian Bureau of Agriculture and Resource Economics and Sciences (ABARES) provides current scientific and economic advice to decision makers to support the plant biosecurity system.

Other Australian Government agencies that contribute to maintaining Australia's plant biosecurity system include the CSIRO, the Office of the Gene Technology Regulator (OGTR), and the Australian Pesticides and Veterinary Medicines Authority (APVMA).

The Australian Trade Commission, Austrade, is the Australian Government's trade, investment and education promotion agency. Austrade's role is to advance Australia's international trade, investment and education interests by providing information, advice and services.

The Australian Centre for International Agricultural Research (ACIAR) is a statutory authority that operates as part of the Australian Government's development cooperation programs. ACIAR encourages Australia's agricultural scientists to use their skills for the benefit of developing countries and Australia.

1.4 State and territory plant biosecurity services

Under the Australian Constitution, state and territory governments are responsible for the delivery of plant biosecurity operations and the supporting legislation within their borders. While each state and territory has a different approach to the role, primarily due to the varied climatic conditions and legislative frameworks across the country, together jurisdictions provide a number of core services. These include:

- Management of state and territory imports and exports:
  - State quarantine services for the clearance of passengers, cargo, mail, plants and plant products moving interstate.
  - Export and market access support, including plant health certification services, the accreditation and auditing of export compliance arrangements, and surveys and inspections to support area freedom.
- Emergency response services, involving activities to prepare for, and respond to, a plant pest incursion.
- Delivery of responsibilities under the Emergency Plant Pest Response Deed (EPPRD) (Chapter 4).
- Core services to support biosecurity:
  - Surveillance and monitoring for early detection of pests, maintaining area freedom and delimiting the extent of pests, in partnership with industry surveillance.
  - Diagnostic services to identify plant pests (both endemic and exotic) found in a broad range of crops.
  - The development and maintenance of information systems to support routine and emergency plant biosecurity management.
  - Communication programs to raise awareness of biosecurity.
- Science based risk analysis to identify pest threats and inform plant biosecurity policy and operations.
- Research, development and extension (RD&E) to support the continued improvement of pest management and protection capabilities.
- Development and administration of plant biosecurity policies and legislation.

State and territory governments work with the Australian Government in a manner set out in the Intergovernmental Agreement on Biosecurity (see page 13). The National Biosecurity Committee is responsible for managing a national approach to all biosecurity issues (see page 16).

Report card on improvements to the plant biosecurity system

Australia's plant biosecurity system is on track to meet the vision set out for 2020, but there is still work for governments and industry bodies to do.

That's according to the National Plant Biosecurity Strategy 2015–20 Implementation Plan released by Plant Health Australia in July 2015.

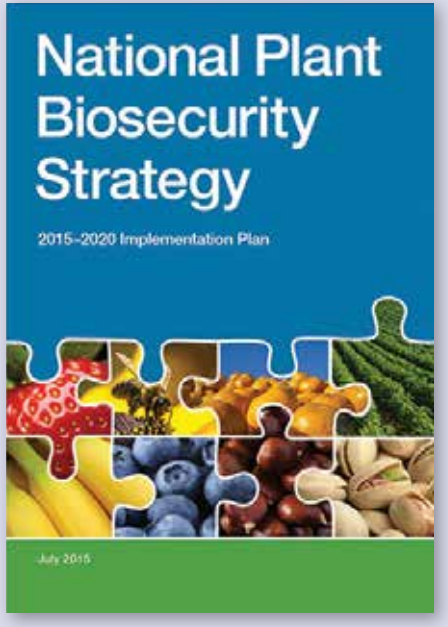
Recognising and responding to a number of substantial challenges facing the plant biosecurity sector, the National Plant Biosecurity Strategy was developed to provide clear guidance on a pathway for the implementation of a world class plant biosecurity system.

In 2014, halfway through the life of the document, PHA reviewed the Strategy, which covers planned improvements in the key functional areas of emergency response, diagnostics, surveillance and communications.

The mid-life review confirmed that the document is still a useful blueprint for the future of the system. It found that most recommendations are progressing well and that some initiatives have been completed.

Remaining improvements are prioritised using a traffic light system and are allocated to stakeholder groups that are best equipped to advance the remaining elements.

PHA will work with members to facilitate ongoing implementation of the Strategy to 2020.



AUSTRALIAN CAPITAL TERRITORY

Lead agency: Territory and Municipal Services (TAMS) Directorate
www.tams.act.gov.au

The ACT Government manages plant biosecurity through the TAMS Directorate, together with the Environment and Planning Directorate (EPD). TAMS is responsible for the operational implementation of biosecurity initiatives and the EPD is responsible for policy development.

Although the ACT does not have many plant production industries, the government is represented on national committees during plant pest emergency responses and participates in the development of associated national frameworks and strategies when it has the expertise to contribute.

Plant biosecurity activities in the ACT are underpinned by the *Plant Diseases Act 2002,* the *Pest Plants and Animals Act 2005,* the *Magistrates Court (Plant Diseases Infringement Notices) Regulation 2005* and the *Nature Conservation Act 2014.*

NEW SOUTH WALES

Lead agency: Department of Primary Industries (NSW DPI)
www.dpi.nsw.gov.au

NSW DPI is the principal agency responsible for plant biosecurity in New South Wales, ensuring that policies, management and procedures are in place to minimise the impact of existing, invasive and emergency pests. NSW DPI maintains rapid response mechanisms for pest incursions in order to protect trade and market access, agricultural resources, regional economies and the environment. The NSW Biosecurity Strategy defines how NSW DPI, in partnership with other government agencies, industry and the public, manages biosecurity risks to NSW.

Within NSW DPI, the Plant Biosecurity and Product Integrity unit develops plant pest policy directions and has oversight of operational responses to emergency plant pests. The group provides advice to and participates actively in national decision making forums for plant pests of national significance and interstate market access for NSW plants and plant products.

Diagnosis and surveillance activities are supported by the Plant Health Diagnostic Service at Elizabeth Macarthur Agricultural Institute, the Australian Scientific Collections Unit at Orange Agricultural Institute, the state wide network of compliance officers and the emergency management First Response Team.

Close collaboration is established with entomology and plant pathology researchers and with the state-wide Local Land Services network.

Current legislation underpinning the NSW Government's plant biosecurity activities, administered by NSW DPI, are the *Plant Diseases Act 1924* No. 38 and the *Plant Diseases Regulation 2008.* In 2017 the *NSW Plant Diseases Act 1924* will be rescinded and powers to respond to plant pests and diseases will be provided by the *NSW Biosecurity Act* which was passed by the NSW parliament in September 2015.

NORTHERN TERRITORY

Lead agency: NT Department of Primary Industry and Fisheries (NT DPIF)
www.nt.gov.au/d

Plant biosecurity in the NT is managed by the Plant Biosecurity Branch, within NT DPIF's Biosecurity and Animal Welfare Division. The Plant Biosecurity Branch is responsible for the development and implementation of plant biosecurity policies, programs and procedures aimed at maintaining NT's freedom from plant pests that could adversely impact on trade, market access, public health and the environment.

The objectives of the Plant Biosecurity Branch include:

- Maintaining and improving the plant health status of the plant and plant product industries of NT.
- Ensuring that plant and plant products that enter NT comply with the *Plant Health Act 2008* and *Plant Health Regulations 2011*.
- Minimise the risk of exotic pests entering NT through compliance and surveillance.
- Ensuring preparedness for effective emergency response mechanisms in the event of an Emergency Plant Pest incursion.
- Facilitating interstate trade of plant and plant products through certification, inspection and the Interstate Certification Assurance program.
- Conducting active and passive pest surveillance to support market access nationally and within NT.
- Conducting active surveillance for the early detection for a range of emergency plant pests.
- Preparing for effective emergency response mechanisms in the event of an emergency plant pest incursion.
- Developing, implementing and reviewing NT's plant health policy and legislation.

The Plant Biosecurity Program is underpinned by the *Plant Health Act 2008* and the *Plant Health Regulations 2011*. The Act and Regulations aim to minimise the risk of plant pests entering and establishing in the NT through movement and importation controls on plants and plant products. They also provide the powers to ensure appropriate action can be taken for the control of pests if an incursion were to occur.

QUEENSLAND

Lead agency: Queensland Department of Agriculture and Fisheries (QDAF)
www.daf.qld.gov.au

Within QDAF, Biosecurity Queensland is responsible for: developing policies, standards, delivery systems and services to reduce the risk of introduction of exotic plant pests; minimising the impacts of new plant pest incursions on Queensland's plant industries, environment and communities; and preserving and expanding market access for Queensland's plant based industries. The Plant Biosecurity and Product Integrity program within Biosecurity Queensland has responsibility for plant biosecurity, diagnostics and the implementation of programs for the detection, control and prevention of certain plant pests.

Agri-Science Queensland, a division of QDAF, undertakes research, development and extension on a wide range of plant pests in the cropping, horticultural and forestry industries. The group provides additional diagnostic capability, undertakes surveillance and develops integrated management packages to limit the impacts of pests within farming systems.

Currently, plant biosecurity management in Queensland is underpinned by the *Plant Protection Act 1989* and *Plant Protection Regulation 2002* which are focused on preventing, controlling and removing pest infestations of plants. This legislation is also complemented by a number of other acts, including the *Apiaries Act 1982*, the *Agricultural Standards Act 1994* and the *Agricultural and Veterinary Chemicals (Queensland) Act 1994*.

SOUTH AUSTRALIA

Lead agency: Department of Primary Industries and Regions SA (PIRSA)
www.pir.sa.gov.au

Biosecurity SA, a division within PIRSA, is responsible for the development and implementation of plant biosecurity policies, programs and procedures aimed at maintaining SA's freedom from pests that could adversely impact trade, market access, public health, food safety, the rural economy and the environment.

Given SA's freedom from fruit flies of economic significance, PIRSA has a strong focus on operations aimed at preventing their entry and establishment. These activities include a dedicated state wide fruit fly trapping grid, static quarantine stations and random roadblocks, targeted awareness and education campaigns, and specific measures to effectively respond to and eradicate any fruit flies detected.

The South Australian Research and Development Institute (SARDI) is the state government's principal research institute and provides Biosecurity SA with plant diagnostic, pathology and entomology advice. SARDI also undertakes targeted research and development to reduce losses from plant disease across cereal, pulse, pasture, viticulture and horticulture industries. This includes delivery of plant health diagnostic services to growers, consultants, state and national plant biosecurity authorities. The group collaborates closely with breeding companies, pre-breeding programs and the private sector to develop disease resistant plant varieties.

Construction of the $3.8 million Sterile Insect Technology facility at Port Augusta commenced in 2015 and is due for completion in September 2016. The facility will produce a male-only strain of Queensland fruit fly and forms part of the National SITplus Consortium investment of $50 million over five years, with R&D focused on developing the flies, area wide management and release strategies, and smart technology.

Plant biosecurity programs in SA are underpinned by the *Plant Health Act 2009* and *Plant Health Regulations 2009.* In addition, the Plant Quarantine Standard SA has been established under the Act to identify the relevant conditions of entry for fruit, vegetables, plants, plant products, machinery or equipment of biosecurity concern.

TASMANIA

Lead agency: Department of Primary Industries, Parks, Water and Environment (DPIPWE)
www.dpipwe.tas.gov.au

The DPIPWE Biosecurity Tasmania Division manages biosecurity policy and programs for plant pests. Branches within this division are responsible for the development and implementation of policies on barrier control, surveillance and monitoring, risk analysis, Emergency Plant Rest (EPP) response and incursion management and plant biosecurity communications.

Central to biosecurity emergency preparedness in Tasmania is the Biosecurity Emergency Preparedness Program. This program features an all-hazard approach and all Biosecurity Emergency Response Team (BERT) members receive the same training regardless of whether they are from animal, plant, fisheries or other natural resource 24 areas. At present BERT consists of over 100 registered volunteers. The Tasmanian Government's Biosecurity Policy and the Tasmanian Biosecurity Strategy provide the state framework for all government biosecurity actions and decision making processes, including EPP responses.

Plant biosecurity in Tasmania is underpinned by the *Plant Quarantine Act 1997*. When needed, this is complemented by the *Emergency Service Act 1976*. This legislation has been shown to provide an appropriate range of specific and general legislative functions and powers to deal with prevention, monitoring, control and eradication of plant pests. In addition, the various Tasmanian Government agency responsibilities are detailed in the Tasmanian Emergency Management Plan, which includes details of biosecurity emergency response arrangements.

VICTORIA

Lead agency: Victorian Department of Economic Development, Jobs, Transport and Resources (DEDJTR)
www.ecodev.vic.gov.au

The Biosecurity Branch of DEDJTR delivers biosecurity and product integrity programs across the agriculture, forest and amenity plant sectors. Activities are guided by the state's Biosecurity Strategy which aims to minimise the impact of emergency plant pest incidents on the environment and production systems and maintain access to local and overseas markets.

The Chief Plant Health Officer Unit of the Biosecurity Branch is responsible for the development, review and monitoring of policies, protocols and procedures in accordance with national and international obligations. The Agriculture Service Biosecurity Operations Branch delivers operational functions from a number of regional centres according to technical standards and protocols which are underpinned by the *Plant Biosecurity Act 2010.* Opportunities are provided under the legislation for producers and marketers to adopt quality assurance arrangements which are subject to regular audit and improvement.

Scientific and diagnostic support is provided by the Biosciences Research Branch. It provides expert technical advice to assist incursion response, market access programs and other biosecurity initiatives (e.g. industry biosecurity plans) as well as technical expert representation on national committees and working groups. This Branch and its associated Crop Health Services diagnostic business supports biosecurity by conducting relevant research and providing diagnoses in the areas of entomology, mycology, nematology, virology and bacteriology. Specialist diagnostic services and expertise has also been provided to interstate jurisdictions to support national incursion responses.

Victoria has led and managed national response programs for chestnut blight, giant pine scale and hazelnut mite. Response work also continues for Queensland fruit fly in Greater Sunraysia and surveillance to support the reinstatement of area freedom for blueberry rust.

Targeted surveillance was undertaken to maintain area freedom status for exotic fruit flies, Asian gypsy moth, Asian citrus psyllid, huanglongbing disease, black spruce longhorn beetle, brown spruce longicorn beetle, wood wasps, Japanese pine sawyer beetle and pine wilt nematode. DEDJTR has worked with the Australian Government to investigate and resolve post-border breaches of dwarf honey bee, red imported fire ant and West Indian drywood termite. Officers also investigated a significant number of suspected emergency plant pests reported by industry and the community.

WESTERN AUSTRALIA

Lead agency: Department of Agriculture and Food WA (DAFWA)
www.agric.wa.gov.au

Maintaining market access and the productive capacity of the agriculture and food sectors are the key drivers for DAFWA investment in biosecurity services. This contributes to market competitiveness, profitability and sustainability in WA. Biosecurity services are delivered through a network of dedicated and skilled staff throughout the state.

Plant biosecurity in WA is governed mainly by the *Biosecurity and Agriculture Management Act 2007.* This Act establishes a modern biosecurity regulatory system to control the entry, establishment, spread and impact of pests, control the use of agricultural and veterinary chemicals, establish standards to ensure the safety and quality of agricultural products and raise funds for biosecurity-related purposes.

Image courtesy of Barry Large.

Prevent fruit fly

Since some of the chemical control options that were commonly used to control fruit fly numbers are no longer available in Australia due to human health concerns, area wide management has become the focus of fruit fly prevention.

Area wide management is a viable method of preventing populations of fruit flies becoming troublesome for farmers, but relies on efforts from everyone in a region. Commercial producers have to deal with fruit flies in their orchards and fields, but they also need help from all other fruit and vegetable growers in the region in order to ensure that they can continue to produce good quality produce while keeping prices down.

This means that gardeners across Australia have a crucial role to play. Everyone who grows fruit and vegetables needs to control fruit fly in order to protect their own fruit and vegetables from being damaged, and to help farmers in the area. Fruit fly management is particularly important in towns in horticulture production areas and peri-urban communities, due to their proximity to commercial growers.

In 2015, PHA set up the Prevent fruit fly website which provides information on two fruit fly species of economic concern: Queensland fruit fly, present in Queensland, NT, NSW, ACT and Victoria, and Mediterranean fruit fly, which is a problem in WA but not in the eastern states of Australia. Only Tasmania and SA are fruit fly free, a status that is maintained with considerable effort. It is worthwhile, since growers in areas that are considered free of fruit fly are able to gain access to additional valuable markets.

Gardeners are advised to choose a control strategy based on their situation and ability, in order to protect their own yield as well as that of farmers in the region.

The website, established on behalf of the National Fruit Fly Council, will be further expanded to become the central hub of other fruit fly awareness raising activities across the country.

The new website encourages gardeners as well as producers to control fruit flies.

Trapping is an integral part of area wide management for fruit flies. Image courtesy of Summerfruit Australia.

1.5 Private sector plant biosecurity services

In addition to the activities performed by the Australian and state and territory governments, and industry bodies, the private sector makes a large contribution to the plant biosecurity system.

PRIVATE CONSULTANTS AND COMMERCIAL AGRONOMISTS

Private consultants and advisers in Australia provide a wide range of professional services to plant production industries and their growers. Across a range of crop types, and in most key production areas, consultants provide extensive plant biosecurity extension advice. Working closely with growers is an effective mechanism for maximising efficiency at farm level when it comes to maintaining biosecurity.

In addition to private consultants, commercial agronomists work across a wide range of Australian plant production industries, providing local services through the major distribution chains. They are backed by national technical networks which provide a comprehensive suite of services to agricultural industries. This group of professional agriculturalists supply a variety of free and consultative services across the spectrum of crops grown in Australia, including specialty services for plant biosecurity issues.

Agronomists assist producers with pest management. Image courtesy of AgNova Technologies.

PROFESSIONAL ASSOCIATIONS

A number of Australian societies and associations whose membership includes scientific professionals are linked with plant biosecurity. These organisations contribute to the development of Australia's plant biosecurity system through a range of activities including:

- Peer reviews and publication of research findings.
- Provision of pest, disease and weed notes.
- Scientific reviews.
- Convening forums to share plant biosecurity research.
- Independent comment and input into the development and implementation of plant biosecurity policy and the development of international phytosanitary standards.
- Encouraging professionalism amongst plant scientists and technicians.

Key associations include the Australasian Plant Pathology Society, the Australian Society for Microbiology, the Australian Entomological Society, the Australian Society of Agronomy and the Council of Australian Weed Societies.

AUSTRALIAN AERIAL AGRICULTURE OPERATORS

Aerial agriculture has played an important role in Australian agriculture for over half a decade. Some 300 agricultural aircraft are used to efficiently apply fertilisers, seed and, importantly for biosecurity, pesticides to a range of crops.

Aerial application allows registered farm chemicals to be used particularly when the height of the crop limits access from the ground, a pest has to be managed within a short window of opportunity or when weather or soil conditions prevent wheeled access to a crop. Agricultural aircraft pilots are highly trained and enable growers to have access to a range of professional specialised application services.

1.6 Plant Health Australia

PHA is the national coordinator of the government-industry partnership for plant biosecurity in Australia. As a not-for-profit company, PHA services the needs of its members and independently advocates on behalf of the national plant biosecurity system.

PHA achieves this by:

- Enhancing the commitment of governments and industries to work together.
- Enhancing the operation and integrity of Australia's plant pest emergency response arrangements.
- Assisting national management of biosecurity risks.
- Monitoring performance and promoting continual improvement of Australia's plant biosecurity system.
- Determining future needs of Australia's plant biosecurity system.
- Facilitating improved national investment in plant biosecurity.

PHA's efforts help to:

- Minimise plant pest impacts.
- Enhance Australia's plant health status.
- Assist trade both domestically and internationally.
- Safeguard the livelihood of producers.
- Support the sustainability and profitability of plant industries and the communities that rely upon them.
- Preserve environmental health and amenity.

All Australian Governments and most major plant-based agricultural industries are members of PHA, bringing the total number to 53. Table 2 (page 29) gives a full list of members.

Being a member enables parties to work together on biosecurity issues. It also gives members the option of being a signatory to the Emergency Plant Pest Response Deed (EPPRD), providing significant benefits for all parties in the event of an EPP incursion.

PARTNERSHIPS

Plant biosecurity in Australia operates as a partnership between governments and industries with shared responsibility for maintaining the integrity and performance of the plant biosecurity system. Shared responsibility for biosecurity was established in recognition that, in addition to plant producers, the wider Australian community benefits from good biosecurity. Benefits include improved productivity, product quality, market access, trade, profitability, sustainability and environmental preservation.

Fostering, strengthening and expanding the government-industry partnership is a primary role for PHA. Through PHA, current and future needs of the plant biosecurity system can be mutually agreed upon, issues identified and solutions to problems found. PHA's independence fosters an impartial approach to servicing member needs, allowing the company to put the interests of the plant biosecurity system first as well as supporting a long term view.

STRATEGIC PERSPECTIVE

PHA's independence and expertise enable the company to take a lead in monitoring the performance of the national biosecurity system and determining its future needs. In close consultation with stakeholders, PHA formulates the strategies, plans and reports that contribute to government and industry policy development, facilitates improved national coordination and collaboration, and targets member efforts and investment to best effect. The National Plant Biosecurity Strategy (Section 1.2) and this status report are examples of this work.

EMERGENCY RESPONSES

Another central role for PHA is the establishment of funding and management arrangements for effective responses to EPP incursions. PHA undertakes this role through its custodianship and administration of the EPPRD and PLANTPLAN, the agreed operational response plan for suspected exotic pests of significance (Chapter 4).

PHA convenes regular meetings of signatories to the EPPRD and facilitates modifications to the agreement to take account of new information and procedural improvements that are identified through post-EPP incident reviews. To assist members to meet their obligations as signatories to the EPPRD and improve their emergency response preparedness, PHA provides a range of services including contingency planning, surveillance and diagnostic systems support, response training and simulation exercises.

PEST RISK MITIGATION

Beyond its contribution to response arrangements, PHA supports the national plant biosecurity system by coordinating and assisting efforts to reduce the risks posed by emergency plant pests. This is achieved in large part by supporting industries and governments to develop strategies and plans that improve biosecurity standards as well as providing assistance with implementation of agreed risk mitigation measures. Biosecurity plans, biosecurity manuals for producers and awareness raising extension services are examples of activities that PHA undertakes with and on behalf of members. Honey bees are included in PHA because of the benefits that pollination brings to crop yield.

FUNDING

PHA's main activities are funded from annual subscriptions paid by members, as detailed in PHA's Annual Operational Plan.

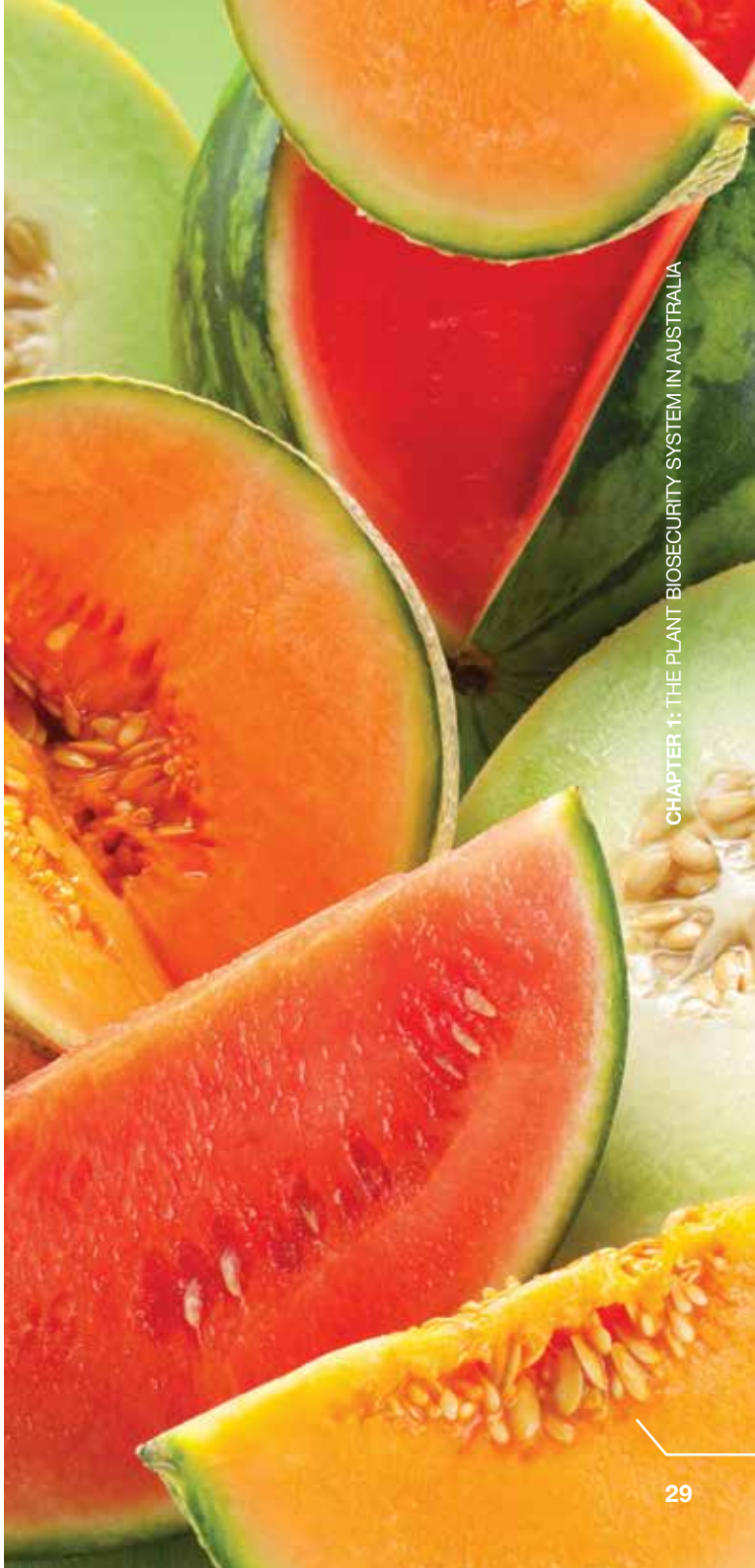
A range of separately funded projects are also undertaken for individual members or groups of members. Non-subscription funded projects boost biosecurity for particular industries. Examples include biosecurity officers who work with growers, government and industry partnership initiatives for honey bee health and manuals and plans for non-members.

Table 2. Plant Health Australia's members at end December 2015

Industry members
Almond Board of Australia Inc.
Apple and Pear Australia Ltd
Australian Banana Growers' Council
Australian Forest Products Association Limited
Australian Ginger Industry Association
Australian Honey Bee Industry Council Inc.
Australian Lychee Growers' Association
Australian Macadamia Society Ltd
Australian Mango Industry Association Ltd
Australian Melon Association Inc.
Australian Olive Association Ltd
Australian Processing Tomato Research Council Inc.
Australian Table Grape Association Inc.
Australian Walnut Industry Association
AUSVEG Limited
Avocados Australia Ltd
CANEGROWERS
Canned Fruit Industry Council of Australia
Cherry Growers of Australia Inc.
Chestnuts Australia Incorporated
Citrus Australia Ltd
Cotton Australia Ltd
Dried Fruits Australia Inc.
Grain Producers Australia Limited
GROWCOM
Hazelnut Growers of Australia Incorporated
Nursery and Garden Industry Australia Ltd
Onions Australia
Passionfruit Australia Incorporated
Pistachio Growers Association Incorporated
Raspberries and Blackberries Australia Inc.
Ricegrowers' Association of Australia Inc.
Strawberries Australia Inc.
Summerfruit Australia Limited
Wine Grape Growers Australia

Government members
Commonwealth of Australia
Australian Capital Territory Government
New South Wales Government
Northern Territory Government
Queensland Government
South Australian Government
Tasmanian Government
Victorian Government
Western Australian Government

Associate members
AgNova Technologies
Cotton Research and Development Corporation
CSIRO
Grains Research and Development Corporation
Horticulture Innovation Australia
Plant Biosecurity CRC
Sugar Research Australia
Victorian Farmers Federation
Wine Australia



1.7 Australia's plant production industries

INDUSTRY REPRESENTATIVE BODIES AND GROWERS

Many of Australia's farmers have peak representative bodies that act on behalf of their members, who are usually growers, on a range of activities including biosecurity.

Industry groups may provide funding at regional, state or national levels for specific plant biosecurity activities, such as research and development, management initiatives and emergency responses. Industries can also set biosecurity priorities that deliver outcomes specific to their needs.

They provide a voice for growers at meetings and conferences and on committees that determine the direction of plant biosecurity in Australia including any emergency plant pest responses. Furthermore, industry groups negotiate and work with government departments on biosecurity issues ranging from international market access through to pest surveillance activities. Industry personnel also represent their industries in any emergency plant pest response activities.

Industry representative bodies play an important part in Australia's biosecurity system by raising awareness among growers of the importance of biosecurity, the key pests they need to protect against and how to implement biosecurity on-farm and along the supply chain.

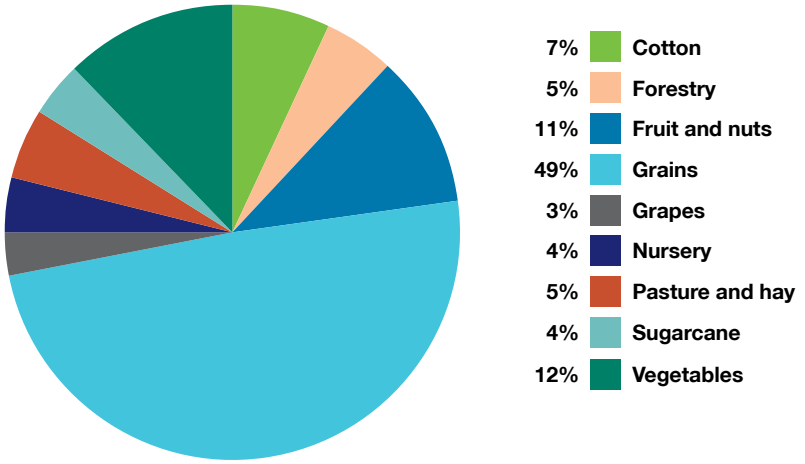
Growers also have an important role to play in supporting Australia's biosecurity on-farm. Each producer needs to implement good biosecurity practices to protect their crops, their livelihood, the region and, in turn, the industry from both endemic and exotic pests. See On-farm biosecurity in Chapter 3.

CROP PRODUCTION SUMMARY

Australian agriculture, of which plant production industries make up over half in value, is an integral part the nation's economy. Plant production industries contributed over $29.1 billion in 2014–15 to annual agricultural production.

Figure 4 shows the contribution of each of the main plant production industries to total plant gross production value in 2013–14 (the latest year for which this breakdown is available).

Figure 4. Comparative value of Australia's plant production industries, based on gross value of production, 2013–14



The industry profiles that follow (for PHA members) show trends in local value of production (LVP), which is the value of agricultural commodities at the farm gate (Australian Bureau of Statistics, 2016). The distribution of production between the states and territories and a list of high priority pests (HPPs) that have been identified as posing the main threats to each industry are also shown.

Industry profiles

Production values for industries shown in this section are for the latest available year. Data are from the Australian Bureau of Statistics or appropriate peak industry bodies and are given only for PHA members.

Image courtesy of Cotton Australia.

ALMONDS

Represented by the Almond Board of Australia Inc.
www.australianalmonds.com.au

In 2013–14, almond production was valued at $342 million (LVP). About three-quarters of Australian almonds are exported, going to 50 countries, with Europe the largest market and India the most valuable export country.

The Australian almond industry is concentrated in Victoria, SA and NSW with almost 30,000 hectares of cultivated almond trees. The industry is undergoing enormous expansion. Production has risen from 12,000 tonnes in 2005 to 80,000 tonnes in 2015. It is predicted that another 15,000 hectares will be planted with almond orchards over the next three years with an expected yield of 130,000 tonnes by 2025.

The almond industry is covered by version 2.0 of the nut biosecurity plan and the Orchard Biosecurity Manual for the Almond Industry Version 1.0.

Table 3. High Priority Pests of the almond industry

Scientific name	Common name
Amyelois transitella	Navel orangeworm
Chinavia hilaris	Green stink bug; pistachio bug
Leptoglossus clypealis	Leaf footed bug
Leptoglossus occidentalis	Western conifer seed bug
Leptoglossus zonatus	Western leaf footed bug
Trogoderma granarium	Khapra beetle
Verticillium dahliae (exotic defoliating strains)	Verticillium wilt
Xylella fastidiosa (including *Xylella fastidiosa* subsp. *Fastidiosa; Xylella fastidiosa* subsp. *Multiplex; Xylella fastidiosa* subsp. *Piercei)*	Almond leaf scorch; pecan bacterial leaf scorch

Navel orangeworm. Image courtesy of Jack Kelly Clark, University of California Statewide IPM Program.

Almond leaf scorch. Image courtesy of Jack Kelly Clark, University of California Statewide IPM Program.

Figure 5. Annual value of almond production, 2007–14

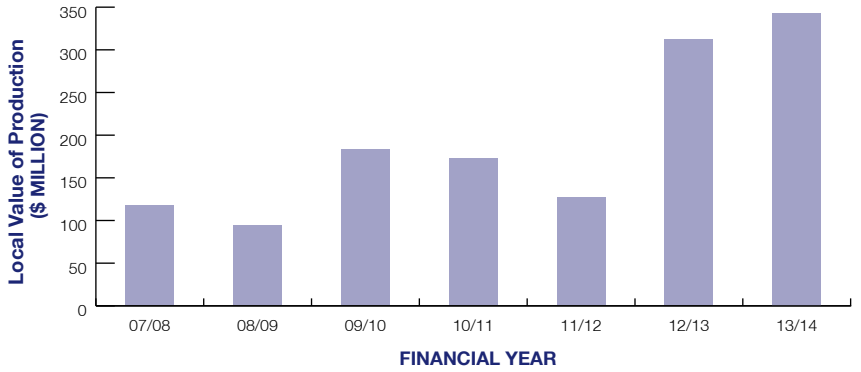
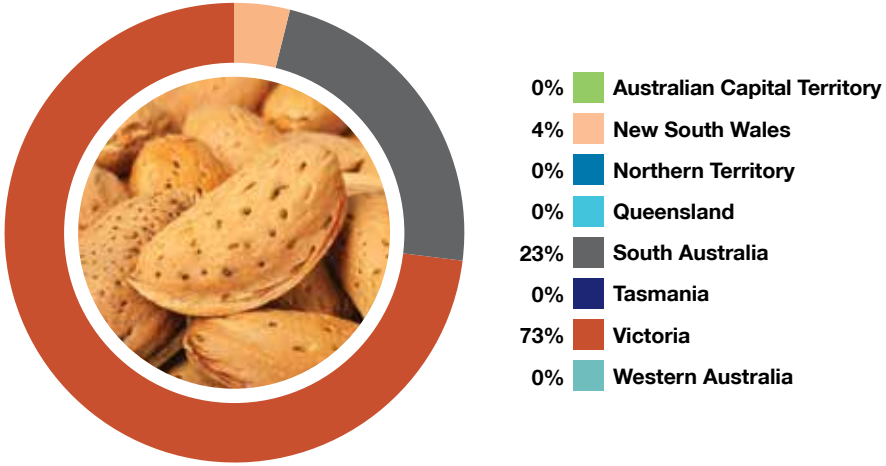


Figure 6. Distribution of almond production by state and territory, 2013–14 (based on LVP)



APPLES AND PEARS

Represented by Apple and Pear Australia Ltd
www.apal.org.au

In 2013–14, apple and pear production was valued at $457 million (LVP). The most popular apple varieties are Cripps Pink (Pink Lady™), Royal Gala™ and Granny Smith, whilst for pears Packham and Williams dominate.

The major production area for the Australian apple and pear industry is in Victoria, primarily in southern Victoria and the Goulburn Valley. This area produces 43 per cent and 89 per cent of Australia's apples and pears respectively. Other major growing areas include Stanthorpe in Queensland, Batlow and Orange in NSW, the Huon and Tamar Valleys in Tasmania, the Adelaide Hills in SA, and Donnybrook, Manjimup and the Perth Hills in WA.

The majority of apple production is consumed domestically, with less than five per cent exported to the premium markets of the United Kingdom and Europe and the markets of south east Asia.

The apple and pear industry is covered by version 2.01 of the apple and pear biosecurity plan and the Orchard Biosecurity Manual for the Apple and Pear Industry Version 2.0.

Table 4. High Priority Pests of the apple and pear industry

Scientific name	Common name
Bactrocera dorsalis	Oriental fruit fly
Conotrachelus nenuphar	Plum curculio
Drosophila suzukii	Spotted-winged drosophila
Dysaphis plantaginea	Rosy apple aphid
Erwinia amylovora	Fire blight
Gymnosporangium juniperi-virginianae	Cedar apple rust
Lymantria dispar	Asian gypsy moth
Monilinia fructigena	Brown rot
Neonectria ditissima	European canker
Rhagoletis pomonella	Apple maggot

Figure 7. Annual value of apple and pear production, 2007–14

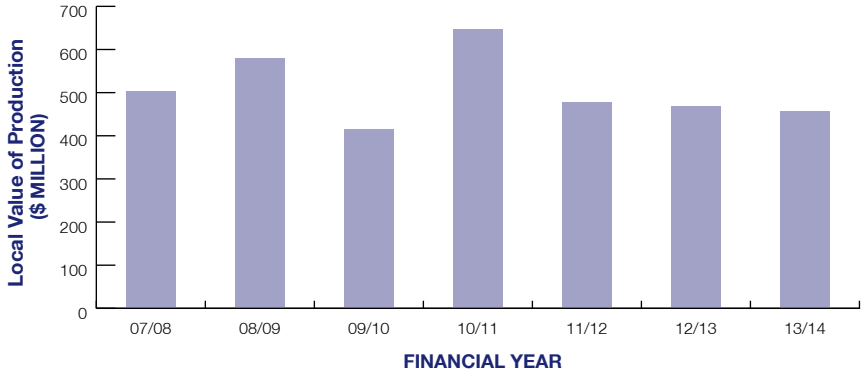
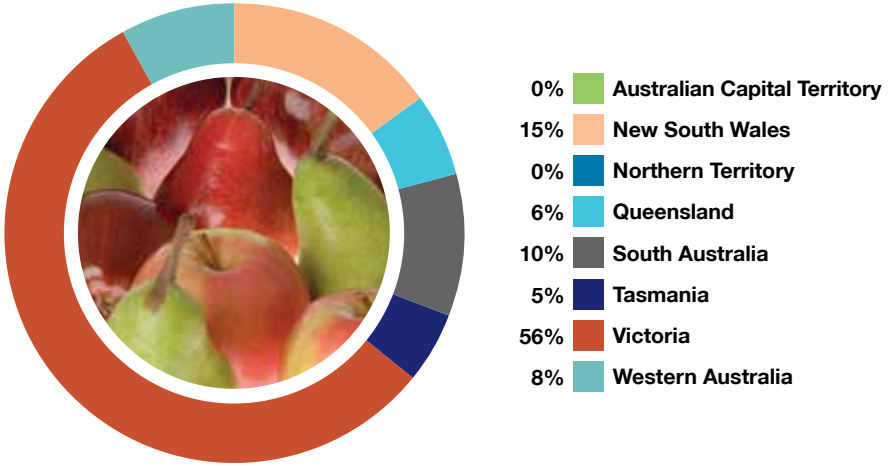


Figure 8. Distribution of apple and pear production by state and territory, 2013–14 (based on LVP)



AVOCADOS

Represented by Avocados Australia Ltd
www.avocado.org.au

In 2013–14, avocado production was valued at $184 million (LVP). The Hass variety is the predominant avocado produced in Australia, accounting for approximately 80 per cent of production, with Shepard accounting for about 15 per cent. A number of other varieties such as Reed, Wurtz, Sharwil and Fuerte make up the balance. Exports are mostly shipped to Singapore and Malaysia.

Queensland dominates Australia's avocado production, followed by WA, NSW, SA and Victoria.

The avocado industry is covered by the avocado biosecurity plan version 2.01 and the Orchard Biosecurity Manual for the Avocado Industry Version 1.0.

Figure 9. Distribution of avocado production by state and territory, 2013–14 (based on LVP)

Figure 10. Annual value of avocado production, 2007–14

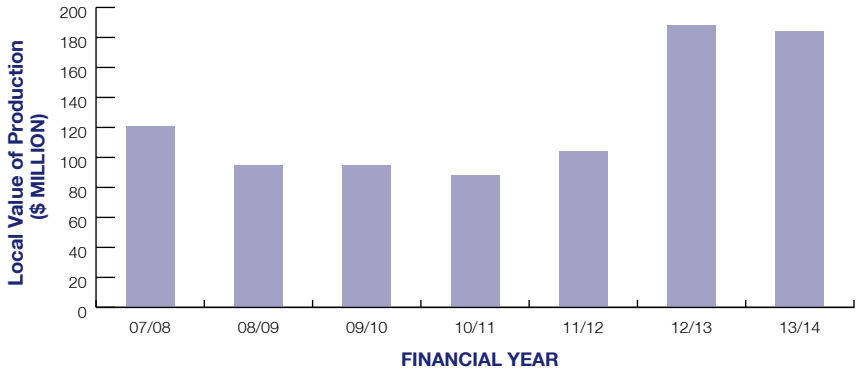


Image courtesy of Avocados Australia.

Table 5. High Priority Pests of the avocado industry

Scientific name	Common name
Avocado sunblotch viroid (symptomatic strains)	Avocado sunblotch
Bactrocera carambolae	Carambola fruit fly
Bactrocera cucurbitae	Melon fruit fly
Bactrocera dorsalis	Oriental fruit fly
Bactrocera facialis	Tropical fruit fly
Bactrocera kandiensis	Fruit fly
Bactrocera kirki	Fijian fruit fly
Bactrocera melanotus	Fruit fly
Bactrocera papayae	Papaya fruit fly
Bactrocera passiflorae	Fijian fruit fly
Bactrocera philippinensis	Philippine fruit fly
Bactrocera xanthodes	Pacific fruit fly
Conotrachelus aguacatae (Barber)	Small avocado seed weevil
Conotrachelus perseae	Small seed weevil
Erwinia herbicola	Avocado blast complex
Heilipus lauri (Boheman)	Large seed weevil
Oligonychus persea (Tuttle, Baker and Abbatiello)	Persea mite
Pseudomonas syringae	Avocado blast complex
Pseudomonas syringae pv. *Syringae* van Hall	Bacterial canker complex
Scirtothrips perseae (Nakahara)	Thrips
Stenoma catenifer (Walsingham)	Stenomid (avocado) moth

BANANAS

Represented by the Australian Banana Growers' Council Inc.
www.abgc.org.au

In 2013–14, banana production was valued at $304 million (LVP). There are currently about 13,500 hectares of bananas grown in Australia.

Bananas are grown all year round with the two main varieties being Cavendish and Lady Fingers. The Cavendish variety accounts for the vast majority of production. The Australian banana industry only supplies the domestic market.

Around 95 per cent of bananas are grown in Queensland, from Ingham to Hopevale (including the Tablelands).

The Australian banana industry is currently involved in two major biosecurity responses for banana freckle in the Northern Territory and Panama Disease Tropical Race 4 (TR4) in north Queensland. There is also a major banana bunchy top virus containment project running in northern NSW and south east Queensland. Additionally, an officer is employed to undertake inspections for the presence of yellow sigatoka in the North Queensland commercial production area.

To contain the TR4 incursion in north Queensland, a TR4 Biosecurity Extension Project has been jointly funded by the Queensland and Australian governments, and is being delivered by the Australian Banana Growers' Council. See box on page 97 for information about the TR4 response.

The banana industry is covered by version 2.0 of the banana industry biosecurity plan and the Farm Biosecurity Manual for the Banana Industry Version 1.0. A review of the biosecurity plan is expected to commence in 2016.

Figure 11. Annual value of banana production, 2007–14

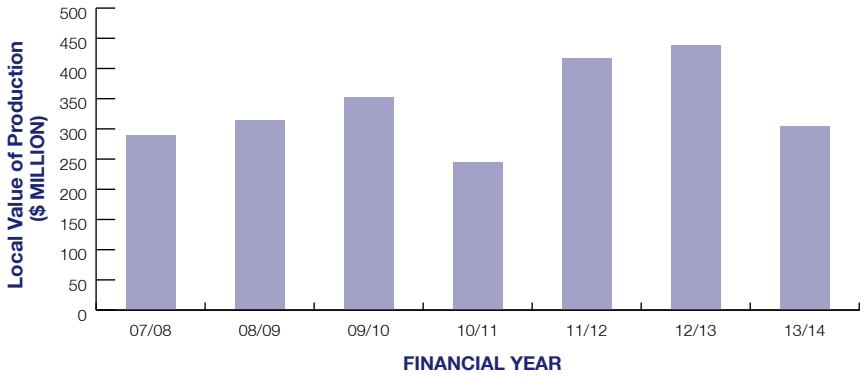


Table 6. High Priority Pests of the banana industry

Scientific name	Common name
Abaca bunchy top virus (Babuvirus)	*Abaca* bunchy top virus
Banana bract mosaic virus (Potyvirus)	Banana bract mosaic disease
Banana bunchy top virus (Nanovirus)	Banana bunchy top disease
Blood disease bacterium	Blood disease
Erionota thrax	Banana skipper butterfly
Fusarium oxysporum f. sp. *cubense*	Panama disease, tropical race 4
Guignardia musae	Banana freckle
Mycosphaerella eumusae	Eumusae leaf spot
Mycosphaerella fijiensis	Black sigatoka
Ralstonia solanacearum, race 2	Moko
Tetranychus piercei	Banana spider mite

Figure 12. Distribution of banana production by state and territory, 2013–14 (based on LVP)

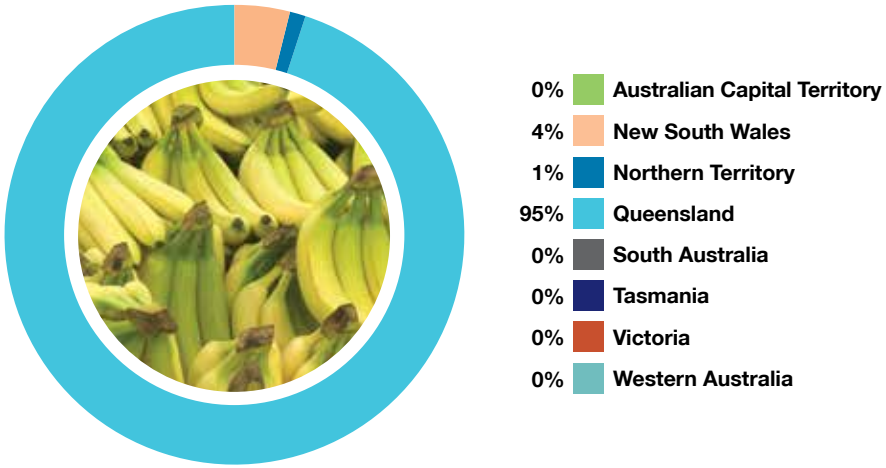


Image courtesy of the Australian Banana Growers' Council Inc.

CANNED FRUITS

Represented by the Canned Fruits Industry Council of Australia
www.fgv.com.au

In 2013–14, production of canned fruit was valued at $13 million (LVP) which was a reduction from the 2012–13 production year when canned fruit was valued at $26 million. Fruit production for canning is carried out from December to May each season and volumes of between 80,000 to 100,000 tonnes are processed annually.

The industry represents more than 300 fruit growing, packing and exporting businesses.

The canned fruits industry is primarily based in the Goulburn–Murray Valleys region of Victoria, processing Australian apples, pears and stone fruit (peaches, apricots and plums).

The canned fruit industry does not have a specific biosecurity plan or manual, but plans and manuals for the pome fruit (apple and pear) and stone fruit (summerfruit) industries contain information of relevance to biosecurity for canned fruit production.

Image courtesy of Canned Fruits Industry Council of Australia.

Figure 13. Annual value of canned fruit production, 2007–14

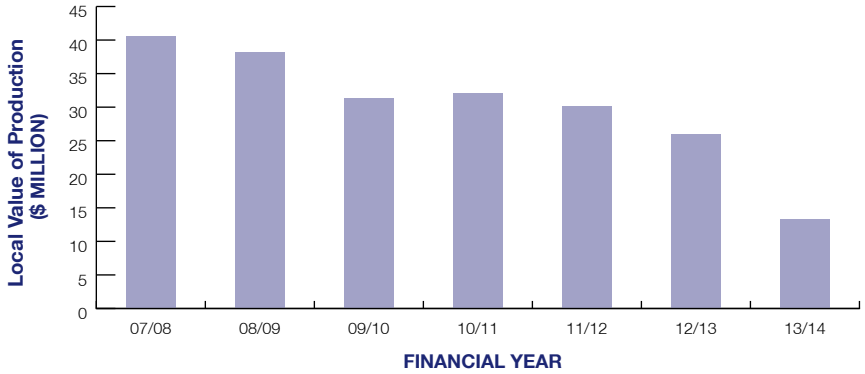
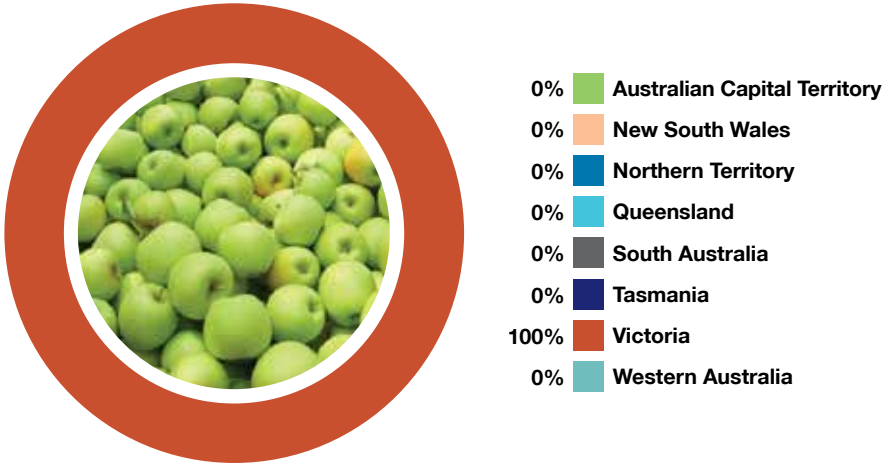


Figure 14. Distribution of canned fruit production by state and territory, 2013–14 (based on LVP)



CHERRIES

Represented by Cherry Growers of Australia Inc.
www.cherrygrowers.org.au

In 2013–14, cherry production was valued at $127 million (LVP). The main varieties grown are Lapin, Sweetheart, Sweet Georgia, Merchant, Stella, Bing, Van, Simone, Regina, Samba and Stacarto.

The Australian cherry industry is concentrated in the following regions: 800 hectares in NSW (Hillston/Narromine, Orange and Young, and Batlow/Tumut); 800 hectares in Victoria (Swan Hill/Sunraysia, Goulburn Valley, north-eastern Victoria, Yarra Valley/Dandenongs); 600 hectares in Tasmania (Huon Valley/Channel, Derwent Valley, Coal Valley, Tamar Valley and north-western Tasmania); 500 hectares in SA (Adelaide Hills, Riverland and south east SA); 70 hectares in WA (Perth Hills, Donnybrook/Manjimup and Mt Barker); and 25 hectares in Queensland (Stanthorpe/Granite Belt).

About 10,000 tonnes of cherries are consumed domestically and another 6,000 tonnes exported at a value of $73 million. Exports are currently shipped to 30 countries, with the top six destinations being Hong Kong, China, Taiwan, Singapore, Korea and the Middle East.

The Australian cherry industry is covered by version 2.01 of the cherry biosecurity plan and the Orchard Biosecurity Manual for the Cherry Industry Version 1.0.

Figure 15. Distribution of cherry production by state and territory, 2013–14 (based on LVP)

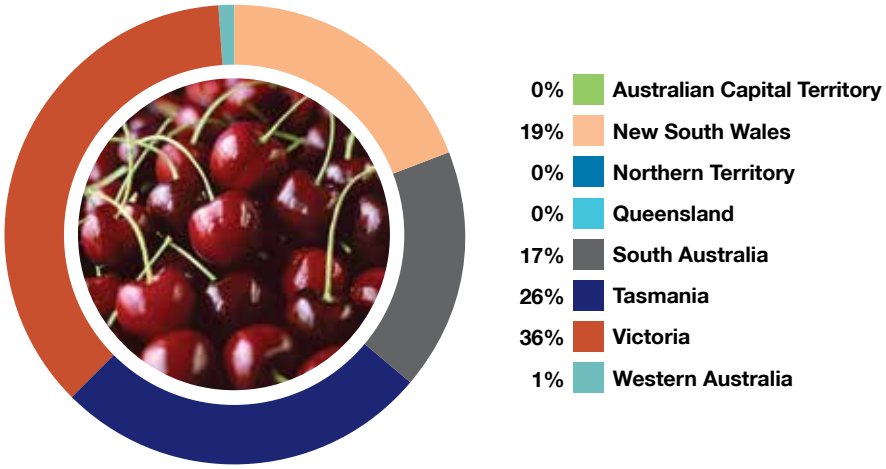


Figure 16. Annual value of cherry production, 2007–14

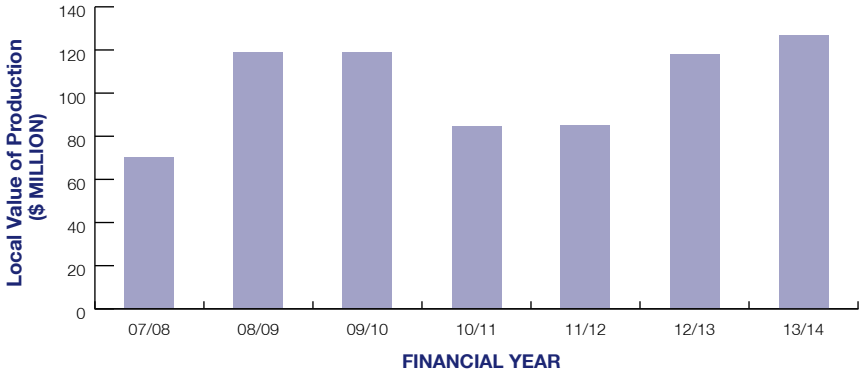


Table 7. High Priority Pests of the cherry industry

Scientific name	Common name
Cherry leaf roll virus (*Nepovirus*) (exotic strains)	Blackline
Choristoneura rosaceana	Oblique banded leaf roller
Conotrachelus nenuphar	Plum curculio
Ctenopseustis obliquana	Brown headed leaf roller
Drosophila suzukii	Spotted-winged drosophila
European stone fruit yellows phytoplasma	European stone fruit yellows
Little cherry virus 1 (unassigned)	Little cherry virus 1
Little cherry virus 2 (*Ampelovirus*)	Little cherry virus 2
Monilinia fructigena	Brown rot
Neonectria ditissima	European canker
Pandemis cerasana	Cherry brown tortrix
Phymatotrichum omnivorum	Texas root rot
Planotortrix octo	Green headed leaf roller
Plum pox virus (*Potyvirus*)	Plum pox virus
Podosphaera clandestina var. *clandestina* (exotic strains)	Powdery mildew of cherry
Rhagoletis fausta	Black cherry fruit fly
Rhagoletis indifferens	Western cherry fruit fly
Rhagoletis pomonella	Apple maggot
X disease phytoplasma	Peach X disease
Xylella fastidiosa	Pierce's disease

Plum curculio. Image courtesy of E. Levine, The Ohio State University, bugwood.org.

European canker. Image courtesy Abrahami.

CHESTNUTS

Represented by Chestnuts Australia Inc
www.chestnutsaustralia.com.au

In 2013–14, chestnut production was valued at $6.5 million (LVP). In 2015 there were around 1,300 hectares containing about 200,000 chestnut trees. It is estimated that with more trees planted, production will rise to approximately $9.8 million by 2020.

The main varieties grown are Red Spanish, Purton's Pride and De CoppiMarone. Chestnuts flower during November and December and are harvested from March through to May. The industry is primarily focused on the domestic market with approximately two per cent exported, mainly to Asian markets.

The Australian chestnut industry operates principally in the southern states of Australia, primarily in Victoria.

Chestnuts Australia Inc is an integral part of the chestnut blight eradication program, being represented on both the NMG and the CCEPP. During 2015, the chestnut industry activated their EPPR Levy, to 1 cent per kilogram, to fund part of the eradication program.

Aspects of biosecurity are well embedded in the Australian Chestnut Industry Five Year Strategic Plan – 2015 to 2020.

The chestnut industry is covered by version 2.0 of the nut biosecurity plan.

Table 8. High Priority Pests of the chestnut industry

Scientific name	Common name
Dryocosmus kuriphilus	Oriental chestnut gall wasp
Lymantria dispar	Gypsy moth (Asian and European strains)
Cryphonectria parasitica	Chestnut blight
Verticillium dahliae (exotic defoliating strains)	Verticillium wilt
Phytophthora ramorum	Sudden oak death

Figure 17. Annual value of chestnut production, 2009–14

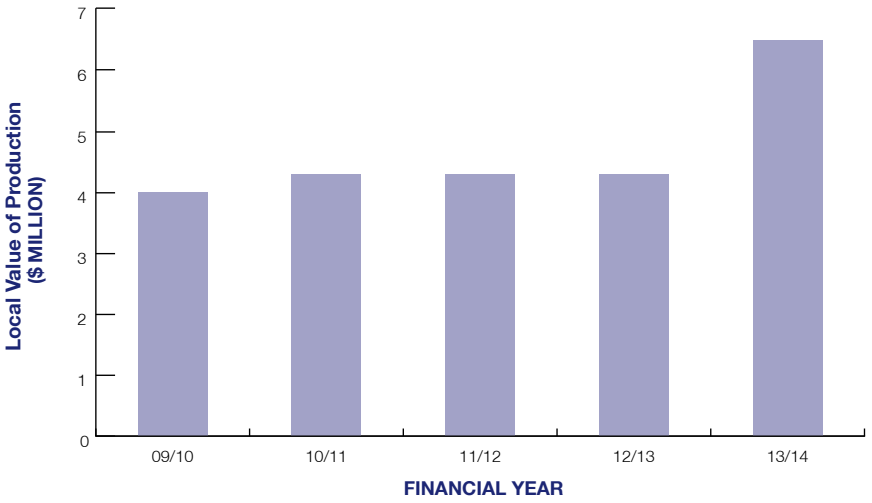


Figure 18. Distribution of chestnut production by state and territory, 2013–14 (based on LVP)

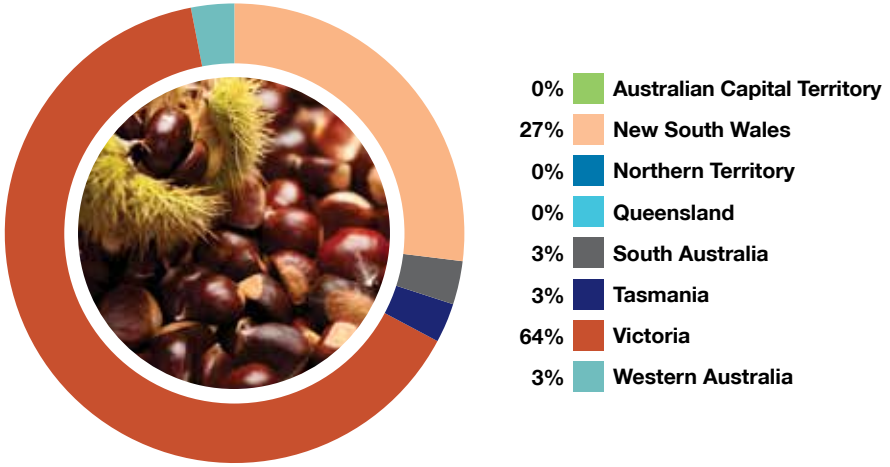


Image courtesy of Citrus Australia.

CITRUS

Represented by Citrus Australia Ltd
www.citrusaustralia.com.au

In 2013–14, citrus production (oranges, mandarins, lemons, limes and grapefruit) was valued at $446 million (LVP). In 2014, production of citrus was estimated to be 620,000 tonnes. Currently, there are about 28,000 hectares of citrus plantings nationally.

Citrus is the largest fresh fruit exporting industry in Australia with major export markets including Hong Kong, Japan, China, Malaysia, Indonesia, Singapore, the United States and New Zealand.

Citrus fruits are grown commercially throughout Australia, with the exception of Tasmania and the Australian Capital Territory. Major growing areas include the Riverina (NSW), Central Burnett and Emerald (Queensland), Riverland (SA) and Murray Valley (Victoria/NSW). Production also occurs in WA and there are a small number of plantings in NT.

The Citrus Biosecurity Project, which is funded by Hort Innovation and jointly managed by PHA and Citrus Australia, continued through 2015, boosting the preparedness of the citrus industry for serious exotic pests.

The citrus industry is covered by version 3.0 of the citrus biosecurity plan and the Biosecurity Manual for Citrus Producers Version 2.0.

Figure 19. Distribution of citrus production by state and territory, 2013–14 (based on LVP)

0%	Australian Capital Territory
49%	New South Wales
0%	Northern Territory
1%	Queensland
36%	South Australia
0%	Tasmania
11%	Victoria
3%	Western Australia

Figure 20. Annual value of citrus production, 2007–14

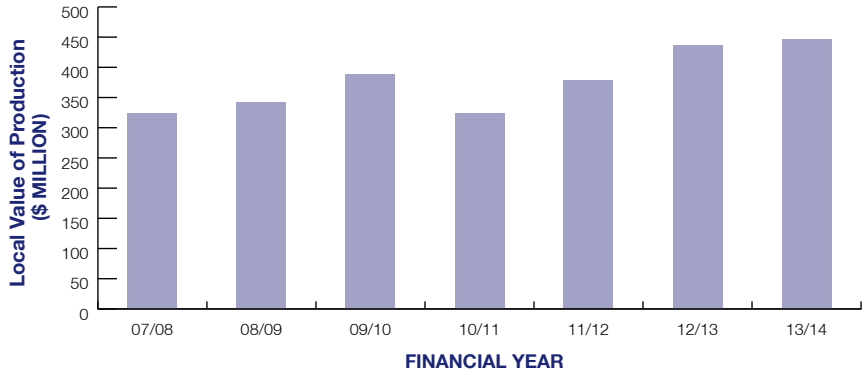


Image courtesy of Citrus Australia.

Table 9. High Priority Pests of the citrus industry

Scientific name	Common name
Anastrepha ludens	Mexican fruit fly
Bactrocera carambolae	Carambola fruit fly
Bactrocera dorsalis	Oriental fruit fly
*Bactrocera invadens**	Fruit fly
Bactrocera kandiensis	Fruit fly
Bactrocera occipitalis	Fruit fly
*Bactrocera papayae**	Papaya fruit fly
*Bactrocera philippinensis**	Philippine fruit fly
Bactrocera trivialis	New Guinea fruit fly
Caliothrips fasciatus	Bean thrips
Candidatus Liberibacter africanus	Huanglongbing (African strain)
Candidatus Liberibacter americanus	Huanglongbing (American strain)
Candidatus Liberibacter asiaticus	Huanglongbing (Asiatic strain)
Citripestis sagittiferella	Citrus fruit borer
Citrus leprosis virus (Cilevirus)	Citrus leprosis
Citrus tristeza virus (Closterovirus) (exotic strains)	Mandarin stem-pitting/citrus tristeza
Diaphorina citri	Asiatic/Asian citrus psyllid
Frankliniella bispinosa	Florida flower thrips
Homalodisca vitripennis	Glassy-winged sharpshooter
Spiroplasma citri	Citrus stubborn disease
Trioza erytreae	African citrus psyllid
Xanthomonas citri subsp. *Citri*	Citrus canker
Xylella fastidiosa subsp. *Pauca*	Citrus variegated chlorosis

* This species has been synonymised with *Bactrocera dorsalis*

COTTON

Represented by Cotton Australia Ltd
www.cottonaustralia.com.au

In 2013–14, cotton production was valued at $2 billion (LVP).

Australian cotton yields are high by international standards—nearly three times the world average. Almost the entire Australian cotton crop is exported, with two thirds sold to China and the remainder mainly to spinning mills in Asia. Australia is the fourth largest cotton exporter in the world, behind the United States, India and Brazil.

Cotton is grown in most of the major inland river valleys of eastern Australia, in a belt stretching from central Queensland in the north, to the Murrumbidgee Irrigation Area and Menindee Lakes in southern and western NSW. Approximately 66 per cent of the national crop is grown in NSW with the remainder grown in Queensland. Cotton is generally grown as an annual irrigated summer crop in fertile alluvial floodplain soils and, in an average season, rain grown cotton represents approximately 16 per cent of the total planted area.

The cotton industry is covered by version 3.0 of the biosecurity plan for the cotton industry and the Farm Biosecurity Manual for the Cotton Industry Version 1.1.

Table 10. High Priority Pests of the cotton industry

Scientific name	Common name
Anthonomus grandis	Cotton boll weevil
Aphis gossypii (exotic strains)	Cotton aphid
Bemisia tabaci (exotic strains)	Silverleaf whitefly
Cotton leaf curl virus (*Begomovirus*)	Cotton leaf curl disease
Cotton leafroll dwarf virus (Polerovirus)	Cotton blue disease
Dysdercus spp. (including: *D. honestus, D. maurus, D. suturellus* (American species))	Cotton strainer; red bugs
Fusarium oxysporum f. sp. *vasinfectum* (exotic races)	*Fusarium* wilt (exotic races)
Halyomorpha halys	Brown mamorated stink bugs
Helicoverpa armigera	Cotton bollworm; African boll worm
Lygus hesperus	Western plant bug
Lygus lineolaris	Tarnished plant bug
Phymatotrichopsis omnivora	Texas root rot
Thaumatotibia leucotreta	False codling moth
Verticillium dahliae (defoliating strain)	*Verticillium* wilt
Xanthomonas citri subsp. *Malvacearum*	Bacterial blight/angular leaf spot

Figure 22. Annual value of cotton production, 2007–14

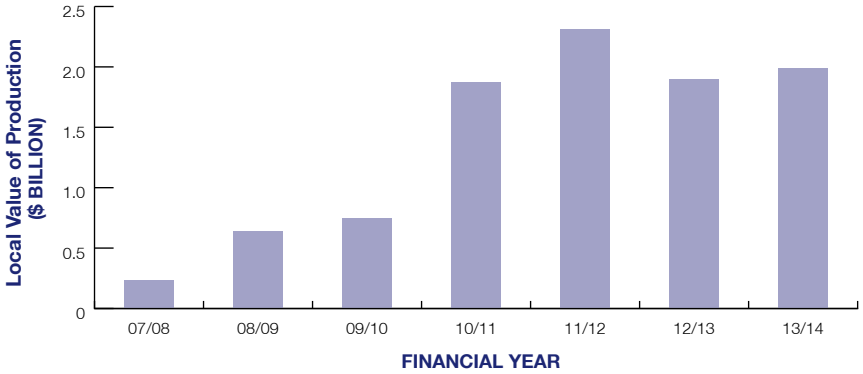
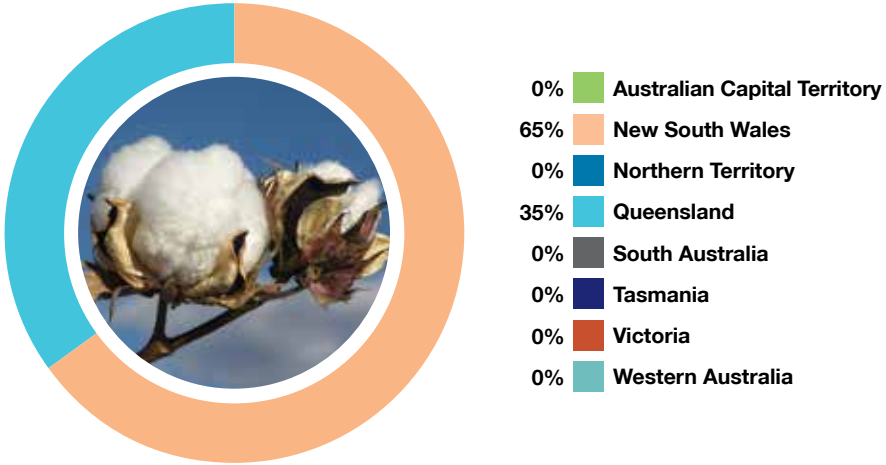


Figure 21. Distribution of cotton production by state and territory, 2013–14 (based on LVP)



DRIED FRUIT

Represented by Dried Fruits Australia Inc.
www.driedfruitsaustralia.org.au

In 2013–14, dried fruit production (sultanas, currants, raisins and sunmuscats) was valued at $33 million (LVP).

The main export markets for dried fruit are dominated by Germany (40 per cent), the United Kingdom (25 per cent) and New Zealand (11 per cent).

In Australia, grapes are grown for the dried fruit industry in the Sunraysia region which spans north western Victoria and south western NSW around the Murray River, and to a lesser extent, in the SA Riverland.

The dried fruit industry regularly distributes biosecurity information and guidelines from PHA to its members via a quarterly publication, The Vine. The viticulture biosecurity manual has been distributed to dried fruit growers through the major industry processors, Sunbeam Foods and Australian Premium Dried Fruits. The industry also undertakes EPPRD training in order to understand the roles and responsibilities of their officers in the event of a pest incursion.

The dried fruit industry is covered by version 3.0 of the biosecurity plan for viticulture and the Biosecurity Manual for the Viticulture Industry Version 1.0.

Figure 23. Distribution of dried fruit production by state and territory, 2013–14 (based on LVP)

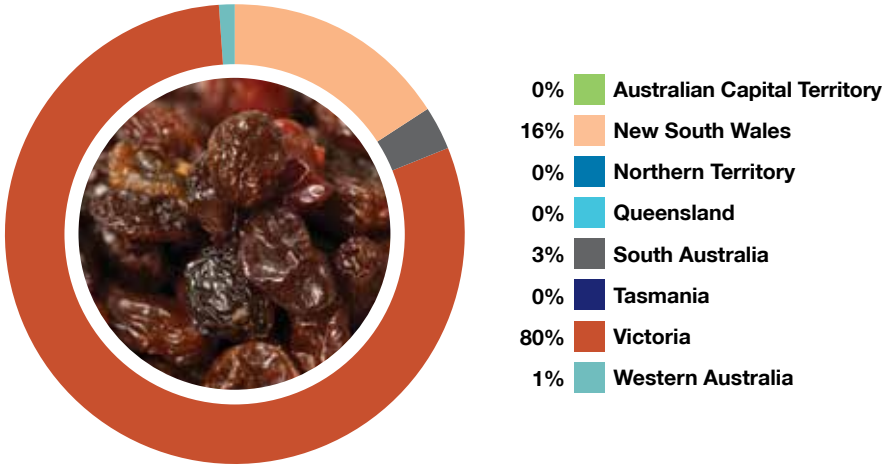


Figure 24. Annual value of dried fruit production, 2007–14

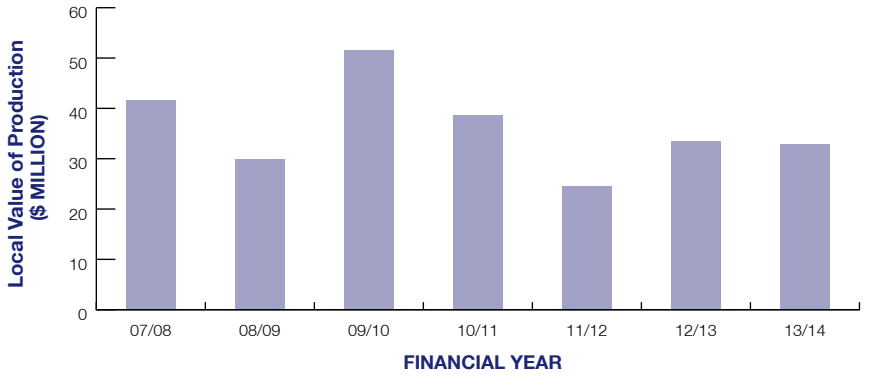


Table 11. High Priority Pests of the dried fruit industry

Scientific name	Common name
Bactrocera carambolae	Carambola fruit fly
Bactrocera dorsalis	Oriental fruit fly
*Bactrocera papayae**	Papaya fruit fly
Candidatus Phytoplasma solani	Bois noir
Daktulosphaira vitifoliae (exotic strains)	Grapevine phylloxera
Drosophila suzukii	Spotted-winged drosophila
Grapevine flavescence dorée phytoplasma	Flavescence dorée
Guignardia bidwellii	Black rot
Homalodisca vitripennis	Glassy-winged sharpshooter
Hyalesthes obsoletus	Cixiidae planthopper
Lobesia botrana	European grapevine moth
Planococcus ficus	Vine mealybug
Polychrosis viteana	American berry moth
Pseudococcus maritimus	Grape mealybug
Xylella fastidiosa	Pierce's disease

* This species has been synonymised with *Bactrocera dorsalis*

GINGER

Represented by Australian Ginger Industry Association
www.australianginger.org.au

In 2013–14, ginger production was valued at $32 million (LVP). Land under ginger cultivation is approximately 280 hectares, which produces around 8,400 tonnes of fresh ginger. It is available year round.

The main ginger varieties grown in Australia are Queensland and Jumbo (Canton). The entire Australian ginger crop is produced for the domestic market. Approximately 60 per cent of ginger produced in Australia is sold as fresh ginger and the remaining 40 per cent is processed.

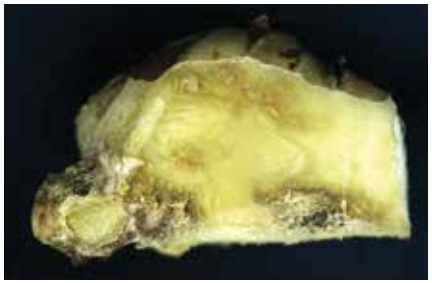
The Australian ginger industry is based predominantly in south east Queensland, followed by the Widebay region and very small percentages in far north Queensland and northern NSW.

The ginger industry is covered by version 1.0 of the biosecurity plan for the ginger industry.

Table 12. High Priority Pests of the ginger industry

Scientific name	Common name
Aspidiella hartii	Yam scale
Elytroteinus subtruncatus	Fijian ginger weevil
Radopholus similis (exotic strains)	Burrowing nematode
Ralstonia solanacearum, race 4 (exotic strains)	Bacterial wilt

Ralstonia solanacearum. Image courtesy of Bruce Mathews, University of Hawaii at Hilo College of Agriculture, Forestry & Natural Resource Management.



Burrowing nematode. Image courtesy of bugwood.org.

Figure 25. Annual value of ginger production, 2010–14

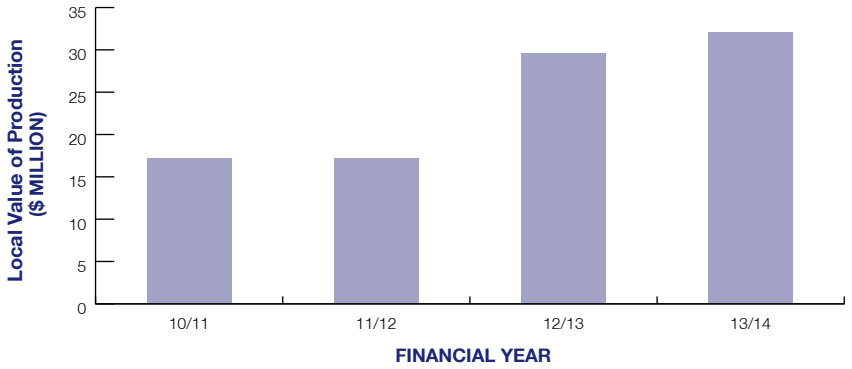
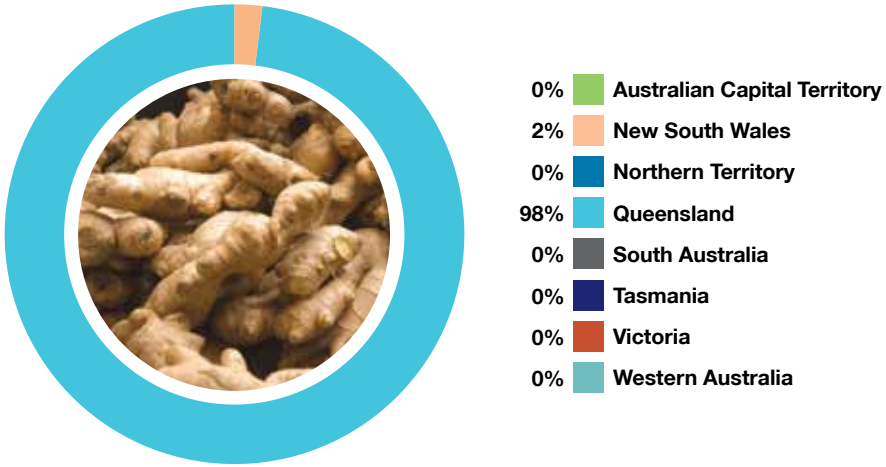


Figure 26. Distribution of ginger production by state and territory, 2013–14 (based on LVP)



GRAINS

Represented by Grain Producers Australia Ltd
www.grainproducers.com.au

In 2013–14, grain production (wheat, barley, canola, sorghum, oats, and lupins) was valued at $13.3 billion (LVP). The grains industry is Australia's largest plant industry with wheat, the largest crop, accounting for more than half of total production. The majority of Australia's grain is produced in the wheat belt located from central Queensland through NSW, Victoria, Tasmania, SA and southern WA.

Most of the grain produced in Australia is exported predominantly to markets in Asia and the Middle East including China, Indonesia, Iraq, Korea, Vietnam, Iran and Vietnam.

The grains industry invests in a biosecurity program to raise awareness and improve practices on-farm. Grain Producers Australia funds the Grains Farm Biosecurity Program which includes the deployment of five Grains Biosecurity Officers embedded in state departments in NSW, Queensland, SA, Victoria and WA.

The grains industry is covered by version 3.0 of the biosecurity plan for grains and the Biosecurity Manual for Grain Producers Version 4.0.

Image courtesy of Barry Large.

Figure 27. Annual value of grains production, 2007–14

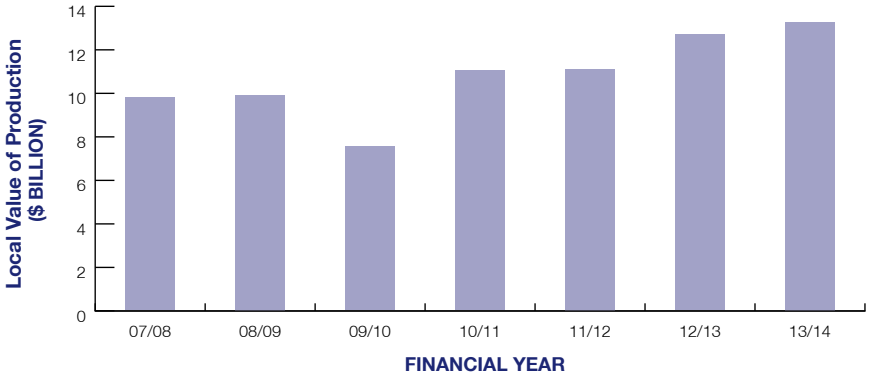
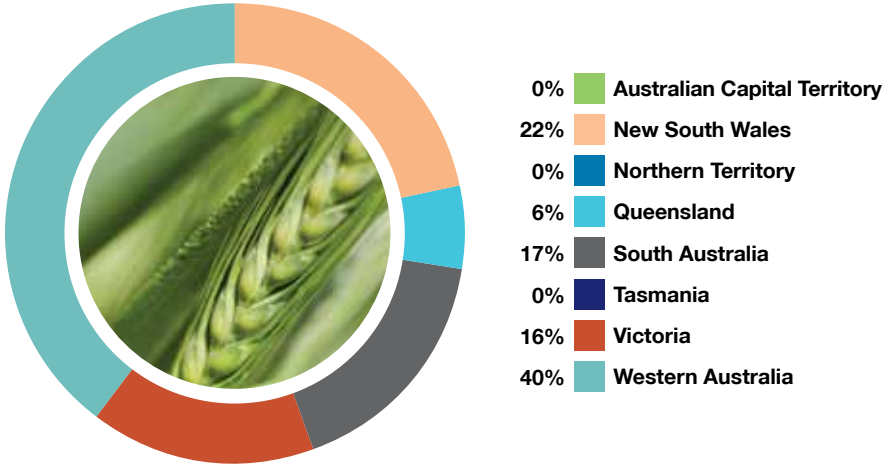


Figure 28. Distribution of grains production by state and territory, 2013–14 (based on LVP)



Finding a fumigant for phosphine resistant grain pests

Pests of stored grain that have developed resistance to the commonly used fumigant phosphine have become an increasing challenge for the Australian grains industry in recent decades.

Phosphine resistance has meant that grain insect pests are more difficult to control both on-farm and in bulk storage sites across grain growing areas. In 2015, a large-scale research project was undertaken by Yong Lin Ren from Murdoch University, funded by the PBCRC to determine the role of sulfuryl fluoride for pest management in stored grain.

Sulfuryl fluoride has long been used to control a variety of insect pests in closed structures. It has many benefits, including being non-flammable, non-corrosive and suitable for use with a range of commodities and structures, including flour mills. It also dissipates quickly during aeration.

The research team evaluated the use of sulfuryl fluoride at an industry storage site in Queensland. They exposed insect pests that were strongly resistant to phosphine to the gas, including lesser grain borers, rice weevils, red-rust flour beetles and rusty grain beetles.

The screening of test insects after fumigation revealed complete control of all four pests, and that the time to re-infestation afterwards is at least three months.

These results have indicated sulfuryl fluoride can offer a viable option to help in breaking the phosphine resistance cycle.

Sulfuryl fluoride can only be used by licensed fumigators to ensure safe and effective use.

Phosphine resistance is most widespread in the lesser grain borer. Image courtesy of PBCRC.

Table 13. High Priority Pests of the grains industry

Scientific name	Common name
Ascochyta rabiei (MAT1-1 mating type is endemic. MAT 1-2 is exotic)	Ascochyta blight
Barley mild mosaic virus (Baymovirus)	Barley mild mosaic virus
Bean common mosaic virus (Potyvirus), Peanut stripe strain	Bean common mosaic virus/peanut stripe strain
Cephus cinctus	Wheat stem sawfly
Cephus pygmeus	European wheat stem sawfly
Ceutorhynchus assimilis	Cabbage seed weevil
Ceutorhynchus napi	Rape stem weevil
Ceutorhynchus pallidactylus	Cabbage seed weevil
Chickpea chlorotic dwarf virus (Mastrevirus)	Chickpea chlorotic dwarf
Chickpea chlorotic stunt virus (Polerovirus)	Chickpea chlorotic stunt virus
Chilo orichalcociliellus	Coastal stalk borer
Colletotrichum truncatum (lentil affecting strain)	Lentil anthracnose
Cylindrocopturus adspersus	Sunflower stem weevil
Diabrotica barberi	Northern corn rootworm
Diabrotica undecimpunctata	Southern corn rootworm/spotted cucumber beetle
Diabrotica virgifera	Western corn rootworm
Diaporthe helianthi	Stem canker
Diuraphis noxia	Russian wheat aphid
Eurygaster integriceps	Sunn pest
Fusarium oxysporum f. sp. *ciceris*	*Fusarium* wilt of chickpea/chickpea wilt
Fusarium oxysporum f. sp. *glycines*	*Fusarium* wilt of soybean
Fusarium oxysporum f. sp. *lupini*	*Fusarium* wilt
Fusarium virguliforme	Sudden death syndrome
Groundnut bud necrosis virus (Tospovirus)	Groundnut bud necrosis virus
Groundnut ringspot virus (Tospovirus)	Groundnut ringspot virus
Harpophora maydis	Late wilt/slow wilt
Heterodera ciceri	Chickpea cyst nematode
Heterodera filipjevi	Cereal cyst nematode
Heterodera glycines	Soybean cyst nematode
Heterodera latipons	Mediterranean cereal cyst nematode
Heterodera sorghi	Sorghum cyst nematode
Homoesoma electellum	Sunflower moth
Magnaporthe grisea	Wheat blast
Mayetiola destructor	Hessian fly
Mayetiola hordei	Barley stem gall midge
Mungbean yellow mosaic virus	Legume yellow mosaic viruses
Nysius huttoni	Wheat bug
Pantoea stewartii	Stewart's disease/bacterial wilt
Peanut clump virus (Pecluvirus)	Peanut clump virus/indian peanut clump virus
Peronosclerospora philippinensis	Philippine downy mildew of maize
Peronosclerospora sorghi	Sorghum downy mildew
Plasmopara halstedii	Downy mildew
Prostephanus truncatus	Larger grain borer
Puccinia graminis f. sp. *tritici*	Wheat stem rust
Puccinia striiformis f. sp. *hordei*	Barley stripe rust
Rhizoctonia solani f. sp. *sasakii*	Banded leaf and sheath spot
Riptortus dentipes	Pod sucking bug
Schizaphis graminum	Greenbug/wheat aphid/spring green aphid
Soil-borne wheat mosaic virus (Furovirus)	Soil-borne wheat mosaic
Thaumatotibia leucotreta	False codling moth
Tilletia indica	Karnal bunt
Trogoderma granarium	Khapra beetle
Zea mosaic virus (Potyvirus)	Zea mosaic virus

Lentil anthracnose. Image courtesy of Robert L. Anderson, United States Department of Agriculture Forest Service.

Pea leafminer. Image courtesy of Merle Shepard, Gerald R. Carner, and P. A. C Ooi.

HAZELNUTS

Represented by Hazelnut Growers of Australia Inc.
www.hazelnuts.org.au

In 2013–14, hazelnut production was valued at $0.9 million (LVP). Because local supply does not meet demand Australia has imported 2,500 tonnes per year, chiefly from Turkey, since 2000.

A northern hemisphere confectionary manufacturer has invested in Australian orchards in recent years to boost production. Plants have been imported through a strict quarantine process from Chile for planting in rural NSW. It is anticipated that close to a million trees will be planted and that hazelnut production will be 300 tonnes valued at $2.1 million by 2020.

The hazelnut industry became a signatory to the EPPRD in November 2015. To boost hazelnut biosecurity exotic pest fact sheets are being developed, the hazelnut section of the nut biosecurity plan is being amended and a biosecurity manual will be published.

Table 14. High Priority Pests of the hazelnut industry

Scientific name	Common name
Chinavia hilaris (Syn. *Acrosternum hilare; Pentatoma hilaris; Chinavia hilare; Nezara hilaris)*	Green stink bug Pistachio bug
Halyomorpha halys	Brown mamorated stink bug
Lymantria dispar	Gypsy moth (Asian and European strains)
Anisogramma anomala	Eastern filbert blight

Hazelnut blight. Image courtesy of Joseph O'Brien, United States Department of Agriculture Forest Service.

Filbertworm. Image courtesy of Todd M. Gilligan and Marc E. Epstein, Colorado State University, United States.

Figure 29. Annual value of hazelnut production, 2010–14

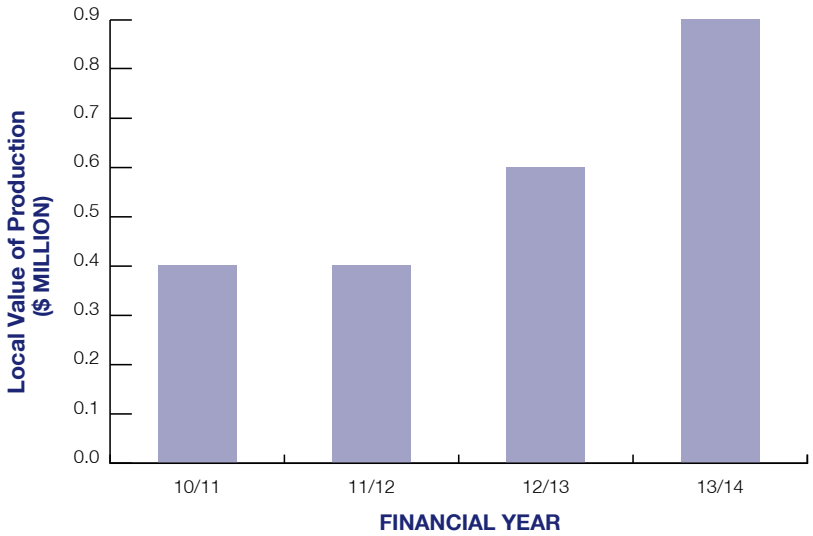
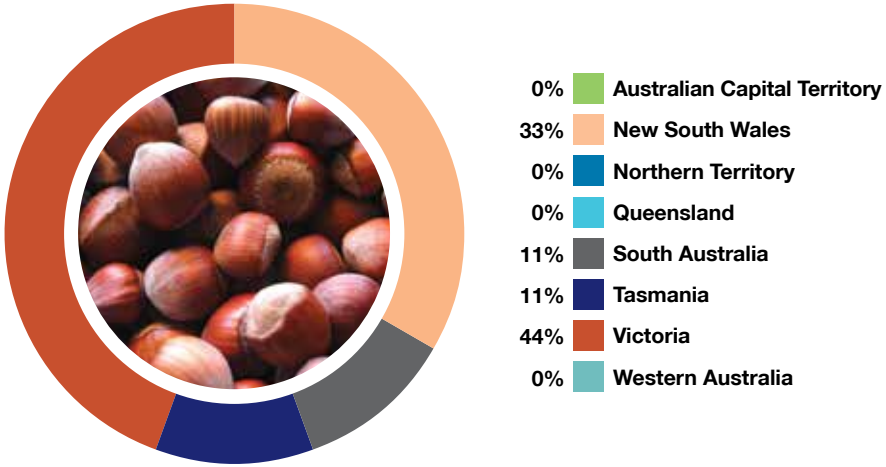


Figure 30. Distribution of hazelnut production by state and territory, 2013–14 (based on LVP)



HONEY BEES

Represented by Australian Honey Bee Industry Council Inc.
www.honeybee.org.au

In 2013–14, honey and beeswax production was valued at $79 million (LVP). Around 12,400 beekeepers are currently registered, operating nearly 530,000 hives. Apiaries range in size from between one and several thousand hives.

In addition to honey and beeswax, there is some trade in live bees but this has declined in recent years due to market closures including the United States.

The honey bee industry is currently a member of PHA due to the benefits that honey bees provide to pollination-dependent plant industries, estimated to be worth $4–6 billion per year. Pest emergency responses relating to honey bees are now covered under the EPPRD. The industry resigned as a member from Animal Health Australia during 2015.

The National Bee Pest Surveillance Program continues to operate at ports around Australia to boost preparedness for exotic pests of bees and pest bees.

A National Bee Biosecurity Program and Code of Practice for beekeeping are currently under development and Bee Biosecurity Officers are being recruited across the states.

The honey bee industry is covered by version 1.0 of the honey bee biosecurity plan and the Biosecurity Manual for Beekeepers Version 1.1.

Table 15. High Priority Pests of the honey bee industry

Scientific name	Common name
Acarapis woodi	Tracheal mite
Apis cerana (exotic strains, genotypes and sub-species)	Asian honey bee
Apis mellifera capensis	Cape honey bee
Apis mellifera scutellata	African honey bee
Apis mellifera scutellata (hybrid)	Africanised honey bee
Deformed wing virus (*Iflavirus*)	Deformed wing virus
Hoplostoma fuligineus	Large hive beetle
Slow paralysis virus (*Iflavirus*)	Slow paralysis virus
Tropilaelaps clareae	*Tropilaelaps* mite
Tropilaelaps mercedesae	*Tropilaelaps* mite
Varroa destructor	*Varroa mite*
Varroa jacobsoni	*Varroa mite*
Vespa spp. (exotic species)	Hornets

Figure 31. Annual value of honey and beeswax production, 2007–14

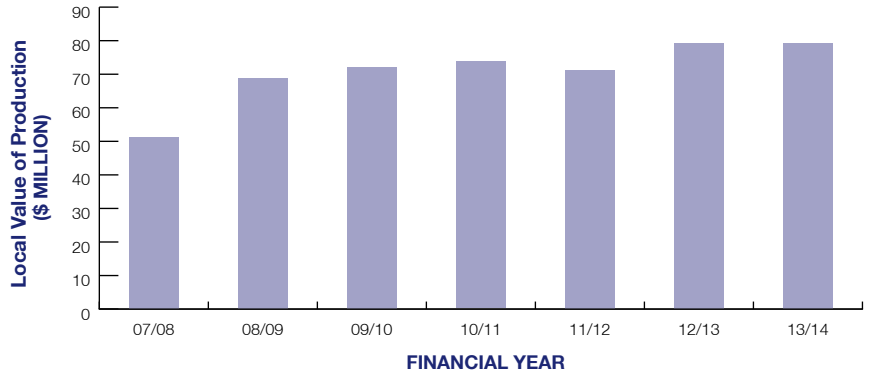
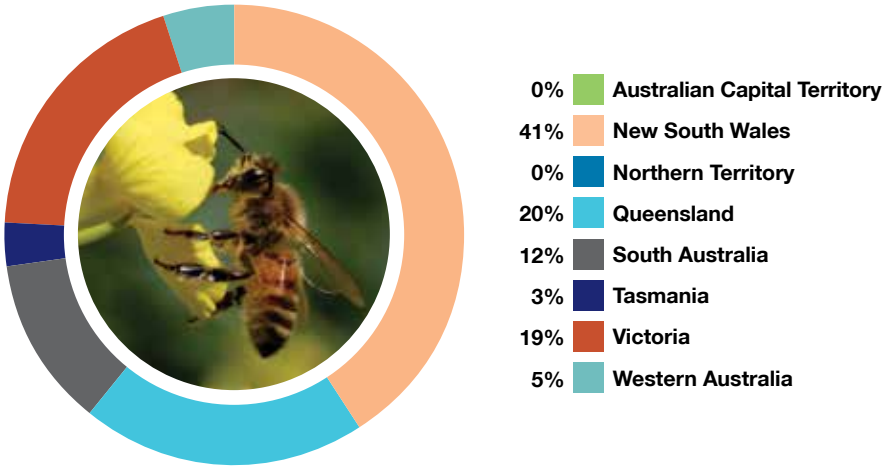


Figure 32. Distribution of honey and beeswax production by state and territory, 2013–14 (based on LVP)



National Bee Pest Surveillance PROGRAM

NATIONAL BEE BIOSECURITY PROGRAM

LYCHEES

Represented by Australian Lychee Growers Association
www.australianlychee.com.au

In 2013–14, lychee production was valued at $14 million (LVP). Lychees are a high value summer fruit in Australia. The main varieties of lychees grown are Kwai May Pink, Bengal, Fay Zee Siu, Kaimana, Salathiel, Souey Tung, Tai So and Wai Chee.

Current annual production ranges from 2,000 to 3,500 tonnes, depending on climatic and seasonal conditions. While grower numbers have reduced over the past decade, a number of existing growers have increased their plantings keeping production steady. There are approximately 250 lychee orchards in Queensland and NSW, but the bulk of the annual tonnage is produced in the North Queensland tablelands and central and south east Queensland.

The majority of lychees are grown for domestic consumption. In 2015, Australia commenced export shipments to the United States and is seeking access to mainland China where counter season production confers an advantage to Australian producers.

The lychee industry is covered by version 1.0 of the lychee biosecurity plan.

Table 16. High Priority Pests of the lychee industry

Scientific name	Common name
Aristobia testudo	Lychee longicorn beetle
Bactrocera dorsalis	Oriental fruit fly
Conopomorpha sinensis	Lychee fruit borer
Paradasynus longirostris	Hong Kong stink bug
Peronophythora litchii	Brown blight
Pseudotheraptus wayi	Coconut bug
Unknown (suspected phytoplasma)	Longan and lychee witches' broom disease

Figure 33. Annual value of lychee production, 2009–14

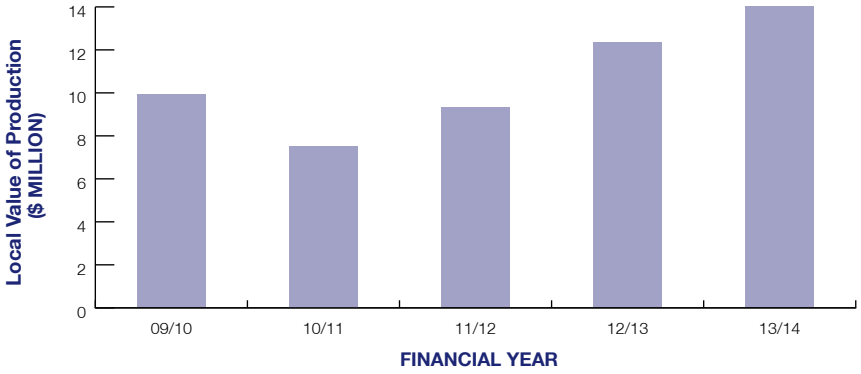
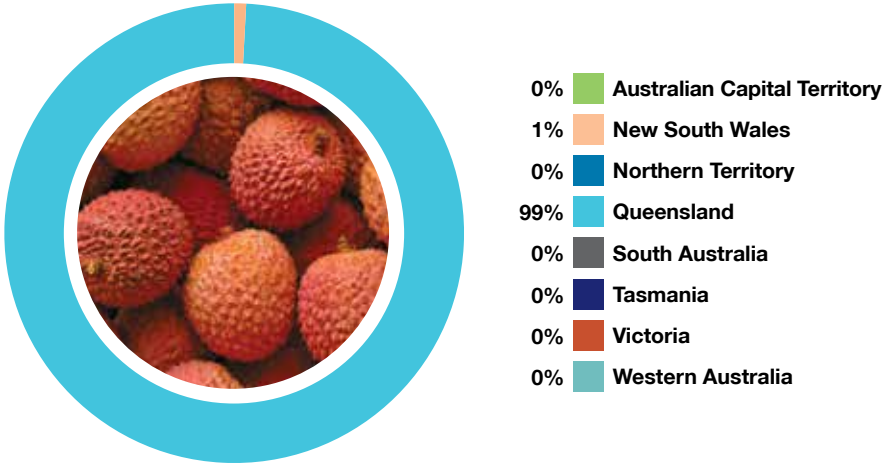


Figure 34. Distribution of lychee production by state and territory, 2013–14 (based on LVP)



MACADAMIAS

Represented by the Australian Macadamia Society Ltd
www.macadamias.org

In 2013–14, macadamia production was valued at $108 million (LVP). There are around 18,000 hectares planted with macadamias in Australia, comprising approximately 5.5 million trees. Annual production is approximately 45,000 tonnes in-shell or 15,000 tonnes of kernel.

The significant majority of plantings are varieties of *Macadamia integrifolia*. Of these about 80 per cent are Hawaiian selections with the remainder being Australian varieties. Harvest commences in March and runs through to August.

Australian macadamia production stretches from Coffs Harbour on the NSW north coast to Mackay on the north Queensland coast. The majority of macadamia plantings are in northern NSW and south east Queensland. The northern rivers region of NSW is the largest production area comprising about 45 per cent of production. The fastest growth in production is occurring in the Bundaberg area which currently represents around 35 per cent of production.

Approximately 70 per cent of the crop is exported, principally to Europe, USA, Japan, China and other Asian countries. Australia is currently the world's largest producer of macadamia kernel and second largest producer overall. South Africa and Kenya are the other major producers.

In order to encourage biosecurity awareness within the industry, approximately 70 per cent of orchards employ professional pest scouts and the Australian Macadamia Society convenes an annual pest scout forum where pest pressures for the previous season are reviewed and any new pest and disease sightings reported.

The macadamia industry is covered by version 2.0 of the nut biosecurity plan.

Table 17. High Priority Pests of the macadamia industry

Scientific name	Common name
Hypothenemus obscurus	Tropical nut borer
Xylella fastidiosa (including *Xylella fastidiosa* subsp. *Fastidiosa; Xylella fastidiosa* subsp. *Multiplex; Xylella fastidiosa* subsp. *Piercei*)	Almond leaf scorch; Pecan bacterial leaf scorch
Phytophthora ramorum	Sudden oak death

Figure 35. Annual value of macadamia production, 2007–14

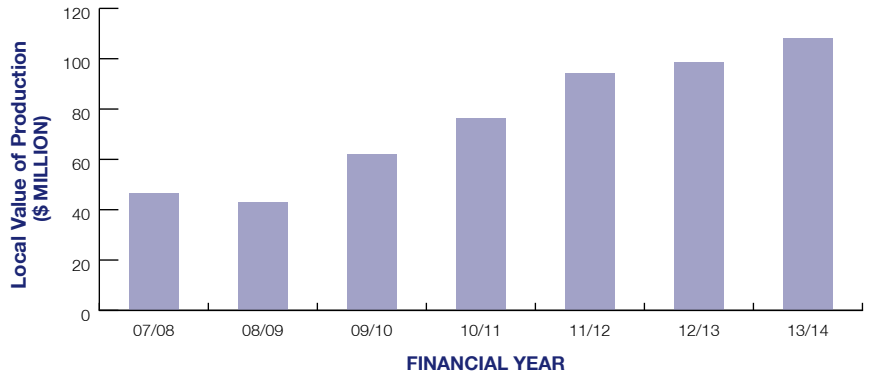
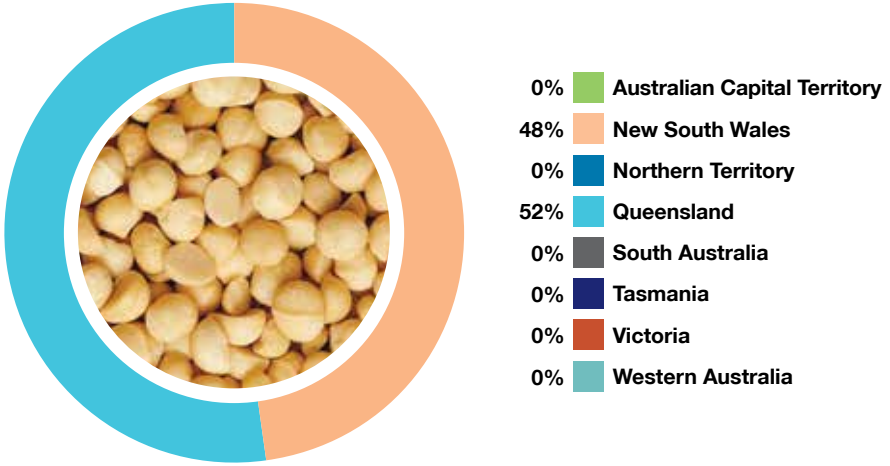


Figure 36. Distribution of macadamia production by state and territory, 2013–14 (based on LVP)



MANGOES

Represented by the Australian Mango Industry Association Ltd
www.industry.mangoes.net.au

In 2013–14, mango production was valued at $79 million (LVP). On average, 85 per cent of total fruit produced is consumed fresh with the remainder processed. The proportion processed is influenced by crop production and the fresh market price.

The most abundant variety, Kensington Pride, accounts for approximately 55 per cent of Australian production. Other varieties include B74 (Calypso™), Brooks, Honey Gold, Keitt, Palmer, Pearl and R2E2, as well as green eating varieties, Keo Savoy and Nam Doc Mai. There is a range of other varieties that are also produced in smaller volumes.

The industry supplies the Australian market, with the majority of production occurring from September to March each year. In Australia, the majority of mangoes are grown in Queensland and the NT, with smaller but significant production in regions throughout WA and other states.

The mango industry is covered by version 2.1 of the biosecurity plan for the mango industry and the Orchard Biosecurity Manual for the Mango Industry Version 1.0.

Table 18. High Priority Pests of the mango industry

Scientific name	Common name
Bactrocera carambolae	Carambola fruit fly
*Bactrocera papayae**	Papaya fruit fly
Ceratocystis fimbriata sensu lato	Mango sudden decline syndrome
Ceratocystis manginecans	Mango sudden decline syndrome
Ceratocystis omanensis	Mango sudden decline syndrome
Deanolis sublimbalis	Red-banded mango caterpillar
Fusarium mangiferae	Mango malformation
Fusarium mexicanum	Mango malformation
Fusarium proliferatum	Mango malformation
Fusarium sterilihyphosum	Mango malformation
Parasa lepida	Blue-striped nettle grub
Procontarinia spp. (exotic species)	Mango gall midges
Sternochetus frigidus	Mango pulp weevil
Xylosandrus compactus	Black twig borer

* This species has been synonymised with *Bactrocera dorsalis*

Figure 37. Annual value of mango production, 2007–14

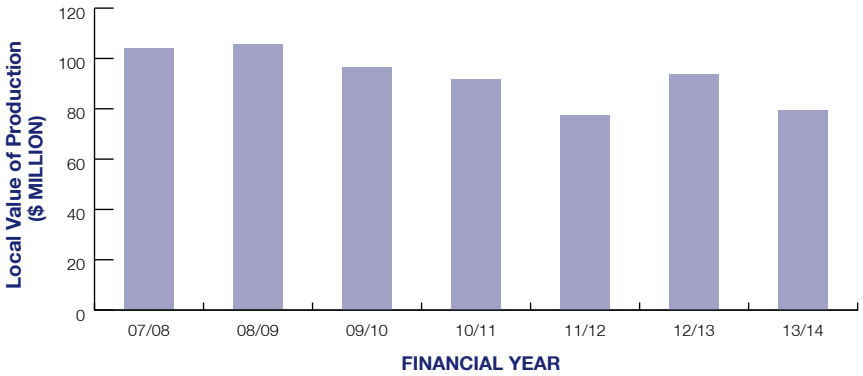
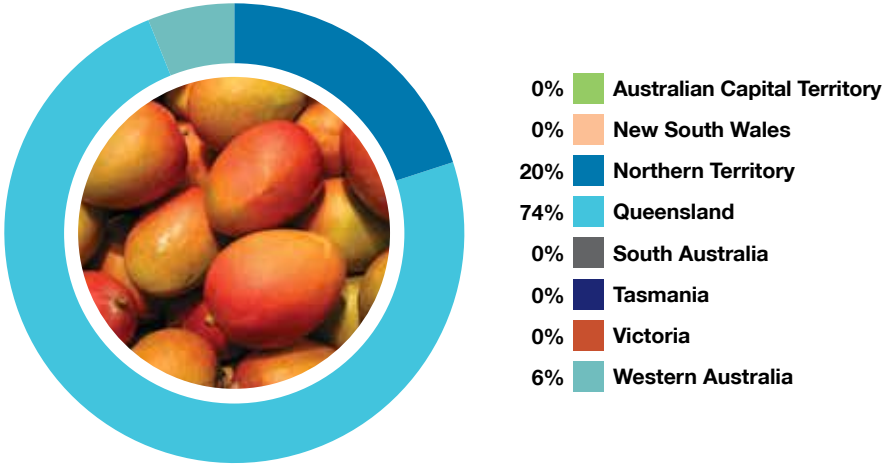


Figure 38. Distribution of mango production by state and territory, 2013–14 (based on LVP)



MELONS

Represented by the Australian Melon Association Inc
www.melonsaustralia.org.au

In 2013–14, melon production was valued at $160 million (LVP). Fresh seedless watermelons, rockmelons and honeydew melons are the major melon products. They are produced all year round and marketed predominantly as commodities. Brands are recognised only at the wholesaler and retailer levels. The main form of value-adding is cut and wrapped fruit. Some melons are used in fresh cut fruit salad mixes and juice products.

The Australian melon industry consists of approximately 300 growers producing, on average, 200,000 tonnes of melons annually across an area of around 7,000 hectares, with the majority of production occurring in Queensland, NT, WA and NSW.

Melons are grown for domestic consumption as well as international export with 85 per cent of all exported products going to New Zealand, United Arab Emirates and Singapore. About one quarter of the produce was watermelons.

The melon industry is working with growers on biosecurity measures to address seed borne diseases, on-farm biosecurity and surveillance. Melons are covered by version 1.0 of the biosecurity plan for the melon industry.

Table 19. High Priority Pests of the melon industry

Scientific name	Common name
Bactrocera cucurbitae	Melon fruit fly
Bactrocera invadens	Fruit fly
Bactrocera latifrons	Solanum fruit fly
Liriomyza b ryoniae	Tomato leafminer
Liriomyza huidobrensis	Pea leafminer/serpentine leafminer
Liriomyza sativae	Vegetable leafminer
Liriomyza trifolii	American serpentine leafminer
Bemisia tabaci (exotic strains and biotypes)	Silerleaf whitefly
Fusarium oxysporum f. sp. *melonis* (exotic races), *Fusarium oxysporum* f. sp. *niveum* (exotic races), *Fusarium oxysporum* f. sp. *radicis-cucumerinum*	*Fusarium* root and stem rot of melons
Monosporascus cannonballus	*Monosporascus* root rot
Erwinia tracheiphila	Cucurbit bacterial wilt

Figure 39. Annual value of melon production 2013–14

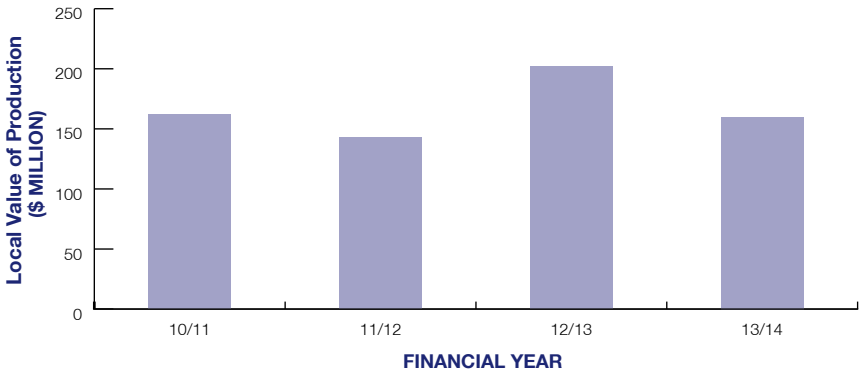
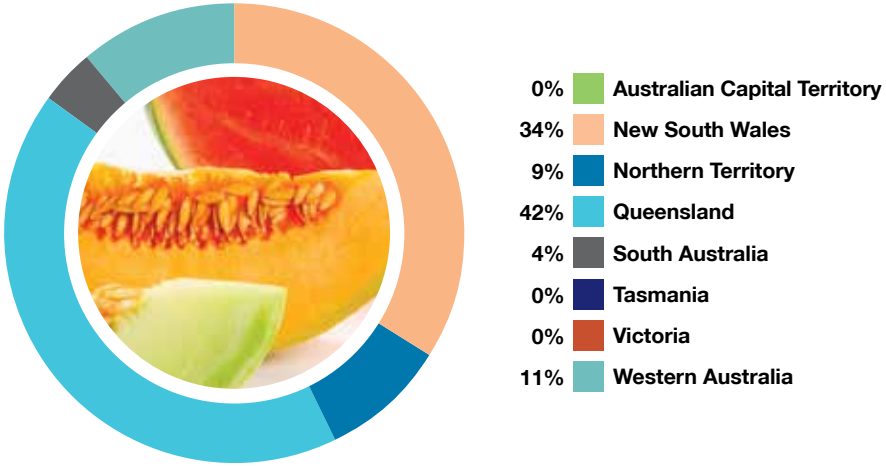


Figure 40. Distribution of melon production by state and territory, 2013–14 (based on LVP)



NURSERY

Represented by the Nursery & Garden Industry Australia Ltd
www.ngia.com.au

In 2013–14, nursery production (propagation stock, seedlings, bedding plants, indoor plants, trees and shrubs) was valued at $660 million (LVP). The nursery industry operates in all states and territories, being one of the largest and most diverse plant industries in Australia.

The industry estimates an annual gross production value of approximately $2.5 billion (production nurseries only) in 2015 across the entire supply chain. This includes ornamental retail, landscape, re-vegetation/rehabilitation and production horticulture sectors (including tree crops e.g. fruit, forestry, tea tree), vegetables and cut flower producers. The industry has a limited export focus of approximately $18 million annually with ample opportunity for international export growth.

A suite of biosecurity resources are available to growers including BioSecure HACCP, the industry on-farm biosecurity program, pest and disease fact sheets, nursery papers, pest management plans including the Australian Nursery Industry Myrtle Rust Management Plan and a biosecurity training program. Extension videos covering topics such as site surveillance, intake inspection and crop monitoring were added from 2013 through to 2015.

The nursery industry is covered by version 3.0 of the nursery and garden biosecurity plan and the Biosecurity Manual for the Nursery Production Industry Version 1.0.

Figure 42. Distribution of production nurseries by state and territory, 2013–14 (based on LVP)

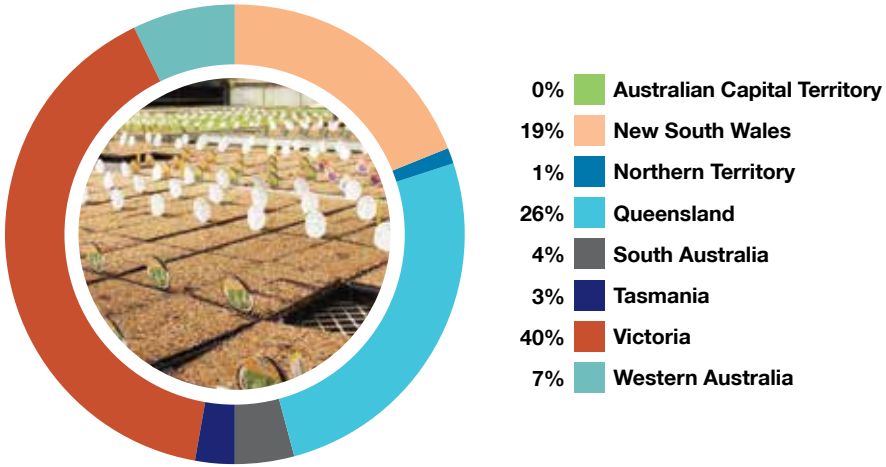


Figure 41. Annual value of nursery production, 2007–14

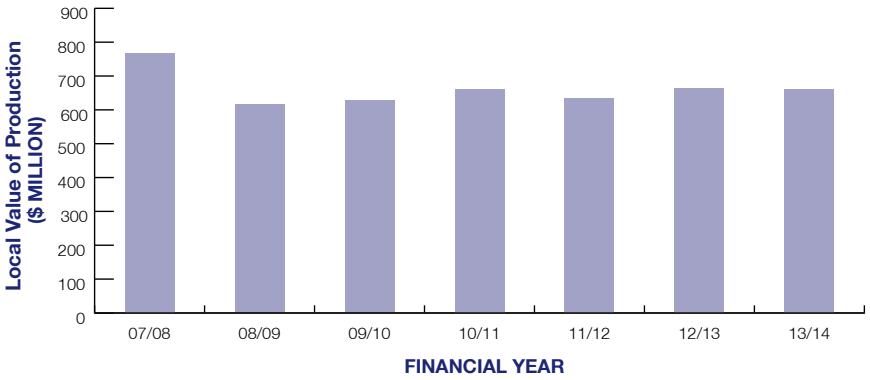


Table 20. High Priority Pests of the nursery industry

Scientific name	Common name
Achatina fulica	Giant African snail
Aphis gossypii (exotic strains)	Cotton aphid
Bemisia tabaci (exotic strains)	Silverleaf whitefly
Candidatus Liberibacter asiaticus	Huanglongbing (Asiatic strain)
Diaphorina citri	Asian citrus psyllid
Echinothrips americanus	Poinsettia thrips
Homalodisca vitripennis	Glassy-winged sharpshooter
Lettuce infectious yellows virus (*Crinivirus*)	Lettuce infectious yellows virus
Liriomyza huidobrensis	Serpentine leaf miner
Lygus lineolaris	Tarnished plant bug
Lymantria dispar	Asian gypsy moth
Oligonychus ilicis	Southern red mite
Phytophthora ramorum	Sudden oak death
Pomacea canaliculata	Golden apple snail
Pseudomonas syringae pv. *syringae* (exotic races)	Bacterial canker
Puccinia psidii sensu lato (exotic variants)	Guava rust/eucalyptus rust
Xylella fastidiosa	Pierce's disease

OLIVES

Represented by the Australian Olive Association Ltd
www.australianolives.com.au

In 2013–14, olive production was valued at $86 million (LVP). The industry estimates that in 2015 the Australian olive industry produced around 22 million litres of olive oil.

Victoria is the largest producer, followed by WA, SA and NSW. The olive industry remains an important employer in regional Australia.

Olive oil accounts for 97 per cent of olive product exports.

The olive industry is covered by version 1.0 of the biosecurity plan for the olive industry.

Table 21. High Priority Pests of the olive industry

Scientific name	Common name
Bactrocera oleae	Olive fly
Liothrips oleae	Olive thrips
Prays oleae	Olive moth
Verticillium dahliae (defoliating strain)	*Verticillium* wilt

Olive fly. Image courtesy of PaDIL, bugwood.org.

Olive fly. Image courtesy of Lorraine Graney, Bartlett Tree Experts, bugwood.org.

Figure 43. Annual value of olive production, 2007–14

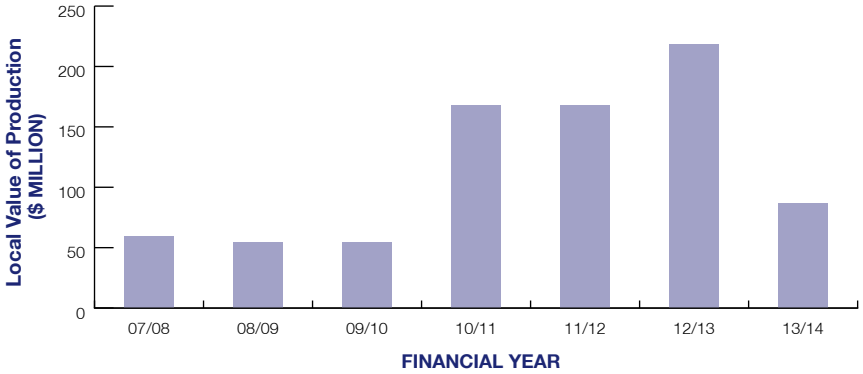
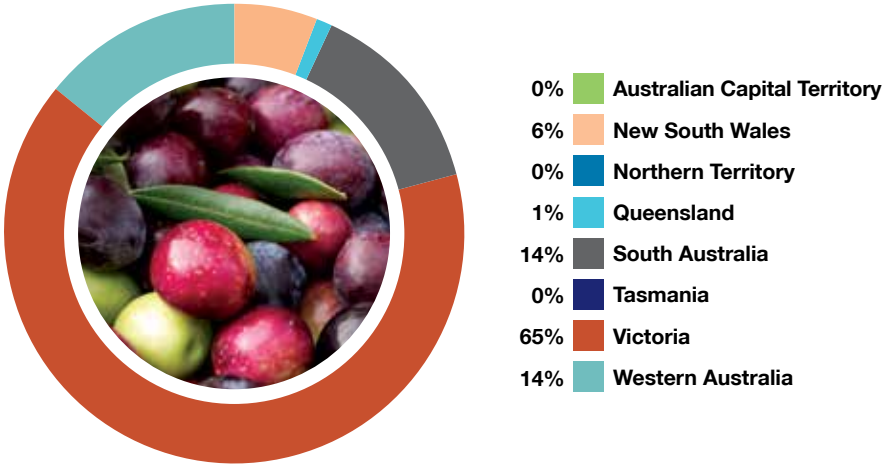


Figure 44. Distribution of olive production by state and territory, 2013–14 (based on LVP)



ONIONS

Represented by Onions Australia
www.onionsaustralia.org.au

In 2013–14, onion production was valued at $161 million (LVP).

The main growing areas for onion production include the Lockyer Valley, St George and Darling Downs in Queensland, Murrumbidgee Irrigation Area in NSW, Adelaide Plains, Riverland and south eastern SA, Manjimup and Pemberton in WA, Werribee and Cranbourne in Victoria and the north-western to northern midlands of Tasmania.

Sowing of onions starts in Queensland during February (short day types) and finishes in the southern states in August (long day types). Harvest starts in Queensland during September and finishes during April in the southern states.

The onion industry is covered by version 2.0 of the onion biosecurity plan.

Table 22. High Priority Pests of the onion industry

Scientific name	Common name
Botrytis squamosa	Leaf blight
Cladosporium allii	Leaf spot
Delia antiqua	Onion fly
Delia florilega	Bean fly
Eumerus amoenus	Onion bulb fly
Eumerus strigatus	Lesser bulb fly
Liriomyza sativae	Vegetable leaf miner
Phytomyza gymnostoma	Allium leaf miner
Puccinia spp. (exotic species)	Rust
Rhizoglyphus callae	Bulb mite
Rhizoglyphus setosus	Bulb mite
Thrips tabaci (exotic strains/biotypes)	Onion thrips
Xanthomonas axonopodis pv. *allii*	*Xanthomonas* leaf blight

Figure 45. Annual value of onion production, 2007–14

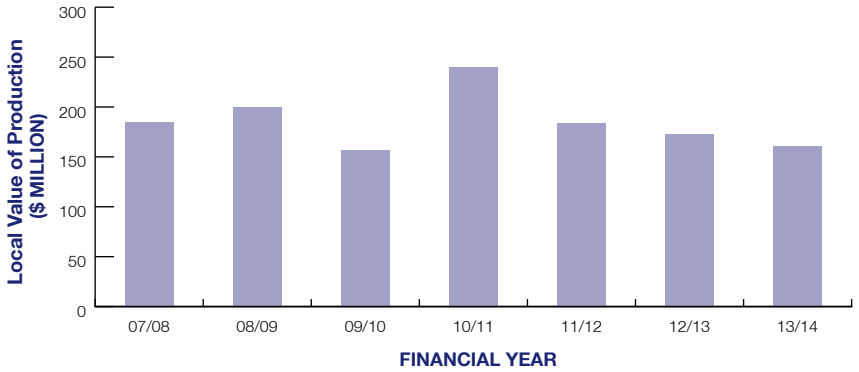
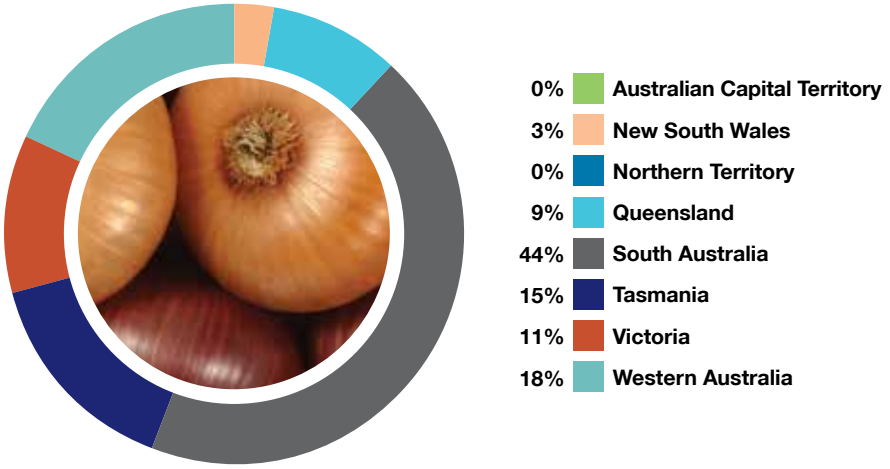
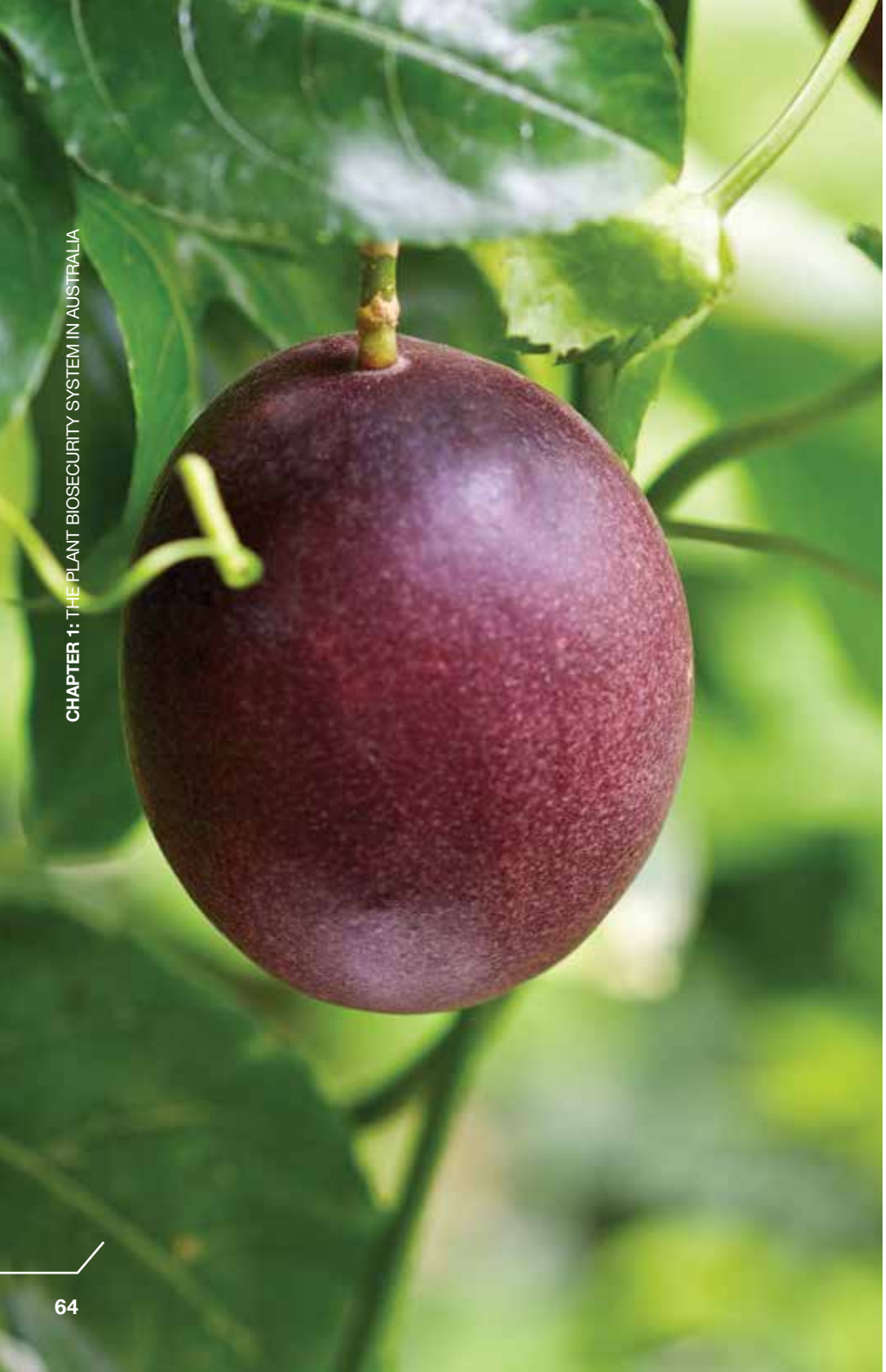


Figure 46. Distribution of onion production by state and territory, 2013–14 (based on LVP)





PASSIONFRUIT

Represented by Passionfruit Australia Inc.
www.passionfruitaustralia.org.au

In 2013–14, passionfruit production was valued at $16 million (LVP). There are currently 300 hectares of passionfruit under cultivation in Australia with about 400,000 passionfruit vines yielding approximately 4,600 tonnes of fruit.

About two thirds of the Australian passionfruit crop is grown in Queensland and around one third in NSW. New plantings around Bundaberg, Queensland and Humpty Doo, Northern Territory will expand the industry in the coming seasons.

Passionfruit is grown year round but main supply times to market are December through to September. The main purple passionfruit varieties grown in Australia are Misty Gem and Sweetheart and the major Panama passionfruit varieties are Pandora and McGuffie's Red.

At present, Australian passionfruit are not exported but an application for export to New Zealand has been made.

The passionfruit industry is covered by version 1.0 of the passionfruit biosecurity plan.

Figure 47. Distribution of passionfruit production by state and territory, 2013–14 (based on LVP)

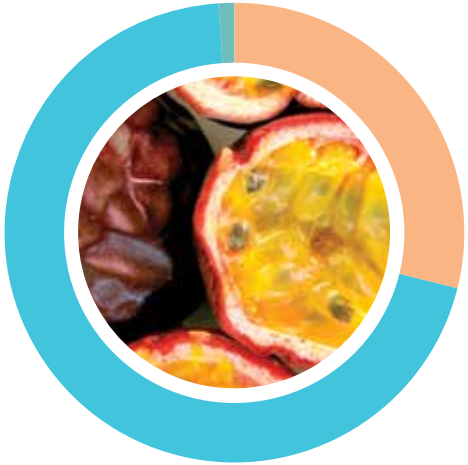


Figure 48. Annual value of passionfruit production, 2007–14

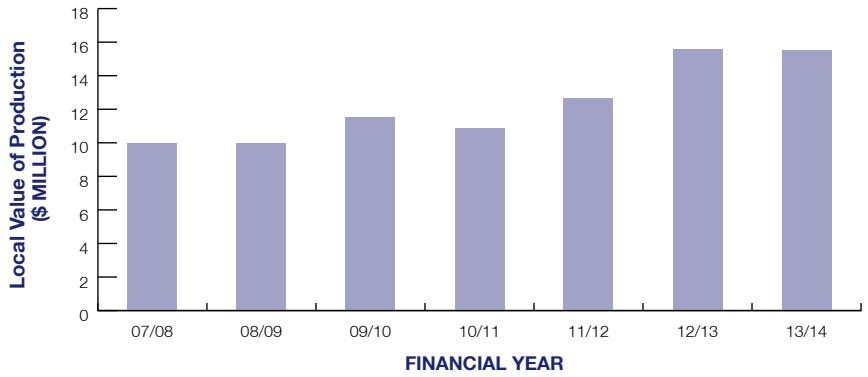


Table 23. High Priority Pests of the passionfruit industry

Scientific name	Common name
Bactrocera carambolae	Carambola fruit fly
Bactrocera cucurbitae	Melon fruit fly
Bactrocera dorsalis	Oriental fruit fly
Bactrocera facialis	Tropical fruit fly
Bactrocera kandiensis	Fruit fly
Bactrocera kirki	Fijian fruit fly
Bactrocera melanotus	Fruit fly
*Bactrocera papayae**	Papaya fruit fly
Bactrocera passiflorae	Fijian fruit fly
*Bactrocera philippinensis**	Philippine fruit fly
Bactrocera psidii	South Sea guava fruit fly
Bactrocera xanthodes	Pacific fruit fly
East Asian passiflora virus (*Potyvirus*)	East Asian passiflora virus
Passiflora chlorosis virus (Potyvirus)	*Passiflora* chlorosis virus
Passionfruit crinkle virus (Potyvirus)	Passionfruit crinkle virus
Passionfruit ringspot virus (Potyvirus)	Passionfruit ringspot virus
Passionfruit severe leaf distortion virus (Begomovirus)	Passionfruit severe leaf distortion virus
Passionfruit Sri Lankan mottle virus (Potyvirus)	Passionfruit Sri Lankan mottle potyvirus
Passionfruit vein clearing virus (*Rhabdovirus*)	Passionfruit vein clearing rhabdovirus
Passionfruit yellow mosaic virus (Tymovirus)	Passionfruit yellow mosaic virus
Xanthomonas axonopodis pv. *passiflorae*	Bacterial blight

* This species has been synonymised with *Bactrocera dorsalis*

Fijian fruit fly. Image courtesy of S. Wilson, Secretariat of the Pacific Community.

Philippine fruit fly. Image courtesy of Anthony O'Toole, Secretariat of the Pacific Community.

PINEAPPLES

Represented by GROWCOM
www.growcom.com.au

In 2013–14, pineapple production was valued at $47 million (LVP), which was up from last year. The industry estimates that in 2015 approximately 44,200 tonnes of fresh fruit and 24,300 tonnes of processed fruit were marketed.

There are approximately 80 commercial pineapple enterprises, all based in Queensland, with key growing districts in Wamuran, Elimbah, Glasshouse Mountains, Beerwah, Yandina, Mary Valley, Maryborough, Hervey Bay, Childers, Bundaberg, Cawarral, Yeppoon and northern Queensland.

Australia contributes less than one per cent to the world's fresh pineapple production and supplies almost the entire domestic market. Four primary packing houses pack and market more than 70 per cent of fresh pineapples. The primary pineapple processor, Heinz Golden Circle Ltd, produces canned pineapple and juice.

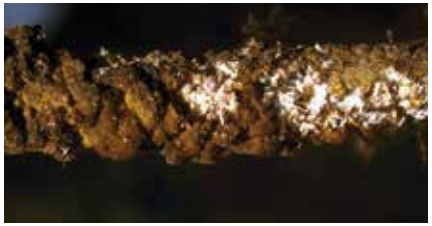
Approximately 55 per cent of pineapple varieties grown are Smooth Cayenne and Queen (Rough leaf). The remaining 45 per cent of plantings are new hybrid varieties that appeal more to the fresh market and this proportion is expected to increase.

The pineapple industry is covered by version 1.0 of the pineapple biosecurity plan.

Table 24. High Priority Pests of the pineapple industry

Scientific name	Common name
Cryptophlebia leucotreta	False codling moth
Dysmicoccus neobrevipes	Grey pineapple mealybug
Erwinia chrysanthemi (distinct pathovar)	Bacterial fruit collapse
Fusarium guttiforme	Fusariosis
Strymon megarus	Pineapple fruit borer

False codling moth. Image courtesy of Marja van der Straten, NVWA Plant Protection Service, bugwood.org.



Grey pineapple mealybug. Image courtesy of William M. Ciesla, Forest Health Management International, bugwood.org.

Figure 49. Annual value of pineapple production, 2007–14

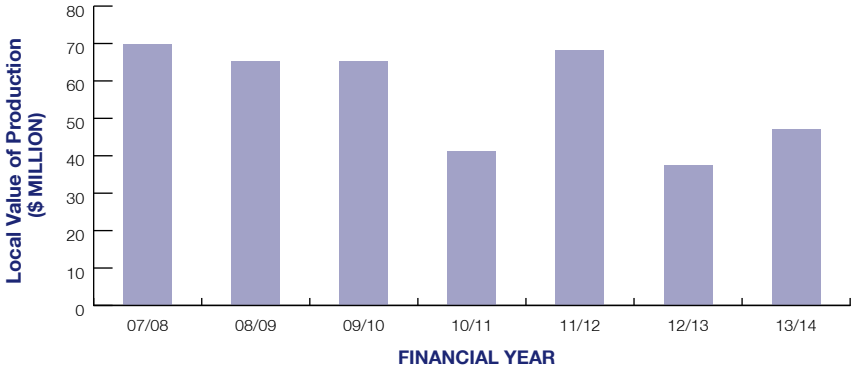
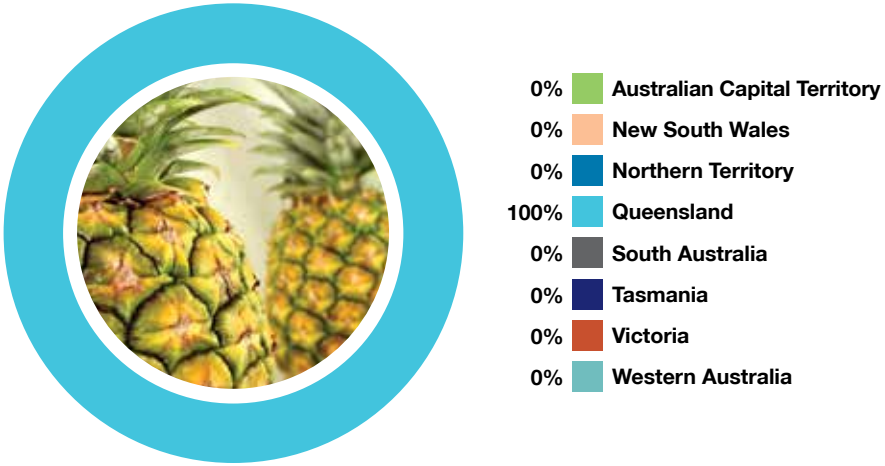


Figure 50. Distribution of pineapple production by state and territory, 2013–14 (based on LVP)



PISTACHIOS

Represented by Pistachio Growers' Association Inc.
www.pgai.com.au

In 2013–14, pistachio production was valued at $12 million (LVP). The industry estimates that in 2015, 950 hectares were under cultivation with pistachio trees, and an on-crop of 1,800 tonnes of pistachio nuts was produced.

The major production areas are along the Murray River Valley between Swan Hill in Victoria and Waikerie in SA. Further plantings are in central west Victoria and Pinnaroo, SA, with small plantings in WA. It is estimated that 30 hectares were planted in 2015, 80 hectares will be planted in 2016 with 50 to 100 hectares per annum in following years.

There are five large pistachio orchards and another five orchards of 10–15 hectares, which is the acknowledged size required to make a living solely from pistachio nut production. Around 20 mixed fruit growers each produce less than 5 tonnes of pistachios (dry) per annum from one to five hectares. There is also a small number of growers in central NSW, southern Victoria and WA.

Australian pistachio production currently only meets 40 per cent of domestic consumption, with the remainder imported from other major producers including Iran and the United States. The domestic production of pistachio is expected to increase to 2,000 tonnes by 2020.

Aspects of biosecurity are well embedded in the Australian Pistachio Industry Five Year Strategic Plan 2015 to 2020.

The pistachio industry participated in a 2015 review of the nut biosecurity plan and is covered by version 2.0 of that plan.

Table 25. High Priority Pest of the pistachio industry

Scientific name	Common name
Trogoderma granarium	Khapra beetle
Chinavia hilaris (Syn. *Acrosternum hilare, Pentatoma hilaris, Chinavia hilare, Nezara hilaris)*	Green stink bug pistachio bug
Leptoglossus clypealis	Leaf footed bug
Leptoglossus occidentalis	Western conifer seed bug
Leptoglossus zonatus	Western leaf footed bug
Amyelois transitella	Navel orange worm
Lymantria dispar	Gypsy moth (Asian and European strains)
Verticillium dahliae (exotic defoliating strains)	*Verticillium* wilt

Figure 51. Annual value of pistachio production, 2008–14

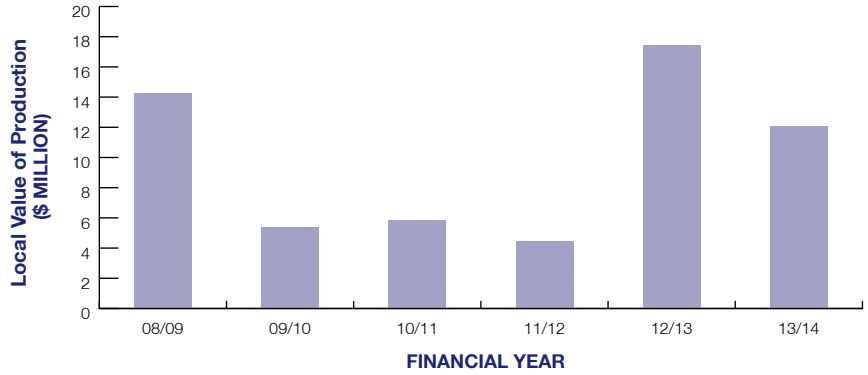
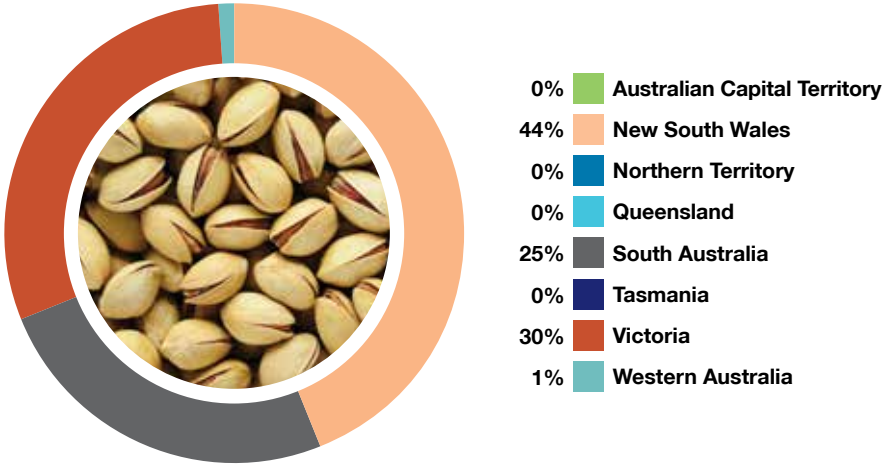


Figure 52. Distribution of pistachio production by state and territory, 2013–14 (based on LVP)



PLANTATION FORESTRY

Represented by the Australian Forest Products Association Ltd
www.ausfpa.com.au

In 2013–14, plantation forestry production was valued at $1.4 billion (LVP). The forest, wood and paper products sector is Australia's 8th largest manufacturing industry. In 2014–15, almost 23 million cubic metres of logs were harvested from Australia's plantation estates for further processing in Australia and to export internationally. Plantations provide around 84 per cent of the log resources. Plantings are split almost evenly between softwood and hardwood.

The softwood plantation estate of over one million hectares is dominated by exotic species of pine, *Pinus radiata* in southern states, *P. elliotti* and *P. caribaea* in Queensland and *P. pinaster* in Western Australia. There is also a notable area (around 50,000 hectares) of native hoop pine *(Araucaria cunninghamii)* in the south east of Queensland and northern NSW. Softwood plantations are predominately long rotation and produce saw, peeler and pulp logs for a range of products including sawn timber, wood-based panels, engineered wood products, paper and paperboard.

The hardwood plantation estate of just under one million hectares is predominantly species of eucalypts grown for pulp and export woodchips. Around 10 per cent of the hardwood estate is grown for saw logs to supplement the native forest sawlog supply. There are also some small plantings of *Acacia mangium*, African mahogany and Sandalwood grown in the NT and northern WA.

Plantations are grown mainly in the medium rainfall zones (greater than 700 mm but less than 1,200 mm) along the east coast and south west corner of mainland Australia, as well as in Tasmania and NT.

The plantation forestry industry is covered by version 2.0 of the plantation forest biosecurity plan and the Biosecurity Manual for the Plantation Timber Industry version 1.0 .

Figure 54. Annual value of plantation forest production, 2007–14

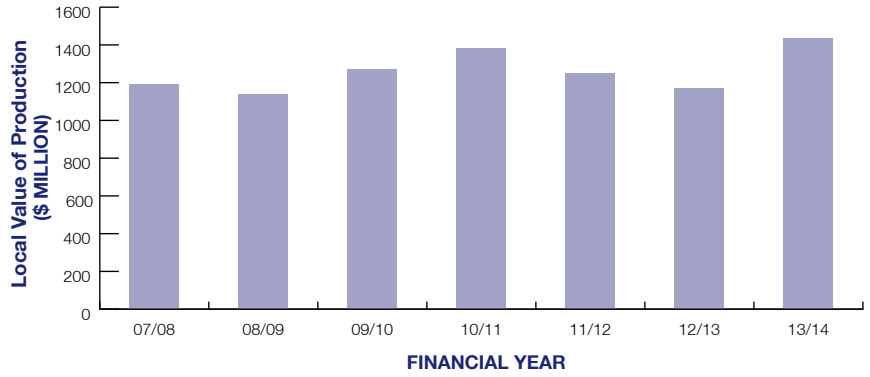


Figure 53. Distribution of plantation forest production by state and territory, 2013–14 (based on LVP)

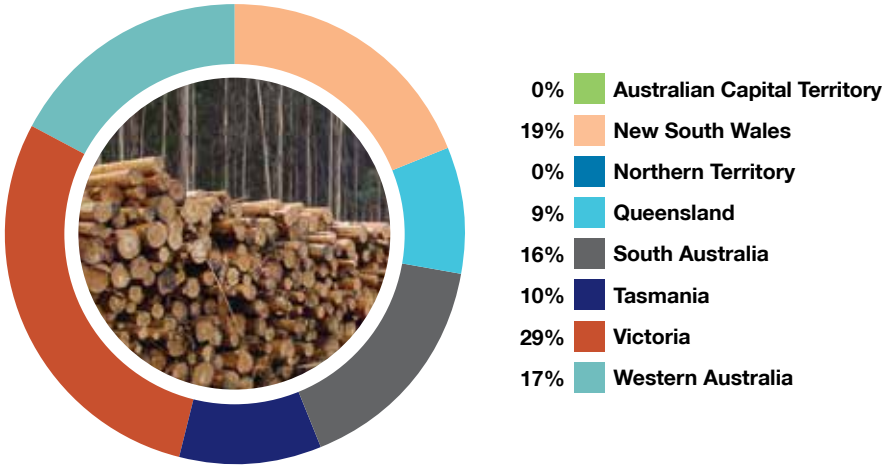


Table 26. High Priority Pests of the plantation forest industry

Scientific name	Common name
Bursaphelenchus spp. including *B. xylophilus*	Pinewood nematode species complex
Chrysoporthe austroafricana	*Eucalyptus* canker disease
Coptotermes formosanus	Formosan subterranean termite
Coptotermes gestroi	Asian subterranean termite
Dendroctonus ponderosae	Mountain pine beetle
Dendroctonus valens	Red turpentine beetle
Endocronartium harknessii	Western gall rust
Fusarium circinatum	Pitch canker
Hylesia nigricans	Burning moth
Ips typographus	Spruce bark beetle
Lymantria dispar	Asian gypsy moth
Lymantria monacha	Nun moth
Monochamus spp. including *M. alternatus, M. galloprovinicialis, M. titillator, M. scutellatus*	Longhorn beetles
Orgyia thyellina	White spotted tussock moth
Phytophthora pinifolia	Dano foliar del Pino
Phytophthora ramorum	Sudden oak death
Puccinia psidii sensu lato (exotic variants)	Guava rust/Eucalyptus rust
Teratosphaeria gauchensis	Coniothyrium eucalyptus canker
Teratosphaeria zuluensis	Coniothyrium eucalyptus canker
Tomicus piniperda	Pine shoot beetle
Urocerus gigas	Giant wood wasp

Mountain pine beetle. Image courtesy of G. D. Amman, United States Department of Agriculture Forest Service.

*Red turpentine beetle (*Dendroctonus valens*) larvae. Image courtesy of Ladd Livingston, Idaho Department of Lands.*

PROCESSING TOMATOES

Represented by the Australian Processing Tomato Research Council Inc.
www.aptrc.asn.au

In 2013–14, processing tomato production was valued at $20.5 million (LVP). The industry estimates that approximately 2,700 hectares were planted in 2014–15 with around 286,000 tonnes delivered for processing, which was an increase of about 28 per cent from the previous year. This included over 7,300 tonnes from growers of fresh tomatoes. In 2014–15, an average yield of 106 tonnes per hectare was achieved by growers of processing tomatoes — a new record. Australia consumes around 550,000 tonnes of processed tomatoes, with the majority of imports coming from Italy and China.

The main varieties grown in Australia are dominated by Heinz cultivars and 99 per cent of the production area is irrigated using sub-surface drip lines.

A biosecurity plan has recently been developed for this industry and will be published in early 2016.

Image courtesy of Australian Processing Tomato Research Council.

Figure 55. Annual value of processing tomato production, 2007–14

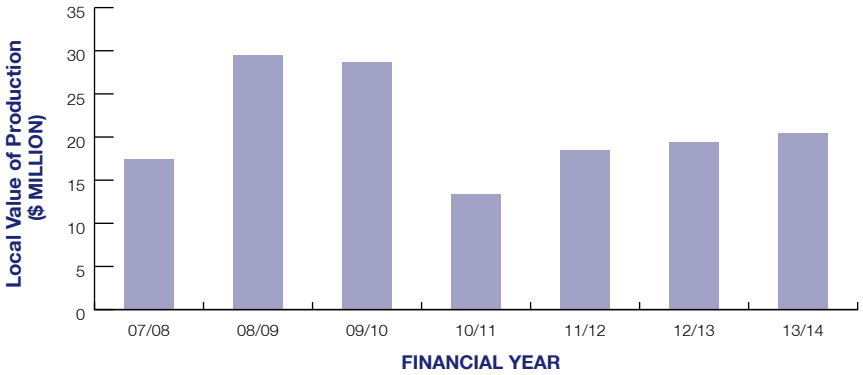
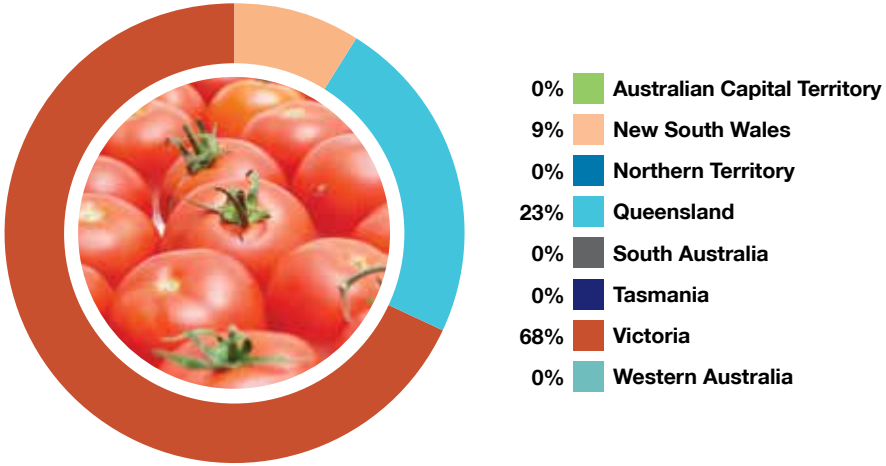


Figure 56. Distribution of processing tomato production by state and territory, 2013–14 (based on LVP)



RASPBERRIES AND BLACKBERRIES

Represented by Raspberries and Blackberries Australia Inc.
www.arga.com.au

In 2013–14, raspberry and blackberry production was valued at $56 million (LVP). There are currently over 380 hectares of land under cultivation with *Rubus* varieties. New plantings continue to see the industry expanding as it responds to increasing consumer demand.

Peak production is early summer to autumn, however fresh Australian raspberries are now available all year-round with plantings in subtropical areas being harvested in late autumn to spring. The increased use of protected cropping and hydroponic systems also extends the harvest season and productivity. Most of the raspberries and blackberries produced in Australia are consumed locally with little to no export of fresh fruit.

The rubus industry is covered by version 1.0 of the biosecurity plan for the rubus industry which was prepared in 2013 using rubus levy funds matched by the Australian Government. RABA signed the EPPRD Act in June 2015 and is in the process of developing the consultation to introduce an EPPR levy at zero and a PHA levy.

Table 27. High Priority Pests of the rubus industry

Scientific name	Common name
Arthuriomyces peckianus	Orange rust (long-cycled)
Cercosporella rubi	Rosette
Drosophila suzukii	Spotted-winged drosophila
Euschistus conspersus	Consperse stink bug
Gymnoconia nitens	Orange rust (short-cycled)
Halyomorpha halys	Brown-marmorated stink bug/ Yellow-brown stink bug
Heterocrossa rubophaga	Raspberry bud moth
Pennisetia hylaeiformis	Raspberry crown borer
Pennisetia marginata	Raspberry crown borer
Popillia japonica	Japanese beetle

Figure 57. Annual value of rubus production, 2009–14

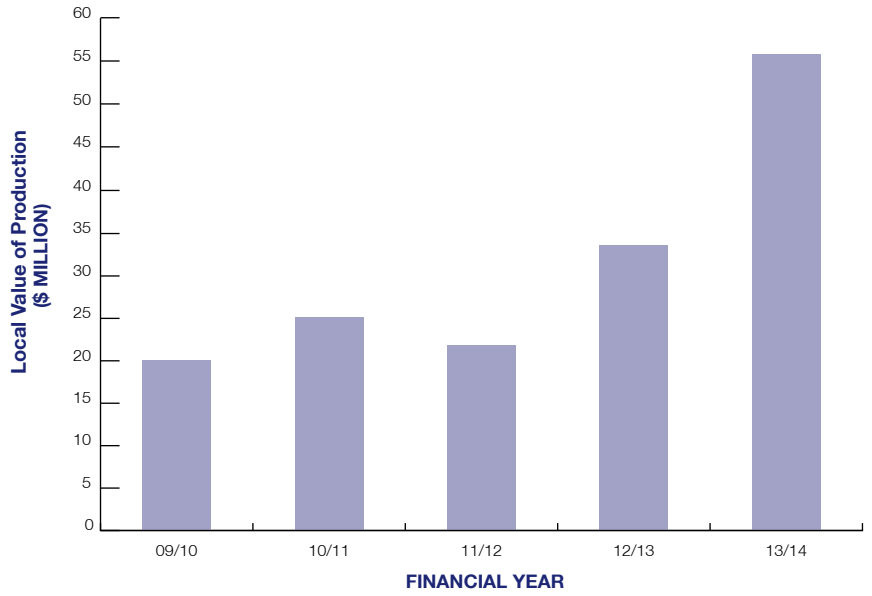


Figure 58. Distribution of rubus production by state and territory, 2013–14 (at the farm gate)

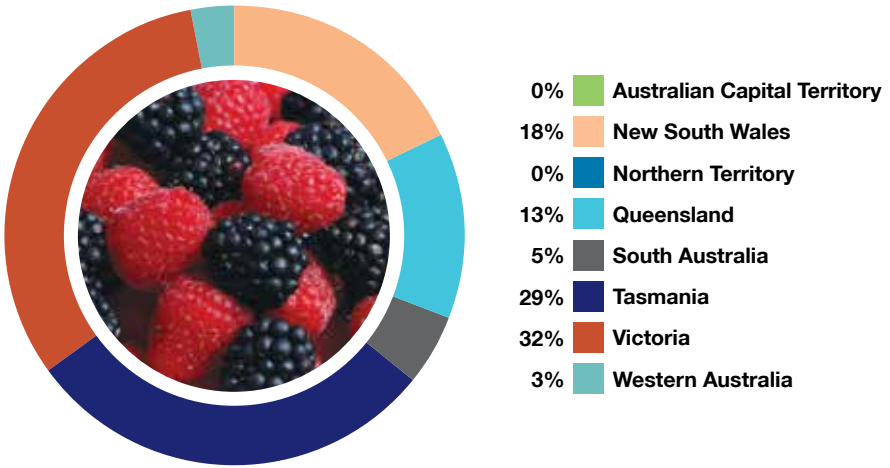


Image courtesy of Ricegrowers' Association of Australia

RICE

Represented by the Ricegrowers' Association of Australia Inc.
www.rga.org.au

In 2013–14, rice production was valued at $255 million (LVP), a little lower than the average of around $300 million (farm gate value) in typical production seasons. After several low production years during the drought, production between 2010–11 and 2014–15 ranged between 690,000 tonnes and 1.1 million tonnes of paddy.

The Australian rice industry is predominantly located in the temperate climatic region of the Riverina in southern NSW. A very small area of rice is also grown in northern NSW and rice growing is emerging as an industry in north Queensland. In the Riverina, the major varieties grown are temperate Japonica varieties planted in October and harvested from March to May of the following year.

The vast majority of Australia's rice is exported to international destinations in Asia, the Middle East, and many nations in the Pacific. Market analysis indicates that there is demand across all market segments, both domestic and international for 950,000 tonnes of paddy production annually.

Following the acquisition of a rice seed company in north Queensland by Ricegrowers' Limited (SunRice), rice is being grown there in increasing tonnages. While still limited, commercial production continues to increase as varieties bred specifically for that environment and management techniques suitable for local conditions are introduced to the cropping system.

Strict biosecurity measures have been put in place to ensure that any rice plant pests which may be endemic in northern Australia are not spread south to the major rice growing area in NSW.

The rice industry is covered by version 3.0 of the rice biosecurity plan.

Figure 59. Annual value of rice production, 2007–14

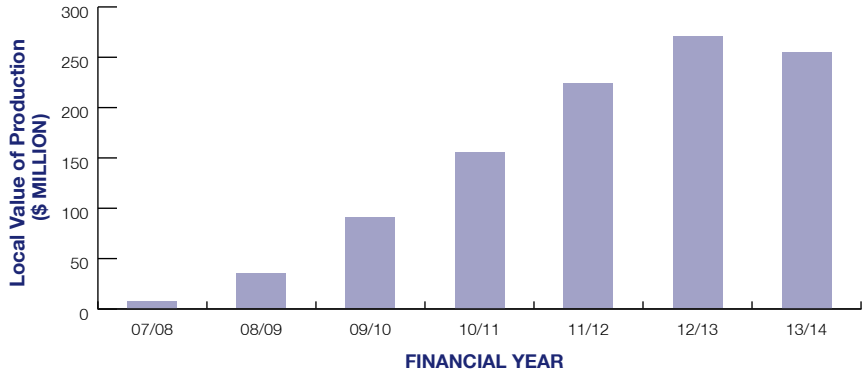


Figure 60. Distribution of rice production by state and territory, 2013–14 (based on LVP)

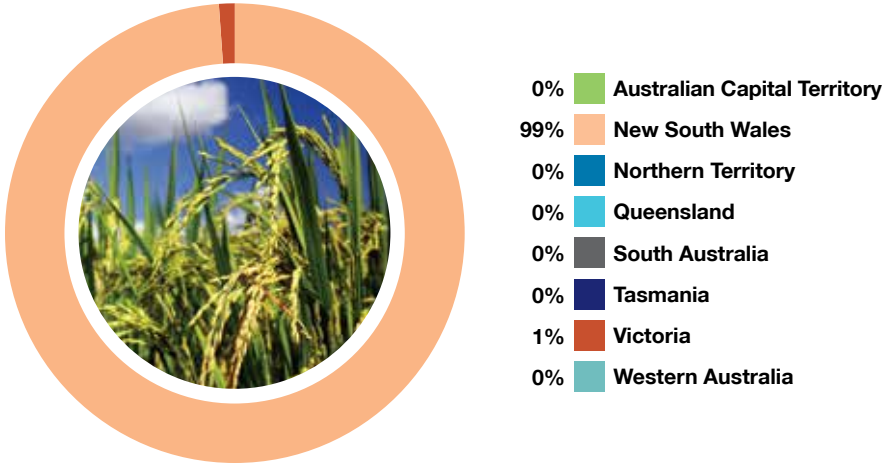


Table 28. High Priority Pests of the rice industry

Scientific name	Common name
Lissorhoptrus oryzophilus	Rice water weevil
Magnaporthe grisea	Rice blast
Pomacea canaliculata	Golden apple snail
Rice grassy stunt virus (Tenuivirus)	Rice grassy stunt virus
Rice ragged stunt virus (Oryzavirus)	Ragged stunt virus
Rice tungro bacilliform virus (unassigned)	Rice tungro bacilliform virus
Rice tungro spherical virus (Waikavirus)	Rice tungro spherical virus/Waika virus
Tilletia barclayana	Kernel smut of rice
Tilletia indica	Karnal bunt
Trogoderma granarium	Khapra beetle

STONE FRUIT

Represented by Summerfruit Australia Ltd
www.summerfruit.com.au

In 2013–14, stonefruit production (fresh apricots, nectarines, peaches and plums) was valued at $175 million (LVP). Nectarines and peaches comprised two-thirds of national stone fruit production, followed by plums and apricots.

Production of stone fruit has grown considerably over the past 10 years, with the majority of this growth directly attributable to prospective export to China. Around $38 million worth of stone fruit was exported in 2014–15—an increase of 14 per cent.

Production is mainly located in subtropical and temperate Australia where the industry is a major rural and regional employer. Victoria produces around 65 per cent of Australia's stone fruit (in the order nationally of 115,000 tonnes) with the remaining production spread between NSW, Queensland, SA, WA and Tasmania.

The stone fruit industry is covered by version 1.0 of the biosecurity plan for the summerfruit industry and the Orchard Biosecurity Manual for the Summerfruit Industry Version 1.0.

Table 29. High Priority Pests of the stone fruit industry

Scientific name	Common name
Bactrocera cucurbitae	Melon fruit fly
Bactrocera dorsalis	Oriental fruit fly
*Bactrocera papayae**	Papaya fruit fly
Conotrachelus nenuphar	Plum curculio
Cryptophlebia leucotreta	False codling moth
Cydia funebrana	Plum fruit moth
Drosophila suzukii	Spotted-winged drosophila
European stone fruit yellows phytoplasma	European stone fruit yellows
Homalodisca vitripennis	Glassy-winged sharpshooter
Monilinia fructigena	Brown rot
Monilia polystroma	Asiatic brown rot
Peach rosette mosaic virus (*Nepovirus*)	Peach rosette mosaic virus
Plum pox virus (*Potyvirus*)	Plum pox virus
Popillia japonica	Japanese beetle
X disease phytoplasma	Peach X disease
Xylella fastidiosa	Pierce's disease

* This species has been synonymised with *Bactrocera dorsalis*

Figure 61. Annual value of stone fruit production, 2007–14

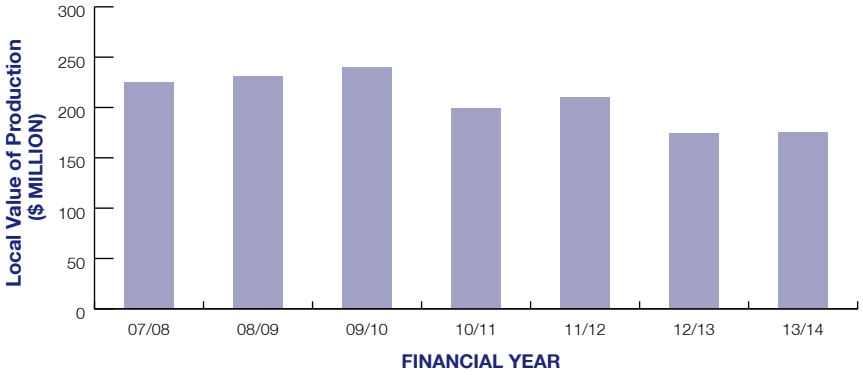
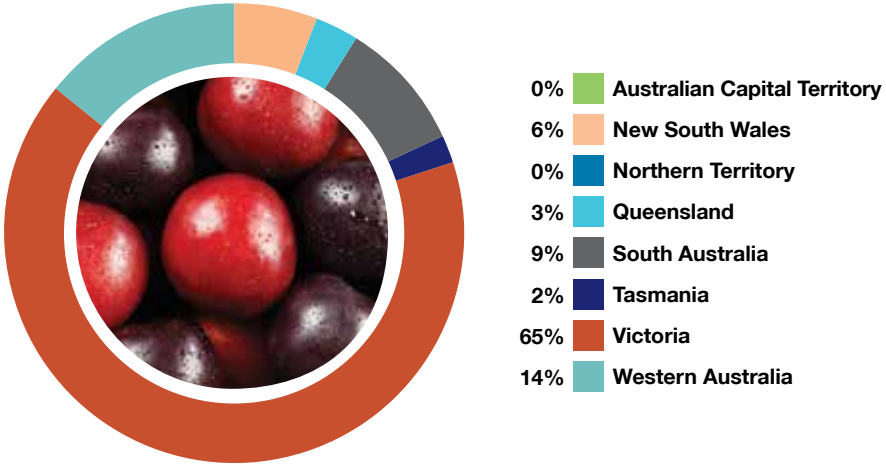


Figure 62. Distribution of stone fruit production by state and territory, 2013–14 (based on LVP)



STRAWBERRIES

Represented by Strawberries Australia Inc.
www.strawberriesaustralia.com.au

In 2013–14, strawberry production was valued at $209 million (LVP).

Strawberries are grown in all states of Australia by an estimated 500 growers concentrated in the Sunshine Coast area of Queensland, the Yarra Valley and the Mornington Peninsula in Victoria, Wannaroo and Albany in WA, the Adelaide Hills in SA and Launceston in Tasmania.

Strawberries are grown throughout the year with Florida varieties grown in subtropical locations (May–October) and Californian varieties grown in temperate climate areas (October–June). The industry is investing in the breeding of Australian varieties and these have gradually entered the market.

The industry is primarily focused on the domestic market with around five per cent exported. The increase in production over the past several years is due primarily to rising per capita consumption, driven by higher planting numbers, improved Australian varieties that have been developed using the best varieties from Europe and the United States, and better cool chain management.

The strawberry industry is covered by version 2.0 of the biosecurity plan for the strawberry industry.

Table 30. High Priority Pests of the strawberry industry

Scientific name	Common name
Lygus hesperus	Western plant bug
Lygus lineolaris	Tarnished plant bug
Phytophthora fragariae var. *fragariae*	Red steele root rot
Raspberry ringspot virus (*Nepovirus*)	Raspberry ringspot virus
Strawberry latent ringspot virus (*Sadwavirus*)	Strawberry latent ringspot virus
Tomato black ring virus (*Nepovirus*)	Tomato black ring virus
Tomato ringspot virus (*Nepovirus*)	Tomato ringspot virus
Xanthomonas fragariae	Strawberry angular leaf spot

Figure 63. Annual value of strawberry production, 2007–14

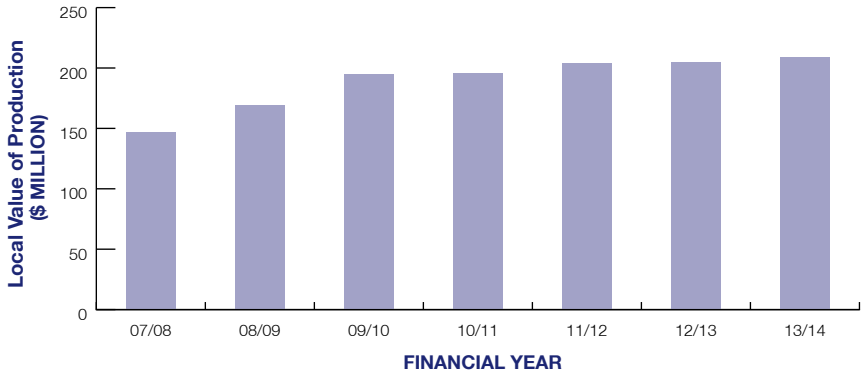
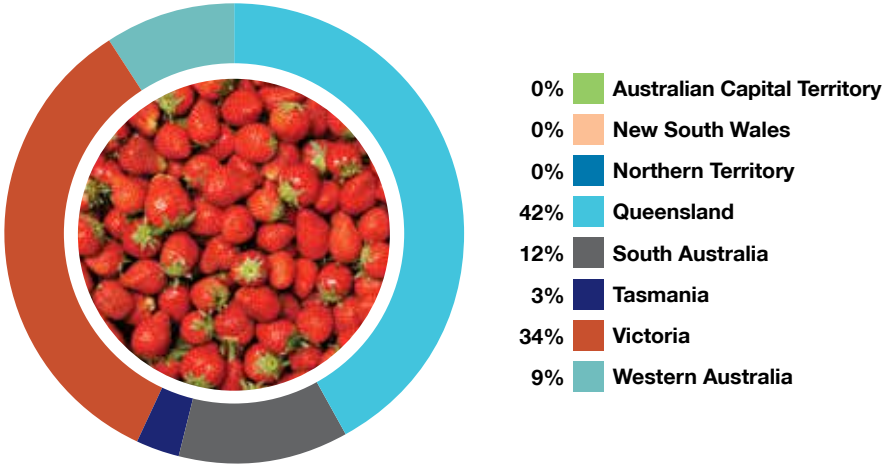


Figure 64. Distribution of strawberry production by state and territory, 2013–14 (based on LVP)



SUGARCANE

Represented by CANEGROWERS
www.canegrowers.com.au

In 2013–14, sugarcane production was valued at $1.2 billion (LVP). The Australian cane industry produces 30–35 million tonnes of cane per year, which when processed equates to around 4–4.5 million tonnes of sugar.

Australia's sugarcane is grown in high-rainfall and irrigated areas along coastal plains and river valleys on 2,100 km of Australia's eastern coastline between Mossman in far north Queensland and Grafton in NSW. Queensland accounts for about 95 per cent of Australia's raw sugar production.

Australia is the world's third largest exporter of raw sugar, with approximately 80 per cent of production sold to international markets. Major export customers include east Asia, China, Indonesia, Japan, Korea, Malaysia, Taiwan, the United States and New Zealand.

The sugarcane industry is covered by version 2.01 of the sugarcane biosecurity plan.

Image courtesy of Canegrowers.

Figure 65. Annual value of sugarcane production, 2007–14

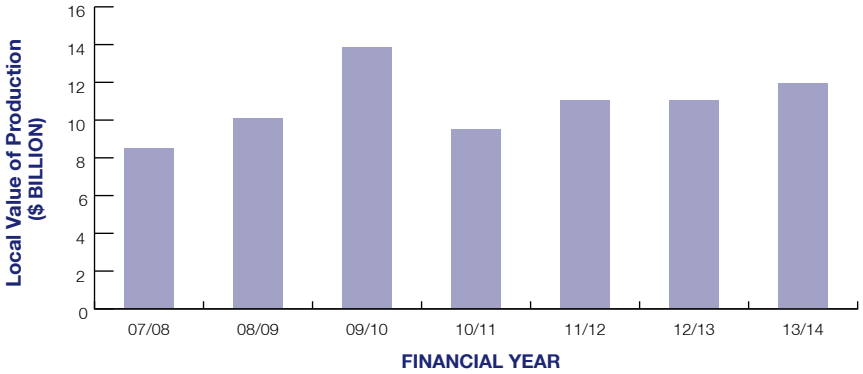


Figure 66. Distribution of sugarcane production by state and territory, 2013–14 (based on LVP)

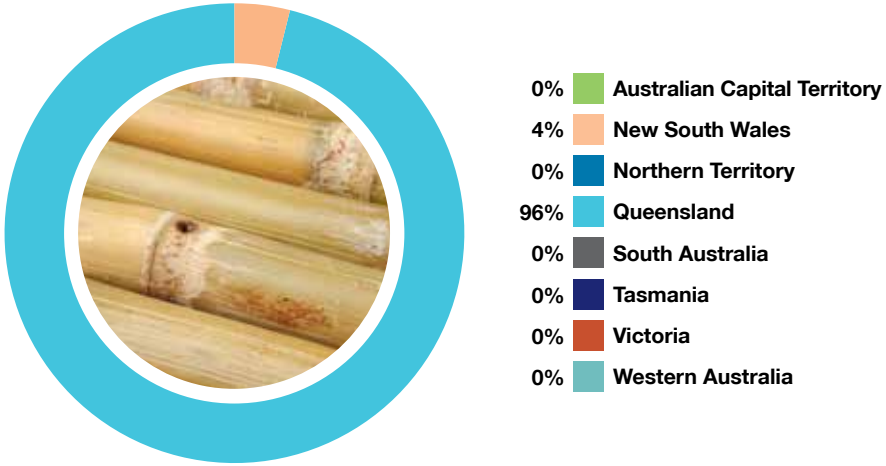


Table 31. High Priority Pests of the sugarcane industry

Scientific name	Common name
Aleurolobus barodensis	Sugarcane whitefly
Ceratovacuna lanigera	Sugarcane woolly aphid
Cercospora longipes	Brown spot
Chilo auricilius	Sugarcane internode borer
Chilo infuscatellus	Yellow top borer of sugarcane
Chilo sacchariphagus	Sugarcane internode borer
Chilo terrenellus	Sugarcane stem borer
Cicadulina mbila	South African maize leafhopper
Dorysthenes buqueti	Sugarcane longhorn stem borer
Fulmekiola serrata	Oriental sugar cane thrips
Lepidiota blanchardi	Blanchard's canegrub
Lepidiota discedens	Canegrub
Lepidiota pruinosa	Pruinose canegrub
Lepidiota reuleauxi	Ramu canegrub
Lepidiota stigma	White canegrub
Leucopholis near *armata*	Canegrub
Perkinsiella bicoloris	Sugarcane sidewinder
Perkinsiella diagoras	Sugarcane sidewinder
Perkinsiella lalokensis	Sugarcane sidewinder
Perkinsiella papuensis	Sugarcane sidewinder
Perkinsiella rattlei	Sugarcane sidewinder
Perkinsiella saccharivora	Sugarcane sidewinder
Perkinsiella vastatrix	Sugarcane sidewinder
Perkinsiella vitiensis	Sugarcane sidewinder
Peronosclerospora philippinensis	Philippine downy mildew of maize
Peronosclerospora sacchari	Sugarcane downy mildew
Peronosclerospora spontanea	Downy mildew
Pulvinaria iceryi	*Pulvinaria* scale
Pyrilla perpusilla	Sugarcane pyrilla
Scirpophaga excerptalis	Top shoot borer
Sesamia grisescens	Stem borer
Sesamia inferens	Pink stem borer
Sorghum mosaic virus (Potyvirus)	Sorghum mosaic virus
Stagonospora sacchari	Leaf scorch
Sugarcane grassy shoot phytoplasma	Grassy shoot
Sugarcane mosaic virus (*Potyvirus*) (exotic strains)	Sugarcane mosaic virus
Sugarcane streak mosaic virus (unassigned)	Sugarcane streak mosaic
Sugarcane white leaf phytoplasma	White leaf
Tetramoera schistaceana	Sugarcane shoot borer
Unknown	Ramu stunt disease

*Sugarcane infested with stem borer (*Sesamia grisescens*) in Papua New Guinea. Image courtesy of Sugar Research Australia.*

Sugarcane longhorn stem borer. Image courtesy of Sugar Research Australia.

Sugarcane downy mildew. Image courtesy of Christian Cumagun, University of the Philippines, Los Banos.

Sugarcane stem borer. Image courtesy of PaDIL.

TABLE GRAPES

Represented by Australian Table Grape Association Inc.
www.australiangrapes.com.au

In 2013–14, table grape production was valued at $278 million (LVP). Green, red and blue/black varieties of table grapes are produced by 1,200 growers in the major growing regions of Sunraysia and the Murray Valley in Victoria, the Riverina in NSW and in south east Queensland.

The table grape industry is covered by version 3.0 of the viticulture biosecurity plan and the Biosecurity Manual for the Viticulture Industry Version 1.0.

Table 32. High Priority Pests of the table grape industry

Scientific name	Common name
Bactrocera carambolae	Carambola fruit fly
Bactrocera dorsalis	Oriental fruit fly
*Bactrocera papayae**	Papaya fruit fly
Candidatus Phytoplasma solani	Bois noir
Daktulosphaira vitifoliae (exotic strains)	Grapevine phylloxera
Drosophila suzukii	Spotted-winged drosophila
Grapevine flavescence dorée phytoplasma	Flavescence dorée
Guignardia bidwellii	Black rot
Homalodisca vitripennis	Glassy-winged sharpshooter
Hyalesthes obsoletus	Cixiidae planthopper
Lobesia botrana	European grapevine moth
Planococcus ficus	Vine mealybug
Polychrosis viteana	American berry moth
Pseudococcus maritimus	Grape mealybug
Xylella fastidiosa	Pierce's disease

* This species has been synonymised with *Bactrocera dorsalis*

Figure 67. Annual value of table grape production, 2007–14

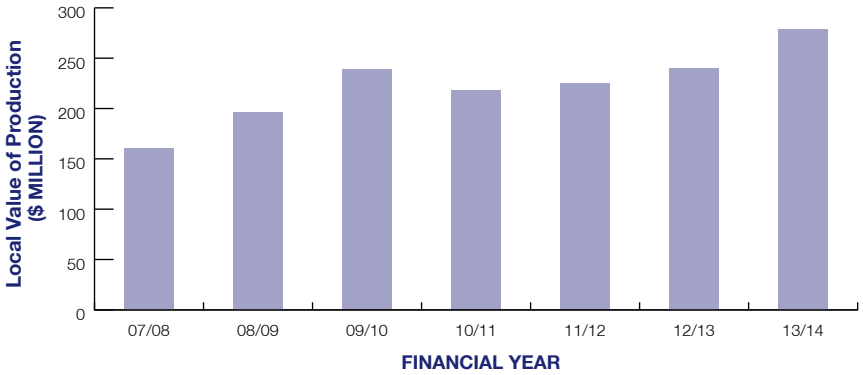
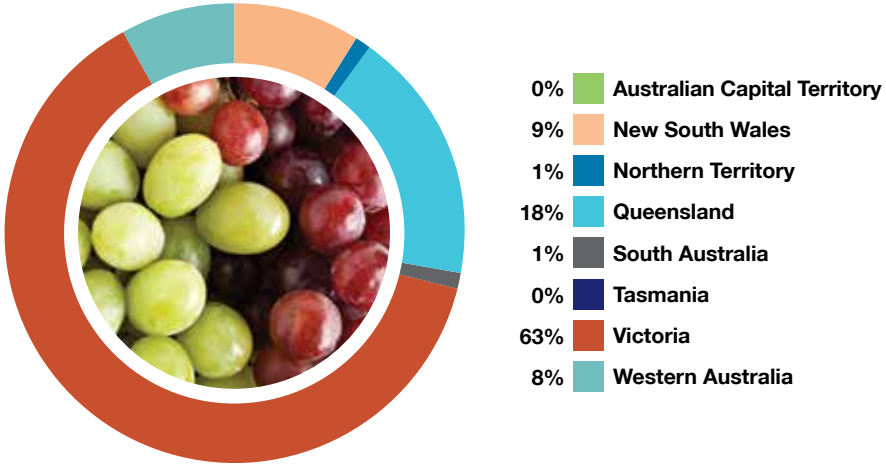
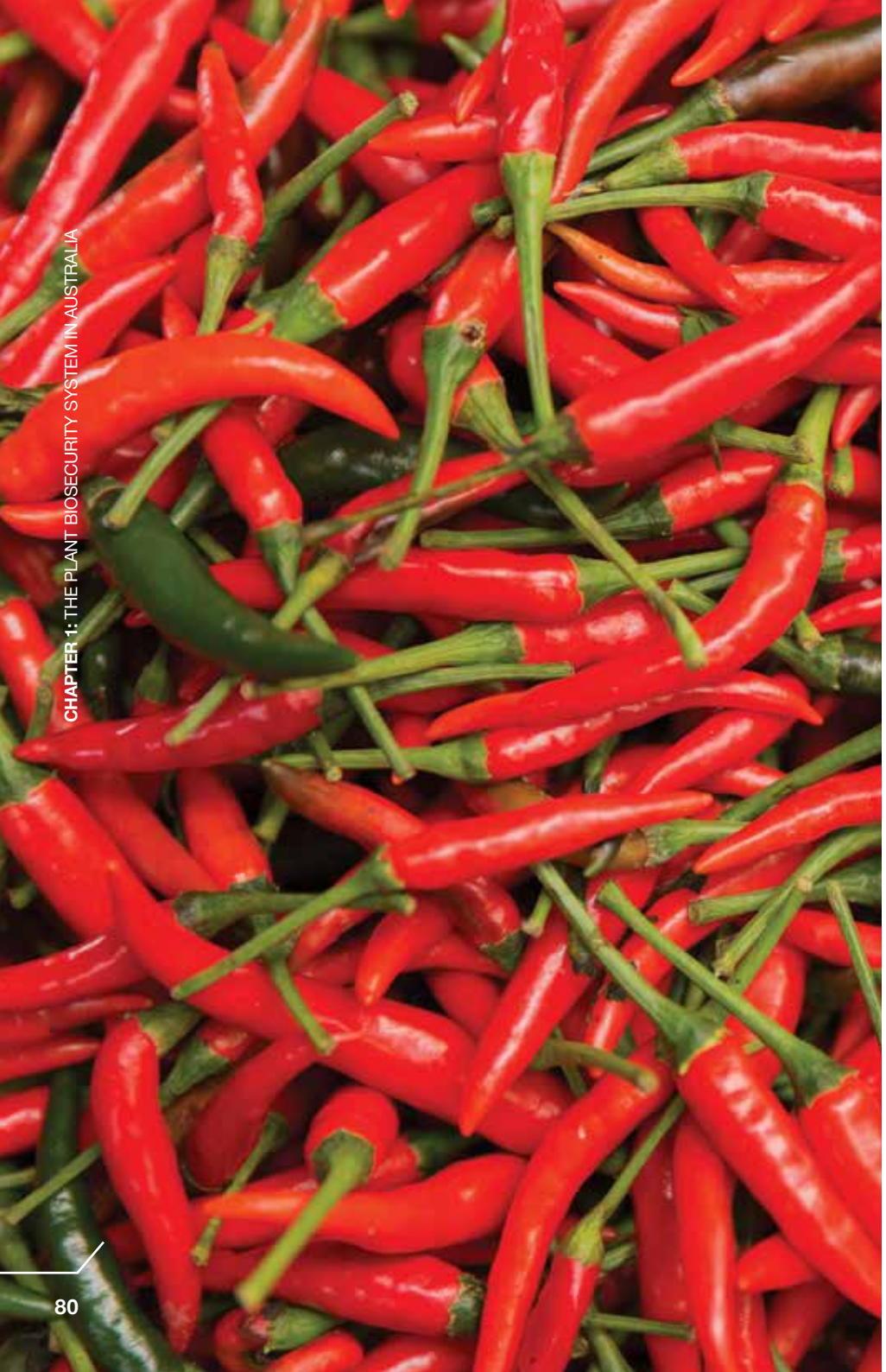


Figure 68. Distribution of table grape production by state and territory, 2013–14 (based on LVP)





VEGETABLES (INCLUDING POTATOES)

Represented by AUSVEG Ltd
www.ausveg.com.au

In 2013–14, vegetable and potato production was valued at $2 billion (LVP). Major crops include potatoes, carrots and lettuce.

Australia's diverse climate and soils accommodate vegetable cultivation in all states and territories, ensuring a constant supply of fresh vegetables. Australian vegetable growers provide the majority of fresh vegetables consumed in Australia and an increasing amount of fresh vegetables consumed overseas.

The Australian vegetable industry is committed to building its capacity to respond to potential biosecurity threats and is engaging with multiple relevant government departments, committees and bodies. This includes participation in technical meetings with the Department of Agriculture and Water Resources and PHA, the appointment of a vegetable industry Biosecurity Advisor and a dedicated Vegetable and Potato Biosecurity Officer.

During 2015, the Vegetable and Potato Biosecurity Officer held a series of biosecurity awareness seminars across Australia and visited a number of growing regions in order to discuss best practice on-farm biosecurity. Raising biosecurity awareness among growers, and especially farm visitors, is a key goal of the program.

AUSVEG is also actively collaborating with state governments. As an example, in 2015 the Vegetable and Potato Biosecurity Officer collaborated with the NT government to develop a National Management Plan for the control of an incursion of the exotic cucumber green mottle mosaic virus. The successful progression of this plan resulted in the implementation of on-farm biosecurity plans for management of the virus and the lifting of quarantine arrangements in NT cucurbit production areas.

The Australian vegetable industry is covered by version 2.0 of the vegetable biosecurity plan, the Farm Biosecurity Manual for the Northern Adelaide Plains Vegetable Growers Version 1.0 and the Biosecurity Induction Manual for Bundaberg Horticultural Farms Version 1.0.

Figure 69. Annual value of vegetable production, 2007–14

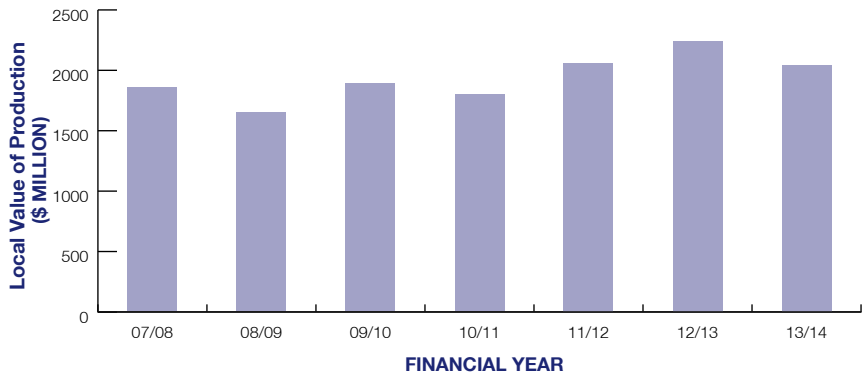


Figure 70. Distribution of vegetable production by state and territory, 2013–14 (based on LVP)

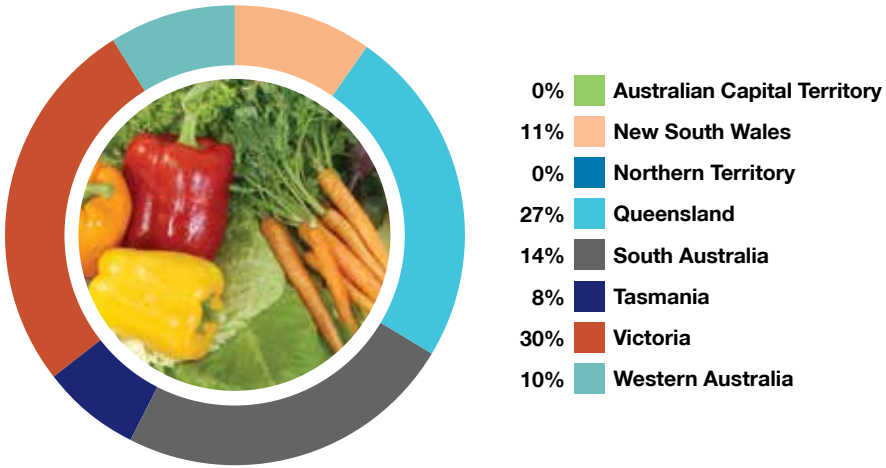


Table 33. High Priority Pests of the vegetable industry

Scientific name	Common name
Bactericera cockerelli	Tomato/potato psyllid
Bactrocera cucurbitae	Melon fruit fly
Candidatus Liberibacter solanacearum	Zebra chip
Globodera pallida (pathotypes PA1, PA2)	Potato cyst nematode (white or pale)
Globodera rostochiensis (exotic strains)	Potato cyst nematode (golden)
Groundnut bud necrosis virus (Tospovirus)	Bud necrosis disease
Heterodera carotae	Carrot cyst nematode
Liriomyza bryoniae	Tomato leaf miner
Liriomyza huidobrensis	Serpentine leaf miner
Liriomyza sativae	Vegetable leaf miner
Liriomyza trifolii	American serpentine leaf miner
Phytophthora infestans (A2 mating type and exotic strains of A1 mating type)	Late blight
Potato spindle tuber viroid (*Pospiviroidae*)	Potato spindle tuber viroid
Potato virus Y (Potyvirus) (exotic strains)	Potato virus Y
Psila rosae	Carrot rust fly
Ralstonia solanacearum race 3 (exotic strains)	Bacterial wilt
Watermelon bud necrosis virus (*Tospovirus*)	Watermelon bud necrosis
Watermelon silver mottle virus (*Tospovirus*)	Watermelon silver mottle

Potato cyst nematode. Image courtesy of Florida Division of Plant Industry Archive, Florida Department of Agriculture and Consumer Service.

Serpentine leaf miner. Image courtesy of Plant Protection Service Archive, bugwood.org.

WALNUTS

Represented by the Australian Walnut Industry Association
www.walnut.net.au

In 2013–14, walnut production was valued at $47 million (LVP). In 2015, the production of Australian walnuts was in excess of 8,000 tonnes (in–shell).

The Australian walnut industry operates in most states of Australia. The industry has grown significantly in recent years due to growth in the establishment of large scale commercial plantings. The area currently under cultivation is approximately 2,980 hectares. Production is expected to increase dramatically in the next five years as new orchards mature and come into bearing.

Walnut production in Australia has been steadily increasing, and local production of in–shell walnuts can satisfy all domestic consumption. About 70 per cent of Australia's walnut production is exported with greatest demand for in-shell walnuts in China, Turkey and Italy.

In December 2015 an Industry Development Officer was appointed with a view to further improving the industry biosecurity program.

Aspects of biosecurity are well embedded in the Australian Walnut Industry Five Year Strategic Plan 2015 to 2020.

The walnut industry participated in a review of the nut biosecurity plan and is covered by version 2.0 of that plan.

Table 34. High Priority Pests of the walnut industry

Scientific name	Common name
Trogoderma granarium	Khapra beetle
Halyomorpha halys	Brown mamorated stink bug
Amyelois transitella	Navel orange worm
Lymantria dispar	Gypsy moth (Asian and European strains)
Verticillium dahliae (exotic defoliating strains)	Verticillium wilt

Figure 71. Annual value of walnut production, 2007–14

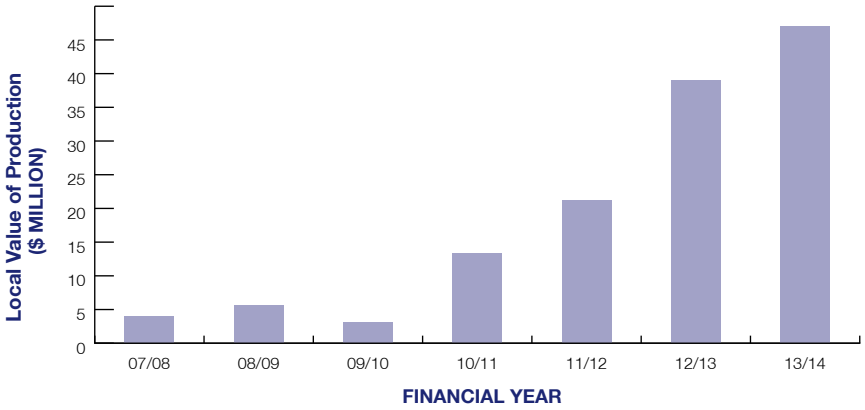
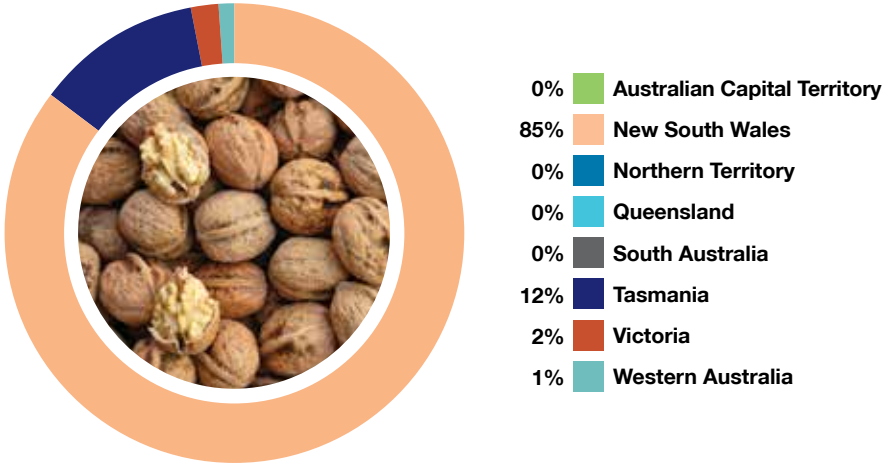


Figure 72. Distribution of walnut production by state and territory, 2013–14 (based on LVP)



WINE GRAPES

Represented by the Wine Grape Growers Australia
www.wgga.com.au

In 2013–14, wine grape production was valued at $672 million (LVP). The wine industry has a significant footprint in Australia, comprising over 5,100 winegrowers over a vineyard area of 135,178 hectares, made into wine at over 2,300 wineries, and generating gross sales of $773 billion. Wine grape production was 1.67 million tonnes in 2015, about the same as the previous year. It is estimated that the wine industry contributes over $40 billion to the Australian economy, and directly employs over 68,000 people.

In 2015, the most grown wine grape varieties were Shiraz (23 per cent), Chardonnay (22 per cent) and Cabernet Sauvignon (13 per cent). The major varieties by colour are Shiraz, Cabernet Sauvignon and Merlot for reds and Chardonnay, Sauvignon Blanc and Semillon for whites.

WGGA estimates that there has been a net removal of vines of 2–3 per cent each year since the 2007–2008 season, although production has been steady.

The wine grape industry is covered by version 3.0 of the viticulture biosecurity plan and the Biosecurity Manual for the Viticulture Industry Version 1.0.

Figure 73. Annual value of wine grape production, 2007–14

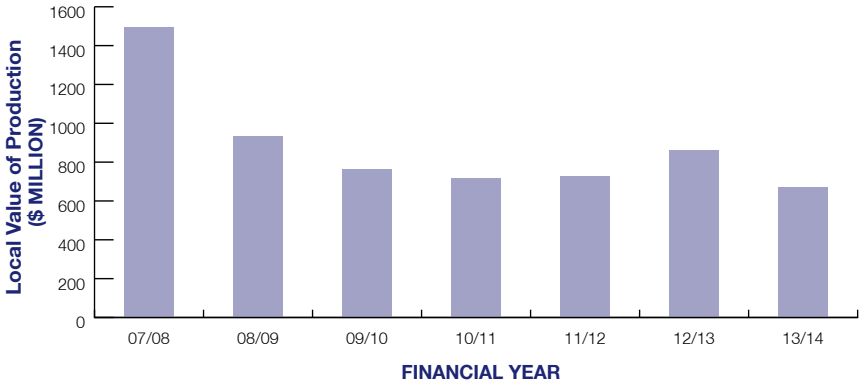


Figure 74. Distribution of wine grape production by state and territory, 2013–14 (based on LVP)

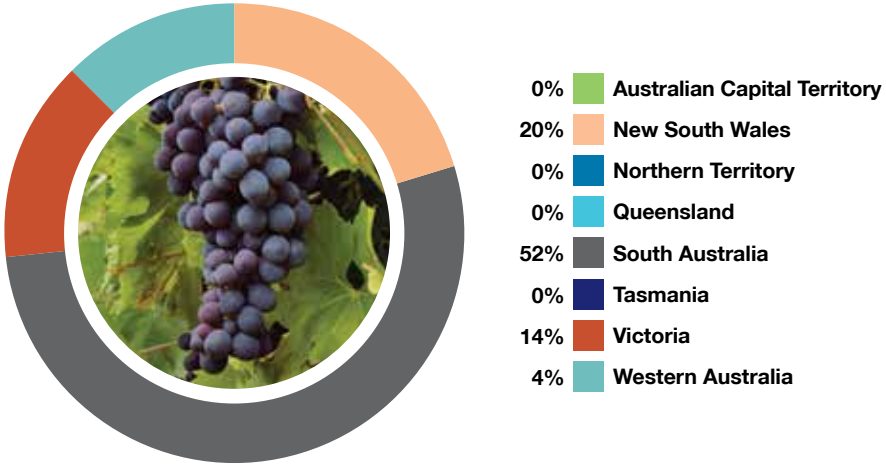


Table 35. High Priority Pests of the wine grape industry

Scientific name	Common name
Bactrocera carambolae	Carambola fruit fly
Bactrocera dorsalis	Oriental fruit fly
*Bactrocera papayae**	Papaya fruit fly
Candidatus Phytoplasma solani	Bois noir
Daktulosphaira vitifoliae (exotic strains)	Grapevine phylloxera
Drosophila suzukii	Spotted-winged drosophila
Grapevine flavescence dorée phytoplasma	Flavescence dorée
Guignardia bidwellii	Black rot
Homalodisca vitripennis	Glassy-winged sharpshooter
Hyalesthes obsoletus	Cixiidae planthopper
Lobesia botrana	European grapevine moth
Planococcus ficus	Vine mealybug
Polychrosis viteana	American berry moth
Pseudococcus maritimus	Grape mealybug
Xylella fastidiosa	Pierce's disease

* This species has been synonymised with *Bactrocera dorsalis*

Melon fruit fly. Image courtesy of Florida Division of Plant Industry Archive, Florida Department of Agriculture and Consumer Services, bugwood.org.

Serpentine leafminer larvae. Image courtesy of Merle Shepard, Gerald R. Carner, and P. A. C Ooi, bugwood.org.

Black rot. Image courtesy of Bruce Watt, University of Maine.

Grape mealybug. Image courtesy of Jack Kelly Clark, University of California.

Chapter 2

Threats to Australia's plant production

This chapter lists some 380 plant pests that have been identified as posing the greatest risk to plant production in Australia. Identifying the pests that pose the greatest risk enables agreed targeted measures to prevent pest entry, establishment and spread.

The list of High Priority Pests was developed through biosecurity planning for each plant industry. Plant pest experts have identified that each one represents a high risk to one or more crops with a severe economic impact if it is established in Australia.

Pests that are currently contained to particular regions are also listed and current eradication responses to Emergency Plant Pests are described.

The chapter ends with a description of the management of weeds in Australia, which also pose a considerable threat to plant production.

The exotic pest chestnut blight is being eradicated from Victoria. Image courtesy of DEDJTR.

2.1 Australia's High Priority Pests

The basis of any risk mitigation system begins with identifying threats. For Australia's plant producers and beekeepers, this includes exotic pests that could have a significant impact on production or trade, should they establish in Australia, as well as pests that are in Australia but confined to particular regions.

To identify and prioritise exotic pests of quarantine concern, pest risk assessments are made on an industry-by-industry basis, during the development of biosecurity plans. Through consultation with industry and government experts who form an Industry Biosecurity Group, estimates are made of the level of risk associated with each pest. The process takes into account the pest's likelihood of entry, establishment and spread, as well as the economic impact it would be expected to have if it became established in Australia. The assessment includes all entry pathways including legal, illegal, accidental or through natural causes.

High Priority Pests (HPPs) are those found to pose the greatest risk with the largest potential economic impact. It is important to note that pest risk assessments are general analyses of overseas pest risks, a process that differs from the Import Risk Analysis processes conducted for individual import applications (See 3.1 International Trade).

Once the HPPs for an industry or crop have been identified, the Industry Biosecurity Group develops and agrees risk mitigation measures for each. Agreed measures also form part of the biosecurity plan.

Measures to mitigate the risk posed by a particular HPP might include surveillance protocols to check for the presence of the pest, the development of diagnostic protocols to ensure the pest can be identified accurately should it make it to Australia, and the development of contingency plans that outline the approach to dealing with such a pest should an incursion occur. Public awareness programs and pre-emptive breeding or other research might also be included.

Biosecurity plans undergo formal reviews on a regular basis to ensure they remain up-to-date given new research and changes to potential pathways.

Table 36 lists all 377 HPPs that have been identified from the 28 biosecurity plans developed by PHA (see Table 44) in conjunction with industries and governments, along with those listed in Schedule 13 of the EPPRD, which are pre-categorised pests.

Whilst this list predominantly contains exotic pests, it does contain some species that are already present in Australia. These regionalised pests are usually controlled through active management or containment programs, yet are still of significant quarantine concern nationally.

Table 36. Pests designated as High Priority Pests during biosecurity planning

Scientific name	Common name	Risk assessments
Abaca bunchy top virus (*Babuvirus*)	Abaca bunchy top virus	Banana
Acarapis woodi	Tracheal mite	Honey bee
Achatina fulica	Giant African snail	Nursery and Garden, Tomato
Acleris comariana	Strawberry tortrix	EPPRD
Adoxophyes orana	Summer fruit tortrix	EPPRD
Aleurolobus barodensis	Sugarcane whitefly	EPPRD, Sugarcane
Amyelois transitella	Navel orangeworm	EPPRD, Nut
Anastrepha ludens	Mexican fruit fly	Citrus
Anisogramma anomala	Eastern filbert blight hazelnut blight	EPPRD, Nut
Anthonomus bisignatus	Strawberry bud weevil	EPPRD
Anthonomus grandis	Cotton boll weevil	EPPRD, Cotton
Aphis gossypii (exotic strains)	Cotton aphid	Cotton, Nursery and Garden
Apiosporina morbosa	Black knot	EPPRD
Apis cerana (exotic strains, genotypes and sub-species)	Asian honey bee	Honey bee
Apis mellifera capensis	Cape honey bee	Honey bee
Apis mellifera scutellata	African honey bee	Honey bee
Apis mellifera scutellata (hybrid)	Africanised honey bee	Honey bee
Apple proliferation phytoplasma	Apple proliferation	Apple and Pear
Aristobia testudo	Lychee longicorn beetle	Lychee
Arthuriomyces peckianus	Orange rust (long-cycled)	Rubus
Ascochyta rabiei (MAT1-1 is endemic, MAT 1-2 is exotic)	*Ascochyta* blight	Grains
Aspidiella hartii	Yam scale	Ginger
Atherigona soccata	Sorghum shoot fly	Grains
Avocado sunblotch viroid (asymptomatic strains)	Avocado sunblotch	Avocado
Avocado sunblotch viroid (symptomatic strains)	Avocado sunblotch	Avocado
Bactericera cockerelli	Tomato/potato psyllid	EPPRD, Potato, Tomato
Bactrocera carambolae	Carambola fruit fly	Avocado, Citrus, Mango, Papaya, Passionfruit, Tomato, Viticulture
Bactrocera dorsalis	Oriental fruit fly	EPPRD, Apple and Pear, Avocado, Citrus, Lychee, Papaya, Passionfruit, Summerfruit, Viticulture
Bactrocera facialis	Tropical fruit fly	Avocado, Passionfruit, Tomato
*Bactrocera invadens**	Fruit fly	Citrus, Melon
Bactrocera kandiensis	Fruit fly	Avocado, Citrus, Passionfruit
Bactrocera kirki	Fijian fruit fly	Avocado, Passionfruit
Bactrocera latifrons	Solanum fruit fly	Melon
Bactrocera melanotus	Fruit fly	Avocado, Passionfruit
Bactrocera occipitalis	Fruit fly	Citrus
Bactrocera oleae	Olive fly	Olive
*Bactrocera papayae**	Papaya fruit fly	EPPRD, Avocado, Citrus, Mango, Papaya, Passionfruit, Summerfruit, Viticulture
Bactrocera passiflorae	Fijian fruit fly	Avocado, Papaya, Passionfruit
*Bactrocera philippinensis**	Philippine fruit fly	EPPRD, Avocado, Citrus, Papaya, Passionfruit
Bactrocera psidii	South Sea guava fruit fly	Passionfruit
Bactrocera trivialis	New Guinea fruit fly	Citrus
Bactrocera xanthodes	Pacific fruit fly	Avocado, Passionfruit
Banana bract mosaic virus (*Potyvirus*)	Banana bract mosaic disease	EPPRD, Banana
Banana bunchy top virus (*Nanovirus*)	Banana bunchy top disease	Banana
Barley mild mosaic virus (*Bymovirus*)	Barley mild mosaic virus	Grains
Bean common mosaic virus (*Potyvirus*) (peanut stripe strain)	Bean common mosaic virus	Grains
Bemisia tabaci (Biotypes other than B and AN)	Silverleaf whitefly	Cotton, Melon, Nursery and Garden
Bemisia tabaci (Types Asia 1, China 1, China 2, Asia II (1-8), Italy, Sub-Saharan Africa (1-4), Uganda, New World, Mediterranean, Middle East Asia Minor 2, Indian Ocean)	Silverleaf whitefly	Cotton, Melon, Nursery and Garden, Tomato

* This species has been synonymised with *Bactrocera dorsalis*

Table 36. Pests designated as High Priority Pests during biosecurity planning

Scientific name	Common name	Risk assessments
Blood disease bacterium	Blood disease	EPPRD, Banana
Botrytis squamosa	Leaf blight	Onion
Bursaphelenchus spp. including *B. xylophilus*	Pinewood nematode species complex	Plantation forest
Caliothrips fasciatus	Bean thrips	Citrus
Candidatus Liberibacter africanus	Huanglongbing (African strain)	Citrus
Candidatus Liberibacter americanus	Huanglongbing (American strain)	Citrus
Candidatus Liberibacter asiaticus	Huanglongbing (Asiatic strain)	Citrus, Nursery and Garden
Candidatus Liberibacter psyllaurous	*Candidatus* Liberibacter psyllaurous	EPPRD
Candidatus Liberibacter solanacearum	Zebra chip	Potato, Tomato
Candidatus Phytoplasma solani	Bois noir	Viticulture
Cephus cinctus	Wheat stem sawfly	Grains
Cephus pygmeus	European wheat stem sawfly	Grains
Ceratocystis fimbriata sensu lato	Mango sudden decline syndrome	Mango
Ceratocystis manginecans	Mango sudden decline syndrome	Mango
Ceratocystis omanensis	Mango sudden decline syndrome	Mango
Ceratocystis ulmi	Dutch elm disease	EPPRD
Ceratovacuna lanigera	Sugarcane woolly aphid	Sugarcane
Cercospora longipes	Brown spot	Sugarcane
Cercosporella rubi	Rosette	Rubus
Ceutorhynchus assimilis	Cabbage seedpod weevil	Grains
Ceutorhynchus napi	Rape stem weevil	Grains
Ceutorhynchus pallidactylus	Cabbage stem weevil	Grains
Cherry leaf roll virus (*Nepovirus*) (exotic strains)	Blackline	EPPRD, Cherry, Rubus
Chickpea chlorotic dwarf virus (Mastrevirus)	Chickpea chlorotic dwarf virus	Grains
Chickpea chlorotic stunt virus (Polerovirus)	Chickpea chlorotic stunt virus	Grains
Chilo auricilius	Sugarcane internode borer	Sugarcane
Chilo infuscatellus	Yellow top borer of sugarcane	Sugarcane
Chilo orichalcociliellus	Coastal stem borer	Grains
Chilo partellus	Spotted stem borer	Grains
Chilo sacchariphagus	Sugarcane internode borer	Sugarcane
Chilo terrenellus	Sugarcane stem borer	Sugarcane
Chinavia hilaris (syn. *Chinavia hilare)*	Green stink bug	Nut
Choristoneura rosaceana	Oblique banded leaf roller	Cherry
Chrysoporthe austroafricana	*Eucalyptus* canker disease	Plantation forest
Ciborinia camelliae	Camellia petal blight	EPPRD
Cicadulina mbila	South African maize leafhopper	Sugarcane
Citripestis sagittiferella	Citrus fruit borer	Citrus
Citrus leprosis virus (unassigned)	Citrus leprosis disease	Citrus
Citrus tristeza virus (*Closterovirus*) (mandarin stem-pitting strain)	Mandarin stem-pitting	Citrus
Cladosporium allii	Leaf spot	Onion
Clavibacter michiganensis subsp. *sepedonicus*	Bacterial ring rot	EPPRD
Colletotrichum truncatum (lentil strain)	Lentil anthracnose	Grains
Conopomorpha sinensis	Lychee fruit borer	Lychee
Conotrachelus aguacatae	Small avocado seed weevil	Avocado
Conotrachelus nenuphar	Plum curculio	EPPRD, Apple and Pear, Cherry, Summerfruit
Conotrachelus perseae	Small seed weevil	Avocado
Coptotermes formosanus	Formosan subterranean termite	Plantation forest
Coptotermes gestroi	Asian subterranean termite	Plantation forest
Cotinis mutabilis	Fig beetle	Pineapple
Cotton leaf curl virus (*Begomovirus*)	Cotton leaf curl disease	EPPRD, Cotton
Cotton Leafroll dwarf virus (*Polerovirus*)	Cotton blue disease	Cotton

Table 36. Pests designated as High Priority Pests during biosecurity planning

Scientific name	Common name	Risk assessments
Cryphonectria parasitica	Chestnut blight	EPPRD, Nut
Ctenopseustis obliquana	Brown headed leaf roller	Cherry
Cydia funebrana	Plum fruit moth	Summerfruit
Cylindrocopturus adspersus	Sunflower stem weevil	Grains
Daktulosphaira vitifoliae (biotype B)	Grape phylloxera type B	EPPRD
Daktulosphaira vitifoliae (exotic strains)	Grapevine phylloxera	Viticulture
Deanolis sublimbalis	Red-banded mango caterpillar	Mango
Deformed wing virus (*Iflavirus*)	Deformed wing virus	Honey bee
Delia antiqua	Onion fly	Onion
Delia florilega	Bean fly	Onion
Dendroctonus ponderosae	Mountain pine beetle	Plantation forest
Dendroctonus valens	Red turpentine beetle	Plantation forest
Diabrotica barberi	Northern corn root worm	Grains
Diabrotica undecimpunctata	Southern corn root worm	Grains
Diabrotica virgifera	Western corn root worm	Grains
Diaphorina citri	Asian citrus psyllid	EPPRD, Citrus, Nursery and Garden
Diaporthe helianthi	Sunflower stem canker	Grains
Dickeya spp. (pineapple infecting strains) syn. *Erwinia chrysanthemi*	Bacterial fruit collapse/ Bacterial heart rot	Pineapple
Diuraphis noxia	Russian wheat aphid	EPPRD, Grains
Dorysthenes buqueti	Sugarcane longhorn stem borer	Sugarcane
Drosophila suzukii	Spotted-winged drosophila	Apple and Pear, Cherry, Rubus, Summerfruit, Viticulture
Dryocosmus kuriphilus	Oriental chestnut gall wasp	Nut
Dysaphis plantaginea	Rosy apple aphid	Apple and Pear
Dysdercus spp. (including: *D. honestus, D. maurus, D. suturellus* (American species))	Cotton staine	Cotton
Dysmicoccus neobrevipes	Grey pineapple mealybug	Pineapple
East Asian Passiflora virus (*Potyvirus*)	East Asian *Passiflora* virus	Passionfruit
Echinothrips americanus	Poinsettia thrips	Nursery and Garden
Elytroteinus subtruncatus	Fijian ginger weevil	Ginger
Endocronartium harknessii	Western gall rust	Plantation forest
Erionota thrax	Banana skipper butterfly	EPPRD, Banana
Erwinia amylovora	Fire blight	EPPRD, Apple and Pear
Erwinia herbicola (exotic strains)	Avocado blast	Avocado
Erwinia papayae	Bacterial crown rot	Papaya
Erwinia spp.	Mushy canker	Papaya
Erwinia tracheiphila	Cucurbit bacterial wilt	Melon
Eumerus amoenus	Onion bulb fly	Onion
Eumerus strigatus	Lesser bulb fly	Onion
European stone fruit yellows phytoplasma	European stone fruit yellows	EPPRD, Cherry, Summerfruit
Eurygaster integriceps	Sunn pest	Grains
Euschistus conspersus	Consperse stink bug	Rubus
Frankliniella bispinosa	Florida flower thrips	Citrus
Frankliniella intonsa	Flower thrips	Tomato
Fulmekiola serrata	Oriental sugar cane thrips	Sugarcane
Fusarium circinatum	Pitch canker	Plantation forest
Fusarium mangiferae	Mango malformation	EPPRD, Mango
Fusarium mexicanum	Mango malformation	Mango
Fusarium oxysporum f. sp. *ciceris*	*Fusarium* wilt of chickpea	Grains
Fusarium oxysporum f. sp. *cubense*	Panama disease, Tropical race 4	EPPRD, Banana
Fusarium oxysporum f. sp. *glycines*	*Fusarium* wilt of soybean	Grains
Fusarium oxysporum f. sp. *lupini*	*Fusarium* wilt of lupin	Grains
Fusarium oxysporum f. sp. *vasinfectum* (exotic races)	*Fusarium* wilt	Cotton
Fusarium oxysporum f. sp. *melonis* (exotic races)	*Fusarium* root and stem rot of melons	Melon

Table 36. Pests designated as High Priority Pests during biosecurity planning

Scientific name	Common name	Risk assessments
Fusarium oxysporum f. sp. *niveum* (exotic races)	*Fusarium* root and stem rot of melons	Melon
Fusarium oxysporum f. sp. *radicis-cucumerinum*	*Fusarium* root and stem rot of melons	Melon
Fusarium proliferatum	Mango malformation	Mango
Fusarium spp. *(F. ananatum* and *F. guttiforme* Synonym: *Fusarium subglutinans* f.sp. *ananas)*	Fusariosis/*Fusarium* stem rot/ Pineapple eye rot/Fruitlet core rot	Pineapple
Fusarium sterilihyphosum	Mango malformation	Mango
Fusarium virguliforme	Sudden death syndrome	Grains
Fusicladium effusum (syn. *Cladosporium caryigenum)*	Pecan scab	Nut
Globodera pallida (pathotypes PA1, PA2)	Potato cyst nematode (white or pale)	Potato
Globodera rostochiensis (exotic strains)	Potato cyst nematode (golden)	EPPRD, Potato
Grapevine flavescence dorée phytoplasma	Flavescence dorée	Viticulture
Groundnut bud necrosis virus (*Tospovirus*)	Bud necrosis disease	Grains, Vegetable
Groundnut ringspot virus (Tospovirus)	Groundnut ringspot virus	Grains
Guignardia bidwellii	Black rot	EPPRD, Viticulture
Guignardia musae	Banana freckle	EPPRD, Banana
Gymnoconia nitens	Orange rust (short-cycled)	Rubus
Gymnosporangium juniperi-virginianae	Cedar apple rust	Apple and Pear
Halyomorpha halys	Brown-marmorated stink bug	Cotton, Nut, Rubus
Harpophora maydis	Late wilt	Grains
Heilipus lauri	Large seed weevil	Avocado
Helicoverpa armigera (carrying *Bt* resistance alleles)	Cotton bollworm	Cotton
Heterocrossa rubophaga	Raspberry bud moth	Rubus
Heterodera carotae	Carrot cyst nematode	Vegetable
Heterodera ciceri	Chickpea cyst nematode	Grains
Heterodera filipjevi (exotic strains)	Cereal cyst nematode	Grains
Heterodera glycines	Soybean cyst nematode	Grains
Heterodera latipons	Mediterranean cereal cyst nematode	Grains
Heterodera sorghi	Sorghum cyst nematode	Grains
High plains virus (unassigned)	High plains virus	EPPRD
Homalodisca vitripennis	Glassy-winged sharpshooter	Citrus, Nursery and Garden, Summerfruit, Viticulture
Homoeosoma electellum	Sunflower moth	Grains
Hoplostoma fuligineus	Large hive beetle	Honey bee
Hyalesthes obsoletus	Cixiidae planthopper	Viticulture
Hylesia nigricans	Burning moth	Plantation forest
Hypothenemus obscurus	Tropical nut borer	Nut
Ips typographus	Spruce bark beetle	Plantation forest
Lepidiota blanchardi	Blanchard's canegrub	Sugarcane
Lepidiota discedens	Canegrub	Sugarcane
Lepidiota pruinosa	Pruinose canegrub	Sugarcane
Lepidiota reuleauxi	Ramu canegrub	Sugarcane
Lepidiota stigma	White canegrub	Sugarcane
Leptinotarsa decemlineata	Colorado potato beetle	EPPRD
Leptoglossus clypealis	Leaf footed bug	Nut
Leptoglossus occidentalis	Western conifer seed bug	Nut
Leptoglossus zonatus	Western leaf footed bug	Nut
Lettuce infectious yellows virus (*Crinivirus*)	Lettuce infectious yellows virus	Nursery and Garden
Leucopholis near armata	Canegrub	Sugarcane
Liberobacter asiaticus	Huanglongbing/Citrus greening	EPPRD
Liothrips oleae	Olive thrips	Olive
Liriomyza bryoniae	Tomato leaf miner	Melon, Vegetable, Tomato
Liriomyza huidobrensis	Serpentine leaf miner	Melon, Nursery and Garden, Vegetable, Tomato
Liriomyza sativae	Vegetable leaf miner	EPPRD, Melon, Onion, Vegetable, Tomato
Liriomyza trifolii	American serpentine leaf miner	Melon, Vegetable, Tomato
Lissorhoptrus oryzophilus	Rice water weevil	EPPRD, Rice

Table 36. Pests designated as High Priority Pests during biosecurity planning

Scientific name	Common name	Risk assessments
Little cherry virus 1 (unassigned)	Little cherry virus 1	Cherry
Little cherry virus 2 (*Ampelovirus*)	Little cherry virus 2	Cherry
Lobesia botrana	European grapevine moth	Viticulture
Lygus hesperus	Western plant bug	EPPRD, Strawberry
Lygus lineolaris	Tarnished plant bug	Cotton, Nursery and Garden, Strawberry
Lymantria dispar	Asian gypsy moth	Apple and Pear, Nursery and Garden, Plantation forest
Lymantria monacha	Nun moth	Plantation forest
Magnaporthe grisea	Rice blast	EPPRD, Grains, Rice
Marchalina hellenica	Giant pine scale	EPPRD
Mayetiola destructor	Hessian fly	EPPRD, Grains
Mayetiola hordei	Barley stem gall midge	Grains
Monilia polystroma	Asiatic brown rot	Summerfruit
Monilinia fructigena	Brown rot	EPPRD, Cherry, Summerfruit
Monochamus spp. (including *M. alternatus, M. galloprovinicialis, M. titillator, M. scutellatus)*	Longhorn beetles	Plantation forest
Monosporascus cannonballus	*Monosporascus* root rot	Melon
Mungbean yellow mosaic virus (Begomovirus)	Mungbean yellow mosaic virus	Grains
Mycosphaerella eumusae	Eumusae leaf spot	Banana
Mycosphaerella fijiensis	Black sigatoka	EPPRD, Banana
Mythimna unipuncta	Armyworm	EPPRD
Neonectria ditissima	European canker	Apple and Pear, Cherry
Noorda albizonalis	Red banded borer	EPPRD
Numonia pirivorella	Pear fruit moth	EPPRD
Nysius huttoni	Wheat bug	Grains
Oligonychus ilicis	Southern red mite	Nursery and Garden
Oligonychus perseae	Persea mite	Avocado
Orgyia thyellina	White spotted tussock moth	Plantation forest
Otiorhynchus rugosostriatus	Rough strawberry weevil	EPPRD
Pandemis cerasana	Cherry brown tortrix	Cherry
Pantoea stewartii	Stewarts wilt of maize	Grains
Paracoccus marginatus	Papaya mealy bug	Papaya
Paradasynus longirostris	Hong Kong stink bug	Lychee
Parasa lepida	Blue-striped nettle grub	Mango
Passiflora chlorosis virus (*Potyvirus*)	*Passiflora* chlorosis virus	Passionfruit
Passionfruit crinkle virus (*Potyvirus*)	Passionfruit crinkle virus	Passionfruit
Passionfruit ringspot virus (*Potyvirus*)	Passionfruit ringspot virus	Passionfruit
Passionfruit severe leaf distortion virus (*Begomovirus*)	Passionfruit severe leaf distortion virus	Passionfruit
Passionfruit Sri Lankan mottle virus (*Potyvirus*)	Passionfruit Sri Lankan mottle potyvirus	Passionfruit
Passionfruit vein clearing virus (*Rhabdovirus*)	Passionfruit vein clearing rhabdovirus	Passionfruit
Passionfruit yellow mosaic virus (*Tymovirus*)	Passionfruit yellow mosaic virus	Passionfruit
Peach rosette mosaic virus (*Nepovirus*)	Peach rosette mosaic virus	Summerfruit
Peanut clump virus (Pecluvirus)	Peanut clump virus	Grains
Pennisetia hylaeiformis	Raspberry crown borer	Rubus
Pennisetia marginata	Raspberry crown borer	Rubus
Peridroma saucia	Variegated cutworm	EPPRD
Perkinsiella bicoloris	Sugarcane sidewinder	Sugarcane
Perkinsiella diagoras	Sugarcane sidewinder	Sugarcane
Perkinsiella lalokensis	Sugarcane sidewinder	Sugarcane
Perkinsiella papuensis	Sugarcane sidewinder	Sugarcane
Perkinsiella rattlei	Sugarcane sidewinder	Sugarcane
Perkinsiella saccharivora	Sugarcane sidewinder	Sugarcane
Perkinsiella vastatrix	Sugarcane sidewinder	Sugarcane
Perkinsiella vitiensis	Sugarcane sidewinder	Sugarcane
Peronophythora litchii	Brown blight	Lychee
Peronosclerospora philippinensis	Philippine downy mildew of maize	Grains, Sugarcane
Peronosclerospora sacchari	Sugarcane downy mildew	EPPRD, Sugarcane

Table 36. Pests designated as High Priority Pests during biosecurity planning

Scientific name	Common name	Risk assessments
Peronosclerospora sorghi	Downy mildew of sorghum	Grains
Peronosclerospora spontanea	Downy mildew	Sugarcane
Phakopsora euvitis	Grapevine leaf rust	EPPRD
Phoma tracheiphila	Mal secco	EPPRD
Phymatotrichum omnivorum	Texas root rot	EPPRD, Cherry, Cotton
Phytomyza gymnostoma	Allium leaf miner	Onion
Phytophthora fragariae var. *fragariae*	Red steele root rot	EPPRD, Strawberry
Phytophthora infestans (A2 mating type and exotic strains of A1 mating type)	Late blight	Potato
Phytophthora kernoviae	Phytophthora blight	Avocado
Phytophthora mengei	Trunk canker	Avocado
Phytophthora pinifolia	Dano foliar del Pino	Plantation forest
Phytophthora ramorum	Sudden oak death	EPPRD, Avocado, Nursery and Garden, Plantation forest
Planococcus ficus	Vine mealybug	Viticulture
Planotortrix octo	Green headed leaf roller	Cherry
Plasmopara halstedii	Sunflower downy mildew	Grains
Plum pox virus (*Potyvirus*)	Plum pox virus	EPPRD, Cherry, Summerfruit
Podosphaera clandestina var. *clandestina* (exotic strains)	Powdery mildew of cherry	Cherry
Polychrosis viteana	American berry moth	Viticulture
Pomacea canaliculata	Golden apple snail	EPPRD, Nursery and Garden, Rice
Popillia japonica	Japanese beetle	Rubus, Summerfruit
Potato spindle tuber viroid (*Pospiviroidae*)	Potato spindle tuber viroid	EPPRD, Potato
Potato virus Y (*Potyvirus*) (exotic strains)	Potato virus Y	Potato
Prays oleae	Olive moth	Olive
Procontarinia spp. (exotic species)	Mango gall midges	Mango
Prostephanus truncatus	Larger grain borer	Grains
Pseudococcus maritimus	Grape mealybug	Viticulture
Pseudomonas syringae pv. *syringae* (exotic races)	Bacterial canker	Avocado, Nursery and Garden
Pseudotheraptus wayi	Coconut bug	Lychee
Psila rosae	Carrot rust fly	Vegetable
Puccinia asparagi	Asparagus rust	EPPRD
Puccinia graminis f. sp. *tritici* (pathotype Ug99)	Stem rust of wheat	Grains
Puccinia psidii sensu lato (exotic variants)	Guava rust/*Eucalyptus* rust	Nursery and Garden, Plantation forest
Puccinia spp. (exotic species)	Rust	Onion
Puccinia striiformis f. sp. *hordei*	Barley stripe rust	Grains
Pulvinaria iceryi	*Pulvinaria* scale	Sugarcane
Pyrilla perpusilla	Sugarcane pyrilla	Sugarcane
Radopholus similis (exotic strains)	Burrowing nematode	Ginger
Raffaelea lauricola	Laurel wilt	Avocado
Ralstonia solanacearum, race 2	Moko	EPPRD, Banana
Ralstonia solanacearum, race 3 (exotic strains)	Bacterial wilt	Potato
Ralstonia solanacearum, race 4 (exotic strains)	Bacterial wilt	Ginger
Raspberry ringspot virus (*Nepovirus*)	Raspberry ringspot virus	Rubus, Strawberry
Rhagoletis fausta	Black cherry fruit fly	Cherry
Rhagoletis indifferens	Western cherry fruit fly	Cherry
Rhagoletis pomonella	Apple maggot	Apple and Pear, Cherry
Rhizoctonia solani f. sp. *sasaki* (AG 1)	Banded leaf and sheath spot	Grains
Rhizoglyphus callae	Bulb mite	Onion
Rhizoglyphus setosus	Bulb mite	Onion
Rice grassy stunt virus (*Tenuivirus*)	Rice grassy stunt virus	Rice
Rice ragged stunt virus (*Oryzavirus*)	Ragged stunt virus	Rice
Rice tungro bacilliform virus (unassigned)	Rice tungro bacilliform virus	Rice
Rice tungro spherical virus (*Waikavirus*)	Rice tungro spherical virus Waika virus	Rice

Table 36. Pests designated as High Priority Pests during biosecurity planning

Scientific name	Common name	Risk assessments
Riptortus dentipes	Pod sucking bug	Grains
Roesleria subterranea	Grape root rot	EPPRD
Schizaphis graminum	Greenbug	Grains
Scirpophaga excerptalis	Top shoot borer	Sugarcane
Scirtothrips aurantii	South African citrus thrips	EPPRD, Citrus
Scirtothrips perseae	Avocado thrips	Avocado
Sesamia grisescens	Stem borer	EPPRD, Sugarcane
Sesamia inferens	Pink stem borer	Sugarcane
Slow paralysis virus (*Iflavirus*)	Slow paralysis virus	Honey bee
Soil-borne wheat mosaic virus (Furovirus)	Soil-borne wheat mosaic virus	Grains
Sorghum mosaic virus (*Potyvirus*)	Sorghum mosaic virus	Sugarcane
Sphaceloma perseae	Avocado scab	Avocado
Spiroplasma citri	Stubborn	Citrus
Stagonospora sacchari	Leaf scorch	EPPRD, Sugarcane
Stenoma catenifer	Avocado seed moth	Avocado
Sternochetus frigidus	Mango pulp weevil	EPPRD, Mango
Strawberry latent ringspot virus (*Sadwavirus*)	Strawberry latent ringspot virus	Rubus, Strawberry
Strymon megarus (as a vector of *Fusariosis)*	Pineapple fruit borer	Pineapple
Sugarcane grassy shoot phytoplasma	Grassy shoot	Sugarcane
Sugarcane mosaic virus (*Potyvirus*) (exotic strains)	Sugarcane mosaic virus	Sugarcane
Sugarcane streak mosaic virus (unassigned)	Sugarcane streak mosaic	EPPRD, Sugarcane
Sugarcane white leaf phytoplasma	White leaf	EPPRD, Sugarcane
Teratosphaeria gauchensis	Coniothyrium *Eucalyptus* canker	Plantation forest
Teratosphaeria zuluensis	Coniothyrium *Eucalyptus* canker	Plantation forest
Tetramoera schistaceana	Sugarcane shoot borer	Sugarcane
Tetranychus piercei	Banana spider mite	EPPRD, Banana
Thaumatotibia leucotreta syn. *Cryptophlebia leucotreta*	False codling moth	EPPRD, Cotton, Grains, Pineapple, Summerfruit
Thrips tabaci (exotic strains/ biotypes)	Onion thrips	Onion
Tilletia barclayana	Kernel smut of rice	EPPRD
Tilletia indica	Karnal bunt	EPPRD, Grains
Tomato black ring virus (*Nepovirus*)	Tomato black ring virus	Strawberry
Tomato ringspot virus (*Nepovirus*)	Tomato ringspot virus	Rubus, Strawberry
Tomicus piniperda	Pine shoot beetle	Plantation forest
Toxotrypana curvicauda	Papaya fly	Papaya
Tribolium castaneum (phosphine resistant)	Rust red flour beetle	EPPRD
Trioza erytreae	African citrus psyllid	Citrus
Trogoderma granarium	Khapra beetle	EPPRD, Grains, Nut, Rice
Tropilaelaps clareae	Tropilaelaps mite	Honey bee, Nut
Tropilaelaps mercedesae	Tropilaelaps mite	Honey bee, Nut
Tuta absoluta	South American tomato moth tomato leafminer	Tomato
Unknown	Ramu stunt disease	EPPRD, Sugarcane
Unknown (suspected phytoplasma)	Longan and lychee witches' broom disease	Lychee
Uredo rangelii	Myrtle rust	EPPRD
Urocerus gigas	Giant wood wasp	Plantation forest
Varroa destructor	*Varroa* mite	Honey bee , Nut
Varroa jacobsoni	*Varroa* mite	Honey bee
Verticillium dahliae (defoliating strain)	*Verticillium* wilt	EPPRD, Cotton, Nut, Olive
Verticillium longisporum	Canola *Verticillium* wilt	Grains
Vespa spp. (exotic species)	Hornets	Honey bee
Watermelon bud necrosis virus (*Tospovirus*)	Watermelon bud necrosis	Vegetable
Watermelon silver mottle virus (*Tospovirus*)	Watermelon silver mottle	Vegetable
Wheat spindle streak mosaic virus (*Bymovirus*)	Wheat spindle streak mosaic virus	EPPRD

Scientific name	Common name	Risk assessments
X disease phytoplasma	Peach X disease	EPPRD, Cherry, Summerfruit
Xanthomonas axonopodis pv. *allii*	*Xanthomonas* leaf blight	Onion
Xanthomonas axonopodis pv. *citri*	Citrus canker	EPPRD
Xanthomonas axonopodis pv. *malvacearum*	Bacterial blight Angular leaf spot	EPPRD
Xanthomonas axonopodis pv. *passiflorae*	Bacterial blight	Passionfruit
Xanthomonas campestris (avocado strain)	Bacterial canker	Avocado
Xanthomonas citri subsp. *citri*	Citrus canker	Citrus
Xanthomonas citri subsp. *malvacearum*	Bacterial blight/Angular leaf spot	Cotton
Xanthomonas fragariae	Strawberry angular leaf spot	EPPRD, Strawberry
Xylella fastidiosa	Pierce's disease	EPPRD, Cherry, Citrus, Nursery and Garden, Nut, Summerfruit, Viticulture
Xylosandrus compactus	Black twig borer	Mango
Zea mosaic virus (Potyvirus)	Zea mosaic virus	Grains
*Zeugodacus curcubitae (*syn. *Bactrocera cucurbitae)*	Melon fruit fly	Avocado, Melon, Papaya, Passionfruit, Summerfruit, Tomato, Vegetable

Banana industry shaken by the discovery of Panama tropical race 4

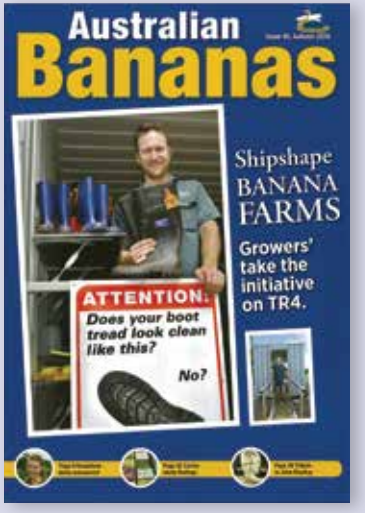
In March 2015, a case of Panama disease tropical race 4 (TR4) was detected in Cavendish banana plants in the Tully Valley, in the heart of Australia's banana producing region in north Queensland. The disease, also known as *Fusarium* wilt, poses a serious threat to the banana industry.

In spite of rapid action by government and industry, the nature of the disease led to an early determination that the incursion would not be technically feasible to eradicate. Notable features contributing to that decision were: that there is no known cure for the disease; it is caused by a fungus that can survive in the soil for as long as 30 to 40 years; it can be transported in soil, water and planting material; and the time frame between infection and when the first plant shows symptoms can range from two months to three years, so that the fungus may have spread elsewhere by the time an infection is detected.

While the response to the incursion cannot be managed under the terms of the Emergency Plant Pest Response Deed (since it has been declared non-eradicable) efforts to contain and manage the disease are underway with industry working in close partnership with the Australian and Queensland governments.

Given the ease of transmission and no known cure for the disease, banana growers have been advised to strengthen their on-farm biosecurity to protect their individual enterprises.

Biosecurity Queensland and the Australian Government produced a grower kit on how to protect properties from TR4 and the Australian Banana Growers Council is hosting workshops to assist banana growers to develop appropriate on-farm biosecurity measures.



Australian Bananas magazine features on-farm biosecurity measures.

Since the initial detection of TR4, there has been several other sites on that same farm where plant samples have returned a positive for the pathogen. The farm is subject to strict biosecurity controls to prevent spread of the pathogen. No detections of TR4 have been found on other farms.

Panama disease is considered to be the most destructive disease of banana in modern times. Panama disease is caused by the fungus *Fusarium* (the full name is *Fusarium oxysporum* f. sp. *cubense*). It is a soil pathogen which infects the root system and goes on to colonise the plant through the vascular system. Hyphae of the fungus can even reach the leaves.

Mediterranean fruit fly is found in WA. Image courtesy of James Nilard.

2.2 Australia's regionalised pests

When new exotic pests with the potential to cause serious economic impact on plant production industries are detected, eradication is the ideal goal. Australia has had great success in eradicating exotic pests but there are instances where this is not possible.

Following the establishment of these pests, measures can still be taken to minimise negative impacts, primarily through containment. Regionalised pests can be contained at a local, regional or state level, depending on current distribution and the ability to implement cost beneficial measures for containment.

State and territory government legislation underpins containment activities which are carried out by the jurisdictions in cooperation with other states, territories and relevant industries.

The regionalised pests listed in Table 36 are those formally recognised and backed by legislation.

Mediterranean fruit fly larvae make production difficult for many growers in WA. Courtesy of DAFWA.

Table 37. Australia's regionalised pests

Scientific name	Common name	Area of regionalisation
New South Wales		
Bactrocera tryoni	Queensland fruit fly	Endemic within all of NSW excluding the NSW portion of the Greater Sunraysia Pest Free Area as defined in Order O-458 of the *NSW Plant Diseases Act 1924* No. 38
Banana bunchy top virus (*Babuvirus*)	Banana bunchy top virus	Far north coast, NSW – regulated via Order OR117 under the *NSW Plant Diseases Act 1924* No. 38
Daktulosphaira vitifoliae	Grapevine phylloxera	Present within the NSW Phylloxera Infested Zone, comprised of the Sydney and the Albury/Corowa regions as defined in Proclamation P176 of the *NSW Plant Diseases Act 1924* No.38
Fusarium oxysporum f. sp. *cubense* (Race 1 and Subtropical race 4)	Panama disease endemic strains	Far northcoast, NSW – regulated via Order OR121 under the *NSW Plant Diseases Act 1924* No. 38
Panonychus citri	Citrus red mite	The 'Citrus Quarantine Area' of Cumberland and Northumberland Counties as outlined in Plant Diseases (Citrus Red Mite) Notification 2016 under the *NSW Plant Diseases Act 1924* No. 38
Potato viruses belonging to the *Potyviridae* family (including *Potato virus Y*) and the *Luteoviridae* family (including *Potato leaf roll virus*)		Endemic in NSW excluding the NSW Seed Protected Areas as defined in Order O-443 of the *NSW Plant Diseases Act 1924* No.38
Ralstonia solanacearum	Bacterial wilt in potatoes	Endemic in NSW excluding the NSW Seed Protected Areas as defined in Order O-443 of the *NSW Plant Diseases Act 1924* No. 38
Spongospora subterranea	Powdery scab in potatoes	Endemic in NSW excluding the NSW Seed Protected Areas as defined in Order O-443 of the *NSW Plant Diseases Act 1924* No. 38
Northern Territory		
Aleuroides dispersus	Spiraling whitefly	Darwin, Palmerston, Darwin rural area, Katherine
Bactrocera tryoni	Queensland fruit fly	Darwin, Palmerston, Darwin rural area, Katherine, Tennant Creek, Alice Springs
Bemisia tabaci	Silver leaf whitefly	Darwin, Palmerston, Darwin rural area, Katherine
Brontispa longissima	Palm leaf beetle	Darwin, Palmerston, Darwin rural area
Citripestis eutrapera	Mango fruit borer	Darwin, Darwin rural area, Katherine
Fusarium mangiferae	Mango malformation disease	Darwin, Darwin rural area, Adelaide River
Fusarium oxysporum f. sp. *cubense* (Race 4 – tropical)	Panama disease	Darwin rural area
Idioscopus nitidulus	Mango leaf hopper	Darwin, Palmerston, Darwin rural area, Adelaide River, Pine Creek, Katherine
Parlatoria blanchardi	Date palm scale	Alice Springs
Selenothrips rubrocinctus	Red-banded thrips	Darwin, Palmerston, Darwin rural area, Adelaide River, Pine Creek, Katherine
Sternochetus mangiferae	Mango seed weevil	Darwin, Palmerston, Darwin rural area, Batchelor, Adelaide River
Tetranycus gloveri	Glovers mite	Darwin rural area
Thrips palmi	Melon thrips	Darwin rural area
Queensland		
Aleurodicus dispersus	Spiraling whitefly	Torres Strait Islands, Cape York Peninsula, Mareeba, Charters Towers, coastal towns south to Bundaberg
Anoplolepis gracilipes	Yellow crazy ant	Populations dotted in various locations spanning Cairns to the Gold Coast
Apis cerana, Java genotype	Asian honey bee	Surrounding Cairns region, north to Bonnie Doon (near Mossman), west of Atherton and Mareeba and south to Mena Creek.
Banana bunchy top virus (*Babuvirus*)	Bunchy top	From Noosa south to the NSW border
Cryptotermes brevis	West indian drywood termite	Greater Brisbane, Wide Bay, Rockhampton, Bowen and Townsville
Deanolis sublimbalis	Red banded mango caterpillar	Far northern Cape York Peninsula
Eumetopina flavipes Muir	Island sugarcane planthopper	Torres Strait island archipelago and on the northern peninsula area of Cape York, Queensland
Fusarium oxysporum f. sp. *cubense* (Race 1, Race 2, Sub-tropical race 4 and Tropical race 4)	Panama disease	Race 1 – endemic throughout banana growing regions Race 2 – South Johnstone and Cairns Race 4 (subtropical) – South-East Queensland as far north as Rosedale Race 4 (tropical) – Detected in 2015 on a single property in the Tully Valley, far north Queensland. A containment program has been established.

Table 37. Australia's regionalised pests

Scientific name	Common name	Area of regionalisation
Queensland *continued*		
Idioscopus clypealis	Mango leafhopper	Cape York Peninsula and Mareeba area, south to Atherton, and along the coast from Wangetti to Gordonvale
Idioscopus nitidulus	Mango leafhopper	Cape York Peninsula; extension of range to Coen
Mycosphaerella fijiensis	Black sigatoka	South east Queensland as far north as Bundaberg area
Papaya ringspot virus (*Potyvirus*)	Papaya ringspot virus	South east Queensland as far north as Bundaberg area
Procontarinia sp.	Mango leaf gall midge	Torres Strait and northern tip of Cape York Peninsula
Solenopsis invicta	Red imported fire ant	South east Queensland including parts of Brisbane, Ipswich, Lockyer, Redland, Logan, Somerset, Scenic Rim and Gold Coast councils. Yarwun, Gladstone. The Brisbane Airport is a separate response as it is a new incursion not genetically related to the SEQ.
Striga asiatica	Red witchweed	Isolated to a small number of properties in the Mackay region
Sugarcane Fiji disease virus (Fijivirus)	Fiji disease	Sugarcane Pest Quarantine Areas (PQA) 5, 6 and 7
Sugarcane mosaic virus (*Potyvirus*)	Sugarcane mosaic virus	Sugarcane PQAs 5 and 6
Sugarcane striate mosaic virus (*Carlavirus*)	Sugarcane striate mosaic virus	Sugarcane PQA 3
Thrips palmi	Melon thrips	South east Queensland as far north as Bundaberg area. North Queensland – coastal areas from Ayr to Mossman, and Atherton Tablelands
Ustilago scitaminea	Sugarcane smut	Sugarcane PQAs 2, 4, 5 and 6
Wasmannia auropunctata	Electric ant	Far north Queensland, Cairns hinterland and Bingle Bay
South Australia		
Urocystis cepulae	Onion smut	Annual surveys of Allium crops in SA – quarantine measures are applied in 2 remaining quarantined zones
Victoria		
Bactrocera tryoni	Queensland fruit fly	Permanent fruit fly zone (refer to specific orders)
Daktulosphaira vitifoliae	Grapevine phylloxera	Phylloxera infested zone (PIZ) and Phylloxera free zone (refer to specific orders)
Globodera rostochiensis	Potato cyst nematode	Management of PCN linked and infested lands, and Plant Protection District (PPD) (refer to specific orders)
Western Australia		
Achroia grisella	Lesser wax moth	Regulations/controls for movement and control in specified areas
Aethina tumida	Small hive beetle	Kimberley – Host material restricted from moving to rest of state
Bemisia tabaci (B biotype)	Silverleaf whitefly	Perth & Carnarvon – Host material restricted from moving to Kununurra
Brontispa longissima	Palm leaf beetle	Broome – Host material restricted from moving to rest of state
Cantareus apertus	Green snail	Regulations/controls for movement and control in specified areas
Ceratitis capitata	Mediterranean fruit fly	Absent from east Kimberley region – Regulations/controls for movement and control in specified areas
Chortoicetes terminifera	Australian plague locust	Regulations for control in specified areas
Cosmopolites sordidus	Banana weevil borer	Kununurra – Host material restricted from moving to rest of state
Cryptolestes ferrugineus	Flat grain beetle	Regulations/controls for movement and control in specified areas
Cryptolestes pusillus	Flat grain beetle	Regulations/controls for movement and control in specified areas
Ephestia elutella	Tobacco moth	Regulations/controls for insecticide resistant strains
Ephestia kuehniella	Mediterranean flour moth	Regulations/controls for insecticide resistant strains
Fusarium oxysporum f. sp. *cubense* (Race 1)	Panama disease	Carnarvon – Host material restricted from moving to rest of the state

Table 37. Australia's regionalised pests

Scientific name	Common name	Area of regionalisation
	Western Australia *continued*	
Galleria mellonella	Larger wax moth	Regulations/controls for movement and control in specified areas
Hylotrupes bajalus	European house borer	Present in WA – Regulations/controls for movement and control in specified areas
Oryzaephilus surinamensis	Sawtooth grain beetle	Present in WA – Regulations/controls for insecticide resistant strains
Pentalonia nigronervosa	Banana aphid	Carnarvon – Host material restricted from moving to rest of the state
Plodia interpunctella	Indian meal moth	Regulations/controls for insecticide resistant strains
Potato spindle tuber viroid	Potato spindle tuber viroid (PSTVd)	Carnarvon
Pythium tracheiphilum	Lettuce blight	Gingin and Perth metropolitan area
Rhyzopertha dominica	Lesser grain borer	Regulations/controls for insecticide resistant strains
Sitophilus granarius	Granary weevil	Regulations/controls for insecticide resistant strains
Sitophilus oryzae	Rice weevil	Regulations/controls for insecticide resistant strains
Sitotroga cerealella	Angoumois grain moth	Regulations/controls for insecticide resistant strains
Thrips palmi	Melon thrips	Kimberley – Low pest prevalence area
Tribolium castaneum	Rust red flour	Regulations/controls for insecticide resistant strains
Tribolium confusum	Confused flour beetle	Regulations/controls for insecticide resistant strains
Trogderma variabile	Warehouse beetle	Regulations/controls for movement and control in specified areas

Biosecurity officers check for signs of chestnut blight. Image courtesy of DEDJTR.

2.3 Responses to Emergency Plant Pests

With increasing global trade and tourism, up from 31.5 million arrivals and departures in Australia in 2013 to 34.8 million in 2015 (ABS 3401.0), and the potential for pests to enter via natural routes, Australia has a formal legal agreement between government and industry for dealing with Emergency Plant Pests (EPPs) and sharing the costs of responses to eradicate them. The Emergency Plant Pest Response Deed, is detailed in Section 4.2.

Table 37 identifies the status of responses to EPPs as at 31 December 2015. In addition, there were a number of new pests detected in Australia in 2015 for which no further action was required or which are still under investigation (Table 38).

COST SHARED EMERGENCY RESPONSES IN 2015

Four Cost Shared responses to Emergency Plant Pest incursions were underway in 2015.

Giant pine scale (*Marchalina hellenica*) activities continued following detection in pine trees in urban areas of South Australia and Victoria in October 2014. A Cost Shared response was agreed to by the National Mangement Group (NMG) in March 2015. Affected Parties for the response include the Australian Government, state and territory governments, Australian Forest Products Association and Nursery and Garden Industry Australia (NGIA). Response activities in 2015 included surveillance, tree destruction and removal. There have been no detections in commercial pine plantations.

Banana freckle (*Phyllosticta cavendishii*) eradication on Cavendish bananas in the NT continued in 2015 and the response is proving effective. Affected Parties for this response include the Australian Government, state and territory governments, Australian Banana Growers Council (ABGC) and NGIA. Following surveillance and destruction of host plants in identified zones, Phase 2, a host free period extending through the wet season, commenced in May 2015.

Exotic fruit flies in the Torres Strait are dealt with under new arrangements from 2015. NMG agreed a Response Plan for 1 July 2015 to 30 June 2018 that includes an annual program of surveillance and eradication activities for Oriental fruit fly, New Guinea fruit fly and melon fly. The new arrangements mean that costs are now being shared between the Australian Government, state and territory governments and 12 Affected industry Parties. See more on page 159.

Chestnut blight in Victoria is well on the way to eradication following activity that began in 2010. The Proof of Freedom phase commenced in 2015 with declaration of eradication expected in July 2016. Affected Parties for this response include the Australian Government, state and territory governments, and Chestnuts Australia.

Table 38. Emergency responses to plant pests under EPPRD arrangements

Scientific name	Common name	Crops affected	Region	Past action	Current situation and status
Bactrocera dorsalis *Bactrocera trivialis* *Zeugodacus cucurbitae*	Oriental fruit fly New Guinea fruit fly Melon fly	Various fruits and vegetables	Torres Strait		Exotic fruit flies are sporadically detected in the Torres Strait and eradicated to protect mainland Australia. In November 2015 NMG endorsed the Exotic Fruit Flies in the Torres Strait Response Plan for the period July 2015 to June 2018. Surveillance and eradication activities will occur on an annual basis. For further information see page 159.
Cryphonectria parasitica	Chestnut blight	Chestnuts	VIC	First detected in September 2010. NMG endorsed a Response Plan in November 2010 and eradication activities undertaken. Further detection in June 2014. Revised Response Plan endorsed by NMG August 2014. All infected trees were destroyed.	Eradication program in the Proof of Freedom phase, with ongoing surveillance being undertaken to confirm that the EPP has been eradicated.
Cucumber green mottle mosaic virus	Cucumber green mottle mosaic virus	Vegetables, melons, nursery and garden	NT, QLD	Detected on commercial watermelon farm in NT in July 2014. Diseased material destroyed, hosts removed and tracing and surveillance undertaken.	In March 2015 NMG supported the CCEPP recommendation that it was not technically feasible to eradicate. Currently being managed under a national management plan.
Fusarium mangiferae *F. proliferatum* *F. pseudocircinatum* *F. sterilihyphosum* sensu lato	Mango malformation disease (MMD)	Mangoes, nursery and garden	QLD	The CCEPP is considering the technical feasibility of eradication for *Fusarium* species causing MMD in Australia. A Scientific Advisory Panel was convened to address technical questions related to *Fusarium* species causing MMD in Australia.	The Scientific Advisory Panel met and prepared recommendations for consideration by the CCEPP.
Fusarium oxysporum f. sp. *cubensis*	Panama disease Tropical Race 4	Bananas, nursery and garden	QLD		Detected in Tully in March 2015. In April 2015 the NMG supported the CCEPP recommendation that it was not techncially feasible to eradicate.
Liriomyza sativae	Vegetable leafminer	Tomatoes, vegetables, cotton, legumes, onions, nursery and garden	Torres Strait, QLD	First detected in the Torres Strait in 2008 and again in May 2014. In August 2014 the CCEPP determined that it was not technically feasible to eradicate from the Torres Strait.	Detected in the Cape York Peninsula in May 2015. This pest is under consideration by the CCEPP whilst surveillance is undertaken.
Marchalina hellenica	Giant pine scale	Pine trees, nursery and garden	SA, VIC	Detected in Victoria and South Australia in October 2014. Tracing and surveillance undertaken.	Response Plan endorsed by NMG in March 2015. Eradication activities and surveillance ongoing.
Pepper chat fruit viroid	Pepper chat fruit viroid (PCFVd)	Capsicums, tomatoes, nursery and garden	SA	Detected in August 2013. Diseased material destroyed, potential hosts removed and tracing and surveillance undertaken.	CCEPP considered eradication report and recommended to NMG that PCFVd is eradicated.
Phyllosticta cavendishii	Banana freckle	Bananas, nursery and garden	NT	Detected on 17 July 2013. NMG endorsed a Response Plan on 3 October 2013 and eradication activities were undertaken.	Destruction of host material continued and host free period commenced May 2015.
Potato spindle tuber viroid	Potato spindle tuber viroid (PSTVd)	Potatoes, wild gooseberries, tomatoes, capsicums, white potato vine, nursery and garden	WA, SA, QLD, VIC	Detected in September 2009. Diseased material was destroyed, strict quarantine and hygiene measures were implemented, and a National Surveillance Program was undertaken to determine the extent of PSTVd in Australia.	CCEPP considered the outcomes of the National Surveillance Program for PSTVd and NMG supported the CCEPP recommendation that it was not techncially feasible to eradicate.
Xanthomonas fragariae	Strawberry angular leaf spot	Strawberries	QLD	Detected in May 2010. Infected plants were destroyed and delimiting surveys have been undertaken. A proposal for declaring eradication was prepared.	CCEPP considered eradication report and recommended to NMG that *Xanthomonas fragariae* is eradicated.

Table 39. Pest detections notified under the EPPRD that did not result in a formal Cost-Shared emergency response*

Scientific name	Common name	Region	State
Adelges (Dreyfusia) *nordmannianae complex*	Silver fir Adelges	Glen Waverley, Narre Warren North and Berwick	VIC
Adelges (Gilletteella) *cooleyi complex*	Cooley spruce gall adelgid	Hoddles Creek and Macclesfield	VIC
Aeroglypus robustus	Warty grain mite	Sydney	NSW
Asthma plant polerovirus 1	Asthma plant polerovirus 1	Emerald	QLD
Bemisia tabaci (exotic biotype)	Silverleaf whitefly	Darwin NT, Wyndham WA	NT, WA
Blumeria graminis f. sp. *tritici*	Wheat powdery mildew	Cobitty	NSW
Catharanthus mosaic virus	Catharanthus mosaic virus	Bremmer Bay	WA
Cecidophyes cf. *galii*	Eriophyoid mites	Dynnyrne	TAS
Cherry green ring mottle virus	Cherry green ring mottle virus	Various locations	TAS, VIC
Cherry necrotic rusty mottle virus	Cherry necrotic rusty mottle virus	Various locations	TAS
Curvularia trifolii	Leaf blight of *Trifolium*	Newmerella	VIC
Dasineura cordylineae	Cordyline gall midge	Wongawallan	QLD
Diaporthe australafricana		Manjimup	WA
Diaporthe sp. on *neem*		Townsville	QLD
Eotetranychus sexmaculatus	Six-spotted spider mite		TAS
Fusarium flocciferum		Derwent Valley	TAS
Fusarium lateritium		Toolara	QLD
Fusarium oxysporum	*Fusarium* wilt on lupin	Northampton	WA
Fusarium solani f. sp. *phalaenopsis*		Various locations	NSW
Hemicriconemoides mangiferae	Ring nematode	Mutchilba	QLD
Jamesdicksonia dactylidis		Gretna	TAS
Lasiodiplodia iraniensis	Blueberry stem blight	Brisbane	TAS
Lasiodiplodia mahajangana		Bundaberg	QLD
Little cherry virus 1	Little cherry virus 1	Various locations TAS, Orange NSW	TAS, NSW
Little cherry virus 2	Little cherry virus 2		NSW
Meloidogyne incognita	Southern root-knot nematode	Ayr	QLD
Neofusicoccum luteum	Canker and dieback disease	Penguin	TAS
Neofusicoccum parvum	Dieback and canker disease	Eurobin	VIC
Neolithocolletis pentadesma	Angsana leaf miner	Darwin	NT
Neomaskellia bergii	Sugarcane white fly	Broome	WA
Oligonychus palus		Napranum	QLD
Oligonychus plegas	Red spider mite	Napranum	QLD
Pantoea stewartii sub sp. nov		Wyndham	WA
Penicillifer martinii	Fairway patch	Sydney	NSW
Peronospora sp.	Downy mildew of wild poppy	Various locations	TAS
Phakopsora cherimoliae	Rust	Darwin	NT
Phasey bean mild yellow virus	Phasey bean mild yellow virus	Esperance	WA
Phoma tropica			NSW
Phyllocoptes gracilis	Dryberry mite	Dunorlan	TAS
Phytophthora moyootj		Fitzgerald and Jarrahdale	WA
Phytopthora sp. on pecan		North Coast	NSW
Plum bark necrosis stem pitting associated virus	Plum bark necrosis stem pitting associated virus	Various locations	TAS, QLD, VIC

Scientific name	Common name	Region	State
Protopulvinaria pyriformis	Pyriform scale	Perth	WA
Pseudocercospora purpurea	Cercospora spot	Darwin	NT
Pseudoidium sp.	Powdery mildew	Dareton	NSW
Puccinia ludovicianae	Artemisia rust	Gregory Hills	NSW
Pythium aristosporum	Damping off, root rot, crown rot	Robinvale	VIC
Rhubarb decline associated virus	Rhubarb decline associated virus	Various locations	QLD
Rotylenchulus leptus	Nematode	Menangle	NSW
Rotylenchulus reniformis	Reniform nematode	Rockhampton	QLD
Rugonectria castaneicola	Rugonectria canker	Lane Cove	NSW
Rugonectria sp.	Rugonectria canker	Wahroonga	NSW
Sweet potato leaf curl virus	Sweet potato leaf curl virus	Bundaberg	QLD
Thelonectria sp.		Wahroonga	NSW
Thelonectria torulosa		Wahroonga	NSW
Uredo rangelii	Myrtle rust	Burnie TAS, Tiwi Island NT	TAS, NT
Verticillium dahliae defoliating strain (VCG1A)	Verticillium wilt defoliating strain (VCG1A)	Narrabri	NSW
Verticillium tricorpus	Verticillium wilt	Ballarat	VIC

* Some pests listed in this table are still under investigation and an emergency response may be undertaken. These pests may be new detections, extensions of range or new host records

Limnocharis flower. Image courtesy of Biosecurity Queensland.

2.4 Managing weed threats in Australia

The scope of Australia's biosecurity system covers more than just invertebrates and pathogens, with a range of activities also in place to address the threat posed by weeds. Weeds are among the most serious threats to Australia's natural environment and plant production industries. They displace native species, contribute to land degradation and reduce productivity. Many weeds have also developed herbicide resistance, making management even more difficult.

While there are many potential weed species that have not yet entered the country or become established in Australia, an estimated 2,300 species currently impact the natural environment nationally, and a further 1,000 species have a direct impact on plant production. The total economic cost of weeds in Australia has been estimated at over $4 billion annually.

Managing and responding to weed threats involves all levels of government, industry and the community. Legislation across the country sets out the varying roles of governments to managing weeds across Australia.

WEED PREVENTION

The Australian Government, through the Department of Agriculture and Water Resources, develops and implements quarantine policies for plant imports through Weed Risk Assessments (WRAs) for all exotic plant species prior to importation and when conducting border inspections. Plant import policies have been tightened considerably over the last 15 years with the implementation of mandatory WRAs and the development of the Permitted Seeds List. Weeds are also an integral part of the Northern Australia Quarantine Strategy (NAQS) surveillance activities in Australia's north and neighbouring countries.

Local councils and state and territory government departments of primary industries and environment have responsibility for weed management within their jurisdictions. Each state and territory has a herbarium that houses collections of weed species to support weed management activities such as conducting weed identifications.

At the local level, weed surveillance is undertaken by most local councils, which report new weed incursions in their areas. Plant production industries and their growers manage weeds on their properties to reduce the impact on plant production, and play an integral part in the weed detection and reporting network. Community based weed spotter programs are active in many states and local areas. Volunteers in these groups report new weed detections in their areas, and are generally supported in their activities by government agencies. Farm biosecurity activities include prevention of weeds as well as plant pests.

ERADICATION AND CONTAINMENT

The Australian, state and territory governments manage and coordinate nationally cost-shared invasive weed eradication programs through the Consultative Committee on Exotic Plant Incursions (CCEPI). Eradication and containment programs for weeds depend on early detection and an early response from governments and industry stakeholders. Most successful weed eradication programs have occurred when the infested area was less than four hectares.

National Four Tropical Weeds Eradication Program

The National Four Tropical Weeds Eradication Program (NFTWEP) targets weed species native to tropical America that are in north Queensland.

In 2015 the program targeted eradication of:

- Limnocharis (*Limnocharis flava*)
- Miconia (*Miconia calvescens, Miconia nervosa, Miconia racemosa*)
- Mikania vine (*Mikania micrantha*).

Limnocharis, miconia and mikania vine are all considered serious weeds in other countries, while *Miconia nervosa* and *Miconia racemosa* have exhibited invasive characteristics in north Queensland.

The combined impacts of these weeds on agriculture and the environment in tropical and sub-tropical areas of Australia would be significant if allowed to expand unchecked. The national eradication program involves targeted weed surveys and weed control, extensive community engagement to identify infested areas and research components.

The program is managed by Biosecurity Queensland and is cost-shared by the Australian, Queensland, NSW, NT and WA governments.

Eradicating limnocharis as part of the National Four Tropical Weeds Eradication Program. Image courtesy of Biosecurity Queensland.

Limnocharis is a weed found in North Queensland. Image courtesy of Biosecurity Queensland.

WEED MANAGEMENT

Combating weeds at the farm level is an integral part of most farming systems. Problem weeds and their management differ greatly between industries and regions, but most production systems use a mixture of chemical and non-chemical control methods. Some plant production industry peak bodies produce integrated weed management (IWM) manuals, and the larger industry organisations conduct weed surveillance and research.

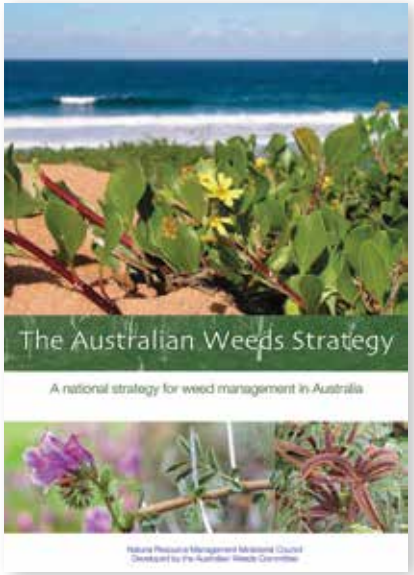
In Australian broadacre plant production industries, weeds are most commonly managed through competition with other plants, herbicide sprays, tillage, slashing, grazing, burning, or a combination of these measures through IWM. In horticultural production systems, weed control focuses on mechanical cultivation and herbicide applications. No-till production systems, which use herbicides to control weeds, are now commonly implemented in Australia.

Local councils are responsible for weed management on land that they own, control or manage, including conservation reserves and roadside verges, and some jurisdictions also conduct weed inspections on private land. Local community groups support the activities of industry and governments in weed management. Formal organisations such as Landcare Australia, Conservation Volunteers and Greening Australia, together with smaller informal groups such as local 'friends of …' groups, organise volunteers to restore and maintain local bushland.

The Sustainable Agriculture stream of the Australian Government's Caring for our Country program provides funding for national surveillance of weeds, containment and eradication of incursions that threaten production or the environment, or impact on trade or communities. Phase two of this program, from July 2013–2018, integrates the Natural Heritage Trust, the National Landcare Program, the Environment Stewardship Program, and the Working on Country Indigenous ranger programs. The National Landcare Program now delivers the Caring for our Country Program.

COORDINATION OF WEED MANAGEMENT

The Invasive Plants and Animals Committee (IPAC) provides an inter-governmental mechanism for identifying and resolving weed issues at a national level. It is a cross-jurisdictional committee with members from the Australian Government and all state and territory governments. Observers on the committee include representatives from CSIRO, Plant Health Australia and the New Zealand Government.



The Australian Weeds Strategy guides weed management.

The IPAC oversees the administration of the Australian Weeds Strategy (AWS), which is the overarching policy for weed management in Australia. The AWS outlines goals and actions required to keep Australia's economic, environmental and social assets secure from the impacts of weeds.

In 2013, PHA reviewed weed management in Australia for the Rural Industries Research and Development Corporation (RIRDC). The study revealed that Australia has a robust weed management system with many stakeholders. The report *Mapping Australia's Weed Management System* (RIRDC 13/019) is available from RIRDC and PHA websites.

Miconia is another species being eradicated under a cost sharing agreement. Courtesy of Biosecurity Queensland.

Volunteers help to control weeds in nature reserves across Australia. Courtesy of Friends of the Pinnacle.

Chapter 3

Maintaining Australia's plant biosecurity status

Australia's plant biosecurity system involves multiple players working together to prevent the introduction, spread and establishment of plant pests.

Plant production, the economy and our unique natural environment are protected through the joint efforts of Australian governments, plant production industries, researchers, producers, Plant Health Australia and the wider public.

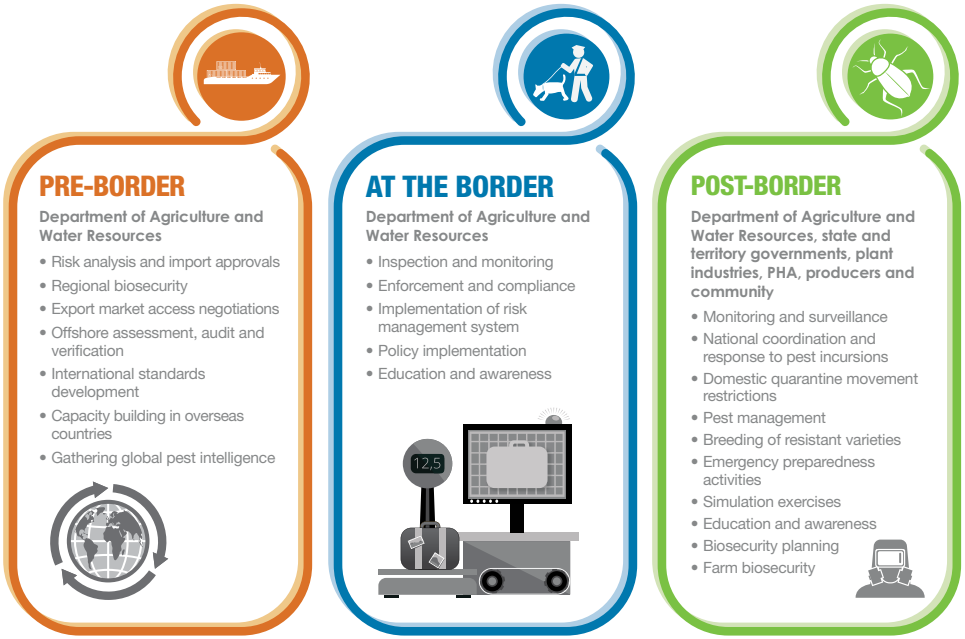
The challenges are increasing with growing international travel and trade, since all movements pose a risk of spreading plant pests. Australia devotes many resources to facilitating safe import and export of produce and is a signatory to international phytosanitary agreements, with inherent responsibilities and obligations to prevent the spread of plant pests.

This chapter explains the activities that maintain Australia's plant pest status in the three areas of activity: pre-border, at the border and post-border.

3.1 Biosecurity and international trade

Australia gains significant economic benefits as a net exporter of agricultural products, with around two-thirds of national agricultural production exported to overseas markets. Australia also benefits from importing a range of goods from overseas. Imports provide access to a wide range of products, technology and services that enable economic growth in multiple sectors. The movement of plant produce around the world is covered by international agreements that function to prevent the spread of plant pests, known as phytosanitary agreements.

Figure 73. Key components of Australia's plant biosecurity continuum



PARTICIPATING IN INTERNATIONAL PLANT PEST AGREEMENTS

As an active trading nation, Australia has entered into a number of multilateral and bilateral trade agreements that influence its plant biosecurity system. On a multilateral level, Australia's rights and obligations in relation to plant biosecurity are set out under World Trade Organization (WTO) agreements, particularly the Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement), although others, such as the General Agreement on Tariffs and Trade 1994, may apply in certain circumstances.

The SPS Agreement provides WTO member countries with the right to use sanitary and phytosanitary measures to protect human, animal and plant life or health. The agreement also imposes a number of obligations, including that sanitary and phytosanitary measures cannot be used to inhibit trade where there is no danger to human, animal or plant health.

The WTO allows members to specify the level of protection that they consider appropriate to protect human, animal or plant life or health within their territory (this is known as the appropriate level of protection or acceptable level of risk) provided it is science-based, is applied consistently and takes into account the objective of minimising negative trade effects. Australia's appropriate level of protection, which reflects community expectations through Australian Government policy, is expressed as "providing a high level of sanitary and phytosanitary protection aimed at reducing risk to a very low level, but not to zero."

All Australian state and territory governments have agreed to this statement as the basis for the national biosecurity system. Consistent with these requirements, Australia's policy is to reduce biosecurity risk to a very low level, but not to zero, through the use of science-based risk assessments.

Australia has a number of bilateral free trade agreements with other countries, each of which deals with biosecurity issues in a slightly different way. However, all agreements are consistent with the SPS Agreement and Australia does not negotiate on specific quarantine measures within its free trade agreements.

There are also multilateral agreements on plant protection to which Australia is a party that outline a number of responsibilities and obligations to members. These agreements also set standards to help harmonise phytosanitary measures.

The International Plant Protection Convention

The International Plant Protection Convention (IPPC) is an international agreement that protects the world's plant resources from the spread of serious pests (including diseases and invasive species) in international trade. The IPPC is an Article XIV statutory body of the Food and Agriculture Organization of the United Nations (FAO), from which it receives program funding, sourced from FAO assessed contributions and donors.

The IPPC is recognised by the SPS Agreement as the body responsible for the establishment of phytosanitary standards relating to plants and plant products in international trade, as well as to anything that can act as a vector for the spread of plant pests.

These standards, known as International Standards for Phytosanitary Measures (ISPMs), provide specific requirements for the management of biosecurity issues, such as the development of pest risk analyses or guidelines for surveillance. Importantly, these standards are a means by which governments can harmonise their phytosanitary regulations. The standards not only reduce the number of pests moved through international trade, but also help facilitate safe trade. Australia, through the Department of Agriculture and Water Resources, coordinates and provides input into three governance bodies:

- Commission on Phytosanitary Measures, the governing body that oversees implementation of the IPPC
- IPPC Strategic Planning Group, which determines strategic priorities for IPPC activities
- IPPC Standards Committee and associated working groups responsible for the development of ISPMs.

At the last meeting of the Commission on Phytosanitary Measures in 2015, a number of cold treatment ISPMs supporting Australia's trade objectives were adopted.

Reporting and exchange of information, including pest status of parties, is available on the International Phytosanitary Portal at **www.ippc.int.**

The Plant Protection Agreement for the Asia and Pacific Region

The Plant Protection Agreement established the Asia and Pacific Plant Protection Commission (APPPC), a Regional Plant Protection Body (RPPO) recognised under the IPPC. The APPPC covers phytosanitary issues relating to movement of pests in trade, pesticide use and regulation, and integrated pest management. Following the acceptance of amendments to the funding mechanism for the APPPC, Australia makes an annual mandatory contribution to the organisation to support the work program.

The APPPC develops Regional Standards for Phytosanitary Measures (RSPMs) that deal with specific regional issues, support the region's trade and may form the basis of an international standard. Australia is an active participant in the APPPC assisting with the development of standards. The APPPC implements relevant RSPMs, for example on training requirements for plant quarantine inspectors.

Australia abides by international phytosanitary agreements.

During its 2013 biennial meeting, the APPPC adopted two new RSPMs: *Approval of irradiation facilities* and *Approval of fumigation facilities,* the development of which had been led by Australia. Officers from the Department of Agriculture and Water Resources facilitated an Australian-funded pilot workshop, which focused on the implementation of RSPMs through a systems approach, based on International Standards for Phytosanitary Measures (ISPM) 14.

A follow up activity led by Australia was delivered in 2015. At its biennial meeting in 2015, the APPPC adopted several Australian-led initiatives supporting regional harmonisation; the development of a RSPM on hot water dipping treatment for fruit flies on mangoes, and a six year surveillance work plan and associated workshops to assist with the implementation of ISPM6 Guidelines for Surveillance.

Canberra Agreement

Australia is also a member of a second RPPO, the Pacific Plant Protection Organisation (PPPO), which is an auxiliary body established under the then South Pacific Commission of the Canberra Agreement. The PPPO provides advice on phytosanitary measures to facilitate international trade whilst protecting the plant health status of parties. The Pacific region covers Pacific island countries and United States and French territories, together with Australia and New Zealand.

During 2015, the PPPO hosted an IPPC regional workshop to consider draft ISPMs and other IPPC activities funded under the DFAT program, Pacific Horticultural and Agricultural Market Access. At the triennial PPPO Board meeting in 2015 Pacific island countries discussed the region's biosecurity interests. At this meeting Australia took up the vice-Chair position on the PPPO Board.

REGULATING IMPORTS TO MANAGE RISK

Since imported plant products could bring exotic pests into the country, the importation of plants and plant products into Australia is strictly regulated. The Australian Government has responsibility for regulation under the *Quarantine Act 1908,* the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999*, and where relevant, the *Gene Technology Act 1989* and any subordinate legislation. The *Biosecurity Act 2015*, which replaces the *Quarantine Act 1908*, passed through Parliament in June and will be enacted on 16 June 2016.

Import conditions are imposed to ensure that produce entering the country does not introduce new pests and diseases to Australia. Import conditions are determined on a case-by-case basis, depending on the pest risks associated with the product, the location of production and the shipping arrangements. The Department of Agriculture and Water Resources verifies that imported material meets these conditions and compliant goods are allowed entry.

Some imported material requires an import permit and these are issued under the *Quarantine Proclamation 1998.* Permits may also be required under the *EPBC Act 1999* for imports of internationally endangered species designated by CITES, the Convention on International Trade in Endangered Species of Wild Fauna and Flora, and live specimens.

The Biosecurity Import Conditions system (BICON) replaced ICON in October 2015. The system can be found on the Department of Agriculture and Water Resources website and contains the Australian import conditions for more than 20,000 plant, animal, mineral and human commodities.

In establishing import conditions, Australia must be confident that the required risk management measures are properly implemented and can be maintained. Off-shore site visits or audits may be required.

The 2015 Agriculture Competitiveness White Paper has provided funding for the review of all import conditions over four years. Early reviews are underway on timber pest pathways, orchids and some nursery stock, following the introduction of emergency measures for the bacterial disease *Xylella fastidiosa* in November 2015 (see box page 120).

Import risk assessment is an important part of Australia's biosecurity protection. Assessments are conducted by technical and scientific experts and can take several forms, such as import risk analyses (IRAs), pest risk assessments and policy reviews. IRAs have a timeframe for completion which is regulated by legislation and the process includes mandated public consultation periods and a formal appeal process.

Assessments are conducted in accordance with Australia's rights and obligations under the SPS Agreement and following the guidance of relevant international standard setting bodies. The IPPC is internationally recognised as the body that sets standards for plant health. Of particular relevance are ISPM 2 (Framework for Pest Risk Analysis) and ISPM 11 (Pest Risk Analysis for Quarantine Pests).

Table 40 details policy advice finalised by 31 December 2015, as well as draft policy advice that is currently in progress. Refer to Section 3.2 for further information on pre-border activities.

Table 40. Department of Agriculture and Water Resources finalised and draft import policy advice

Policy	Country (from)	Year released
Finalised policy advice		
Apple/Pear (budwood)	Generic	2002
Apples	New Zealand	2007
Apples	China	2010
Apples	New Zealand (review)	2011
Apples (Fuji)	Japan	1998
Avocados (revision)	New Zealand	2007
Bananas	Philippines	2009
Candidatus Liberibacter psyllaurous (capsicum, nursery stock, potato tubers, tamarillo fruit, tomato)	New Zealand, USA	2009
Candidatus Liberibacter species and their vectors associated with *Rutaceae*	All countries	2011
Capsicums	Korea	2009
Cherries (to Western Australia)	New Zealand	2003
Citrus	Egypt	2002
Citrus (revision)	Israel	2003
Dactylopius tomentosus 'fulgida' biotype for the biological control of coral cactus (*Cylindropuntia fulgida* var. *mamillata*).	All countries	2015
Drosophila suzukii (spotted wing drosophila)	All countries	2013
Durian	Thailand	1999
Durian (supplement)	Thailand	2000
Fresh ginger	Fiji	2015
Ginger	Fiji	2013
Grains	Various	2006, 2007, 2008
Grapes (table)	USA	2002
Grapes (table)	Chile	2005
Grapes (table)	Korea	2011
Grapes (table)	China	2011
Grapes (table)	Japan	2014
Grapes (table; revisions)	USA	2003, 2006
Grapevine propagative materials	All countries	2013
Hazelnut	Chile	2011
Hops propagative materials	All countries	2010

Policy	Country (from)	Year released
Island cabbage	Cook Islands, Fiji, Samoa, Tonga, Vanuatu	2013
Lentil (seed and human consumption)	All	2002
Lettuce (re-instatement)	New Zealand	2007
Lilium spp.	Taiwan	2013
Limes (Tahitian)	New Caledonia	2006
Lychee	Taiwan and Vietnam	2013
Lychee/longan	China, Thailand	2004
Maize (bulk)	USA	2003
Mandarin (Unshu)	Japan	2009
Mangoes	Philippines	1999
Mangoes	Taiwan	2006
Mangoes	India	2008
Mangoes	Philippines (additional areas)	2010
Mangoes	India (revised conditions)	2011
Mangoes	Pakistan	2011
Mangoes	Indonesia, Thailand, Vietnam	2015
Mangosteen	Thailand	2004
Mangosteen	Indonesia	2012
Medium Risk Nursery Stock review (internal)	All countries	2014
Olive (plants approved sources)	Generic	2003
Oranges (sweet)	Italy	2005
Papaya	Fiji	2002
Pears	Korea	1999
Pears	China	2005
Pears (Asian)	China	2003
Pears (Ya)	China	1998
Permitted seeds	All countries	2006
Persimmon	Israel, Japan, Korea	2004
Phalaenopsis orchids (nursery stock)	Taiwan	2010
Phytophthora spp. host propagative material	All countries	2015
Pineapple	Philippines, Solomon Islands, Sri Lanka, Thailand	2002
Pineapple (de-crowned)	Malaysia	2012
Pineapple (modification)	Philippines, Solomon Islands, Sri Lanka, Thailand	2003
Pome fruit testing	China, Japan, Korea	2003
Potato propagative material	All countries	2013
Pseudomonas syringae p.v. *Actindae*	New Zealand	2011
Salacca	Indonesia	2014
Seed contaminants (review of tolerances)	All countries	2000
Stone fruit	USA	2010
Stone fruit (Western Australia)	New Zealand	2006
Sweet corn (seed)	USA	2003
Tachardiaephagus somervillei for the biological control of yellow lac scale	All countries	2015
Tomato (truss)	Netherlands	2003
Tomato (truss, review)	New Zealand	2002
Wood packaging	Generic	2006
Draft policy advice (in progress)		
Apples	USA	2009 (stop the clock provisions have been activated on this policy)
Candidatus Liberibacter Solanacearum	All countries	2015
Citrus spp. nursery stock	All countries	2014
Fruit fly pest free areas	China	2009
Grapes (table)	India	2010 (Commencement announced. A draft report has not yet been released)
Nectarines	Peoples Republic of China	2015
Potatoes for processing	New Zealand	2012
Prunus spp. propagative material	All countries	2014
Zantedeschia propagative material	All countries	2014

ENSURING AUSTRALIAN EXPORTS MEET REQUIRED STANDARDS

Many Australian plant industries export a proportion of the food and fibre that they produce. Just as imports are subject to restrictions to protect plant health, exports must also meet conditions.

The provisions of the *Export Control Act 1982* and its subordinate legislation provides the legal framework by which Australian producers can export their products. Exporters must meet the requirements of the Act and any quarantine requirements of the importing country.

The Department of Agriculture and Water Resources provides export and phytosanitary inspection, verification, and certification services for plants and plant products in accordance with importing country requirements and Australia's international obligations. The department also negotiates technical market access for Australian export produce, and has responsibility for the Australian Wood Packaging Certification Scheme which enables Australia to provide ISPM 15 compliant wood packaging material for export.

The *Export Control (Plant and Plant Products) Orders 2011* provide criteria for the export of fresh fruits, fresh vegetables, dried fruits, prescribed grain, and plants or plant products for which a phytosanitary certificate, or any other official certificate, is required by an importing country authority.

More specific export legislation is listed in Table 40. Strong linkages are maintained with exporters through industry consultative committees (the Grain and Plant Products Export Industry Consultative Committee and Horticulture Export Industry Consultative Committee) which are instrumental in developing effective and efficient operational responses to government policy and legislation.

To assist exporters, the Manual of Importing Country Requirements (MICoR) Plants provides information on export conditions required to export plants and plant products from Australia. This includes details on requirements for import permits, phytosanitary certificates, additional declarations and treatments, and any other relevant export information and documentation. Information in MICoR Plants is intended as a guide only and exporters are responsible to check the importing country's requirements before exporting.

For plant industries the Export Documentation (EXDOC) system supports the preparation of export documentation for primary produce prescribed under the *Export Control Act 1982* and associated legislation. The system provides certification for grain and horticulture exports, as well as for animal products. EXDOC accepts details of proposed exports from exporters and creates a request for permit. This is linked to endorsements and the results of inspections as required, and where applicable, an export permit and phytosanitary certificate is issued.

Technical market access negotiations between Australia and its trading partners, in close consultation with industry stakeholders, facilitate access to markets for Australian producers by addressing phytosanitary issues. Changes in pest status, the emergence of new or improved treatment technologies, and reviews by trading partners of their import conditions mean that negotiations surrounding market improvement and market maintenance are increasingly the focus of technical market access activities which ensure Australia can continue to export its plant products.

Table 41 details market access achievements since 2000, including access to new markets, improving opportunities in existing markets and maintenance of existing market access.

There is a high level of departmental investment in negotiating protocols and building export systems to increase the value of plant exports. When prioritising market access activities, the department consults with industry to ensure its market access prioritisation processes select market pathways with the highest likelihood of technical and commercial success, with a strong focus on evidence-based analyses.

For dried bulk commodities, the Grains Industry Market Access Forum provides a conduit between government and industry to ensure market access decisions are informed and prioritised in line with overall industry benefit.

For the horticulture industry, advice to the Department of Agriculture and Water Resources on the industry's priorities for new or improved market access requests is provided through Hort Innovation's Trade Assessment Panel.

Table 41. Australia's export legislation

Legislation
Export Control Act 1982
Export Control (orders) Regulations 1982
Export Control (Plants and Plant Products) Order 2011
Export Control (Prescribed Goods – General) Order 2005
Export Control (Hardwood Wood Chips) Regulations 1996
Export Control (Organic Produce Certification) Orders
Export Control (Regional Forest Agreements) Regulations
Export Control (Unprocessed Wood) Regulations
Exports (Fresh Fruit) Regulations
Export Charges (Collection) Act 2015
Export Charges (Imposition – Customs) Act 2015
Export Charges (Imposition – Excise) Act 2015
Export Charges (Imposition – General) Act 2015
Export Control (Fees) Order 2015
Export Charges (Collection) Regulation 2015
Export Charges (Imposition – Customs) Regulation 2015
Export Charges (Imposition – General) Regulation 2015

Table 42. Market access achievements for plant product exports from Australia since 2000

Country	Commodity	Year achieved
Market access gained and restored		
South Korea	Oranges	2000
South Korea	Lemons	2000
New Zealand	Multiple products (Goulburn Valley) – pest free area	2003
Peru	Olives – rooted cuttings	2003
USA	Tomatoes – greenhouse	2003
Brazil	Lychees – nursery stock	2004
China	Mangoes	2004
Morocco	Olives – rooted cuttings	2004
New Zealand	Mangoes – irradiated	2004
China	Citrus	2005
Japan	Cherries (Tasmania)	2005
South Africa	Seed potatoes – micro-tubers	2005
South Korea	Mangoes	2005
South Korea	Citrus (unspecified)	2005
Japan	Apples	2006
New Zealand	Bananas – resumption of trade	2006
New Zealand	Papaya	2006
Thailand	Seed potatoes (Victoria and WA)	2006
Thailand	Potatoes – brushed ware	2006
South Korea	Multiple products	2007
South Korea	Mangoes	2007
New Zealand	Lychees	2008
South Korea	Lupins	2008
USA	Cherries (mainland)	2008
India	Peanuts – processed	2009
Japan	Citrus (Sunraysia) – seasonal freedom	2009
China	Table grapes	2010
European Union	Citrus	2010
India	Kiwifruit	2010
Japan	Citrus – grapefruit	2010
South Korea	Cherries (Tasmania)	2010
Taiwan	Cherries – access reinstated for non-pest free areas	2010
Saudi Arabia	Lentils	2011
Bolivia	Sunflower seeds – sowing	2012
Chile	Grapevines – nursery stock	2012
Egypt	Honey	2012
India	Pearl millet seeds – sowing	2012
Indonesia	Table grapes, summerfruits and cherries	2012
Peru	Wax flowers – rooted cuttings	2012
Peru	Paulowina – rooted cuttings	2012
Peru	Sorghum seeds – sowing	2012
Peru	Chia seeds – sowing	2012
Taiwan	Carrots	2012
Taiwan	Whole lupins – processing	2012
USA	Cotton seed – stockfeed	2012
Uruguay	Hemp seeds – sowing	2012
China	Cherries – access after initialling a protocol and meeting Chinese requirements	2013
China	Canola – re-opening of trade after resolving quarantine issues preventing exports since 2009	2013
Ecuador	Macadamia nuts – access gained for macadamia nuts-in-shell for consumption	2013
Ecuador	Barley – for consumption following a technical submission in 2008	2013
Malaysia	Creeping signal grass – sowing	2013
Peru	Teak seeds – sowing	2013
Phillipines	Bana grass cuttings	2013
USA	Apples	2013
China	Grape seed	2014
Japan	Table grapes	2014
South Korea	Table grapes	2014
Thailand	Cherries	2014
Thailand	Summerfruit – apricots, plums, nectarines and peaches	2014
USA	Mangoes	2015
India	Blueberries	2015

Table 42. Market access achievements for plant product exports from Australia since 2000

Country	Commodity	Year achieved
Market access gained and restored *continued*		
Vietnam	Table grapes – market access restored following suspension for all Australian fruit	2015
Vietnam	Citrus – market access restored following import suspensions for Australian fruit	2015
Saudi Arabia	Lentils – market access restored	2015
Improvements in market access		
New Zealand	Zucchinis – removal of Queensland fruit fly from the pest list	2005
Thailand	Citrus – 2-3 degree cold disinfestation	2005
Malaysia	Mangoes – new phytosanitary requirements	2006
New Zealand	Tomatoes – improved conditions	2006
South Korea	Carrots – freedom from nematode	2006
South Korea	Citrus – 3 degree cold disinfestation	2006
Taiwan	Multiple products (Tasmania) – reinstatement of Queensland fruit fly area freedom	2006
Japan	Citrus – 2-3 degree cold disinfestation	2007
India	Oats	2008
India	Mangoes – irradiated	2008
Indonesia	Table grapes – in-transit cold disinfestation	2008
Indonesia	Citrus – in-transit cold disinfestation	2008
Japan	Cherries (Tasmania) – revised protocol	2008
Japan	Mangoes – reduced inspection rate	2008
Taiwan	Multiple products – 2-3 degree cold disinfestation	2008
United Arab Emirates	Multiple products – removal of SOPP requirement	2008
China	Citrus – revised protocol	2009
China	Mangoes – revised protocol	2009
China	Apples (Tasmania) – improved conditions	2010
Japan	Grapefruit	2010
South Korea	Citrus	2010
USA	Cherries (mainland) – stand alone cold treatment	2010
India	Macadamia nuts	2011
Indonesia	Table grapes – in-transit cold disinfestation from non-pest free areas	2011
Indonesia	Citrus – in-transit cold disinfestation from non-pest free areas	2011
USA	Citrus – 3 degree cold disinfestation	2011
India	Citrus (unspecified) – more favourable temperatures and flexible conditions	2012
India	Citrus (unspecified) – 3 degree in-transit cold treatment	2012
New Zealand	Citrus (unspecified) – in-transit cold treatment	2012
New Zealand	Pears – in-transit cold treatment	2012
New Zealand	Table grapes – in-transit cold treatment	2012
New Zealand	Avocado – in-transit cold treatment	2012
USA	Apples	2012
China	Canola	2013
Hong Kong	Plants and plant products	2013
Indonesia	Soybeans – removal of a five per cent tariff	2013
Iran	Grain and seed	2013
Kenya	Wheat	2013
Libya	Grain and seed	2013
Phillipines	Fruit – revised protocol including favourable cold treatment conditions	2013
Qatar	Hay	2013
South Korea	All products – FTA negotiations concluded in December 2013	2013
Taiwan	Apples	2013
Thailand	Citrus – some import limitations removed by Thailand	2013
Thailand	Grain and seed	2014
China	Wheat and barley – access improved with new protocol	2015
Thailand	Citrus – more varieties approved for export from non-pest free area districts	2015
Thailand	Tablegrapes – new temperature for cold treatment	2015
Thailand	Cherries – new temperature for cold treatment	2015
Thailand	Persimmons – irradiation for fruit fly control	2015
Korea	Cherries – improved inspection rates	2015
Maintained market access		
Malaysia	Cut and dried flowers	2004
South Korea	Potatoes	2004

Table 42. Market access achievements for plant product exports from Australia since 2000

Country	Commodity	Year achieved
Maintained market access *continued*		
Thailand	Citrus	2004
Various	Citrus	2004
Indonesia	Multiple products	2006
Canada	Summerfruit	2007
China	Citrus (unspecified)	2007
India	Grain	2007
Mauritius	Citrus	2007
Mauritius	Potatoes	2008
Thailand	Multiple products	2009
New Zealand	Mangoes	2010
New Zealand	Papaya	2010
New Zealand	Lychees	2010
Taiwan	Summerfruit – peach and nectarine	2011
Thailand	Multiple products	2011
Thailand	Table grapes	2011
Thailand	Citrus	2011
Vietnam	Multiple products	2011
China	Table grapes	2014
India	Pome fruit	2012
Indonesia	Multiple products	2012
South Korea	Barley (malting) – processing	2012
Taiwan	Summerfruit – plums	2012
Vietnam	Multiple products	2012
Thailand	Apples	2013
Thailand	Pears	2013
Thailand	Avocado	2013
Thailand	Kiwifruit	2013
Thailand	Strawberries	2013
Thailand	Persimmon	2013
All markets	All products – implementation of a new security paper for export health certificates	2013
Taiwan	Apples – revised improved export protocol	2013
USA	Cotton seeds – for stockfeed (reinstated Methyl Bromide fumigation and new tolerance levels)	2013
Indonesia	Wheat – access maintained for grain for consumption	2015
Vietnam	Seed for sowing	2015
Vietnam	Grains for consumption	2015
Vietnam	Nuts for consumption	2015
Vietnam	Plant based stockfeed	2015

Xylella threat prompts tighter quarantine restrictions for imported plants

The Australian Government Department of Agriculture and Water Resources has responded to the threat of the exotic pest *Xylella fastidiosa*, an invasive bacterial plant pathogen that is spreading around the world, by tightening plant import requirements from November 2015.

Xylella is a biosecurity priority because it affects over 200 commercial and ornamental plant species and because if it gets into Australia the chances of eradicating it are slim.

The disease caused by *Xylella* is known by a range of common names, including: Pierce's disease, California vine disease, Anaheim disease (in grapevine), alfalfa dwarf disease (in lucerne), phony disease (in peach), leaf scald (in plum), quick decline (in olive), leaf scorch (in coffee, almond, blueberry, olive, oleander, elm, oak, plane, mulberry, maple), and variegated chlorosis (in citrus).

Xylella is spreading around the world, and although it is not present in Australia it is of major concern to Australia's plant industries.

Key changes to import requirements came into effect, including Xylella-free certification of plant material coming in from overseas or holding and testing in an approved post entry quarantine facility.

It is expected that the restrictions will reduce the volume of some ornamental plant material and tree species permitted entry to Australia, and the cost of importing will increase. This is due to the need for laboratory testing and longer observation times in quarantine.

All producers and importers are urged to abide by the new restrictions to avoid an incursion that would have widespreadand serious implications for production in Australia.

One of the diseases caused by the exotic bacteria Xylella *– Pierce's disease in grapevines. Image courtesy of Christine Horlock, QDAF.*

3.2 Pre-border activities

The Department of Agriculture and Water Resources has primary responsibility for pre-border biosecurity activities. These are focused on minimising the likelihood of exotic pests and diseases reaching our border, while enabling the movement of people and goods across the border. They provide assurance to the community and producers about the biosecurity status of commodities imported into Australia.

Pre-border activities include:

- Conducting risk assessments to consider the level of biosecurity risk that may be associated with imports and identifying risk management measures.
- Conducting offshore verifications, inspections and audits.
- Collaborating with international partners on plant health issues and standards.
- Regional capacity building through collaborative activities.
- Intelligence gathering to determine and assess potential biosecurity risks.

ASSESSING RISKS ASSOCIATED WITH IMPORTS

Biosecurity risks are managed in keeping with Australia's legislative framework for biosecurity and international obligations, particularly the SPS Agreement. See section 3.1 for further information on the role of risk assessments in assessing biosecurity risks associated with imports.

VERIFICATIONS, INSPECTIONS AND AUDITS

A range of verifications, inspections and audits are undertaken offshore to manage risks prior to import to Australia, and to ensure that exporting countries can meet Australia's biosecurity requirements, provide export systems for safe trade and prevent the arrival of non-compliant consignments at the border.

Some horticultural exports from China, the United States, Chile and New Zealand have the option of offshore pre-shipment inspection by Department of Agriculture and Water Resources officers. Regular verifications and audits are also undertaken to ensure compliance of specified plant material with prescribed risk management procedures. Controls also extend to production areas and for stock feed processing facilities to ensure compliance with Australia's import permit requirements.

A new program implemented in 2015 will develop an offshore audit and verification framework. The department is working with national plant protection organisations in exporting countries to increase confidence in their systems' ability to effectively manage biosecurity risks offshore. This will reduce the pressure on mitigating risks at the border and provide opportunities to reduce onshore intervention.

PARTICIPATING IN INTERNATIONAL PLANT HEALTH SYSTEMS

Australia engages in international activities to gather national and international plant pest information. The information is made available to regional plant health practitioners through a variety of sources including published records, surveillance data, insect and herbarium collections and networks. Intelligence assessments of high priority exotic plant pests informs offshore risk management and early detection of any pests that may enter and establish in Australia.

Australia also participates in setting standards for both international and regional bodies (refer to section 3.1). This cooperative approach boosts Australia's ability to actively monitor pests pre-border, limit their spread, and reduce their impact on the agricultural systems of regional neighbours and trading partners. Significant effort is also invested in gaining intelligence and promoting Australia's interests in the evolution of trade regulations, codes and standards.

BUILDING CAPACITY IN THE ASIA-PACIFIC REGION

Capacity building activities are delivered for a number of Asia-Pacific countries in close proximity to Australia and for important and emerging trading partners. Commonly, these activities are coordinated through regional bodies, such as the Association of Southeast Asian Nations (ASEAN) or the Asia-Pacific Economic Cooperation (APEC) group of countries. Activities are often delivered with the assistance of funding from the Department of Foreign Affairs and Trade.

Capacity building activities yield a better understanding of the plant pest risks in the region, improve regional biosecurity, build diagnostic networks and capabilities, and foster links among plant health and biosecurity agencies and experts. These programs also help Australia to meet its formal international obligations to assist developing countries. Increasingly, capacity building activities promote approaches to managing phytosanitary risk that safeguard existing trade or create opportunities for expanding markets.

ANTICIPATING EXOTIC PLANT PEST THREATS

A range of sophisticated technologies and approaches including research, shared international resources and intelligence are used to anticipate exotic plant pest threats and to help prevent their introduction and spread. Work is undertaken with domestic and international partners to inform responses to emerging risks and to risks associated with deliberate and inadvertent non-compliance.

Information and intelligence is shared between partners through legislative requirements, memoranda of understanding and agreements with international bodies. The intelligence is used to develop cargo profiles and campaigns, and to support identification and management of non-compliance, enabling resources to be targeted at the areas of greatest risk.

Image courtesy of WTO.

WORLD TRADE ORGANIZATION

3.3 Activities at the border

The Department of Agriculture and Water Resources has primary responsibility for border biosecurity activities. With increasing levels of international travel and trade, the detection of threats at the border remains an important element of the biosecurity system.

Biosecurity activities at the border are focused on:

- Screening and inspecting international vessels, passengers, cargo, mail, animals, plants, and plant products arriving in Australia.
- Managing the high biosecurity risks of live plants and animals through containment, observation and treatment at quarantine facilities.
- Identifying and evaluating the specific biosecurity risks facing northern Australia through the Northern Australia Quarantine Strategy.
- Raising awareness of Australia's biosecurity requirements among travellers, importers and industry operators.

Activities at the border are risk-based, informed by evidence and subject to review and continual improvement.

SCREENING AND INSPECTION

The Department of Agriculture and Water Resources employs more than 3,900 officers, many of whom contribute to the inspection of international vessels and passengers, cargo and mail as they arrive at ports of entry.

A range of techniques are used including risk profiling, detector dogs and x-ray machines. Surveillance and inspection activities are performed at international airports, seaports, mail facilities and container depots to screen and inspect incoming goods and people.

Audits are also undertaken on businesses that import goods to ensure compliance with biosecurity requirements. All plants or plant parts, fruits, seeds, cuttings, bulbs and wood or bamboo items are examined and treated as required. Low and medium risk plants can be imported and screened for exotic pests in privately operated quarantine approved facilities, whereas high risk plants are sent to either Australian or state government post-entry quarantine facilities.

Australian Government border inspections in 2015

In 2015 staff from the Department of Agriculture and Water Resources screened:

- 11.9 million mail items out of 138 million mail items received
- 4.5 million air passengers out of 23 million international air passengers
- Sea passengers (number unknown)
- 17,800 international sea vessels
- 33.5 million consignments of cargo imported via air and sea freight (2014–15 figures).

Unusual border finds during the year included:

- A stuffed European (Melinae) badger on a log filled with moss and soil was found in a parcel from Germany at Sydney international mail centre.
- Exotic burnt pine longicorn beetles were found on a cruise ship in Brisbane.
- A biosecurity officer at the Sydney mail centre found a book with eight paper packets filled with seeds, hidden in a cut-out compartment.
- Department officers denied entry to an excavator from Papua New Guinea during an inspection on the wharf at Townsville because it was covered in masses of biosecurity risk material.

While the stuffed badger proved not to be a biosecurity hazard, the log contained plant and soil material. Image courtesy Department of Agriculture and Water Resources.

PROTECTING OUR NORTHERN COASTLINE—NORTHERN AUSTRALIA QUARANTINE STRATEGY

Since 1989, the Northern Australia Quarantine Strategy (NAQS) has been meeting the unique biosecurity challenges facing Australia's north, stretching from Cairns to Broome and including the Torres Strait (Figure 74). The northern coastline is vast and sparsely populated, and commercial plantings are few and far between, making surveillance a challenge.

The primary biosecurity risk is the close proximity of neighbouring countries to the Australian mainland. Indonesia, Timor-Leste and Papua New Guinea have many insect pests, plant diseases and weeds not present in Australia. These pests and diseases have the potential to arrive through human activities or natural means.

NAQS designs and conducts surveillance for pest and disease incursions to facilitate eradication before they spread or become established further south. In addition, NAQS collects information about the absence of significant pests and diseases which contributes to market access and broader biosecurity strategies. Increasingly, surveillance is conducted in partnership with industry and other government partners.

NAQS also regulates the biosecurity aspects of the southwards movement of people, vessels, aircraft and goods through the Torres Strait to the mainland. The key to success has been the cooperation and goodwill of the Torres Strait communities.

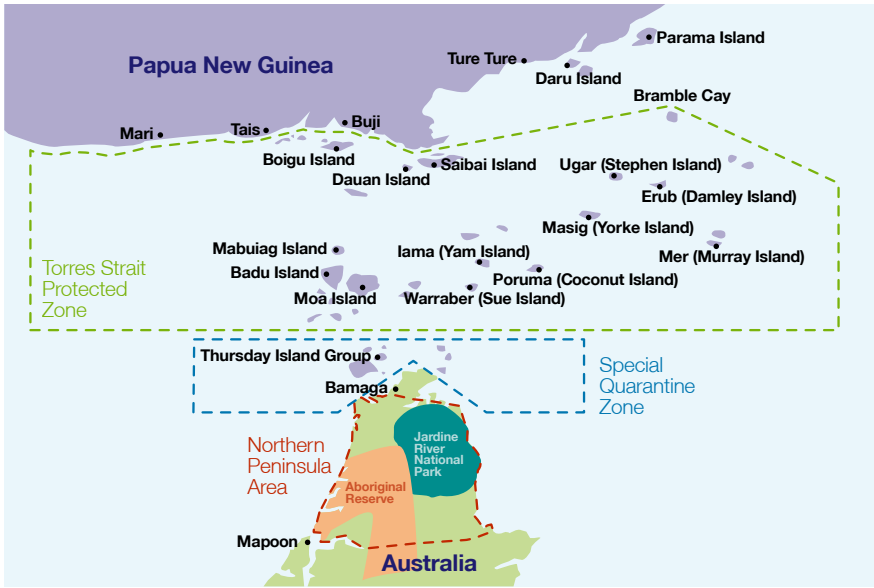
NAQS delivers on its objectives through a program that involves:

- Scientific teams in Darwin and Cairns delivering plant health surveys and monitoring across northern Australia.
- Public awareness activities to encourage local people and communities to report unusual pests and diseases.
- Officers at strategic locations, including the inhabited islands of Torres Strait, regulating plant risks associated with movements of people and goods through the islands (from the Torres Strait Protected Zone to the Special Quarantine Zone, and from either zone to the mainland as seen in Figure 75).
- Delivery of pest and disease surveys and capacity building activities in Papua New Guinea, Indonesia, Timor-Leste and Solomon Islands.

In 2015, plant scientists from NAQS conducted targeted surveillance for 156 exotic pests and diseases on most horticultural hosts and a range of native and cultivated alternate hosts across northern Australia. In addition to targeted activity, damage symptoms are regularly investigated. As part of the Torres Strait Fruit Fly Monitoring Program, NAQS maintained a set of permanent traps in Torres Strait and Northern Peninsular Area of Cape York to target three exotic fruit fly species: Oriental fruit fly, melon fly, and New Guinea fruit fly.

Figure 74. NAQS surveillance area (shown in dark green)

Figure 75. Quarantine zones in the Torres Strait (shown in red, blue and green)



3.4 Post-border activities

Despite all of the precautions in place, exotic pests can make it into Australia. This might be as a result of some imported goods still containing a pest, illegal imports in parcels or luggage or via natural pathways such as wind and water currents.

Recognising the need for a range of post-border measures aimed at limiting the impact of any detected pest or disease, Australia has established a unique and highly effective post-border biosecurity system to provide additional protection against exotic pests. Post-border activities range from planning and preparedness through to everyday pest management operations.

Identifying exotic threats and being prepared for their arrival significantly increases the chance of containing and successfully eradicating them should they arrive. Preparedness activities include agreed and implemented biosecurity plans for plant industries, pre-emptive breeding of resistant species and other targeted research and development, measures to raise awareness of plant pest risks among growers and internationally recognised surveillance systems capable of early detection and demonstrating area freedom.

When an emergency plant pest is detected in Australia, formal emergency response arrangements are activated to ensure timely decisions and actions, providing the best chance of eradicating the new pest (see Chapter 4). For signatories to the Emergency Plant Pest Response Deed and the National Environmental Biosecurity Response Agreement, there are formal arrangements to share the cost of responding to an incursion between the Australian Government, state and territory governments and relevant industry partners.

In addition to responses to exotic plant pest incursions, there are numerous activities aimed at minimising the impact of pests already endemic in Australia. Some pests are contained to specific regions of Australia, so domestic arrangements are in place to allow trade to both domestic and international markets without spreading these pests. The Australian Government, state and territory governments and industry all contribute to the management of endemic pests and preparing for potential exotic pest incursions.

POST-ENTRY PLANT QUARANTINE

All imported plant nursery stock and high risk seeds are subject to pest risk management to prevent the entry of pests. Australia maintains a post-entry plant quarantine program that enables high and medium risk nursery stock and restricted seeds to be grown and screened for pests at an approved facility (Table 43). Material is released from quarantine once it has been verified free from specific pests.

Table 43. Australian post-entry plant quarantine facilities

Location	Australian Government facilities	State government facilities approved for growing high-risk plant material	Scientific (S) and Privately (P) operated facilities approved for growing high-risk plant material	Privately operated facilities approved for growing medium risk plant material	Scientific research facilities approved for holding high and medium risk plant material for research purposes – no material released from quarantine
ACT	–	–	1 (S)	–	1
NSW	1	1	1 (S), 1 (P)	8	–
QLD	–	2	1 (S), 2 (P)	8	2
SA	–	1	2 (S)	–	1
Tas	–	1	1 (S)	1	–
Vic	1	3	4 (S), 2 (P)	13	4
WA	–	1	2 (P)	5	1
NT	–	–	–	–	–

Imported plant material is subject to strict entry requirements. Image courtesy of PHA.

Australia's new post entry quarantine facility opens

In 2015, Australia's new Post Entry Quarantine (PEQ) facility at Mickleham in Victoria opened, providing a new system of post entry quarantine for the import of live animals and plants to protect the nation from biosecurity risks.

The new $379 million facility built by the Department of Agriculture and Water Resources provides a single entry point for high risk plant and animal imports to improve and simplify the import process.

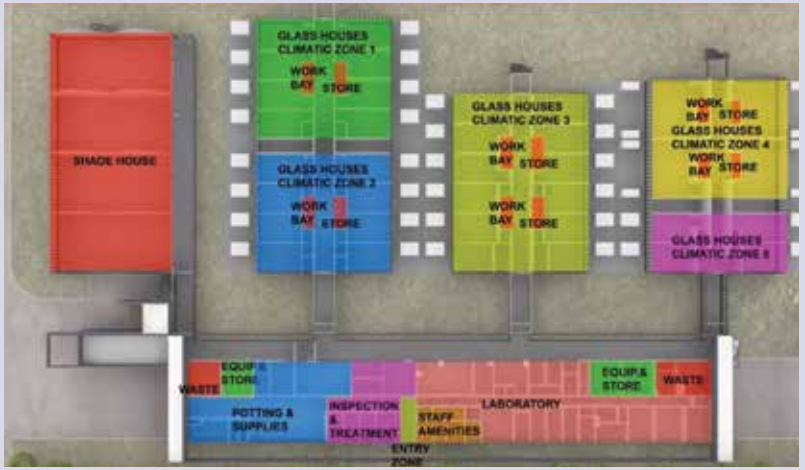
The new facility is vast. It covers 144 hectares, consolidating and replacing four government-owned facilities located in Sydney, Melbourne and Adelaide.

It came on line progressively, with imported bees first to be processed at Mickleham, followed by cats, dogs and horses and, from December 2015, plants.

Glass houses at the site can accommodate plants from various climates, with adjustable temperatures to suit different species. Prior to commissioning, the glass houses were tested with locally grown plants. The facility has a capacity of 2,000 square metres of glass house space plus shade houses and a diagnostic laboratory.

The department has shifted to an online booking and payment system for post entry quarantine reservations, further simplifying the import process.

Construction of additional facilities continues until 2018.



The plant compound of the new post entry quarantine facility has glass houses for various climatic zones. Image courtesy of DAWR.

DOMESTIC QUARANTINE

Newly established and regionalised pests (Section 2.2 Australia's regionalised pests) can be easily spread from one part of Australia to another through the movement of plants, plant products, people, soil or equipment. Restrictions on the movement of high risk items apply in each state and territory to reduce this risk. Domestic quarantine restrictions operate under state and territory legislation (Table 1) to complement and support the national quarantine legislation that governs the export and import of goods to and from Australia.

Restrictions apply to domestic travellers as well as to interstate movement of goods. There is a list for travellers detailing what they can and cannot carry across state and regional borders in the booklet *Australian Interstate Quarantine: A Traveller's Guide* and on the website **www.quarantinedomestic.gov.au.** The website is currently being updated by PHA with a new interactive site due for release in 2016.

Interstate certification

Interstate certification is used to govern the movement of plant products under the different state and territory quarantine regulations. This certification scheme provides a harmonised approach for interstate movement of plant products and provides evidence that the quarantine regulations of the importing state or territory have been met. In many instances this may require specific treatments such as growing produce in a particular way (e.g. under cover), or undergoing disinfestation treatments after harvest (e.g. fumigation).

There are two types of certificates that may be issued:

- Plant Health Certificate – which is issued by a government officer from the state or territory of origin.
- Plant Health Assurance Certificate – which is supplied by an approved business under an Interstate Certification Assurance scheme arrangement. In order to issue these certificates, a business must meet specific requirements and undergo regular audits by the state or territory government accreditation authority.

The Subcommittee on Domestic Quarantine and Market Access

The Subcommittee on Domestic Quarantine and Market Access (SDQMA) reports to Plant Health Committee (Section 1.3 National Committees) and consists of senior regulators from the Australian Government and state and territory governments. The objective of the committee is to develop, review and maintain domestic quarantine standards and conditions that allows export of produce around the country while avoiding the risk of spreading regionalised plant pests.

The committee's oversight of a wide range of quarantine conditions means it has an important role in developing domestic market access conditions for plants and plant products in Australia. For example, produce from fruit fly affected regions can be moved to non-affected regions for sale, once it has met certain conditions such as in-field and post-harvest treatments.

SDQMA is tasked with ensuring that conditions are:

- Technically justified, to minimise regulatory burdens on industry.
- Coordinated and harmonised across the country and regions to the extent possible.
- Consistent with Australia's international obligations under the World Trade Organization's Agreement of the Application of Sanitary and Phytosanitary Measures.

SDQMA works closely with state and national plant quarantine agencies and industries to develop and implement new treatment arrangements which not only provide for domestic trade, but also present a potential pathway to support international market access.

PRE-EMPTIVE BIOSECURITY PLANNING

Biosecurity planning provides a mechanism for plant production industries, in collaboration with governments and other relevant stakeholders, to identify and prioritise plant pest threats that could have a significant impact on their crops.

In addition to identifying the greatest threats to a particular industry or crop, biosecurity plans provide an agreed framework for individual industries and other biosecurity stakeholders including governments, to focus biosecurity risk mitigation activity on the greatest risks. Biosecurity plans thereby enhance the ability to prevent, prepare for and effectively respond to, pest incursions. The pre-emptive planning process ensures that industries are better placed to maintain domestic and international trade, negotiate access to new overseas markets, and reduce the social and economic costs of any pest incursions to growers and the wider community.

PHA facilitates the development of each plan in consultation with an Industry Biosecurity Group that is assembled each time. The group is comprised of representatives from industry and government, as well as research and development organisations. Biosecurity plans are reviewed and updated at least every five years.

As of December 2015, 28 biosecurity plans have been developed by PHA, covering 34 of Australia's major plant industries (Table 44). Further information on biosecurity planning can be found on the PHA website.

Table 44. Current industry biosecurity plans covering Australia's plant industries

Current biosecurity plans	
Apple and Pear (Version 2.01)	Olive (Version 1.0)
Avocado (Version 2.01)	Onion (Version 2.0)
Banana (Version 2.0)	Papaya (Version 1.0)
Bluberry (Version 1.0)	Passionfruit (Version 1.0)
Cherry (Version 2.01)	Pineapple (Version 1.0)
Citrus (Version 3.0)	Plantation timber (Version 2.0)
Cotton (Version 3.0)	Potato (Version 2.0)
Ginger (Version 1.0)	Rice (Version 3.0)
Grains (Version 3.0)	Rubus (Version 1.0)
Honey Bee (Version 1.0)	Strawberry (Version 2.0)
Lychee (Version 1.0)	Sugarcane (Version 2.01)
Mango (Version 2.1)	Summerfruit (Version 1.0)
Melon (Version 1.0)	Truffle (Version 1.0)
Nursery and Garden (Version 3.0)	Vegetable (Version 2.0)
Nuts (Version 2.0)	Viticulture (Version 3.0)

PHA published biosecurity plans for grains, citrus and blueberry industries in 2015.

MANAGING ECONOMICALLY SIGNIFICANT SPECIES OF FRUIT FLIES

Fruit flies are a troublesome group of pests nationally. They affect a range of horticultural commodities and the potentially affected industries are spread across all Australian states and territories. The presence of particular species of fruit flies in a growing area can have potentially large economic impacts for producers through increased production costs, loss of domestic and international markets, or a requirement for post-harvest treatments. Fruit flies are also a problem for non-commercial producers, requiring control costs or causing damage to fruit.

Given the widespread ramifications, it is in everyone's interest to tackle fruit fly management collectively. The National Fruit Fly Strategy (NFFS) developed in 2008 detailed the importance of a collaborative approach and a subsequent cost-benefit analysis undertaken in 2012 by the Australian Bureau of Agricultural and Resource Economics and Sciences estimated that if fully implemented the NFFS could generate benefits of between $29 and $38 million per year.

The National Fruit Fly Strategy Advisory Committee (NFFSAC) was established in May 2014 to coordinate the ongoing activities under the NFFS and to provide national policy oversight of the domestic management of all fruit fly issues, including endemic and exotic species. The NFFSAC had an initial 18 month term that concluded in November 2015.

In December 2015 the National Fruit Fly Council was established to carry on the work started by the NFFSAC and to drive the delivery of a national system that prevents fruit flies being a constraint to sustainable production or a barrier to trade and market access. The Council includes representatives from government, research, and industry across Australia with an independent Chair. It is supported by a National Manager and an independent secretariat from PHA.

The Council's main focus areas are:

- **Fruit fly management systems** for the prevention, detection, eradication, and management of fruit flies.
- **Market access discussions**, including activities that assist in securing entry conditions for horticultural produce into markets.
- **Legislation and regulation discussions** to ensure that regulation and legislative controls for managing fruit flies are harmonised across Australia and in line with international standards.
- **Research and development opportunities** to ensure that Australian R&D provides technically justifiable approaches and innovative solutions to meet the requirements of the three areas above.

PEST MANAGEMENT

The agricultural plant production industries of Australia manage pests through multiple methods that are tailored to crop types, target pests and geographical conditions. Most growers regularly employ a mixture of methods as part of their integrated pest management (IPM) program.

IPM combines chemical, cultural, mechanical and biological control methods with the needs of a particular crop to develop a multi-faceted approach to controlling the most economically threatening pests. IPM is an approach, not a defined method, and is usually unique to each grower. The strength of employing an IPM approach to managing pests is that it targets individual pests specifically and is highly adaptable to change when new and improved methods of pest management are created.

Chemical control

For many pests, chemical control is considered the fastest and easiest option available, though it is strictly regulated and can be costly. Chemicals are often necessary for pest incursion management and they underpin on-farm biosecurity with most growers using at least some type to maintain productive agriculture.

A recent report estimated that up to 68 per cent ($17.6 billion) of Australia's total value of crop production is attributable to the use of crop protection products[4]. Table 45 illustrates the amount and type of agricultural chemicals used for controlling plant pests in Australia. This total expenditure on pesticides for plants represents over six per cent of the gross value of production for all crops in Australia[5].

All agricultural chemicals sold or used in Australia must be registered with the Australian Pesticides and Veterinary Medicines Authority (APVMA). A national registration system ensures that all agricultural chemical products, when used as directed on the product label, will be effective and have no harmful or unintended effects on people, animals, crops, the environment or international trade. The use of chemicals is regulated by state and territory governments.

Although many pesticide products are formulated and packaged in Australia, almost all the active constituent chemicals are manufactured overseas, with many chemicals not registered in Australia. This means that Australian growers and other land managers often do not have access to chemicals needed to manage exotic pests.

Minor use permits and emergency permits can be issued by the APVMA. Approximately 83 per cent of minor use permit applications are submitted to the APVMA because no other options are currently available in Australia to manage a particular pest. Contingency plans on how to deal with an exotic pest, and response plans setting out how an incursion is dealt with, usually depend on the timely availability of appropriate chemicals, and permits often need to be obtained quickly by quarantine authorities when emergency plant pest incursions occur.

4 CropLife Australia, 2015. Economic activity attributable to crop protection products. Deloitte Access Economics Pty Ltd

5 ABARES, 2013. Agricultural commodity statistics 2013. Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra

Cultural and mechanical control

Cultural and mechanical control refers to the practice of modifying the growing environment of production crops to reduce the prevalence of unwanted pests. Examples include changing soil pH levels, irrigation practices, tillage methods, temperatures and fallow periods in order to make the environment less favourable for the survival, growth and reproduction of pest species. These practices can provide significant relief from pests when used effectively.

Biological control

Biological control is a method of controlling pests through the use of natural enemies, biologically-based products such as pheromones, resistant plant varieties and techniques such as insect sterilisation. Natural enemies of pests are known as biological control agents and include predators, herbivores, parasitoids and pathogens.

Biological control has been highly successful in many instances, with a number of pest problems permanently resolved by importation and successful establishment of biological control agents. These successes have been limited largely to certain types of ecosystems or pest situations, such as introduced pests in perennial ecosystems. However, biological control can provide long-term and even permanent results and poses no risk to human health.

Table 45. Sales of plant chemicals in Australia, 2014–15

Product type	Number of products	Value of product sales ($ million)
Herbicide	3,119	1,545.49
Insecticide	1,514	332.45
Fungicide	959	206.61
Mixed function pesticide	219	71.74
Miticide	128	20.86
Molluscicide	53	15.57
Nematicide	18	3.90
Total	6,010	2,196.62

Source: APVMA Gazette No.6, 22 March 2016.

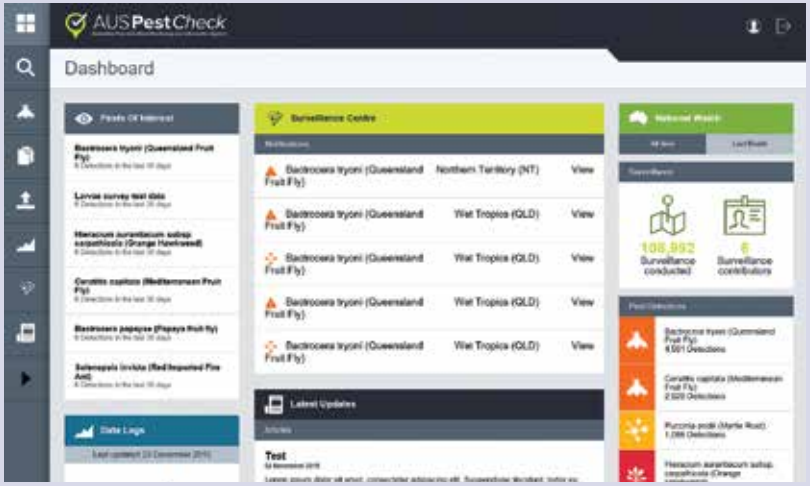
Collecting surveillance data

Many organisations including industry bodies, arrange systematic testing of crops for exotic pests to make sure they have not made it into Australia. This 'evidence of absence' is highly valuable because it supports market access negotiations, allowing Australia's producers to sell to additional markets. However, to make effective use of checks for pests not present, the data must be collated into summaries that demonstrate the extent of surveillance.

Up until now, Australia has relied on the online National Plant Surveillance Reporting Tool (NPSRT) to capture the data. In 2015, PHA developed a state of the art surveillance database system, AUSPestCheck, which gathers data from a broad range of industry and government stakeholders including the checks for absent exotic pests.

The innovative system is being rolled out across multiple pest surveillance programs in Australia and will be launched in 2016. The project, made possible from funding by an Australian Government National Landcare Program Innovation Grants initiative, will bring widespread benefits.

AUSPestCheck will support the early detection of new pests, report evidence of area freedom from pests, expedite pest incursion responses and support the effective management of established pests.



AUSPestCheck will revolutionise the way that surveillance data is captured and accessed by players in the plant biosecurity system.

Setting a light trap. Image courtesy of DPIPWE.

PRE-EMPTIVE BREEDING OF CROP SPECIES TO IMPROVE PEST RESISTANCE

Many Australian industries prepare for a potential exotic pest incursion through pre-emptive breeding of crops to incorporate or improve pest tolerance or resistance characteristics that can reduce the impacts of target pest species. In the absence of a pest, pre-emptive breeding programs rely on offshore testing of new Australian varieties or use resistance gene markers or other traits that allow for the selection of resistance.

In the event of an incursion, pre-emptive breeding allows the development of crop varieties that are more resistant to pest damage, reducing negative impacts on production. Programs in Australia include the Australian Cereal Rust Control Program and the identification of new wine grape cultivars for resistance to fungal pathogens.

SURVEILLANCE FOR EXOTIC SPECIES

Onshore surveillance activities for exotic plant pests are carried out by governments, industries and the wider community to provide information for:

- **Early detection:** surveillance designed to detect new pest incursions before they become widely established, increasing the chance of successful eradication or containment responses.
- **Market access:** surveillance to demonstrate the absence (i.e. 'evidence of absence') of a pest from the country, state or region, to support access to international and domestic markets.
- **Delimiting surveys:** following a pest incursion, delimiting surveys provide information on the distribution and spread of pests for use in response management activities or to confirm the successful eradication of the pest.
- **Improved pest management:** management of established pests requires regular inspections to determine population levels to improve management decisions.
- **Identifying high risk pathways and high risk areas:** in order to focus future surveillance efforts.

Australia uses a mix of targeted and general surveillance programs. General surveillance programs work through raising awareness about specific pests with growers and the wider community, and rely on these stakeholders to look for and report these pests during their day-to-day activities. To ensure that all detections of new pests through general surveillance are reported, all states and territories run the Exotic Plant Pest Hotline (1800 084 881). Calls to the hotline are directed to the relevant state or territory agriculture department.

The majority of onshore targeted surveillance is undertaken by state and territory governments. Several national programs are also supported by the Australian Government, and some industries undertake targeted surveillance for their pests of concern.

Subcommittee on National Plant Health Surveillance

The Plant Health Committee (PHC) established the Subcommittee on National Plant Health Surveillance (SNPHS) to provide expert policy and technical advice on national plant health surveillance issues and ensure the continued effective operation of the surveillance system. SNPHS has responsibility for supervising the implementation of the National Plant Biosecurity Surveillance Strategy and facilitates the development and implementation of national plant biosecurity surveillance strategies that promote both domestic and international market access.

SNPHS comprises representatives from the Australian Government, state and territory governments, PHA, the Plant Biosecurity Cooperative Research Centre and CSIRO. Observers to the group include representatives from SPHD and forestry experts. SNPHS and SPHD also collaborate through joint Working Groups on common topics, as required.

Producers and agronomists are encouraged to ring a national hotline to report anything unusual.

Targeted surveillance programs in 2015

During 2015, Australian governments carried out 139 surveillance programs, detailed in Table 46. The figures below show surveillance by target lost and target pest type.

Figure 76. Surveillance programs by target host

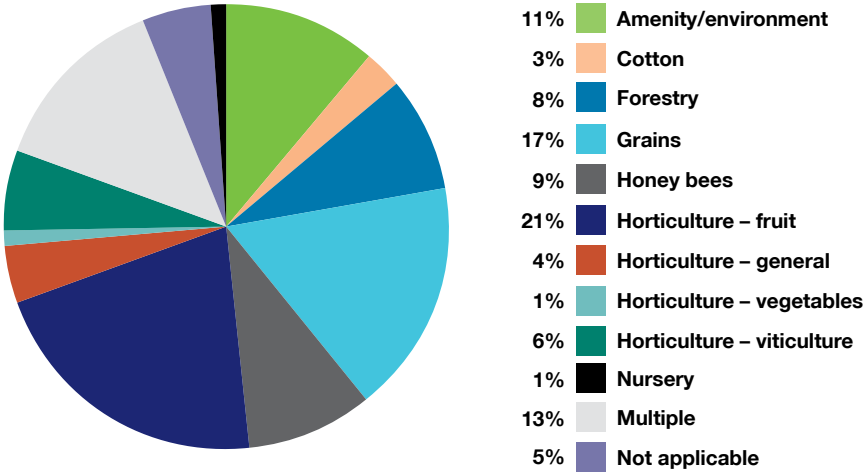
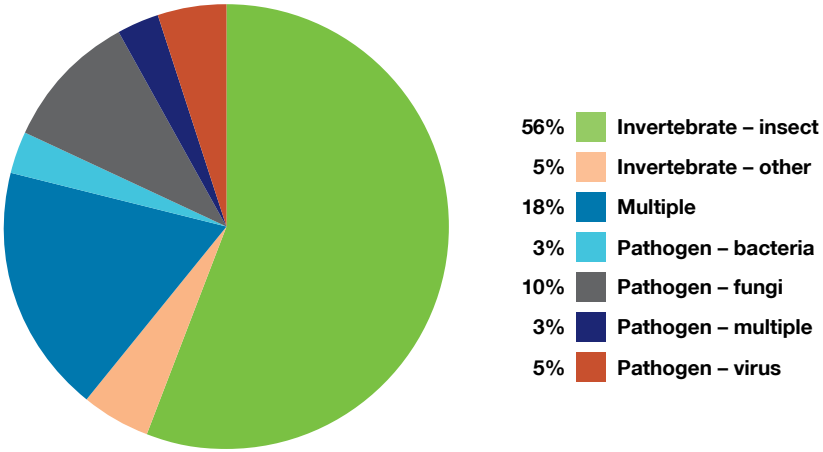


Figure 77. Surveillance programs by target pest type



Collaborating with New Zealand to exclude exotic stink bug

Brown marmorated stink bug (BMSB) is an exotic pest that feeds on more than 300 hosts, primarily fruit trees and woody ornamentals but also field crops. Originally found in Asia, it has aggressively invaded the US and could successfully establish in New Zealand and Australia if it found its way here.

In late 2015 New Zealand held an exercise in Wellington to boost that country's biosecurity preparedness with a test of procedures under the new Government Industry Agreement for Biosecurity Readiness and Response (GIA).

Exercise RAWAHO (invader in Maori) involved a simulated incursion of BMSB in Auckland. Three representatives from Australia attended the exercise and had a series of meetings with their New Zealand counterparts.

In addition to being a pest of crops, the BMSB could pose a significant public nuisance if it established in either country since it tends to make its way into houses. When disturbed or crushed it lives up to its name, emitting an unpleasant and long-lasting odour.

Collaborating with New Zealand on common biosecurity issues like the exotic stink bug makes sense, given the large amount of trade and travel between the two countries.

Representatives from Australia took part in a simulated incursion of the Brown marmorated stink bug in New Zealand. Images courtesy of bugwood.org.

Table 46. Australia's plant biosecurity surveillance programs

Name	Target hosts	Target pests
Australian Government		
National Bee Pest Surveillance Program	European honey bees	Asian honey bee (*Apis mellifera*), giant honey bee (*Apis dorsata*), red dwarf honey bee (*Apis florea*), tracheal mite (*Acarapis woodi*), *Tropilaelaps* mites (*Tropilaelaps mercedesae, T. clareae*), *Varroa* mites (*Varroa destructor, V. jacobsoni*)
Northern Australia Quarantine Strategy pest and disease surveys	Multiple surveillance programs of tropical horticultural and agricultural species	157 high priority exotic pests
Northern Australia Quarantine Strategy exotic fruit fly trapping	Horticulture	Exotic fruit flies (*Bactrocera* spp.)
Asian honey bee		Asian honey bee (*Apis cerana*)
New South Wales		
Aphids	Field crops, horticulture	Multiple species
Asian gypsy moth	Various tree hosts around ports	Asian gypsy moth, *Lymantria* spp.
Asian citrus psyllid trapping	Citrus	Asian citrus psyllid, *Diaphorina citri*
Banana freckle	Banana	Banana freckle, *Phyllosticta cavendishii*
Diseases of cotton	Cotton	Exotic strains of bacterial blight (*Xanthomonas campestris*), cotton blue disease (*Luteovirus*), cotton leaf curl virus (*Begomovirus*), Texas root rot (*Phymatotrichum omnivorum*, exotic strains of *Verticillium* wilt (*Verticillium dahliae*), exotic strains of *Fusarium* wilt (*Fusarium oxysporum* f. sp. *vasinfectum*)
Exotic fruit flies – Ports	Various production and ornamental	Multiple – *Bactrocera cucurbitae*, *B. tau, B. carambolae, B. dorsalis, B. albistrigata, B. umbrosa, B. trivialis, B. facialis, B. kirki, B. melanotus, B. passiflorae, B. xanthodes, B. psidii, B. zonata, Ceratitis capitata*
Exotic fruit flies – Riverina	Various horticultural (citrus, stone fruit)	Mediterranean fruit fly (*Ceratitis capitata*), papaya fruit fly (*Bactrocera papayae**), various cuelure attracted exotic fruit flies
Exotic Longhorn Beetle Trapping	Various hosts around ports	Asian longhorn beetle (*Anoplophora glabripennis*), Japanese pine sawyer beetle (*Monochamus alternatus*), Brown mulberry longhorn beetle (*Apriona germari*)
Forestry Corporation of NSW Forest Health Surveillance	General forest health	Various exotic and endemic high priority pests
Forestry High Risk Surveillance Program	Pine forest	Various exotic and endemic high priority pests of *Pinus* spp.
Giant pine scale	Multiple pine species	Giant pine scale, *Marchalina hellenica*
Grains Farm Biosecurity Surveillance Program	Wheat, Barley, Canola, Lupin	Russian wheat aphid (*Diuraphis noxia*), barley stripe rust (*Puccinia striiformis* f. sp. *hordei*), Karnal bunt (*Tilletia indica*), khapra beetle (*Trogoderma granarium*), cabbage seedpod weevil (*Ceutorhynchus obstrictus*), Hessian fly (*Mayetiola destructor*), lupin anthracnose (*Colletotrichum gloeosporioides*)
Little cherry disease	Cherries	Little cherry virus 1 & 2
Longhorn beetle	Urban tree hosts	Asian longhorn beetle (*Anoplophora glabripennis*), brown mulberry longhorn beetle (*Apriona germari*), Japanese sawyer beetle (*Monochamus alternatus*)
Panama disease TR4	Banana – Cavendish variety	Panama disease TR4, *Fusarium oxysporum* f. sp. *cubense*
Phylloxera surveillance	Grapevines	Grapevine phylloxera, *Daktulosphaira vitifoliae*
Tramp ants	Urban, horticulture	Tramp ants, *Solenopsis* spp.

* This species has been synonymised with *Bactrocera dorsalis*

Table 46. Australia's plant biosecurity surveillance programs

Name	Target hosts	Target pests
Urban hazard site surveillance	Multiple	Numerous targets including spiralling whitefly (*Aleurodicus dispersus*), exotic whiteflies, *Solenopsis* mealybug (*Phenacoccus solenopsis*), exotic aphids, glassy winged sharpshooter/Pierce's disease (*Homalodisca vitripennis/Xylella fastidiosa*), Asian citrus psyllid/Huanglongbing (*Diaphorina citri/Candidatus* Liberibacter asiaticus), fireblight (*Erwinia amylovora*), tomato potato psyllid (*Bactricera cockerilli*), exotic mites (incl. *Brevipalpus* spp., *Aceria granati*), spotted winged drosophila (*Drosophila suzukii*), exotic leaf miners (*Liriomyza* spp.), brown marmorated stink bug (*Halyomorpha halys*)
Northern Territory		
Banana freckle	Bananas	Banana freckle (*Guignardia musae*)
Citrus gall wasp	Citrus	Citrus gall wasp (*Bruchophagus fellis*)
Citrus canker	Citrus	Citrus canker (*Xanthomonas axonopodis* pv. *Citri*)
Cucumber green mottle mosaic virus	Cucurbit hosts	Cucumber green mottle mosaic virus (*Tobamovirus*)
Exotic bee mites	Exotic bee swarms	*Varroa* mite (*Varroa destructor*), *Tropilaelaps* mite (*Tropilaelaps clareae*), tracheal mite (*Acarapis woodi*)
Exotic bee surveillance	Exotic bee swarms	Asian honey bee (*Apis cerana* (exotic species))
Forest pest surveillance	*Pinus* spp.	Needle blight (*Dothistroma pini*)
Fruit fly monitoring and surveillance	Horticulture	Queensland fruit fly (*Bactrocera tryoni*), melon fruit fly (*Bactrocera cucurbitae*), Mediterranean fruit fly (*Ceratitis capitata*), Papaya fruit fly (*Bactrocera papayae**), Philippine fruit fly (*Bactrocera philippinensis**)
Giant African snail	Soil, imported cargo	Giant African snail (*Achatina fulica*)
Grapevine leaf rust	Grapevines	Grapevine leaf rust (*Phakopsora euvitis*)
Mango malformation disease	Mangoes	Mango malformation (*Fusarium mangiferae*)
Mango pulp weevil	Mangoes	Mango pulp weevil (*Sternochetus frigidus*)
Myrtle rust	*Myrtaceae* spp., *Callistemon* spp., *Melaleuca* spp., *Eucalyptus* spp.	*Eucalyptus* rust (*Puccinia psidii* sensu lato (exotic variants))
Red banded caterpillar	Mangoes	Red-banded mango caterpillar (*Deanolis sublimbalis*)
Red imported fire ant	All nursery stock ex Queensland, unclean machinery	Red imported fire ant (*Solenopsis invicta*)
Queensland		
Banana pest surveillance	Bananas	Banana bract mosaic disease (*Banana bract mosaic virus* (*Potyvirus*)), Banana bunchy top virus (*Babuvirus*), banana skipper butterfly (*Erionota thrax*), banana stem weevil (*Odoiporus longicollis*), black sigatoka (*Mycosphaerella fijiensis*), eumusae leaf spot (*Mycosphaerella eumusae*), leaf speckle (*Mycosphaerella musae*), leaf spot (*Mycosphaerella musicola*), moko (*Ralstonia solanacearum*), Panama disease (*Fusarium oxysporum* f. sp. *cubense*), *Periconiella musae*, *Veronaea musae*
Cape York Peninsula surveys	Various	A range of pests
Exotic fruit fly trapping	Fruits and vegetables	Exotic fruit flies (*Bactrocera* spp., *Zeugodacus* spp, *Ceratitis* spp.)
Grow Help Australia diagnostic service project	Fruit, vegetable and ornamental	All pests and pathogens that can affect horticultural crops, national parks, gardens, hobby growers and home gardeners. Commonly encountered pathogens include *Phytophthora* spp., *Fusarium* spp., *Colletotrichum* spp., *Alternaria* spp., *Rhizoctonia* spp., *Pythium* spp., *Ralstonia* spp., *Erwinia* spp. and viruses
Gypsy moth surveillance	Multiple	Gypsy moths (*Lymantria* spp.)

* This species has been synonymised with *Bactrocera dorsalis*

Table 46. Australia's plant biosecurity surveillance programs

Name	Target hosts	Target pests
		Queensland *continued*
Incident response surveys	Multiple	Including cucumber green mottle mosaic virus, various mealybug species, vegetable leaf miner, spider mites
Multiple pest surveillance	Plantation and native forest species, sugarcane, citrus, lychee, guava and tropical and subtropical fruit	A range of species, including sugarcane longhorn beetle (*Dorysthenes buqueti*), Asian and citrus longhorn beetle (*Anoplophora* spp.), lychee longicorn beetle (*Aristobia testudo*), lateral-banded mango longhorn beetle (*Bactocera rubus*), sawyer beetles (*Monochamus* spp.), drywood longicorn beetle (*Stromatium barbatum*), ambrosia beetles bark beetles (*Ips* spp.), pine bark beetles (*Dendroctonus* spp.), wood wasps (Siricid wasps e.g. *Uroceris gigas*)
National Electric Ant Eradication Program	Amenity and environment	Electric ant (*Wasmannia auropunctata*)
National Red Imported Fire Ant Eradication Program	Amenity and environment	Red imported fire ant (*Solenopsis invicta*)
Sugar industry surveys, seed cane inspections, variety trials and general pest surveys	Sugarcane	Ratoon stunting disease (*Leifsonia xyli* subsp. *xyli*), leaf scald (*Xanthomonas albilineans*), sugarcane mosaic virus (*Potyvirus*), Fiji leaf gall (Fiji disease virus (*Fijivirus*)), sugarcane smut (*Sporisorium scitamineum*), sugarcane rust (*Puccinia melanocephala, P. kuehnii*), yellow spot (*Mycovellosiella koepkei*), exotic pests and diseases
West Indian drywood termite surveys	Timber structures	West Indian drywood termite (*Cryptotermes brevis*)
Bulk handlers	Stored grains	Khapra beetle (*Trogoderma granarium*), Karnal bunt (*Tilletia indica*)
On-Farm storage monitoring project	Stored grains	Khapra Beetle (*Trogoderma granarium*), Karnal bunt (*Tilletia indica*)
Grains Farm Biosecurity Program	Summer grain crops	*Striga* spp. (esp asiatica – red witchweed), sorghum downy mildew (*Peronosclerospora sorghi*), downy mildew of millet (*Sclerospora graminicola*), sorghum mosaic virus, *Orobanche* spp., phoma blight (*Phoma* spp.), stem nematode (*Ditylenchus dipsaci*), sunflower downy mildew (*Plasmopara halstedii*)
Grains Farm Biosecurity Program	Winter grain crops	Russian wheat aphid (*Diuraphis noxia*), barley stripe rust (*Puccinia striiformis* f. sp. *hordei*), khapra beetle (*Trogoderma granarium*), Karnal bunt (*Tilletia indica*)
Endemic and exotic diseases of cotton	Cotton	Exotic strains of bacterial blight (*Xanthomonas campestris*), blue disease (*Luteovirus* [suspected]), *cotton leaf curl virus* (*Begomovirus*), Texas root rot (*Phymatotrichum omnivorum*), exotic strains *Verticillium* wilt (*Verticillium dahliae)*, exotic strains *Fusarium* wilt (*Fusarium oxysporum* f. sp. *vasinfectum*), endemic cotton diseases, including *Fusarium* spp. and *Verticillium* spp.
Endemic and exotic grains virus surveys	Grains	Various viruses, especially aphid transmitted *Polerovirus complex*
Endemic and exotic cotton virus surveys	Cotton	Cotton bunchy top virus, cotton leafroll dwarf virus (*Polerovirus*), cotton leaf curl virus (*Begomovirus*) and all other exotic viruses
National Phosphine Resistance Monitoring program	Grains	Lesser grain borer (*Rhyzopertha dominica*), rice weevil (*Sitophilus oryzae*), rust-red flour beetle (*Tribolium castaneum*), rusty grain beetle (*Cryptolestes ferrugineus*), sawtoothed grain beetle (*Oryzaephilus surinamensis*)
Plant Pest Diagnostic Service (broadacre cropping)	Broadacre field crops	All pathogens that can affect broadacre crops (cotton, grains, pastures)
Silverleaf whitefly resistance monitoring	Cotton	Silverleaf whitefly (Bemisia tabaci B-type)
Sucking pest management in cotton	Various	Solenopsis mealybug (*Phenacoccus solenopsis*)
Monochamus Surveillance Program	*Pinus* spp.	Japanese pine sawyer beetle (*Monochamus alternatus*)
Hazard site surveys	Multiple	Various pests

Table 46. Australia's plant biosecurity surveillance programs

Name	Target hosts	Target pests
	South Australia	
National Plant Health Surveillance Program	Rutaceae	Hualongbing (*Candidatus* Liberibacter asiaticus)
National Plant Health Surveillance Program	Rutaceae	Citrus canker (*Xanthomonas axonopodis* pv. *Citri*)
National Plant Health Surveillance Program	Rutaceae	Citrus variegated chlorosis (*Xylella fastidiosa*)
National Plant Health Surveillance Program	Rutaceae/trapping	Glassy winged sharpshooter (*Homalodisca vitripennis*)
National Plant Health Surveillance Program	Rutaceae/trapping	Asian citrus psyllid (*Diaphorina citri*)
National Plant Health Surveillance Program	*Vitus vinifera*	Pierce's disease (*Xylella fastidiosa*)
National Plant Health Surveillance Program	*Vitus vinifera*	Glassy-winged sharpshooter (*Homalodisca vitripennis*)
National Plant Health Surveillance Program	Sampling	Red imported fire ant (*Solenopsis invicta*)
National Plant Health Surveillance Program	Sampling	Tropical fire ant (*Solenopsis geminata*)
National Plant Health Surveillance Program	Sampling	Electric ant (*Wasmannia auropunctata*)
National Plant Health Surveillance Program	Sampling	African big-headed ant (*Pheidole megacephala*)
National Plant Health Surveillance Program	Sampling	Yellow crazy ant (*Anoplolepis gracilipes*)
National Plant Health Surveillance Program	Sampling	Argentine ant (*Linepithema humile*)
National Plant Health Surveillance Program	Sampling	Browsing ant (*Lepisiota frauenfeldi*)
Ports of Entry Trapping Program	*Eucalyptus* spp./ornamental trees/ trapping	Exotic gypsy moths (*Lymantria* spp.)
Ports of Entry Trapping Program	Fruit Fly host/trapping	Fruit flies (*Bactrocera* and *Ceratitis* spp.)
Myrtle rust	Myrtaceae	Myrtle rust (*Puccinia psidii*)
European house borer	Pinus	European house borer (*Hylotrupes bajulus Linnaeus*)
Onion smut	Allium	Onion smut (*Urocystis cepulae*)
Tomato yellow curl leaf virus	Solanaceae	Tomato yellow curl leaf virus (TYLCV)
Potato spindle tuber viroid	Solanaceae	Potato spindle tuber viroid (PSTVd)
Giant pine scale	Pinaceae	Giant pine scale (*Marchalina hellenica*)
Mediterranean fruit fly	Sampling	Mediterranean fruit fly (*Ceratitus capitata*)
Queensland fruit fly	Sampling	Queensland fruit fly (*Bactrocera tryoni*)
National Bee Pest Surveillance Program	Sampling	Bumblebees (*Bombus* spp.)
National Bee Pest Surveillance Program	Sampling	Varroa mites (*Varroa destructor* and *V. jacobsoni*), Tropilaelaps mites (*Tropilaelaps clareae* and *T. mercedesae*), Tracheal mite (*Acarapis woodi*) and Small hive beetle (*Aethina tumida*)

Table 46. Australia's plant biosecurity surveillance programs

Name	Target hosts	Target pests
Tasmania		
Multiple Pest Surveillance Program – Gypsy moth	Multiple including forest and amenity trees	Gypsy moth (including *Lymantria dispar asiatica, L. dispar dispar* and *L. dispar japonica*), moths including (*L. umbrosa, L. albescens, L. postalba, L. xylina, L. monacha, L. pulverea, L. minomonis, L. concolor, L. dissoluta, L. sinica, L. marginata, L. atameles* and *L. fumida*)
Fruit Fly Trapping Program	Fruit trees, fruit and vegetables	*Bactrocera tryoni, Ceratitis capitata, Bactrocera dorsalis* and other exotic fruit flies*
Multiple Pest Surveillance Program – Black rot	Grapevines	Black rot (*Guignardia bidwellii*)
Multiple Pest Surveillance Program – Pierce's disease	Grapevines	Pierce's disease (*Xylella fastidiosa*)
Multiple Pest Surveillance Program – Pacific spider mite	Grapevines	Pacific spider mite (*Tetranychus pacificus*)
Multiple Pest Surveillance Program – Yellow vine mite/Hornbeam mite	Grapevines	Yellow vine mite/hornbeam mite (*Eotetranychus carpini*)
Multiple Pest Surveillance Program – Grape mealybug	Grapevines	Grape mealybug (*Pseudococcus maritimus*)
Codling moth trapping survey	Apples, cherries	Codling moth (*Cydia pomonella*)
Bees – American foulbrood	European honey bees	American foulbrood
Silverleaf White Fly Sticky Trap Survey	Nursery stock	Silverleaf whitefly (*Bemisia tabaci*)
Myrtle Rust Survey	*Myrtaceae* spp. Forest, private land, public land, nurseries and commercial growers	Myrtle rust, *Eucalyptus* rust (*Puccinia psidii* sensu lato (exotic variants))
Blueberry Rust Survey	Commercial blueberries	Blueberry rust (*Thekopsora minima*)
Warehouse Beetle Survey	Stored grains	Warehouse beetle (*Trogoderma variable*)
Victoria		
Nationally cost shared eradication program	*Pinus* species	Giant pine scale (*Marchelina hellenica*)
Nationally cost shared eradication program	Chestnut and oak trees	Chestnut blight (*Cryphonectria parasitica*)
National Plant Health Surveillance Program	Fruit and vegetable crops	Fruit flies (*Bactrocera* spp.)
Victorian funded eradication program	Blueberry	Blueberry rust (*Thekopsora minima*)
National Plant Health Surveillance Program	Melon and pumpkin crops	Cucumber green mottle mosaic virus
National Plant Health Surveillance Program	Citrus	Asian citrus psyllid (*Diaphorina citri*)
National Plant Health Surveillance Program	Citrus	Huanglongbing (*Liberibacter asiaticus*)
National Plant Health Surveillance Program	Melbourne ports	Japanese sawyer beetle (*Monocamus alternatus*)
National Plant Health Surveillance Program	Melbourne ports	Wood wasp (*Urocerus fantoma*)
National Plant Health Surveillance Program	Melbourne ports	Black spruce longhorn beetle (*Tetropium castaneum*)
National Plant Health Surveillance Program	Melbourne ports	Brown spruce longhorn beetle (*Tetropium fuscum*)

* This species has been synonymised with *Bactrocera dorsalis*

Table 46. Australia's plant biosecurity surveillance programs

Name	Target hosts	Target pests
National Plant Health Surveillance Program	Melbourne ports	Asian gypsy moth (*Lymantria dispar*)
National Plant Health Surveillance Program	Melbourne ports	Pine wilt nematode (*Bursaphelenchus* spp.)
Victorian funded containment program	Pasture and fruit trees	Giant green snail (*Cantareus apertus*)
Western Australia		
Qfly Trapping	Pheromone trap	Queensland fruit fly (*Bactrocera tryoni*)
Medfly Area Freedom	Pheromone trap	Mediterranean fruit fly (*Ceratitis capitata*)
Port of Entry Fruit Fly Trapping	Pheromone trap	Various *Bactrocera* and *Ceratitis* species
Port of Entry Asian Gypsy Moth Trapping	Pheromone trap	Asian gypsy moth (*Lymantria dispar*)
Multiple Pest Surveillance	Pome, citrus	Fire blight (*Erwinia amylovora*), huanglongbing (*Liberibacter asiaticus*), citrus canker (*Xanthomonas axonopodis* pv. *Citri*), citrus longicorn beetle (*Anoplophora chinensis*), red imported fire ants (*Solenopsis invicta*)
Codling moth Trapping	Pheromone trap	Codling moth (*Cydia pomonella*)
Cucumber green mottle mosaic virus	Cucurbits and host weeds	Cucumber green mottle mosaic virus
Browsing ant surveillance	Various	Browsing ant (*Lepisiota frauenfeldi*)
European wasp surveillance	Various	European wasp (*Vespula germanica*)
Grain insect ecology studies	Grains	Multiple
Grain insect diagnostics	Grains	Multiple
Khapra beetle surveillance	Stored Grains	Khapra beetle (*Trogoderma granarium*)
MyPestGuide e-surveillance	Various	Multiple
PestFax e-surveillance	Various	Multiple
MyCrop e-surveillance	Various	Multiple
AgWest grain testing laboratory	Grains	Multiple
National grain insect resistance monitoring	Grains	Multiple
Grains agronomy	Grains	Multiple
Grains crop protection – PestFax	Grains	Multiple
Grains soils management	Grains	Multiple
National Variety Trials (NVT)	Grains	Multiple
Crop Variety Trials	Grains	Multiple
Grains cereal physiology	Grains	Multiple
Grains legume genetic	Grains	Multiple
Kalyx agriculture NVT	Grains	Multiple
Agrisearch NVT	Grains	Multiple

National Bee Pest Surveillance PROGRAM

National Bee Pest Surveillance Program

Sentinel hives are beehives that are set up near entry points into Australia that are checked regularly for any signs of exotic pests of bees, or exotic bee species. The National Bee Pest Surveillance Program (NBPSP) coordinates this and other aspects of exotic bee surveillance as an early warning system to detect new incursions of pest bees and exotic bee pests. Key targets of the program are *Varroa* mites, *Tropilaelaps* mites and tracheal mite, each of which causes serious damage to hives of honey bees overseas.

Effort is put into the early detection of exotic pests of honey bees because early detection is essential if an incursion of a new pest is to be eradicated. PHA has managed the program since 2012 because of the huge benefits that honey bees bring to crop production through pollination.

In July 2013, the NBPSP became a cost-shared initiative between the honey bee industry, industries that rely on pollination (represented by Hort Innovation) and the Australian Government Department of Agriculture and Water Resources, for two years. PHA, the honey bee industry, pollination-reliant plant industries, research and development agencies, and governments are currently working towards implementing a long-term funding agreement for an expanded NBPSP from July 2015.

Checking sentinel hives at Port Kurnell. Image courtesy of Jenny Shanks.

Table 47. Number of samples examined for pests of bees, by state and territory, 2015

State or territory	Samples examined
New South Wales	156
Northern Territory	98
Queensland	186
South Australia	100
Tasmania	113
Victoria	162
Western Australia	124
TOTAL	**939**

Table 48. Number of samples tested under the National Bee Pest Surveillance Program, by pest, 2015

Pest	Samples examined
Pest bees (*A. cerana, A. florea, A. dorsata*)[1]	61[2]
Tracheal mite	160[3]
Small hive beetle	138[4]
Varroa and *Tropilaelaps* mites[5]	580[6]
TOTAL	**939**

1 A total of 23 swarms of Asian honey bee (*Apis cerana* Java genotype) were collected in the Cairns port area in 2015 by Operational Science Services. No exotic mites were found.

2 The development of floral maps and coordinated floral sweep netting commenced in late 2014 around Australia for the detection of pest bees. This figure is the number of floral sweep netting runs conducted in 2015.

3 Between 30 and 60 randomly selected bees from sentinel hives were dissected to check for tracheal mite.

4 Small hive beetle samples included Apithor traps, oil traps and hive inspection of sentinel hives in WA, NT and Tasmania. All samples were negative for small hive beetle.

5 In addition, 814 samples were collected from hives across Australia for sugar shaking, alcohol washing and drone uncapping, including 669 in Victoria as part of their routine sugar shaking program.

6 The number of sentinel hives tested with an acaricide and a sticky mat.

The Australian Honeybee Industry Biosecurity Code of Practice

The honey bee industry, represented by the Australian Honey Bee Industry Council (AHBIC) and PHA have been working towards developing a nationally agreed Honey Bee Industry Biosecurity Code of Practice to protect Australia's honey bees.

The aim of the Code of Practice is to improve the management of established pests and diseases, as well as increase the preparedness and surveillance of exotic pest threats in the honey bee industry. The Code will underpin the National Bee Biosecurity Program, which will see the employment of Bee Biosecurity Officers in each state beginning in 2016. It is expected that the Code will be endorsed in July 2016.

Improvements to the National Bee Pest Surveillance Program in 2015

- The number of sentinel hives posted around Australia's coastline increased from 146 sentinel hives in 2014 to 160. Each hive is monitored every eight weeks.
- More than 50 catch boxes were deployed at many southern ports as an additional surveillance measure. These empty hives provide an attractive home for any new bee swarms in the port area, allowing for testing for exotic pests.
- Twenty remote surveillance hives are currently being trialled around Australia. These hives use mobile phone technology to report the presence of bee swarms so that the bees can be checked for exotic pests. It is hoped that when the trial finishes in early 2016 all catch boxes will gradually be replaced with remote surveillance hives.
- More hobby beekeepers involved in coordinated surveillance of hives for exotic pests in areas surrounding high-risk ports. Beekeepers conduct simple detection tests on bees such as sugar shaking and alcohol washing.
- APVMA issued a new permit for the use of two new chemical products (Bayvarol (flumethrin) and Apistan (tau-fluvalinate)) in sentinel hives boosting the ability to detect exotic mites.
- A statistical redesign of the surveillance carried out under the program is underway to further improve its sensitivity and cost-effectiveness. This project will act as the catalyst for PHA, the honey bee industry, pollination-reliant plant industries, research and development agencies, and governments to implement a long-term funding agreement for the NBPSP from 2016–17.

Sentinel hives are posted at ports arround Australia.

DIAGNOSTICS – ACCURATE IDENTIFICATION OF PLANT PESTS

The accurate diagnosis of plant pests fundamentally underpins all aspects of the plant biosecurity system. It is essential that diagnostic services are able to quickly and accurately identify both endemic and exotic plant pests.

Australia relies on its diagnostic experts to detect and respond to new pests in an appropriate and timely manner. In the event of an incursion, diagnostic expertise is required to identify an initial detection, assess the magnitude of the incursion (which is a critical factor in determining whether a pest is eradicable), and to allow subsequent surveillance programs. Diagnostics also provides the evidence necessary to claim that the pest has been eradicated.

Diagnostic capacity also supports much of the everyday management practices involved in the production and trade of plant products. Pest management programs, including the selection and application of farm chemicals, rely on the accurate identification of pests. Rapid identification also supports quarantine processes, such as maintaining pest free areas, allowing access to markets both domestically and internationally.

These critical diagnostic services are distributed across every state and territory in Australia and are available throughout most major agricultural and horticultural production areas. Services are delivered by a range of agencies, including state and territory governments, the Australian Government, commercial and private diagnostic laboratories, museums, the CSIRO and universities (Table 49).

Services are provided on an ad hoc, commercial or nationally coordinated basis, as required. Diagnostic operations are often performed as part of collaborative research activities that focus on specific pests of concern.

Australia's diagnosticians meet regularly for professional development. Image courtesy of PHA.

Subcommittee on Plant Health Diagnostics

The Subcommittee on Plant Health Diagnostics (SPHD) was established in December 2004 by Plant Health Committee to sustain and improve the quality and reliability of plant diagnostics in Australia. Key roles and responsibilities of SPHD include:

- Reviewing and developing diagnostic policies, protocols and standards.
- Reviewing and developing strategies to address national capability and capacity issues.
- Endorsing National Diagnostic Protocols (NDPs) (see Figure 78 on p146).
- Coordinating and fostering the National Plant Biosecurity Diagnostic Network (NPBDN).
- Coordinating national capability building through a professional development framework.
- Driving development and uptake of accreditation and quality management systems for diagnostic laboratories.

National coordination of plant biosecurity diagnostics

In order to strengthen connections between stakeholders in plant pest diagnostics, a National Plant Biosecurity Diagnostic Strategy and a national network of diagnosticians were developed in 2011 and 2012.

The formation of the NPBDN was driven by SPHD to build diagnostic capacity for Australasia. Network members are from a range of organisations involved in the delivery of plant pest diagnostics, including state and territory governments, the Australian Government, CSIRO, PBCRC, PHA, universities and the New Zealand Ministry for Primary Industries.

Members include entomologists, general plant pathologists, virologists, phytoplasmologists, bacteriologists, molecular biologists, mycologists, nematologists, botanists and weed scientists.

The NPBDN improves capacity by facilitating communication between experts and sharing of diagnostic resources, as well as offering professional development activities. Each year the Diagnosticians' Workshop brings members of the network together to share ideas and knowledge, as well as identify future activities.

An integrated, national network has numerous benefits, including more efficient delivery of services, preventing any duplication of effort or identifying and addressing any gaps, and providing surge capacity during incursions.

More information on the NPBDN can be found at **www.plantbiosecuritydiagnostics.net.au.**

Table 49. Australia's diagnostic services, their capabilities and accreditations

Laboratory and location	Organisation	Diagnostic capability	Accreditation	Collections
Australian Capital Territory				
Black Mountain Laboratories, Canberra	CSIRO Biosecurity Flagship, CSIRO	Bee pathogens		
Black Mountain Laboratories, Canberra	CSIRO Biosecurity Flagship, CSIRO	Fungal identification		
Black Mountain Laboratories, Canberra	National Research Collections Australia, CSIRO (Australian National Herbarium)	Fungal identification		Herbarium and fungi collections
Black Mountain Laboratories, Canberra	National Research Collections Australia, CSIRO (Australian National Insect Collection)	Insect, nematode and mite identification		Herbarium and fungi collections
New South Wales				
Agricultural Scientific Collections Unit, Orange Agricultural Institute, Orange	NSW Department of Primary Industries (NSW DPI)	Invertebrates and pathogens, specialist insect and mite identification (mycology and entomology)	NATA accreditation (ISO/IEC 17025:2005)	Fungal, bacterial and arthropods
Australian Cotton Research Institute, Narrabri	NSW DPI/CSIRO	Cotton pathology (mycology, virology, bacteriology)	ISO9001	
Australian Museum, Sydney	Australian Museum	Collection		Entomology
CSIRO Cotton Research Unit, Narrabri	CSIRO	Entomology		
Elizabeth Macarthur Agricultural Institute, Menangle	NSW DPI	Invertebrates and pathogens (virology, bacteriology and mycology)	NATA accreditation (ISO/IEC 17025:2005)	
Forest Health Management Laboratory, West Pennant Hills	NSW DPI	Internal routine diagnostics		
Grafton Agricultural Research and Advisory Station, Grafton	NSW DPI	Insect pests		
Macleay Museum, Sydney	University of Sydney	Collection		Entomology
Operational Science, Department of Agriculture, Rosebery	Australian Government Department of Agriculture and Water Resources (DAWR)	Pest and disease identification, collection and rearing of immature stages of arthropods, pathology investigation to determine causal agent	Australian Government Department of Agriculture accredited quarantine containment 5.2/7.2	Entomology
Royal Botanic Garden, Sydney	NSW Office of Environment and Heritage	Plant pathogens using both classical and molecular methods		
Tamworth Agricultural Institute, Tamworth	NSW DPI	Invertebrates and pathogens (entomology, pathology of broadacre crops)		
The Cereal Rust Laboratory, Cobbitty	NSW DPI, University of Sydney,	Rust pathology		
Wagga Wagga Agricultural Institute, Wagga Wagga	Charles Sturt University, NSW DPI	Plant pathology, nematode identification, molecular biology		
Yanco Agricultural Institute, Yanco	NSW DPI	Invertebrates and pathogens (vegetable and rice pathology)		

Table 49. Australia's diagnostic services, their capabilities and accreditations

Laboratory and location	Organisation	Diagnostic capability	Accreditation	Collections
Northern Territory				
CSIRO Tropical Ecosystems Research Centre, Darwin	CSIRO	Ant identification for general public and biosecurity purposes		Tropical Ecosystems Research Centre ant collection
Department of Primary Industry and Fisheries Entomology Laboratory, Berrimah Agricultural Laboratories, Berrimah	NT Department of Primary Industry and Fisheries (DPIF)	Insects and mites		The Northern Territory Economic Insect Reference Collection
Department of Primary Industry and Fisheries Plant Pathology Laboratory, Berrimah Agricultural Laboratories, Berrimah	DPIF	Plant pathology, virology, bacteriology, PCR, mycology, diagnostics		Darwin Northern Australian Plant Pathology Herbarium
Herbarium, Flora and Fauna Division, Department of Land Resource Management, Palmerston	NT Department of Land Resource Management	Plant identification for general public and commercial purposes	Registration for exchange (export and import) of scientific specimens	Native plant collection of the Northern Territory
Museum and Art Galleries of the Northern Territory, Department of Arts and Museums, Darwin	NT Department of Arts and Museums	Insect identification for general public and commercial purposes. A gastropod collection that has been assisting DAWR quarantine inspectors with intercepted samples.	Registration for exchange (export and import) of scientific specimens	Insects with a focus on native species. Gastropoda with a number of border collections.
Northern Australia Quarantine Strategy Regional Laboratory, Darwin	DAWR	Tropical plant pests. Plant pathology: microscopy, serology and molecular biology (conventional and real time PCR). Entomology: microscopy and limited molecular biology capacity. Botany: microscopy.		Plant pathology: herbarium specimens and desiccated virus/virus-like disease collections. Entomology: Northern Territory Quarantine Insect Collection, which comprises: general entomology insect pests; WA, NT & Timor Leste tephritidae; WA, NT & overseas Culicoides biting midges
Queensland				
Eagle Farm	DAWR	Temperate and tropical plant pests. Plant pathology: microscopy and molecular biology (conventional PCR). Entomology: microscopy and limited molecular biology capacity.	Australian Government Department of Agriculture accredited quarantine Containment 5.2/7.2	Limited plant pathogen and insect collections
Northern Australia Quarantine Strategy Regional Laboratory, Cairns	DAWR	Tropical plant pests. Plant pathology: microscopy, serology and molecular biology (conventional and real time PCR). Entomology: microscopy and limited molecular biology capacity. Botany: microscopy.		Plant pathology: herbarium specimens and desiccated virus/virus-like disease collections. Extensive insect and herbarium collections.

Table 49. Australia's diagnostic services, their capabilities and accreditations

Laboratory and location	Organisation	Diagnostic capability	Accreditation	Collections
Queensland *continued*				
QDAF, Biosecurity Queensland Control Centre, Moggill	QDAF	Fire ants		Fire ant reference collection
QDAF, Bowen Research Station, Bowen	QDAF	Entomology		
QDAF, Redden Street, Cairns	QDAF	Plant pest and disease triage		
QDAF, Centre for Tropical Agriculture, Mareeba	QDAF	Entomology, plant pathology, molecular biology, bacteriology		Entomology
QDAF, Ecosciences Precinct, Dutton Park	QDAF	Entomology, plant pathology, virology, bacteriology, mycology, nematology and molecular biology, exotic fruit fly screening	Australian Government Department of Agriculture accredited quarantine containment 5.2/5.3	Plant pathology, entomology
Queensland Alliance for Agriculture and Food Innovation (QAAFI), St Lucia, Dutton Park, Warwick, Nambour	QAAFI, University of Queensland	Plant pathology, virology		
QDAF, Gatton Research Station, Gatton	QDAF	Vegetable pests and diseases		
QDAF, Maroochy Research Station, Nambour	QDAF	Plant pathology		
QDAF, South Johnstone Research Station, South Johnstone	QDAF	Nematology, entomology, plant pathology		
QDAF, Tor Street, Toowoomba	QDAF	Field crop pests and diseases, molecular biology, entomology, virology, nematology, and mycology		
USQ, Toowoomba	University of Southern Queensland	Plant pathology, nematology		
Sugar Research Australia (SRA), Indooroopilly, Woodford, Mackay, Tully	SRA	Sugarcane pests and diseases		
Queensland Museum, South Brisbane, Brisbane	Queensland Museum	Aracology, entomology		Acaralogy, entomology
South Australia				
South Australian Research and Development Institute (SARDI), Adelaide	SARDI	Molecular diagnostics, plant pathology (mycology, nematology, virology, taxonomy), entomology and surveillance	Molecular Diagnostics Laboratory is NATA accredited under Biologicals. NATA accredited for potato virus testing.	Entomology collection, Adelaide University
School of Agriculture, Food and Wine, Waite Institute, Adelaide	University of Adelaide	Nematology and viticulture virology		
School of Earth and Environmental Sciences, Adelaide	University of Adelaide	Entomology		
South Australian Museum, Adelaide	SA Department of Premier and Cabinet	Entomology		

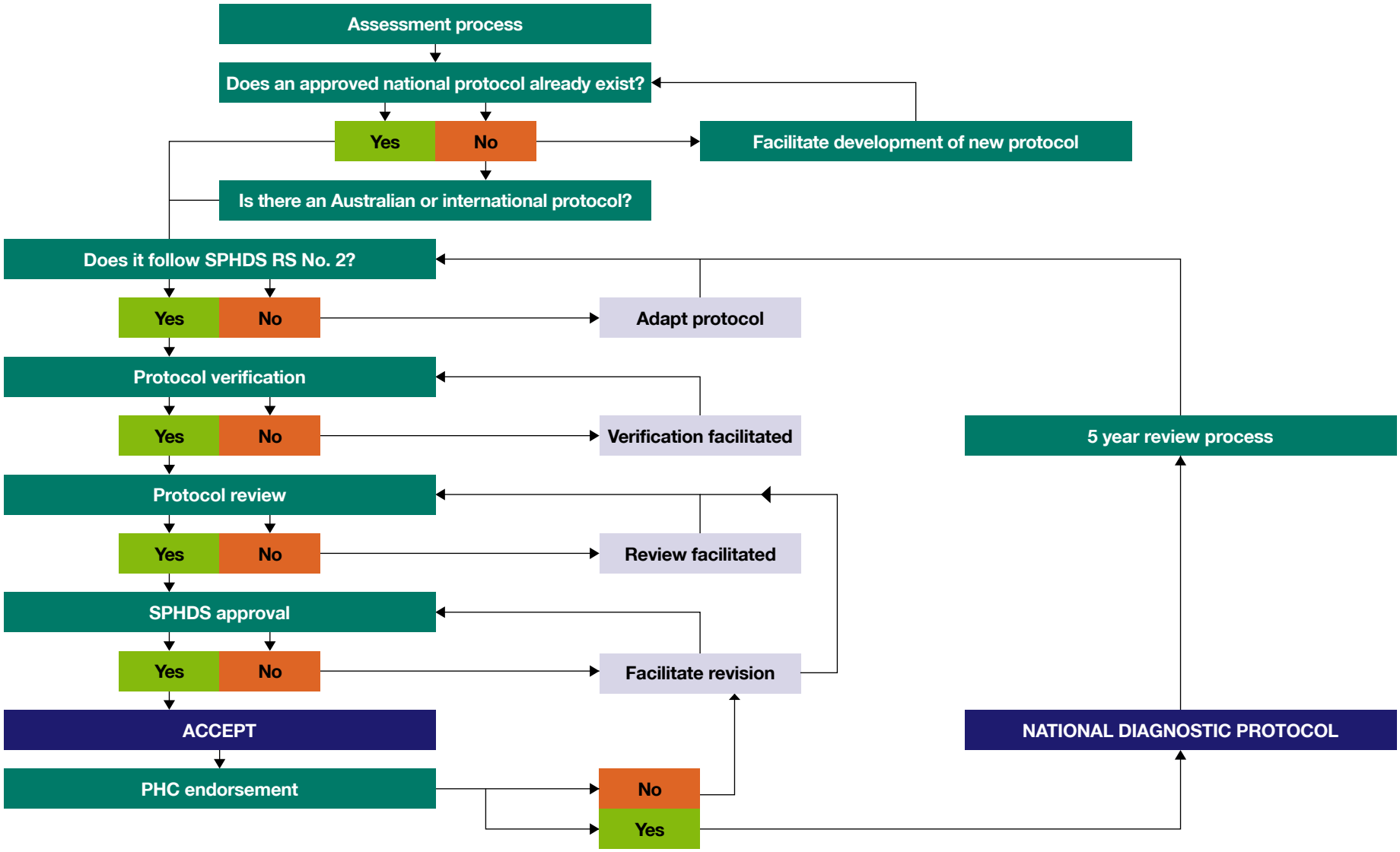
Table 49. Australia's diagnostic services, their capabilities and accreditations

Laboratory and location	Organisation	Diagnostic capability	Accreditation	Collections
Tasmania				
Forestry Tasmania, Hobart	Forestry Tasmania	Limited diagnostics in pathology, main focus is on testing for *Phytophthora cinnamomi*		Tasmanian forest insect collection
Peracto, Devonport	Peracto	Plant pathology	Laboratory DAWR containment approved	
Plant Health Laboratories, New Town (satellite entomology laboratories at Devonport and Launceston)	Tasmanian Department of Primary Industries, Parks, Water and Environment (DPIPWE)	Entomology, plant pathology (virology, mycology and bacteriology), TASAG ELISA testing services, virology	Laboratories DAWR containment approved, TASAG laboratories have NATA accreditation (ISO/IEC 17025:2005)	Insect reference collection
Queen Victoria Museum and Art Gallery, Launceston	Queen Victoria Museum and Art Gallery	Insect identification for the general public		Invertebrate reference collection covering most groups including insects
Seed Analysis Laboratory, Mt Pleasant	DPIPWE	Feed grain quarantine assessments for declared species	ISTA accredited	Prohibited and quarantinable species seed reference collection
Tasmanian Museum and Art Gallery, Hobart	Tasmanian Museum and Art Gallery	Entomology (specialising in beetles and moths), insect identification for the general public		Small insect reference collection, herbarium including weeds and fungi
University of Tasmania, Cradle Coast Campus, Burnie	University of Tasmania and Tasmanian Institute of Agriculture	Plant pathology, nematology		Limited collection of fungal pathogens
University of Tasmania, Sandy Bay Campus, Hobart	University of Tasmania and Tasmanian Institute of Agriculture	Entomology, forest pathology, molecular laboratory	Laboratory DAWR containment approved	
Victoria				
AgriBio, Bundoora	Victorian Department of Development, Jobs, Transport and Resources (DEDJTR)	Entomology, mycology, virology, nematology, bacteriology, general plant pathology, fungal and insect taxonomy, high throughput molecular diagnostics, weeds	DAWR approved AS/NSZ 9001:2000/QA certification. Laboratory is NATA accredited under Biologicals. NATA accredited for potato virus testing, potato cyst nematodfe identification, fruit fly and *Phylloxera* identification	Fungal, bacterial, nematode, invertebrates, limited virus
Forest Health Laboratory, Heidelberg	University of Melbourne	Forest pathology and entomology		
Horsham Research Centre, Horsham	DEDJTR	General plant pathology and virology (grains focus)		
Irymple Research Centre, Irymple	DEDJTR	General plant pathology and entomology		
Operational Science Laboratory, Tullamarine Airport	DAWR	Entomology and plant pathology	DAWR accredited quarantine containment 5.2/7.2	Entomology collection

Table 48. Australia's diagnostic services, their capabilities and accreditations

Laboratory and location	Organisation	Diagnostic capability	Accreditation	Collections
Victoria *continued*				
Plant Post Entry Quarantine facility, Mickleham	DAWR	General plant pathology including mycology, bacteriology, botany, virology and nematology		
Royal Botanic Gardens Melbourne, Melbourne	Royal Botanic Gardens Melbourne	Mycology and weeds		
Rutherglen Research Centre, Rutherglen	DEDJTR	Entomology		
Tatura Research Centre, Tatura	DEDJTR	Entomology		
Western Australia				
DAFWA Diagnostic Plant Laboratories, South Perth	Department of Agriculture and Food Western Australia (DAFWA)	Commercial diagnostic laboratory for plant pathogen identification, entomology, nematology, virology, bacteriology, mycology, seeds and limited number of bee pathogens	Seed lab is ISTA and QC2 accredited – Plant quarantine laboratory is QC2 accredited	Western Australian plant pathogen and invertebrate collections
Department of Environmental Biology, Perth	Curtin University of Technology	Mycology		
Northern Australia Quarantine Strategy, Broome	DAWR	Identification of quarantine intercept samples, mostly exotic pests		Small reference collection, mostly exotic invertebrates
Operational Science, Department of Agriculture, Perth International Airport	DAWR	Identification of quarantine intercept samples, mostly exotic pests including arthropods, fungi, bacteria and viruses	DAWR accredited quarantine containment 5.2/7.2	Small reference collection, mostly exotic invertebrates with a limited collection of seed and cultures
Phytophthora Laboratory, Murdoch	Murdoch University	Commercial and research *Phytophthora* diagnostic laboratory		
Western Australian State Agricultural Biotechnology Centre	Murdoch University	Commercial and research molecular biology laboratory for plant pathogen identification		
Western Australian Museum, Kewdale	Western Australian Museum	Insect identification for general public		Largest insect collection in Western Australia

Figure 78. National Diagnostic Protocol endorsement process



National diagnostic protocols

Diagnostic protocols are documents that contain detailed information about a specific plant pest or related group of pests, relevant to its diagnosis. Such information is crucial for the management of established and exotic pests, including:

- general surveillance for pest status
- testing of material for compliance with certification procedures
- surveillance as part of an official control or eradication program
- pest diagnostic operations associated with phytosanitary certification
- routine diagnosis of pests found in imported consignments
- detection of a pest in an area where it is not known to occur.

National Diagnostic Protocols (NDPs) are diagnostic protocols for the unambiguous taxonomic identification of a pest in a manner consistent with ISPM No. 27—Diagnostic Protocols for Regulated Pests. They have been nationally endorsed for use in the event of an incursion, providing transparency when comparing diagnostic results between laboratories. NDPs include diagnostic procedures and data on the pest, its hosts, taxonomic information, detection and identification.

Australia has a coherent and effective system for the development of NDPs for plant pests through SPHD. NDPs are developed according to SPHD[13] Reference Standards 1–4 which include the processes of peer review, verification and endorsement by PHC as shown in Figure 78. NDPs, both under development and endorsed[14], are listed in Table 50.

Current SPHD Reference Standards include:

- Glossary of Terms (Version 3)
- Development of Diagnostic Protocols—Technical Procedures (Version 4)
- Guidelines for the Approval Process of National Diagnostic Protocols (Version 4)
- Guidelines for Verification and Peer Review Reports (Version 3).

In some cases, a lucid key has been developed for pest identification. A lucid key is an interactive diagnostic tool based on observable characteristics, rather than a protocol using a pre-defined tree.

13 SPHD Reference Standards can be found at **www.plantbiosecuritydiagnostics.net.au/resource-hub/documents**
14 Endorsed NDPs are available at **plantbiosecuritydiagnostics.net.au/resource-hub/priority-pest-diagnostic-resources**

New diagnostic test for fire blight

Fire blight, caused by the bacterium *Erwinia amylovora*, is the most devastating disease of pome fruit (apples, pears) worldwide. It is found in nearly every apple producing country, except Australia and Japan.

In 1997 an incursion of fire blight found in Melbourne's Royal Botanic Gardens cost the Australian pome and nursery industries an estimated $20 million in lost revenue, mainly through a prohibition on interstate movement of host plants and related produce during the three-year eradication response.

While the 1997 incursion was eradicated, biosecurity workers found that the internationally accepted diagnostic test used to detect fire blight was unreliable, so there was a real need to develop a new accurate diagnostic tool.

Through the work of Rachel Mann and the Plant Biosecurity CRC, researchers found genetic sequences that are only present in the *E. amylovora* pathogen, allowing them to develop a much more accurate and effective diagnostic tool.

A diagnostic tool for field surveillance is also under development, which will improve the speed and accuracy of fire blight identification should there ever be another incursion in Australia.

A new diagnostic test will make identification of fireblight easier and faster. Image courtesy of Clemson University, USDA Cooperative Extension Slide Series, bugwood.org.

Table 50. National diagnostic protocols

Scientific name	Common name	Status[13]
Adoxophyes orana	Summer fruit tortrix	Draft[b]
Agrilus planipennis	Emerald ash borer	Draft
Anastrepha spp., *Bactrocera* spp., *Ceratitis* spp., *Dacus* spp., *Dirioxa* spp. *and Rhagoletis* spp.	Fruit flies (exotic and endemic species of priority to Australia)	Draft, FF[c] handbook, Lucid key[a]
Bactericera cockerelli	Potato tomato psyllid	Endorsed (NDP 20)
Banana bract mosaic virus (Potyvirus)	Banana bract mosaic disease	Draft
Bemisia tabaci	Silver leaf white fly	Lucid key
Blood disease bacterium	Blood disease	Draft
Broad bean mottle virus	Broad bean mottle virus	Draft
Broad bean stain (Comovirus)	Broad bean stain virus	Draft
Broad bean true mosaic (Comovirus)	Broad bean true mosaic virus	Draft
Burkholderia glumae	Panicle blight, bacterial grain rot of rice	Draft
Bursaphelenchus spp. including *B. xylophilus*	Pine wilt nematode, pinewood nematode species complex	Draft
Candidatus Liberobacter asiaticus	Huanglongbing, citrus greening	Endorsed (NDP 25)
Candidatus Liberobacter psyllaurous	Zebra chip	Endorsed (NDP 18)
Candidatus Liberobacter solani	Bois noir	
Ceratosystus ulmi	Dutch elm disease	Draft
Ceratovacuna lanigera	Sugarcane woolly aphid	Draft
Cherry leaf roll virus (Nepovirus)	Blackline	Endorsed (NDP 10)
Chilo auricilius	Sugarcane internode borer	Draft
Chilo infuscatellus	Sugarcane yellow top borer	Draft
Chilo partellus	Spotted stalk borer	Draft
Chilo polychrysus	Stem borer	Draft
Chilo sacchariphagus	Dark headed stripe borer	Draft
Chilo terrenellus	Sugarcane stem borer	Draft
Cicadulina mbila	South African maize leafhopper	Draft
Citripestis eautraphera	Mango fruit borer	Draft
Citripestis sagittiferella	Citrus fruit borer	Draft

13 a. **Endorsed –** the standard has been assessed by SPHD and endorsed by PHC as a National Diagnostic Protocol
Draft – the standard has not yet been assessed and verified by SPHD
b. **FF handbook –** included in the Australian Handbook for the Identification of Fruit Flies
c. **Lucid key –** only a lucid key for this species exists

Table 50. National diagnostic protocols

Scientific name	Common name	Status[13]
Clavibacter michiganensis subsp. *nebraskensis*	Goss's bacterial wilt, blight of corn	Draft
Clavibacter michiganensis subsp. *sepedonicus*	Bacterial ring rot of potato	Endorsed (NDP 8)
Colletotrichum lentis	Lentil anthracnose	Draft
Coryphodema tristis	South African cossid moth	Draft
Cotton leaf curl virus (Begomovirus)	Cotton leaf curl disease	Draft
Cotton leafroll dwarf virus	Cotton leaf curl disease	
Cryphonectria parasitica	Chestnut blight	Endorsed (NDP 11)
Daktulosphaira vitifolii/viteus	Grape phylloxera, type B	Draft
Deanolis sublimbalis	Red banded mango caterpillar adult	Draft
Dendroctonus frontalis	Mountain pine beetle	Draft
Dendroctonus ponderosae	Southern pine beetle	Draft
Dendroctonus valens	Red turpentine beetle	Endorsed (NDP 24)
Diaphorina citri	Citrus psyllid	Draft
Diuraphis noxia	Russian wheat aphid	Endorsed (NDP 28)
Drosophila suzukii	Spotted winged drosophila	Draft
Dysaphis plantaginea	Rosy apple aphid	Draft
Echinothrips americanus	Poinsettia thrips	Endorsed (NDP 4)
Endocronartium harknessii	Pine gall rust	Endorsed (NDP 32)
Erionota thrax	Banana skipper butterfly	Draft
Erwinia amylovora	Fireblight	Draft
European stone fruit yellows phytoplasma	European stone fruit yellows	Endorsed (NDP 12)
Exotic aphids	Exotic aphids	Draft
Flavescence dorée phytoplasma	Flavescence dorée	Draft
Furoviruses and *Bymoviruses (Wheat mosaic, cereal mosaic, chinese mosaic virus, wheat spindle streak* and *wheat yellow mosaic virus)*	Wheat soilborne viruses	Draft
Fusarium circinatum	Pine pitch canker	Draft
Fusarium oxysporum f. sp. *ciceris*	Fusarium wilt of chickpea	Draft
Fusarium oxysporum f. sp. *cubense* tropical Race 4	Panama disease	Draft
Gibberella fujikuroi	Bakanae	Draft
Globodera pallida	Potato cyst nematode	Draft
Globodera rostochiensis	Potato cyst nematode	Draft
Guignadia bidwellii	Black rot	Endorsed (NDP 13)
Homalodisca vitripennis	Glassy winged sharpshooter	Endorsed (NDP 23)
Hyalesthes obsoletus	Cixxidae planthopper	Draft
Leptinotarsa decemlineata	Colorado potato beetle	Endorsed (NDP 22)
Liriomyza bryoniae	Tomato leaf miner	Lucid key
Liriomyza cicerina	Chickpea leafminer	Draft
Liriomyza huidobrensis	Serpentine leafminer	Draft
Liriomyza sativae	American leafminer	Lucid key
Liriomyza trifolii	American serpentine leafminer	Endorsed (NDP 27)
Lissorhoptrus oryzophilus	Rice water weevil	Draft
Lobesia botrana	Grape berry moth	Draft
Lymantria dispar	Asian gypsy moth, gypsy moth complex	Draft
Magnaporthe grisea	Rice blast	Endorsed (NDP 14)
Maize dwarf mosaic virus (Potyvirus)	Maize dwarf mosaic virus	Draft
Mayetiola destructor	Hessian fly	Draft
Monilinia fructigena	Brown rot	Endorsed (NDP 1)
Mycosphaerella eumusae	Eumusae leaf spot	Draft
Mycosphaerella fijiensis	Black sigatoka	Draft
Neonectria ditissima	European canker	Endorsed (NDP 21)
Orthaga euadrusalis	Mango leaf webber	Draft
Pantoea stewartii subsp. *stewartii*	Stewart's wilt of maize	Draft
Pea early browning virus (Tobravirus)	Pea early browning virus	Draft
Pea enation mosaic virus (Enamovirus)	Pea enation mosaic virus	Draft
Pepino mosaic virus (Potexvirus)	Pepino mosaic virus	Draft

Table 50. National diagnostic protocols

Scientific name	Common name	Status[13]
Peronosclerospora sacchari	Sugarcane downy mildew	Draft
Phakopsora euvitis	Grapevine leaf rust	Endorsed (NDP 29)
Phoma tracheiphila	Mal secco	Endorsed (NDP 26)
Phomopsis/Diaporthe helianthi	Sunflower stem canker	Draft
Phymatotrichum omnivorum	Texas root rot	Draft
Phytophthora infestans A2 mating type	Potato late blight	Draft
Phytophthora ramorum	Sudden oak death	Endorsed (NDP 5)
Plum pox virus (Potyvirus)	Plum pox virus	Endorsed (NDP 2)
Pomacea canaliculata	Golden apple snail	Draft
Potato mop top virus (Pomovirus)	Potato mop top virus	Endorsed (NDP 15)
Potato spindle tuber viroid (Pospiviridae)	Potato spindle tuber viroid	Endorsed (NDP 7)
Potyvirus general	Potyvirus	Draft
Protopulvinaria pyriformis	Pyriform scale	Endorsed (NDP 33)
Pseudomonas maritimus	Grape mealybug	Draft
Pseudomonas syringae pv. *papulans*	Blister spot of apples	Draft
Puccinia psidii sensu lato (exotic strain)	Guava rust, *eucalyptus* rust	Draft
Puccinia striiformis f. sp. *hordei*	Barley stripe rust	Draft
Pulvinaria iceryi (Signoret)	Pulvinaria scale	Endorsed (NDP 34)
Raffaelea lauricola	Laurel wilt (and beetle vector)	Draft
Ralstonia solanacearum	Bacterial brown rot of potatoes	Draft
Ralstonia solanacearum Race 2	Moko and bugtok	Draft
Red clover vein mosaic virus (Carlavirus)	Red clover vein mosaic virus	Draft
Roesleria subterranea	Grape root rot	Endorsed (NDP 35)
Unknown	Sugarcane white leaf	Draft
Scirpophaga excerptalis	Top borer, top shoot borer	Draft
Scirpophaga nivella	White rice borer	Draft
Scirtothrips aurantii	South African citrus thrips	Draft
Scirtothrips perseae	Avocado thrips	Endorsed (NDP 3)
Scolytines	Bark beetles	Draft
Semiaphis dauci	Carrot aphid	Draft
Sesamia grisescens	Stem borer	Draft
Sitobion avenae	Wheat aphid	Draft
Stagonospora sacchari	Leaf scorch	Draft
Sternochetus frigidus	Mango pulp weevil	Draft
Synchytrium endobioticum	Potato wart	Endorsed (NDP 16)
Termites		Draft
Tetranychidae spp.	Spider mites	Lucid key
Tetranychus desertorum	Prickly pear spider mite	Draft
Tetranychus lombardinii	Crimson spider mite	Draft
Tetranychus pacificus	Pacific spider mite	Draft
Tetranychus piercei	Spider mites	Draft
Tetranychus turkestani	Strawberry spider mite	Draft
Tilletia controversa	Dwarf bunt of wheat	Draft
Tilletia horrida (nee *barclayana*)	Kernel smut of rice	Draft
Tilletia indica	Karnal bunt	Endorsed (NDP 19)
Trioza erytreae	African citrus psyllid	Draft
Unknown	Ramu stunt	Draft
Uromyces vicia-fabae (lentil strain)	Lentil rust	Endorsed (NDP 31)
Verticillium dahliae	Verticillium wilt (defoliating strain)	Draft
Wheat spindle streak mosaic virus (Bymovirus)	Wheat spindle streak mosaic virus	Draft
X disease phytoplasma	Peach X disease	Endorsed (NDP 17)
Xanthomonas subsp. *citri*	Citrus canker	Endorsed (NDP 9)
Xanthomonas campestris pv. *musacearum*	Bacterial wilt	Draft
Xanthomonas citri subsp. *malvacearum*	Hypervirulent bacterial blight of cotton	Draft
Xanthomonas fragariae	Angular leaf spot	Draft
Xanthomonas vasicola pv. *musacearum*	Banana bacterial wilt	Draft
Xylella fastidiosa	Pierce's disease	Endorsed (NDP 6)
Xylophilus ampelina	Bacterial blight	Draft

FOREST HEALTH AND BIOSECURITY SUBCOMMITTEE

At a meeting in March 2015 Australian Forests Products Association (AFPA) Resources Chamber agreed to establish the AFPA Resources Chamber Forest Health and Biosecurity (FHaB) Subcommittee, to replace the Subcommittee on National Forest Health, which was disbanded earlier in the year.

The FHaB Subcommittee includes both industry representatives responsible for managing forest health within their organisations and forest health technical experts. Also included are representatives from Plant Health Committee, PHA and the New Zealand forest researchers Scion.

Key functions of FHaB Subcommittee include:

- Discussing and raising awareness of forest health and biosecurity issues within the AFPA membership and the broader forest industry.
- Providing expert advice to inform federal and state government policy on forest health and biosecurity issues.
- Supporting AFPA as the industry representative for Plant Health Australia and as signatory to the Emergency Plant Pest Response Deed.
- Offering technical advice to AFPA members during an emergency plant pest incursion.
- Guiding forestry representatives on the Plant Health Committee's Subcommittees on National Plant Health Surveillance (SNPHS) and Diagnostics (SPHD).

Early work for the FHaB Subcommittee includes reviewing and implementing the procedures outlined in the Biosecurity Manual for the Plantation Timber Industry, developing a process for reporting results of pest surveillance, enhancing the recently drafted Framework for National Biosecurity Surveillance of Exotic Forest Pests and simplifying the reporting requirements for the annual Forest Health Status report. The group is also investigating the development of a Forest Health and Biosecurity Training module to standardise forest health and biosecurity training.

ON-FARM BIOSECURITY

The actions of producers on-farm are important in maintaining Australia's plant biosecurity status.

Farm biosecurity is a set of measures designed to protect a property from the entry and spread of pests, diseases and weeds.

So that it actually gets done amid the rest of the jobs that need doing on farm, biosecurity needs to become second nature—integrated into everyday activities.

Increasingly, growers are seeing the benefits of on-farm biosecurity and its role in preventing the spread of pest and disease causing organisms, and in maintaining access to markets.

Biosecurity manuals for producers

PHA, in partnership with plant production industries and governments, has released a number of crop-specific biosecurity manuals (Table 51). These booklets are specifically tailored for growers and consultants, outlining simple and effective measures that can be incorporated into day-to-day operations to improve biosecurity and help protect their farm from both new and established pests. It is a joint responsibility of industry and governments to implement the advice in the manuals. Manuals for PHA members are available on the Farm Biosecurity website.

The Farm Biosecurity Program

Recognising the increasing number of mixed farming enterprises in Australia, PHA has partnered with AHA in a joint communication and awareness campaign, Farm Biosecurity, which provides biosecurity advice for both crop and livestock producers.

The program aims to help producers identify and reduce the risks to their enterprises posed by diseases, pests and weeds. The program website **farmbiosecurity.com.au** provides an array of information, including biosecurity manuals, templates for records, gate signs for sale, industry specific information, videos, a personal profile builder and a biosecurity planner.

Resources produced by Farm Biosecurity all include the six biosecurity 'essentials'. By considering how these principles apply to their properties, producers can go a long way towards protecting their farms and their future from the impact of new or established diseases, pests and weeds.

Table 51. Current PHA biosecurity manuals for producers of various industries

Manual	Version
Orchard Biosecurity Manual for the Almond Industry	1.0
Orchard Biosecurity Manual for the Apple and Pear Industry	2.0
Orchard Biosecurity Manual for the Avocado Industry	1.0
Biosecurity Manual for the Banana Industry	1.0
Biosecurity Induction Manual for Bundaberg Horticultural Farms	1.0
Orchard Biosecurity Manual for the Cherry Industry	1.0
Biosecurity Manual for Citrus Producers	2.0
Farm Biosecurity Manual for the Cotton Industry	1.1
Biosecurity Manual for Grain Producers	4.0
Biosecurity Manual for the Honey Bee Industry	1.0
Orchard Biosecurity Manual for the Mango Industry	1.0
Biosecurity Manual for the Nursery Production Industry	1.0
Farm Biosecurity Manual for the Northern Adelaide Plains Vegetable Growers	1.0
Farm Biosecurity Manual for the Organic Grains Industry	1.0
Biosecurity Manual for the Papaya Industry	1.0
Orchard Biosecurity Manual for the Summerfruit Industry	1.0
Biosecurity Manual for the Viticulture Industry	1.0
Biosecurity Manual for the Plantation Timber Industry	1.0

Tidy honey bees win 2015 Farmer of the Year Award for beekeeper

Beekeeper Lindsay Bourke has bred bees that clean out their brood nest at the whiff of a pest or disease. This was one of the initiatives that won him the 2015 Plant Biosecurity Farmer of the Year Award, sponsored by Plant Health Australia.

Lindsay, who owns and runs Australian Honey Products, manages 3,600 hives for honey production and for crop pollination to boost yields for plant producers. He is driven by biosecurity to make sure that the best quality honey is produced and his bees provide the best possible results for pollination dependant crops.

“Biosecurity is essential for maintaining the beekeeping and food industry now and in the future,” Lindsay said.

Recently he has been breeding bees that may be more resistant to the effects of pests and diseases, because they’re good housekeepers.

“Hygienic behaviour is a genetic characteristic that bees can inherit,” Lindsay said. “Bees that have the genes can smell disease and pests in their brood nest and remove the affected cells before the problem spreads.”

Bees that show hygienic behaviour against *Varroa* mite and American foulbrood (a pest that is already in Australia), the two biggest biosecurity threats to the industry, can be tested, selected and bred.

Experts agree that it is likely that *Varroa* will arrive in Australia, with an estimated loss of 50-70 per cent of pollinating hives. The impact on pollination for farmers and food security will be significant. Establishing apiaries with bees showing increased hygienic behaviour is expected to help when *Varroa* mite makes it into Australia.

Lindsay Bourke’s tireless efforts to improve honey bee biosecurity earned him the award in 2015.

PLANT BIOSECURITY COMMUNICATION

Efforts relating to communication and awareness-raising reflect jurisdictional boundaries among governments. The Australian Government is primarily responsible for messages about national border protection, international requirements and pre-border initiatives, while state and territory governments disseminate information about biosecurity in their regions.

Information for producers and others along the supply chain is generally communicated by industry bodies and the Farm Biosecurity program (run jointly by PHA and AHA), with governments playing a supporting role. Plant industries also work to mitigate risks through heightened awareness about plant pests and improving the practices of their producers. They use a variety of communication tools including, increasingly, biosecurity officers on the ground.

Information during a plant pest emergency is delivered to the public by the affected state agency. However, messages are determined by the Consultative Committee that coordinates the response, which usually includes government and industry parties. See Chapter 4.

Biosecurity Incident National Communication Network

The National Communication Network (NCN) consists of communication managers from the Australian Government, state and territory agencies, and biosecurity organisations including PHA and AHA. The NCN works to produce nationally consistent public information during responses to pest and disease outbreaks and animal welfare incidents, based on information arising from Consultative Committee meetings. The NCN also advances preparedness and prevention awareness activities in areas where a national approach is warranted.

Plant biosecurity IT tools, databases and networks

Information technology tools are increasingly central to the plant biosecurity sector, and are being developed for everything from production management through to diagnosing plant pests. Local and web based tools are rapidly being supplemented with mobile technologies, improving accessibility to the tools and integration into biosecurity operations.

New devices and vehicles such as hand held wireless microscopes, unmanned aerial vehicles and other detection devices are improving links with the range of information technology tools. There are also a number of tools that connect systems and data sources together to improve their usability and value, such as the Australian Plant Pest Database and the Atlas of Living Australia.

The Biosecurity Portal, developed by PHA, was launched in 2014. It brings together a suite of online biosecurity information for ease of access, see **www.biosecurityportal.org.au.**

Chapter 4

Responding to plant pest incursions

Even with a highly effective biosecurity system, including strong border controls, there is still the risk that new plant pests will enter the country. Passenger arrivals and goods imports are increasing with time and, together with natural entry pathways such as wind and water currents, the risk of exotic pest incursions is ever present.

As a result, Australia has mechanisms in place to rapidly and effectively respond to plant pests in order to minimise any negative impacts.

The Emergency Plant Pest Response Deed is the legally binding agreement between governments and industries that sets out how emergency plant pests are dealt with when detected in Australia. The agreement ensures that any new detection is dealt with swiftly, providing the best chance of containing and eradicating the pest.

This chapter uses the EPPRD definition of a **Plant Pest**: *any species, biotype or strain of invertebrate pest or pathogen injurious to Plant Health, Unprocessed Plant Products or Bees, provided that it is discrete, identifiable and genetically stable but excludes Genetically Modified Organisms*. The EPPRD definition of a Plant Pest does not include weeds.

Defined terms under the EPPRD are used throughout this chapter, identified through capitalisation. For the full list of definitions, refer to clause 1 of the EPPRD available at **www.planthealthaustralia.com.au/epprd**.

4.1 The Emergency Plant Pest Response Deed

The EPPRD is a formal, legally binding agreement between PHA, the Australian Government, all state and territory governments, and 33 plant industry peak bodies. The EPPRD, of which PHA is the custodian, covers the management and funding of eradication responses to Emergency Plant Pests (EPP).

For a pest to be covered by the EPPRD, it must be an EPP, with categorised EPPs listed in schedule 13 of the EPPRD. If there is an Incident of an uncategorised Plant Pest the response action may commence if it is reasonably believed to meet one of the following criteria:

- A known exotic Plant Pest that could have an adverse economic impact regionally and nationally if established in Australia.
- A variant form of an established Plant Pest which can be distinguished by appropriate investigative methods, and could have an adverse economic impact regionally and nationally if established in Australia.
- A serious Plant Pest of unknown or uncertain origin which may be an entirely new Plant Pest.
- A Plant Pest of potential economic importance to the area endangered and not yet present there or being officially controlled.

A Plant Pest is not formally designated to be an EPP until the Categorisation Group makes the determination that it meets one of the above criteria and this is approved by Relevant Parties. Honey bees and their pests also fall under the EPPRD, since a pest affecting the honey bee industry would also affect plant industries that benefit from pollination.

The EPPRD is designed to ensure a rapid and effective response to an EPP incursion, and to provide certainty on the management and funding of that response. It specifies Parties' roles in the decision making and operational processes of the EPP response and how government and Industry Parties will share the costs, based on an assessment of the relative private and public benefits of eradication.

The terms of the EPPRD ensure that no single Party is exclusively responsible for decision making about a response to a Plant Pest incursion. Instead, formal committees are assembled to agree actions. These committees are made up of representatives from government and industry Parties that are likely to be Affected by the Plant Pest. Only EPPRD signatories can take an active part in these decision making groups.

NATIONAL MANAGEMENT GROUP

The National Management Group (NMG) is responsible for making the key decisions in the response to an EPP incursion under the EPPRD. The group is formed when an incursion is identified. It consists of representatives from PHA, the Australian Government, all state and territory governments and Industry Parties Affected by the Plant Pest.

The group is responsible for approving a Response Plan, including the budget, if it is agreed that eradication is technically feasible and cost beneficial. The NMG is advised on technical matters by the Consultative Committee on Emergency Plant Pests (CCEPP).

CONSULTATIVE COMMITTEE ON EMERGENCY PLANT PESTS

The CCEPP is a technical committee set up to make recommendations to the NMG on EPP incursion responses. As with the NMG, the CCEPP is formed when an EPP is detected or suspected to be present. The committee consists of the Australian Chief Plant Protection Officer, all state and territory Chief Plant Health Managers, PHA, and nominated representatives from each Affected Industry Party.

The CCEPP is responsible for assessing the grounds for eradication and for providing the technical advice needed for the NMG to make decisions. A Scientific Advisory Panel may be convened by the CCEPP on an ad hoc basis, to provide advice on specific technical matters.

CATEGORISATION GROUP

The Categorisation Group is assembled to determine a category for an EPP for the purposes of applying the provisions of the EPPRD, including the proportion of costs that each Party will pay. Each category is based on the public versus private benefit of eradication and assigns the Cost Sharing split borne by Affected Parties. The four categories are shown in Table 52. Relevant Parties must agree unanimously to the category recommended by the Categorisation Group.

Each Categorisation Group comprises nominated representatives from the Affected Industry Parties, relevant technical experts nominated by government and Industry Parties, an economic expert and an independent Chair from PHA.

Table 52. EPP categories and the associated Affected Party Cost Sharing splits

Category 1
The eradication of Category 1 EPPs would have very high public benefits and would be 100 per cent government funded. These are EPPs which, if not eradicated, would: • cause major environmental damage to natural ecosystems; and/or • potentially affect human health or cause a major nuisance to humans; and/or • cause significant damage to amenity flora; and/or • have relatively little impact on commercial Crops. This category also covers situations where the EPP has a wide range of hosts, including native flora, and there is considerable uncertainty as to the relative impacts on Crops. In short, it is almost impossible to properly determine which Cropping Sectors benefit from eradication and to what extent, and in any case the incursion primarily affects native flora and/or amenity plants, and/or is a major nuisance, if not a health risk to humans.
Category 2
The eradication of Category 2 EPPs would have high public benefits and so would be funded 80 per cent by governments and 20 per cent by Affected Industry Parties. These are EPPs, which if not eradicated, would: • cause significant public losses either directly through serious loss of amenity, and/or environmental values and/or effects on households; or indirectly through very severe economic impacts on regions and the national economy, through large trade losses with flow on effects through the economy; and • impose major costs on the Affected Cropping Sectors such that the Cropping Sectors would benefit significantly from eradication.
Category 3
The eradication of Category 3 EPPs would have moderate public benefits and would be funded 50 per cent by governments and 50 per cent by Affected Industry Parties. These are EPPs, which if not eradicated, would: • primarily harm the Affected Cropping Sectors, but there would also be some significant public costs as well (that is, moderate public benefits from eradication). The EPP could adversely affect public amenities, households or the environment, and/or could have significant, though moderate trade implications and/or national and regional economic implications.
Category 4
The eradication of Category 4 EPPs would mainly, if not wholly, have private benefits and would be funded 20 per cent by governments and 80 per cent by Affected Industry Parties. These are EPPs, which if not eradicated, would: • have little or no public cost implications and little or no impacts on natural ecosystems. The Affected Cropping Sectors would be adversely affected primarily through additional costs of production, extra control costs, or nuisance costs; and • generally there would be no significant trade issues that would affect national and regional economies.

Biosecurity officers responding to the exotic plant pest giant pine scale in Victoria. Image courtesy of DEDJTR.

Three new EPPRD Signatories in 2015

Three new industries joined the EPPRD during 2015, bringing the total to 33 industries now signed up to the protections and obligations of the agreement.

Raspberries and Blackberries Australia joined in June, Hazelnut Growers of Australia in November and Australian Melon Association in December 2015.

With Australia's nine governments and PHA, at the end of 2015 there were 43 signatories to the agreement, which sets out response and cost sharing arrangements for suspected Emergency Plant Pest incursions in Australia.

Three new industry bodies signed the EPPRD in 2015 for hazelnuts, melons and rubus.

4.2 PLANTPLAN

PLANTPLAN is the agreed technical Response Plan used by governments and industries in responding to a Plant Pest Incident dealt with in accordance with the EPPRD. PLANTPLAN underpins the EPPRD as part of schedule 5 and is endorsed by all EPPRD signatories.

It provides nationally consistent guidelines for response procedures under the EPPRD, outlining the phases of an incursion (investigation and alert, operational and stand down), as well as the key roles and responsibilities of industry and government Parties during each of these phases. It incorporates best practice in EPP responses and is further updated each year to incorporate the findings of Incident debriefs and simulation exercises. PHA manages the continued development of PLANTPLAN on behalf of EPPRD Parties.

PLANTPLAN is supported by a number of documents providing detail on specific topics to make access to information easier in training and emergency response situations. In 2015 Parties endorsed a number of new and revised supporting documents, all of which are available online at **www.planthealthaustralia.com.au/plantplan.**

CONTINGENCY PLANNING

Contingency planning is a pre-emptive preparedness initiative that assesses the risks posed by particular exotic pest threats. Before any incursion occurs, experts are brought together to collate information about a designated pest or pest group and to devise the best strategies for surveillance, control and destruction. In the event of an incursion the information contained in a contingency plan allows an effective Response Plan to be developed quickly.

Table 53 provides a listing of contingency plans for over 90 plant pests and pest groups that have been developed by industries and governments in Australia. These plans make a considerable contribution to Australia's preparedness for serious plant pest risks.

New cost-sharing arrangements for eradicating exotic fruit flies from the Torres Strait

Exotic fruit flies are found each year in the Torres Strait, blown south from neighbouring countries including Papua New Guinea. Significant effort goes into ensuring that these exotic species are eradicated before they reach mainland Australia because any one of them would cause significant problems for our crop industries.

Almost all fruit and many vegetable crops would be susceptible to infestation by at least one exotic species and the disruption to domestic and international trade if any one of the species were to establish on the mainland of Australia would be severe. In 2013, ABARES put a dollar figure on the likely losses, estimating that an incursion spreading from far north Queensland to the rest of Australia would cost producers around $2.1 billion.

For the past 20 years the Australian and Queensland Governments have worked in partnership to share the cost of biosecurity activities to monitor and eradicate incursions on islands before the flies make it to the Australian mainland, yet the benefits of the program are felt more widely.

To address this, in 2015 new arrangements have begun that put exotic fruit fly control in the Torres Strait under the EPPRD, bringing these efforts into line with those for other eradicable exotic plant pest incursions in Australia.

The exotic Oriental fruit fly is one of three fruit fly species that will be dealt with under a new cost sharing agreement.

Table 53. Contingency plans

Pest scientific name	Pest common name	Year	Location of document	Scope
Acarapis woodi	Tracheal mite	2012	PHA	National – honey bee industry
Agromyza ambigua, A. megalopsis, Cerodontha denticornis, *Chromatomyia fuscula* and *Chromatomyia nigra*	Cereal leaf miners	2009	PHA	National – grains industry
Agrotis segetum	Turnip moth	2011	Department of Agriculture and Water Resources	National – grains industry
Alternaria humicola	Leaf spot of field pea	2009	PHA	National – grains industry
Alternaria triticina	Leaf blight of wheat	2009	PHA	National – grains industry
Anoplophora chinensis	Citrus longicorn beetle	2009	PHA	National – production nurseries
Aphis fabae, Haplothrips tritici and *Schizaphis graminum*	Exotic sap-sucking pests	2015	PHA	National – grains industry
Atherigona soccata	Sorghum shoot fly	2008	PHA	National – grains industry
Bactericera cockerelli and *Candidatus* Liberibacter solanacearum	Zebra chip complex	2011	Hort Innovation, PHA	National – vegetable and potato industries
Bactrocera papayae, B. tryoni* and *Ceratitis capitata*	Papaya fruit fly, Queensland fruit fly and Mediterranean fruit fly	Updated bi-annually	PIRSA	State
Bactrocera tryoni and *Ceratitis capitata*	Queensland fruit fly and Mediterranean fruit fly	2013	DPIPWE	State
Bactrocera tryoni, Ceratitis capitata and exotic species	Fruit flies	Updated bi-annually	PIRSA	State
Barley stripe mosaic virus (*Hordeivirus*)	Barley stripe mosaic virus	2009	PHA	National – grains industry
Beet pseudo-yellows virus (*Closterovirus*), *Diodia vein chlorosis virus* (*Crinivirus*), *lettuce infectious yellows virus* (*Crinivirus*) and *tomato yellow leaf curl virus* (*Begomovirus*)	Whitefly-transmitted viruses	2011	PHA	National – production nurseries
Bipolaris spicifera	Leaf blotch of cereals	2009	PHA	National – grains industry
Braula coeca	Braula fly	2012	PHA	National – honey bee industry
Burkholderia glumae	Panicle blight	2008	PHA	National – rice industry
Candidatus Liberibacter africanus, *Ca.* L. americanus, *Ca* L. asiaticus, *Diaphorina citri* and *Trioza erytreae*	Huanglongbing and vectors	2013	QDAF, NGIA	National – production nurseries
Candidatus Liberibacter *africanus, Ca.* L. americanus, *Ca.* L. asiaticus, *Diaphorina citri* and *Trioza erytreae*	Huanglongbing and vectors	2009	Hort Innovation	National – citrus and nursery industries (under review)
Candidatus Liberibacter africanus, Ca. L. americanus, Ca. L. asiaticus, *Diaphorina citri* and *Trioza erytreae*	Huanglongbing and vectors	2014	Hort Innovation, PHA	National – citrus and nursery industries (under review)
Cantareus apertus	Green snail	2012–13	DEDJTR	State
Cephus pygmeus	European wheat stem sawfly	2008	PHA	National – grains industry
Ceratocystis ulmi	Dutch elm disease	2001	DEDJTR	State
Ceutorhynchus assimilis, Dasineura brassicae	Cabbage seedpod weevil and *Brassica* pod midge	2011	Department of Agriculture and Water Resources	National – grains industry

* This species has been synonymised with *Bactrocera dorsalis*

Table 53. Contingency plans

Pest scientific name	Pest common name	Year	Location of document	Scope
Chilo partellus	Spotted stem borer	2009	PHA	National – grains industry
Chilo spp.	Sugarcane stem borer	2008	SRA	National – sugarcane industry
Chortoicetes terminifera	Plague locusts	2010	PIRSA	State
Chromatomyia horticola, Liriomyza bryoniae, L. cicerina, L. huidobrensis, L. sativae and *L. trifolii*	Agromyzid leaf miners	2008	PHA	National – grains industry
Chrysanthemum stem necrosis virus (*Tospovirus*), *Impatiens necrotic ringspot virus* (*Tospovirus*), *Pelargonium flower break virus* (*Carmovirus*) and *tomato spotted wilt virus* (*Tospovirus*)	Thrips-transmitted viruses	2011	PHA	National – production nuseries
Colletotrichum truncatum (lentil strain)	Lentil anthracnose	2008	PHA	National – grains industry
Cryphonectria parasitica	Chestnut blight	2010	DEDJTR	State – chestnut industry
Daktulosphaira vitifolii	Grape phylloxera	Updated bi-annually	PIRSA	State – viticulture industry
Deanolis sublimbalis	Red-banded mango caterpillar	2008	PHA	State
Diatraea spp.	Sugarcane borer	2008	SRA	National – sugarcane industry
Diuraphis noxia	Russian wheat aphid	2012	PHA	National – grains industry
Dorysthenes buqueti	Sugarcane longhorn stemborer	2009	SRA	National – sugarcane industry
Echinothrips americanus	Poinsettia thrips	2010	PHA	National – production nuseries
Eldana saccharina	African sugarcane moth borer	2008	SRA	National – sugarcane industry
Eoreuma loftini	Mexican rice borer	2008	SRA	National – sugarcane industry
Erwinia amylovora	Fire blight	2002	DEDJTR	State
Erwinia amylovora	Fire blight	2007	Hort Innovation, PHA	National – apple and pear industry
Erwinia amylovora (and its impact on honey bees)	Fire blight	2004	DPIPWE	State – honey bee industry
Erwinia papayae	Bacterial crown rot	2011	PHA	National – papaya industry
Eumetopina flavipes	Island sugarcane planthopper	2009	SRA	National – sugarcane industry
Eurogaster integriceps	Sunn pest	2008	PHA	National – grains industry
Fulmekiola serrata	Oriental sugarcane thrips	2009	SRA	National – sugarcane industry
Fusarium oxysporum f. sp. *ciceris, F. oxysporum* f. sp. *lentis* and *F. oxysporum* f. sp. *lupini*	Fusarium wilt of chickpea, lentil and lupin	2009	PHA	National – grains industry
Fusarium oxysporum f. sp. *conglutinans*	Fusarium wilt of canola	2007	PHA	National – grains industry
Gibberella fujikuroi	Bakanae	2005	NSW DPI	National – rice industry
Gibberella fujikuroi	Bakanae	2008	PHA	National – rice industry
Globodera pallida	Potato cyst nematode	2001	DPIPWE	State
Globodera rostochiensis	Potato cyst nematode	2002	DEDJTR	National
Harpophora maydis and *Plasmopara halstedii*	Exotic soil-borne pathogens of grains	2013	PHA	National – grains industry

Table 53. Contingency plans

Pest scientific name	Pest common name	Year	Location of document	Scope
Helicoverpa zea	Corn earworm	2009	PHA	National – grains industry
Heterodera avenae, H. latipons and *H. filipjevi*	Cereal cyst nematodes	2012	PHA	National – grains industry
Heterodera carotae	Carrot cyst nematode	2008	DAFWA, Hort Innovation	National – vegetable industry
Heterodera ciceri, H. glycines and *H. zeae*	Exotic nematodes of grains	2013	PHA	National – grains industry
Homalodisca vitripennis	Glassy-winged sharpshooter	2009	PHA	National – production nurseries
Hylotrupes bajulus	European house borer	2006	DAFWA	State
Hylotrupes bajulus	European house borer	2011	QDAF	State
Liriomyza bryoniae, L. huidobrensis, L. sativa, L. trifolii and *Chromatomyia horticola*	Agromyzid leaf miners	2008	QDAF, Hort Innovation	National
Liriomyza huidobrensis	Serpentine leaf miner	2009	PHA	National – production nurseries
Lissachatina fulica (Achatina fulica)	Giant African snail	2015	NGIA	National – ornamentals, vegetables, legumes
Lissorhoptrus oryzophilus	Rice water weevil	2005	NSW DPI	National – rice industry
Lissorhoptrus oryzophilus	Rice water weevil	2008	PHA	National – rice industry
Lygus lineolaris	Tarnished plant bug	2011	PHA/DAWR	National – production nurseries
Lymantria dispar	Asian gypsy moth/gypsy moth complex	2002	Department of Agriculture, NSW DPI	National
Lymantria dispar dispar	Gypsy moth (Asian and European strains)	2009	PHA	National – production nurseries
Magnaporthe grisea	Rice blast	2005	DAFWA, NSW DPI	National – rice industry
Magnaporthe grisea	Rice blast	2008	PHA	National – rice industry
Maize dwarf mosaic virus (*Potyvirus*)	Maize dwarf mosaic virus	2011	PHA	National – grains industry
Mayetiola destructor	Hessian fly	2005	DAFWA, PHA	National – grains industry
Mayetiola hordei	Barley stem gall midge	2008	PHA	National – grains industry
Meromyza americana and *M. saltatrix*	Wheat stem maggots	2009	PHA	National – grains industry
Nysius huttoni	Wheat bug	2008	PHA	National – grains industry
Paracoccus marginatus	Papaya mealy bug	2011	PHA	National – papaya industry
Peronosclerospora philippinensis and *P. sorghi*	Downy mildew of maize and sorghum	2009	PHA	National – grains industry
Phakopsora euvitis	Grapevine leaf rust	2006	QDAF	National
Phyllophaga spp.	May beetle	2008	PHA	National – grains industry
Phytophthora ramorum	Sudden oak death	2010	PHA	National – production nurseries
Plum pox virus (*Potyvirus*) and *Tobacco etch virus* (*Potyvirus*)	Aphid-transmitted viruses	2011	PHA	National – production nurseries
Pomacea canaliculata	Golden apple snail	2008	PHA	National – rice industry
Potato spindle tuber viroid	Potato spindle tuber viroid (PSTVd)	2012–13	DEDJTR	State – eradication plan
Psila rosae	Carrot rust fly	2009	DAFWA, Hort Innovation	National – vegetable industry

Table 53. Contingency plans

Pest scientific name	Pest common name	Year	Location of document	Scope
Puccinia graminis f. sp. *tritici* (pathotype Ug99)	Stem rust of wheat	2009	PHA	National – grains industry
Puccinia psidii sensu lato	*Eucalyptus* rust	2009	PHA	National – production nurseries
Puccinia striiformis f. sp. *hordei*	Barley stripe rust	2010	NSW DPI, PHA	National – grains industry
Pyrenophora teres f. sp. *teres*	Net form of net blotch	2009	PHA	National – grains industry
Red clover vein mosaic virus (*Carlavirus*)	Red clover vein mosaic virus	2008	PHA	National – grains industry
Scirpophaga spp.	Top borer	2008	SRA	National – sugarcane industry
Sesamia spp.	Sugarcane and maize borers	2008	SRA	National – sugarcane industry
Sitobion avenae	Wheat aphid	2009	PHA	National – grains industry
Sitona spp. complex, especially *S. lineatus*	Pea leaf weevil	2005	DAFWA, PHA	National – grains industry
Solenopsis invicta	Red imported fire ant	2013	QDAF, NBC	National
Solenopsis invicta	Red imported fire ant	2013	QDAF, TACC	State
Thekopsora minima	Blueberry rust	2014	DEDJTR	State
Tilletia barclayana	Kernel smut of rice	2008	PHA	National – rice industry
Tilletia contraversa	Dwarf bunt of wheat	2007	DAFWA, PHA	National – grains industry
Tilletia indica	Karnal bunt	2006	DAFWA, NSW DPI	National – grains industry
Tilletia indica	Karnal bunt	2013–14 draft	PIRSA	State
Tilletia indica	Karnal bunt	2005	PHA	National – grains industry
Trogoderma granarium	Khapra beetle	2005	DAFWA, PHA	National – grains industry
Tropilaelaps clareae and *T. mercedesae*	*Tropilaelaps* mites	2012	PHA	National – honey bee industry
Uredo rangelii	Myrtle rust	2012–13	DEDJTR	State
Uredo rangelii	Myrtle rust	2015	PIRSA	State
Uromyces pisi and *U. viciae-fabae*	Field pea and lentil rust	2009	PHA	National – grains industry
Ustilago scitaminea	Sugarcane smut	1997	SRA	National – sugarcane industry
Various	Various	2015	DEDJTR	National – production nurseries
Varroa destructor and *V. jacobsoni*	*Varroa* mites	2012	PHA	National – honey bee industry
Venturia inaequalis	Apple scab fungus	1992	DAFWA	State
Verticillium longisporum	*Verticillium* wilt of canola	2011	PHA	National – grains industry
Wasmannia auropunctata	Electric ant	2013	QDAF, TACC	State
Xanthomonas citri subsp. *citri*	Citrus canker	2006	QDAF	State – citrus industry
Xanthomonas translucens pv. *translucens* and *X. translucens* pv. *undulosa*	Bacterial leaf streak	2011	PHA	National – grains industry
Xylella fastidiosa	Pierce's disease	2011	PHA	National – production nurseries
Xyllela fastidiosa	Pierce's disease	2002	DEDJTR	National – viticulture industry

TRAINING

For an Emergency Plant Pest response to work effectively there must be a sufficient number of appropriately trained people who understand their role ahead of time. Trained personnel are required at all levels of a response, including representatives from both industry and government and from members of the national decision making committees through to the surveillance officers carrying out field activities.

Delivery of this specialist training in emergency responses is provided by PHA, the Australian Government, state and territory governments, the Plant Biosecurity CRC and peak plant industry bodies. Training is offered in a variety of forms, from short presentations and e-learning courses, through to complete qualifications.

In addition to emergency response training, a range of skills-based training is offered to members of the plant biosecurity system. For example, plant pest diagnostic training is available to members of the National Plant Biosecurity Diagnostic Network to address any identified gaps in skills or capacity.

National Biosecurity Emergency Preparedness Training Specialist Task Group

The National Biosecurity Emergency Preparedness Training Specialist Task Group (TSTG) is a skills-based working group that guides training to enhance Australia's biosecurity emergency preparedness, response and initial recovery arrangements. In it's national capacity, the TSTG identifies risks, gaps and duplication in biosecurity emergency training, and provides advice and support to those undertaking delivery. The TSTG also ensures that biosecurity emergency training is consistent with contemporary emergency management practices.

The TSTG reports to the National Biosecurity Emergency Preparedness Expert Group (NBEPEG) and supports delivery of Schedule 7 of IGAB.

Biosecurity emergency response qualifications

The Biosecurity Emergency Training Working Group (the predecessor to the TSTG) developed three biosecurity emergency response qualifications, which have been nationally endorsed as part of the Public Safety Training Package. These qualifications align with the emergency response role training already delivered by jurisdictions, allowing personnel undertaking this training to achieve formal qualifications based on their work experience and training achievements.

These qualifications put biosecurity response personnel on the same footing as those in other emergency response areas, such as police and firefighters. The system ensures that biosecurity emergency response training across the country meets the desired standard. Qualifications available are:

- PUA33112 – Certificate III in Public Safety (Biosecurity Response Operations)
- PUA42912 – Certificate IV in Public Safety (Biosecurity Response Leadership)
- PUA52412 – Diploma of Public Safety (Biosecurity Response Management).

National EPP Training Program

PHA conducts the National EPP Training Program on behalf of its members, delivering training to industry and government representatives, growers and other biosecurity stakeholders. The aim is to highlight the key elements of the EPPRD and PLANTPLAN, ensuring that members are able to fulfill their roles and obligations as EPPRD Parties.

The National EPP Training Program is delivered through a combination of face-to-face sessions and simulation exercises, which are supported by the e-learning platform BOLT. Access to BOLT is open to all plant biosecurity stakeholders and can be accessed through **www.planthealthaustralia.com.au/bolt.**

Plant Biosecurity Program

Online training also extends to postgraduate studies with the Plant Biosecurity Program **www.plantbiosecurity.edu.au,** which is coordinated by the PBCRC and supported by the Department of Agriculture and Water Resources. Students can undertake a Graduate Certificate of Biosecurity, Graduate Diploma of Biosecurity, Masters of Biosecurity or Masters of Food Security.

The Plant Biosecurity Program is delivered through five Australian universities: Charles Darwin University, La Trobe University, Murdoch University, the University of Queensland and the University of Adelaide.

Image courtesy of Natalie O'Donnell.

Chapter 5

Research, development and extension

The science that underpins plant biosecurity makes a significant contribution to how plant pests are managed. Australian research is needed to provide answers to problems that Australian producers are facing.

As a result, significant investment is made in plant biosecurity research, development and extension (RD&E). Extension is the term for communicating research and development outcomes to allow uptake of the newly developed knowledge, process or product.

RD&E activities are conducted by a number of research institutions including CSIRO, Research and Development Corporations, Cooperative Research Centres, the Australian Government, state and territory agencies as well as universities, plant industries and private organisations.

PHA developed the National Plant Biosecurity RD&E Strategy to ensure that valuable research funding is spent efficiently and effectively.

This chapter catalogues the key organisations carrying out plant biosecurity RD&E and lists the projects active in 2015.

Image courtesy of Plant Breeding Institute.

5.1 National Plant Biosecurity RD&E Strategy

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

Until recently, there has been no overarching framework coordinating the research that is done. PHA devised the National Plant Biosecurity RD&E Strategy in 2013 in collaboration with stakeholders around Australia, 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 pests that may enter, emerge, establish or spread within Australia, by strengthening biosecurity research, development and extension for Australia's plant industries and those dependent on them.

Since 2014 an Implementation Committee has been bringing the strategy to life. The Committee is comprised of representatives from the Australian Government, state governments, PHA, Hort Innovation, and the following research organisations: Council of Rural Research and Development Corporations, GRDC, CSIRO and PBCRC. With administrative support from PHA, the Committee has an independent chair and reports to the AGSOC Research and Innovation Committee.

The committee has developed a strategic framework identifying the outcomes sought, key focus areas and specific activities to commence implementation and delivery of the strategy.

Plant biosecurity research at the Elizabeth Macarthur Agricultural Institute, one of the research organisations that will benefit from the implementation of the RD&E Strategy.

Image courtesy of PBCRC.

5.2 Australian Government RD&E

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 (DAWR) but also through the Department of Industry, the Department of Environment and the Department of Foreign Affairs and Trade.

AUSTRALIAN GOVERNMENT AGENCIES AND STATUTORY AUTHORITIES

Australian Centre for International Agricultural Research
www.aciar.gov.au

The Australian Centre for International Agricultural Research (ACIAR) was established to help identify agricultural problems in developing countries, and to commission collaborative RD&E, 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.

ACIAR's biosecurity projects are spread across several program areas, including crop protection, horticulture, agricultural systems, economics and management, crop improvement and management, forestry, agricultural development, support for market driven adaptive research, soil management and crop nutrition.

Australian Research Council
www.arc.gov.au

The Australian Research Council (ARC) is an independent agency within the Australian Government's Education and Training portfolio. The ARC administers the National Competitive Grants Program; administers Excellence in Research for Australia; and provides advice to the Minister 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.

Commonwealth Scientific and Industrial Research Organisation
www.csiro.au

CSIRO is Australia's innovation catalyst, Australia's national science agency and one of the largest and most diverse research organisations in the world. CSIRO creates value for customers through innovation that delivers positive impacts for Australia. CSIRO feeds into Australia's plant biosecurity system via its Health and Biosecurity, and Agriculture business units together with its National Research Collections.

CSIRO's successes include:

- Diagnosing devastating pests and diseases in plants.
- Improving biosecurity infrastructure.
- Designing integrated strategies to manage invasive pests in agriculture.
- Providing rigorous risk analysis protocols.
- Delivering biological control for many exotic weeds that are found in production landscapes and the wider environment.

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.

The Plant Biosecurity Cooperative Research Centre (PBCRC) is the one CRC that is directly related to plant production.

Plant Biosecurity CRC
www.pbcrc.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 analysis, modelling and agricultural engineering.

PBCRC is a collaborative venture with 27 government, industry and research participants from: DAWR; the Bio-Protection Research Centre New Zealand; CAB International; CBH Group; Charles Darwin University; CSIRO; the Department of Agriculture and Food, Western Australia; the Department of Economic Development, Jobs, Transport and Resources, Victoria; GrainCorp Operations Limited; the Grains Research and Development Corporation;

Horticulture Innovation Australia Limited; 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; Plant Health Australia; 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 Viterra 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. PBCRC commenced its six-year term on 1 July 2012, following on from the Cooperative Research Centre for National Plant Biosecurity, which began operating in November 2005.

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. There are 15 rural RDCs in operation covering almost all of Australia's 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.

Cotton Research and Development Corporation
www.crdc.com.au

The Cotton Research and Development Corporation (CRDC) was established in 1990 and is a partnership between the Australian Government and the Australian cotton industry. CRDC's purpose is to invest in RD&E projects that support the performance of the cotton industry, helping to increase both productivity and profitability.

The cotton industry has always placed great emphasis on the value of its RD&E and the results speak for themselves. Over the past 10 years alone, RD&E has helped cotton growers reduce their pesticide use by 87 per cent, and increase their water use efficiency by 40 per cent. Thanks to RD&E, Australian cotton growers are now growing more cotton on less land and with less impact upon the environment. Biosecurity is a key focus of CRDC's investment.

TAPPAS – Computer modelling wind borne threats

Long distance spread of pests such as insects via wind currents is a recognised pathway into Australia, particularly in the north. But knowing when and where to check for these exotic pests has been difficult up until now, with the launch in 2015 of TAPPAS—Tool for Assessing Pest or Pathogen Airborne Spread—which is able to predict dispersal patterns.

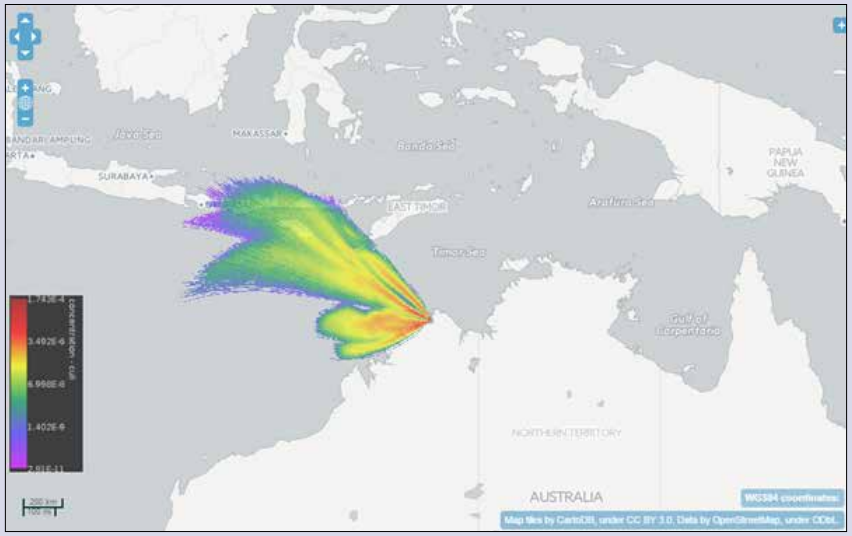
Wind dispersion models are important tools for predicting where and how quickly air pollutants, such as volcanic ash, pollen load, or an accidental chemical release may spread.

Pest or pathogen dispersion is different to dust or pollutant dispersion because living organisms respond differently within the atmosphere. They might die if it is too hot or cold, if the wind is too turbulent, or if they are susceptible to ultra-violet light. All these organism-specific parameters need to be taken into account to establish if there is a biosecurity risk.

TAPPAS links to high performance computers that have access to global air circulation information from the Bureau of Meteorology, the dispersion model HYSPLIT and knowledge of the biology of the organism.

It produces a series of maps showing the risk of dispersal over a period of time, pinpointing the ideal times and locations to undertake surveillance for potential wind borne threats.

TAPPAS is a collaboration between CSIRO, the Bureau of Meteorology and Intersect.



TAPPAS visualisation to determine if an exotic pest found in Kalumburu, WA could have travelled from Indonesia on the wind. Image courtesy of CSIRO.

Forest and Wood Products Australia
www.fwpa.com.au

Forest and Wood Products Australia (FWPA) is an industry service company that provides a national 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 competiveness of forest and wood products. FWPA is funded by private companies and government agencies within the Australian forest and wood products sector, with the exception of pulp and paper manufacturers.

Grains Research and Development Corporation
www.grdc.com.au

The GRDC is a leading grains research organisation, responsible for planning, investing in, and overseeing RD&E across the Australian grains industry. Funding is provided through a levy on grain growers, which is matched (up to a specified limit) by the Australian Government.

GRDC's research portfolio covers 25 leviable crops, spanning temperate and tropical cereals, oilseeds and pulses, which are worth over $11.5 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.

Wine Australia
www.research.wineaustralia.com

Wine Australia supports a competitive wine sector by investing in RD&E, growing global demand 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.

Horticulture Innovation Australia (Hort Innovation)
www.horticulture.com.au

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

Hort Innovation's key functions include:

- Providing leadership to and promote the development of the Australian horticulture sector.
- Increasing the productivity, farm gate profitability and global competiveness of the horticultural industries by investing grower levies and government funds in RD&E and 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.

Hort Innovation was established following the acceptance of the recommendations of an independent review of Horticulture Australia Limited (HAL) 2014. The financial and other assets of HAL were transferred to HIA under the *Horticulture Marketing and Research and Development services (Transfer of Industry Assets and Liabilities) Regulation 2014.*

Rural Industries Research and Development Corporation
www.rirdc.gov.au

Rural Industries Research and Development Corporation (RIRDC) was set up by the Australian Government to work closely with Australian rural industries regarding the organisation and funding of their RD&E needs. The focus of RIRDC is on new and emerging industries as a way to diversify rural enterprises in Australia. This role is enhanced by responsibility for the RD&E for a range of established rural industries and for key generic issues concerning the rural sector.

RIRDC is involved in a number of investments with their industries in biosecurity RD&E, including:

- incursion risk analysis
- biosecurity planning
- pest management
- weed management
- resistance breeding
- containment
- adoption of knowledge
- emergency response.

Sugar Research Australia
www.sugarresearch.com.au

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.

Monash University School of Biological Sciences. Image courtesy of Ros Gleadow.

Image courtesy of CSIRO.

5.3 State and territory government RD&E

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 region. These organisations carry out a significant proportion of Australia's agricultural RD&E. As well as research projects done to meet state and territory government needs, projects are often commissioned by commercial clients.

Monash University School of Biological Sciences. Image courtesy of Ros Gleadow.

5.4 University and private research institution RD&E

In every state and territory, Australia has a number of universities that provide research and education services for the community. Within universities, research often addresses local and regional issues. Research is funded by governments, industry, domestic or international sources, and is often carried out in partnership with other organisations.

Private research institutions are often established in collaboration with a university to provide research facilities and services in specific subject areas. These organisations generate and contain specialist knowledge and research skills in areas of particular significance to the Australian community and plant production industries.

5.5 Plant biosecurity RD&E in 2015

In 2015, a substantial amount of RD&E that benefits plant biosecurity occurred across Australia. Data collection methods have improved for this edition of the National Plant Biosecurity Status Report, improving the reliability of the data presented here over previous years. Research organisations and funders have reported more than 570 projects that directly support the development and enhancement of the national plant biosecurity system.

Table 53 gives a complete listing of plant biosecurity related research projects that were active during 2015. RD&E projects are presented by affected crop type, pest type, biosecurity area, research type and project size in Figures 79-83.

Research projects covered the spectrum of crops and pest types relevant to Australian plant production industries, with a similar distribution to the RD&E projects captured in the 2014 edition of this report. The highest proportion of projects were categorised as pest management.

Figure 79. RD&E projects by crop type

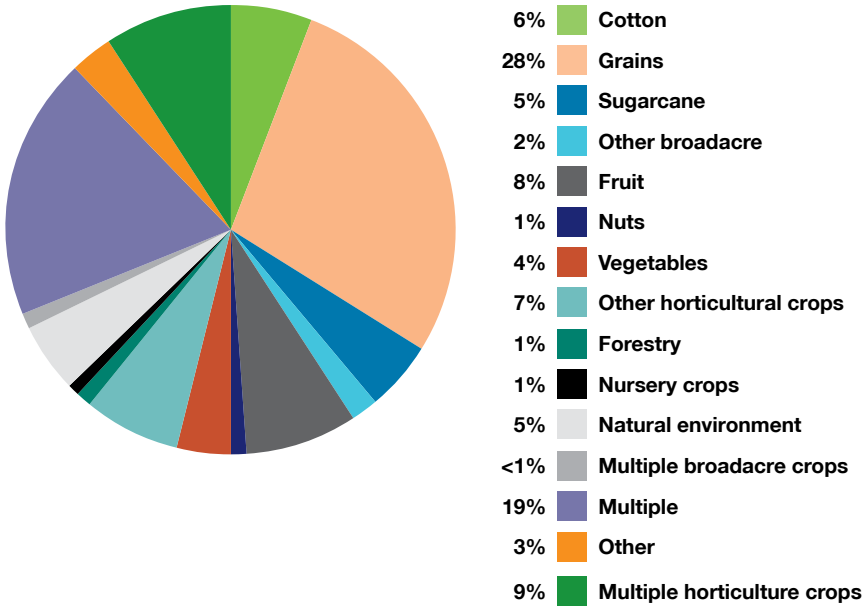


Figure 80. RD&E projects by pest type

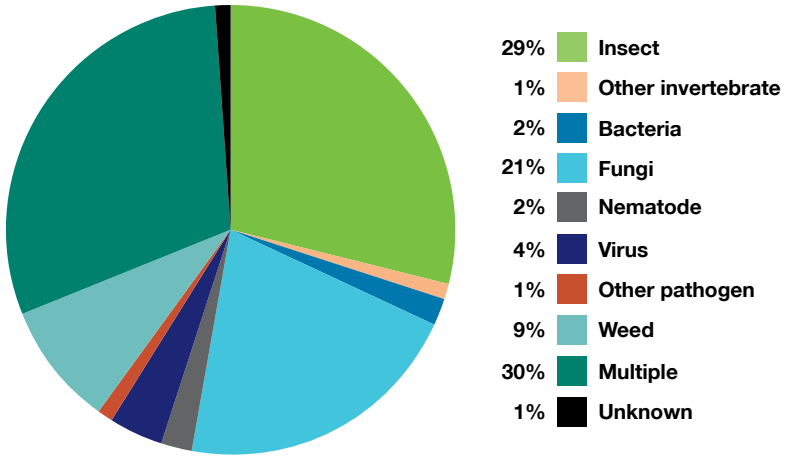


Figure 81. RD&E projects by biosecurity area

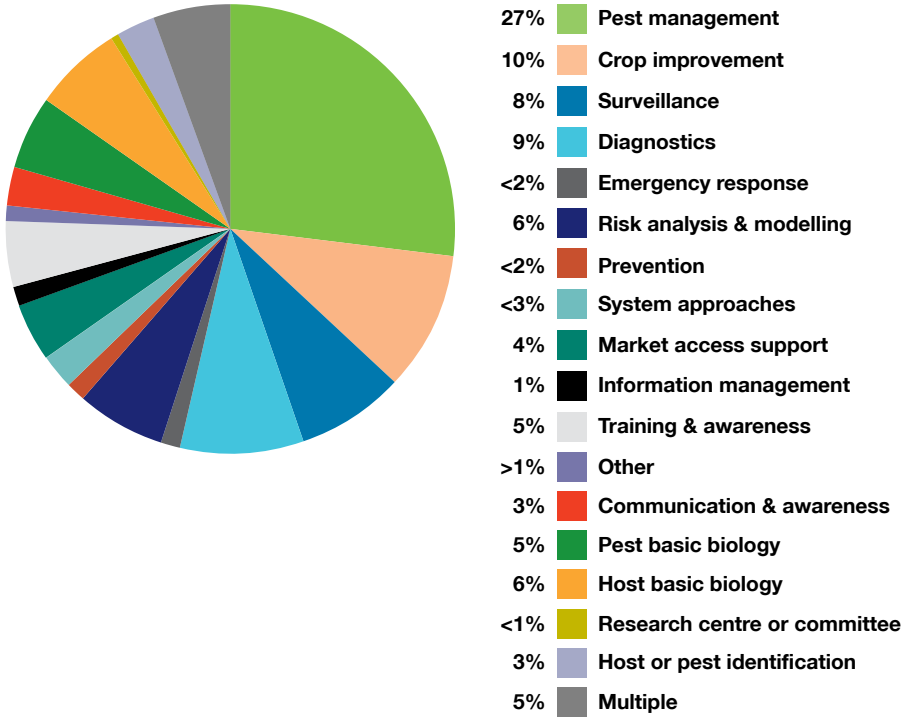


Figure 82. RD&E projects by research type or location

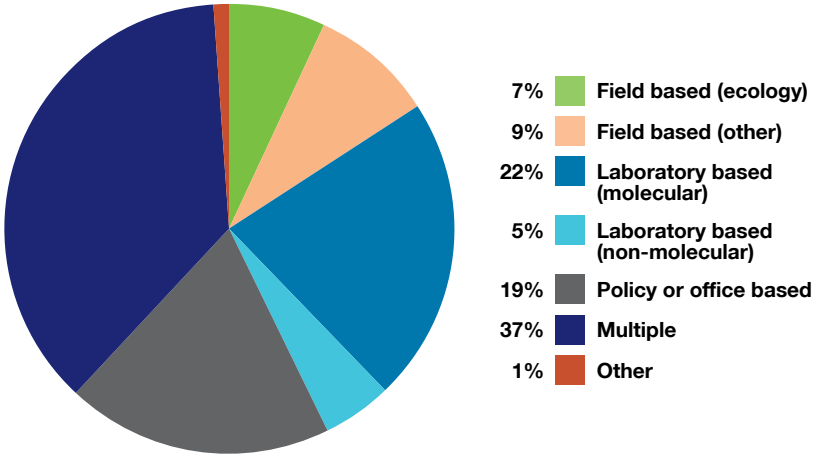
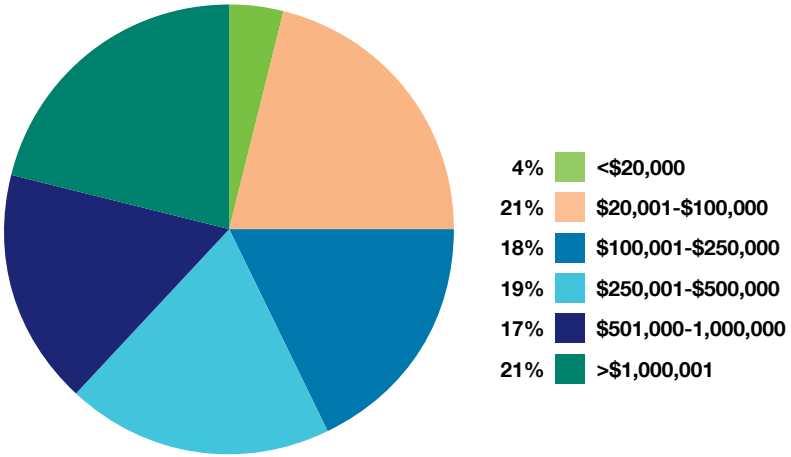


Figure 83. RD&E projects by project size



Research, development and extension projects

Image courtesy of Sam Simons.

Table 54. Plant biosecurity research projects

Project title	Organisation undertaking the research	Funding source/ body
Broadacre – Cotton		
Aphids, mites and mirids in cotton 2014–2019	NSW DPI	CRDC
Australian cotton production and best practice web documentaries	QDAF	CRDC
Biosecurity training for growers & agronomists	CA	CRDC
Conventional insecticide resistance in *Helicoverpa*	NSW DPI	CRDC, NSW DPI
Crop Protection Development Specialist	QDAF	CRDC
Development of eco-friendly alternatives for crop pest management	University of Queensland	ARC
Disease of Cotton XI	NSW DPI	CRDC
Enhancing IPM in cotton systems	CSIRO	CRDC, CSIRO
Establishing Southern Cotton – IPM	NSW DPI	CRDC, NSW DPI
Fusarium wilt management in cotton	QDAF	CRDC, QDAF
Hard to control weeds in northern farming systems	NSW DPI	CRDC, NSW DPI
Helicoverpa egg collecting in cotton regions to support *Bt* and insecticide resistance monitoring	CCA	CRDC
Helicoverpa punctigera in inland Australia – what has changed?	University of New England	CRDC
Host plant relationships of green mirids – is alternative control possible?	University of Queensland	CRDC
Identification of beneficials attacking silverleaf whitefly and green vegetable bug	CSIRO	CRDC
Identifying potential lepidopteran pests in *Bt* cotton	CSIRO	CRDC
Investigating the risk of mycotoxin contamination in Australian cotton production systems	NSW DPI	CRDC
Management of mirids, stinkbugs and *Solenopsis* mealybug	QDAF	CRDC, QDAF
Molecular genetic methods to detect neonicotinoid resistance in cotton aphid	NSW DPI	CRDC
Molecular VCG	NSW DPI	CRDC
Monitoring to manage resistance to *Bt* toxins	CSIRO	CRDC, CSIRO
Multiple host use and gene-flow in green vegetable bug relative to cotton crop	University of Queensland	CRDC
National Cotton Extension Development & Delivery Crop Protection	QDAF	CRDC, QDAF
National Cotton Extension Development & Deliver – Stewardship of biotechnologies	CRDC	CRDC
Neonicotinoid study (PhD)	NSW DPI	CRDC
Networking remote diagnostics for the Australian cotton industry	PBCRC	CRDC
Silverleaf whitefly resistance monitoring	QDAF	CRDC, QDAF
Staying ahead of weed evolution in changing cotton systems	QAAFI	CRDC, QDAF
Substitutes for pupae busting – commercial scale trials of moth busting	University of New England	CRDC
Surveillance and monitoring for endemic and exotic virus diseases of cotton	QDAF	CRDC, QDAF
Surveillance for exotic cotton viruses: multiple targets in and nearby Australia	QDAF	CRDC
Sustainable resistance management of mites, aphids and mirids in Australian cotton	NSW DPI	CRDC, NSW DPI
Updating and expanding Weedpak in support of the cotton industry & myBMP	NSW DPI	CRDC, NSW DPI
Viruses, vectors & endosymbionts: Exploring interactions for control whitefly-transmitted cotton viruses	University of Queensland, QDAF	CRDC
Broadacre – Grains		
Accelerating the utilisation and deployment of durable adult plant resistance to leaf rust in barley	University of Sydney	GRDC
ACRCP3 Durable Genes	University of Sydney	GRDC
ACRCP3 Molecular Genetics	CSIRO	GRDC
ACRCP3 National Breeding Support	University of Sydney	GRDC
ACRCP3 Rust Surveillance	University of Sydney	GRDC
Advancement of new genes for stem and leaf rust resistance from uncultivated relatives of wheat (continuation)	University of Adelaide	GRDC
An integrated approach to manage pests and resistance to phosphine in stored grain	QDAFF	PBCRC
Aphid and insecticide resistance management in oil seed and pulse crops	cesar Pty Ltd	GRDC

Table 54. Plant biosecurity research projects

Project title	Organisation undertaking the research	Funding source/ body
Assessing collections of wild chickpea relatives for resistance to root-lesion nematodes	University of Southern Queensland	GRDC
Assessing the biology impacts of wheat-infecting *Botryosphaeria* spp. (PhD)	Australian National University	GRDC
Australian Cereal Rust Control Program – Towards 2019 and a century of monitoring cereal rust pathogens in Australia	University of Sydney	GRDC
Australian Herbicide Resistance Initiative (phase 5)	University of WA, QDAF	GRDC
Australian Wheat and Barley Molecular Marker Program – Genetic Analysis	University of Adelaide	GRDC
Barley germplasm progression	QDAF	GRDC
Beneficial Microbes Program 2 – progressing new microbial products for Australian grain production to commercialisation	Flinders University	GRDC
Biological control of snails	CSIRO	GRDC
Cereal and pulse cultivar resistance ratings for the Southern region	DEDJTR	GRDC
Characterisation of a major quantitative trait locus on wheat chromosome 3BL responsible for *Fusarium* crown rot resistance	University of WA	ARC
Characterisation of effector proteins from necrotrophic fungal wheat pathogens	Australian National University	GRDC
Chemical residues of stored grain	Murdoch University	PBCRC
Combining monitoring and incursion surveillance for grains	NSW DPI	PBCRC
Components of immunity to *Stagnospora nodurum* in wheat (PhD)	Australian National University	GRDC
Agricultural management options for herbicide resistant weeds	QDAF, Charles Sturt University	GRDC
DAN00175: National crown rot epidemiology and management	DEDJTR	GRDC/DAFWA/ NSW DPI/SARDI/ QDAF/DEDJTR/ University of WA
DAN00202: Virus threats: New tools and germplasm for Australian pulse and oil seeds breeding programs	DEDJTR	GRDC/DAFWA/ NSW DPI/SARDI/ QDAF/DEDJTR/ University of WA
DAQ00187: National barley foliar pathogen variety initiative program	DEDJTR	GRDC/DAFWA/ NSW DPI/SARDI/ QDAF/DEDJTR/ University of WA
DAS00137: National improved molecular diagnostics for disease management	DEDJTR	GRDC/DAFWA/ NSW DPI/SARDI/ QDAF/DEDJTR/ University of WA
DAV00128: National Nematology Project	DEDJTR	GRDC/DEDJTR
DAV00129: Grain crop disease management in Victoria	DEDJTR	GRDC/DEDJTR
DAV00134: Diagnostic services for pulse germplasm enhancement and breeding programs	DEDJTR	GRDC/DEDJTR
DAV00136: NVT: Increasing grower management of crop diseases through resistance knowledge	DEDJTR	GRDC/DEDJTR
DAV00144: Cereal and pulse cultivar resistance ratings for the southern region	DEDJTR	GRDC/DEDJTR
DAW00228: National pathogen management modelling and delivery of decision support	DEDJTR	GRDC/DAFWA/ NSW DPI/SARDI/ QDAFF/University of WA/DEDJTR
DAW00245: Impacts of host resistance on disease-induced yield loss	DEDJTR	GRDC/DAFWA/ NSW DPI/SARDI/ QDAFF/University of WA/DEDJTR
DAW00247: Germplasm enchangement for yellow spot resistance	DEDJTR	GRDC/DAFWA/ NSW DPI/SARDI/ QDAFF/University of WA/DEDJTR
Delivery and adoption of nitrogen/low oxygen and nitrogen + phosphine technology for the management of grain storage pests and grain quality	Murdoch University	PBCRC
Deployment of a synthetic amorphous silica product for the control of grain storage pests	PBCRC	PBCRC
Developing tools for in-field surveillance of pathogens	SARDI	PBCRC
Development of gene deployment strategies: using evolutionary principles to optimise the deployment of genetic resistance in crops	CSIRO	GRDC

Table 54. Plant biosecurity research projects

Project title	Organisation undertaking the research	Funding source/ body
Broadacre – Grains *continued*		
Development of genetic tools for Australian barley crops against leaf rust	University of Sydney	GRDC
Development of tools to accelerate nematode resistance gene deployment	University of Adelaide	GRDC
Genetic characterization of *Tilletia indica* for development of simpler, sensitive and high throughput diagnostic assay for quarantine	NSW DPI, Ramaciotti Centre for Functional Genomics, University of NSW and CSIRO	NSW DPI, CSIRO, Ramaciotti Centre for functional genomics
Diamondback moth control and insecticide resistance management	SARDI	GRDC
Digital systems for pest identification and surveillance in grains	PBCRC	PBCRC
Disease Screening Service (Fee for Service)	DEDJTR	Fee for Services provider to Australian grains industry
DNA marker development and their use in monitoring and eradication of phosphine resistance in stored grain pests (PhD)	University of Queensland	PBCRC
Ecology of *Sitophilus* and *Cryptolestes* species	QDAF, University of Queensland, DAFWA, NSW DPI, Kansas State University, Viterra Ltd	PBCRC
Effective control of barley yellow dwarf virus in wheat	University of Tasmania	GRDC
Effective genetic control of *Septoria tritici blotch*	NSW DPI	GRDC
Effective genetic control of *Stagonospora nodorum blotch*	WAAA	GRDC
Emerging foliar diseases of canola	University of WA	GRDC
Evaluating chlorine dioxide (PhD)	Kansas State University	PBCRC
Evaluation of chlorine dioxide and ozone to control stored product insects	Kansas State University	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
FACE – Pathology	DEDJTR	GRDC, DEDJTR
Field trials of attract-and-kill for diamondback moth	University of New England	GRDC
Fungicide control of *Rhizoctonia*	SARDI	GRDC
Fungicide insensitivity in rusts	NSW DPI	Collaborative Research
Fungicide resistance management strategy and communications	Curtin University of Technology	GRDC
Fungus and rust red flour beetles – Identifying the fungal volatiles attractive to *Tribolium castaneum* (PhD)	University of Queensland	PBCRC
Future NIPI 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
Genetic options for nematode control in the southern region	SARDI	GRDC
Grain economic analyses for biosecurity	University of WA	PBCRC
Grain e-surveillance project	DAFWA	Royalties for regions and DAFWA
Grain industry delivery sites	PBCRC, QDAF	PBCRC
Grain storage extension	QDAF	GRDC
Grain Weeds Advisory Committee	Rural Directions Pty Ltd	GRDC
Grains surveillance and diagnostic tools	SARDI	PBCRC
Harvest weed seed control for the southern region	Southern Farming Systems	GRDC
Herbicide tolerance screening in the Northern Region (phase IV)	QDAF	GRDC

Table 54. Plant biosecurity research projects

Project title	Organisation undertaking the research	Funding source/ body
Identification and utilisation of novel sources of resistance to crown rot and the root lesion nematodes in adapted spring and durum wheat	CIMMYT	GRDC
Identifying DAFF-intercepted *Cryptolestes* and an 'unknown' *Cryptolestes* in New South Wales and Queensland stored grain	CSIRO	PBCRC
Identifying unknown *Cryptolestes*	CSIRO	PBCRC
Impact of seeding time and *Pratylenchus neglectus* on *Rhizoctonia* fungicide yield responses	SARDI	SAGIT
Improved fungicide use for cereal rust control	Foundation for Arable Research	GRDC
Improved herbicide efficacy and longevity in southern no-till farming systems	University of Adelaide	GRDC
Improved management of snails and slugs	SARDI	GRDC
Improved resistance to oat pathogens and abiotic stress management	SARDI	GRDC
Improving grower surveillance, management, epidemiology knowledge and tools to manage crop disease	QDAF, University of Southern Queensland	GRDC
Improving grower surveillance, management, epidemiology knowledge and tools to manage crop disease – QDAF	University of Southern Queensland	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 IWM practice in the northern region	University Of Queensland	GRDC
Improving IWM practice of 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
Increasing skills in cereal rust pathology and genetics in the developing world	University of Sydney	Bill and Melinda Gates Foundation
Inducing suppression of *Fusarium* crown rot complexes	CSIRO	GRDC
Insecticidal surface coatings to control pests of stored grains	QDAF	PBCRC
Integrated genetic solutions to crown rot in wheat	University of Sydney	GRDC
Integrated strategy to manage phosphine resistance	QDAF	PBCRC
Integration of control methods and information on ecology of insects of stored grain into a systems approach for insect control on-farm and in bulk storages	QDAF, NSW DPI, GrainCorp	PBCRC
Investigating the role of gamma-aminobuturic acid in pathogenicity of fungal wheat diseases (PhD)	Australian National University	GRDC
Investigation of new control options for phosphine resistant pests of stored grain	University of Queensland	PBCRC
IPM training	QDAF	GRDC
IWM extension northern region	Independent Consultant Australia Network	GRDC
Linking crop protection, weeds and native vegetation management: on-the-ground NRM action to benefit grain growers	CSIRO	GRDC
Maintaining a barley pre-breeding capability in Queensland	QDAF	GRDC
Management of insecticide resistance in RLEM and screening new MoA chemistry	University of Melbourne	GRDC
Management of spray drift through inversion risk awareness	WAAA	GRDC
Managing crop disease – Improving cereal (wheat and barley) root disease resistance supplement	SARDI	GRDC

Table 54. Plant biosecurity research projects

Project title	Organisation undertaking the research	Funding source/ body
Broadacre – Grains *continued*		
Managing crop disease – Improving chickpea pathogen resistance (PRR)	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 of Technology	GRDC
Mechanisms, evolution and inheritance of resistance	University of Adelaide	GRDC
Modelling VaporPhos and ProFume distribution in bulk storages to improve efficacy against insects	Kansas State University	PBCRC
Molecular markers for broadening the genetic base of stem rust resistance genes effective against strain Ug99	University of Sydney	ACIAR
Molecular markers for pulse breeding programs	DEDJTR	GRDC
More than defence: primary roles for cyanogenic glucosides	Monash University	ARC
National Barley Foliar Pathogen Variety Improvement Program	QDAF	GRDC
National Brassica Germplasm Improvement Program (phase II)	NSW DPI	GRDC
National coordination of invertebrate pest research and insecticide resistance management	University of Melbourne	GRDC
National improved molecular diagnostics for disease management	SARDI	GRDC
National monitoring program for resistence to chemicals in stored grain pests	QDAF, NSWT&I, WAAA, Kansas State University, PHA, GrainCorp	PBCRC
National Variety Trials (NVT) Service Agreement	QDAF	GRDC
Network analysis of post-border pest spread (PhD)	Lincoln University	PBCRC
New fungicide technologies for crown rot management	SARDI	GRDC
New knowledge to improve the timing of pest management decisions in grain crops	CSIRO Entomology	GRDC
New strategies for disease resistance to wheat stripe rust	NSW DPI	Collaborative Research
New technology for stored grain pest management (phase 2)	Queensland University of Technology	GRDC
New tools and germplasm for Australian pulse and oil seeds breeding programs to respond to changing virus threats	NSW DPI	GRDC
New tools and germplasm for Australian pulse and oilseeds breeding programs to respond to changing virus threats	QDAF, NSW DPI	GRDC
New tools for field grains surveillance and diagnostics of high priority pests	SARDI, QDAF, DEDJTR	GRDC, PBCRC
New uses for existing chemistry	Southern Farming Systems	GRDC
Non-chemical method for stored grain (PhD)	Murdoch University	PBCRC
Non chemical management of stored grain pests and strategy for phosphine resistance	Murdoch University	PBCRC
Non-chemical technologies to protect grain (PhD)	Kansas State University	PBCRC
Northern NSW integrated disease management	NSW DPI	GRDC
Northern pulse and grains IPM	QDAF	GRDC
NZ rust pathotype survey	NSW DPI	PBCRC
Options for improved insecticide and fungicide use and canopy penetration in cereals and canola	University of WA	GRDC
PBCRC3114: Adoption of new treatments and combination of treatments for stored grain	DEDJTR	PBCRC, University of Queensland, QDAF, DEDJTR
PestFax Map II National	WAAA	GRDC
Phosphine distribution modelling (PhD)	Kansas State University, DAFWA	PBCRC
Pre-emptive chickpea pre-breeding for biotic stresses and germplasm enhancement for abiotic stresses	ICARDA	GRDC

Table 54. Plant biosecurity research projects

Project title	Organisation undertaking the research	Funding source/ body
'Proof of concept' for approaches designed to increase disease resistance to fungal pathogens of canola	University of Melbourne	GRDC
Pulse Germplasm Enhancement Program – Resistance to biotic stresses	DEDJTR	GRDC
Reforming an integrated Australasian cereal rust surveillance system	NSWT&I	PBCRC
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
Smart-trap design and deployment strategies (PhD)	Kansas State University	PBCRC
Smart-use of fertilisers to minimise and manage the risk of pest infestations in growing canola	University of Western Australia	GRDC
Strategies to provide resistance to the economically important fungal pathogen, *Rhizoctonia solani*	CSIRO	GRDC
Strength and spatio-temporal dynamics of resistance to phosphine and contact insecticides in key stored grain pests in Australia and USA	QDAF, NSW DPI, DAFWA, Kansas State University, PHA, Graincorp	PBCRC
Surveillance of herbicide resistant weeds in Australian grain cropping	Charles Sturt University	GRDC
The role of weedy hosts in disease incidence and emergence in barley	QDAF	GRDC
Towards genome methylation based crop improvement	University of Queensland	ARC
Understanding disease resistance mechanisms across the Brassicaceae	University of Queensland	ARC
Use of ProFume gas fumigant in Australian grain storages	QDAF	Dow AgroSciences
Weed surveillance	QDAF	GRDC
White grain disorder in wheat	SARDI	GRDC
Yield loss response curves for host resistance to leaf, crown and root diseases in wheat and barley	WAAA, QDAF	GRDC
Zea mays model and *Phytophthora cinnamomi*	Deakin University	Australian Government
Broadacre – Sugarcane		
A novel polyphasic framework to resolve yellow canopy syndrome paradox	University of Western Sydney	SRA, QDAF
Advancing yield, disease resistance and ratooning by exploiting new sources of genetic variability from wild relatives of sugarcane	SRA	SRA, QDAF
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
Development of controlled-release formulations of imidacloprid for canegrub control	SRA	SRA, Nufarm
Diagnostic laboratory for ratoon stunting disease	SRA	SRA
General pathology diagnostic, training and technical advice: Tully	SRA	SRA
General pathology diagnostic, training and technical advice: Woodford	SRA	SRA
General pest management: Central Qld	SRA	SRA
General pest management: North Qld	SRA	SRA
General pest management: South Qld	SRA	SRA
Innovative approaches to identifying the cause of chlorotic streak and new management strategies	SRA	SRA, QDAF
International and domestic quarantine for sugarcane germplasm	SRA	SRA
Investigation of smut resistance mechanisms in sugarcane	CSIRO	SRA
Leaf sucrose: the link to diseases, physiological disorders such as YCS and sugarcane productivity	SRA	SRA, QDAF
Mass production of the Adelina disease to better manage greyback canegrubs	SRA	SRA
New germplasm to develop more productive varieties with enhanced resistance to nematodes, *Pachymetra* root rot and smut	SRA, CSIRO	SRA, QDAF, CSIRO
Pachymetra awareness project for Condong mill area	NSW CANEGROWERS	SRA

Table 54. Plant biosecurity research projects

Project title	Organisation undertaking the research	Funding source/ body
Broadacre – Sugarcane *continued*		
Preparing the Australian sugar industry for threats from exotic pests and diseases	SRA	SRA, QDAF, Ramu Agri-Industries (RAIL)
Rapid detection of ratoon stunting disease	CSIRO	SRA, QDAF
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
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 PNG biosecurity threats	SRA	SRA, QDAF, RAIL
SmutBuster: accelerated breeding of smut resistant sugarcane varieties	SRA	SRA
Soil diagnostic assay laboratory: nematodes and *Pachymetra* root rot	SRA	SRA
Solving the yellow canopy syndrome	SRA	SRA, DAFQ
Strategies to manage soil-borne fungi and mitigate sugarcane yield decline	CSIRO	SRA
Validation of LSB-PCR diagnostic for ratoon stunting disease and characterisation of non-Lxx strains of *Leifsonia* associated with sugarcane	NSW Sugar	SRA
What biological factors causes or drive the development of YCS	SRA	SRA
Broadacre crops – Other		
Australian rice weed management	Agropraisals Pty Ltd	RIRDC
Breaching the defences: the role of hydrophobin protein monolayers in rice blast fungal infections	University of Sydney	ARC
Characterisation of rice blast races present in Australia	University of WA	RIRDC
Hydrophobin proteins on the fungal frontline	University of Sydney	ARC
Improved rice biosecurity	NSW DPI	RIRDC
Improved subterranean clover seed production from multiple disease resistance	University of WA	RIRDC
Improving pest and disease biosecurity in the Australian rice industry	NSW DPI	RIRDC
Isolation and functional characterisation of a pathogen meta effector able to inhibit detection of multiple disease effectors by resistant plants	Australian National University	ARC
Knowledge transfer and uptake of new practices for pest management in irrigated rice	Charles Darwin University	PBCRC
Molecular basis of rust infection and host plant resistance	Australian National University	ARC
Potential exotic virus threats to lucerne seed production in Australia	University of Queensland	RIRDC
The co-evolution of wild rice and its pathogens, especially *Pyricularia* spp. (PhD)	University of Queensland	PBCRC
Rice weed resistance testing	Charles Sturt University	RIRDC
Broadacre crops – Multiple		
Can genetic diversity predict the potential for emergent glyphosate resistance?	University of Queensland	CRDC
Forestry		
Asian Gypsy Moth – National Surveillance Program	QDAF	QDAF
Collaboration with Korean University and Quarantine Department to evaluate EDN for nematode control on logs	Murdoch University	Korean Government
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 State, NSW DPI, Forestry Tasmania
Exotic forest pest surveillance scoping study	NSW DPI	Commonwealth Grants via Allocation
Genome-wide determination of *Puccinia psidii* s.l. rust resistance in eucalypts	University of Melbourne	ARC
Giant Pine Scale Eradication Program	DEDJTR	DEDJTR
Horticulture – Fruit		
A generic approach to improving spray coverage	University of Queensland	AGWA
An inventory of *Colletotrichum* species infecting tropical and subtropical fruit crops in Australia based on molecular phylogenetics	QDAF	ABRS

Table 54. Plant biosecurity research projects

Project title	Organisation undertaking the research	Funding source/ body
AP15001: Integrated pest and disease management – PIPs II	DEDJTR	Hort Innovation, DEDJTR
Banana Bunchy Top Virus (phase 2)	Australian Banana Growers' Council	Hort Innovation
Banana Plant Protection Program	University of Queensland, QDAF	Hort Innovation
BS10029: Developing virus molecular diagnostics for post entry quarantine and certification of strawberry runners	DEDJTR	Hort Innovation
Child 10: DAF – Multi-scale monitoring tools for managing Australian tree crops: industry meets innovation	QDAF	Hort Innovation
Collaboration with Korean University and Quarantine Department to evaluate ethyl formate plus phosphine for aphid control on pineapple	Murdoch University	Korean Government
Detection and prevention of scab disease (PhD)	La Trobe University	PBCRC
Detection and prevention of scab disease in Asian and European pears	La Trobe University	PBCRC, La Trobe University
Development of molecular diagnostic tools to detect endemic and exotic pathogens of *Prunus* species for Australia	La Trobe University, DEDJTR	Hort Innovation
Development of disease management recommendations for blueberry production	NSW DPI	Hort Innovation
Disinfestation of citrus with ethyl formate	Murdoch University	PBCRC
Effect of pre-harvest fungicides on post-harvest decay of papaya	QDAF	HAL
Enhancing Australia's capability and capacity to diagnose *Fusarium oxysporum* f. sp. *cubense* Tropical Race 4	NSWT&I	PBCRC
Evaluate the potential for low-dose methyl bromide as a postharvest disinfestation treatment for citrus	QDAF	Hort Innovation
Evaluating the sugar flotation method for testing cherries for Queensland fruit fly	NSW DPI	Hort Innovation
Evaluation of citrus varieties	NSW DPI	Collaborative Research
Export market scoping study for the lychee industry	Trade and Investment Queensland	Hort Innovation
Final proof of zero infestation in fresh fruit for export	NSW DPI	Hort Innovation
Fusarium oxysporum f.sp. *cubense* on banana	University of Queensland	Hort Innovation, ABGC, PBCRC, University of Queensland
Fusarium oxysporum on strawberry	QDAF, University of Queensland	QDAF, University of Queensland
Fusarium wilt Tropical Race 4 – Biosecurity and sustainable solutions	QDAF	Hort Innovation
Fusarium wilt Tropical Race 4 – Research Program	QDAF	Hort Innovation
Gold3 cold disinfestation	NSW DPI	Private industry
Host-pathogen interactions in the *Venturia-Pyrus* pathosystem	La Trobe University	New Zealand Institute for Plant and Food Research (PFRNZ)
Improved diagnostic tools for AUSCITRUS	NSW DPI	Horticulture Innovation Australia Ltd
Improving soil health in support of sustainable development in the Pacific	QDAF	ACIAR
Improving yield and quality in avocado through disease management (phase 2)	QDAF, University of Queensland	Hort Innovation
In-line approaches to control surface pests of concern from export citrus	PFRNZ	Hort Innovation
Integrated crop management strategies for papaya in the Phillipines and Australia	QDAF	ACIAR
Integrated management of yellow sigatoka and other banana diseases in far north Qld	Australian Banana Growers Council	Hort Innovation
Low dose methyl bromide against fruit flies to improve market access for summerfruit	QDAF	Hort Innovation
Mass-trapping methods for codling moth females in disrupted orchards	DEDJTR	Hort Innovation
Mechanically transmitted DNA virus control of *Botrytis*	PFRNZ	PBCRC
MRL risk analyses and risk management options for major citrus export markets	AKC Consulting Pty Ltd	Hort Innovation

Table 54. Plant biosecurity research projects

Project title	Organisation undertaking the research	Funding source/ body
Horticulture – Fruit *continued*		
MRL risk analyses for major export markets of the pome fruit industry	AKC Consulting Pty Ltd	Hort Innovation
National Citrus Postharvest Science Program	SARDI	Hort Innovation
Overcoming passionfruit viruses	QDAF	Hort Innovation
Panama disease – Longitudinal analysis of community wellbeing	CSIRO	CSIRO
Pineapple model and *Phytophthora cinnamomi*	Deakin University	Deakin University
Precise recognition for automated harvesting and grading of strawberries	Griffith University	ARC
Protecting Australia's citrus genetic material	NSW DPI	Collaborative Research
Scoping herbicide impacts on banana production and soil health	QDAF	Hort Innovation
Horticulture – Nuts		
Control of *Carpophilus* beetle in almonds using attract and kill system	DEDJTR	Hort Innovation, DEDJTR
Food safety in almonds	DEDJTR	Hort Innovation, CSIRO
Horticulture – Vegetables		
Alternaria on tomato	University of Queensland	University of Queensland
Bacterial spot of tomatoes (PhD)	La Trobe University, DEDJTR	PBCRC
Broccoli and *Plasmodiophora brassicae*	Deakin University	DEDJTR
Chemical control of WFT in processing tomatos	NSW DPI	Hort Innovation
Detection and management of bacterial diseases in Australian allium crops	QDAF	Hort Innovation
Developing vegetable export opportunities in Asia and the Middle East – 2014	AUSVEG Ltd	Hort Innovation
Disinfestation of tomatoes against Mediterranean fruit fly for interstate market access	WAAA	Hort Innovation
Disinfestation of springtails on celery	Murdoch University	Sumich
Export Readiness Program	AUSVEG Ltd	Hort Innovation
Fruit fly research: gap analysis	Applied Horticultural Research Pty Ltd	Hort Innovation
Fusarium oxysporum on ginger	University of Queensland	RIRDC, QDAF
Improved detection and identification of xanthomonads affecting vegetable crops (PhD)	La Trobe University	PBCRC
Improving productivity of fruiting solanaceous crops through area wide management of insect vectored viruses in Bowen	QDAF	Hort Innovation
Innovating new virus diagnostics and planting bed management in the Australian sweetpotato industry	Australian Sweetpotato Growers Association, QDAF	Hort Innovation
Integrated crop management to enhance vegetable profitability and food security	NSW DPI, QDAF	ACIAR
International acceptance of Australian solanaceous and cucurbit seed tests	PBCRC	PBCRC
Management and detection of bacterial leaf spot in capsicum and chilli crops	QDAF	Hort Innovation
Managing soilborne diseases of onions	SARDI	Hort Innovation
New end-point treatment solutions to control fruit fly	QDAF, NSW DPI	Hort Innovation
PBCRC2148: International acceptance of Australian tomato seed tests	DEDJTR	PBCRC, DEDJTR, NSWT&I, Department of Agriculture
Perceptions towards biosecurity threats across Vietnamese farming communities in Australia (PhD)	Charles Darwin University	PBCRC
Pythium sulcatum on carrot	University of Queensland	University of Queensland
Strengthening biosecurity for the Australian vegetable industry	AUSVEG Ltd	Hort Innovation
Tomato potato psyllid and Liberibacter ecology	PFRNZ	PBCRC
Horticulture crops – Other		
A trial of 'Vapormate' fumigant for the disinfestation of Australian wildflowers	Cedar Hill Flowers	Package assisting small exporters
Assessment of *Pythium* diversity in ginger	University of Queensland	RIRDC
Biology and control of the systemic form of poppy downy mildew	University of Tasmania	DPIPWE

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Project title	Organisation undertaking the research	Funding source/ body
Biology, epidemiology and management of *Elsinoe* leaf spot in tea tree	NSW DPI	RIRDC, ATTIA
Determining pathogenicity and methyl bromide control of ginger nematodes	QDAF	RIRDC
Developing a threat-specific contingency plan for the exotic pest angular leaf scorch	SARDI, Cornell University, University of South Australia	AGWA
Developing and updating diagnostic protocols for key viticulture high priority exotic pest threats	DEDJTR	AGWA
Diet medicated RNAi Sterile Insect Technology	CSIRO	Hort Innovation
Discovery of genetic resistance markers to myrtle rust in Myrtaceae	Australian National University	RIRDC, ANFIL, ATTIA
Disease and Pest Testing Technology	SARDI	SA Government
Effective management of summer root rot of parsley	NSW DPI	Hort Innovation
Elsinoe leaf spot of tea tree	NSW DPI	RIRDC
Epidemiology, impact and management of myrtle rust in lemon myrtle plantations (PhD)	University of Queensland	PBCRC
Evaluating and demonstrating new resistant varieties for warm irrigated regions	CSIRO	AGWA
Genetic transformation of grapevine to test significant abiotic stress and pest resistance genes	CSIRO	AGWA
Grapes e-surveillance project	DAFWA	Royalties for regions and DAFWA
Identification and marker-assisted selection of genes for reducing the susceptibility of new winegrape cultivars to fungal pathogens	CSIRO	AGWA
Improved tissue culture production of clean ginger planting material	QDAF	RIRDC
Improving soil health to suppress soilborne diseases of ginger	QDAF	RIRDC
Improving the sustainability of cocoa production in eastern Indonesia through integrated pest, disease and soil management in an effective extension and policy environment	La Trobe University	ACIAR, La Trobe University
Induced *Pythium* and *Fusarium* resistance in ginger	Hortus	RIRDC
Integrated pest disease management in tea tree oil – Monitoring and extension	RIRDC, ATTIA	RIRDC, ATTIA
Myrtle rust screening in lemon myrtle provenance plantings (part 2)	Sunshine Coast University	RIRDC
National Biosecurity Strategy for the Cut Flower and Foliage Industry	Flower Association of Queensland Inc	Hort Innovation
New rootstocks for Australian conditions	CSIRO	AGWA
Objective measures for powdery mildew	University of Adelaide	AGWA
Phylloxera biosecurity	DEDJTR	AGWA, DEDJTR
Phylloxera rootstock screening	DEDJTR	CSIRO
Practical management of grapevine trunk diseases	SARDI	AGWA
Red blue beetle table grape disinfestation research	Agriculture Victoria Services Pty Ltd	Hort Innovation
Risks and management of exotic and endemic *Phylloxera*	DEDJTR	AGWA
Sampling strategies for *Phylloxera* area freedom	Vinehealth Australia, SARDI	PBCRC
Sampling strategies for sensitive, accurate and cost effective detections of *Phylloxera* for quantifying area freedom status	Grape Industry Board of South Australia	AGWA
Sustaining vineyards through practical management of grapevine trunk diseases	SARDI	New Zealand Winegrowers
Table grape disinfestation	DEDJTR	Hort Innovation
Technical support, extension and minor use development for the ginger industry	AGIA	RIRDC
To develop a National Diagnostic Protocol based on molecular DNA characters to rapidly confirm detection of the grape berry moth *Lobesia botrana* at all life stages	CSIRO	AGWA
Towards elite mildew resistant selections suitable for industry use	CSIRO	AGWA
Understanding fungicide resistance in powdery and downy mildew	SARDI	AGWA

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Project title	Organisation undertaking the research	Funding source/ body
Horticulture – Multiple		
Adaptive area-wide management of Qfly using SIT	CSIRO	Hort Innovation, CSIRO, DAWR
Area wide IPM SIT for the control of Qfly	NSW DPI	Hort Innovation
Blends versus pure chemicals: understanding the mechanisms of host fruit location by Qfly (PhD)	Queensland University of Technology	PBCRC
Characterising *Ilarviruses* of *Prunus* species (PhD)	La Trobe University, DEDJTR	La Trobe University
Comparisons of new sexing strains of Qfly	Macquarie University	International Atomic Energy Agency Co-operative Research Program
Compliance and risk based sampling for horticulture exports	CEBRA	University of Melbourne, DAWR
Creating a novel lure and kill device for Qfly	Queensland University of Technology, QDAF	PBCRC
Decision intelligence determining pest natal origin	NSW DPI, BRCNZ	PBCRC
Desk audit of the Fruit Fly Body of Knowledge – identifying the gaps and strengths of past fruit fly research	NSWT&I	PBCRC
Engaging communities in biosecurity strategies (PhD)	University of WA	PBCRC
Essential Market Access Data Packages	QDAF	Hort Innovation
Establishment of areas of low pest prevalence of Medfly for market access	WAAA	Hort Innovation
Establishment of systems to validate Pest Free Place of Production for Qfly in the Yarra Valley	DEDJTR	Hort Innovation
Farm-wide fruit fly management systems for the east coast of Australia	QDAF	Hort Innovation
Feasibility study on novel lures for pest fruit flies that are non-responsive to known male attractants	QDAF	ACIAR
Fruit fly management incorporating SPLAT Technology	NSW DPI	Hort Innovation
Grape berry moth diagnostics	CSIRO	GWRDC
High density mass Qfly trapping	NSWT&I	PBCRC
Impact of fruit fly populations outside an area wide management zone in Indonesia and Australia	QDAF	ACIAR
Improved postharvest market access treatment for horticultural commodities	PFRNZ, QDAF, NSW DPI	PBCRC
Improving efficacy of MAT to enhance area-wide management of Qfly	Macquarie University	Hort Innovation
Industrial Transformation Training Centre (ITTC), 'Centre for Fruit Fly Biosecurity Innovation'	Macquarie University	ARC
Irradiation doses for mites and thrips on fresh produce	NSW DPI	New Zealand Ministry of Agriculture and Forestry
Larval diets for high-productivity mass-rearing of Qfly for SIT	Macquarie University	Hort Innovation
Male only sterile Qfly (SITplus)	SARDI	Hort Innovation
Molecular basis of response to sublethal stresses	Murdoch University	PBCRC
Mypolonga Fruit Fly Monitoring – Market Access Program	RDA Murraylands & Riverland Inc	Hort Innovation
National Fruit Fly Research, Development and Extension Plan	PBCRC	PBCRC
New and improved fruit fly lures for border security and management	Macquarie University	Hort Innovation
New fruit fly systems for mangoes and market access	DPIF	Hort Innovation
New in-field treatment solutions to control fruit fly	Macquarie University	Hort Innovation
Next generation national fruit fly diagnostics and handbook	QUT, QDAF, WAAA, PHA	PBCRC
OHMA Operational Support 2012 to 2015	Hort Innovation	Hort Innovation
PBCRC2153: Natural dispersal (phase 2)	DEDJTR	PBCRC, DEDJTR, Department of Agriculture, PHA
Pheromone component of a multi target approach to fruitspotting bug management	NSW DPI, QDAF	Hort Innovation

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Project title	Organisation undertaking the research	Funding source/ body
Piloting new techniques to control and eradicate Medfly	DAFWA	Royalties for regions and DAFWA
Post harvest disinfestation using microwave technology	CSIRO	CSIRO, Hort Innovation
Probiotics for enhancing fruit fly SIT	NSW DPI, University of Western Sydney	PBCRC
Providing data packages for new fruit fly control technology	QDAF	Hort Innovation
Research and development of integrated crop management for mango production in the southern Philippines and Australia	QDAF	ACIAR
Risk evaluation and improvements to diagnostics of south-eastern Australian fruit flies	DEDJTR	DEDJTR
Semiochemical-mediated enhancement of sterile male Qfly	NSW DPI	Universities
SITplus - raising Qfly SIT to world standard	Macquarie University	Hort Innovation
Social and institutional aspects of grower participation in area-wide fruit fly management programs in Australian horticulture industries (PhD)	Charles Darwin University	PBCRC
SPLAT Cuelure based management of Qfly	SARDI	Hort Innovation
Strategies for area-wide fruit fly management in Indonesia and Australia	QDAF	ACIAR
Study of NUL 3146 on western flower thrips	NSW DPI	Private industry
Sunraysia Pest Free Area – Qfly response and market access program	DEDJTR	Hort Innovation
Surveillance & management of horticultural crop diseases	NSW DPI	Private industry
Symbionts of Qfly	NSW DPI	Miscellaneous organisations
Natural Environment		
A predictive framework for invaded communities	Monash University	ARC
A weed by any other name? Comparing local knowledge and uses of environmental weeds around the Indian Ocean	Monash University	ARC
Acacia gall rust (PhD)	University of Queensland	PBCRC
Assessing pollination services of honey bees in native ecosystems and threats posed by parasites	James Cook University	ARC
Commercialisation of a bioherbicide for the control of *Parkinsonia aculeata*	University of Queensland, BHA	BHA, Meat & Livestock Australia (MLA)
Controlling aquatic weeds with endothal (multiparty)	DEDJTR	Goulburn Murray Rural Water Corporation, Ord Irrigation Co-operative, Coleambally Irrigation Cooperative, Murrumbidgee Irrigation
Detection of *Rosellinia* spp. on Maquarie Island	University of Tasmania	DPIPWE
Development of a biohebicide for control of prickly acacia	University of Queensland, BHA	MLA & BHA
Development of *Phytophthora cinnamomi* biocontrol agents	University of Queensland	ARC DP
Distribution of *Euphorbia paralias*	University of Wollongong	University of Wollongong
Effectiveness of biocontrol agents for bitou bush	University of Wollongong	University of Wollongong
Eradication of *Phytophthora cinnamomi* from infested haul roads and rehabilitated bauxite mine sites in the *Eucalyptus marginata* forest	Murdoch University	ARC
Evolution and function of terpenes in *Eucalyptus*	Australian National University	ARC
Impact of drawdown on *Egeria* in Lake Mulwala	DEDJTR	Goulburn Murray Rural Water Corporation
Invasion and impact: predicting the causes and consequences of plant invasions	University of Canberra	ARC
Lake Benalla *Cabomba* control	DEDJTR	GBCMA

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Project title	Organisation undertaking the research	Funding source/ body
Natural Environment *continued*		
Linking flow, nutrients, seagrass and fish: an integrated approach to estuary management	Monash University	ARC
Managing myrtle rust and its impact in Australia	QDAF, NSW DPI	PBCRC
Morphological and molecular variation in *Gynaikothrips* on fig trees in Australia, and generic revisions of *Lissothrips* and *Strepterothrips* (Thysanoptera)	QDAF	ABRS
Multi-scale seed dispersal models for improved regional weed management	Monash University	ARC
New invasive species management in wetlands	DEDJTR	DEDJTR
Role of mycorrhizae in invasion	University of Wollongong	University of Wollongong
Sagittaria (phase 2)	DEDJTR	Goulburn Murray Water Corporation, Goulburn Broken CMA, Coleambally Irrigation Cooperative, Murrumbidgee Irrigiation, Murray Irrigation
Tradescantia biocontrol (phases 1 & 2)	DEDJTR	DAWR
Understanding the drivers of aquatic weed success	Macquarie University	Macquarie University
Understanding the mechanisms underpinning range expansion in exotic plant species	Macquarie University	Macquarie University
Wandering *Tradescantia* and *Fraxinus* control	DEDJTR	Melbourne Water
Western Grasslands Project	DEDJTR	DEDJTR
Other		
A risk-return prioritisation tool for global trade inspections	CSIRO	PBCRC
A test for Africanisation in imported honey bee semen	University of Sydney	RIRDC
DECO PILOT: Defence Trade Controls Act	PBCRC	PBCRC, DECO
Get tough, get toxic or get a bodyguard	University of Western Sydney	ARC
Pests and diseases of truffles and their tree hosts in Australia	Australian National University	RIRDC
Solutions & understanding African whitefly	CSIRO	NRI
Systematic gene silencing and relevance to plant biology	University of Queensland	ARC
Tracing the evolutionary history of plant developmental mechanisms	Monash University	ARC
Transcriptome analysis of *Phytophthora*-plant interactions: characterisation of plant inhibitor proteins targeting *Phytophthora* extracellular effectors	Australian National University	ARC
Understanding the role of small RNA pathways in plant defence against fungal pathogens (PhD)	Australian National University	CSIRO
UV influence on interactions of *Hyaloperonspora parastica* on *Arabidopsis*	Deakin University	Deakin University
Nursery Crops		
Plant health risk management, planning and capacity building for the nursery industry	QDAF	Hort Innovation
Understanding the evolution of fungicide resistance for durable control of fungal pathogens in *Pyrethrum*	University of Tasmania	ARC
Multiple		
Advancing collaborative knowledge systems for plant biosecurity surveillance	CSIRO	PBCRC
Agricultural weed surveillance in the south west to protect industry profitability	DAFWA	Royalties for regions, DAFWA
Air inversion modelling to manage spray drift	Micrometeorlogical Research and Educational Services	GRDC
Analytical assessment of leakage surveys	CEBRA	University of Melbourne, DAWR
Anticipating, combating and exploiting the evolution of pesticide resistance in Australian agricultural pests and disease vectors	Australian National University	ARC
Arabidopsis and *Plasmodiophora brassicae*	Deakin University	DEDJTR
Automated insect monitoring for pest management	CSIRO	CRDC
Autonomous fruit fly traps	CSIRO	CSIRO
Big data analytics for biosecurity	CSIRO	CSIRO

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Project title	Organisation undertaking the research	Funding source/ body
Biopesticide use and insect resistance in Australian agriculture	University of Adelaide	ARC
Candidatus Liberibacter solanacearum on Norfolk Island	QDAF	PBCRC
Centre for Fruit Fly Biosecurity Innovation	Macquarie University	ARC Industrial Transformation Training Centre
Citizen science to surveillance	CSIRO	PBCRC
Collaborative planning and shared decision making amongst stakeholders	QDAF	PBCRC
Collaboration with Indian Department of Agriculture to evaluate different treatment methods for Khapra beetle	Murdoch University	Indian Government
Co-management of the Greater Sunraysia Pest Free Area for market access	DEDJTR	Hort Innovation
Crop Hygiene – Hort Indexing	DEDJTR	Fee for Services provider to Australian Horticultural Industries
Curtailing exotic fungal spore incursions (PhD)	DAFWA, University of WA	PBCRC
Data mining to improve biosecurity risk profiling	CEBRA	University of Melbourne, DAWR
Deciphering the role of microRNAs during pathogen attack: new concepts for disease resistance in plants	University of Queensland	ARC
Decision making for eradication and quarantine	Queensland University of Technology	PBCRC
Delivery of an integrated internet-based bioinformatics toolkit for plant biosecurity diagnosis and surveillance of viruses and viroids	Murdoch University	PBCRC
Deployment of validated genome-informed bacterial diagnostics	NSW DPI	PBCRC
Design and evaluation of targeted biosecurity surveillance systems	University of WA	PBCRC
Determining the relative sensitivity and contribution of criteria in prioritising the plant pests along the biosecurity continuum	CEBRA	University of Melbourne, DAWR
Develop an attractant specific to *A. cerana* Java strain	University of Newcastle	RIRDC
Developing an alternative herbicide management strategy to replace PSII herbicides in the Wet Tropics area	SRA, James Cook University	SRA, QDAF
Development of pre-emptive APVMA emergency permits for exotic plant pest incursion containment and control	PHA	GRDC
DITA regulation (West Indian drywood termite)	QDAF	QDAF
DNA barcoding *Echium* weed	NSW DPI	Universities
Do informal networks represent a biosecurity risk? (PhD)	Murdoch University	PBCRC
Ecological impact of myrtle rust (*Puccinia psidii*) in native and managed ecosystems (PhD)	NSW DPI, Macquarie University	PBCRC
Emerging viruses in agriculture: development of a network for biosecurity and biosurveillance to support food security	La Trobe University, DEDJTR	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, Charles Sturt University	ACIAR
Engagement in resilience in indigenous communities	PFRNZ	PBCRC
Extended genetic effects of eucalypt plant secondary metabolites on communities and ecosystems	University of Tasmania	ARC
Evolution of multiple herbicide resistance is widespread in *Lolium rigidum* in Australia	University of WA	ARC
Evolutionary aerial robotics	CSIRO	CSIRO
Front line field plant pest diagnostic service for horticultural and broadacre cropping industries	QDAF	QDAF
Future climates northern Tablelands biosecurity	CSIRO	NSW DPI
Global threat to agriculture from invasion	CSIRO	CSIRO

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Project title	Organisation undertaking the research	Funding source/ body
Multiple *continued*		
Grand challenge designing aphid	CSIRO	University of Melbourne
Identification of immune receptor and signalling proteins from plants	Australian National University	ARC
Identification of novel insecticidal molecules from Australian native plants	La Trobe University, Hexima Ltd	Industry
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 2,4D herbicide resistance in the economically important weed *Raphanus raphanistrum* (wild radish)	University of Western Australia, Newfarm	ARC
Implementation of new fumigation technology into industry supply chain	Murdoch University	PBCRC
Import clearance performance management	CEBRA	University of Melbourne, DAWR
Intelligence gathering and analysis	CEBRA	University of Melbourne, DAWR
Intelligence tools for regulated goods traded via e-commerce	CEBRA	University of Melbourne, DAWR
Intelligent image retrieval from distorted and partial queries for rapid mobile identification of pests threatening food and the environment	Griffith University	ARC
Investigation into the possible recent incursion of an insecticide-resistant biotype of green peach aphid into Australia	CSIRO	GRDC
Knowledge systems for surveillance	CSIRO	PBCRC
Making Green Guard® greener: enhancing the efficacy of a biopesticide	University of Sydney	ARC
Management of new industry minor use permits – A transition to industry ownership	Agaware	RIRDC
Market-based incentives for biosecurity compliance	CEBRA	University of Melbourne, DAWR
Molecular basis of synergy between proteinase inhibitors and plant and animal defensins against fungal pathogens	La Trobe University, Hexima Ltd	Industry, ARC Discovery
Nanoassembling agrochemicals – A new paradigm in delivery for enviro-friendly crop treatment	Monash University	ARC
National weed biological control project	DEDJTR	DAWR, MLA, DEDJTR, NSW DPI, CSIRO, QDA
New approaches for diagnosing bacterial pathovars	Kansas State University, La Trobe University, DEDJTR, NSW DPI	PBCRC, DEDJTR
New tools for insect surveillance and eradication	PFRNZ	PBCRC
New Zealand psyllids (PhD)	Lincoln University	PBCRC
Novel insecticide resistance in green peach aphid	CSIRO	Hort Innovation, GRDC
Optimising surveillance protocols using unmanned aerial systems	Kansas State University, QDAF	PBCRC
Pathways and Risk Assessment Framework for High Impact Species	CSIRO	PBCRC
PBCRC rating system for myrtle rust	NSW DPI	PBCRC
PBCRC2110: Design and evaluation of targetted biosecurity surveillance systems	DEDJTR	PBCRC, University of WA, DEDJTR, WAAA, PFRNZ, PGIB
Peptide toxins from animal venoms specifically targeting voltage-gated sodium channels as novel analgesics and pesticides	Australian National University	NHMRC
Pest and Disease Image Library	PBCRC	PBCRC, DAWR
Phytophthora cinnamomi and native vegetation	Deakin University	DAWR, Parks Victoria
Pilot study of the application of portfolio resource allocation tools to support biosecurity investment decision making	Australian National University	DAWR
Plant and associated microbiome responses to indoleamines and potential applications in agriculture	La Trobe University	La Trobe University

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Project title	Organisation undertaking the research	Funding source/ body
Plant Laboratory Diagnostics Services	DEDJTR	DEDJTR
Plant-product pathways and the continuous sampling plan	CEBRA	University of Melbourne, DAWR
Provision of plant biosecurity capacity development services for the Sub-Saharan Africa	PBCRC	ACIAR
Psyllid microflora – Implications for Liberibacter disease surveillance and pest control (PhD)	La Trobe University	PBCRC
Psyllids as biosecurity threats to plantation and native eucalypts in Australia and internationally	La Trobe University	ARC
Real-time plant discrimination and weed detection platform	Edith Cowan University	ARC
Redesign of bee surveillance	CSIRO	DAWR
Reduced herbicide usage through application technology	Edith Cowan University	GRDC
Reducing impact of *Nosema*	CSIRO	RIRDC
Remote sensing for biosecurity surveillance	CSIRO	CSIRO
Risk assessment for the large African hive beetle	University of Sydney	RIRDC
Risk maps for optimising biosecurity surveillance	CEBRA	University of Melbourne, DAWR, Ministry for Primary Industries, New Zealand
Semiochemical management for occasional pests of cotton and grains	University of New England	CRDC
Structural basis of host-pathogen interactions	La Trobe University	ARC
The culture of weeds: invasion biology, identity and aesthetics in Australia	Australian National University	ARC
The effects of damage and repair of fungal DNA on animal and plant diseases	University of Melbourne	ARC
The Trojan Female Technique: a novel non-lethal approach for pest population control	Monash University	New Zealand Ministry of Business, Innovation and Employment
Tools and approaches for invasive species distribution modelling for surveillance	CEBRA	University of Melbourne, DAWR
Torres Strait risk and resource allocation project	CEBRA	University of Melbourne, DAWR
Towards the first wearable microscope	Australian National University	PBCRC
TraitCapture: genomic modelling for plant phenomics under environmental stress	Australian National University	ARC
Transport risk pathways for emerging invasive species	University of Adelaide	ARC
Understanding the biochemical and molecular mechanisms of glyphosate and glufosinate resistance in *Elausine indica*	University of WA	ARC
Unique epigenetic states in plant stem cell niches for safeguarding genome integrity	University of WA	ARC
Update Australian Plant Pest Database	NSW DPI	PBCRC
Upgrading knowledge on pathogens (particularly viruses) of Australian honey bees	CSIRO	RIRDC
Use of citizen science surveillance	CSIRO	PBCRC
Using cutting edge technology to develop diagnostic capability for Khapra beetle and dermestids including different geographical strains	Murdoch University	Chinese Government
What makes some genotypes invasive	CSIRO	CSIRO
Wind spread of plant viral pathogens into northern Australia	University of WA, DAFWA, CSIRO	PBCRC
With the benefit of hindsight: a bioeconomic analysis of past pest incursions	University of WA, University of Queensland, NSW T&I	PBCRC
Yellow crazy ant eradication in and next to the Wet Tropics World Heritage Area	James Cook University	Wet Tropics Management Authority

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Project title	Organisation undertaking the research	Funding source/ body
Levy-funded projects		
Development of a code of practice and national bee biosecurity program	PHA	RIRDC
Development of an Australian bee health and management website	PHA	RIRDC, Australian Honey Bee Industry Council
Extending biosecurity preparedness and surveillance strategies and developing a chemical supply framework for pest incursions	PHA	PBCRC
National bee pest surveillance program (2013-15) and facilitator	PHA	RIRDC
National fruit fly strategy implementation advisory group	PHA	Hort Innovation
National honey bee pest surveillance program	PHA	Hort Innovation
Protecting Australia's citrus industry from biosecurity threats	PHA	Hort Innovation, Citrus Australia Ltd
Grains Farm Biosecurity Program	PHA	Grain Producers Australia Ltd
Review of the biosecurity plan for the citrus industry	PHA	Hort Innovation, Citrus Australia Ltd
Review of the biosecurity plan for the cotton industry	PHA	CRDC, PHA
Development of a tomato industry biosecurity plan	PHA	Hort Innovation, Australian Processing Tomato Research Council, Northern Victoria Fresh Tomato Industry Development Council
Development of a blueberry industry biosecurity plan	PHA	Hort Innovation, Australian Blueberry Growers' Association
Review of the biosecurity plan for the tree nut industry	PHA	Hort Innovation, Australian Nut Industry Council, macadamia and almond R&D levies
Review of the biosecurity plan for the cutflower industry	PHA	Hort Innovation, Flower Association of Queensland Inc
Review of the biosecurity plan for the pineapple industry	PHA	Hort Innovation, Growcom
Review of the biosecurity manual for beekeepers	PHA	NSWWA, Beekeepers Association of the ACT, Wheen Bee Foundation, Amateur Beekeepers Association of NSW, AHBIC and the Victorian Apiary Industry Advisory Committee, via DEDJTR
Enhancing capacity to identify and respond to high priority exotic pests	PHA	DAWR
Developing a response strategy for exotic stink bugs	PHA	DAWR
National surveillance system for weeds and plant pests: virtual coordination centre	PHA	DAWR
Next generation national fruit fly diagnostics and handbook	PHA, Queensland University of Technology, QDAF, DAFWA	PBCRC
Determining equivalent zones of agriculture for the generation of registration data	PHA, AEA, CSIRO	GRDC
Extending chemical usefulness 'spray application technologies project'	PHA	GRDC
The facilitation of Category 25 submissions in the Australian grain industry	PHA	GRDC

Appendices

Organisation contact details

Organisation	For more information
AgNova Technologies	**www.agnova.com.au/** +61 3 9899 8100
Almond Board of Australia	**www.australianalmonds.com.au** +61 8 8584 7053
Apple and Pear Australia	**www.apal.org.au** +61 3 9329 3511
Atlas of Living Australia	**www.ala.org.au** +61 2 6246 4061
Australasian Plant Pathology Society	**www.appsnet.org** +61 7 4632 0467
Australian Agency for International Development – Department of Foreign Affairs and Trade	**www.dfat.gov.au** +61 2 6261 3111
Australian Banana Growers' Council	**www.abgc.org.au** +61 7 3278 4786
Australian Bureau of Agricultural and Resource Economics and Sciences – Department of Agriculture and Water Resources	**www.agriculture.gov.au/abares** +61 2 6272 3933
Australian Centre for International Agricultural Research	**www.aciar.gov.au** +61 2 6217 0500
Australian Entomological Society	**www.austentsoc.org.au** +61 3 9895 4462
Australian Forest Products Association	**www.ausfpa.com.au** +61 2 6285 3833
Australian Honey Bee Industry Council	**www.honeybee.org.au** +61 7 5467 2265
Australian Lychee Growers Association	**www.australianlychee.com.au** +61 417 639 927
Australian Macadamia Society	**www.australian-macadamias.org** +61 2 6622 4933
Australian Mango Industry Association	**www.industry.mangoes.net.au** +61 7 3278 3755
Australian Melon Association Inc.	**www.melonsaustralia.org.au** +61 413 101 646

Organisation	For more information
Australian National University Research Services	**www.services.anu.edu.au/business-units/research-services-division** + 61 2 6125 9569
Australian Olive Association	**www.australianolives.com.au** +61 8 8573 6545
Australian Pesticides and Veterinary Medicines Authority	**www.apvma.gov.au** +61 2 6210 4701
Australian Processing Tomato Research Council	**www.aptrc.asn.au** +61 3 5825 4633
Australian Research Council	**www.arc.gov.au** +61 2 6287 6600
Australian Society for Microbiology	**www.theasm.org.au** +61 1300 656 423
Australian Table Grape Association	**www.australiangrapes.com.au** +61 3 4009 0127
Australian Walnut Industry Association	**www.walnut.net.au** +61 418 664 672
AUSVEG	**www.ausveg.com.au** +61 3 9882 0277
Avocados Australia	**www.industry.avocado.org.au** +61 7 3846 6566
Canegrowers Australia	**www.canegrowers.com.au** +61 7 3864 6444
Canned Fruits Industry Council of Australia	**www.planthealthaustralia.com.au/industries/canned-fruit/**
Centre of Excellence for Biosecurity Risk Analysis	**www.cebra.unimelb.edu.au** +61 3 8344 4405
Central Queensland University	**www.cqu.edu.au** +61 7 4930 9777
cesar pty ltd	**www.cesaraustralia.com** +61 3 9349 4723
Charles Darwin University	**www.cdu.edu.au** +61 8 8946 7766
Charles Sturt University	**www.csu.edu.au** +61 1800 334 733

Organisation	For more information
Cherry Growers of Australia	**www.cherrygrowers.org.au** +61 3 6231 1229
Chestnuts Australia	**www.chestnutsaustralia.com.au** +61 3 5751 1466
Citrus Australia	**www.citrusaustralia.com.au** +61 3 5023 6333
Commonwealth Scientific and Industrial Research Organisation	**www.csiro.au** +61 1300 363 400
Cotton Australia	**www.cottonaustralia.com.au** +61 2 9669 5222
Cotton Research and Development Corporation	**www.crdc.com.au** +61 2 6792 4088
Council of Australasian Weed Societies	**www.caws.org.au** +61 8 9821 3246
Curtin University	**www.curtin.edu.au** +61 8 9266 9266
Deakin University	**www.deakin.edu.au** +61 3 5227 2673
Department of Agriculture and Water Resources	**www.agriculture.gov.au** +61 2 6272 3933
Department of Agriculture and Food, Western Australia	**www.agric.wa.gov.au** +61 8 9368 3333
Department of Agriculture and Fisheries, Queensland	**www.daf.qld.gov.au** +61 13 25 23
Department of Economic Development, Jobs, Transport and Resources, Victoria	**www.economicdevelopment.vic.gov.au** +61 136 186
Department of Foreign Affairs and Trade	**www.dfat.gov.au** +61 2 6261 1111
Department of Primary Industries and Fisheries, Northern Territory	**www.dpif.nt.gov.au** +61 8 8999 206
Department of Primary Industries and Regions, South Australia	**www.pir.sa.gov.au** +61 8 8226 0995
Department of Primary Industries, New South Wales	**www.dpi.nsw.gov.au** +61 1800 808 095

Organisation	For more information
Department of Primary Industries, Parks, Water and Environment, Tasmania	**www.dpipwe.tas.gov.au** +61 1300 368 550
Department of Environment	**www.environment.gov.au** +61 2 6274 1111
Dried Fruits Australia	**www.driedfruitsaustralia.org.au** +61 3 5023 5174
Edith Cowan University	**www.ecu.edu.au** +61 13 43 28
Emergency Plant Pest Response Deed, Plant Health Australia	**www.planthealthaustralia.com.au/epprd** +61 2 6215 7700
Exotic Plant Pest Hotline	+61 1800 084 881
Farm Biosecurity	**www.farmbiosecurity.com.au** +61 2 6215 7700
Farm Biosecurity Manuals, Plant Health Australia	**www.planthealthaustralia.com.au/about-us/documents** +61 2 6215 7700
Flinders University	**www.flinders.edu.au** +61 8 8201 3911
Forest and Wood Products Australia	**www.fwpa.com.au** +61 3 9927 3200
Graincorp	**www.graincorp.com.au** +61 2 9325 9100
Grain Producers Australia	**www.grainproducers.com.au** +61 2 6273 3000
Grains Research and Development Corporation	**www.grdc.com.au** +61 2 6166 4500
Griffith University	**www.griffith.edu.au** +61 7 3735 7111
Growcom	**www.growcom.com.au** +61 7 3620 3844
Hazelnut Growers of Australia	**www.hazelnuts.org.au** +61 2 6379 1616
Horticulture Innovation Australia	**www.horticulture.com.au** +61 2 8295 2300

Organisation contact details

Organisation	For more information
International Plant Protection Convention	**www.ippc.int**
James Cook University	**www.jcu.edu.au** +61 7 4781 4111
La Trobe University	**www.latrobe.edu.au** +61 1300 528 7623
Macquarie University	**www.mq.edu.au** +61 2 9850 7111
Monash University	**www.monash.edu.au** +61 3 9902 6000
Murdoch University	**www.murdoch.edu.au** +61 8 9360 6000
New South Wales State Forests	**www.forestrycorporation.com.au** +61 1300 655 687
Northern Australia Quarantine Strategy, Department of Agriculture and Water Resources	**www.agriculture.gov.au/biosecurity/quarantine/naqs** +61 1800 900 090
Nursery and Garden Industry Australia	**www.ngia.com.au** +61 2 8861 5100
Onions Australia	**www.onionsaustralia.org.au** +61 8 8725 8862
Passionfruit Australia	**www.passionfruitaustralia.org.au** +61 439 596 174
Pistachio Growers Association	**www.pgai.com.au** +61 428 922 576
Plant Biosecurity Cooperative Research Centre Ltd	**www.pbcrc.com.au** +61 2 6201 2882
Plant Breeding Institute, University of Sydney	**www.sydney.edu.au/agriculture/plant_breeding_institute/index.shtml** +61 2 9351 8800
Plant & Food Research, Australia Plant & Food Research, New Zealand	**www.plantandfood.com.au** **www.plantandfood.co.nz** +64 9 925 7000
Plant Health Australia	**www.planthealthaustralia.com.au** +61 2 6215 7700

Organisation	For more information
PLANTPLAN, Plant Health Australia	**www.planthealthaustralia.com.au/plantplan** +61 2 6215 7700
Queensland University of Technology	**www.qut.edu.au** +61 7 3138 2000
Raspberries and Blackberries Australia	**www.arga.com.au** +61 407 242 757
Ricegrowers' Association of Australia	**www.rga.org.au** +61 2 6953 0433
Rural Industries Research and Development Corporation	**www.rirdc.gov.au** +61 2 6271 4100
South Australian Research and Development Institute	**www.pir.sa.gov.au/research** +61 8 8303 9400
Strawberries Australia	**www.strawberriesaustralia.com.au**
Subcommittee on Domestic Quarantine and Market Access	**www.domesticquarantine.org.au** +61 2 6215 7700
Subcommittee on National Plant Health Surveillance	**www.agriculture.gov.au/plant/health/committees/snphs** +61 1800 900 090
Subcommittee on Plant Health Diagnostic Standards	**www.plantbiosecuritydiagnostics.net.au/sphds** +61 2 6272 4568
Sugar Research Australia	**www.sugarresearch.com.au** +61 7 3331 3333
Summerfruit Australia	**www.summerfruit.com.au** +61 2 6041 6641
Tasmanian Institute of Agriculture	**www.utas.edu.au/tia** +61 3 6226 6368
Territory and Municipal Services, Australian Capital Territory	**www.tams.act.gov.au** +61 13 22 81
Trade and Market Access Division, Department of Agriculture and Water Resources	**www.agriculture.gov.au/market-access-trade** +61 1800 900 090
University of Adelaide	**www.adelaide.edu.au** +61 8 8313 4455

Organisation	For more information
University of Canberra	**www.canberra.edu.au** +61 2 6201 5111
University of Melbourne	**www.unimelb.edu.au** +61 3 13 6352
University of New England	**www.une.edu.au** +61 2 6773 3333
University of New South Wales	**www.unsw.edu.au** +61 2 9385 1000
University of Queensland	**www.uq.edu.au** +61 7 3365 1111
University of Sunshine Coast	**www.usc.edu.au** +61 7 5430 1234
University of Sydney	**www.sydney.edu.au** +61 1800 793 864
University of Tasmania	**www.utas.edu.au** +61 3 6226 2999
University of Western Australia	**www.uwa.edu.au** +61 8 6488 6000
University of Western Sydney	**www.westernsydney.edu.au** +61 2 9852 5222
University of Wollongong	**www.uow.edu.au** +61 2 4221 3555
Vine Health Australia	**www.vinehealth.com.au** +61 8 8273 0550
Viterra Ltd	**www.viterra.com.au** +61 1800 018 205
Weeds of National Significance	**www.weeds.org.au/WoNS** +61 3 6344 9657
Wine Grape Growers Australia	**www.wgga.com.au** +61 8 8133 4400
Wine Australia	**www.wineaustralia.com** +61 8 8228 2000
Wine Australia Research and Development Corporation	**www.research.wineaustralia.com** +61 8 8228 2000

Glossary

Term	Definition
Appropriate Level of Protection	The level of protection deemed appropriate by a country establishing a sanitary or phytosanitary measure to protect human, animal and plant life or health within its territory.
Area freedom	Absence of a specific pest in a specified location.
Biosecurity	The protection of the economy, environment and human health from the negative impacts associated with entry, establishment or spread of exotic pests.
Biosecurity activities	Activities undertaken to manage biosecurity risks.
Biosecurity continuum	The range of biosecurity activities and arrangements that are undertaken in pre-border, border and post-border locations.
Border	In relation to the biosecurity continuum: airports, seaports and land borders that represent the potential point of entry for a pest into Australia.
Commonwealth	The Commonwealth of Australia, including its external territories.
Contingency plans	Management plans that outline pest specific information for use in the event of an emergency response.
Diagnostic protocols	Protocols that describe the procedures and methods for the identification of a pest to a defined level.
Diagnostics	Processes and standards associated with the accurate identification of a pest.
Disinfestation	Post-harvest management measures focussed on eliminating the presence of pests within plants and plant products.
Domestic quarantine	Activities designed to prevent the movement and spread of pests within Australia.
Emergency Plant Pest	A pest that is included in Schedule 13 of the Emergency Plant Pest Response Deed or which is determined by the Categorisation Group to meet one or more of the EPP criteria listed in Clause 1 of the EPPRD.
Emergency Plant Pest Response Deed	A pre-agreed cost sharing and response framework for dealing with an incursion of an Emergency Plant Pest.
Emergency response	The actions undertaken to eradicate an exotic pest after its detection.
Endemic pests	Pests that are known to occur naturally in Australia.
Established pests	Non-endemic pests that have established in Australia.
Exotic pests	Pests not currently present in Australia.
High Priority Pest	A pest that has been identified to have the greatest potential economic impact to a particular plant industry and is listed in an Industry Biosecurity Plan or in Schedule 13 of the EPPRD.
International Standard for Phytosanitary Measures	An international standard adopted by the commission on Phytosanitary Measures, established under the International Plant Protection Convention.
National Diagnostic Protocols	Diagnostic protocols for the official taxonomic identification of a pest in a manner consistent with ISPM No. 27 – Diagnostic protocols for regulated pests. National Diagnostic Protocols include diagnostic procedures and data on the pest, its hosts, taxonomic information, detection and identification.
Pre-border	Measures to address risks that are undertaken before goods arrive at the border.
Post-border	Measures to address risks that are undertaken inside Australia's border.
Pest	Any insect, mite, snail, nematode, pathogen (disease) and weed that is injurious to a plant or plant product.
Pest Free Area	An area in which a pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained.
Phytosanitary measure	Any legislation, regulation or official procedure having the purpose to prevent the introduction and/or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests.
Plant biosecurity	The protection of plants or plant products from pests that may impact on production or market access.
Plant production industries	All plant industries in the agricultural, horticultural and forestry sectors.
PLANTPLAN	The national contingency planning framework for the management of plant pest emergencies in Australia.

Term	Definition
Quarantine	The system of measures that are used to minimise risks associated with the entry of pests.
RD&E	Research aimed at developing solutions for particular problems and communication (extension) to users.
Regionalised pests	Pests contained within a geographic region due to specific quarantine and/or management arrangements.
Response Plan	An integrated plan for undertaking a response to an EPP incident.
Risk analysis	The process of evaluating scientific and economic evidence to determine the risk posed by a pest to Australia's environment, plant production industries and economy.
Surveillance	Processes which collect and record data on pest occurrence or absence by survey, monitoring or other procedures.
Weeds of National Significance	Weeds considered to currently pose serious threats at a national level.

Image courtesy of Katie Rivers.

Acronyms

Acronym	Full name
ABARES	Australian Bureau of Agriculture and Resource Economics and Sciences
ABS	Australian Bureau of Statistics
ACIAR	Australian Centre for International Agricultural Research
ACT	Australian Capital Territory
AGSOC	Agriculture Senior Officials Committee
AGWA	Australian Grape and Wine Authority
AHA	Animal Health Australia
AHC	Animal Health Committee
ANFIL	Australian Native Food Industry Limited
APVMA	Australian Pesticides and Veterinary Medicines Authority
ARC DP	Australia Research Council Discovery Programme
ATTIA	Australian Tea Tree Industry Association
BHA	BioHerbicides Australia
BICON	Biosecurity Import Conditions Database
BIMS	Biosecurity Incident Mangement System
BOLT	Biosecurity Online Training
BRCNZ	Bio-Protection Research Centre New Zealand
CA	Cotton Australia
CCA	Crop Consultants Australia
CCEPP	Consultative Committee on Emergency Plant Pests
CCEPI	Consultative Committee on Exotic Plant Incursions
CEBRA	Centre of Exellence for Biosecurity Risk Analysis
CIMMYT	International Maize and Wheat Improvement Center
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CRC	Cooperative Research Centre
CRDC	Cotton Research and Development Corporation
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAWR	Australian Government Department of Agriculture and Water Resources
DAF	Department of Agriculture and Fisheries, Queensland
DAFWA	Department of Agriculture and Food, Western Australia
DECO	Defence Export Controls
DEDJTR	Department of Economic Development, Jobs, Transport and Resources, Victoria

Acronym	Full name
DFAT	Australian Government Department of Foreign Affairs and Trade
DPIF	Department of Primary Industries and Fisheries, Northern Territory
DPI	Department of Primary Industries, New South Wales
DPIPWE	Department of Primary Industries, Parks, Water and Environment, Tasmania
EPP	Emergency Plant Pest
EPPRD	Emergency Plant Pest Response Deed
FAR	Foundation for Arable Research
FWPA	Forest and Wood Products Australia
GBCMA	Goulburn Broken Catchment Management Authority
GRDC	Grains Research and Development Corporation
Hort Innovation	Horticulture Innovation Australia Limited
HPP	High Priority Pest
ICON	Import Conditions Database
IPPC	International Plant Protection Convention
IGAB	Intergovernmental Agreement on Biosecurity
ISPMs	International Standards for Phytosanitary Measures
LVP	Local value of production
MICoR	Manual of Importing Country Requirements
MLA	Meat and Livestock Australia
MR&ES	Micrometeorlogical Research and Educational Services
NAQS	Northern Australia Quarantine Strategy
NBC	National Biosecurity Committee
NCN	Biosecurity Incident National Communications Network
NEBRA	National Environmental Biosecurity Response Agreement
NFFS	National Fruit Fly Strategy
NMG	National Management Group
NPBDN	National Plant Biosecurity Diagnostic Network
NPBDS	National Plant Biosecurity Diagnostic Strategy
NPBS	National Plant Biosecurity Strategy
NPSRT	National Plant Surveillance Reporting Tool
NRI	National Rural Independents Limited
NSW	New South Wales

Acronym	Full name
NSWT&I	New South Wales Trade & Investment
NT	Northern Territory
NZMPI	New Zealand Ministry for Primary Industries
PBCRC	Plant Biosecurity Cooperative Research Centre
PHA	Plant Health Australia
PHC	Plant Health Committee
PIRSA	Department of Primary Industries and Regions, South Australia
PFRNZ	The New Zealand Institute for Plant and Food Research
QAAFI	Queensland Alliance for Agriculture ad Food Innovation
QDAF	Department of Agriculture and Fisheries, Queensland
RAIL	Ramu Agri-Industries Limited
RD&E	Research, Development and Extension
RDC	Research and Development Corporation
RIRDC	Rural Industries Research and Development Corporation
SA	South Australia
SAGIT	South Australian Grain Industry Trust Fund
SAP	Scientific Advisory Panel
SARDI	South Australian Research and Development Institute
SDQMA	Subcommittee on Domestic Quarantine and Market Access
SNPHS	Subcommittee on National Plant Health Surveillance
SPHD	Subcommittee on Plant Health Diagnostic
SPS	Sanitary and Phytosanitary
SRA	Sugar Research Australia
TAMS	Department of Territory and Municipal Services, ACT
TIQ	Trade & Investment, Queensland
UNE	University of New England
UWA	University of Western Australia
WA	Western Australia
WAAA	Western Australia Agricultural Authority
WA RDC	Wine Australia Research and Development Corporation
WTO	World Trade Organisation

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Note: f = figure, t = table

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