The National Plant Biosecurity **Status Report**

2018

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Cover image: Close up of banksia flower in Killcare, NSW

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Image courtesy of Jane Richter

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Image courtesy of the Canned Fruits Industry Council of Australia

Foreword

Australia maintains its freedom from many serious plant pests by devoting considerable resources to plant biosecurity. While often taken for granted, this benefits all Australians. Our unique ecosystems, plant production industries, high standard of social amenity and rural way of life are sustained by our biosecurity system.

The goal is the delivery of an internationally first-class biosecurity system capable of supporting sustainable plant production and environmental health while maintaining and enhancing market access.

The National Plant Biosecurity Status Report is one of several tools that assists in monitoring continuous improvement in the plant biosecurity system.

The 2018 National Plant Biosecurity Status Report is the 11th such report, with the first report being published in 2008. For the first time, a timeline of notable biosecurity events during 2018 is provided, which link to features throughout the report.

The report touches on governance of biosecurity in Australia, the role of many stakeholders and the most concerning exotic plant pests. It features our plant industries, pre-border, border and post-border biosecurity efforts, pest surveillance and diagnostics, emergency responses and domestic quarantine matters. It also lists more than 600 plant biosecurity research, development and extension projects being undertaken around Australia.

I believe that Australia has developed a modern, dynamic and integrated system through the cohesive partnership between government and industry. We are all working together to fill the gaps that have been faced and preparing for future challenges.

Compiling the 2018 National Plant Biosecurity Status Report relies on input of more than 100 organisations. We are very grateful for your cooperation that allows the monitoring of the plant biosecurity system and the publication of this report annually.

I encourage you to share the report widely with those who would benefit from its content.

Steve McCutcheon
Chairman
Plant Health Australia

Dorrigo National Park, NSW

Introduction

The importance of plant biosecurity

Australia is fortunate to be free from many serious plant pests that exist overseas, due to more than a century of effective quarantine measures and our geographic isolation.

Our enviable plant health status confers significant benefits to us all. Without biosecurity efforts, plant pests such as insects, fungi, bacteria and viruses spread to suitable host plants in new areas and countries aided by the movement of people and goods.

Due to wide climate variability across Australia (see Figure 1), there are many varied natural ecosystems and crop species grown. Each ecosystem and crop has a set of pests that pose a threat.

Figure 1. Australia's varied climatic zones

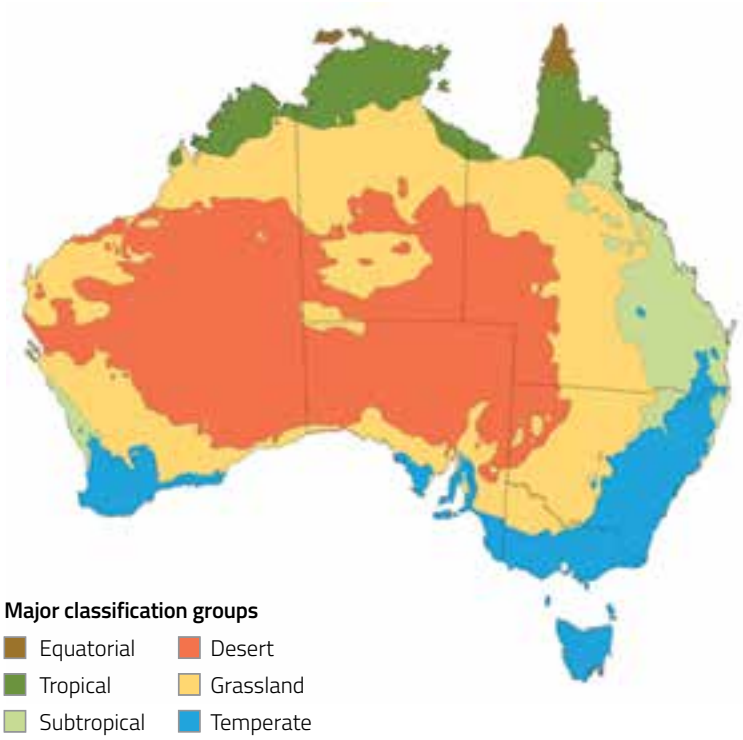


Image courtesy of the Bureau of Meteorology

Almost half of Australia's total land area is used for agriculture. In the tropical and subtropical zones, crops such as bananas, sugarcane, pineapples, mangoes and ginger are grown. In more southern temperate zones, pome and stone fruits, grapes, nuts, onions and potatoes can be cultivated. Vast areas with grassland climate are suited to broadacre production of grains, pulses, cotton, forestry, and pasture for livestock production, and vegetables are grown in many areas.

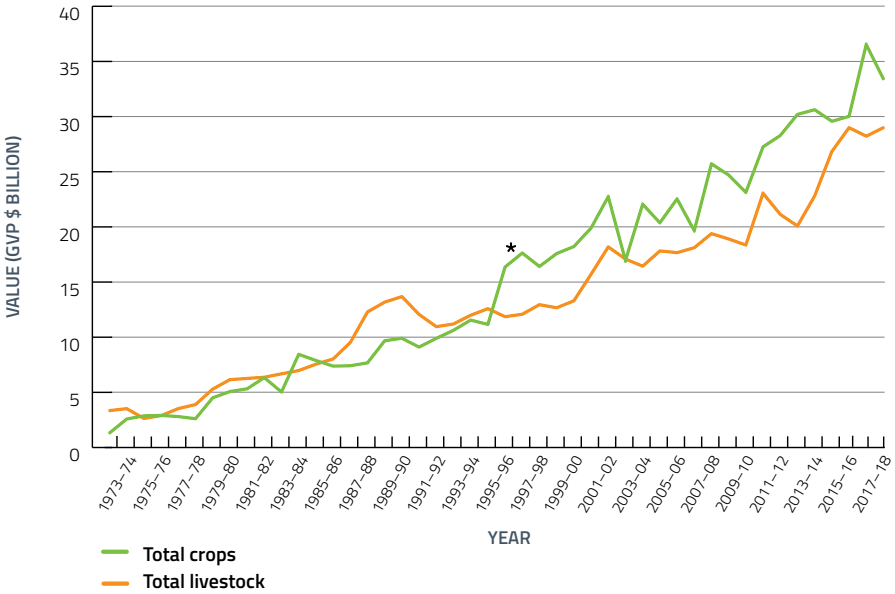
Plant industries make a significant contribution to agricultural production and exports. In 2016–17, around 394 million hectares was farmed by 88,073 crop and livestock businesses, with plant industries representing a gross value of $33.5 billion[1] (see Figure 2). Plant exports were worth more than $31 billion, including large quantities of grains (such as wheat, barley and canola) as well as sugar, wine, forestry, cotton and horticultural products.

Produce destined for overseas must meet the standards set for market access, which often includes evidence that production areas are free from certain pests. Production and trade could be jeopardised by an incursion of a new pest that makes its way into our fields, orchards and plantations.

Protecting our unique, biodiverse, natural environments is also a very high priority. Australia has more than 500 national parks, which cover over 28 million hectares and four per cent of the total land area. A further six per cent or more of Australia is protected and includes conservation areas within state forests, nature reserves, indigenous protected areas and conservation reserves[2]. In 2017 the Australian Bureau of Statistics estimated these areas brought more than $6 trillion worth of benefits to Australia. Invasive exotic plant pests and weeds could threaten native species, disrupt ecosystems and change the face of these landscapes, along with parklands and other public amenities[3].

1. Australian Bureau of Agricultural and Resource Economics, Canberra. Agricultural commodities March Quarter 2019 – Statistics Data Table 13. Accessed online 31 May 2019 agriculture.gov.au/abares/research-topics/agricultural-commodities/mar-2019#download-report
2. Commonwealth of Australia 2007. Conserving Australia: Australia's National parks, conservation reserves and marine protected areas. Accessed online 19 July 2019 aph.gov.au/Parliamentary_Business/Committees/Senate/Environment_and_Communications/Completed_inquiries/2004-07/nationalparks/report/index
3. Australian Bureau of Statistics, Canberra. ABS 2017, Australian environmental–economics accounts, 2017, Cat. No. 4655.0. Accessed online 19 July 2018 abs.gov.au/AUSSTATS/abs@.nsf/Lookup/4655.0Main+Features12017

Figure 2. Gross value of plant and animal production industries in Australia, 1972–2018*



** Includes forestry from 1995–96*

The definition of a pest used in this report covers insects, mites, snails, nematodes, pathogens (diseases) and weeds that have the potential to adversely affect food, fibre, ornamental crops, bees and stored products, as well as environmental flora and fauna. Exotic pests are those not currently present in Australia. Established or regionalised pests are those currently present within Australia.

Growing threats to plant health

Factors such as globalisation, international and interstate movement, climate change, tourism and the increasing volume of goods moved are all contributing to increasing biosecurity risks[4].

Plant pests and diseases spread in three main ways:

- through trading goods and movement of people
- by environmental forces including water and wind
- carried by vectors such as insects.

The growth in trade and international movement of people presents biosecurity challenges for Australia. Annually there is now nearly 100 million tonnes of freight arriving by sea[5], 1 million tonnes by air[6], and 21 million international travellers arriving[7], including 8.5 million foreigners.

To maintain Australia's favourable biosecurity status in this age of increased global trade and travel, a high priority is placed on plant biosecurity. During 2018, Australian biosecurity officers intercepted more than 350,000 items of biosecurity concern across the country, including 60,000 items sniffed out by biosecurity detector dogs[8].

It takes a great effort to keep exotic pests out of Australia. With a total coastline stretching almost 60,000 km, our borders can only be protected from plant pests by collaborative partnerships, and by coordinated activities that occur pre-border (overseas), at the border and within Australia (post-border).

Some 370 high priority pests have been identified for Australia's plant industries through biosecurity planning by Plant Health Australia (PHA) (see **Chapter 2**). The high priority plant pests for the environmental landscapes will be identified in 2019.

Just as important as keeping exotic pests out of Australia is the management of established or regionalised pests that are already present.

Some of the highlights relating to significant plant biosecurity events in 2018 are shown over the page. They include exotic plant pest detections, biosecurity surveillance and preparedness activities, public awareness activities, international collaborations, significant reports, innovations, events and announcements.

4. Commonwealth of Australia. Priorities for Australia's Biosecurity System: Response from Australian agriculture ministers (November 2018). Accessed online 16 July 2019 agriculture.gov.au/SiteCollectionDocuments/igab-review-response.pdf
5. Department of Infrastructure, Regional Development and Regional Economics. Australian Sea Freight 2015–16. Accessed online 16 July 2019 bitre.gov.au/publications/2018/asf_2015_16.aspx
6. Department of Infrastructure, Regional Development and Regional Economics. Aviation Statistics. Accessed online 16 July 2019 bitre.gov.au/statistics/aviation
7. Austrade. Latest International Visitor Survey Results, March 2019. Accessed online 16 July 2019 tra.gov.au/International/International-tourism-results/overview
8. Department of Agriculture and Water Resources. Biosecurity Matters Edition 1 2019. Accessed online 16 July 2019 agriculture.gov.au/biosecurity/australia/reports-pubs/biosecurity-matters/2019-01

Plant biosecurity highlights in 2018

Below is a timeline of some key plant biosecurity related events during 2018 that involved a broad range of stakeholders across Australia working to protect our plant resources. These events are referenced throughout the report.

JAN

Queensland fruit fly found in Tasmania (23 January). Pest free status reinstated 9 January 2019
See **page 140**

FEB

Plant and animal health surveys in Solomon Islands
See **page 141**

Xylella–Priority Actions Workshop (15 February)
See **page 223**

Plant Sure Scheme Workshop in Sydney (23 February)
See **page 219**

MAR

Exercise Border Bridge undertaken (5–9 March)
See **page 195**

Australian Biosecurity Awards (6 March)
See **page 210**

Biosecurity Innovation Exchange with NZ (8 March)
See **page 232**

Diagnosticians' Workshop (21 March)
See **page 167**

Release of Queensland Biosecurity Strategy (29 March)
See **page 28**

APR

Suspected citrus canker incursion in NT (19 April). National response initiated 1 June
See **page 188**

Exercise Bee Prepared in ACT (26 April)
See **page 196**

Launch of Onion Growers' Biosecurity Manual
See **page 61**

MAY

Launch of new inflight video 'Don't be sorry' (1 May)
See **page 144**

Exercise Bee Prepared NSW (24 May)
See **page 196**

JUN

International Clean Seed Pathway Workshop (7–8 June)
See **page 23**

New Fruit Fly ID Australia website and handbook launched (14 June)
See **page 178**

Varroa mite detected at Port Melbourne (25 June) with freedom declared 10 August
See **page 31**

Pacific Plant Biosecurity Capacity Building Workshop in Fiji (26–27 June)
See **page 24**

Release of Potato Growers' Biosecurity Manual
See **page 61**

JUL

- Review of hitchhiker pest and contaminant biosecurity risk management released (13 July)
  See **page 25**
- Exercise Bee Prepared Tasmania (17–18 July)
  See **page 196**

AUG

- National Fruit Fly Symposium (14–15 August)
  See **page 209**

SEP

- ABARES releases wheat rust report (6 September)
  See **page 54**
- NGIA BioSecure HACCP 'approved' thirty-party biosecurity scheme announced (25 September)
  See **page 106**

OCT

- Chief Environmental Biosecurity Officer appointed (4 October)
  See **page 22**
- Exercise Orange Juice in NSW (14 October)
  See **page 195**
- WA Biosecurity Blitz (19 October–16 November)
  See **page 156**
- NT grower biosecurity surveys (late October)
  See **page 147**
- Spotted Wing Drosophila Workshop (29 October)
  See **page 38**
- Botanic Gardens and Arboreta Surveillance Network Workshop (30 October)
  See **page 157**

NOV

- Australia and NZ enter new collaboration on biosecurity research (9 November)
  See **page 229**
- National simulation exercise to test response to *Xylella fastidiosa* in Brisbane (14–15 November)
  See **page 195**
- Minister's response to the IGAB review released (29 November)
  See **page 20**

DEC

- First Australian avocados arrive in Japan (11 December)
  See **page 136**
- Second vessel directed to leave Australian territory due to risk of brown marmorated stink bugs (19 December)
  See **page 143**
- UN proclaims 2020 the International Year of Plant Health (21 December)
  See **page 35**

Chapter 1

Australia's plant biosecurity system

Everyone has a role to play in safeguarding Australia from weeds, pests and diseases. Image taken in Rundle Mall, Adelaide

Australia's plant biosecurity system

Australia works across the three layers of the biosecurity continuum – pre-border, at the border and post-border – with activities to help prevent the introduction, spread and establishment of pests and diseases. Surveillance and monitoring of risk areas are critical to the integrity of the system, along with border control activities, which focus on assessing and managing potential biosecurity threats at Australia's airports, seaports and international mail centres.

The three layers of protection and the whole of system assets, are expanded upon throughout this report (see Figure 3).

The enormous challenge of protecting Australia from plant pests can only be achieved by stakeholders operating in a coordinated fashion, referred to as the plant biosecurity partnership.

While the activities of the Australian Government, such as restrictions on what comes in at international arrival points, are often the most visible aspects of the plant biosecurity system, in fact all Australians have a role to play in keeping Australia free from new pests.

Other key stakeholders with important roles to prevent the spread of weeds and pests include state government agencies, peak industry bodies and their growers, local councils, grower groups, transporters, research organisations, international and domestic travellers, gardeners and anyone who visits a farm, including utility providers such as electricity and water service staff.

The principle of biosecurity partnerships was established in recognition that, in addition to plant producers and governments, the wider Australian community benefits from the biosecurity system. Benefits include improved productivity, product quality and cost, market access, trade, profitability, sustainability and environmental preservation.

Figure 3. Key components of Australia's plant biosecurity system

PRE-BORDER

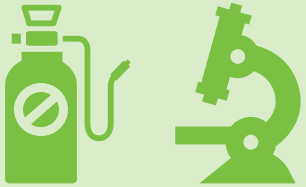
- Analysing pest risks associated with proposed imports
- Inspecting, verifying and auditing overseas exporters
- Undertaking pest surveillance overseas
- Developing international standards
- Building capacity overseas
- Anticipating pest threats by gathering global pest intelligence
- Negotiating export market access
- Maintaining the Manual of Importing Country Requirements (MICoR) and Export Documentation System (EXDOC) to facilitate exports

AT THE BORDER

- Inspecting and monitoring arrivals of people, cargo, mail and plant products
- Raising awareness of plant pests and movement restrictions
- Imposing biosecurity measures at ports
- Encouraging the reporting of suspected new pests by port workers and importers
- Protecting Australia's north from exotic pests with the Northern Australia Quarantine Strategy (NAQS)
- Enforcing border restrictions
- Isolating newly arrived plant material in post-entry quarantine
- Prioritising exotic pests to target with preparedness and prevention activities

POST-BORDER

- Preventing the spread of regionalised pests
- Providing early warning of incursions of exotic pests with surveillance
- Eradicating exotic pests under the Emergency Plant Pest Response Deed
- Managing risks under the control of everyday Australians
- Encouraging the reporting of anything unusual
- Managing established pests
- Maintaining the ability to diagnose plant pests
- Maintaining emergency response capacity
- Responding to environmental threats with the National Environmental Biosecurity Response Agreement
- Protecting farms with on-farm biosecurity measures
- Managing pest fruit flies on a national basis
- Managing weeds



Plant biosecurity framework and legislation

The framework for managing the cooperative partnership that underpins Australia's effective plant biosecurity system is supported by a suite of strategies, agreements, review reports, policies and legislation, developed over many years. These not only provide the current structure but provide a vision of how the plant biosecurity system should operate into the future.

The Australian Government Department of Agriculture and Water Resources administers a range of Australian Government legislation to manage Australia's biosecurity system, manage imports and regulate export certification of agriculture, fish and forest products. As an Australian Government regulator, the department also carries the responsibility for monitoring compliance with import and export legislation.

NATIONAL COMMITTEES

While state and territory governments have responsibility for implementing many biosecurity activities within their borders, a level of coordination is required between the jurisdictions and with the Australian Government.

National committees provide a formal mechanism for developing and coordinating key plant biosecurity policy and procedures that are nationally consistent. As such, Australia's plant biosecurity committee structure plays a major role in facilitating partnerships between governments.

Figure 4 shows the structure of Australian government biosecurity committees that are tasked with national coordination of plant biosecurity.

The Agriculture Senior Officials' Committee (AGSOC) is responsible for primary industry 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 **National Biosecurity Committee** (NBC).

The NBC is responsible for managing a national, strategic approach to biosecurity issues and threats relating to plant and animal pests and diseases, marine and aquatic pests, and the impact of these on agriculture production, the environment, community wellbeing and social amenity. It does this by focusing its efforts on those areas that have been identified as priority reforms for the national biosecurity system, as well as managing ongoing or 'normal' commitments.

A core objective of the committee is to promote cooperation, coordination and consistency across and between Australian governments. The NBC reports to ministers responsible for biosecurity through relevant Chief Executive Officers. The NBC provides advice to the AGSOC on national biosecurity matters and progress towards implementing the Intergovernmental Agreement on Biosecurity (see **page 20** for more information) and priority reform areas.

The Secretary of the Department of Agriculture and Water Resources is a member of AGSOC and chairs the NBC. The Australian Government is also represented by the Department of Agriculture and Water Resources Deputy Secretary responsible for biosecurity (or a delegate), and a Deputy Secretary from the Department of the Environment and Energy (or a delegate). Plant Health Australia (PHA) and Animal Health Australia are observers. Remaining members are senior representatives from the departments of primary industry and/or environment for each state and territory. Jurisdictions may have up to two representatives.

The **Plant Health Committee** (PHC) is the peak government plant biosecurity policy forum. Its role is to maintain or improve plant health in Australia to support the economy, environment and community. PHC's membership comprises representatives from the Australian, state and territory governments. PHA and subcommittee chairs attend PHC meetings with observer status.

PHC reports to the NBC and provides strategic policy, technical and regulatory advice, and national leadership on plant biosecurity matters. It is responsible for overseeing the implementation of the government aspects of the **National Plant Biosecurity Strategy** and the Intergovernmental Agreement on Biosecurity (IGAB) with respect to plant health.

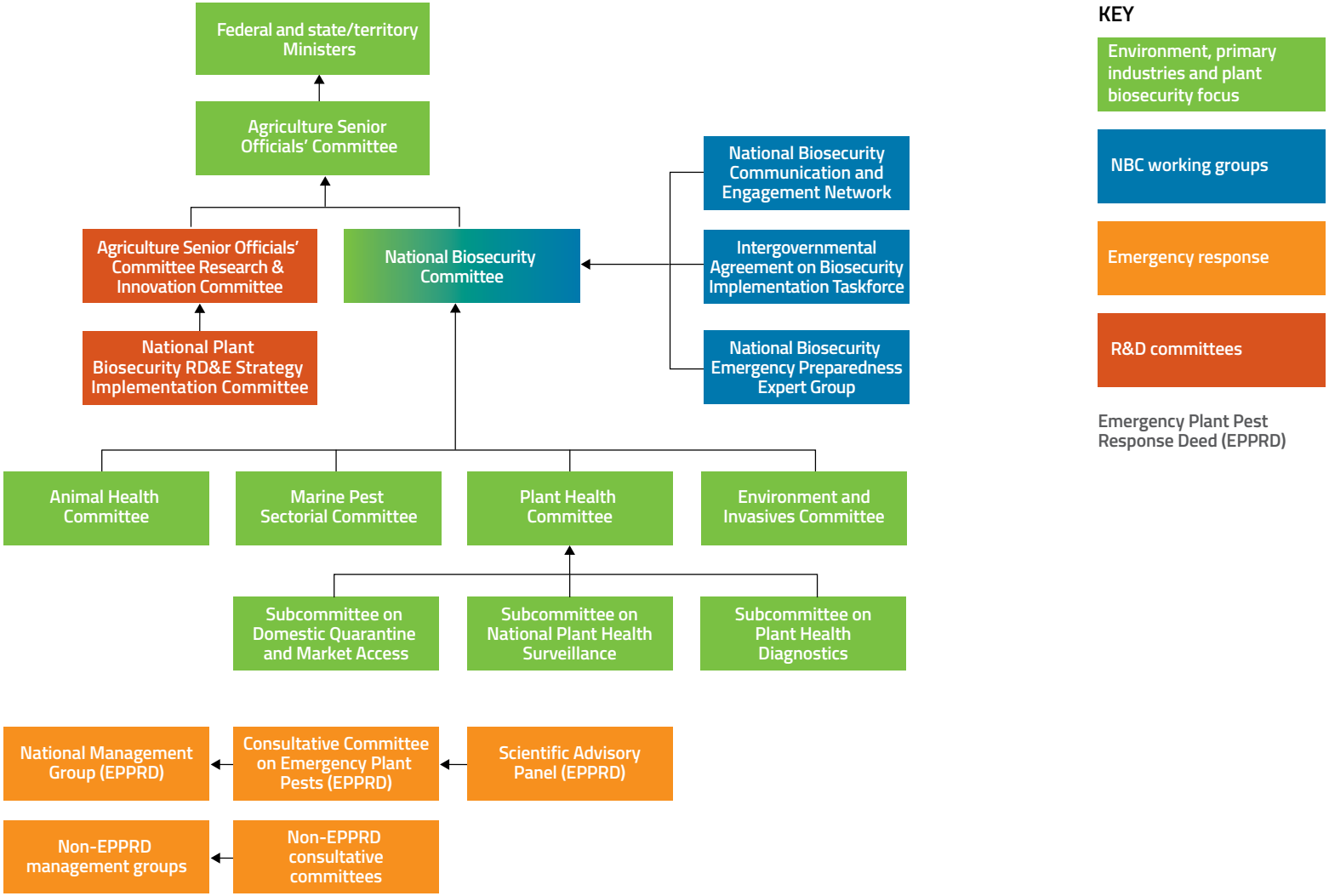
In 2018, PHC continued implementation of the National Plant Biosecurity Strategy, using the document as one of the main guiding principles when determining work area priorities. PHC also continued to progress various lines of work to support and maintain trade and market access, both domestically and internationally.

Through its subcommittees – the Subcommittee on Plant Health Diagnostics, Subcommittee on National Plant Health Surveillance and Subcommittee on Domestic Quarantine and Market Access – PHC also facilitates a consistent national approach to legislative outcomes and standards within the plant biosecurity sector.

PHA has observer status at NBC and is a member of PHC and its three subcommittees, as well as the majority of emergency response committees. It is also an observer of the Environment and Invasives Committee, which considers environmental biosecurity matters and manages many of the exotic plants and pests that have established in Australia.

There are also a number of government and industry representative committees overseeing biosecurity. They include groups such as the Northern Australia Biosecurity Reference Group, the National Fruit Fly Council and the Plant Health Surveillance Consultative Committee, amongst others, such as biosecurity reference groups for each industry.

Figure 4. National government biosecurity committees and working groups with plant focus



THE REVISED INTERGOVERNMENTAL AGREEMENT ON BIOSECURITY

For governments, Australia's partnership approach to biosecurity was cemented by the **Intergovernmental Agreement on Biosecurity** (IGAB), which came into effect in January 2012.

The IGAB was developed under the Council of Australian Governments to strengthen the working partnership between the Australian Government and state and territory governments. It defines the roles and responsibilities of each jurisdiction and outlines priority areas for collaboration to minimise the impact of pests and diseases on Australia's economy, environment and community. It ensures all governments work together on biosecurity issues.

As global trade increases biosecurity risks change, and pests can enter the country in faster and more complex ways. The objective of the biosecurity system is to manage risk to a very low level – not to zero – to ensure the safe movement of people, animals, plants, food and cargo into Australia. To do this, complementary measures are applied across the biosecurity continuum, pre-border, at the border and post-border.

Continuous review of the biosecurity system is essential to ensure it is contemporary and flexible, and that resources are allocated appropriately to reflect changing risks and priorities. In 2016, the IGAB was reviewed by an independent panel as part of a broader review of Australia's biosecurity system. In July 2017 the final report, **Priorities for Australia's Biosecurity System**, was presented to the Agriculture Ministers' Forum.

The review recognised the significant achievements of the IGAB (since its commencement in 2012), including the strong and healthy working relationships it fosters between governments, and the development of sound national policy principles and frameworks for an effective and well-regarded system.

The **final intergovernmental response** to the review's recommendations agreed by agriculture ministers was published on 29 November 2018. Agriculture ministers have agreed, or agreed in principle, to all of the review's 42 recommendations. The response is structured according to the priority themes identified by the review. They were: engagement and communication with system participants; financial sustainability of the system; system governance; risk and capability; and governance performance and accountability.

The review has also guided the development of a revised IGAB, known as IGAB2. The new agreement between first ministers is now in effect and will be implemented over the next five years.

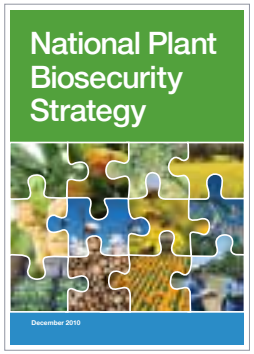
The structure of IGAB2 differs from its predecessor in an attempt to simplify, clarify and strengthen the agreement by clearly defining the roles and responsibilities of each party.

Agriculture ministers have also agreed on four key priority reform areas for the national biosecurity system, which are:

- a unified, strategic framework for the national biosecurity system
- enhanced national capacity to manage risks associated with priority pests and diseases
- reduced impediments to maintaining and growing market access
- improved system performance and accountability.

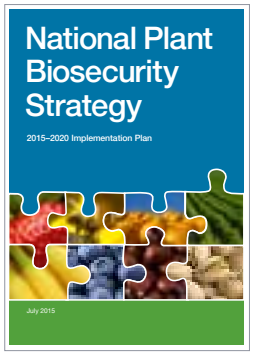
THE NATIONAL PLANT BIOSECURITY STRATEGY

The National Plant Biosecurity Strategy 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, aligning them with the IGAB to ensure consistency.



The national strategy was finalised in December 2010 (prior to IGAB) 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.

Towards the end of 2014, halfway through its lifespan, PHA reviewed the strategy and assessed progress against each of the recommended activities and alignment with IGAB. An implementation plan that lists 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.

Implementation of government responsibilities is overseen by the Plant Health Committee, with specific input from the Subcommittee on Plant Health Diagnostics and the Subcommittee on National Plant Health Surveillance in relation to implementing the diagnostic and surveillance aspects, respectively. More information about the work of the diagnostics and surveillance subcommittees is in Chapter 5. The Subcommittee on Domestic Quarantine and Market Access works to ensure consistency of biosecurity requirements across states and internationally. More information is available in **Chapter 7**.

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

The National Plant Biosecurity Strategy continues to provide the focus and strategic direction for national plant biosecurity activities and, through its implementation, will strengthen the 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 as at 31 December 2018 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 the export of agricultural commodities. There are also laws covering 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 NSW *Biosecurity Act 2015* was assented to in September 2015 and came into effect during 2017. The new legislation aligns with Queensland's *Biosecurity Act 2014*, introducing into law the principle that everyone has a responsibility for mitigating biosecurity risks under their control, known as the general biosecurity obligation or duty. Other state and territory governments have indicated that they will also formalise this responsibility in legislation in the future. Tasmania is developing a new Biosecurity Act to be introduced in 2019. More information about the general biosecurity obligation or duty is on **page 208**.

Table 1. Plant biosecurity related legislation across Australia

Jurisdiction	Administering authority	Legislation
Commonwealth	Department of Agriculture and Water Resources	▪ *Biosecurity Act 2015* ▪ *Biosecurity (Consequential Amendments and Transitional Provisions) Act 2015*
Commonwealth	Department of the Environment and Energy	▪ *Environment Protection and Biodiversity Conservation Act 1999* ▪ *Environment Protection and Biodiversity Conservation Regulations 2000*
ACT	Environment Planning and Sustainable Development Directorate	▪ *Plant Disease Act 2002* ▪ *Pest Plants and Animals Act 2005*
NSW	Department of Primary Industries	▪ *Biosecurity Act 2015* ▪ *Biosecurity Regulation 2017* ▪ *Biosecurity Order (Permitted Activities) 2017* and other supporting legislation such as Control Orders
NT	Department of Primary Industries and Resources	▪ *Plant Health Act 2008* ▪ *Plant Health Regulations 2011*
Queensland	Department of Agriculture and Fisheries	▪ *Biosecurity Act 2014* ▪ *Biosecurity Regulation 2016*
SA	Primary Industries and Regions	▪ *Plant Health Act 2009* ▪ *Plant Health Regulations 2009*
Tasmania	Department of Primary Industries, Parks, Water and Environment	▪ *Plant Quarantine Act 1997* ▪ *Weed Management Act 1999*
Victoria	Department of Jobs, Precincts and Regions	▪ *Plant Biosecurity Act 2010* ▪ *Plant Biosecurity Regulations 2016*
WA	Department of Primary Industries and Regional Development	▪ *Biosecurity and Agricultural Management Act 2007* ▪ *Biosecurity and Agriculture Management Regulations 2013*

Government roles

THE AUSTRALIAN GOVERNMENT

Under national legislation, the Australian Government has responsibility for the bulk of biosecurity activities pre-border and at the border. This includes screening and compliance at the multiple entry points that make up the nation's border, international phytosanitary (plant health) obligations, carrying out risk analysis for proposed imports, and post-entry plant quarantine.

As well as regulating imports, the Australian Government's biosecurity activities also play a key role in the export of Australian produce. This is because overseas markets can reject produce if it is grown in areas known to have particular pests.

The Australian Government assists in market access negotiation by working with states and territories and plant industry peak bodies to collect and analyse plant health surveillance data, to provide trading partners with evidence of our freedom from pests and diseases.

The Australian Government also undertakes negotiations to determine what, if any, treatments or conditions need to be met to send Australia's plant products overseas.

In addition to bilateral and multilateral trade negotiations Australia also plays a leading role in developing and implementing international agreements known as phytosanitary agreements that aim to prevent the spread of plant pests.

Under the **Agricultural Competitiveness White Paper, Stronger Farmers, Stronger Economy**[9], the Australian Government invested $200 million into improving biosecurity surveillance and analysis, to better target critical biosecurity risks and improve market access for Australian producers.

In May and June 2018, the Australian Government announced a major ongoing funding boost to strengthen the biosecurity system to further protect Australia's farm industries and environment. This amounted to a $313 million investment over six years from 2017–18 to help detect, identify and respond to exotic pests and diseases earlier to keep Australia's clean, green image and favourable pest and disease status.

9. Commonwealth of Australia (2015). Agricultural Competitiveness White Paper, Stronger Farmers, Stronger Economy, Canberra

Department of Agriculture and Water Resources

Most of the responsibilities of the Australian Government are delivered through the agriculture portfolio, in collaboration with other agencies described in the following pages.

The Australian Government Department of Agriculture and Water Resources (DAWR) focuses on maintaining a strong and resilient biosecurity system into the future that will protect Australia from new biosecurity challenges, whatever they may be.

DAWR administers national legislation to manage imports and regulate export certification of agriculture, fish and forest products. It is also responsible for monitoring compliance with import and export legislation.

The millions of people, mail parcels, baggage, ships, animals, plants and cargo containers that enter Australia every year are screened and inspected by DAWR staff, supported by x–ray machines, surveillance activities and detector dogs. Of equal importance are the pre-border measures to prevent pests and diseases from arriving in the country. Managing Australia's biosecurity is a big job and DAWR promotes a shared responsibility with clients, stakeholders and the general public, all of whom have a role to play.

Australia's Chief Plant Protection Officer, currently Dr Kim Ritman, is the primary representative of, and an advisor to, the Australian Government on all matters relating to Australia's plant health status and its supporting systems. Working within DAWR, the officer aims to promote a shared vision for plant health that protects and enhances Australia's valuable plant resources and production capacity. They are also Australia's official contact point for the International Plant Protection Convention.

The position of Chief Environmental Biosecurity Officer was established to ensure Australia's environment and amenity is safeguarded from the impacts of exotic pests and diseases. The position provides policy leadership on national environmental biosecurity issues.

The role of the Chief Environmental Biosecurity Officer is to:

- enhance understanding and oversight of environmental biosecurity risks
- perform a national policy, engagement and leadership role including major source of advice to the Commonwealth on environmental biosecurity matters
- ensure environmental and community biosecurity risks are better defined and prioritised
- improve the maturity of environmental biosecurity preparedness, surveillance and response capacity
- support responses to detections and incursions of environmental pests and diseases.

Ian Thompson was appointed as Chief Environmental Biosecurity Officer in October 2018.

There are more details on environmental biosecurity and the new Chief Environmental Biosecurity Officer in **Chapter 2**.

DAWR also pursues international market access for Australia's plant production industries and access to the Australian market for our trading partners through bilateral, regional and multilateral engagement. Priority is given to:

- working to remove barriers to international trade
- progressing and resolving market access priorities and issues
- facilitating targeted technical assistance and agricultural cooperation
- assisting the development of international standards.

This work is supported and enhanced by a network of agricultural counsellors located in Belgium, China, Dubai, Europe, France, India, Indonesia, Italy, Malaysia, Japan, Taiwan, Korea, the Middle East, Thailand, Saudi Arabia, Vietnam, Chile, Mexico, the United Kingdom and the United States.

The agricultural counsellors' role is to build and maintain key relationships with Australia's trading partners. Counsellors organise and lead discussions, receive and respond to requests for information, facilitate visits and inspections to progress market access requests and promote Australian products. They work closely with industry, overseas authorities and the department in the process.

The negotiations for access to overseas markets, including technical consultations about the importing nation's biosecurity requirements, can sometimes take years to work through. The department's overseas officers play a key role in facilitating this process.

Within DAWR, 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.

Sowing the seeds for an international movement system

In June 2018 the International Clean Seed Pathway Workshop was held in Brisbane following the World Seed Congress. The aim was to discuss an integrated system for regulating the phytosanitary health of seeds.

Managing the safe movement of seed is critical as clean seed is the foundation for healthy, vigorous crops. Seeds are a potential pathway for introducing diseases that can have devastating consequences. This is particularly relevant to Australia, as large volumes of seeds, particularly vegetable seeds, are imported every year.

More than 60 participants, comprising seed producers and users, importers, exporters, researchers and regulators from 12 countries – Australia, Belgium, Canada, Chile, India, Indonesia, Malaysia, the Netherlands, New Zealand, Switzerland, Thailand and the United States – took part in the workshop.

The group showed overwhelming support to develop a single system to facilitate the global movement of clean seed. They also agreed that the International Plant Protection Convention was a logical forum for global adoption of the system.

Prior to the workshop, in April DAWR organised a Global Integrated System of Seed Production Workshop with the Australian Seed Federation to discuss the current and potential systems of seed production, process and biosecurity risk management.

DAWR also presented Australia's work at the International Seed Federation Systems Approach Workshop in Rome in April 2018.

Australia imports large quantities of vegetable seeds every year. Image courtesy of AUSVEG

Growing plant biosecurity in the Pacific region

On 26–27 June 2018, a Pacific Plant Biosecurity Capacity Building Workshop was held in Nadi, Fiji, to strengthen biosecurity in the Pacific.

This was part of a new biosecurity capacity building program of the Australian Government's Australian Centre for International Agricultural Research (ACIAR). Initially the program will run in Fiji, Kiribati, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu.

The Pacific region is facing major new threats, such as the giant African snail, the coconut rhino beetle and coffee berry borer, and the challenge of maintaining biosecurity levels for existing commodity exports.

Preliminary analysis identified 57 specific pest and diseases as either current threats or potential risks in the Pacific. Other key issues included lack of appropriate infrastructure and equipment, outdated policy, legislation and regulations, concerns about lack of shared surveillance information, limited emergency response capabilities and market access barriers due to inadequate treatment facilities.

The program is targeting regional, national, institutional and individual needs, with a training program backed up by mentoring, including work placements. This will in turn lead to strong relationships and a responsive biosecurity network being developed across the region.

A fellowship program will consider country specific key issues and build on existing knowledge, networks and systems.

A new plant biosecurity fellowship program aims to build a responsive biosecurity network across the Pacific region. Image courtesy of ACIAR

Department of Foreign Affairs and Trade

The **Department of Foreign Affairs and Trade** (DFAT) helps make Australia stronger, safer and more prosperous by promoting and protecting our interests internationally and contributing to global stability and economic growth.

DFAT helps progress Australia's international trade interests by promoting a strong biosecurity system to trading partners. This work helps to facilitate trade and market access. DFAT is engaged in new work to address non-tariff barriers that impede Australian exports.

DFAT is also responsible for progressing Australia's international aid and development policy to enhance economic growth, stability and security in the Indo-Pacific region, including through regional biosecurity and trade.

Other agencies within the portfolio include:

- The **Australian Trade and Investment Commission** (Austrade), whose 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), a statutory authority that is 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.

Department of the Environment and Energy

The **Department of the Environment and Energy** (DEE) contributes to the development of national policies on pests and invasive plants that cause harm to the environment.

The *Environment Protection and Biodiversity Conservation Act 1999* establishes a list of specimens considered suitable for live import into Australia, known as The Live Import List. Amendments to the list to include live animal specimens are managed by DEE. Imports of live plants are managed by the DAWR. The import of live plants and animals should not be inconsistent with the *Biosecurity Act 2015*.

The DEE is responsible for ensuring that Australia complies with its obligations under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Permits for the import of CITES listed species (plants or animals) are managed by DEE.

Advice is also provided to the DAWR on environmental issues in relation to risk assessments.

Department of Home Affairs

The **Department of Home Affairs**, formed in 2017, 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 DAWR and the Department of Defence, to regulate and control the movement of goods and people across the Australian border.

The Inspector-General of Biosecurity

Australia's biosecurity system relies on various government programs, in cooperation with industry, to ensure the safe international movement of people and goods.

The **Inspector-General of Biosecurity** was established to enhance the integrity of Australia's biosecurity systems through independent evaluation of the performance of these programs across the whole system: pre-border, at the border and post-border.

The position is independent from the DAWR and its Minister, though they will consider particular review requests.

The Inspector-General may review the performance of functions and the exercise of powers by the Director of Biosecurity and make recommendations for improvement to the overall system.

A review program is published annually, set in consultation with the Minister for Agriculture and Water Resources and the Director of Biosecurity. In 2018, the Inspector-General of Biosecurity completed four reviews: hitchhiker pest and contaminant biosecurity risk management in Australia; military biosecurity risk management in Australia; horse importation biosecurity risk management; and the implementation of Interim Inspector-General of Biosecurity recommendations. These reports are available from **igb.gov.au**

Other Australian Government organisations

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

For a list of other Australian Government organisations that support plant biosecurity research, development and extension, see **Chapter 8**.

Review of hitchhiker pest and contaminant biosecurity risk management

On 13 July 2018 the Inspector-General of Biosecurity released a review of the effectiveness of the management of biosecurity risks associated with major hitchhiker pest and contaminants to Australia.

This is a major challenge because of greater global trade and movement of pests and diseases around the world, and the fact that the pests may already be endemic to other countries who no longer consider them a high priority.

The review looked at the adequacy of processes of the Department of Agriculture and Water Resources to manage the risks and to identify and respond to emerging risks associated with arriving sea vessels – such as sea containers, break-bulk cargo and bulk cargo ships – as well as aircraft and air cargo containers.

The review team saw operations first hand at sea and airports, and visited regional offices around Australia for discussions with staff. The team also discussed with key stakeholders how industry bodies interact with the department to apply hitchhiker and contaminant management measures through the supply chain (including pre-border). They also observed how the New Zealand Government Ministry for Primary Industries works with industry and the community to manage hitchhiker and contaminant biosecurity risks.

The report found the department's efforts to intercept and exterminate hitchhikers and contaminants are preventing a great deal of biosecurity risk material, pests and diseases from entering Australia.

However, it found with the volume of sea containers entering Australia likely to continue to rise steadily, automated container washing at major container receival ports may provide the biggest short-term reduction in external biosecurity risk. The development and validation of automated inspection methods could further improve the system.

Because more hitchhiker pests have been found in recent years, the border surveillance program and increased engagement with industry and with state and territory governments are essential to detect pests that breach border biosecurity controls.

The Inspector-General's report said adequate continued resourcing of current programs and frontline inspection services – and ongoing development of improved systems – will be essential to long-term biosecurity risk management. Without this, Australia risks being overwhelmed by biosecurity threats posed by increasing trade volumes and changing global pest and disease threats.

To read the report visit **igb.gov.au/SiteCollectionDocuments/hitchhikers-contaminants-report.pdf**

NSW Biosecurity Collections technical officer Ros Mirington preparing insect microscope slides for examination. Image courtesy of NSW DPI

STATE AND TERRITORY GOVERNMENTS

While the Australian Government has responsibilities for the majority of pre-border and border biosecurity activities, state and territory governments are responsible for the delivery of plant biosecurity operations and the supporting legislation within their borders.

Each state and territory has a different approach to the role, primarily due to the varied climatic conditions and legislative frameworks across the country. Jurisdictions each provide a number of core services, most of which involve the community.

Broadly, these are activities concerned with preventing the spread of existing plant pests further within Australia, including any newly detected exotic pests. State and territory government responsibilities include:

- Managing domestic imports and exports into and out of their jurisdiction, primarily to prevent the spread of regionalised pests around Australia. There are two components to this:
  - Domestic quarantine services for the clearance of passengers, cargo, mail, plants and plant products moving interstate.
  - Export and market access support for producers who want to sell their produce across state boundaries. This includes plant health certification services, surveys and inspections to support area freedom and the accreditation and auditing of export compliance arrangements.
- Providing quarantine services, involving activities to prepare for, and respond to, any plant pest incursions in their jurisdiction, including communicating with communities.
- Maintaining the capacity and capability to deliver responsibilities under the Emergency Plant Pest Response Deed, which is activated when a suspected Emergency Plant Pest is detected in their jurisdiction. Responsibilities may include setting up and enforcing quarantine zones, informing the public and treating pests and plants. The lead agency also carries out surveillance to find out how far pests have spread, and at the end of the response, to confirm that eradication has been achieved.
- Undertaking pest surveillance in their jurisdiction, in partnership with industry and community volunteers. There are 110 surveillance programs carried out by state and territory governments, requiring significant resourcing. Pest surveillance is crucial for the early detection of new pests, discovering the extent of pest spread (delimiting), and providing evidence of area freedom to facilitate market access.
- Providing diagnostic services to identify plant pests (both endemic and exotic) found in their jurisdiction, or to assist other jurisdictions. This includes holding reference collections for comparison of species.
- Developing and maintaining information systems to support routine and emergency plant biosecurity management.
- Sending out public information to raise awareness of biosecurity threats and calls to action, and raising awareness in the community of the importance of biosecurity.
- Carrying out science-based risk analyses to identify pest threats and inform plant biosecurity policy and operations.
- Funding and providing research, development and extension to support the continued improvement of pest management and protection capabilities.
- Developing and administering plant biosecurity policies and legislation, and work on national committees to ensure that these are in line with other governments around Australia.

State and territory governments coordinate their activities through the Intergovernmental Agreement on Biosecurity (**page 20**), the Plant Health Committee and subcommittees (**page 18**), through Plant Health Australia (**page 32**) and through the Emergency Plant Pest Response Deed (**page 183**).

Australian Capital Territory

Lead agency: Environment Planning and Sustainable Development (EPSD) Directorate
environment.act.gov.au

The ACT Government manages plant biosecurity through the EPSD Directorate, together with the Transport Canberra and City Services (TCCS). The directorate is responsible for policy development and shares operational implementation with TCCS.

Plant biosecurity activities in the ACT are underpinned by the *Plant Diseases Act 2002* and the *Pest Plants and Animals Act 2005*. Although the ACT does not have many plant production industries within its boundaries, the government participates on national committees during plant pest emergency responses and in the development of associated national frameworks and strategies when it has expertise to contribute. It has particular expertise in forestry, urban tree management and national parks.

Following release of the ACT Biosecurity Strategy 2016–26 in 2016, the ACT has commenced development of a comprehensive Biosecurity Bill to modernise the ACT's biosecurity legislative framework and align it with similar legislation in other jurisdictions, particularly NSW.

Modern biosecurity tools with enhanced emergency response powers will help address the biosecurity risks presented by international flights to Canberra Airport which began in 2016, as will the regular plant surveillance conducted around the airport to check for exotic pests such as exotic fruit flies, Asian gypsy moth and bee pests.

In 2018 the ACT conducted considerable training in the management of bee disease incursions and participated in Exercise Bee Prepared in cooperation with Plant Health Australia. See more on Exercise Bee Prepared on **page 196**.

New South Wales

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

NSW DPI is the principal agency responsible for plant biosecurity in the state, ensuring that policies, management and procedures are in place to minimise the impact of existing, invasive and emergency plant 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 2013–21** 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.

Diagnostic and surveillance activities are supported by the Plant Health Diagnostic Service at the Elizabeth Macarthur Agricultural Institute, the Biosecurity Collections Unit at Orange Agricultural Institute, the state-wide network of compliance officers, Local Land Services and the emergency management First Response Team. Close collaboration with entomology and plant pathology researchers is integral to these activities.

Following the commencement of the *Biosecurity Act 2015* in 2017, all NSW plant biosecurity incursions, infringements and investigations in 2018 were confidently and successfully managed under this new legislative structure. The Act has proven to be an innovative and positive step forward in the way NSW DPI manages biosecurity.

Northern Territory

Lead agency: Northern Territory Department of Primary Industry and Resources (NT DPIR)
dpir.nt.gov.au

Plant biosecurity in the Northern Territory (NT) is managed by the Plant Biosecurity Branch, within NT DPIR'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 NT agricultural sector provides over $610 million to the Australian economy each year. Horticultural industries contribute almost a quarter of this value, in annual production of iconic Territory produce such as mangoes and melons. Other markets offer growth opportunities.

To protect this, the environment and social amenity, the Plant Biosecurity Branch undertakes the following services:

- maintaining and improving the plant health status of the plant and plant product industries of NT
- minimising the risk of exotic pests entering NT through compliance and surveillance
- 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 of a range of Emergency Plant Pests
- preparing effective response mechanisms in the event of an Emergency Plant Pest incursion
- developing, implementing and reviewing NT's plant health policy and legislation.

Recently, the NT has been providing front line services to eradicate or manage pests including: banana freckle, as part of the National Banana Freckle Eradication Program; browsing ant, as part of the National Browsing Ant Eradication Program; citrus canker, as part of the Citrus Canker Emergency Response; Asian honey bee, as part of the Asian Honey Bee Emergency Response; and the Queensland Fruit Fly Eradication Program.

Plant biosecurity programs in the NT are underpinned by the *Plant Health Act 2008* and *Plant Health Regulations 2011*. In addition, the *Agricultural and Veterinary Chemicals (Control of Use) Act* and the *Biological Control Act* support NT work.

Queensland

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

Biosecurity Queensland is the lead agency within the department responsible for managing biosecurity risks within the state. The Plant Biosecurity and Product Integrity program within Biosecurity Queensland is responsible for developing policies, standards, delivery systems and services to reduce the risk of introducing exotic plant pests, minimise the impacts of new plant pest incursions on Queensland's plant industries, environment and communities, and facilitate market access for Queensland's plant-based industries.

The Plant Biosecurity and Product Integrity program is responsible for plant biosecurity diagnostics and the implementation of programs for the detection, prevention, control and containment of certain plant pests.

Other QDAF business groups also contribute to biosecurity risk management. Links with other Queensland Government departments provide access to a range of relevant expertise across all plant production sectors, including native and plantation forestry. Key links include:

- QDAF's Agri-Science Queensland business area, which provides science, innovation and associated services, including additional diagnostic capability, surveillance and integrated management packages to limit the impacts of pests within farming systems
- Department of Environment and Science, which plays a role in managing the natural environment and environmental pests
- Queensland Museum, which specialises in the identification of molluscs, mites and spiders.

The *Biosecurity Act 2014* and *Biosecurity Regulation 2016*, provide the framework for plant biosecurity management in Queensland. The act is risk-based and is underpinned by the concept of shared responsibility, where everyone has a general biosecurity obligation to take all reasonable and practical steps to manage biosecurity risks that are within their control.

This legislation is also complemented by a number of other acts, including the *Chemical Usage (Agricultural and Veterinary) Control Act 1988* and the *Agricultural and Veterinary Chemicals (Queensland) Act 1994*.

On 29 March 2018, the Queensland Government released the **Queensland Biosecurity Strategy**, the five-year plan to build the framework for Queensland's future biosecurity system to protect the state's almost $20 billion agriculture industry.

The new strategy departs from previous ones in that it is not just for government, but for all Queenslanders. More than 30 organisations contributed to the development of the strategy and the six strategic themes that underpin it.

South Australia

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

Biosecurity SA, a division within PIRSA, develops and implements 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 focuses on operations to prevent their entry and establishment. Activities include a dedicated state-wide fruit fly trapping grid, static quarantine stations and random roadblocks, targeted awareness and education campaigns, regulatory arrangements for importers, and specific measures to effectively respond to and eradicate any fruit flies that are detected.

The South Australian Government has, in partnership with **Hort Innovation** and the SITplus consortium, constructed and commissioned the National Sterile Insect Technology (SIT) Facility in Port Augusta, capable of producing 50 million sterile Queensland fruit flies per week.

The South Australian Research and Development Institute (SARDI) is the 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 diseases in the cereal, pulse, pasture, viticulture and horticulture industries. This includes delivery of plant health diagnostic services to state and national plant biosecurity authorities, growers and consultants. The group collaborates closely with breeding companies, pre-breeding programs and the private sector to develop disease resistant plant varieties.

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 and equipment of biosecurity concern.

Citrus Canker Eradication Program plant health inspectors conducting removal activities in Nakara restricted area of Darwin. Image courtesy of NT DPIR

Detector dog at work checking incoming passengers to Tasmania. Image courtesy of DPIPWE Tasmania

Tasmania

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

The department's Biosecurity Tasmania Division manages biosecurity policy and programs for plant pests. The Plant Biosecurity and Diagnostics Branch of the division supports and maintains Tasmania's biosecurity system in the development of plant biosecurity policy and the delivery of plant health diagnostic and associated service areas. It does this via programs across three areas: plant biosecurity policy and administration, plant health diagnostics (entomology) and plant health diagnostics (plant pathology). The branch also contains a market access unit in relation to plants and plant products, and a plant biosecurity surveillance unit that manages the policy and smaller operational aspects of surveillance.

The branch also provides diagnostic and control advice for plant pests and diseases in primary industry, horticulture and biosecurity situations. Plant Diagnostic Services, administered by the branch, provides state-wide laboratory services that supply a range of tests for plant pests and pathogens, using microbiological, molecular, ELISA and electron microscopy techniques on a wide range of plants and seeds for private industry, government research bodies and certification schemes.

The branch maintains and develops Tasmania's capability to effectively respond to and recover from plant biosecurity emergencies, compiles and maintains official pest records to assist market access and trade, and leads the implementation of plant biosecurity risk analysis activities consistent with the Import Risk Analysis Framework.

The Biosecurity Operations Branch implements regulatory requirements with respect to the import of plants and plant products into Tasmania, and also does a range of surveys for plant pests, including Queensland and Mediterranean fruit fly.

A draft Biosecurity Bill 2019 has been developed and will be considered by the Tasmanian Parliament during 2019. The single new Biosecurity Act will promote good regulatory practices through an efficient and effective legislative framework. The framework will support a strong biosecurity system in Tasmania that facilitates trade and protects business, the environment and the community.

Victoria

Lead agency: Victorian Department of Jobs, Precincts and Regions (DJPR)
ecodev.vic.gov.au

The Biosecurity and Agriculture Services Branch, within DJPR, delivers biosecurity and product integrity programs across the agriculture, horticulture, forest and amenity plant sectors. Activities are guided by the Biosecurity and Agricultural Services Strategy which aims to minimise the impact of Emergency Plant and Apiary Pest incidents on the environment and production systems and maintain access to local and overseas markets.

The Chief Plant Health Officer Unit is responsible for the development, review and monitoring of policies, protocols and procedures in accordance with national and international obligations.

The Plants, Chemicals and Invasives Unit operates from metropolitan and regional centres according to technical standards and protocols that are underpinned by the *Plant Biosecurity Act 2010* and *Livestock Disease Control Act 1994* and implemented by the *Plant Biosecurity Regulations 2016* and *Livestock Disease Control Regulations 2017*. Opportunities are provided under the legislation for producers and marketers to adopt quality assurance arrangements which are subject to regular audits and improvement.

Scientific and diagnostic support is provided by the staff of Agriculture Victoria Research, including expert technical advice on suspect and exotic plant and apiary pests, and assistance with incursion responses, market access programs and other biosecurity initiatives. Staff also help develop and review biosecurity plans for industries, conduct pest risk analyses and import risk analyses and serve on national committees and working groups.

The research team, and its associated Crop Health Services diagnostic business, supports biosecurity by conducting research and providing diagnostic services in the areas of entomology, mycology, nematology, virology and bacteriology. Specialist services and expertise is also provided to other jurisdictions as required, to support responses to new pests.

Agriculture Victoria invests extensive resources into emergency preparedness planning, surveillance and training to prevent the entry and establishment of exotic plant and apiary pests and diseases that threaten agricultural industries.

Western Australia

Lead agency: Department of Primary Industries and Regional Development (DPIRD)
dpird.wa.gov.au

DPIRD is the lead agency responsible for plant biosecurity in WA, with development and implementation of plant biosecurity policies, programs and procedures delivered under the Sustainability and Biosecurity organisational pillar. This includes biosecurity, resource management, operations and compliance functions. It largely focuses on regulations and market access, helping WA to maintain its reputation as a producer of safe, sustainable and biosecure agricultural and aquatic products.

Plant biosecurity in WA is mainly managed under the *Biosecurity and Agriculture Management Act 2007*. The act provides for a modern biosecurity system to control the entry, establishment, spread and impact of harmful organisms, 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.

Plant biosecurity highlights in Victoria in 2018

The response to an interception of *Varroa destructor* at the Port of Melbourne on 25 June 2018 demonstrated the effectiveness of Agriculture Victoria's planning and capacity to respond to an exotic pest. Recent pest incursions to which Agriculture Victoria (AgVic) responded include Psa 3 in kiwifruit, Khapra beetle, chestnut blight, as well as chocolate band, Monacha and Cernuella snails.

Participation in emergency response exercises has also strengthened organisational readiness for future incursions (see **page 195**).

The Victorian component of Exercise Bee Prepared was held at Attwood on 13 March 2018. The exercise tested AgVic's response capacity and capability in the first two to seven days after the detection of varroa mites. A full incident management team of 19 staff ran the scenario, which included planning, operations, public information dissemination and liaising with a representative of the **Australian Honey Bee Industry Council**. The post-exercise evaluation of surveillance and response protocols indicated that the scenario was effectively managed and that AgVic has sufficient capacity to manage such an incident in the future.

AgVic also held Exercise Coombes at Attwood in June 2018. This exercise simulated the detection of tarnished plant bug, one of Victoria's 'Top 20' emergency pests and pathogens. Sixty AgVic and industry staff participated in a two-day operation designed to test the components of an emergency response and the arrangements for industry involvement during an incursion. Post-exercise evaluation identified ways in which to improve preparedness. Industry participants also have a greater appreciation of the structure of the Incident Management Team and how they can better work with AgVic in this area.

AgVic participated in Exercise Bee Prepared in cooperation with PHA

Non-government roles

PLANT HEALTH AUSTRALIA

Plant Health Australia (PHA) is the national coordinator of the government–industry partnership for plant biosecurity in Australia.

PHA facilitates this partnership and drives action to improve policy, practice and performance of Australia's plant biosecurity system and to build capability to respond to plant pest emergencies.

PHA independently advocates on behalf of the national biosecurity system to benefit plant industries and the environment. The company's goal is to minimise plant pest impacts on Australia, boost industry productivity and profitability and enhance market access.

PHA's efforts help to:

- minimise plant pest impacts
- enhance Australia's plant health status
- assist trade 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.

Plant Health Australia members

PHA members comprise all major plant industry peak bodies that represent Australia's growers and beekeepers, plus all state and territory governments and the Australian Government, a total of 61 as at 31 December 2018. Table 2 gives a full list of industry, government and associate members. The honey bee industry is a member of PHA because of the benefits that pollination brings to crop yield.

Being a PHA member enables parties to stay up to date on plant biosecurity issues and to work together on strengthening all aspects of the system. Membership 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 Emergency Plant Pest incursion (see Chapter 6).

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 autonomy 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.

The number of plant biosecurity partnerships are increasing over time, and the model is proving highly successful. One example of a biosecurity partnership facilitated by PHA is the National Bee Pest Surveillance Program, described on page 154.

PHA provides 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, facilitate improved national coordination and collaboration, and target member efforts and investment to best effect. The National Plant Biosecurity Strategy, biosecurity plans for industries and the series of annual plant biosecurity status reports are examples of this work.

PHA facilitates and manages emergency responses to exotic plant pests

Another central role for PHA is the establishment of funding and management arrangements for effective responses to Emergency Plant Pest incursions. PHA undertakes this role through its custodianship and administration of the EPPRD, and its operational guide PLANTPLAN, which sets out the agreed approach that government and industry stakeholders will take whenever an Emergency Plant Pest (a new exotic pest of significance) is found.

At the end of 2018, there were 47 signatories to the EPPRD and eradication responses were underway. In addition to ensuring that a response is carried out and cost-shared in accordance with the EPPRD, PHA runs a process to continually improve its provisions. Twice a year, PHA convenes meetings of signatories to discuss and agree modifications to the agreement to take account of new information and procedural improvements that are identified through post-incident reviews.

In addition, PHA assists signatories to meet their preparedness and prevention obligations that are stipulated under the EPPRD. As part of this, PHA provides a range of services including contingency planning, surveillance and diagnostic systems support, response training and simulation exercises, all of which boost preparedness.

PHA works with members to mitigate risks posed by pests

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 and by providing assistance to implement agreed risk mitigation measures.

Biosecurity plans, manuals for producers and awareness raising extension services are examples of activities that PHA undertakes with and on behalf of members. See more in Chapter 2.

PHA also works to ensure that the system is supported with assets such as information systems, diagnostic expertise, targeted research, development and extension activities, and surveillance protocols and provides information on exotic pests including the Pest Information Document Database. This online information resource holds publicly available fact sheets and other kinds of information on serious exotic pests, which is frequently used by PHA members.

Additional activities to mitigate risk

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

In addition, PHA is also commissioned to undertake many risk mitigation projects by individual members, groups of members in partnership, and non-members. Often these non-subscription funded projects boost biosecurity for particular industries. Examples of such projects include industry funded biosecurity outreach officers, Emergency Plant Pest response simulations, and biosecurity manuals to inform growers.

In a new initiative, PHA is coordinating Australia's engagement with the **International Plant Sentinel Network** that is linking botanic gardens and arboreta, national plant protection organisations and plant health scientists around the world to enable monitoring for pests of native Australian flora.

For more information see **planthealthaustralia.com.au**

Table 2. Plant Health Australia members

Industry members				
Almond Board of Australia	Australian Macadamia Society	Australian Truffle Growers' Association	Chestnuts Australia	Onions Australia
Apple and Pear Australia	Australian Mango Industry Association	Australian Vigerons	Citrus Australia	Passionfruit Australia
Australian Banana Growers' Council	Australian Melon Association	Australian Walnut Industry Association	Cotton Australia	Pistachio Growers' Association
Australian Blueberry Growers' Association	Australian Olive Association	AUSVEG Limited	Dried Fruits Australia	Raspberries and Blackberries Australia
Australian Forest Products Association	Australian Processing Tomato Research Council	Avocados Australia	Grain Producers Australia	Ricegrowers' Association of Australia
Australian Ginger Industry Association	Australian Sweetpotato Growers	CANEGROWERS	GROWCOM	Strawberries Australia
Australian Honey Bee Industry Council	Australian Table Grape Association	Canned Fruit Industry Council of Australia	Hazelnut Growers of Australia	Summerfruit Australia
Australian Lychee Growers' Association	Australian Tea Tree Industry Association	Cherry Growers Australia	Nursery and Garden Industry Australia	Winemakers' Federation of Australia
Government members				
Australian Capital Territory Government	New South Wales Government	Queensland Government	Tasmanian Government	Western Australian Government
Commonwealth of Australia	Northern Territory Government	South Australian Government	Victorian Government	
Associate members				
AgNova Technologies	CSIRO	Northern Territory Farmers Association	Victorian Farmers Federation	
Bendigo Kangan Institute of TAFE	Grains Research and Development Corporation	Plant Biosecurity CRC	Vinehealth Australia	
Cotton Research and Development Corporation	Horticulture Innovation Australia	Sugar Research Australia	Wine Australia	

PEAK PLANT INDUSTRY BODIES

Australia's farmers have peak representative bodies that act on their behalf on a range of activities of collective importance, including biosecurity.

Most plant industry peak bodies represent producers of one crop, such as avocadoes, or a group of similar crops such as vegetables. In addition to broadacre farmers and horticulture producers, industry peak bodies represent truffle growers, foresters and beekeepers (due to the importance of honey bees as pollinators for many crops), and most of these peak bodies are members of PHA.

Industry bodies consider biosecurity to be a matter of importance, since it underpins the sustainability of their industry. New plant pests can make production more expensive due to increased use of pesticides, greater labour costs or additional procedures. Pests can lower yields, reduce quality or cause damage to stored produce. In some cases, these factors mean it is no longer viable to grow a particular crop in a region. Pests can also cause loss of access to markets so that some growers have fewer market options to sell their crops.

As a result of these potential biosecurity threats to sustainability, Australia's peak industry bodies are proactive about biosecurity risk mitigation. Most have joined PHA to be a part of the plant biosecurity partnership, which ensures that they are kept up to date on biosecurity and can contribute to strengthening the plant biosecurity system.

The majority (37 of 40 industry members) of PHA's plant industry members are also signatories to the EPPRD. This provides a number of benefits including the potential to provide Owner Reimbursement Costs to represented growers in the event of an Emergency Plant Pest response. In becoming a signatory to the EPPRD, peak plant industry bodies establish a funding mechanism called an Emergency Plant Pest Response Levy. This ensures that the industry can pay their share of an agreed Cost Shared eradication response for an Emergency Plant Pest that affects their crops. This levy is established under the terms of the Australian Government Levy Principles and Guidelines and requires consultation with and support of relevant growers.

Importantly, plant industry bodies represent growers in an Emergency Plant Pest response, which can be a significant commitment. They also contribute to scientific advisory panels when Emergency Plant Pest responses need information to make decisions.

Plant industry peak bodies also:

- work with government departments to negotiate international market access
- take part in government consultation events such as Biosecurity Roundtables
- communicate with growers about the need for on-farm biosecurity and other biosecurity risk mitigation activities
- work with government departments on pest surveillance activities
- develop information on exotic pests, often in collaboration with the relevant state or territory department of agriculture or PHA.

Other levies or funding mechanisms at regional, state or national levels are increasingly being used to fund specific plant biosecurity preparedness activities that benefit the industry, such as research and development projects or industry outreach programs. Other initiatives may include the funding of surveillance activities for early detection of high-risk pests or the development of contingency plans to facilitate the preparation of a Response Plan in the event of an Emergency Plant Pest incursion. More information on Emergency Plant Pest responses is provided in **Chapter 6**.

Peak industry bodies have contributed to industry profiles in **Chapter 3** of this report.

PRIVATE SECTOR

The private sector makes a large contribution to the plant biosecurity system.

Plant producers and beekeepers have a responsibility to protect their enterprises and those of others in their region and industry from new pests and weeds by using on-farm biosecurity measures and resources (covered in **Chapter 7**).

Trade, transport and logistics companies include importers (commercial and non-commercial), customs brokers, freight forwarders and agents, integrated logistic suppliers, vessel and port operators. They are required to follow strict guidelines to ensure exotic pests do not enter Australia on plant products or on cargo, and do not move around Australia.

Private consultants and advisers provide extensive plant biosecurity advice across a range of crop types, and in most key production areas. Commercial agronomists also provide local services through the major distribution chains. They are backed by national technical networks which provide a comprehensive suite of services to agricultural industries.

Australian societies and associations have members that include scientific professionals who 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.

RESEARCH FUNDERS AND PROVIDERS

Research funders and scientists ensure that scientific research, development and extension (RD&E) activities provide answers to pest problems faced by Australian producers. Researchers have a responsibility to protect Australia from biosecurity risks and are required to report any findings of biosecurity concern, such as finding new variants or species of pests in the course of their work. They also have a responsibility to protect Australia's plant resources through safe biosecurity practices when conducting research, particularly when doing field work.

Research activities are carried out by university, government and industry researchers, often through cooperative funding organisations like research and development corporations (RDCs) and the **Plant Biosecurity Research Initiative**, a joint initiative of seven RDCs. Research includes methods of identifying pests (diagnostics), effective management techniques and work to breed resistant crop varieties. Plant biosecurity research is covered in **Chapter 8**.

COMMUNITY

The community includes the general Australian public and others such as local governments, landholders, travellers returning from overseas, tourists, home gardeners and anyone moving goods into or around the country or visiting rural areas.

Primarily, community members have post-border biosecurity responsibilities, although people returning from overseas and those importing goods from overseas must abide by international border restrictions to prevent incursions of exotic pests. The roles of community in preserving the integrity of Australia's plant biosecurity status are explained in **Chapter 7**.

International Year of Plant Health 2020

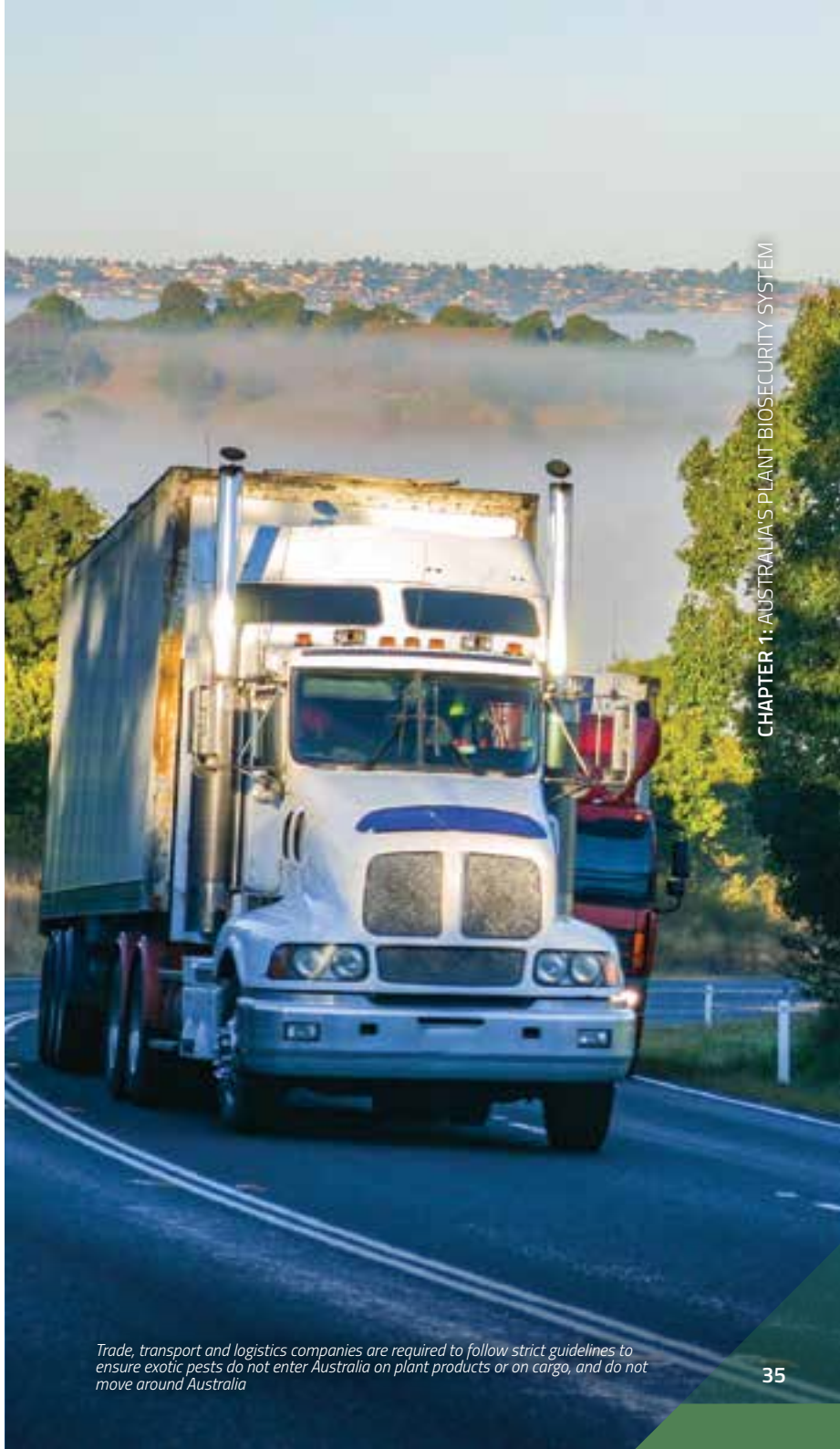
INTERNATIONAL YEAR OF PLANT HEALTH 2020

On 20 December 2018 the UN Food and Agriculture Organization and the International Plant Protection Convention Secretariat welcomed the UN General Assembly's adoption of a resolution proclaiming 2020 as the International Year of Plant Health (IYPH).

The theme of the year will be 'Protecting the world's plant resources from pests' with the goal to mobilise governments, industries, civic organisations, scientist and the public to:

- work together to protect the world's plants against the spread of devastating pests
- encourage scientific innovation to address pest threats
- promote responsible practices that reduce pest spread
- increase public and private sector support for more sustainable plant health strategies and services.

Australia will be actively participating in the International Year of Plant Health in 2020. More information is available from **ippc.int/en/iyph**



Trade, transport and logistics companies are required to follow strict guidelines to ensure exotic pests do not enter Australia on plant products or on cargo, and do not move around Australia

Chapter 2

Protecting Australia's plant resources

Protecting Australia's plant resources

The damage to plants caused by pests varies from species to species, but it can be significant. It is estimated that every year between 20 and 40 per cent of crops are lost to plant pests and weeds globally[10]. Some invasive exotic pest species also have the potential to cause permanent damage to native plants in our unique natural ecosystems. Others can reduce the social value of public amenities such parks and gardens.

This chapter covers the priority pest and disease threats to the environment and for each of the major plant production industries. It describes Australia's plant resources and environmental biosecurity, and summarises key features and biosecurity planning activities by most of the peak plant industry bodies.

Figure 5 shows the catchment scale land uses in Australia as at December 2018[11]. The map shows the single dominant land use for a given area, based on the primary management objective of the land manager (as identified by state and territory agencies).

Improving preparedness for spotted wing drosophila

On 29 October 2018, growers, government biosecurity officers and international experts came together to consider the threat posed by spotted wing drosophila (*Drosophila suzukii*, SWD), an exotic fly of high biosecurity concern.

At the workshop, international researchers Professor Rufus Isaacs from Michigan State University, USA, and Dr Bethan Shaw from the National Institute of Agricultural Botany, UK, shared how berry growing industries in their countries were impacted by the arrival of SWD and highlighted the strategies that can be used to manage the pest.

Following the workshop, presentations to raise awareness of SWD were held between 30 October to 2 November in Wandin (Victoria), Launceston (Tasmania), Coffs Harbour (NSW) and Caboolture (Queensland), giving growers from a range of production regions a chance to hear from these international experts.

The events were held as part of a project PHA, cesar and New Zealand's Plant & Food Research are working on together to improve Australia's preparedness for the pest. The project is funded by Hort Innovation with the support of the strawberry, raspberry and blackberry, cherry and summerfruit R&D levies.

10. Savery, 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
11. ABARES (2018). Catchment scale land use of Australia. Accessed online 15 May 2019 agriculture.gov.au/abares/aclump/Pages/land-use/Catchment-scale-land-use-of-Australia-2018.aspx

Figure 5. Catchment scale land use in Australia

FIGURE LEGEND

Conservation and natural environments

- Nature conservation
- Managed resource protection
- Minimal use

Production from relatively natural environments

- Grazing native vegetation
- Production native forests

Production from dryland agriculture and plantations

- Plantation forests*
- Grazing modified pastures
- Cropping
- Perennial horticulture
- Seasonal horticulture
- Land in transition

Production from irrigated agriculture and plantations

- Irrigated plantation forests*
- Grazing irrigated modified pastures
- Irrigated cropping
- Irrigated perennial horticulture
- Irrigated seasonal horticulture
- Irrigated land in transition

Intensive uses

- Intensive horticulture

* commercial and other

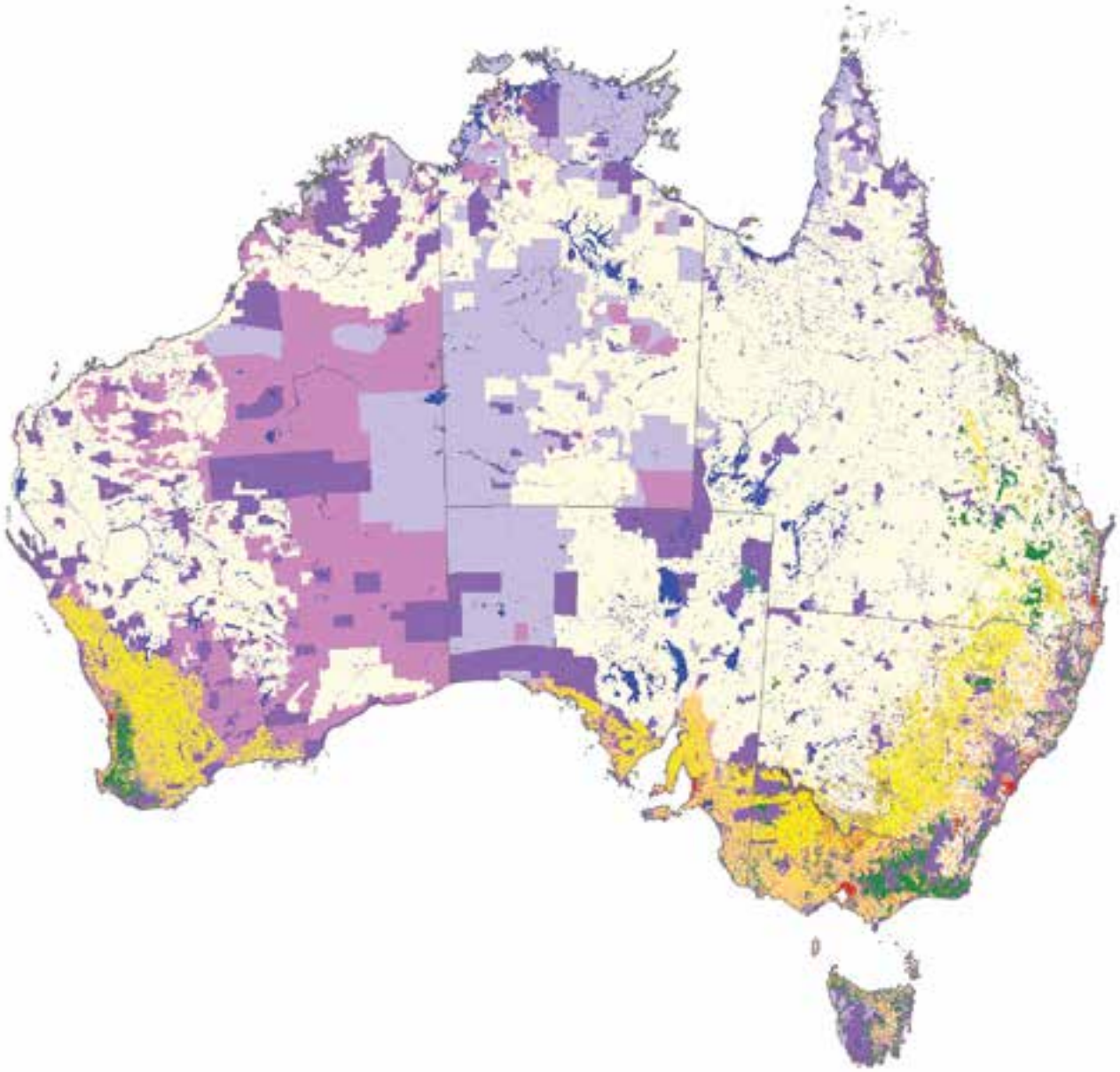


Image courtesy of the Department of Agriculture and Water Resources

Priority pests and diseases

Identifying exotic pest threats and the ways in which they might make it into Australia can significantly increase the chance of containing and successfully eradicating them should they arrive. Prioritising pests according to their potential impact allows biosecurity activities – such as surveillance, pathway analysis, and border screening and inspection – to target the most serious risks.

NATIONAL PRIORITY PLANT PESTS

Australia's least wanted plant pests and diseases were endorsed by the Plant Health Committee in June 2016. Australia's National Priority Plant Pests are listed in Table 3, with the top 10 featured in Table 4.

The pests were identified considering:

- the likelihood of them entering the country
- their ability to become established and spread
- the consequences for businesses, human health and the environment if they do
- the ability to demonstrate a need for and benefit from nationally coordinated action.

Identifying the National Priority Plant Pests enables decision makers to focus biosecurity activities to achieve higher returns on investments in risk management, facilitating an integrated and harmonised approach to prevent and prepare for pest threats.

Potential areas to focus national investment include:

- national pre-border or border measures to reduce the likelihood of entry
- controls on the movement of plant products that can carry regionalised pests interstate
- surveillance for early warning of the presence of pests, area freedom from pests and delimiting the extent of an incursion
- diagnostics, as a tool for border protection, surveillance and incursion responses
- contingency planning, which may highlight areas for improvement such as:
  - tracing the origin and spread of pests
  - developing mapping systems
  - breeding new plant varieties
  - negotiating access to markets
  - training to improve preparedness
  - pre-emptive registration of new pesticides for use in incursions
  - identifying possible biological control agents
  - identifying research needs
  - gaps in the regulatory system.

Table 3. Australia's National Priority Plant Pests

National priority plant pests	
Xylella fastidiosa and confirmed and unconfirmed vectors	Hessian fly, barley stem gall midge
Khapra beetle	Texas root rot
Exotic, economic fruit fly (both lure and non-lure responsive)	Wheat stem sawfly
Karnal bunt	Golden apple snail
Huanglongbing and Asian, African citrus psyllid complex	Barley stripe rust
Exotic gypsy moth	Cereal cyst nematode
Solenopsis spp. and other exotic invasive ant species	Sharka
Internal and external mites of bees	Exotic drywood termite
Giant African snail	Exotic subterranean termite
Brown marmorated stink bug	Exotic longhorn beetle (*Anoplophora* spp.)
Zebra chip and tomato potato psyllid complex	Red ring disease, pine wood nematode complex
Ug 99 wheat stem rust	Fusarium wilt
Russian wheat aphid (holocyclic form)	Sugarcane stalk borer
Citrus canker	Black sigatoka
Guava (Eucalyptus) rust (exotic strains)	Potato late blight
Air-borne *Phytophthora* spp.	Sunn pest
Exotic bees	Western plant bug, tarnished plant bug
Panama tropical race 4	Exotic sawyer beetles
Potato cyst nematode	Burning moth
Leafminers (*Liriomyza* spp.)	European canker
Fire blight	Dutch elm disease

For more information on National Priority Plant Pests go to **agriculture.gov.au/pests-diseases-weeds/plant/national-priority-plant-pests-2016**

Table 4. The top 10 National Priority Plant Pests

1. *Xylella fastidiosa*

Christine Horlock, QDAF

Xylella fastidiosa is a bacteria that could devastate horticultural crops, native flora and gardens as hundreds of native, commercial and ornamental plant species are susceptible. There is no treatment and no documented example of it ever being eradicated once it has become established. It could enter Australia with illegally introduced plant material or with infected sap sucking insects that can hitch a ride to Australia.

2. Khapra beetle

Pest and Diseases Image Library, Bugwood.org

Khapra beetle is a pest of stored grain that would have a major impact on the grains industry if it were to establish in Australia, threatening access to export markets. The beetle is small but tough: larvae can survive in a dormant state for up to two years with very little food. It could arrive in cargo, machinery, food or mail items, or be brought in by travellers in personal effects. Once here, it could spread easily via the movement of seed, straw, stored grain, cargo or machinery.

3. Exotic fruit flies

John Davis

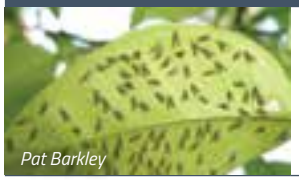
Exotic fruit flies are one the world's most destructive group of horticultural pests and put at risk more 300 types of fruit and vegetables. While Australia already has some fruit flies, other exotic species such as spotted wing drosophila (*Drosophila suzukii*) (pictured left) are kept out by ongoing biosecurity measures.

4. Karnal bunt

FAO

Karnal bunt is a disease caused by the fungus *Tilletia indica*, a highly invasive exotic grain pest which threatens Australia's wheat industry by its potential heavy impact on the quality and ability to sell infected crops. If introduced, Karnal bunt would be almost impossible to eradicate as its spores can persist in soil for up to four years.

5. Huanglongbing



Pat Barkley

Huanglongbing is a disease caused by *Candidatus* Liberibacter asiaticus and was previously known as citrus greening disease. One of the worst diseases of citrus trees worldwide, it spreads through the tree canopy, causing decline and then death of the tree. There is no cure – the only way to stop the disease is to destroy all infected trees.

6. Gypsy moths

E. Bradford Walker, Vermont Department of Forests, Parks and Recreation, Bugwood.org

Gypsy moths (*Lymantria* spp.) are destructive pests of forests and horticulture. They pose a high biosecurity risk to Australia because of their tendency to hitchhike and their high reproductive rate. If gypsy moths became established, they would be extremely difficult and expensive to manage, partly because of their broad host range.

7. Tramp ants

Scott Bauer, USDA Agricultural Research Service, Bugwood.org

Tramp ants are a diverse group of aggressive, invasive ants that can rapidly establish and spread if introduced. Several species of tramp ants are amongst the most serious global invasive pests. Australia's environmental, economic, and social wellbeing are threatened by these ants, some of which have already been introduced and are now established.

8. Mites of bees

Scott Bauer, USDA Agricultural Research Service, Bugwood.org

Mites of bees such as varroa mite (*Varroa destructor*) would pose a serious threat to bees, reducing the numbers of unmanaged European honey bees and the pollination services they provide by 90 to 100 per cent if it established in Australia. Other exotic pests like tracheal mite (*Acarapsi woodi*) and tropilaelaps mite (*Tropilaelaps* spp.) would also seriously impact the honey bee and honey bee reliant plant industries.

9. Giant African snail

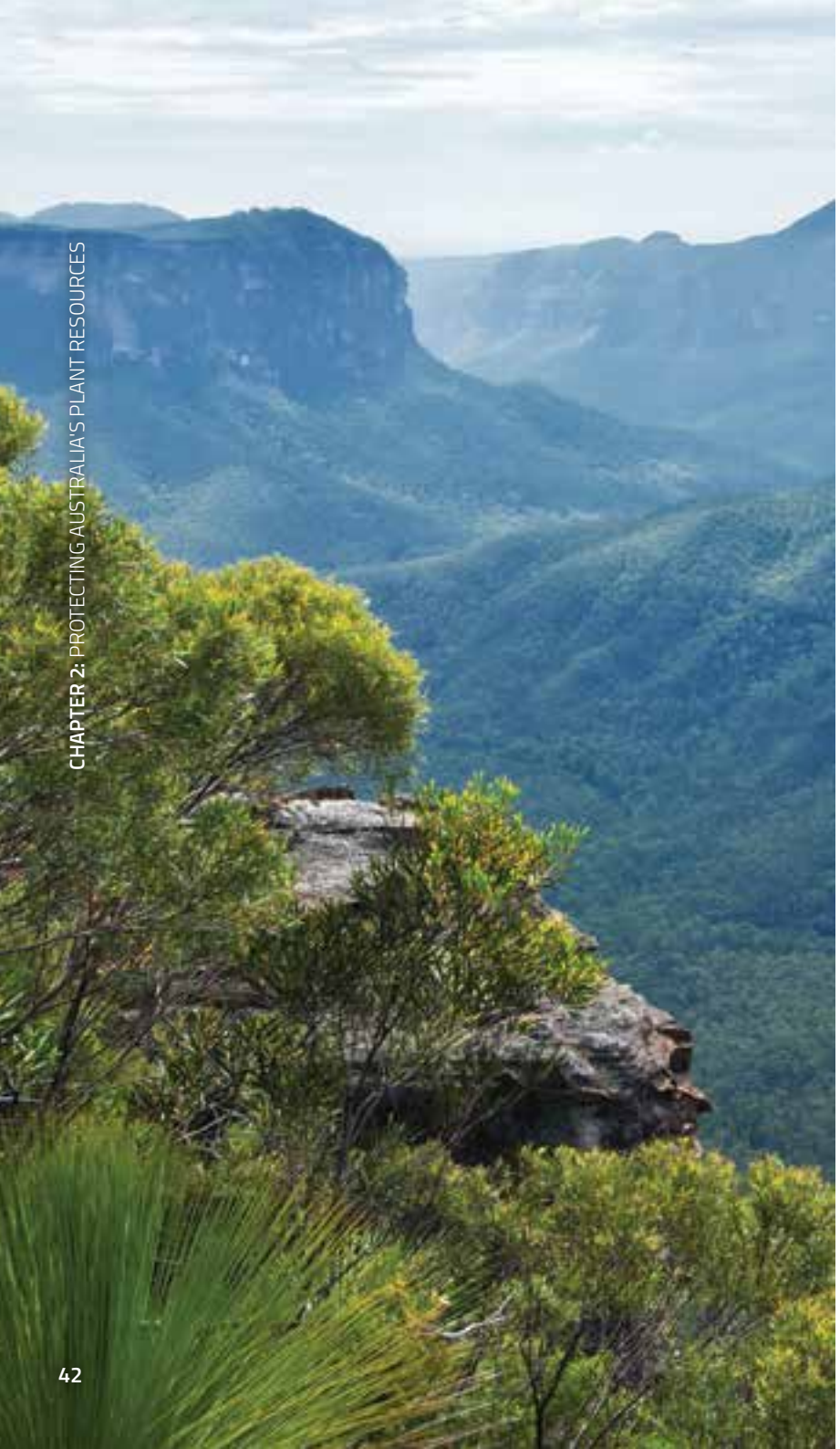
Pest and Diseases Image Library, Bugwood.org

Giant African snail (*Lissachatina fulica*) has a voracious appetite and eats more than 500 plant species, making it one of the most damaging land snails. It can also affect human health, infecting people with bacteria and parasites if handled with bare hands or if eaten raw or partially cooked.

10. Brown marmorated stink bug

Steven Valley, Oregon Department of Agriculture, Bugwood.org

Brown marmorated stink bug (*Halyomorpha halys*) poses a high biosecurity risk because it affects a very wide range of horticulture and other crops and could also impact native and amenity plants. If it established in Australia it would be extremely difficult and expensive to manage and have a broad impact on the community. The ability of this stink bug to lie dormant and spread hidden in cargo has enabled it to make its way to new regions of the world and spread rapidly.



Environmental biosecurity

Environmental biosecurity is the protection of plants in the environment and those planted for social amenity from the risks and negative effects of pests and diseases entering, emerging, establishing or spreading in Australia.

The 'environment' includes Australia's natural terrestrial, inland water and marine ecosystems, and its natural and physical resources. 'Social amenity' includes the social, economic and cultural aspects of the environment, such as tourism, human infrastructure, cultural assets and national image.

Environmental biosecurity is distinct from agricultural biosecurity, which focuses on pests and diseases that could have an economic impact on Australia's agricultural productivity. Although distinct, there may be a significant overlap in pests that affect plants grown for agricultural purposes and those found in the natural environment or that have social amenity in urban spaces. Examples include growing eucalypt and tea tree species as commercial crops for harvest and the propagation of native plants by production nurseries for landscaping and home gardeners.

An example of two pests that together can affect both agricultural crops and native vegetation is Australia's top biosecurity threat ***Xylella fastidiosa*** and an insect that can carry and spread the disease it causes, the glassy winged sharpshooter. They can cause and spread disease in production crops such as grapevines and olives, along with acacia, grevillea and Myrtaceae species that are significant in the environment, urban and rural settings, and also garden plants such as lavender and oleander.

The National Biosecurity Committee and the Environment and Invasives Committee (see page 19) administer environmental biosecurity. The committees include representatives from national and state agriculture and environment departments to ensure cross agency awareness and action on environmental biosecurity issues.

The National Environmental Biosecurity Response Agreement (NEBRA) establishes national emergency response arrangements, including for cost-sharing, for responding to biosecurity incidents such as pests and diseases that primarily impact on the environment or social amenity and where the response is for the public good. The agreement was signed by the Commonwealth, state and territory governments in January 2012.

Australia's preparedness for biosecurity incidents is also developed through training, simulation exercises and planning. Planning allows stakeholders to determine pests of highest priority, analyse the risks they pose, and to put in place practices and procedures to rapidly detect and respond to an incursion. This work minimises the impact if a pest incursion occurs and reduces the chance of pests becoming established.

In November 2018, a simulation exercise tested the response to a detection of *Xylella fastidiosa*. The exercise centred on the decision-making process and the eradication strategy implemented in response to the presence of both the bacterium and its insect carrier. See page 195 for more information.

Environmental biosecurity can make use of and build on many aspects of the system established for production biosecurity. The approach to environmental biosecurity is similar to that for production pests and diseases, involving preparedness, response, management and actions taken to address the issues.

In Australia environmental Biosecurity Roundtables are held twice each year to facilitate discussion on environmental biosecurity issues, to identify potential solutions to shape future actions and share information on initiatives. The roundtables are an initiative of the Australian Government Department of Agriculture and Water Resources (DAWR) and the Department of the Environment and Energy.

In 2018, the Inspector-General for Biosecurity conducted a review of environmental risk management in Australia. The review was instigated to examine how effectively the DAWR manages environmental biosecurity concerns. The report was not released as of the end of 2018.

It is anticipated that in late 2019 the inaugural national priority list of exotic environmental pests, weeds and diseases will be announced by the office of the Chief Environmental Biosecurity Officer.

Biosecurity plan for acacia species

In 2018 a biosecurity plan for acacia species was produced by PHA with funding from the Australian Government Department of Agriculture and Water Resources.

Acacia is the largest genus of flowering plants in Australia, with more than 700 native species. In addition to being critical to many of Australia's ecosystems, some species are used in horticulture, forestry and for revegetation programs.

A number of exotic plant pests have the potential to impact on Australian acacia species and the stakeholders who depend on them. One of the major pest threats is *Xylella fastidiosa*.

By identifying and prioritising the key biosecurity risks through developing the biosecurity plan, stakeholders are better placed to reduce the social and economic costs of pest incursions on acacia growers, the environment and the wider community.

The plan will be updated in 2019 in collaboration with the office of the Chief Environmental Biosecurity Officer.

The Chief Environmental Biosecurity Officer, Ian Thompson. Image courtesy of the Department of Agriculture and Water Resources

Plant industry biosecurity preparedness

There are a number of ways that industries and governments can minimise the risks posed by exotic pests to plant industries. One is to identify the exotic pests that pose the greatest risk to an industry through biosecurity planning. The planning process also prioritises activities to mitigate the risks associated with these pests and improve biosecurity overall for an industry.

Contingency planning can also prepare an industry for exotic pest incursions. A contingency plan identifies the information needed when planning an emergency response to an exotic pest. Industries can also improve awareness of exotic pests and biosecurity practices by developing a biosecurity manual for use by producers.

BIOSECURITY PLANNING

One of the first steps to reduce the biosecurity risks to an industry is to develop a biosecurity plan for the crop(s) produced. A risk assessment is made to identify high priority pests and guide the biosecurity activities undertaken by industry and government. Each of PHA's plant industry members has developed a biosecurity plan in partnership with governments. Developing a biosecurity plan is a requirement for Emergency Plant Pest Response Deed signatories and they are generally funded by a research and development corporation (RDC) or plant industry peak body. See Table 5 for a list of biosecurity plans prepared by PHA.

Table 5. Current biosecurity plans covering Australia's plant industries

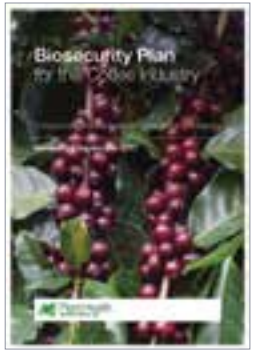
Industry plans		
Apple and Pear BP (Version 3.0)	Honey bee IBP (Version 1.1)	Plantation forest IBP (Version 2.0)
Avocado IBP (Version 2.01)	Lychee BP (Version 1.0)	Potato IBP (Version 2.0)
Banana IBP (Version 2.0)	Mango IBP (Version 2.1)	Rice IBP (Version 3.0)
Blueberry BP (Version 1.0)	Melon IBP (Version 1.0)	Rubus IBP (Version 1.0)
Cherry BP (Version 3.0)	Nursery IBP (Version 3.0)	Strawberry IBP (Version 2.0)
Citrus BP (Version 3.0)	Nuts BP (Version 3.0)	Sugarcane IBP (Version 3.0)
Coffee BP (Version 3.0)	Olive BP (Version 2.0)	Summerfruit IBP (Version 1.0)
Cotton BP (Version 3.0)	Onion IBP (Version 2.0)	Tomato BP (Version 1.0)
Cut flower BP (Version 1.0)	Papaya IBP (Version 1.0)	Truffle BP (Version 1.0)
Ginger IBP (Version 1.0)	Passionfruit IBP (Version 1.0)	Vegetable BP (Version 3.0)
Grains BP (Version 3.0)	Pineapple BP (Version 2.0)	Viticulture IBP (Version 3.0)

To identify and prioritise exotic plant pests, experts from the industry and government(s) are brought together to form a Technical Expert Group. Pest risk assessments take into account the pest's likelihood of entry, establishment and spread, as well as the economic impact if it established in Australia. The assessment includes all entry pathways including legal, illegal, accidental or through natural dispersal. This is broader than the Department of Agriculture and Water Resources Import Risk Assessment process which focuses only on specific regulated import pathways (see **page 130**).

The exotic pests that pose the greatest risk with the largest potential economic impact for an industry are deemed to be High Priority Pests. Table 6 lists all of the High Priority Pests identified in the 33 biosecurity plans developed by PHA. The same pests are also listed throughout **Chapter 3** with the crops that they affect.

Having identified the pests that pose the greatest risk to industry the next step is to develop and agree on effective biosecurity measures to protect against them. This involves the industry, governments, the relevant RDC and PHA working in partnership with each other. Agreed risk mitigation methods might include:

- developing contingency plans that will assist the response to particular plant pests, should they make it to Australia
- developing diagnostic protocols so that pests can be identified quickly
- promoting on-farm biosecurity measures among growers to limit the potential for entry and spread of pests
- developing surveillance plans so that incursions of exotic pests are detected early
- carrying out pre-emptive plant breeding programs to develop more resistant crop varieties
- gaining pre-emptive permit registration for pesticides that would be needed to manage pests.



The biosecurity plan is endorsed by the peak industry body and by all Australian governments through the Plant Health Committee. This means that key stakeholders in the plant biosecurity system have agreed on the priorities and risk mitigation efforts to protect that industry.

Since 2017, a Biosecurity Reference Panel of government and industry experts has been appointed to assess the progress of activities in individual plans. This ensures that by the end of a plan activities have been achieved, providing a significant boost in protection from pest threats. Biosecurity plans undergo formal reviews every four to five years to ensure they remain up-to-date, taking into consideration new research, incursions overseas and changes to potential entry pathways.

In 2018 revised biosecurity plans were produced for the vegetable, coffee and cherry industries.

Growers too can support Australia's biosecurity status by implementing biosecurity practices to protect their crops from established and exotic pests. See on-farm biosecurity in **Chapter 7** and biosecurity manuals for producers on **page 61**.

Table 6. High Priority Pest threats

Scientific name	Common name	High priority pest of
Abaca bunchy top virus (Babuvirus)	Abaca bunchy top virus	Banana
Acarapis woodi	Tracheal mite	Honey bee
Achatina achatina	Giant African snail	Vegetable
Aleurolobus barodensis	Sugarcane whitefly	Sugarcane
Alternaria humicola	Leaf spot	Vegetable
Amyelois transitella	Navel orangeworm	Nut
Anastrepha ludens	Mexican fruit fly	Citrus
Anisogramma anomala	Eastern filbert blight (hazelnut blight)	Truffle, Nut
Anthonomus grandis	Cotton boll weevil	Cotton
Aphis fabae	Black bean aphid	Vegetable
Aphis gossypii (exotic strains)	Cotton aphid	Cotton, Production nurseries
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
Aristobia testudo	Lychee longicorn beetle	Lychee
Arthuriomyces peckianus	Orange rust (long-cycled)	Rubus
Ascochyta rabiei (MAT1-1 is exotic, MAT1-2 is endemic)	Ascochyta blight	Grains
Aspidiella hartii	Yam scale (rhizome scale)	Ginger
Aulacophora foveicollis	Red pumpkin beetle	Vegetable
Avocado sunblotch viroid (asymptomatic strains)	Avocado sunblotch	Avocado
Avocado sunblotch viroid (symptomatic strains)	Avocado sunblotch	Avocado
Bactericera cockerelli	Tomato potato psyllid	Tomato, Potato
Bactrocera carambolae	Carambola fruit fly	Avocado, Tomato, Citrus, Mango, Papaya, Passionfruit, Vegetable, Viticulture

Table 6. High Priority Pest threats (continued)

Scientific name	Common name	High priority pest of
Bactrocera cucurbitae	Melon fruit fly	Vegetable
Bactrocera dorsalis (syn. *B. invadens, B. papayae, B. philippinensis*)	Oriental fruit fly	Apple and Pear, Avocado, Coffee, Cherry, Citrus, Lychee, Mango, Melon, Papaya, Passionfruit, Summerfruit, Tomato, Vegetable, Viticulture
Bactrocera facialis	Tropical fruit fly	Avocado, Passionfruit, Tomato
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 passiflorae	Fijian fruit fly	Avocado, Papaya, Passionfruit, Vegetable
Bactrocera psidii	South Sea guava fruit fly	Passionfruit
Bactrocera trivialis	New Guinea fruit fly	Citrus, Vegetable
Bactrocera xanthodes	Pacific fruit fly	Avocado, Passionfruit
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, Production nurseries
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, Production nurseries, Tomato, Vegetable
Blood disease bacterium	Blood disease	Banana

Scientific name	Common name	High priority pest of
Botrytis squamosa	Leaf blight	Onion
Burkholderia caryophylli (syn. *Pseudomonas caryophylli*)	Bacterial wilt of carnation	Cut flower
Bursaphelenchus spp. including *B. xylophilus*	Pinewood nematode species complex	Forestry
Cacoecimorpha pronubana	Carnation tortrix	Cut flower
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, Production nurseries
Candidatus Liberibacter solanacearum (syn. *Candidatus* Liberibacter psyllaurous)	Zebra chip	Potato, Tomato, Vegetable
Candidatus Phytoplasma pruni (syn. X disease phytoplasma)	Peach X disease	Cherry, Summerfruit
Candidatus Phytoplasma prunorum	European stone fruit yellows	Cherry, Summerfruit
Candidatus Phytoplasma solani	Bois noir	Viticulture
Carposina sasakii	Peach fruit moth, small peach fruit borer	Apple and Pear
Cephus cinctus	Wheat stem sawfly	Grains
Cephus pygmeus	European wheat stem sawfly	Grains
Ceratocystis fimbriata sensu lato	Mango sudden decline syndrome	Coffee, Mango
Ceratocystis manginecans	Mango sudden decline syndrome	Mango
Ceratocystis omanensis	Mango sudden decline syndrome	Mango
Ceratovacuna lanigera	Sugarcane woolly aphid	Sugarcane
Cercosporella rubi	Rosette	Rubus

Table 6. High Priority Pest threats (continued)

Scientific name	Common name	High priority pest of
Ceutorhynchus assimilis (syn. *Ceutorhynchus obstrictus*)	Cabbage seedpod weevil	Grains
Ceutorhynchus napi	Rape stem weevil	Grains
Ceutorhynchus pallidactylus	Cabbage stem weevil	Grains
Cherry leaf roll virus (Nepovirus) (exotic strains)	Blackline	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
Chilo tumidicostalis	Spotted sugarcane stem borer	Sugarcane
Chinavia hilaris (syn. *Chinavia hilare*)	Green stink bug	Nut
Chromatomyia horticola	Pea leafminer	Cut flower
Chrysoporthe austroafricana	Eucalyptus canker disease	Forestry
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
Colletotrichum higginsianum	Anthracnose	Vegetable
Colletotrichum kahawae subsp. *kahawai* (syn. *Colletotrichum coffeanum*)	Coffee berry disease	Coffee
Colletotrichum lentis (lentil affecting strain)	Lentil anthracnose, soybean anthracnose	Vegetable

Scientific name	Common name	High priority pest of
Colletotrichum truncatum (lentil strain)	Lentil anthracnose	Grains
Conopomorpha sinensis	Lychee fruit borer	Lychee
Conotrachelus aguacatae	Small avocado seed weevil	Avocado
Conotrachelus nenuphar	Plum curculio	Cherry, Summerfruit
Conotrachelus perseae	Small seed weevil	Avocado
Coptotermes formosanus	Formosan subterranean termite	Forestry
Coptotermes gestroi	Asian subterranean termite	Forestry
Cotinis mutabilis	Fig beetle	Pineapple
Cotton leaf curl virus (Begomovirus)	Cotton leaf curl disease	Cotton
Cotton leafroll dwarf virus (Polerovirus)	Cotton blue disease	Cotton
Croesia curvalana	Blueberry leaftier	Blueberry
Cryphonectria parasitica	Chestnut blight	Nut
Cryptosporella umbrina	Brown rose canker	Cut flower
Cydia funebrana	Plum fruit moth	Summerfruit
Cydia inopinata (syn. *Grapholita inopinata*)	Manchurian fruit moth	Apple and Pear
Cylindrocopturus adspersus	Sunflower stem weevil	Grains
Daktulosphaira vitifoliae (exotic strains)	Grapevine phylloxera	Viticulture
Dasineura mali	Apple leaf curling midge	Apple and Pear
Deanolis sublimbalis (syn. *Noorda albizonalis*)	Red banded mango caterpillar (red banded borer)	Mango
Deformed wing virus (Iflavirus)	Deformed wing virus	Honey bee
Delia antiqua	Onion fly	Onion, Vegetable
Delia floralis	Summer cabbage fly	Vegetable
Delia florilega	Bean fly	Onion, Vegetable
Dendroctonus ponderosae	Mountain pine beetle	Forestry
Dendroctonus valens	Red turpentine beetle	Forestry
Diabrotica barberi	Northern corn root worm	Grains

Table 6. High Priority Pest threats (continued)

Scientific name	Common name	High priority pest of
Diabrotica undecimpunctata	Southern corn root worm	Grains
Diabrotica virgifera	Western corn root worm	Grains
Diaphorina citri	Asian citrus psyllid	Citrus, Production nurseries
Diaporthe helianthi	Sunflower stem canker	Grains
Dickeya dianthicola (syn. *Erwinia chrysanthemi* pv. *dianthicola*)	Slow wilt	Cut flower
Dickeya spp. (pineapple infecting strains) syn. *Erwinia chrysanthemi*	Bacterial fruit collapse, bacterial heart rot	Pineapple
Dickeya spp. (onion infecting exotic pathovars) syn. *Erwinia chrysanthemi*	Bacterial soft rot	Onion
Drosophila suzukii	Spotted wing drosophila	Apple and Pear, Blueberry, Cherry, Rubus, Summerfruit, Viticulture
Dryocosmus kuriphilus	Oriental chestnut gall wasp	Nut
Dysaphis plantaginea	Rosy apple aphid	Apple and Pear, Summerfruit
Dysdercus spp. (including *D. honestus, D. maurus, D. suturellus* (American species))	Cotton stainer	Cotton
Dysmicoccus neobrevipes	Grey pineapple mealybug	Pineapple
East Asian passiflora virus (Potyvirus)	East Asian passiflora virus	Passionfruit
Echinothrips americanus	Poinsettia thrips	Production nurseries
Eldana saccharina	African sugarcane stalkborer	Sugarcane
Elytroteinus subtruncatus	Fijian ginger weevil	Ginger
Endocronartium harknessii	Western gall rust	Forestry
Epichoristodes acerbella	South African carnation tortrix, South African carnation miner	Cut flower
Ericaphis fimbriata (with blueberry scorch Carlavirus)	Blueberry aphid	Blueberry
Erionota thrax	Banana skipper butterfly	Banana
Erwinia amylovora	Fire blight	Apple and Pear

Scientific name	Common name	High priority pest of
Erwinia herbicola (exotic strains)	Avocado blast	Avocado
Erwinia herbicola pv. *gypsophilae*	Bacterial gall	Cut flower
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, Vegetable
Eumetopina flavipes	Sugarcane leafhopper (vector of Ramu stunt disease)	Sugarcane
Eurygaster integriceps	Sunn pest	Grains
Euschistus conspersus	Consperse stink bug	Rubus
Eutetranychus banksi	Texas citrus mite	Coffee
Frankliniella bispinosa	Florida flower thrips	Citrus
Frankliniella intonsa	Flower thrips	Cut flower, Tomato
Frankliniella tritici	Eastern flower thrips	Cut flower
Fusarium circinatum	Pitch canker	Forestry
Fusarium mangiferae	Mango malformation	Mango
Fusarium mexicanum	Mango malformation	Mango
Fusarium oxysporum f. sp. *chrysanthemi*	Fusarium wilt of chrysanthemum	Cut flower
Fusarium oxysporum f. sp. *ciceris*	Fusarium wilt of chickpea	Grains
Fusarium oxysporum f. sp. *cubense*	Panama disease, tropical race 4	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
Fusarium oxysporum f.sp. *niveum* (exotic races)	Fusarium root and stem rot of melons	Melon

Table 6. High Priority Pest threats (continued)

Scientific name	Common name	High priority pest of
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* syn. *F. 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
Fusarium xylarioides f. sp. *abyssiniae* and *F. xylarioides* f. sp. *canephorae*	Coffee wilt	Coffee
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)	Potato
Grapevine flavescence dorée phytoplasma	Flavescence dorée	Viticulture
Grassy shoot phytoplasma	Grassy shoot	Sugarcane
Groundnut bud necrosis virus (Tospovirus)	Bud necrosis disease	Grains, Vegetable
Groundnut ringspot virus (Tospovirus)	Groundnut ringspot virus	Grains
Guignardia bidwellii	Black rot	Viticulture
Guignardia musae	Banana freckle	Banana
Gymnoconia nitens	Orange rust (short-cycled)	Rubus
Halyomorpha halys	Brown marmorated stink bug	Apple and Pear, Cherry, Cotton, Nut, Rubus, Truffle, Vegetable
Haplothrips chinensis	Chinese thrips	Cut flower
Harpophora maydis	Late wilt	Grains, Vegetable
Heilipus lauri	Large seed weevil	Avocado
Helicoverpa armigera (carrying Bt resistance alleles)	Cotton bollworm	Cotton

Scientific name	Common name	High priority pest of
Hemileia vastatrix	Coffee leaf rust	Coffee
Heterocrossa rubophaga	Raspberry bud moth	Rubus
Heterodera carotae	Carrot cyst nematode	Vegetable
Heterodera ciceri	Chickpea cyst nematode	Grains, Vegetable
Heterodera filipjevi	Cereal cyst nematode	Grains
Heterodera glycines	Soybean cyst nematode	Grains
Heterodera latipons	Mediterranean cereal cyst nematode	Grains
Heterodera sorghi	Sorghum cyst nematode	Grains
Homalodisca vitripennis (syn. *Homalodisca coagulata*)	Glassy winged sharpshooter	Cherry, Citrus, Production nurseries, Summerfruit, Viticulture
Homoeosoma electellum	Sunflower moth	Grains
Hoplostoma fuligineus	Large hive beetle	Honey bee
Hyalesthes obsoletus	Cixiidae planthopper	Viticulture
Hylesia nigricans	Burning moth	Forestry
Hypothenemus hampei	Coffee berry borer	Coffee
Hypothenemus obscurus	Tropical nut borer	Nut
Ips typographus	Spruce bark beetle	Forestry
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	Production nurseries
Liriomyza bryoniae	Tomato leafminer	Melon, Tomato, Vegetable
Liriomyza congesta	Pea leafminer	Cut flower
Liriomyza huidobrensis	Serpentine leafminer	Cut flower, Melon, Production nurseries, Tomato, Vegetable
Liriomyza sativae	Vegetable leafminer, American leafminer	Melon, Onion, Tomato, Vegetable

Table 6. High Priority Pest threats (continued)

Scientific name	Common name	High priority pest of
Liriomyza trifolii	American serpentine leafminer	Cut flower, Melon, Tomato, Vegetable
Lissachatina fulica (syn. *Achatina fulica*)	Giant African snail	Production nurseries, Tomato, Vegetable
Lissorhoptrus oryzophilus	Rice water weevil	Rice
Lobesia botrana	European grapevine moth	Viticulture
Lygus hesperus	Western plant bug	Cotton, Strawberry, Vegetable
Lygus lineolaris	Tarnished plant bug	Cotton, Production nurseries, Strawberry
Lymantria dispar	Asian gypsy moth	Apple and Pear, Forestry, Nut, Production nurseries
Lymantria mathura	Rosy gypsy moth, pink gypsy moth	Apple and Pear
Lymantria monacha	Nun moth	Apple and Pear, Forestry, Truffle
Magnaporthe grisea	Rice blast	Grains, Rice
Mayetiola destructor	Hessian fly	Grains
Mayetiola hordei	Barley stem gall midge	Grains
Meloidogyne enterolobii (syn. *Meloidogyne mayaguensis*)	Root knot nematode	Vegetable
Meloidogyne naasi	Barley root knot nematode	Vegetable
Monilinia fructigena	Brown rot	Apple and Pear, Blueberry, Cherry, Summerfruit
Monilinia mali	Monilinia leaf blight, blossom wilt	Apple and Pear
Monilinia polystroma	Asiatic brown rot	Apple and Pear, Summerfruit
Monilinia vaccinii-corymbosi	Mummy berry, cotton ball disease	Blueberry
Monochamus spp. including *M. alternatus, M. galloprovinicialis, M. titillator, M. scutellatus*	Longhorn beetles	Forestry
Monosporascus cannonballus	Monosporascus root rot	Melon

Scientific name	Common name	High priority pest of
Mungbean yellow mosaic virus (Begomovirus)	Mungbean yellow mosaic virus	Grains
Mycosphaerella eumusae	Eumusae leaf spot	Banana
Nemorimyza maculosa	Chrysanthemum leafminer	Cut flower
Neonectria ditissima (syn. *Nectria galligena* and *Neonectria galligena*)	European canker	Apple and Pear, Cherry
Nysius huttoni	Wheat bug	Grains
Oligonychus ilicis	Southern red mite	Coffee, Production nurseries
Oligonychus perseae	Persea mite	Avocado
Orgyia thyellina	White spotted tussock moth	Forestry
Pantoea stewartii	Stewart's wilt of maize	Grains
Paracoccus marginatus	Papaya mealy bug	Coffee, 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 virus	Passionfruit
Passionfruit vein clearing virus (Rhabdovirus)	Passionfruit vein clearing virus	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

Table 6. High Priority Pest threats (continued)

Scientific name	Common name	High priority pest of
Perkinsiella vastatrix	Sugarcane plant hopper	Sugarcane
Perkinsiella vitiensis	Sugarcane plant hopper	Sugarcane
Peronophythora litchii	Brown blight	Lychee
Peronosclerospora philippinensis	Philippine downy mildew of maize	Grains, Sugarcane
Peronosclerospora sacchari	Sugarcane downy mildew	Sugarcane
Peronosclerospora sorghi	Downy mildew of sorghum	Grains
Phialophora cinerescens	Phialophora wilt	Cut flower
Phymatotrichopsis omnivora (syn. *Phymatotrichum omnivorum, Ozonium texanum*)	Texas root rot	Cotton
Phytomyza gymnostoma	Allium leafminer	Onion, Vegetable
Phytophthora fragariae var. *fragariae*	Red steele root rot	Strawberry
Phytophthora infestans (A2 mating type and exotic strains of A1 mating type)	Late blight	Potato, Vegetable
Phytophthora kernoviae	Phytophthora blight	Avocado
Phytophthora mengei	Trunk canker	Avocado
Phytophthora pinifolia	Dano foliar del pino	Forestry
Phytophthora ramorum	Sudden oak death	Avocado, Blueberry, Cut flower, Forestry, Nut, Production nurseries, Truffle
Planococcus ficus	Vine mealybug	Viticulture
Planotortrix octo	Green headed leaf roller	Cherry
Plasmopara halstedii	Downy mildew of sunflower	Grains
Plum pox virus (Potyvirus)	Plum pox virus	Cherry, Summerfruit
Polychrosis viteana	American berry moth	Viticulture
Polyocha depressella	Root borer	Sugarcane
Pomacea canaliculata	Golden apple snail	Production nurseries, Rice

Scientific name	Common name	High priority pest of
Popillia japonica	Japanese beetle	Rubus, Summerfruit
Potato spindle tuber viroid (Pospiviroidae)	Potato spindle tuber viroid	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
Pseudocercospora fijiensis (syn. *Mycosphaerella fijiensis*)	Black sigatoka	Banana
Pseudococcus cryptus (syn. *Pseudococcus citriculus*)	Citrus mealybug, citriculus mealybug, cryptic mealybug	Coffee
Pseudococcus maritimus	Grape mealybug	Viticulture
Pseudomonas avellanae (syn. *P. syringae* pv. *avellanae*)	Bacterial canker	Truffle
Pseudomonas syringae pv. syringae (exotic races)	Bacterial canker	Avocado, Production nurseries
Pseudotheraptus wayi	Coconut bug	Lychee
Psila rosae	Carrot rust fly	Vegetable
Puccinia agrophila		Vegetable
Puccinia graminis f. sp. *tritici* (exotic pathogenic races e.g. Ug 99)	Stem rust of wheat	Grains
Puccinia opizii	Lettuce rust	Vegetable
Puccinia psidii sensu lato (exotic variants)	Guava rust, Eucalyptus rust	Cut flower, Forestry, Production nurseries
Puccinia spp. (exotic species affecting *Allium* spp.)	Rust	Onion
Puccinia striiformis f. sp. *hordei*	Barley stripe rust	Grains
Pucciniastrum coryli	Hazelnut rust	Truffle
Pyrilla perpusilla	Sugarcane pyrilla	Sugarcane
Radopholus similis (exotic strains)	Burrowing nematode	Ginger

Table 6. High Priority Pest threats (continued)

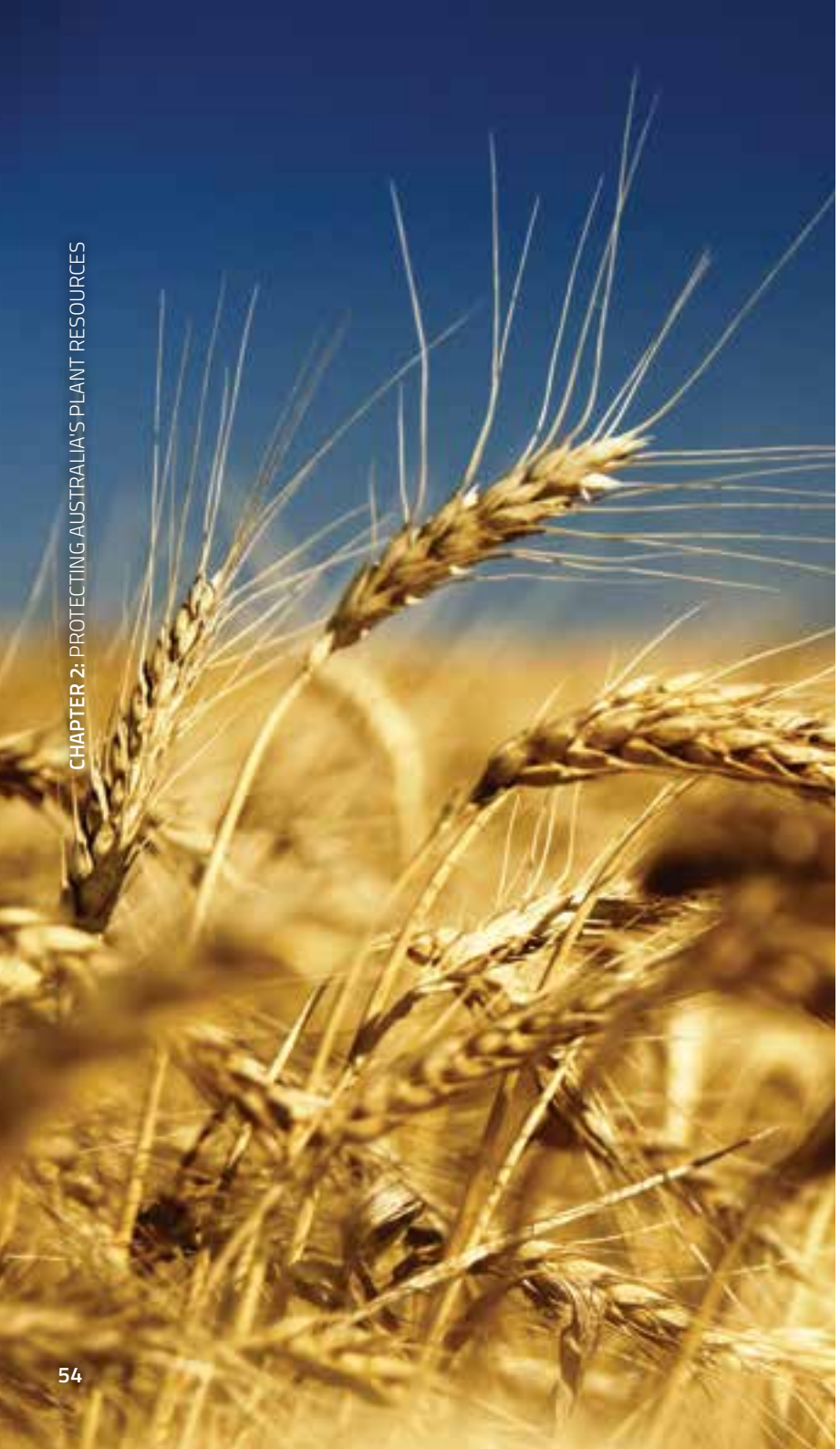
Scientific name	Common name	High priority pest of
Raffaelea lauricola	Laurel wilt	Avocado
Ralstonia solanacearum, race 2	Moko	Banana
Ralstonia solanacearum, race 3 (exotic strains)	Bacterial wilt	Potato
Ralstonia solanacearum, race 4 (exotic strains) (syn. *Pseudomonas solanacearum*)	Bacterial wilt	Ginger
Raspberry ringspot virus (Nepovirus)	Raspberry ringspot virus	Rubus, Strawberry
Rastrococcus spinosus	Mango mealybug	Coffee
Rhagoletis pomonella	Apple maggot	Apple and Pear
Rhizoctonia solani f. sp. *sasaki* (AG 1)	Banded leaf and sheath spot	Grains, Vegetable
Rhizoglyphus callae	Bulb mite	Onion
Rhizoglyphus setosus	Bulb mite	Cut flower, Onion, Vegetable
Rhodococcus fascians	Leafy gall	Cut flower
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, waikavirus	Rice
Riptortus dentipes	Pod sucking bug	Grains
Schizaphis graminum	Greenbug	Grains
Scirpophaga excerptalis	Top shoot borer	Sugarcane
Scirtothrips perseae	Avocado thrips	Avocado
Sesamia grisescens	Stem borer	Sugarcane
Slow paralysis virus (Iflavirus)	Slow paralysis virus	Honey bee
Soil-borne wheat mosaic virus (Furovirus)	Soil-borne wheat mosaic virus	Grains
Sphaceloma perseae	Avocado scab	Avocado
Spiroplasma citri	Stubborn	Citrus
Spodoptera eridania	Southern armyworm	Cut flower
Spodoptera frugiperda	Fall armyworm	Cut flower
Spodoptera littoralis	Cotton leafworm	Cut flower

Scientific name	Common name	High priority pest of
Stagonospora sacchari	Leaf scorch	Sugarcane
Stenoma catenifer	Avocado seed moth	Avocado
Sternochetus frigidus	Mango pulp weevil	Mango
Strawberry latent ringspot virus (Sadwavirus)	Strawberry latent ringspot virus	Rubus, Strawberry
Strymon megarus (as a vector of fusariosis)	Pineapple fruit borer	Pineapple
Sugarcane streak mosaic virus (Poacevirus)	Sugarcane streak mosaic	Sugarcane
Teratosphaeria gauchensis	Coniothyrium eucalyptus canker	Forestry
Teratosphaeria zuluensis	Coniothyrium eucalyptus canker	Forestry
Tetranychus piercei	Banana spider mite	Banana
Thaumatotibia leucotreta (syn. *Cryptophlebia leucotreta*)	False codling moth	Citrus, Cotton, Grains, Pineapple, Summerfruit, Vegetable
Thrips tabaci (exotic strains and biotypes)	Onion thrips	Onion
Tilletia indica	Karnal bunt	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	Forestry
Toxotrypana curvicauda	Papaya fly	Papaya
Trichoplusia ni	Cabbage looper	Vegetable
Trioza erytreae	African citrus psyllid	Citrus
Trogoderma granarium	Khapra beetle	Grains, Nut, Rice
Tropilaelaps clareae	Tropilaelaps mite	Apple and Pear, Honey bee, Nut
Tropilaelaps mercedesae	Tropilaelaps mite	Apple and Pear, Honey bee, Nut
Tuta absoluta	South American tomato moth, tomato leafminer	Tomato, Vegetable
Unknown	Ramu stunt disease	Sugarcane, Vegetable

Table 6. High Priority Pest threats (continued)

Scientific name	Common name	High priority pest of
Unknown (suspected phytoplasma)	Longan and lychee witches' broom disease	Lychee
Urocerus gigas	Giant wood wasp	Forestry
Uromyces lineolatus	Rust	Vegetable
Varroa destructor	Varroa mite	Apple and Pear, Honey bee, Nut
Varroa jacobsoni	Varroa mite	Honey bee
Verticillium dahliae (defoliating strain)	Verticillium wilt	Cotton, Nut, Olive
Vespa spp. (exotic species)	Hornets	Honey bee
Watermelon bud necrosis virus (Tospovirus)	Watermelon bud necrosis	Vegetable
White leaf phytoplasma	White leaf	Sugarcane
Xanthomonas albilineans (exotic strains, serological groups 2 or 3)	Leaf scald	Sugarcane
Xanthomonas axonopodis pv. *allii*	Xanthomonas leaf blight	Onion
Xanthomonas axonopodis pv. *passiflorae*	Bacterial blight	Passionfruit
Xanthomonas campestris (avocado strain)	Bacterial canker	Avocado
Xanthomonas citri subsp. *citri* (syn. *X. axonopodis* pv. *citri*)	Citrus canker	Citrus
Xanthomonas citri subsp. *malvacearum* (syn. *X. axonopodis* pv. *malvacearum*)	Bacterial blight, angular leaf spot	Cotton
Xanthomonas fragariae	Strawberry angular leaf spot	Strawberry
Xylella fastidiosa (subspecies not specified)	Pierce's disease, blueberry leaf scorch, olive leaf scorch, olive quick decline, phony peach	Blueberry, Cherry, Viticulture
Xylella fastidiosa subsp. *fastidiosa*	Pierce's disease, blueberry leaf scorch, olive leaf scorch	Coffee, Nut
Xylella fastidiosa subsp. *multiplex*	No common name	Nut, Olive
Xylella fastidiosa subsp. *pauca*	Pierce's disease, blueberry leaf scorch, olive quick decline	Citrus, Coffee, Olive
Xylella fastidiosa subsp. *piercei*	Almond leaf scorch, pecan bacterial leaf scorch	Nut
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

Image courtesy of the Australian Melon Association



CONTINGENCY PLANNING

Contingency planning is a pre-emptive preparedness initiative that improves readiness for a particular exotic pest threat. Contingency plans are developed by PHA, industries and governments.

Before any incursion occurs, experts are brought together to collate information on a particular pest or pest group, its biology and available control measures. Each contingency plan provides guidelines and options for steps to be undertaken and considered when developing a Response Plan for this pest.

Table 7 provides a list of 124 contingency plans that have been developed to date. These plans make a considerable contribution to Australia's preparedness for serious exotic plant pest threats. Contingency plans are available on PHA's website, in the Pest Information Document Database.

Wheat rust outbreak could cost Australia up to $1.4 billion

On 6 September 2018 the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) issued a report on the potential economic impacts of the wheat stem rust strain Ug 99 in Australia.

The Ug 99 strain is not present in Australia, but it poses a major risk to the $6 billion wheat industry in terms of revenue losses and increased production costs, should it arrive in the country.

The report provides estimates of the economic impact over 10 years of three scenarios for disease spread, ranging from $574 million for wheat-growing areas in the western region, to $1.4 billion if all wheat growing areas in Australia were to become affected.

Disruptions to Australian wheat exports may also result if markets that are sensitive to Ug 99 contamination were to ban imports of Australian wheat.

Eradication of Ug 99 would likely only be technically feasible if the rust is detected while still contained within a very small area with a light spore load, so it is crucial Australia takes measures to keep Ug 99 from entering the country in the first place.

To help manage the risk posed by this significant wheat disease, work is being done in surveillance, monitoring pathogen populations to track the evolution of potential virulence, and pre-breeding of resistant varieties of wheat.

Potential economic impacts of the wheat stem rust strain Ug 99 in Australia is available at **agriculture.gov.au/wheat-stem-rust-report**

Table 7. Contingency plans

Scientific name	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 *C. nigra*	Cereal leafminers	2009	PHA	National – grains industry
Agrotis segetum	Turnip moth	2011	PHA	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
Austropuccinia psidii (syn. *Uredo rangelii*)	Myrtle rust	2012–13	DJPR	State
Austropuccinia psidii (syn. *Uredo rangelii*)	Myrtle rust	2015	PIRSA	State
Bactericera cockerelli	Tomato potato psyllid	2017–18	PIRSA	State
Bactericera cockerelli and *Candidatus* Liberibacter solanacearum	Zebra chip complex	2011	Hort Innovation, PHA	National – vegetable and potato industries
Bactrocera dorsalis, B. tryoni and *Ceratitis capitata*	Oriental 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 fruit fly 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
Curvularia spicifera (syn. *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 (under review)	Hort Innovation	National – citrus and nursery industries
Candidatus Liberibacter africanus, *Ca.* L. americanus, *Ca.* L. asiaticus, *Diaphorina citri* and *Trioza erytreae*	Huanglongbing and vectors	2015	Hort Innovation, PHA	National – citrus and nursery industries
Cantareus apertus	Green snail	2012–13	DJPR	State

Table 7. Contingency plans (continued)

Scientific name	Common name	Year	Location of document	Scope
Cephus cinctus and *Thaumatotibia leucotreta*	Wheat stem sawfly and false codling moth	2015	PHA	National – grains industry
Cephus pygmeus	European wheat stem sawfly	2008	PHA	National – grains industry
Ceratocystis ulmi	Dutch elm disease	2001	DJPR	State
Ceutorhynchus assimilis and *Dasineura brassicae*	Cabbage seedpod weevil and brassica pod midge	2011	PHA	National – grains industry
Chilo partellus	Spotted stem borers	2009	PHA	National – grains industry
Chilo spp.	Sugarcane stem borer	2008	SRA	National – sugarcane industry
Chortoicetes terminifera	Plague locust	2010	PIRSA	State
Chromatomyia horticola, Liriomyza bryoniae, L. cicerina, L. huidobrensis, L. sativae and *L. trifolii*	Agromyzid leafminers	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 nurseries
Colletotrichum truncatum (lentil strain)	Lentil anthracnose	2008	PHA	National – grains industry
Conopomorpha cramerella	Cocoa pod borer	2012–14	QDAF	State
Cryphonectria parasitica	Chestnut blight	2010	DJPR	State – chestnut industry
Cucumber green mottle mosaic virus	CGMMV	2015	QDAF	State – containment by melon, vegetable and nursery industries
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	DJPR	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

Table 7. Contingency plans (continued)

Scientific name	Common name	Year	Location of document	Scope
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	DJPR	National
Halyomorpha halys	Brown marmorated stink bug	2016	PHA	Not specific to a particular industry
Harpophora maydis and *Plasmopara halstedii*	Exotic soil-borne pathogens of grains	2013	PHA	National – grains industry
Helicoverpa zea	Corn earworm	2009	PHA	National – grains industry
Heterodera avenae, H. filipjevi and *H. latipons*	Cereal cyst nematodes	2012	PHA	National – grains industry
Heterodera carotae	Carrot cyst nematode	2008	DPIRD, 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
Homalodisca vitripennis	Glassy winged sharpshooter	2018	PHA, NGIA	National – production nurseries
Hylotrupes bajulus	European house borer	2011	QDAF	State
Hypothenemus hampei	Coffee berry borer	2012–13	QDAF	State
Invasive exotic ants	Various	2018 draft	QDAF	National – production nurseries
Liriomyza bryoniae, L. huidobrensis, L. sativa, L. trifolii and *Chromatomyia horticola*	Agromyzid leafminers	2008	QDAF, Hort Innovation	National
Liriomyza huidobrensis	Serpentine leafminer	2009	PHA	National – production nurseries
Lissachatina fulica (syn. *Achatina fulica*)	Giant African land 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	National – production nurseries
Lymantria dispar	Asian gypsy moth, gypsy moth complex	2002	NSW DPI	National
Lymantria dispar dispar	Gypsy moth (Asian and European strains)	2009	PHA	National – production nurseries
Magnaporthe grisea	Rice blast	2005	NSW DPI	National – rice industry
Magnaporthe grisea	Rice blast	2008	PHA	National – rice industry

Table 7. Contingency plans (continued)

Scientific name	Common name	Year	Location of document	Scope
Maize dwarf mosaic virus (Potyvirus)	Maize dwarf mosaic virus	2011	PHA	National – grains industry
Mayetiola destructor	Hessian fly	2005	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
Phytophthora ramorum	Sudden oak death	2018	PHA, NGIA	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	DJPR	State
Psila rosae	Carrot rust fly	2009	DPIRD, Hort Innovation	National – vegetable industry
Puccinia graminis f. sp. *tritici* (pathotype Ug99)	Stem rust of wheat	2009	PHA	National – grains industry
Puccinia psidii	Myrtle rust	2015	DPIRD	State
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 borers	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 weevils	2005	DPIRD, 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	DJPR	State
Tilletia barclayana	Kernel smut of rice	2008	PHA	National – rice industry

Table 7. Contingency plans (continued)

Scientific name	Common name	Year	Location of document	Scope
Tilletia contraversa	Dwarf bunt of wheat	2007	PHA	National – grains industry
Tilletia indica	Karnal bunt	2005	PHA	National – grains industry
Tilletia indica	Karnal bunt	2006	NSW DPI	National – grains industry
Tilletia indica	Karnal bunt	2017	PIRSA	State
Trogoderma granarium	Khapra beetle	2005	PHA	National – grains industry
Tropilaelaps clareae and *T. mercedesae*	Tropilaelaps mites	2012	PHA	National – honey bee industry
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	Tramp ant	2015 draft	DJPR	National – production nurseries
Varroa destructor and *V. jacobsoni*	Varroa mites	2015	DJPR	National – honey bee industry
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	2002, 2011, 2016	DJPR, PHA, QDAF, NGIA	National – viticulture and production nurseries

There are more than 130,000 hectares of vineyards in Australia, tended by 6,200 wine grape growers. Image courtesy of Australian Vignerons

BIOSECURITY MANUALS FOR PRODUCERS

To help guide improved farm biosecurity for specific crops, PHA in partnership with plant production industries and governments, has released 21 crop-specific biosecurity manuals, listed in Table 8. In 2018 two biosecurity manuals were produced: one for potato producers and another for onion producers.

These booklets are designed with growers and consultants in mind, explaining effective measures that can be incorporated into day-to-day operations to improve biosecurity and help protect farms from both new and established pests. Each booklet also raises awareness of the High Priority Pests of that industry, increasing the likelihood of detecting an exotic pest incursion early.

The information from biosecurity manuals is also provided in the crops section of the Farm Biosecurity website **farmbiosecurity.com.au** and complete manuals are available for download.

Table 8. Biosecurity manuals for producers

Manual	Version	Manual	Version
Biosecurity Induction Manual for Bundaberg Horticultural Farms	1.0	Farm Biosecurity Manual for the Northern Adelaide Plains Vegetable Growers	1.0
Biosecurity Manual for Beekeepers	1.1	Farm Biosecurity Manual for the Organic Grains Industry	1.0
Biosecurity Manual for Citrus Producers	2.0	Onion Growers' Biosecurity Manual	1.0
Biosecurity Manual for Grain Producers	4.0	Orchard Biosecurity Manual for the Almond Industry	1.0
Biosecurity Manual for Sugarcane Producers	1.0	Orchard Biosecurity Manual for the Apple and Pear Industry	2.0
Biosecurity Manual for the Nursery Production Industry	1.0	Orchard Biosecurity Manual for the Avocado Industry	1.0
Biosecurity Manual for the Papaya Industry	1.0	Orchard Biosecurity Manual for the Cherry Industry	1.0
Biosecurity Manual for the Plantation Timber Industry	1.0	Orchard Biosecurity Manual for the Mango Industry	1.0
Biosecurity Manual for the Viticulture Industry	1.0	Orchard Biosecurity Manual for the Summerfruit Industry	1.0
Farm Biosecurity Manual for the Banana Industry	1.0	Potato Growers' Biosecurity Manual	1.0
Farm Biosecurity Manual for the Cotton Industry	1.1		

New biosecurity manuals for potato and onion growers

In June 2018 the Potato Growers' Biosecurity Manual was released as a guide to farm biosecurity measures to reduce the risk posed by weeds, pests and diseases. It was developed by PHA in consultation with AUSVEG and potato growers across NSW, Victoria and South Australia.

The manual is designed to be used by potato growers and their staff, as well as contractors, processors, researchers and consultants working in the potato industry. It gives specific advice on what potato producers need to be aware of, and what measures they should be taking on their farm to reduce biosecurity risks.

Onion growers also have tailored advice on recommended farm biosecurity practices to minimise the risk of introducing and spreading pests, diseases and weeds and help protect farms, regions and the onion industry.

The Onion Grower's Biosecurity Manual, launched in April 2018, is for onion growers and staff, as well as contractors, researchers and consultants working in the industry. The manual includes simple procedures that can be used in day-to-day operations to improve farm biosecurity.

The manual focuses on how onion growers can address biosecurity risks related to pests and diseases already in Australia that are restricted to particular growing regions, and exotic pests and diseases that could potentially impact onion growers if they were to enter and become established in Australia.

Chapter 3

Plant industry profiles

Plant industry profiles

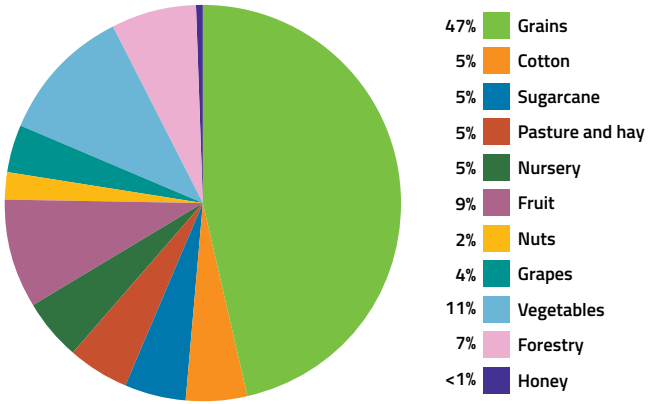
The following pages profile PHA plant industry members, their value, and where crops are produced across the states and territories. Each profile also provides the industry's key exotic pest threats, and the biosecurity initiatives that they have undertaken.

Graphs show trends over recent years in local value of production (LVP), which is the value of agricultural commodities at the farm gate. Note that data used in the graphs are up to 2016–17, the latest year for which they are available.

Farm gate values are sourced from approved statistical authorities such as Australian Bureau of Statistics (ABS), the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) and industry sources. Export figures are sourced from the Australian Horticulture Statistics Handbook 2016–17 (Hort Innovation 2018).

Figure 6 shows the contribution of each of the main plant production industries (including honey and beeswax) to total plant gross value of production in 2016–17 (the latest year for which this breakdown is available).

Figure 6. Comparative value of Australia's plant production industries, based on gross value of production, 2016–17[12]



12. Australian Bureau of Agricultural and Resource Economics. Canberra. Agricultural commodities March Quarter 2019 – Statistics Data Table 13. Accessed online 22 July 2019 agriculture.gov.au/abares/research-topics/agricultural-commodities/mar-2019#download-report, Australian Bureau of Statistics. Canberra. ABS 7503 data series; Value of Agricultural Commodities Produced, Australia, 2016-17. Accessed online 22 July 2019 abs.gov.au/AUSSTATS/abs@.nsf/Lookup/7503.0Main+Features12016-17?OpenDocument

Werribee, Victoria

ALMONDS

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

In 2016–17, almond production was valued at $513 million (LVP), with exports valued at $461 million.

While the domestic market for almonds continues to grow strongly, this is dwarfed by the export market, with three tonnes of almonds being shipped overseas for every tonne consumed in Australia. Historically, India has been the largest export market, but sales to China are increasing, making it the major destination for Australian almonds.

The industry has been expanding rapidly since 2016 with an additional 14,000 hectares being planted, bringing the total industry orchard area to 45,000 hectares. The orchards are concentrated along the Murray Valley in Victoria (56%), SA (22%), and NSW (20%), with an orchard in WA (2%).

The 2018 production was 80,000 tonnes however, when current plantings reach full maturity, the industry's productive capacity will exceed 140,000 tonnes.

Nonpareil continues to be the most popular variety with several pollinator varieties such as Carmel, Price and Monterey planted to overlap the flowering period of Nonpareil to achieve good nut set.

The Australian almond industry depends on honey bees for pollination, with approximately 180,000 hives required during the pollination season. The almond blossoms provide one of the first natural sources of food for bees each spring.

The almond industry is covered by version 3.0 of the nut industry biosecurity plan and the **Orchard Biosecurity Manual for the Almond Industry Version 1.0**.

Table 9. High Priority Pests of the almond industry

Scientific name	Common name
Amyelois transitella	Navel orange worm
Chinavia hilaris (syn. *Acrosternum hilare, Pentatoma hilaris, Chinavia hilarae, Nezara 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
Tropilaelaps clareae	Tropilaelaps mite
Tripilaelaps mercedesae	Tropilaelaps mite
Varroa destructor	Varroa mite
Verticillium dahliae (exotic defoliating strains)	Verticillium wilt
Xylella fastidiosa (including *X. fastidiosa* subsp. *fastidiosa, X. fastidiosa* subsp. *multiplex, X. fastidiosa* subsp. *piercei*) (with vector)	Almond leaf scorch, pecan bacterial leaf scorch

Image courtesy of the Almond Board of Australia

Figure 7. Annual value of almond production, 2007–17

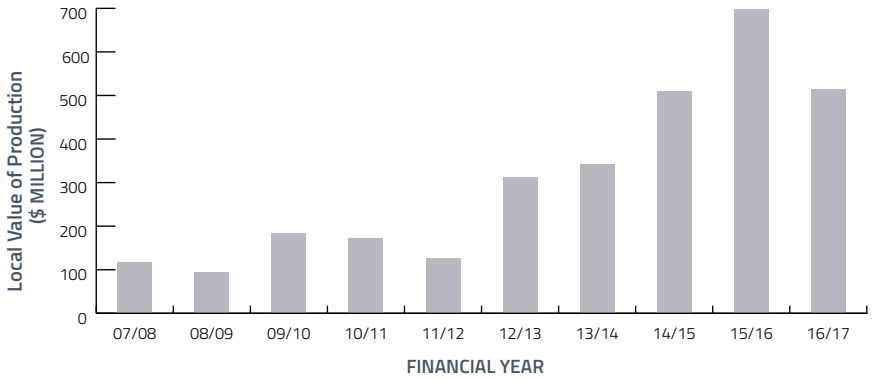
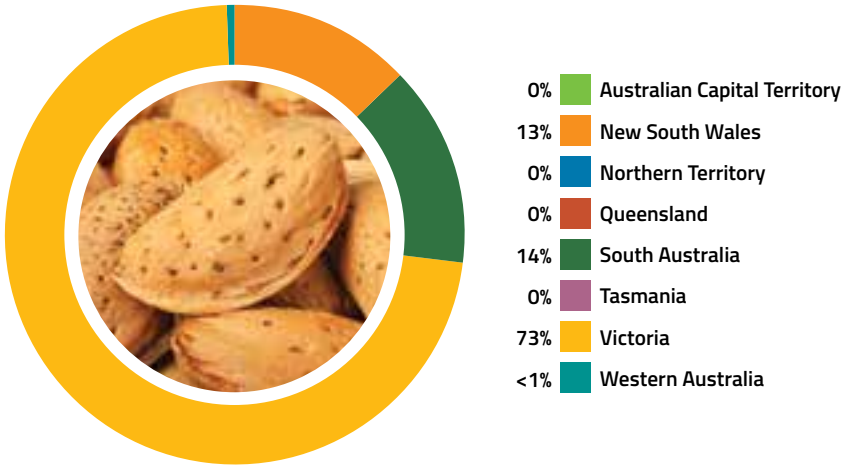
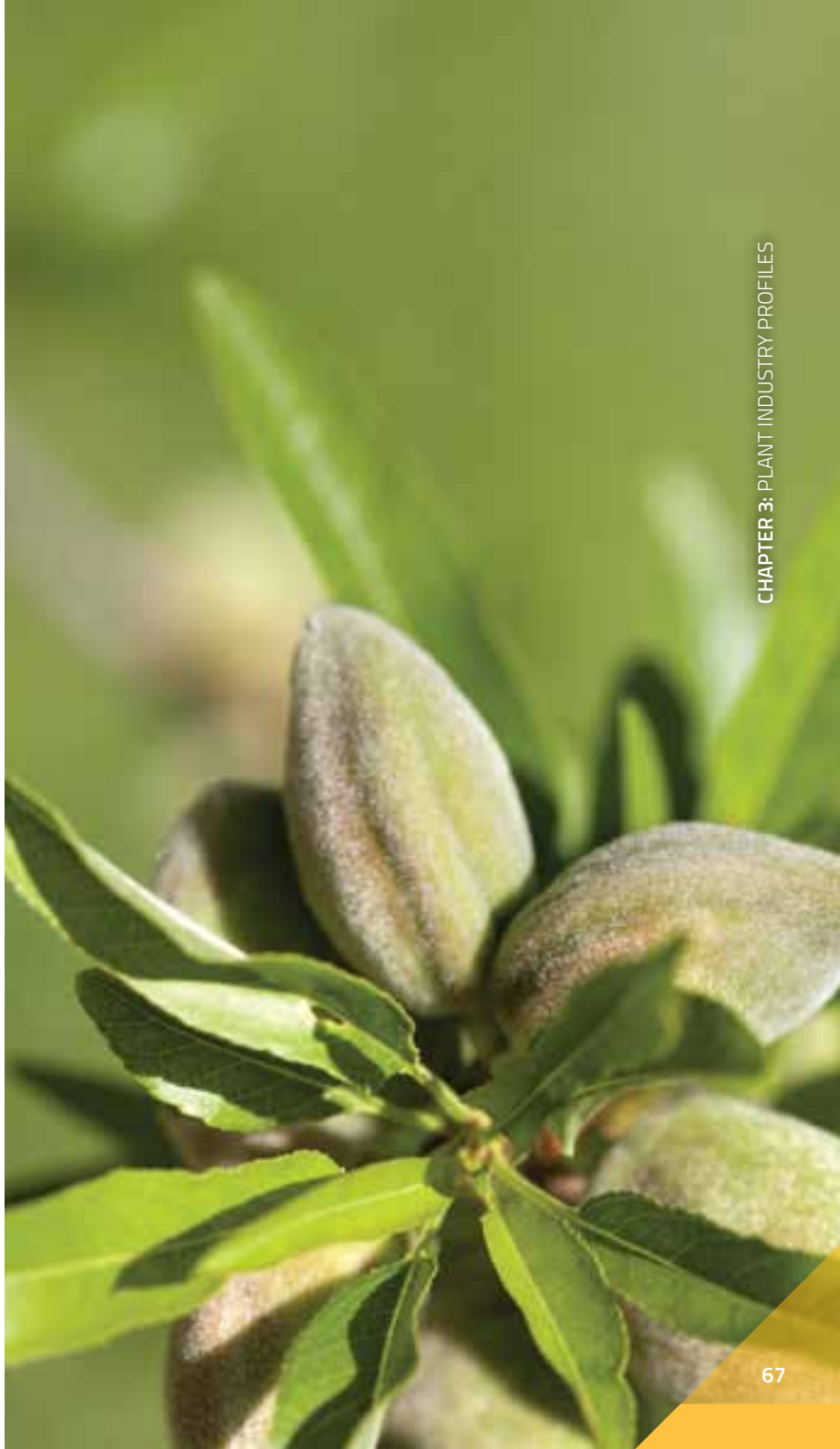


Figure 8. Distribution of almond production by state and territory, 2016–17 (based on LVP)





APPLES AND PEARS

Represented by Apple and Pear Australia
apal.org.au

In 2016–17, apple and pear production was valued at $537 million (LVP) and exports were valued at $24 million. The total planted area for apples was 9,375 hectares and 3,175 hectares for pears.

There are approximately 550 commercial apple and/or pear grower businesses in Australia. Victoria produces 46 per cent of Australia's apples and 88 per cent of pears: the remainder of the gross production is divided evenly across the remaining states.

The major production areas include the Goulburn Valley, Gippsland, Yarra Valley and the Mornington Peninsula in Victoria; Stanthorpe in Queensland; Batlow and Orange in NSW; the Huon Valley and Tamar Valley in Tasmania; the Adelaide Hills in SA; and Donnybrook, Manjimup and the Perth Hills in WA.

The four most common apple cultivars are Cripps Pink (Pink Lady™), Gala, Fuji and Granny Smith. Areas of Cripps Red (Sundowner™), Red Delicious and Golden Delicious are declining. A number of newer club apples such as Jazz™, Kanzi™, Envy™, Smitten™, Rockit™ and Bravo™ have been increasing in production recently. Australia's main apple export markets are Europe, Papua New Guinea, Hong Kong and Indonesia.

Packham and Williams' bon chrétien are the most common pear cultivars grown plus smaller areas of Beurre Bosc and Corella. New cultivars include ANP-0118 (Lanya™), ANP-0131 (Rico™), and Piqa Boo™. The main pear export markets are New Zealand, Indonesia, Canada and Singapore.

The apple and pear industry is covered by version 3.0 of the apple and pear biosecurity plan and the **Orchard Biosecurity Manual for the Apple and Pear Industry Version 2.0**.

Table 10. High Priority Pests of the apple and pear industry

Scientific name	Common name
Bactrocera dorsalis	Oriental fruit fly
Carposina sasakii	Peach fruit moth, small peach fruit borer
Cydia inopinata (syn. *Grapholita inopinata*)	Manchurian fruit moth
Dasineura mali	Apple leaf curling midge
Drosophila suzukii (syn. *Leucophenga suzukii*)	Spotted wing drosophila
Dysaphis plantaginea	Rosy apple aphid
Erwinia amylovora	Fire blight
Halyomorpha halys (syn. *Halyomorpha mista*)	Brown marmorated stink bug
Lymantria dispar	Gypsy moth (Asian and European strains)
Lymantria mathura	Rosy gypsy moth, pink gypsy moth
Lymantria monacha	Nun moth
Monilinia fructigena	Brown rot
Monilinia mali	Monilinia leaf blight, blossom wilt
Monilinia polystroma	Asiatic brown rot
Neonectria ditissima (syn. *Neonectria galligena*)	European canker, nectria canker, crotch canker, eye rot
Rhagoletis pomonella	Apple maggot
Tropilaelaps clareae	Tropilaelaps mite
Tropilaelaps mercedesae	Tropilaelaps mite
Varroa destructor	Varroa mite

Figure 9. Annual value of apple and pear production, 2007–17

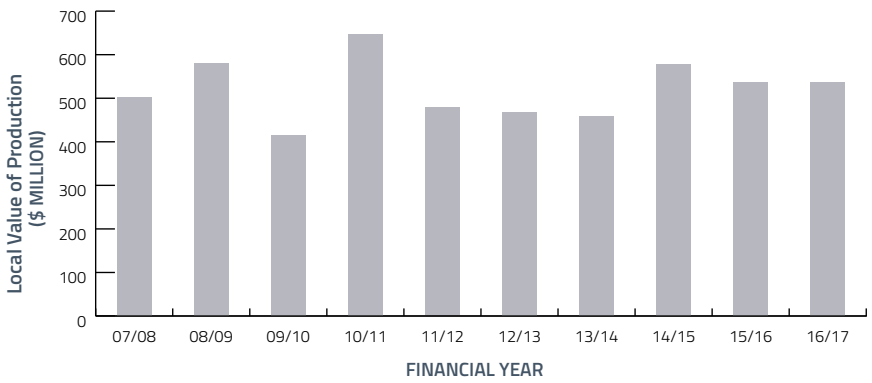
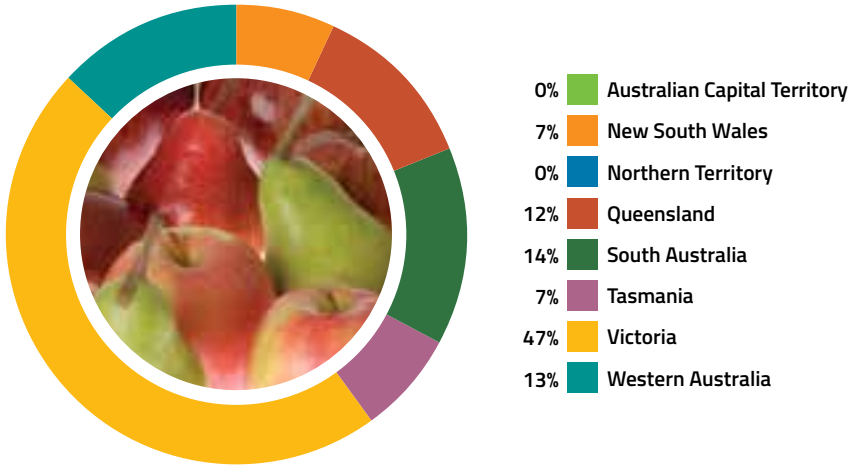


Figure 10. Distribution of apple and pear production by state and territory, 2016–17 (based on LVP)



AVOCADOS

Represented by Avocados Australia
avocado.org.au

In 2016–17, avocado production was valued at $256 million (LVP), with exports worth $12.5 million from just over two per cent of production. Australians' love of avocados has grown steadily each year since the 1990s. Consumption in 2017–18 reached 3.5kg per person, up from 1kg in 1997-98.

Exports were mostly shipped to Malaysia and Singapore. In 2018 market access to Japan was achieved for Hass avocados grown in areas of Australia that are free of Queensland fruit flies (see page 136).

Queensland dominates Australia's avocado production, followed by WA, NSW, Victoria and SA, with a small amount of production in Tasmania. This geographic diversity in growing regions ensures domestic access to Australian avocados year round. Fruit imported from New Zealand supplements supply during spring and summer.

The Hass variety is the predominant avocado produced in Australia, accounting for approximately 78 per cent of production, with Shepard accounting for about 19 per cent. Other varieties such as Reed, Sharwil, Gwen, Wurtz and Fuerte make up the balance.

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**.

Avocados at the markets. Image courtesy of Avocados Australia

Table 11. High Priority Pests of the avocado industry

Scientific name	Common name
Avocado sunblotch viroid	Avocado sunblotch (asymptomatic and symptomatic strains)
Bactrocera carambolae	Carambola fruit fly
Bactrocera cucurbitae	Melon fly
Bactrocera dorsalis	Oriental fruit fly
Bactrocera facialis	Tropical fruit fly
Bactrocera kandiensis	Fruit fly
Bactrocera kirki	Fruit fly
Bactrocera melanotus	Fruit fly
Bactrocera passiflorae	Fijian 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

Figure 11. Annual value of avocado production, 2007–17

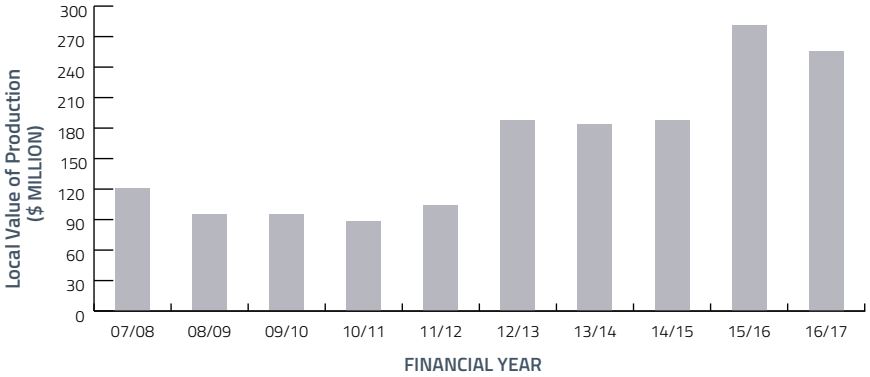
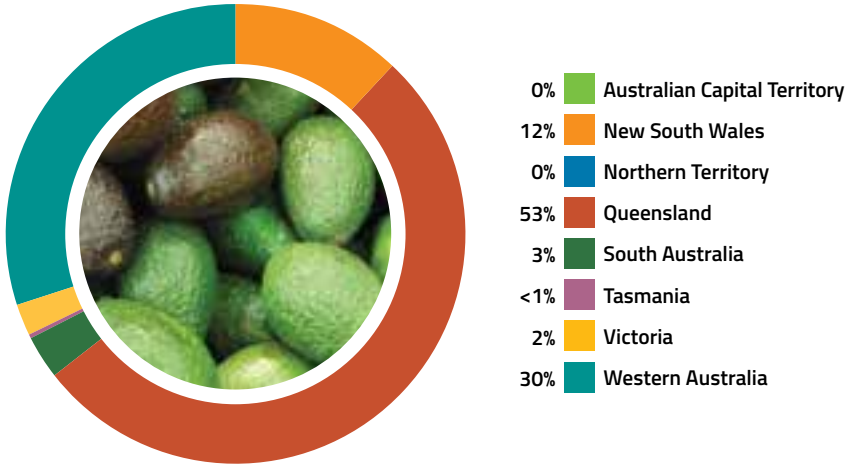


Figure 12. Distribution of avocado production by state and territory, 2016–17 (based on LVP)



Avocado nursery plants. Image courtesy of Avocados Australia

BANANAS

Represented by the Australian Banana Growers' Council (ABGC)
abgc.org.au

In 2016–17, banana production was valued at $580 million (LVP). The vast majority of the Australian banana crop is supplied to the domestic market while a small number of growers are creating export markets in Asia.

Bananas are grown commercially in Queensland, NSW, WA and NT. There are currently about 13,000 hectares of bananas grown in Australia, 94 per cent of which are located in four north Queensland growing regions Tully, Innisfail, Lakeland and the Atherton Tablelands.

Bananas are grown all year round with the two main varieties being Cavendish and Lady Finger. The Cavendish variety accounts for 95 per cent of production.

In 2018, there were three major biosecurity threats challenging the banana industry:

- banana freckle in the NT
- Panama disease tropical race 4 (TR4) in north Queensland
- banana bunchy top virus in northern NSW and south-east Queensland.

The National Banana Freckle Eradication Program (carried out under the Emergency Plant Pest Response Deed) successfully eradicated banana freckle from the NT in 2018, with national proof of area freedom expected to be declared in February 2019.

Panama disease tropical race 4 was first detected on a north Queensland banana farm in March 2015. Due to the collaborative efforts of banana growers, the ABGC and Queensland's Department of Agriculture and Fisheries, the disease has been contained to three farms in the Tully Valley. While the plants on the original infected property were destroyed and all farming operations ceased, the other two quarantined farms continue to produce and pack fruit under strict biosecurity conditions. Biosecurity Queensland continues to conduct surveillance on all medium and high-risk commercial banana farms in north Queensland.

A control program for banana bunchy top virus has been operating in NSW and south-east Queensland since 2009. The aim is to contain the virus to a limited area through targeted surveillance and destruction of infected plant material.

In addition to these major biosecurity threats, ABGC is active in other biosecurity programs. Yellow sigatoka is an important endemic leaf disease that spreads easily if not controlled and causes significant production losses. An officer is employed by the ABGC to undertake inspections for the presence of yellow sigatoka in the north Queensland commercial production area and work with growers to assist them to control the disease.

The ABGC also employs two staff members who have a combined responsibility for coordinating biosecurity related research and development as well as strategy development and implementation.

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**. The biosecurity plan including the High Priority Pest list was reviewed in 2018 and is awaiting final approval. The identification of priority activities has commenced and implementation will continue over the next five years.

Table 12. 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
Erionata 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
Teranychus piercei	Banana spider mite

Figure 13. Annual value of banana production, 2007–17

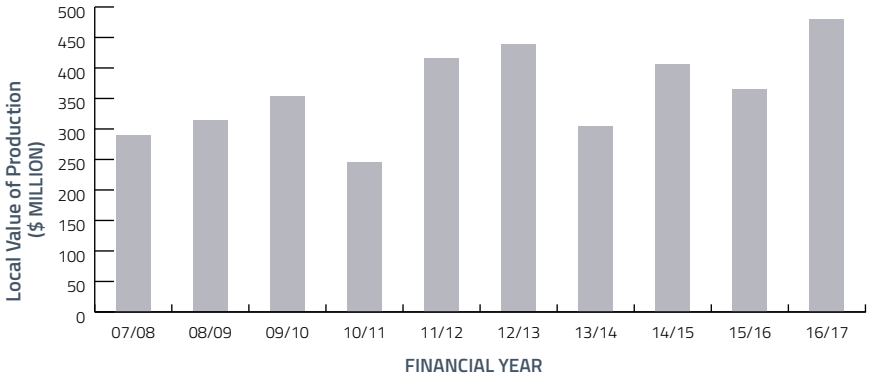
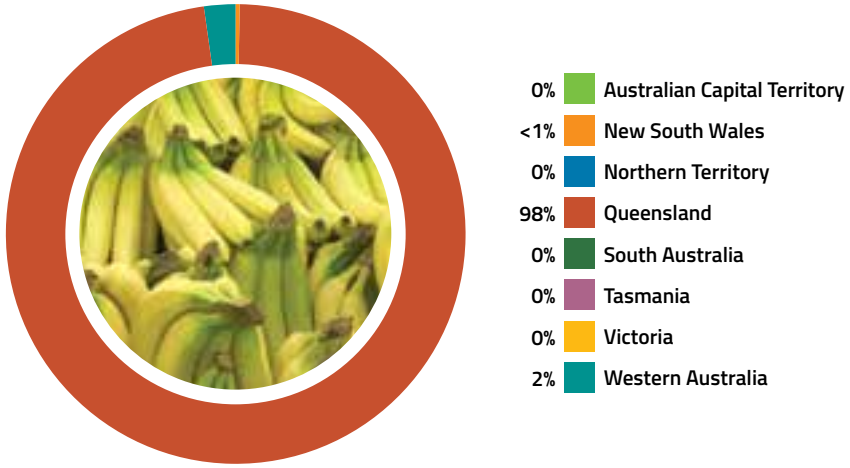


Figure 14. Distribution of banana production by state and territory, 2016–17 (based on LVP)



BLUEBERRIES

Represented by the Australian Blueberry Growers' Association
abga.com.au

In 2016–17, blueberry production was valued at $146 million (LVP). The industry is rapidly expanding with on average 18,000 tonnes of blueberries being produced per annum. The majority of blueberry production is consumed domestically, with less than five per cent exported to markets including Hong Kong, Singapore and Thailand.

Around 300 growers produce blueberries over 2,500 hectares in all states of Australia, except NT. The major production area of the Australian blueberry industry is on the NSW north coast. NSW produced around 70–75 per cent of the Australian crop in 2018. Other regions have increased plantings to take advantage of late and early season fruit, with the aim of having Australian blueberries available all year round.

The crop is grown on the NSW north coast and Tumbarumba in southern NSW; the Atherton Tablelands, Bundaberg and Mundubbera in Queensland; the Tamar Valley, Meander Valley, Bernie, Devonport and the Huon Valley in Tasmania; the Grampians, Silvan and Strathbogie in Victoria; Margaret River and Geraldton in WA; and the Mount Lofty ranges in SA.

There are three varieties of blueberries grown in Australia: northern highbush, southern highbush and rabbiteye. Northern highbush are grown in the cooler climate areas such as Victoria, Tasmania and the southern highlands of NSW, whereas southern highbush and rabbiteye varieties are grown in NSW and Queensland.

The blueberry industry is covered by the **blueberry biosecurity plan version 1.0**.

Table 13. High Priority Pests of the blueberry industry

Scientific name	Common name
Croesia curvalana	Blueberry leaftier
Drosophila suzukii	Spotted wing drosophila
Ericaphis fimbriata (with *Blueberry scorch* (Carlavirus))	Blueberry aphid
Homalodisca vitripennis (with *Xylella fastidiosa*)	Glassy winged sharpshooter
Monilinia fructigena	Brown rot
Monilinia vaccinii-corymbosi	Mummy berry disease
Phytophthora ramorum	Sudden oak death
Xylella fastidiosa	Blueberry leaf scorch, Pierce's disease of grapevine

Figure 15. Annual value of blueberry production, 2011–17

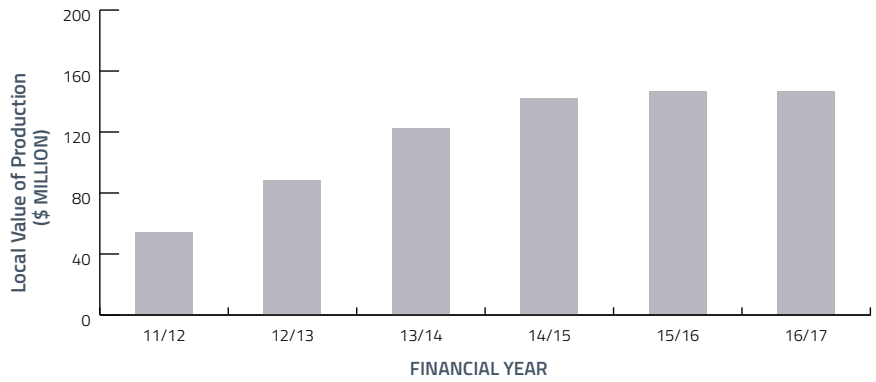
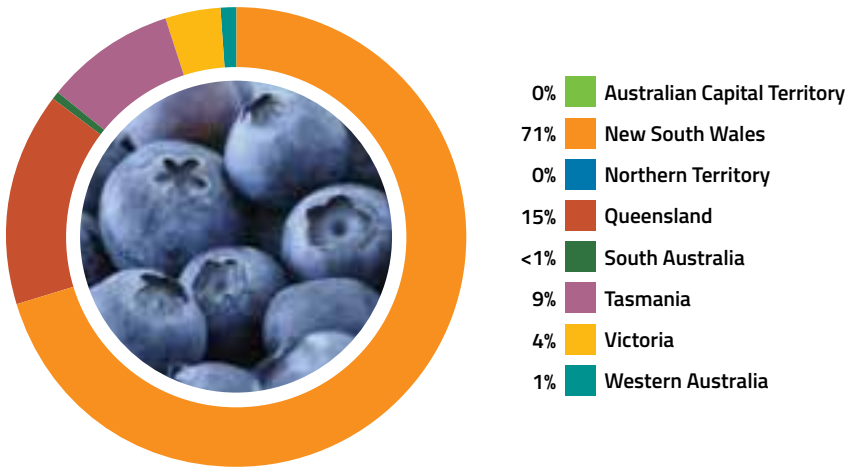


Figure 16. Distribution of blueberry production by state and territory, 2016–17 (based on LVP)



CANNED FRUITS

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

In 2016–17 production of canned fruit was valued at $17.6 million (LVP). Exports were valued at $5.1 million.

Fruit production of the varieties represented by Canned Fruits Industry Council of Australia (apples, apricots, peaches, pears and plums) is carried out from December to May, with volumes of 35,000 to 40,000 tonnes processed annually.

The industry represents more than 110 fruit growing businesses and one processor.

The canned deciduous fruit business is primarily based in the Goulburn-Murray Valleys region of Victoria, processing Australian apples, apricots, peaches, pears and plums at Shepparton.

The canned fruits industry does not have a specific biosecurity plan or manual but is covered by plans and manuals for the **pome fruit** (apple and pear) and **stone fruit** (summerfruit) industries.

Image courtesy of the Canned Fruits Industry Council of Australia

Figure 17. Annual value of canned fruit production, 2007–17

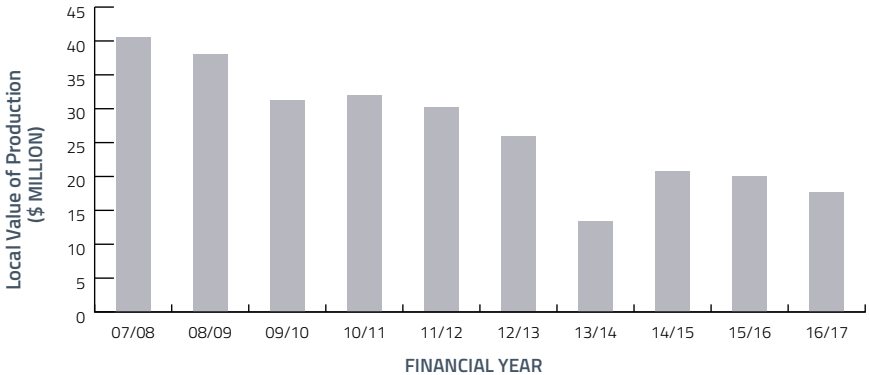
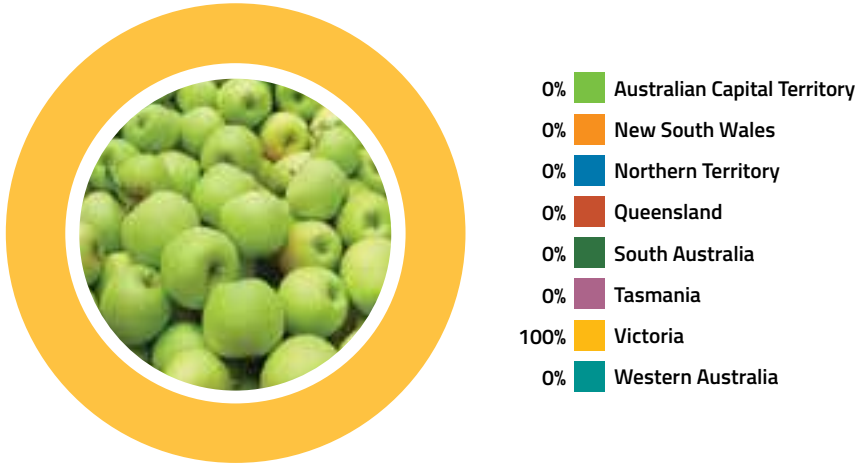


Figure 18. Distribution of canned fruit production by state and territory, 2016–17 (based on LVP)



CHERRIES

Represented by Cherry Growers Australia
cherrygrowers.org.au

In 2016–17, cherry production was valued at $133 million (LVP), with exports valued at $43.3 million. The industry produces more than 15,000 tonnes of cherries every year, of which 40 per cent is exported. This is expected to rise to 20,000 tonnes by 2020 with up to 50 per cent exported.

Cherries are produced in six states, with NSW, Victoria and Tasmania being the three largest producers followed by SA. These four states have a strong export focus. WA and Queensland are relatively small producers primarily focused on the domestic market.

Australian cherries are available from mid to late October until late February. The window of supply in each region is determined by the varieties grown and the local climate.

The cherry industry is increasing its production and moving into new areas. Recent market access to key Free Trade Agreement markets such as China and Vietnam have given mainland growers unprecedented opportunity which until now has been the exclusive domain of Tasmania with its fruit fly free status. As of 1 January 2019, every major market serviced by Australian cherries, except India, will be tariff free.

This improved market access has resulted in an increase in the number of growers registering for export in the 2018–19 season, with approximately 90 Australian growers (>2,000 hectares) registered for protocol markets.

National expansion is underpinned by ongoing research and strong biosecurity principles, established through the cherry industry's Biosecurity Management Programme, and supported by the cherry biosecurity plan version 3.0 and **Orchard Biosecurity Manual for the Cherry Industry Version 1.0**.

Table 14. High Priority Pests of the cherry industry

Scientific name	Common name
Bactrocera dorsalis	Oriental fruit fly
Drosophila suzukii	Spotted wing drosophila
Halyomorpha halys	Brown marmorated stink bug
Homalodisca vitripennis	Glassy winged sharpshooter
Monilinia fructigena	Brown rot
Neonectria ditissima	European canker
Planotortrix octo	Greenheaded leafroller
Plum pox virus (Potyvirus)	Plum pox, sharka
Xylella fastidiosa (multiple subspecies)	Cherry leaf scorch, Pierce's disease

Figure 19. Annual value of cherry production, 2007–17

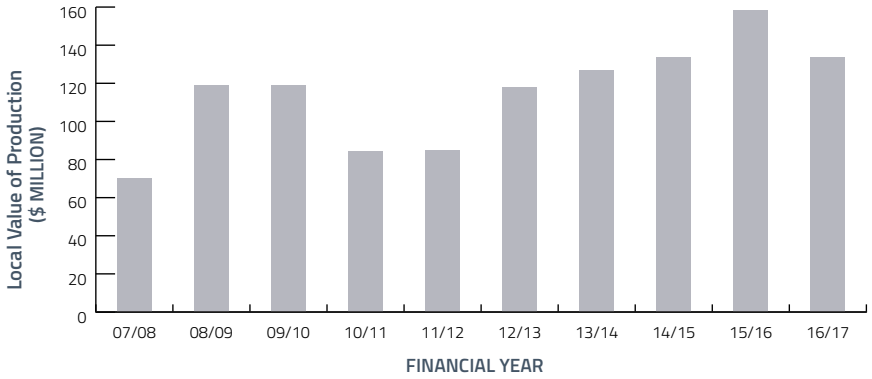
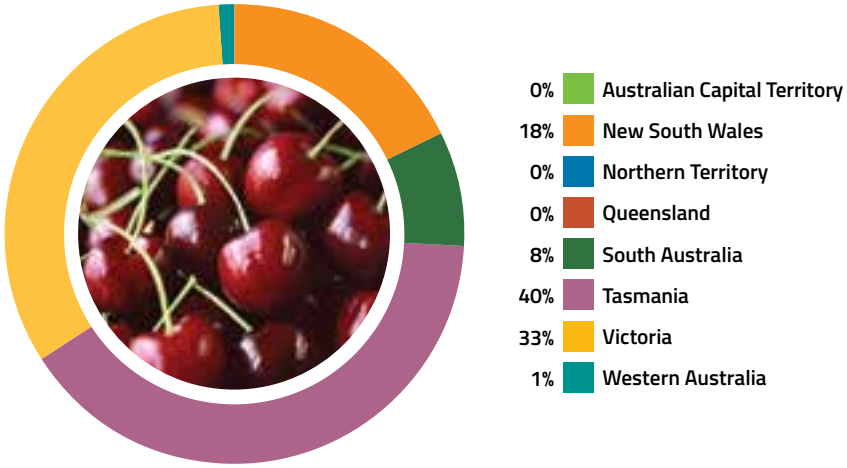
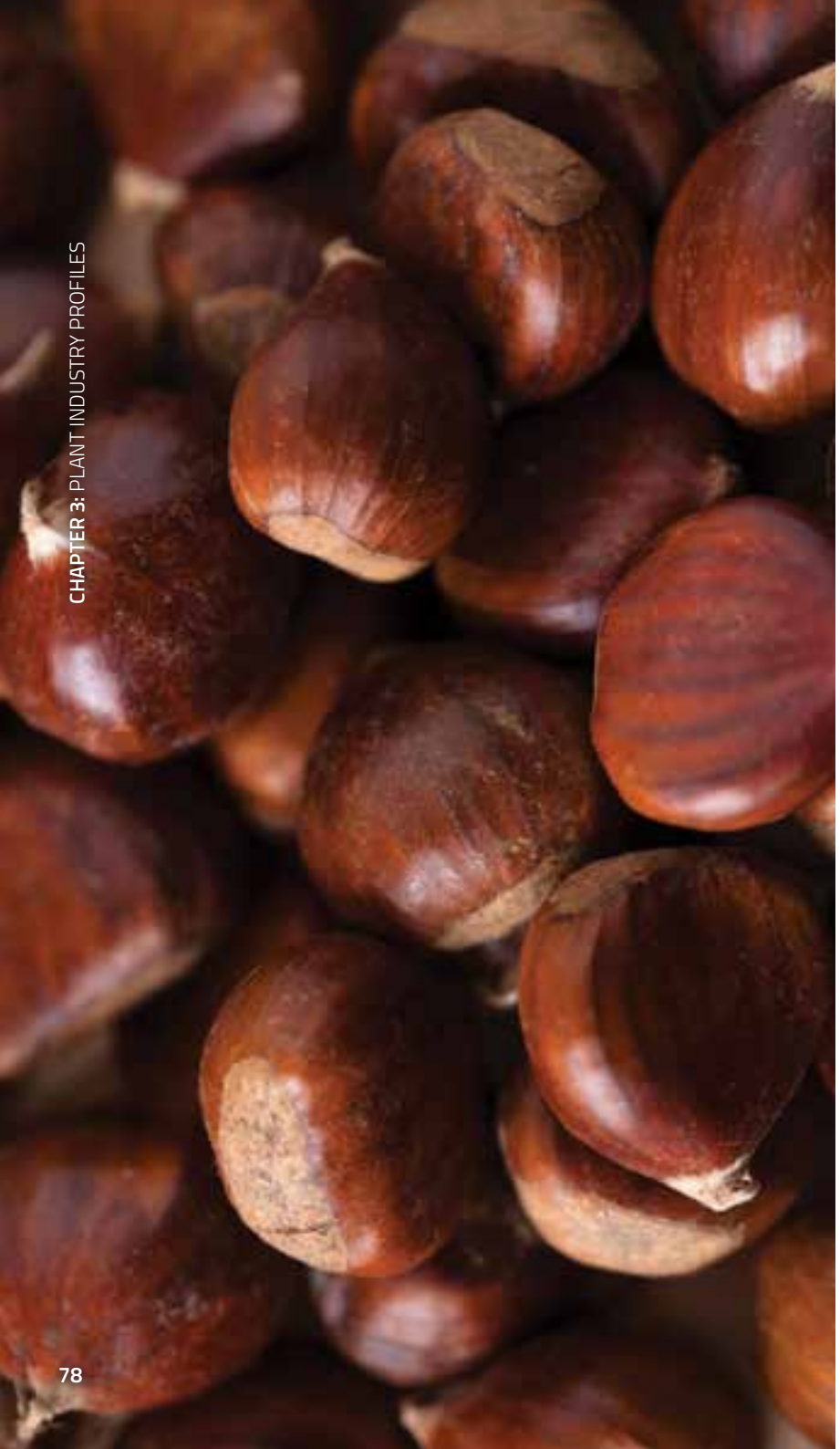


Figure 20. Distribution of cherry production by state and territory, 2016–17 (based on LVP)





CHESTNUTS

Represented by Chestnuts Australia
chestnutsaustralia.com.au

In 2016–17 chestnut production was valued at $12.8 million (LVP). Around 1,480 hectares are planted with 275,000 chestnut trees.

In 2018, approximately 1,100 tonnes of chestnuts were produced. It is estimated that with more trees planted, production will rise to approximately 1,300 tonnes with a value of $12 million by 2021.

The main varieties grown are Red Spanish, Purton's Pride and De Coppi Marone. 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.

Chestnuts are grown mainly in the eastern and southern states of Australia, primarily in Victoria and with an expanding industry in NSW.

Throughout 2018, Chestnuts Australia continued to participate in the Emergency Plant Pest response for chestnut blight, including sitting on the chestnut blight decision-making committees, the Consultative Committee on Emergency Plant Pests (CCEPP) and the National Management Group (NMG). In addition, Chestnuts Australia has participated on other relevant and appropriate NMG and CCEPP activities and exotic incursions.

Australia is free from major exotic insect pests such as the chestnut gall wasp and chestnut weevil.

Chestnuts Australia includes biosecurity as an integral part of its activities. Biosecurity is considered in the Australian Chestnut Industry Five Year Strategic Plan – 2015 to 2020 and is covered by the risk analysis documented in the nut industry biosecurity plan. A biosecurity section is maintained in the industry section of the Chestnuts Australia website. The industry has regular representation at PHA meetings and the Australian Government's Biosecurity Roundtables.

A Hort Innovation project is keeping the industry up to date with the latest news, R&D outputs and other information, including on biosecurity, through a variety of channels.

The chestnut industry is covered by v**ersion 3.0 of the nut industry biosecurity plan**.

Table 15. High Priority Pests of the chestnut industry

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

Figure 21. Annual value of chestnut production, 2009–17

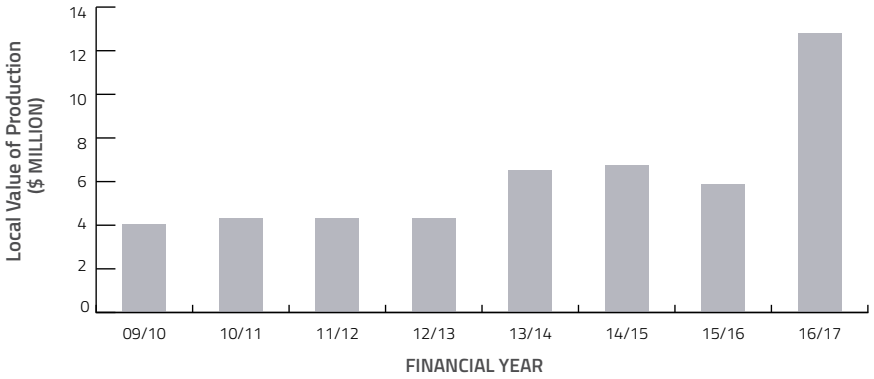
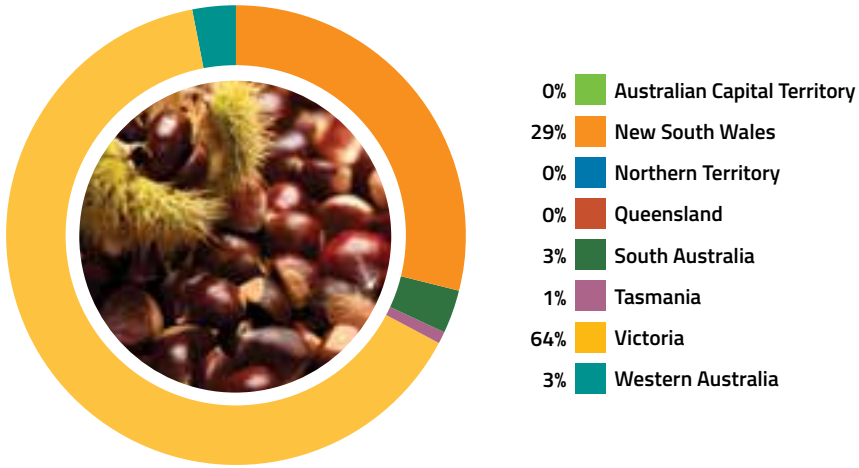


Figure 22. Distribution of chestnut production by state and territory, 2016–17 (based on LVP)



CITRUS

Represented by Citrus Australia
citrusaustralia.com.au

In 2016–17, production of oranges, mandarins, lemons, limes and grapefruit was valued at $627 million (LVP), with exports worth $332 million.

Australia's largest fresh fruit exporting industry by volume, major export markets for Australian citrus include China, Japan, Hong Kong, Malaysia, Indonesia, United Arab Emirates, Singapore, the United States and Thailand.

The five-year production average is 715,000 tonnes per annum, produced from approximately 26,000 hectares of citrus plantings nationally.

Citrus fruits are grown commercially throughout the Australian mainland excluding the ACT. Major growing areas include the Riverina in NSW; Central Burnett, Central Highlands and Far North Queensland in Queensland; Riverland in SA; the Murray Valley in Victoria–NSW and the Midlands and south-west of Western Australia. There are a small number of commercial orchards in Darwin and the Katherine Region in the NT.

A new biosecurity project, Improving Biosecurity Preparedness of the Australian Citrus Industry (CT 17001), commenced in August 2018 funded by Hort Innovation supported by the citrus levy until June 2021. In the first two years additional funding has been received from the Australian Government's Agricultural Competitiveness White Paper. For more information about the project see **page 212**.

The citrus industry is supported by version 3.0 of the citrus biosecurity plan, the **Biosecurity Manual for Citrus Producers Version 2.0**, and the **National Citrus Biosecurity Surveillance Strategy 2018–2028**.

Table 16. 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 kandiensis	Fruit fly
Bactrocera occipitalis	Fruit fly
Bactrocera trivialis	New Guinea fruit fly
Caliothrips fasciatus	Bean thrips
Candidatus Liberibacter africanus	Huanglongbing, citrus greening (African strain)
Candidatus Liberibacter americanus	Huanglongbing, citrus greening (American strain)
Candidatus Liberibacter asiaticus	Huanglongbing, citrus greening (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	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

Figure 23. Annual value of citrus production, 2007–17

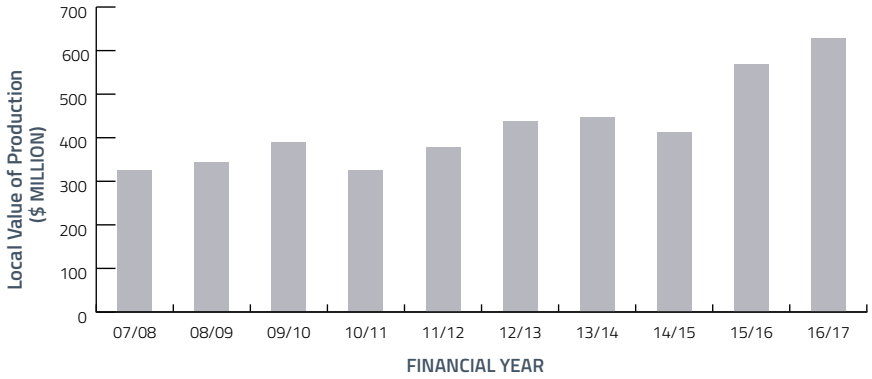
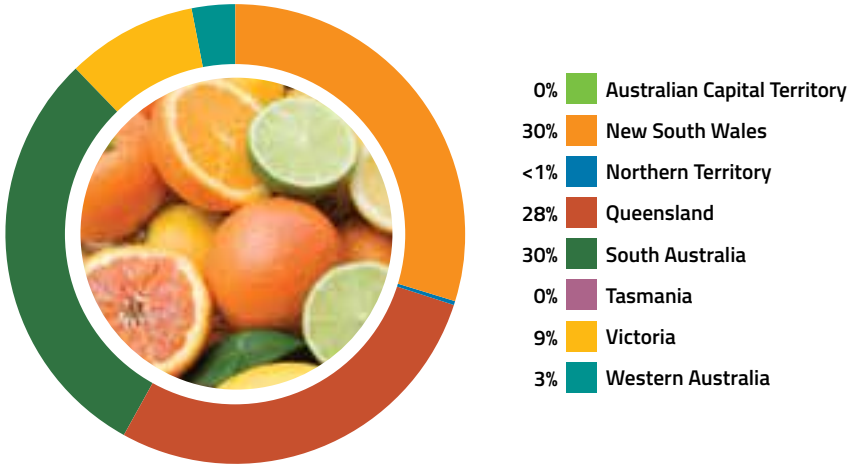
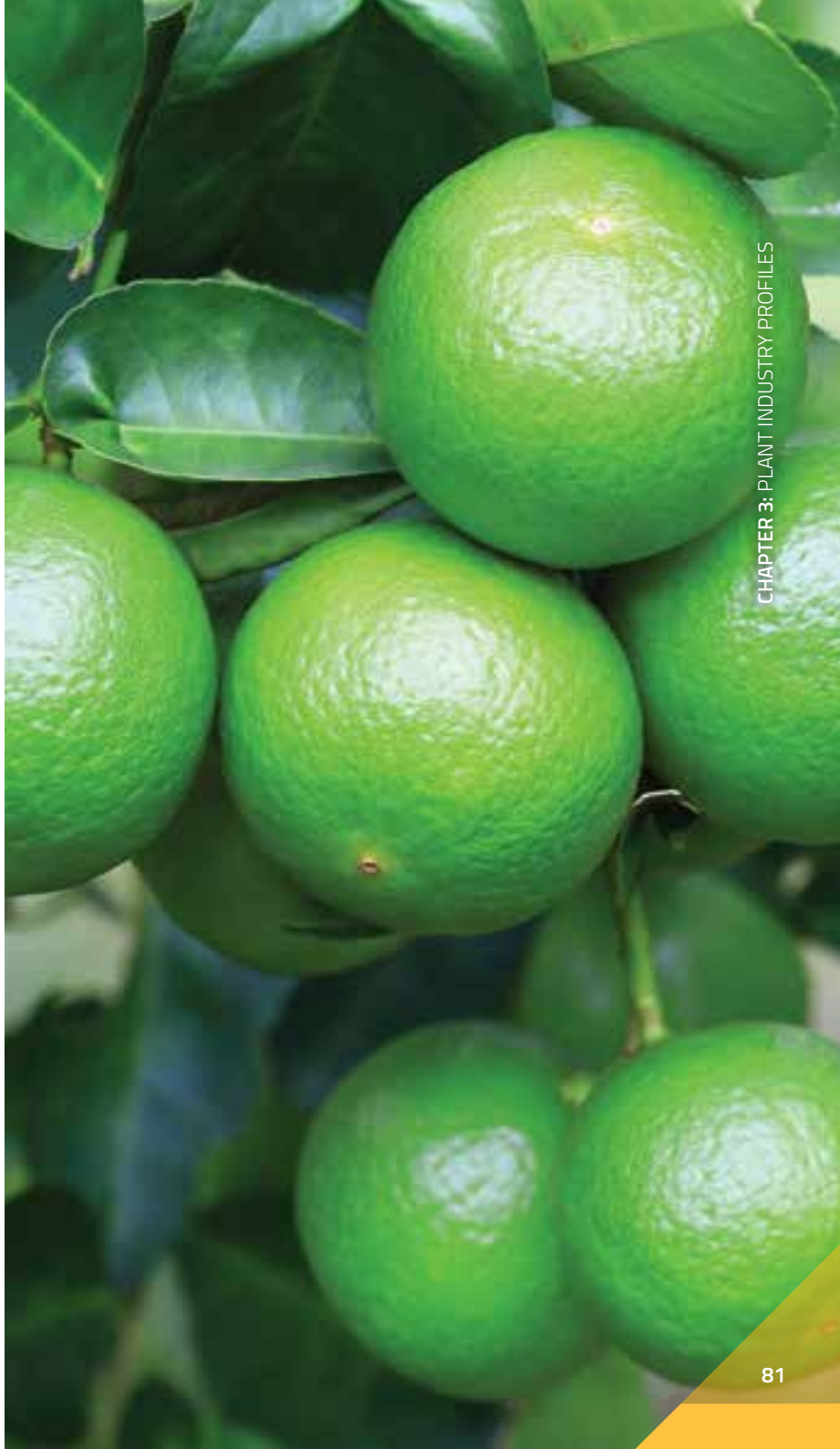


Figure 24. Distribution of citrus production by state and territory, 2016–17 (based on LVP)





COTTON

Represented by Cotton Australia
cottonaustralia.com.au

In 2016–17, cotton production was valued at $1.6 billion (LVP). Almost the entire Australian cotton crop is exported, with the majority sold to China and the remainder mainly to spinning mills in other parts of Asia.

Approximately 60 per cent of the national crop is grown in NSW, with the remainder grown in Queensland and a small number of fields in Victoria. Cotton is predominantly grown as an annual irrigated summer crop, with rain-grown cotton representing approximately 20 per cent of the total planted area.

Although a relatively small producer on the world scale, Australia sustainably produces high quality, low contaminant cottons that attract a premium on the world market. Australian cotton yields are high by international standards, at nearly three times the world average[13].

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 1.01**. The Cotton Industry Biosecurity Group meets annually to discuss biosecurity issues and to make sure industry's responsibilities under the Emergency Plant Pest Response Deed are met each year.

13. Cotton Australia (2018). Australian Cotton Industry Statistics

Table 17. High Priority Pests of the cotton industry

Scientific name	Common name
Anthonomus grandis	Boll weevil
Aphis gossypi (exotic strains)	Cotton aphid (exotic strains)
Bemisia tabaci (biotypes other than B and AN)	Silverleaf whitefly (exotic biotypes)
Cotton leaf curl virus complex (Begomovirus)	Cotton leaf curl virus, cotton leaf crumple virus, cotton leaf curl Alabad virus, cotton leaf curl Burewala virus, cotton leaf curl Gezira virus, cotton leaf curl Kokhran virus, cotton leaf curl Multan virus, cotton leaf curl Rajasthan virus, cotton leaf curl Shahdadpur virus
Cotton leafroll dwarf virus (Polerovirus)	Cotton blue disease
Dysdercus spp. (including *D. honestus, D. marus, D. suturellus* (American species))	Cotton stainer, red bug
Fusarium oxysporum f. sp. *vasinfectum* (exotic races)	Fusarium wilt (exotic races)
Halyomorpha halys	Brown marmorated stink bug
Helicoverpa armigera (carrying Bt resistance alleles)	Cotton bollworm, African boll worm
Lygus hesperus	Western plant bug
Lygus lineolaris	Tarnished plant bug
Phymatotrichopsis omnivora (syn. *Phymatotrichum omnivorum*)	Texas root rot, phymatotrichum root rot, cotton root rot
Thaumatotibia leucotreta (syn. *Cryptophlebia leucotreta*)	False codling moth
Verticillium dahliae (defoliating strain)	Verticillium wilt (defoliating strain)
Xanthomonas citri subsp. *malvacearum* (syn. *X. axonopodis* pv. *malvacearum, X. campestris* pv. *malvacearum*) (exotic, hypervirulent races)	No common name

Figure 25. Annual value of cotton production, 2007–17

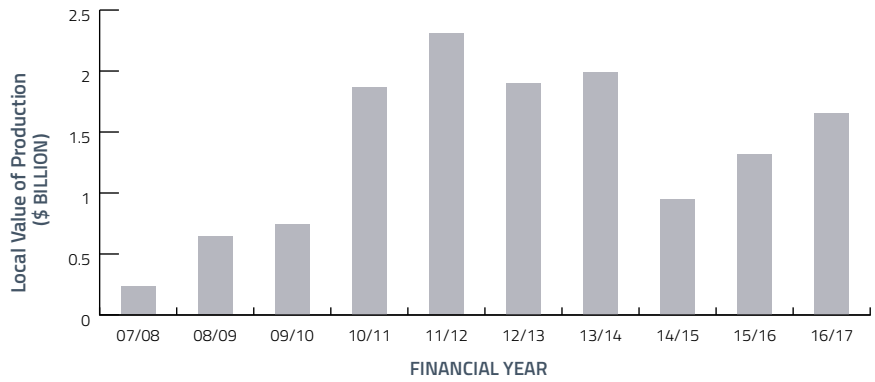
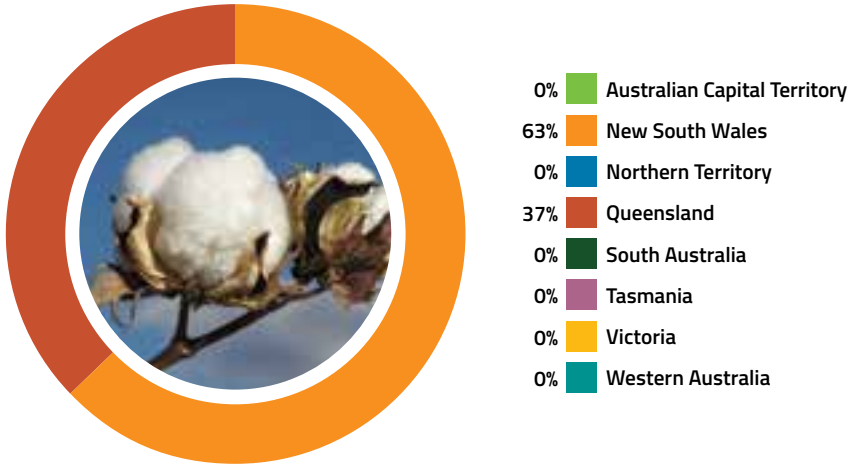


Figure 26. Distribution of cotton production by state and territory, 2016–17 (based on LVP)



DRIED FRUITS (GRAPES)

Represented by Dried Fruits Australia
driedfruitsaustralia.org.au

In 2016–17, dried grape production (sultana types, currants and raisins) was valued at $29 million (LVP), with exports valued at $18.7 million.

The 2019 crop is expected to be 17,000 tonnes. The main export markets for dried grapes are found in Europe, with new market opportunities increasing across Asia. Total exports were higher than average in 2018 at 5,200 tonnes.

Most of Australia's dried grapes are grown in the Sunraysia region, which spans north-western Victoria and south-western NSW around the Murray River, and also in the Riverland of SA.

Dried Fruits Australia regularly distributes biosecurity information and guidelines from PHA to its members via the industry's quarterly magazine, The Vine, and through the fortnightly email newsletter Currant News.

The Biosecurity Manual for the Viticulture Industry has been distributed to dried fruit growers through the major industry processors. The industry also undertakes Emergency Plant Pest Response Deed training to understand the roles and responsibilities of their officers in the event of a pest incursion.

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

Table 18. High Priority Pests of the dried grape industry

Scientific name	Common name
Bactrocera carambolae	Carambola fruit fly
Bactrocera dorsalis	Oriental fruit fly
Candidatus Phytoplasma solani	Bois noir
Daktulosphaira vitifoliae (exotic strains)	Grapevine phylloxera
Drosophila suzukii	Spotted wing drosophila
Grapevine flavescence doree phytoplasma	Flavescence doree
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

Figure 27. Annual value of dried grape production, 2007–17

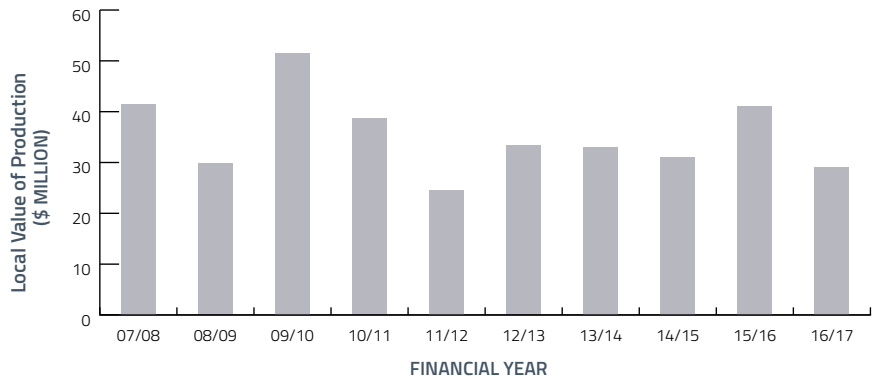


Figure 28. Distribution of dried grape production by state and territory, 2016–17 (based on LVP)

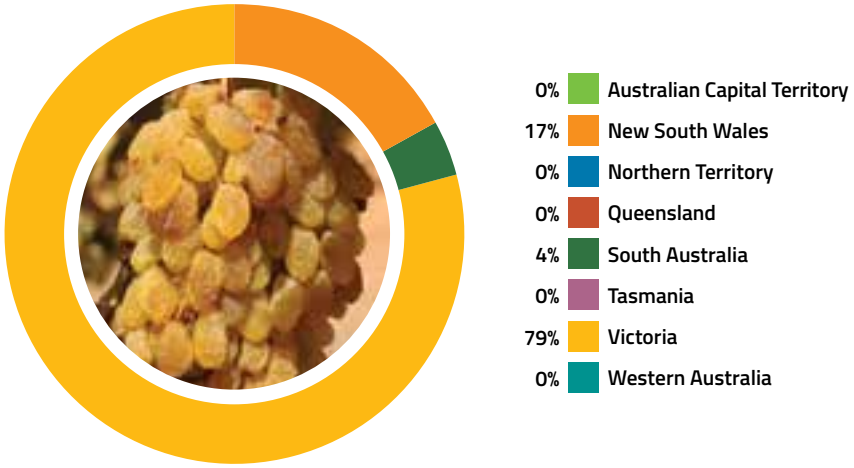


Image courtesy of Mark King, Dried Fruits Australia

FORESTRY

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

In 2016–17, plantation forestry production was valued at $2.2 billion (LVP), with wood product exports valued at $3.5 billion[14]. The forest, wood and paper products sector is Australia's sixth largest manufacturing industry.

Australia is the seventh most forested country in the world, with 123 million hectares of native forest on public and private land and two million hectares of plantation forestry.

Of Australia's 123 million hectares of native forest, only 100,000 hectares is harvested for timber annually (less than 0.06 per cent of Australia's total native forests). All native forest harvested is sustainably regrown, with the regrowth quickly becoming an abundant food source and habitat for native species.

Plantation species are split almost evenly between softwood and hardwood plantations.

Softwood plantations are predominately long rotation (from 28 to 40 years) and produce logs for a range of products including structural timber for housing, appearance grade sawn timber, wood-based panels, engineered wood products, paper and paperboard. The majority of softwood grown in Australia is *Pinus radiata*, which is the dominant species in SA, NSW, Victoria and Tasmania. *P. elliottii* and *P. caribaea* are grown in Queensland and northern NSW, and *P. pinaster* is grown in WA. 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.

Hardwood plantations include short rotation eucalypt species (eight to 12 years) grown for woodchips to be made into tissue, paper and paperboard products, and around 10 per cent are long rotation species, producing logs for a range of products including appearance grade sawn timber and structural timber for housing.

There are also some small plantings of *Acacia mangium*, African mahogany and sandalwood grown in the NT and northern WA.

Of the 36.6 million hectares of native forest both available and suitable for commercial wood production, 7.5 million hectares is multiple-use public forests. The remainder is in leasehold and private forests. Multiple-use native forests are managed by state government departments or agencies in NSW, Queensland, Victoria, WA and Tasmania and are defined as crown land managed for a range of values including wood harvesting, water supply, conservation, recreation and environmental protection.

14. ABARES (May 2018). Australian forest and wood products statistics, September and December quarters 2017

Currently, a funding partnership between the Department of Agriculture and Water Resources and the Australian Forest Products Association is being used to establish a National Forest Biosecurity Surveillance Program. The initiative is being managed by PHA through the National Forest Biosecurity Coordinator.

The forestry industry is covered by version 2.0 of the plantation forest biosecurity plan, the **Biosecurity Manual for the Plantation Timber Industry Version 1.0** and the N**ational Forest Biosecurity Surveillance Strategy 2018–23**.

Table 19. High Priority Pests of the plantation forestry industry

Scientific name	Common name
Bursaphelenchus spp. including *B. xylophilus*	Pinewood nematode species complex
Chrysopothe 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
Monchamus spp. including *M. alternatus, M. galloprovinicialis, M. titillator, M. scutellatus*	Longhorn beetle
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

Figure 29. Annual value of plantation forest production, 2007–17

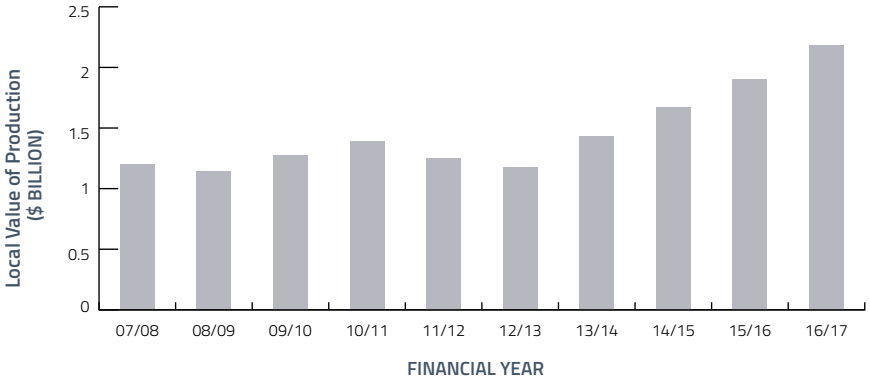
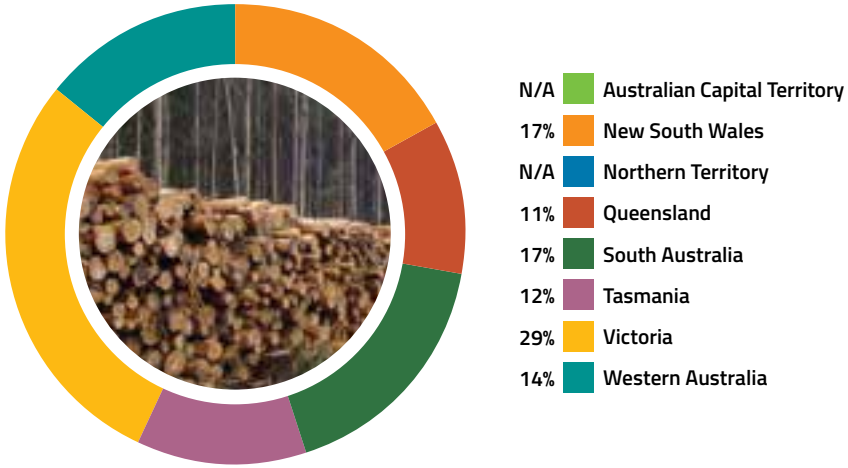


Figure 30. Distribution of plantation forest production by state and territory, 2016–17 (based on LVP)[15]



15. There is a small amount of production within the ACT and NT but data is not available (N/A) for these regions

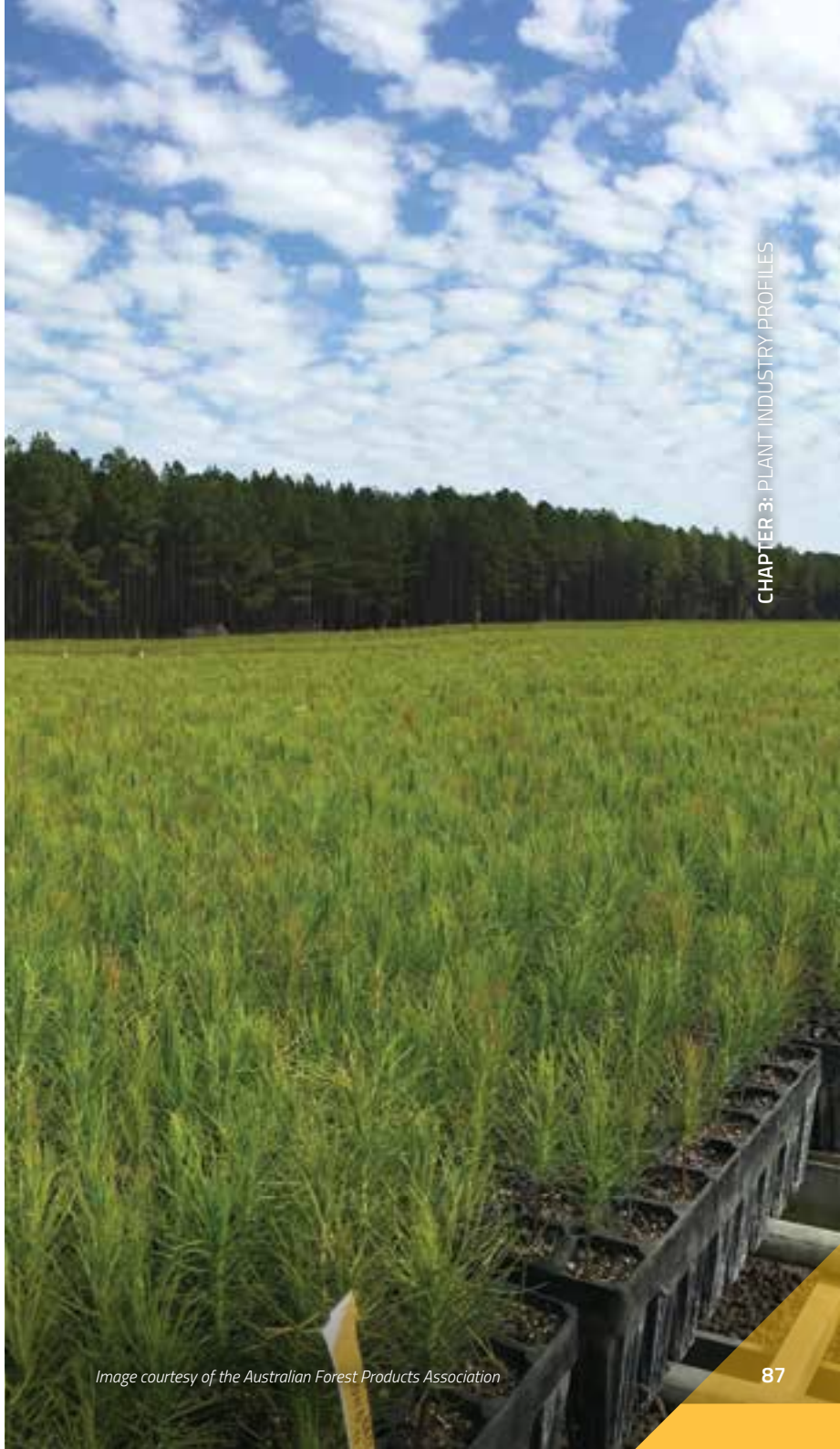


Image courtesy of the Australian Forest Products Association

GINGER

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

In 2016–17, ginger production was valued at $24.8 million (LVP), with exports valued at $0.4 million. Land under cultivation was about 270 hectares and the most popular ginger varieties grown are Jumbo (also known as Canton) and Queensland.

Ginger production takes place in Australia's subtropical and tropical regions. The main concentration of growers is located within south-east Queensland, including the Wide Bay region. Other small areas of ginger are grown in far north Queensland and northern NSW.

The Australian ginger industry is regionally significant, employs both local people and backpackers, with 30 per cent sold to the processing sector and 70 per cent sold to the fresh market.

Biosecurity is included in the AgriFutures Australia's **Ginger Program RD&E Plan 2017–22** and is an integral part of Australian Ginger Industry Associations' activities. The association represents the biosecurity interests of ginger producers and industry by funding and supporting biosecurity initiatives, and information from PHA is shared regularly with members via meetings, newsletters and email up-dates.

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

Table 20. 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

Figure 31. Annual value of ginger production, 2010–17

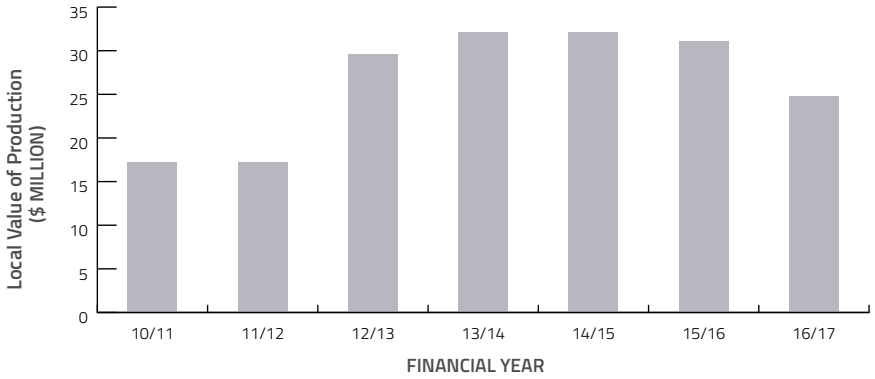
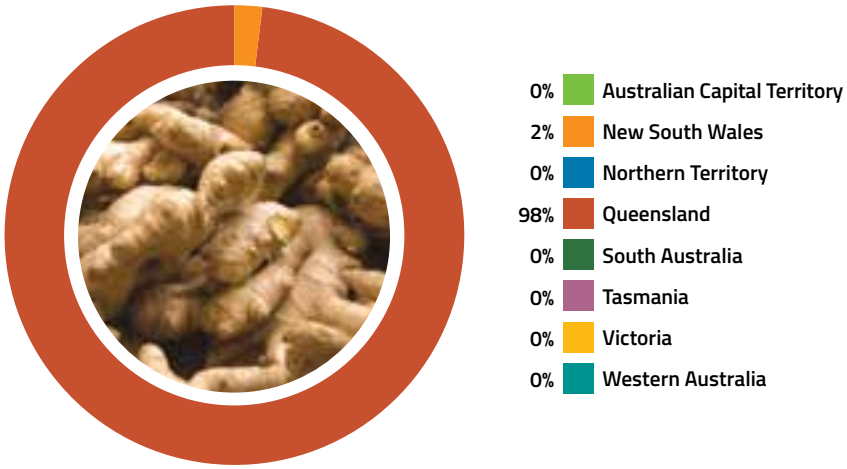


Figure 32. Distribution of ginger production by state and territory, 2016–17 (based on LVP)



GRAINS

Represented by Grain Producers Australia
grainproducers.com.au

In 2016–17, grain production was valued at $14.9 billion (LVP). The grains industry contributed 29 per cent of the total gross revenue from agricultural production and 30 per cent of farm export income in that year, making it Australia's largest plant industry.

Most of Australia's grain is produced in the wheat belt, which stretches from central Queensland through NSW, Victoria, Tasmania, SA and southern WA. However, due to the wide-ranging soil and climatic variability across Australia, a range of crop species and varieties are grown, each of which has specific pests and diseases that pose a threat to production and can influence access to markets (both domestically and overseas).

Since 2007, Grain Producers Australia has funded a biosecurity outreach program managed by PHA to raise awareness and improve practices on farm and boost preparedness to manage biosecurity threats. See **page 211** for more on the **Grains Farm Biosecurity Program**.

The grains industry is covered by version 3.0 of the biosecurity plan for grains, the **Biosecurity Manual for Grain Producers Version 4.0**, and the **Farm Biosecurity Manual for the Organic Grains Industry Version 1.0**.

Figure 33. Annual value of grain production, 2007–17

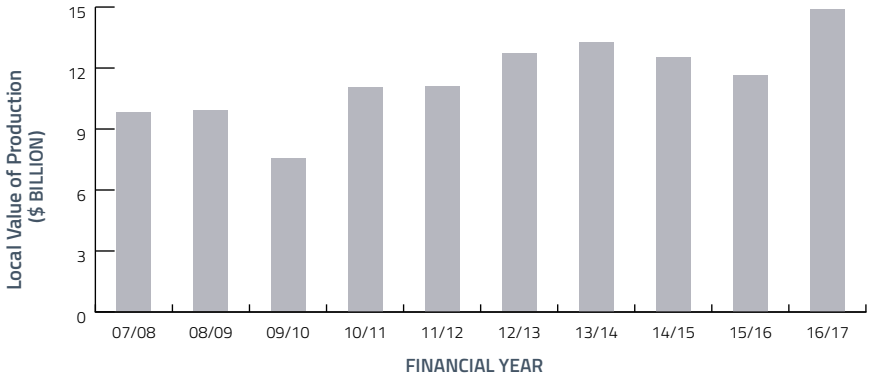


Figure 34. Distribution of grain production by state and territory, 2016–17 (based on LVP)

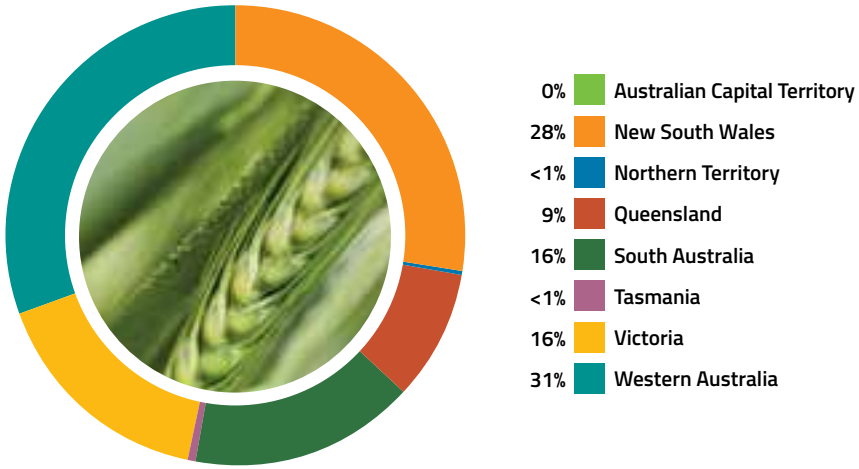


Table 21. High Priority Pests of the grains industry

Scientific name	Common name
Ascochyta rabiei (MAT1-1 is exotic. MAT1-2 is endemic)	Ascochyta blight
Barley mild mosaic virus (Baymovirus)	Barley mild mosaic virus
Bean common mosaic virus (Potyvirus)	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 virus
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
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

Scientific name	Common name
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 virus
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 virus
Thaumatotibia leucotreta	False codling moth
Tilletia indica	Karnal bunt
Trogoderma granarium	Khapra beetle
Zea mosaic virus (Potyvirus)	Zea mosaic virus

HAZELNUTS

Represented by Hazelnut Growers of Australia
hazelnuts.org.au

In 2016–17, hazelnut production was valued at $2.2 million (LVP). The industry has expanded, with major on-farm investment from a northern hemisphere confectionary manufacturer giving renewed confidence to Australian growers. Approximately 2,200 hectares are planted with 1.1 million trees, with approximately 300 tonnes of hazelnuts produced in 2018. The industry estimates that by 2021 hazelnut production will be 5,500 tonnes with a value of $40 million.

Hazelnuts are grown in the temperate areas of south-eastern Australia. The main production regions are the central tablelands of NSW around Orange and Narrandera, and north-east Victoria around Myrtleford. They are also grown in central and eastern Victoria and increasingly in northern Tasmania.

Australia imports 2,500 tonnes of hazelnut product annually, primarily from Turkey. Imported produce is mainly in kernel form for use by mass market confectioners.

In 2018, Hazelnut Growers of Australia was involved in a number of responses to pest incursions affecting the hazelnut industry, including detections of brown marmorated stink bug in cargo.

Australia is free from eastern filbert blight, a serious disease affecting the industry in the United States, and most other hazelnut pests and diseases that affect growers overseas.

Biosecurity is considered in the Australian Hazelnut Industry Five Year Strategic Plan – 2015 to 2020 and the industry peak body is represented at PHA meetings and government Biosecurity Roundtables.

The hazelnut industry is covered by **version 3.0 of the nut industry biosecurity plan**.

Table 22. High Priority Pests of the hazelnut industry

Scientific name	Common name
Anisogramma anomala	Eastern filbert blight
Chinavia hilaris (syn. *Acrosternum hilare, Chinavia hilarae, Nezara hilaris, Pentatoma hilaris*)	Green stink bug, pistachio bug
Halyomorpha halys	Brown marmorated stink bug
Lymantria dispar	Gypsy moth (Asian and European strains)

Figure 35. Annual value of hazelnut production, 2010–17

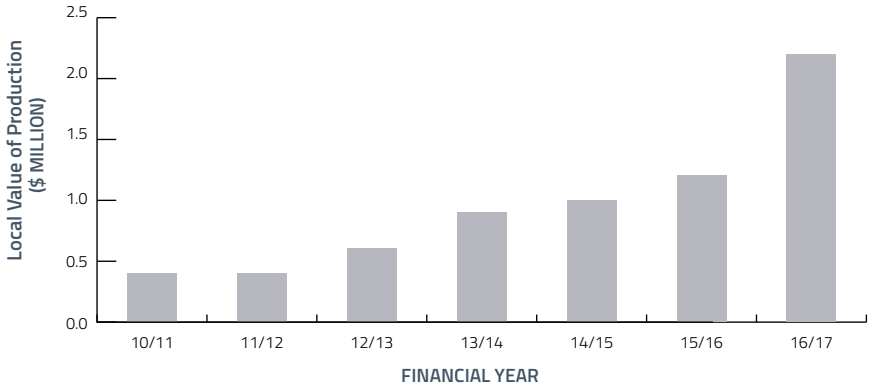
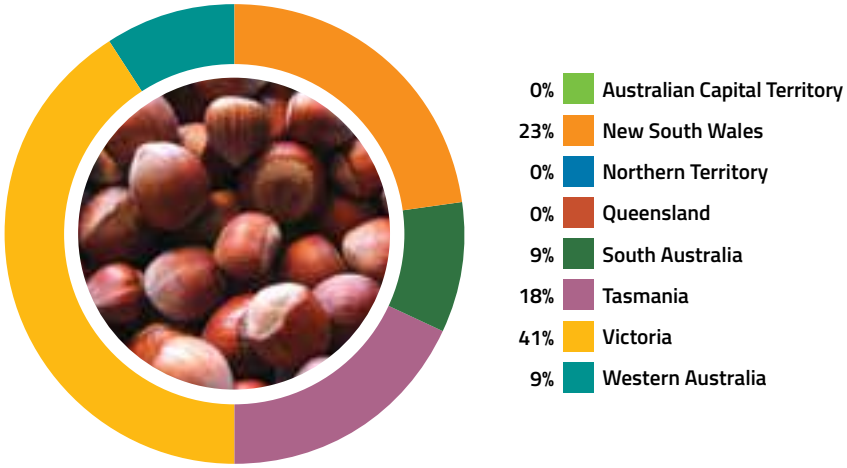


Figure 36. Distribution of hazelnut production by state and territory, 2016–17 (based on LVP)



HONEY BEES

Represented by the Australian Honey Bee Industry Council (AHBIC)
honeybee.org.au

In 2016–17, honey and beeswax production was valued at $104 million (LVP). Around 25,053 beekeepers are currently registered, operating around 672,216 hives. Apiaries range in size from one hive to several thousand.

The industry has products other than honey. Australia exports live bees to some countries and our beeswax commands a premium price overseas. Trade relies on the healthy status of Australia's bees, with beeswax valued highly because it lacks residue from pesticides used overseas to treat varroa mites.

Australia's bees are further valued for the pollination services that they provide to many plant industries, estimated to be worth $8.4–20 billion per year, and is the reason why the industry is a member of PHA.

AHBIC works in partnership with other industries and governments to protect the health of bees with a number of biosecurity initiatives.

AHBIC contributes to the National Bee Pest Surveillance Program which operates at ports around Australia to provide an early detection mechanism for exotic pests of bees and pest bees. This government and industry partnership is featured on **page 154**.

AHBIC worked with PHA and state and territory governments to develop the **Australian Honey Bee Industry Biosecurity Code of Practice** to protect Australia's honey bees, which was endorsed by the honey bee industry in 2016. The aim of the Code of Practice is to improve the management of established pests and diseases, as well as increase preparedness and surveillance for exotic pest threats.

In addition, the National Bee Biosecurity Program, a partnership arrangement involving Bee Biosecurity Officers (BBO) in each state has been established, with officers to be appointed in all states. BBO's help beekeepers to implement biosecurity measures and ensure they are complying with the Code of Practice and relevant legislation. BBO's also provide training and education.

AHBIC is currently a part of a national eradication program for *Varroa jacobsoni* in Townsville in north Queensland. The eradication phase has now concluded, and the program is in a proof of freedom stage.

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

Figure 37. Annual value of honey and beeswax production, 2007–17

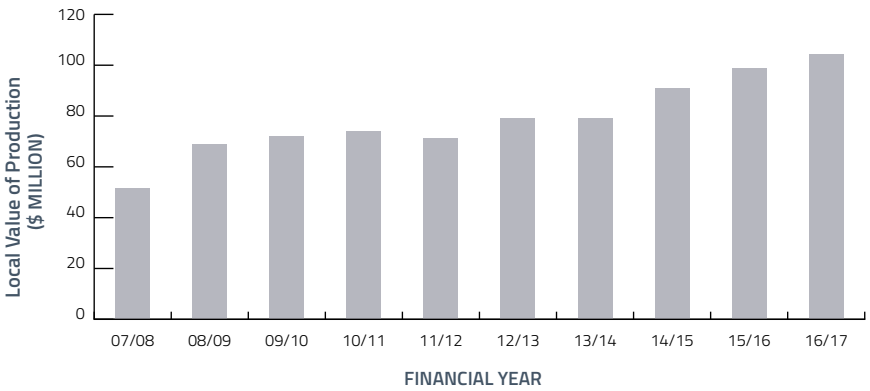


Figure 38. Distribution of honey and beeswax production by state and territory, 2016–17 (based on LVP)

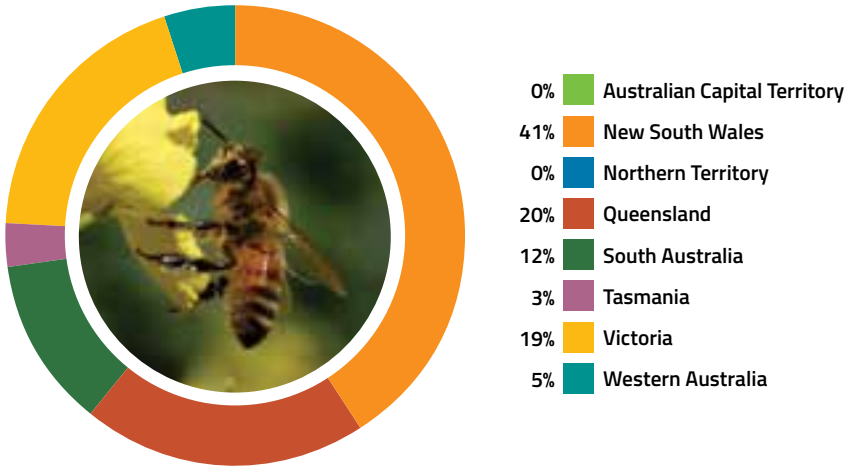


Table 23. High Priority Pests of the honey bee industry

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	Varrora mite
Vespa spp. (exotic species)	Hornets

Image courtesy of Michael Holmes

LYCHEES

Represented by the Australian Lychee Growers' Association
australianlychee.com.au

In 2016–17, lychee production was valued at $26.7 million (LVP), with exports worth $5.6 million. Annual production continues to range between 2,250 to 3,500 tonnes, depending on climatic and seasonal conditions.

There are many varieties of lychee grown in Queensland and NSW, although the Kwai Mai Pink lychee is the most popular and widely grown variety and is a good annual yielding variety for export and domestic markets. A number of larger producers are now choosing to incorporate and plant some of the newer Chinese varieties of Chompogo, Erdon Lee and Baitangying in their orchards.

Lychees are produced as a single annual crop with a harvest period from late October (north Queensland) to March (northern NSW). This gives the Australian lychee season one of the world's longest production periods as well as a counter-seasonal supply to most other lychee producing countries.

Lychee exports have experienced strong growth compared with other tropical fruits, with some 18 per cent of production being exported in 2017–18. Hong Kong is officially the largest market for Australian lychees, accounting for a little over half of Australia's exports for 2017–18. Exports to the United Arab Emirates are less than half of that to Hong Kong but this market is showing very strong growth, followed by New Zealand, Singapore, Canada and the United States.

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

Table 24. 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 39. Annual value of lychee production, 2009–17

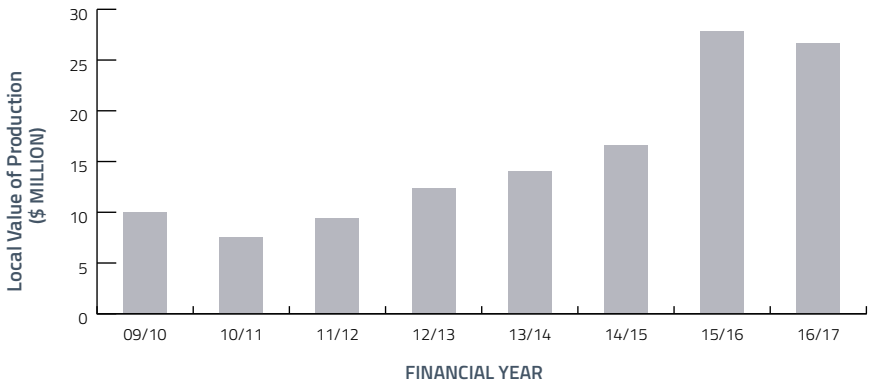
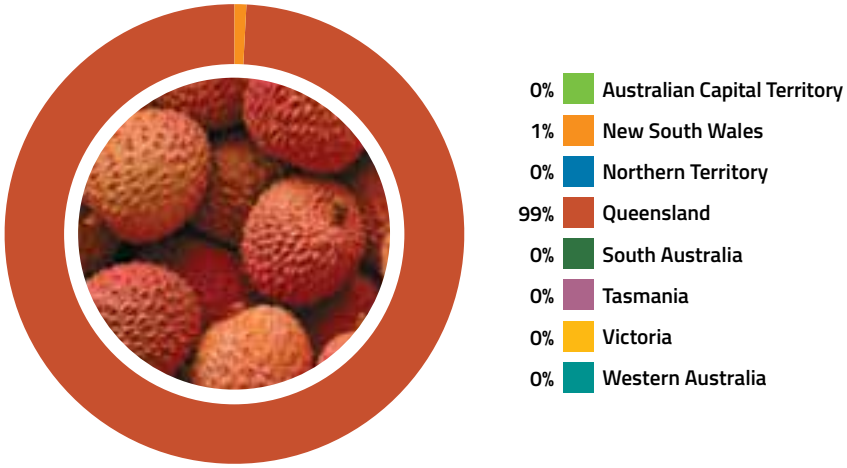


Figure 40. Distribution of lychee production by state and territory, 2016–17 (based on LVP)



MACADAMIAS

Represented by the Australian Macadamia Society
australian-macadamias.org

In 2016–17, macadamia production was valued at $241 million (LVP), with exports worth $291 million. Annual production from approximately 750 growers on 25,000 hectares is approximately 53,000 tonnes in-shell or 16,000 tonnes of kernel.

Approximately 70 per cent of the crop is exported, principally to Europe, the United States, Japan and other Asian countries as kernel and to China in-shell. Australia is currently the world's largest producer of macadamia kernel. South Africa and Kenya are the other major producers.

In Australia the majority of plantings are varieties of *Macadamia integrifolia*. Of these about 75 per cent are Hawaiian varieties with the remainder being Australian. Five new Australian-bred varieties have been released in the last few years including MCT1, a small precocious and high yielding variety that is proving very popular. Harvest commences in March and runs through to August.

Macadamias are grown along the eastern seaboard of NSW and Queensland, from Port Macquarie in the south through to the Atherton Tablelands in the north. About half of the Australian crop is produced in NSW and half in Queensland. Production is growing fastest in Bundaberg in Queensland and the Clarence Valley in NSW. New plantings are also being developed in Mackay, Maryborough and Emerald in Queensland and in the Richmond Valley in NSW. Ownership structures are diverse and comprise a combination of family owned orchards, first time farmers, agribusiness corporates and international and joint venture investments where the scale of new plantings is increasing significantly.

To encourage biosecurity awareness within the industry, approximately 70 per cent of orchards employ professional pest scouts. The Australian Macadamia Society convenes a forum where pest pressures for the previous season are reviewed and any new pest and disease sightings reported. A number of integrated pest and disease management related research projects are currently being funded through Hort Innovation, and the Society recently distributed over 500 farm biosecurity gate signs to macadamia growers.

The macadamia industry is covered by **version 3.0 of the nut industry biosecurity plan**.

Table 25. High Priority Pests of the macadamia industry

Scientific name	Common name
Hypothenemus obscurus	Tropical nut borer
Phytophthora ramorum	Sudden oak death
Tropilaelaps clareae	Tropilaelaps mite
Tripilaelaps mercedesae	Tropilaelaps mite
Varroa destructor	Varroa mite
Xylella fastidiosa (including *X. fastidiosa* subsp. *fastidiosa, X. fastidiosa* subsp. *multiplex, X. fastidiosa* subsp. *piercei*) (with vector)	Almond leaf scorch, pecan bacterial leaf scorch

Figure 41. Annual value of macadamia production, 2007–17

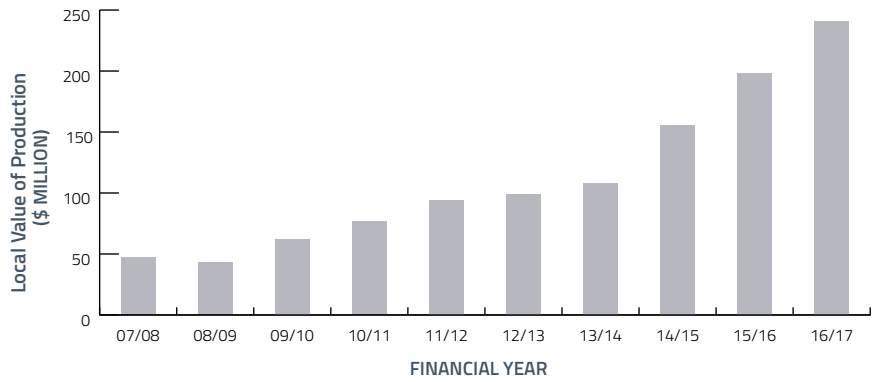
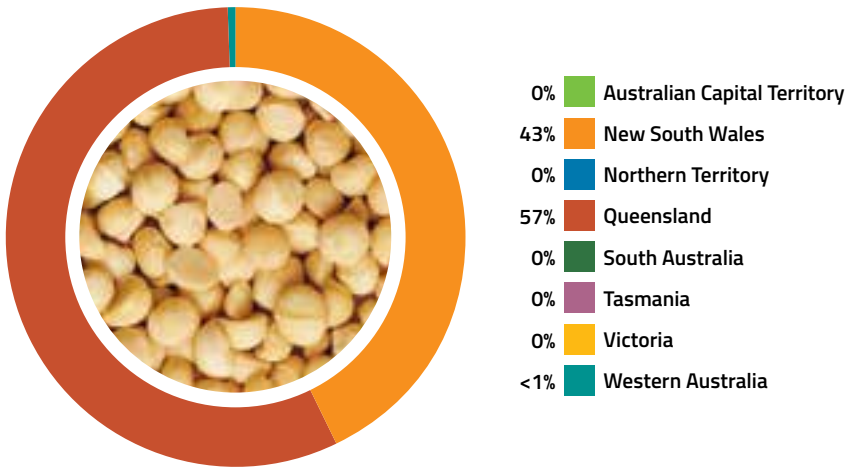


Figure 42. Distribution of macadamia production by state and territory, 2016–17 (based on LVP)



MANGOES

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

In 2016–17, mango production was valued at $112 million (LVP), with exports worth $29.7 million.

Over the last four years the average production volume per year has been 70,000 tonnes. Of this volume, approximately 80 per cent of fruit is consumed fresh, 10 per cent is exported and the remaining fruit is processed.

In Australia, nine varieties of mango are in commercial production. The most abundant variety, Kensington Pride, accounts for around 45 per cent of Australian production. Other varieties include B74 (Calypso), Honey Gold, and R2E2, green eating varieties such as Keow Savoey and Nam Doc Mai, as well as late season varieties such as Brooks, Keitts, Palmers, Kents and Pearls. B74 and R2E2 are popular in export markets. There are other varieties produced in smaller volumes.

The industry supplies the Australian market, with production occurring from August 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.

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**.

Table 26. High Priority Pests of the mango industry

Scientific name	Common name
Bactrocera carambolae	Carambola fruit fly
Bactrocera dorsalis	Oriental 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 midge
Sternochetus frigidus	Mango pulp weevil
Xylosandrus compactus	Black twig borer

Figure 43. Annual value of mango production, 2007–17

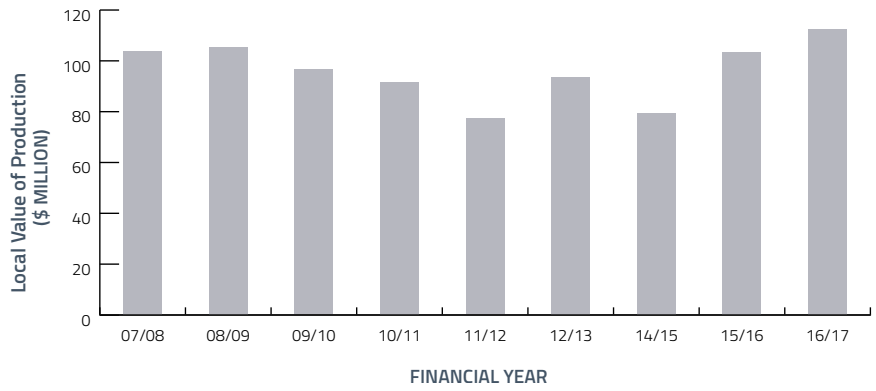
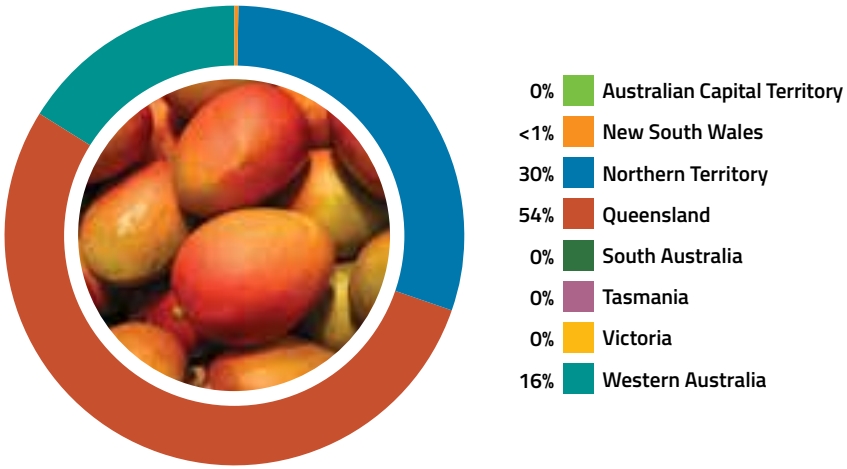


Figure 44. Distribution of mango production by state and territory, 2016–17 (based on LVP)



MELONS

Represented by the Australian Melon Association
melonsaustralia.org.au

In 2016–17, melon production was valued at $189 million (LVP). Melons are grown for domestic consumption as well as international export, valued at $32 million in 2016–17, to New Zealand, United Arab Emirates, Malaysia, Hong Kong and Singapore.

Fresh seedless watermelons, rockmelon, honeydew and Piel de Sapo melons are the major products and are produced all year round. The main form of value-adding is cut and wrapped fruit, fruit salad products and juices.

The Australian melon industry consists of approximately 200 growers producing around 215,000 tonnes of melons annually, with the majority of production occurring in Queensland, NT, WA and NSW. A food safety incident in early 2018 resulted in a decrease in production during 2018.

The Australian melon industry commenced research and development and biosecurity levies in January 2016. The R&D levy is managed through Hort Innovation and the biosecurity levy through PHA. The melon industry is working with growers on biosecurity measures to address seed-borne diseases, on-farm biosecurity and pest surveillance. A biosecurity project that will improve preparedness for, and management of, biosecurity risks in the melon industry at the farm gate and industry level commenced in late 2017.

Melons are covered by **version 1.0 of the biosecurity plan for the melon industry** which is currently under review.

Table 27. High Priority Pests of the melon industry

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

Figure 45. Annual value of melon production, 2010–17

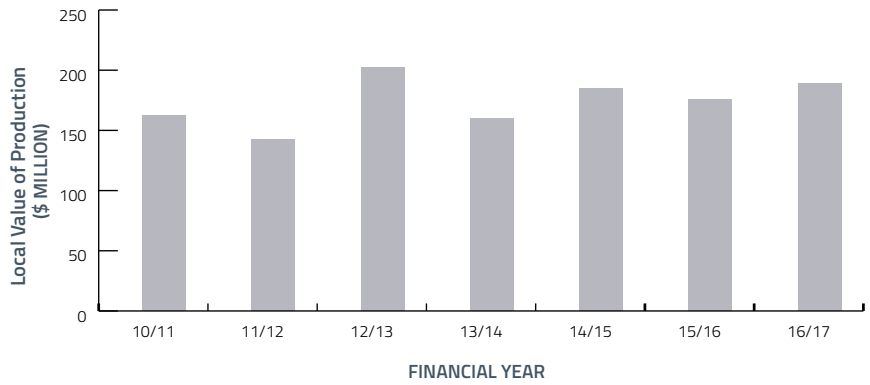
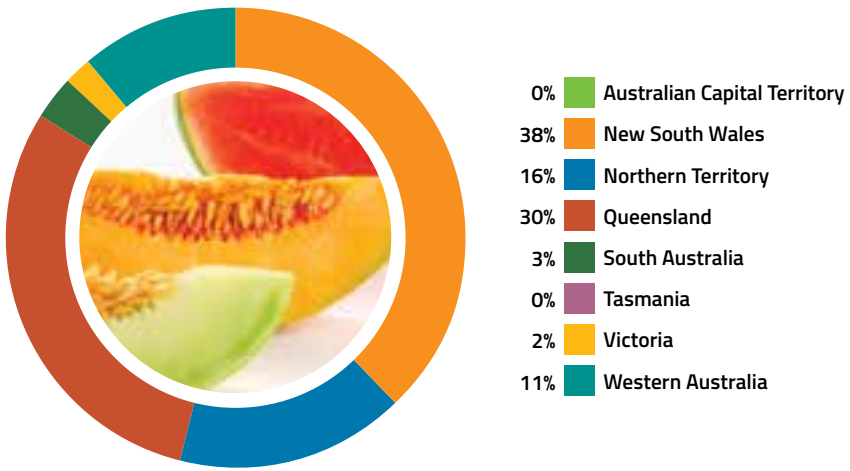


Figure 46. Distribution of melon production by state and territory, 2016–17 (based on LVP)



OLIVES

Represented by the Australian Olive Association
australianolives.com.au

In 2016–17, olive production was valued at $125 million (LVP). In 2018 production of olive oil was 10 million litres, down from 21 million litres in 2017: this was due to local seasonal factors and olive trees having a tendency to bear fruit biennially. Depending on seasonal conditions, Australian production is around 85–90 per cent extra virgin olive oil.

The industry estimates that in 2017–18 the Australian olive industry exported around 5,000 tonnes of olive products, worth $25 million. Olive oil accounted for 95 per cent of the exports, with table olives accounting for the rest. There are no measurable fresh olive exports. Major export markets are United States, China, New Zealand, Japan and Spain.

Australian consumption of olive oil totals 45 million litres per annum, with imports from Spain, Italy and Greece filling the gap in local production.

The Australian olive industry began in earnest in 1990 with the majority of large groves planted between 1996 and 2004. The olive industry is regarded as mainstream agriculture and remains an important employer in regional Australia. In 2013 the industry began collecting a levy to fund RD&E projects.

The industry suffered losses during the global financial crisis which saw a number of groves change hands. Since then, a number of new growers have purchased olive orchards and joined the association bringing renewed enthusiasm and vision. In more recent times there has also been significant replanting of established groves with more suitable varieties. Victoria is the largest producer, followed by WA, SA and NSW; Queensland and Tasmania are minor olive producing states.

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

Table 28. High Priority Pests of the olive industry

Scientific name	Common name
Bactrocera oleae	Olive fly
Prays oleae	Olive moth, olive kernel borer
Xylella fastidiosa subsp. *multiplex* (with vectors)	Leaf scorch
Xylella fastidiosa subsp. *pauca* (with vectors)	Olive quick decline
Verticillium dahliae (exotic defoliating strain)	Verticillium wilt (defoliating strains)

Figure 47. Annual value of olive production, 2007–17

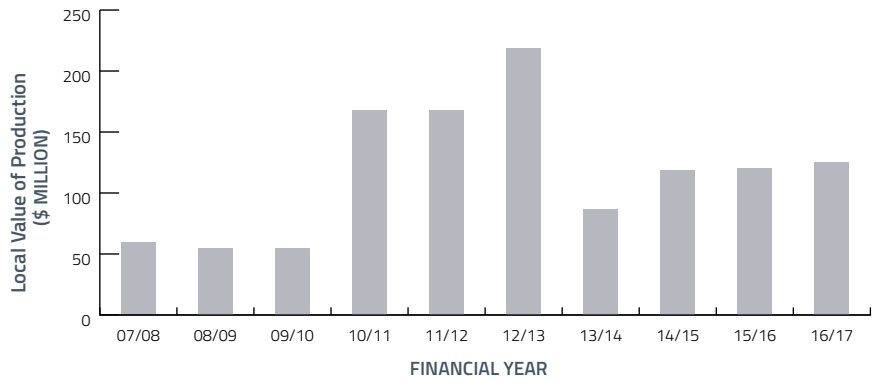
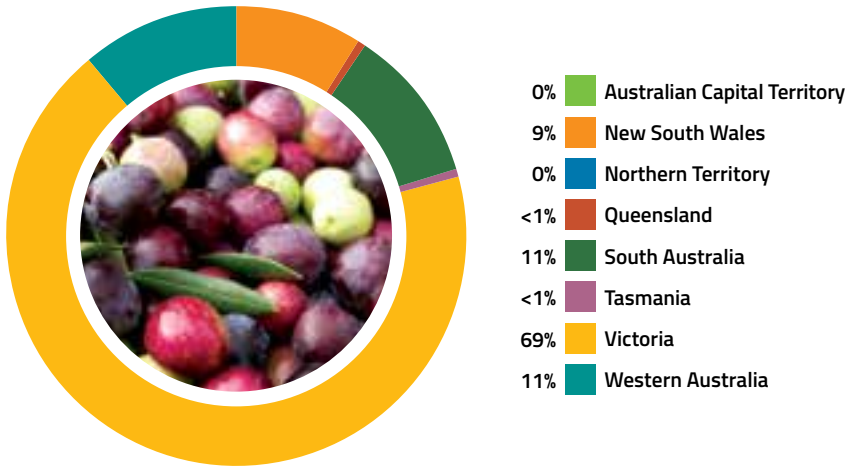


Figure 48. Distribution of olive production by state and territory, 2016–17 (based on LVP)



ONIONS

Represented by Onions Australia
onionsaustralia.org.au

In 2016–17, onion production was valued at $226 million (LVP) and fresh exports were valued at $18.1 million.

Onions are grown in most states, but SA and Tasmania together produce 71 per cent of the Australian crop. Key onion production locations are the Lockyer Valley in Queensland, north-eastern regions and the Adelaide plains of SA and the Devonport–Launceston region of Tasmania. The total area planted to onions is largest in SA, as is the average planting per farm.

The main type of onion grown in Australia is the traditional brown onion, which accounts for 79 per cent of fresh production. Onion production is during late spring, summer and autumn. Planting starts around April through September, harvesting from August to March, and storage supplies the market for the winter months.

The onion industry is covered by version 2.0 of the onion biosecurity plan. **The Onion Growers' Biosecurity Manual Version 1.0** was produced and launched in 2018.

Figure 49. Annual value of onion production, 2007–17

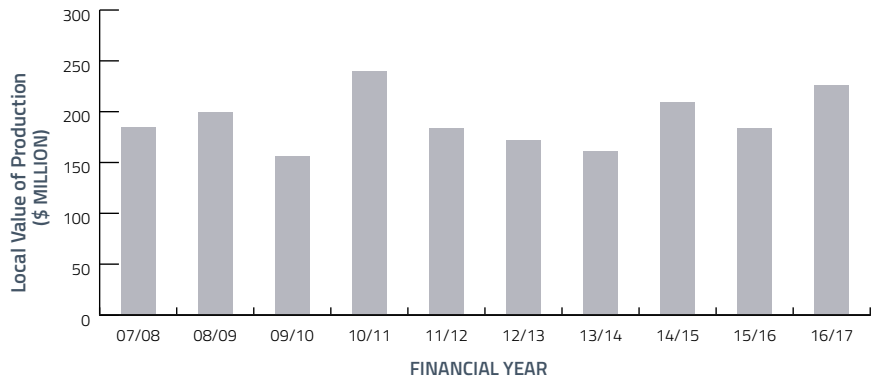
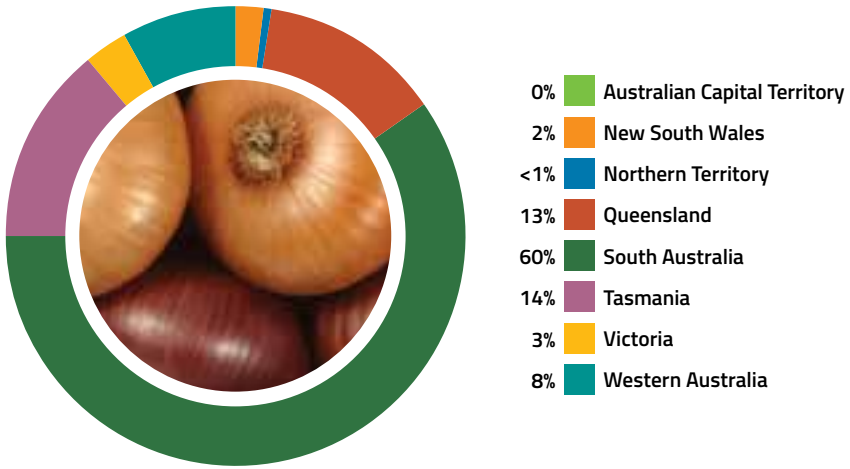


Table 29. High Priority Pests of the onion industry

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 leafminer
Phytomyza gymnostoma	Allium leafminer
Puccinia spp. (exotic species)	Rust
Rhizoglyphus callae	Bulb mite
Rhizoglyphus setosus	Bulb mite
Thrips tabaci (exotic strains, biotypes)	Onion thrip
Xanthomonas axonopodis pv. *allii*	Xanthomonas leaf blight

Figure 50. Distribution of onion production by state and territory, 2016–17 (based on LVP)



PASSIONFRUIT

Represented by Passionfruit Australia
passionfruitaustralia.org.au

In 2016–17, passionfruit production was valued at $17.2 million (LVP). There are currently around 300 hectares of passionfruit under cultivation in Australia with about 400,000 passionfruit vines. They produced 4,790 tonnes of fruit in 2017–18.

About two thirds of the Australian passionfruit crop is grown in Queensland and around one third in NSW. The industry is starting to expand in WA and there are new plantings in the NT and Victoria.

Passionfruit is grown year round, but main supply times to market are December through to September. The main purple passionfruit varieties grown are Misty Gem and Sweetheart, and the major Panama passionfruit varieties are Pandora and Panama Red. A National Breeding Programme is continuing with the goal of developing new commercial varieties in the next five years. New varieties bred in the NT designed for tropical regions are also in the process of being commercialised.

At present, there are still minimal amounts of passionfruit exported, and the industry is yet to develop a concrete plan for exports.

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

Figure 51. Distribution of passionfruit production by state and territory, 2016–17 (based on LVP)

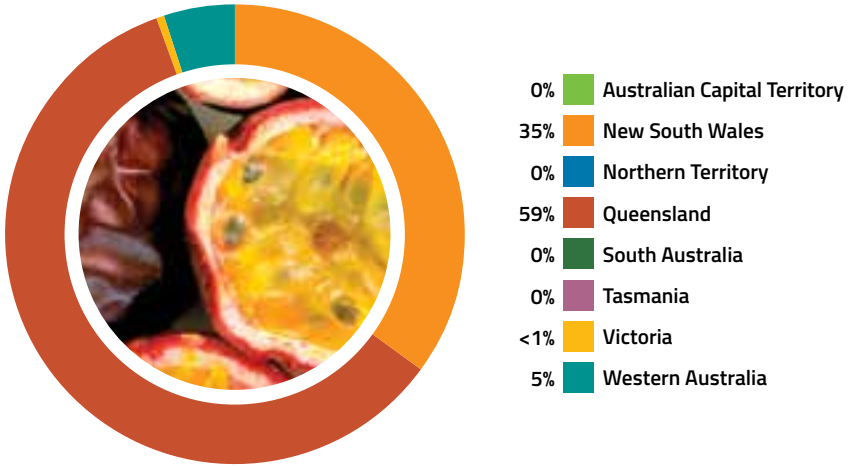


Figure 52. Annual value of passionfruit production, 2007–17

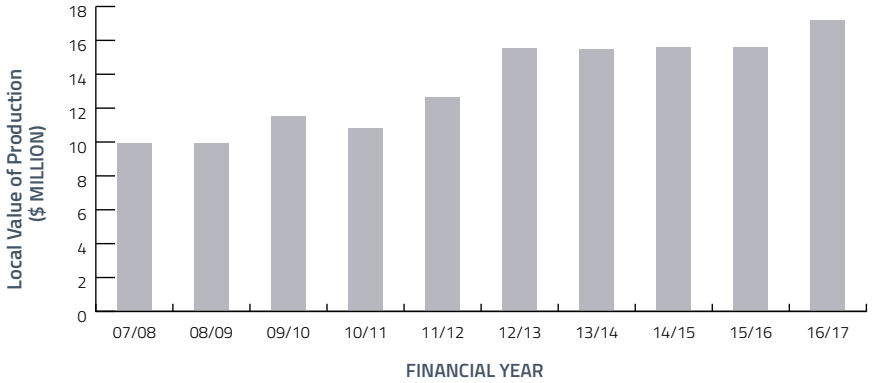


Table 30. High Priority Pests of the passionfruit industry

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 passiflorae	Fijian 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 virus
Passionfruit vein clearing virus (Rhabdovirus)	Passionfruit vein clearing virus
Passionfruit yellow mosaic virus (Tymovirus)	Passionfruit yellow mosaic virus
Xanthomonas axonopodis pv. *passiflorae*	Bacterial blight

PINEAPPLES

Represented by GROWCOM
growcom.com.au

In 2016–17, pineapple production was valued at $47.3 million (LVP). The industry estimates that around 47,500 tonnes of fresh fruit and 28,000 tonnes of processed fruit were marketed.

There are approximately 80 commercial pineapple enterprises, all but one based in Queensland. Key growing districts are in Wamuran, Elimbah, Glasshouse Mountains, Beerwah, Yandina, Mary Valley, Maryborough, Hervey Bay, Childers, Bundaberg, Cawarral, Yeppoon and northern Queensland, with one commercial farm located just outside Darwin in the NT.

Australia contributes less than one per cent of the world's fresh pineapple production but 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 45 per cent of pineapple varieties grown are Smooth Cayenne and Queen (rough leaf). The remaining 55 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 2.0 of the pineapple biosecurity plan**.

Table 31. High Priority Pests of the pineapple industry

Scientific name	Common name
Cotinis mutabilis	Fig beetle
Dickeya spp. (pineapple infecting strains) (syn. *Erwinia chrysanthemi*)	Bacterial fruit collapse, bacterial heart rot
Dysmicoccus neobrevipes	Grey pineapple mealybug, annona mealybug
Fusarium ananatum and *F. guttiforme* (syn. *Fusarium subglutinans* subsp. *ananas*)	Fusariosis, fusarium stem rot, pineapple eye rot, fruitlet core rot
Strymon megarus (as a vector of fusariosis)	Pineapple fruit borer
Thaumatotibia leucotreta (syn. *Cryptophlebia leucotreta*)	False codling moth

Figure 53. Annual value of pineapple production, 2007–17

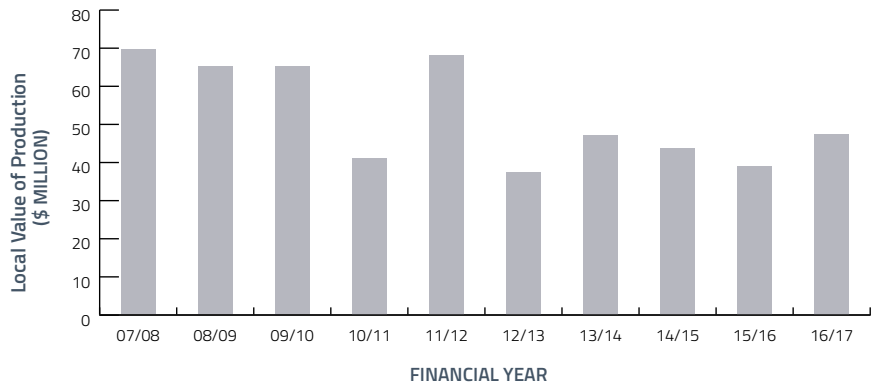
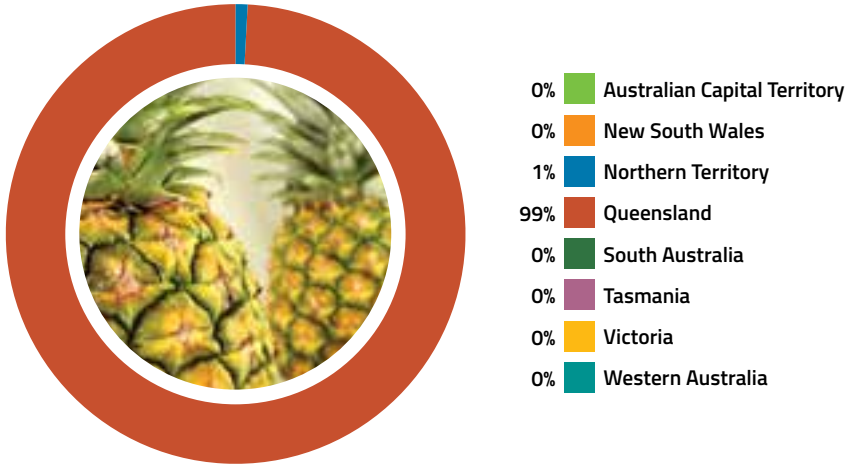


Figure 54. Distribution of pineapple production by state and territory, 2016–17 (based on LVP)



PISTACHIOS

Represented by the Pistachio Growers' Association
pgai.com.au

In 2016–17, pistachio production was valued at $19 million (LVP), with exports valued at $1.8 million. In 2018, there was 1,300 hectares under cultivation with a record 3,200 tonnes of pistachio nuts produced from the productive orchards.

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 200 hectares were planted in 2018 with 150 hectares per annum to be planted in the next three years (2019 to 2021). There are five large pistachio orchards and another five orchards of 10 to 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 five tonnes of pistachios (dry) per annum from one to five hectares.

Australian pistachio production currently meets only 50 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 4,000 tonnes (rolling average of two seasons) by 2021.

In 2018, Pistachio Growers' Association participated in Emergency Plant Pest activities, including as an affected party in the eradication response for Khapra beetle. Australia is free from major pests and diseases that affect pistachios overseas. Biosecurity is a priority for the industry, with aspects of biosecurity embedded in the Australian Pistachio Industry Five Year Strategic Plan – 2015 to 2020, and in two Hort Innovation research projects (PS16000 and PS16002). The industry is represented at PHA meetings and government Biosecurity Roundtables.

The pistachio industry is covered by **version 3.0 of the nut industry biosecurity plan**.

Table 32. High Priority Pests of the pistachio industry

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

Figure 55. Annual value of pistachio production, 2008–17

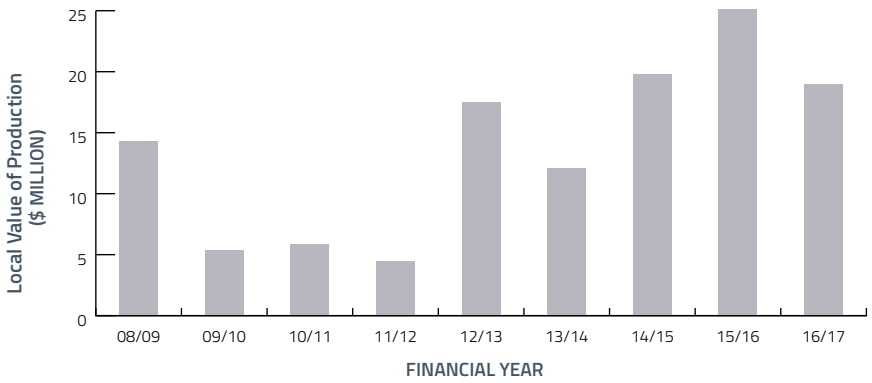
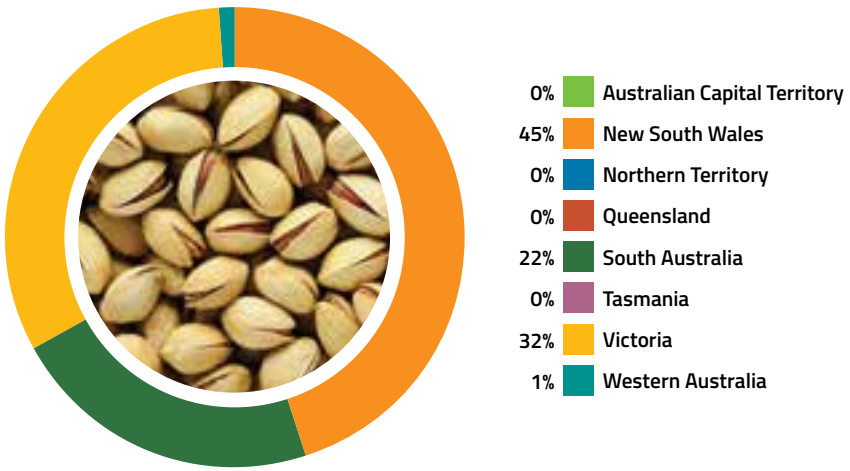


Figure 56. Distribution of pistachio production by state and territory, 2016–17 (based on LVP)



PROCESSING TOMATOES

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

In 2016–17, processing tomato production was valued at $20.6 million (LVP). 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.

Around 227,636 tonnes of tomatoes were delivered for processing during the 2017–18 season. This is a drop of about 42,954 tonnes on the previous year. While 2,457 hectares was planted, delayed harvest and rain early in the season meant 50 hectares of produce was not harvested.

Australia consumes around 553,336 tonnes of processed tomatoes, with the majority of imports coming from Italy and United States.

The processing tomatoes industry is covered by **version 1.0 of the biosecurity plan for the tomato industry**.

Table 33. High Priority Pests of the processing tomato industry

Scientific name	Common name
Achatina fulica	Giant African land snail
Bactericera cockerelli (syn. *Paratrioza cockerelli*)	Tomato potato psyllid
Candidatus Liberibacter solanacearum (with known vector)	Zebra chip
Frankliniella intonsa	Flower thrips
Liriomyza bryoniae	Tomato leafminer
Liriomyza huidobrensis	Pea leafminer, serpentine leafminer
Liriomyza sativae	Vegetable leafminer, American leafminer
Liriomyza trifolii	American serpentine leafminer
Tuta absoluta	South American tomato moth or tomato leafminer

Figure 57. Annual value of processing tomato production, 2007–17

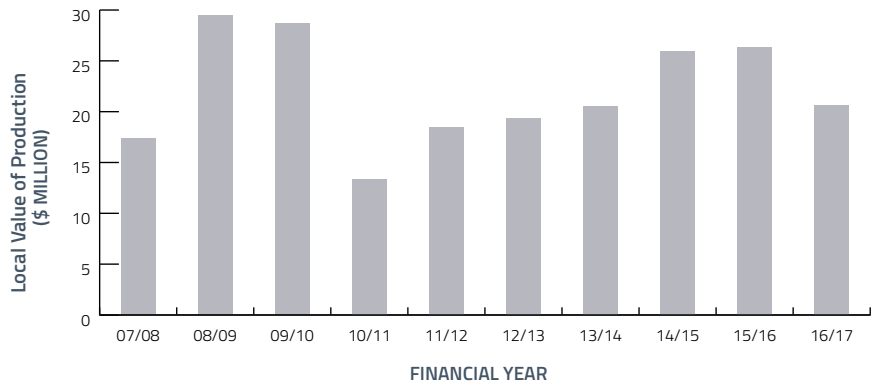


Figure 58. Distribution of processing tomato production by state and territory, 2016–17 (based on LVP)

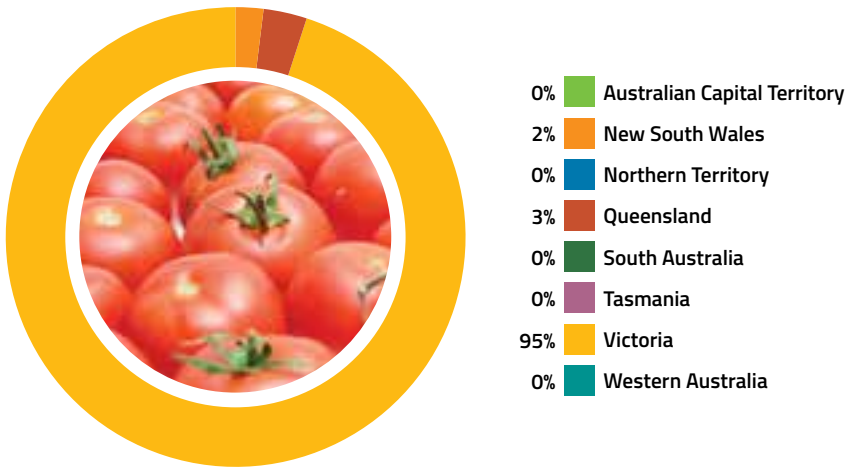


Image courtesy of Nursery and Garden Industry Australia

PRODUCTION NURSERIES

Represented by Nursery & Garden Industry Australia (NGIA)
ngia.com.au

In 2016–17, nursery production (propagation stock, vegetable and forestry seedlings, bedding plants, indoor plants, fruit and landscape trees and shrubs) was valued at $992 million (LVP). The industry has a limited export focus of approximately $18 million annually, however there is ample opportunity for international export growth.

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 2019 across the entire supply chain. NGIA supplies to ornamental retail, landscape, revegetation, rehabilitation and production horticulture sectors including tree crops (e.g. fruit, vines, tea tree), vegetables, forestry and cut flowers with a combined annual production value of more than $15 billion.

In 2016, NGIA developed the Nursery Production Farm Management System website **nurseryproductionfms.com.au** which is the one-stop shop for industry biosecurity information for growers including access to pest fact sheets, management plans, videos and the eLearning portal.

In early 2018, NGIA achieved certification and BioSecure HACCP recognition as an Approved Biosecurity Scheme under the Queensland *Biosecurity Act 2014*, the first such recognition of an industry program in Australia. This was followed by NSW providing equivalent certification under the NSW *Biosecurity Act 2015* in late December 2018.

NGIA continues to work in partnership with state and territory governments on the roll out of BioSecure HACCP, with legal recognition for market access achieved in Queensland, NSW, Victoria, Tasmania, SA and WA by the end of 2017. This allows certified producers to self-certify consignments of nursery stock for interstate market access.

The industry has invested in excess of $5.5 million in biosecurity focused projects including the:

- National Nursery Industry Biosecurity Program (four themes: on-farm biosecurity, biosecurity preparedness, biosecurity awareness and pesticide minor use program) (2015–20)
- Improving Pest Management for the Nursery Industry (2018–20)
- Building the Resilience and On-Farm Biosecurity Capacity of the Australian Production Nursery Industry (2015–20) project continues to develop plant biosecurity resources and to upskill industry members and expand knowledge. For example, extension videos covering topics such as site surveillance, intake inspection and crop monitoring have been developed with NGIA and PHA working together since 2016 to produce six to eight new biosecurity videos annually through to 2019.

The industry continues to build the online electronic plant pest identification resource Pest ID Tool **pestid.com.au** which combines information and images on endemic and key exotic plant pests that impact on production or trade.

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

Figure 59. Annual value of production nurseries, 2007–17

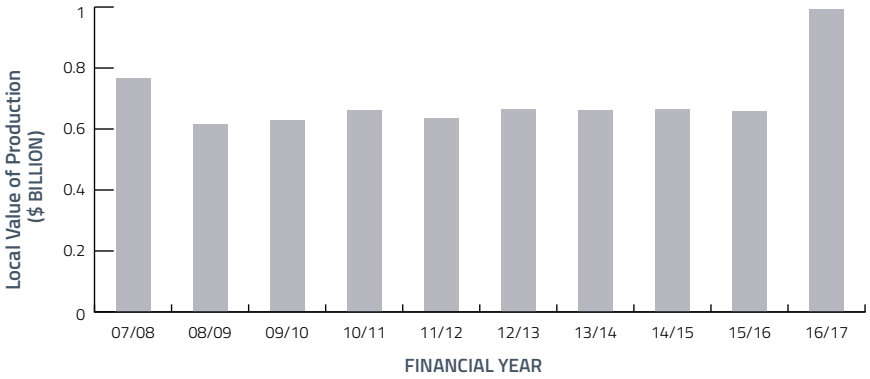


Figure 60. Distribution of production nurseries by state and territory, 2016–17 (based on LVP)

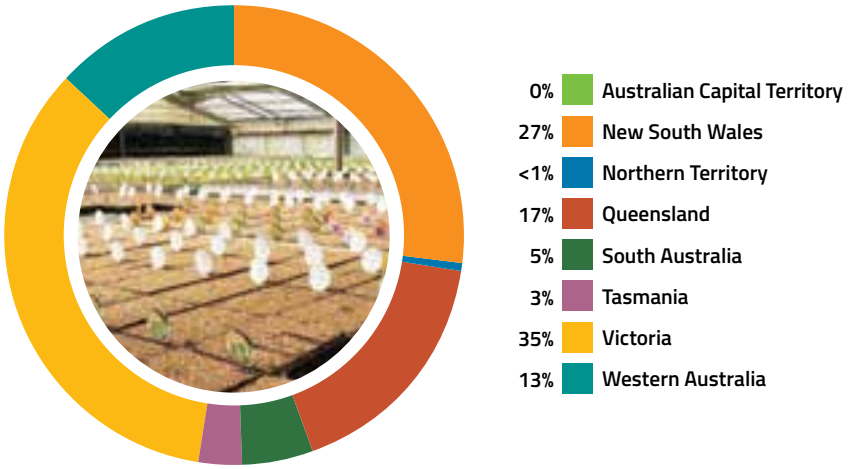


Table 34. High Priority Pests of the production nursery industry

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 thrip
Homalodisca vitripennis	Glassy winged sharpshooter
Lettuce infectious yellows virus (Crinivirus)	Lettuce infectious yellows virus
Liriomyza huidobrensis	Serpentine leafminer
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

Vincas in a green house. Image courtesy of Nursery and Garden Industry Australia

RICE

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

In 2016–17, rice production was valued at $230 million (LVP), with the export value an estimated $149 million.

Most of Australia's rice is exported to Asia, the Middle East, and nations in the Pacific. Market analysis indicates that there is demand across all market segments, both domestic and international, for one million tonnes of paddy production annually.

The Australian rice industry is predominantly located in the temperate climatic region of the Riverina in southern NSW, with a small amount grown in northern NSW and an emerging production area in north Queensland and NT. In the Riverina, the major varieties grown are temperate Japonica varieties planted in October to November and harvested from March to May of the following year.

The rice industry is conducting research into suitable varieties and management techniques to maximise water efficiency and allow production in north Queensland. Strict biosecurity measures have been put in place to ensure that any pests endemic in northern Australia are not spread south to the major rice growing area in NSW. However, there is new concern about what appears to be a relaxing of biosecurity protocols relating to importing of seed into Australia.

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

Table 35. High Priority Pests of the rice industry

Scientific name	Common name
Lissorhoptrus oryzophilus	Rice water weevil
Magnaporthe grisea	Rice blast
Pomacea cancliculata	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 rungro bacilliform virus
Rice tungro spherical virus (Waikavirus)	Rice tungro spherical virus, waikavirus
Tilletia barclayana	Kernel smut of rice
Tilletia indica	Karnal bunt
Trogoderma granarium	Khapra beetle

Figure 61. Annual value of rice production, 2007–17

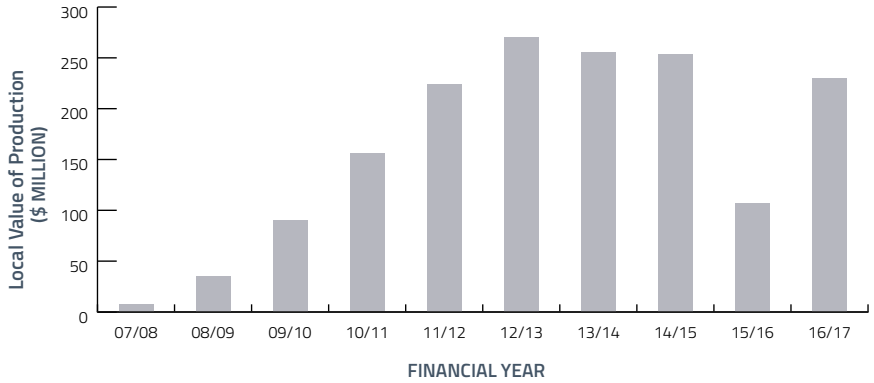
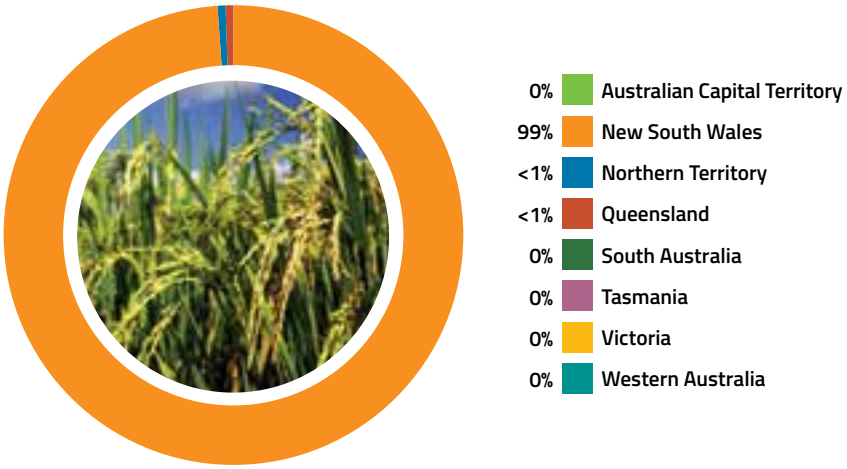


Figure 62. Distribution of rice production by state and territory, 2016–17 (based on LVP)



RUBUS

Represented by Raspberries and Blackberries Australia (RABA)

In 2016–17, the rubus industry was valued at $116 million (LVP). Raspberry, blackberry and hybrid brambles (including silvanberries, boysenberries, loganberries, youngberries and marionberries) are collectively referred to as rubus or cane berries.

There are currently up to 700 hectares of land under cultivation with rubus varieties, much of it under protected cropping (rain shelters). New plantings continue, with the industry expanding in response to consumer demand. Production is also developing in new areas such as north of Perth in WA.

Peak production is early summer to autumn. Year round supply is possible with production in subtropical areas such as south-east Queensland and the mid-north coast of NSW where harvest occurs late autumn to spring. The increased use of protected cropping and hydroponic systems also extends the harvest season and productivity.

Most of the raspberries, blackberries and brambleberries produced in Australia are consumed locally with little export of fresh fruit (less than one per cent). Berries that are exported are sent to non-protocol markets such as Singapore and Hong Kong. In the year to June 2018, the majority of exports were to India and Fiji.

The rubus industry is covered by **version 1.0 of the biosecurity plan for the rubus industry**. RABA signed the Emergency Plant Pest Response Deed agreement in June 2015 and is consulting with growers on a proposal to establish a PHA levy to fund membership and an Emergency Plant Pest Response levy (set at zero).

Table 36. High Priority Pests of the rubus industry

Scientific name	Common name
Arthurimyces peckianus	Orange rust (long-cycled)
Cercosporella rubi	Rosette
Drosophila suzukii	Spotted wing drosophila
Euschistus conspersus	Consperse stinkbug
Halyomorpha halys	Brown marmorated stink bug, yellow-brown stink bug
Heterocrossa rubophaga	Raspberry bud moth
Penniseta hylaeiformis	Raspberry clearwing moth
Penniseta marginata	Raspberry crown borer
Popillia japonica	Japanese beetle

Figure 63. Annual value of rubus production, 2009–17

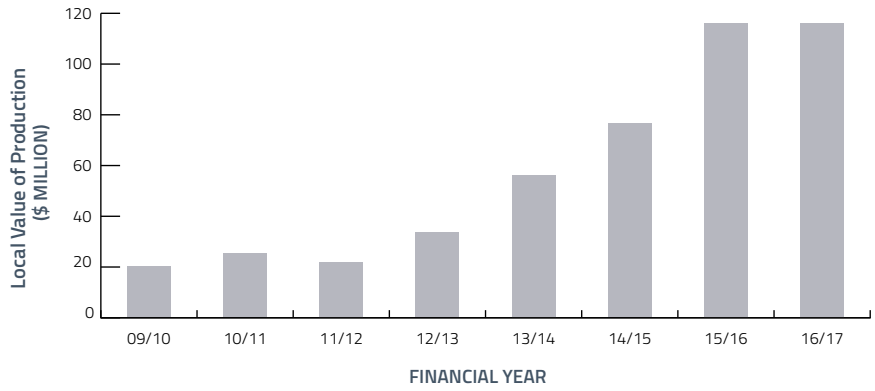
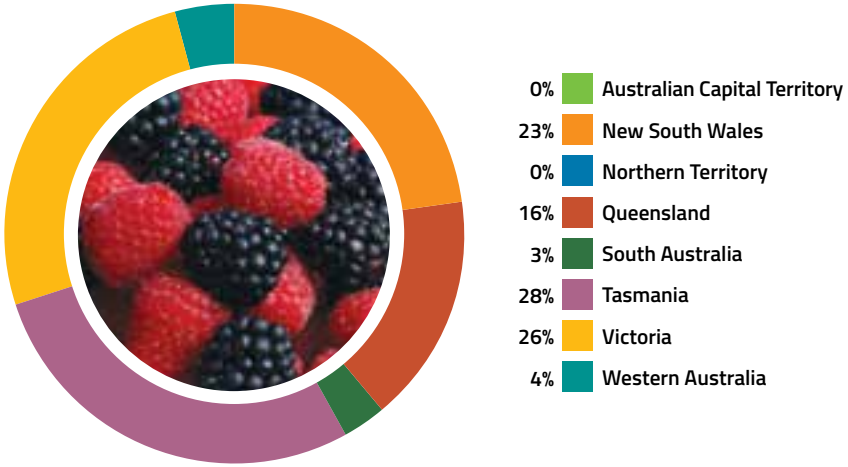


Figure 64. Distribution of rubus production by state and territory, 2016–17 (based on LVP)



STONE FRUIT

Represented by Summerfruit Australia
summerfruit.com.au

In 2016–17, stone fruit production (fresh apricots, nectarines, peaches and plums) was valued at $189 million (LVP), with exports valued at $51.4 million. Nectarines and peaches comprised two thirds of national stone fruit production, followed by plums and apricots.

Production is mainly located in subtropical and temperate Australia where the industry is a major rural and regional employer. Victoria produces around 75 per cent of Australia's stone fruit (in the order of 1,350,000 tonnes nationally) with the remaining production spread between NSW, Queensland, SA, WA and Tasmania.

Market access to mainland China for nectarines (in May 2016) and apricots, peaches and plums (in November 2017) has allowed an expansion of exports. During the 2017–18 export season, 17,785 tonnes were exported (an increase of 27%), with 8,293 tonnes going to China and Hong Kong. Other major markets were United Arab Emirates, Saudi Arabia, Singapore and Malaysia.

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 37. High Priority Pests of the stone fruit industry

Scientific name	Common name
Bactrocera cucurbitae	Melon fruit fly
Bactrocera dorsalis	Oriental fruit fly
Candidatus Phytoplasma prunorum*	European stone fruit yellows
Conotrachelus nenuphar	Plum curculio
Cryptophlebia leucotreta	False codling moth
Cydia funebrana	Plum fruit moth
Drosophila suzukii	Spotted wing drosophila
Homalodisca vitripennis	Glassy winged sharpshooter
Monilinia fructigena	Brown rot
Monilinia 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

* Previously called European stone fruit yellows phytoplasma

Figure 65. Annual value of stone fruit production, 2007–17

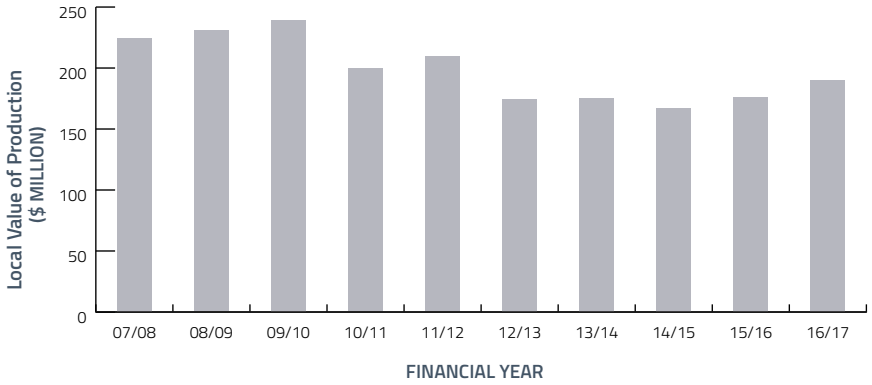
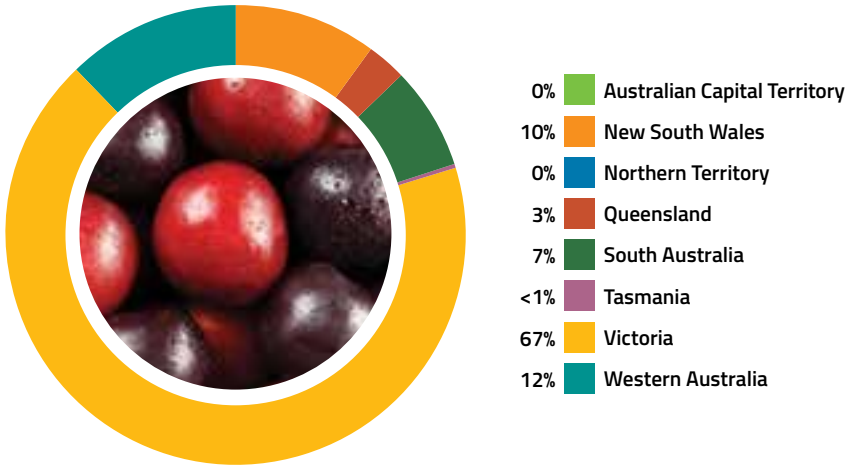


Figure 66. Distribution of stone fruit production by state and territory, 2016–17 (based on LVP)



STRAWBERRIES

Represented by Strawberries Australia
strawberriesaustralia.com.au

In 2016–17, strawberry production was valued at $250 million (LVP) and exports were valued at $32.6 million. Strawberries are grown in all states of Australia (except the ACT and NT) by an estimated 500 growers.

Production is concentrated in the Sunshine Coast area of Queensland, and the Yarra Valley and the Mornington Peninsula in Victoria, with other production areas in Wannaroo, Bullsbrook and Albany in WA; the Adelaide Hills in SA; and Tasmania.

Strawberries are grown in Australia throughout the year, with production in subtropical regions from May to October, and in temperate regions from October to June.

In temperate regions varieties grown are predominantly from California, with some Australian bred varieties, while in subtropical regions Australian bred varieties are increasingly being grown, with some varieties imported from Florida, United States. There is continued industry investment in a national breeding program, and in the 2017–18 season approximately 30 per cent of all varieties grown nationally were bred in Australia.

The industry is primarily focused on the domestic market with 3–3.5 per cent of produce exported. In the year to June 2018, the main export markets were United Arab Emirates, Singapore and New Zealand. The increase in production over recent years is due primarily to rising per capita consumption, driven by higher planting numbers, improved Australian varieties and better cool chain management.

The strawberry industry is covered by **version 2.0 of the biosecurity plan for the strawberry industry**. Strawberries Australia are also a signatory to the Emergency Plant Pest Response Deed.

Table 38. 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 67. Annual value of strawberry production, 2007–17

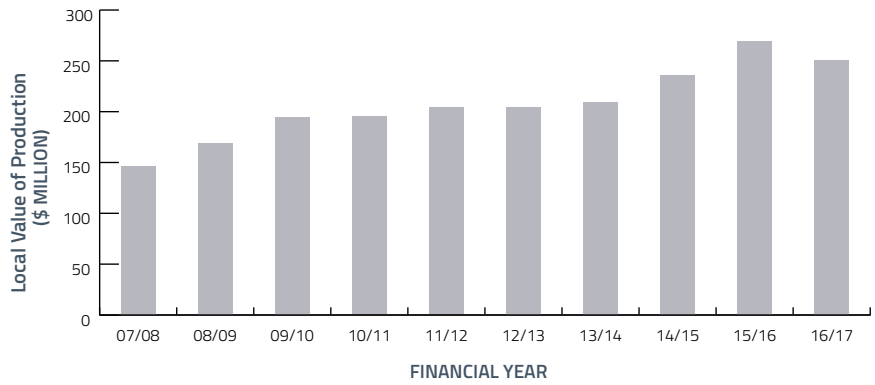
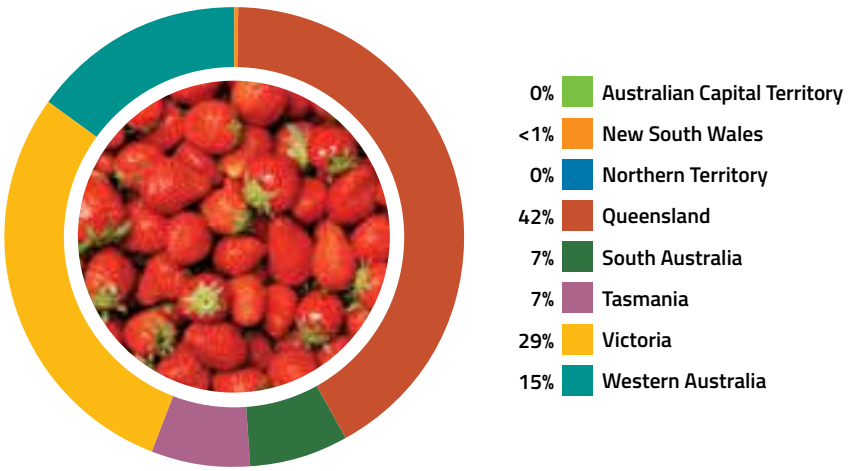


Figure 68. Distribution of strawberry production by state and territory, 2016–17 (based on LVP)



SUGARCANE

Represented by CANEGROWERS
canegrowers.com.au

In 2016–17, sugarcane production was valued up to $1.6 billion. The industry produced 31.5 million tonnes of cane, and 4.41 million tonnes of processed 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 3.0 of the sugarcane biosecurity plan and the **Biosecurity Manual for Sugarcane Producers 1.0**.

Figure 69. Annual value of sugarcane production, 2007–17

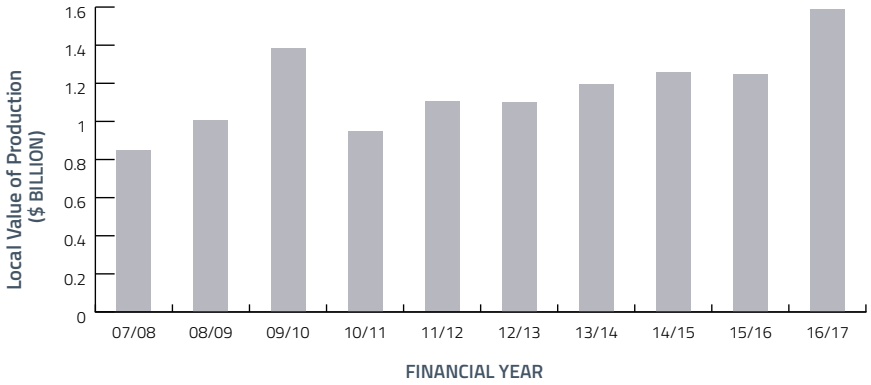


Figure 70. Distribution of sugarcane production by state and territory, 2016–17 (based on LVP)

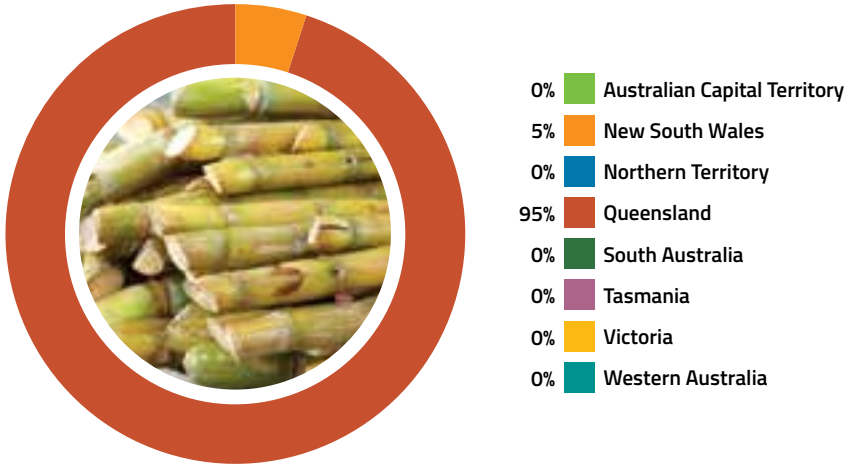


Table 39. High Priority Pests of the sugarcane industry

Scientific name	Common name
Aleurolobus barodensis	Sugarcane whitefly
Ceratovacuna lanigera	Sugarcane woolly aphid
Chilo auricilius	Sugarcane internode borer
Chilo infuscatellus	Yellow top borer of sugarcane
Chilo sacchariphagus	Sugarcane internode borer
Chilo terrenellus	Dark headed rice borer
Chilo tumidicostalis	Spotted sugarcane stem borer
Eldana saccharina	African sugarcane stalkborer
Eumetopina flavipes	Sugarcane leafhopper (as a vector of ramu stunt disease)
Grassy shoot phytoplasma	Grassy shoot (with unknown vector)
Perkinsiella vastatrix	Sugarcane planthopper (as a vector of Fiji leaf gall disease)
Perkinsiella vitiensis	Sugarcane planthopper (as a vector of Fiji leaf gall disease)
Peronosclerospora philippinensis	Downy mildew
Peronosclerospora sacchari	Downy mildew
Polyocha depressella	Root borer
Pyrilla perpusilla	Sugarcane pyrilla
Scirpophaga excerptalis	Top borer
Sesamia grisescens	Pink stalk borer
Stagonospora sacchari	Leaf scorch
Sugarcane streak mosaic virus (Potyvirus)	Sugarcane streak mosaic virus
Suspected virus (Tenuivirus)	Ramu stunt (with vector)
White leaf phytoplasma	White leaf (with vector *Matsumuratettix hiroglyphicus*)
Xanthomonas albilineans (exotic strains, serological groups 2 or 3)	Leaf scald

SWEETPOTATOES

Represented by Australian Sweetpotato Growers
aspg.com.au

In 2016–17, sweetpotato production was valued at $93 million (LVP) with exports valued at $1.8 million. Sweetpotatoes are available all year round in Australia with total production of around 100,000 tonnes. There are around 80 commercial producers with farm sizes ranging from 10 to 200 hectares, with most in the 15–80 hectare range.

Queensland is the biggest producer with over 87 per cent of production, mainly around Bundaberg. The second major production area is around Cudgen in northern NSW. Sweetpotatoes are also grown in Mareeba, Atherton and Rockhampton in Queensland; Murwillumbah in NSW; and Perth, Carnarvon and Kununurra in WA.

Three types of sweetpotato are grown in Australia, categorised by skin and flesh colour. The gold variety (rose-gold skin, gold flesh) dominates the Australian sweetpotato industry with over 90 per cent of production. Red category (red skin, white flesh) makes up around eight per cent, with purple (white skin, purple flesh) making up the remainder. The majority of sweetpotato production is consumed domestically with under one per cent exported.

Commercial growers purchase pathogen-tested planting material every year, a measure that has almost doubled marketable yield per hectare. The pathogen testing scheme is reinforced by industry supported research into virus (and other disease) diagnostics and management, as well as enhancing effective distribution and multiplication of clean planting material.

The sweetpotato industry became a signatory to the Emergency Plant Pest Response Deed in late 2017 and has started to develop a national biosecurity plan.

Sweet potato seedbed. Image courtesy of John Maltby, Australian Sweetpotato Growers

Figure 71. Annual value of sweetpotato production, 2011–17

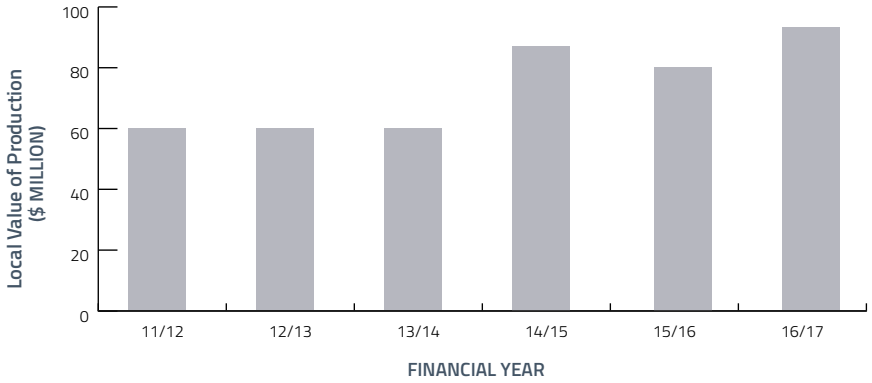


Figure 72. Distribution of sweetpotato production by state and territory, 2016–17 (based on LVP)

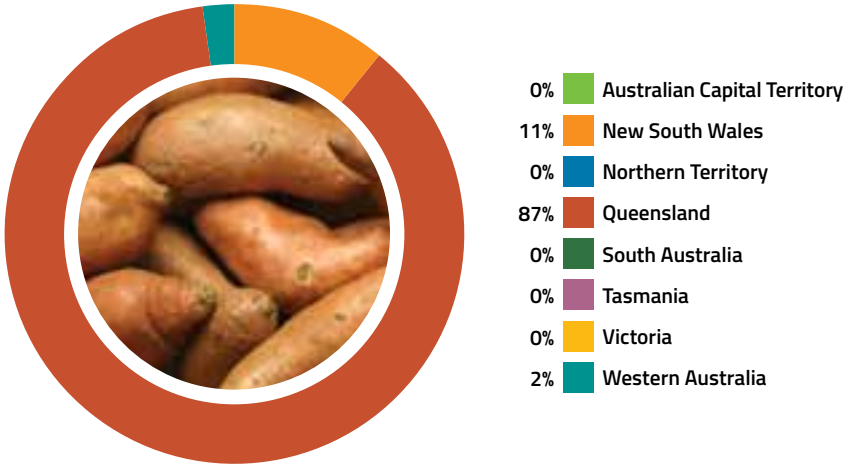


TABLE GRAPES

Represented by the Australian Table Grape Association
australiangrapes.com.au

In 2016–17, table grape production was valued at $450 million (LVP).

In the 12 months ending June 2018, the table grape industry exported 110,281 tonnes, valued at $384 million which was 3 per cent higher than the previous year.

Green, red and blue-black varieties of table grapes are produced by approximately 1,000 growers in the major growing regions of Sunraysia and the Murray Valley in Victoria; the Riverland in SA; Swan Valley, Carnarvon and Geraldton regions of WA; the south-east of Queensland; and Ti Tree in the NT.

In the past three years, there has been a significant expansion in the table grape sector, with both new landholders investing in existing table grape properties, and non-productive land in the Sunraysia region being redeveloped into table grape vineyards and packing shed facilities.

The 2018–19 season is forecast to see approximately 185,000 tonnes produced, with a 40:60 split between the domestic and export markets.

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

Table 40. High Priority Pests of the table grape industry

Scientific name	Common name
Bactrocera carambolae	Carambola fruit fly
Bactrocera dorsalis	Oriental fruit fly
Candidatus Phytoplasma solani	Bois noir
Daktulosphaira vitifoliae (exotic strains)	Grapevine phylloxera
Drosophila suzukii	Spotted wing drosophila
Grapvine flavescence doree phytoplasma	Flavescence doree
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 disesase

Figure 73. Annual value of table grape production, 2007–17

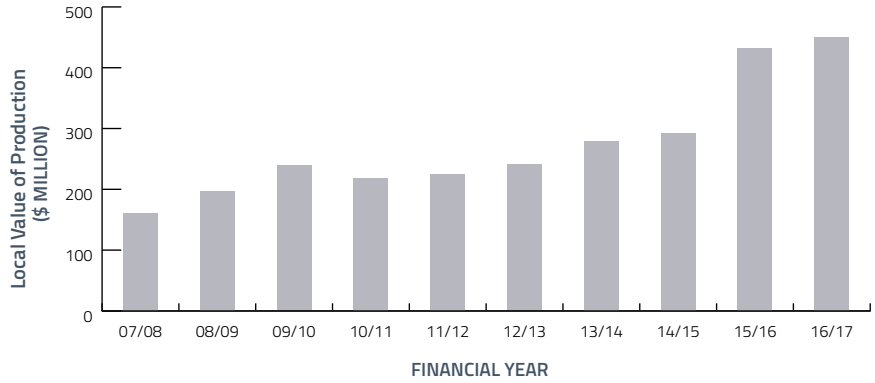
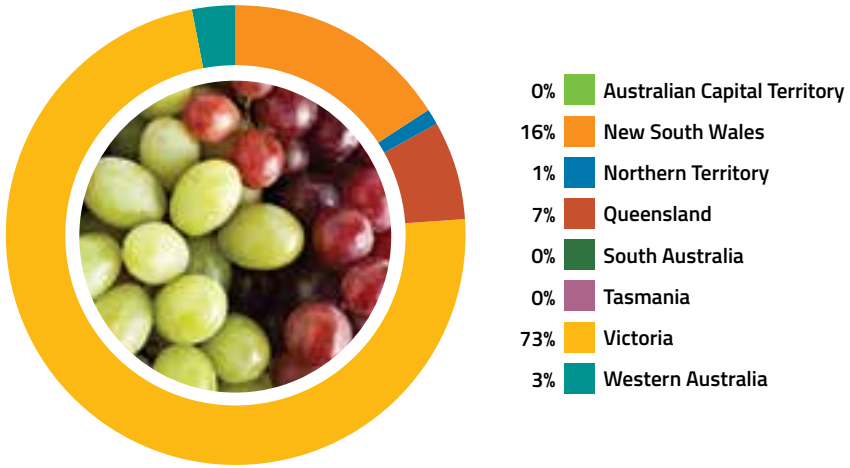


Figure 74. Distribution of table grape production by state and territory, 2016–17 (based on LVP)



TEA TREE

Represented by the Australian Tea Tree Industry Association (ATTIA)
teatree.org.au

In 2016–17, tea tree production was valued at $30 million (LVP). The vast majority (90%) is exported through an established supply chain to over 70 countries, particularly North America and Europe.

In 2018, there were about 130 tea tree growers in Australia and about 4,500 hectares under plantation production. Industry growth has stabilised, with average annual production of 1,000 tonnes of oil.

The main product of the Australian tea tree industry is tea tree oil, which is steam distilled from *Melaleuca alternifolia*, an iconic Australian native plant species. Nearly all Australian tea tree oil production is sourced from plantations. Most plantations (three quarters) are located in the coastal region of northern NSW with 10 per cent located in the Atherton Tablelands of Queensland.

Tea tree oil is exported as bulk oil which is used to make value-added products including healthcare, cosmetic, pharmaceutical, veterinary and aromatherapy products.

Domestic consumption is estimated to be around 95,000 kg per annum with much of this also destined for the export market as value-added cosmetic and therapeutic goods such as soap, shampoo, burn dressings as well as tea tree oil.

The tea tree industry has partnered with AgriFutures Australia on industry RD&E since 1998. The industry established an Emergency Plant Pest Response levy which commenced in July 2017.

In 2017, ATTIA became a member of PHA and a tea tree biosecurity plan is being developed, which will identify the High Priority Pests of the industry.

Figure 75. Annual value of tea tree production, 2009–17

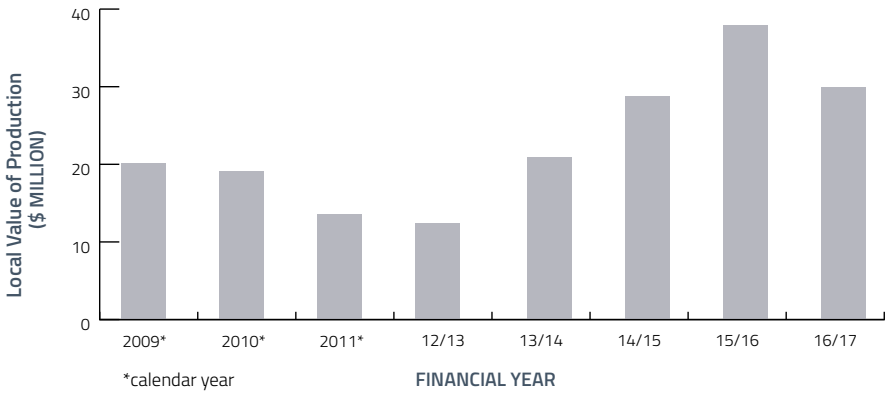
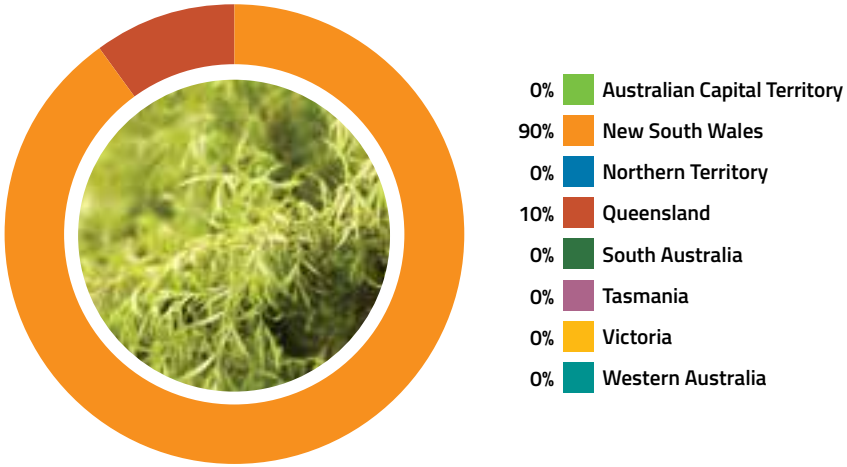


Figure 76. Distribution of tea tree production by state and territory, 2016–17 (based on LVP)



TRUFFLES

Represented by the Australian Truffle Growers' Association
trufflegrowers.com.au

In 2016–17, truffle production was estimated to be valued at $12 million (LVP). The majority of the harvest is exported to 30 different countries, but mainly to Europe, the United States and Asia.

There are some 350 owners of truffle orchards, or truffières, around the country, of which around half have harvested truffles. The Australian Truffle Growers' Association has 120 members across the truffle growing states.

Since the first truffle was harvested in 1999, Australia has become the fourth largest producer of the Périgord black truffle (*Tuber melanosporum*) in the world. The major production area for Australian truffles is the Manjimup region of WA, which accounts for around 80 per cent of the harvest. There is increasing production in Tasmania, ACT, NSW and Victoria.

Australian *T. melanosporum* are recognised for their excellent quality and are highly sought after in overseas markets, particularly in the northern hemisphere, where our produce is available when local product is out of season.

There are another three species of black truffle with limited production in Australia, namely *T. brumale*, *T. aestivum* and *T. uncinatum*. More recently several white truffle species have been found, including *T. maculatum*, *T. puberulum* and *T. dryophilum*. Commercial production of a species of white truffle, *T. borchii*, has commenced, principally in Victoria.

Version 1.0 of the truffle industry biosecurity plan was published in 2016.

Table 41. High Priority Pests of the truffle industry

Scientific name	Common name
Halyomorpha halys	Brown marmorated stink bug
Lymantria monacha	Nun moth
Anisogramma anomala	Eastern filbert blight
Phytophthora ramorum	Sudden oak death
Pseudomonas avellanae (syn. *P. syringae* pv. *avellanae*)	Bacterial canker
Pucciniastrum coryli	Hazelnut rust

Figure 77. Annual value of truffle production, 2012–17

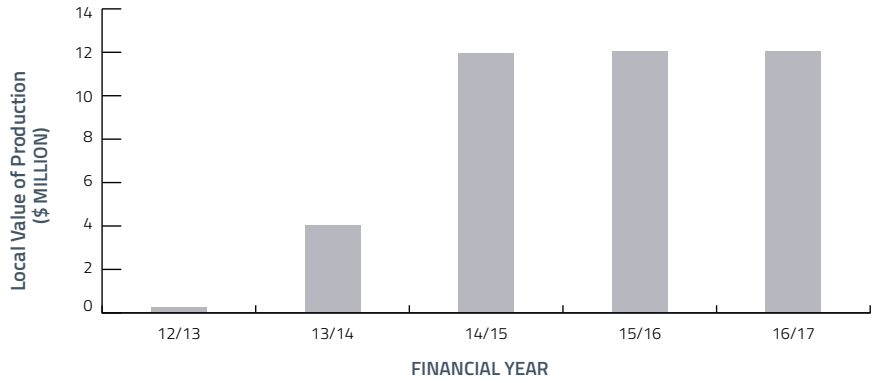
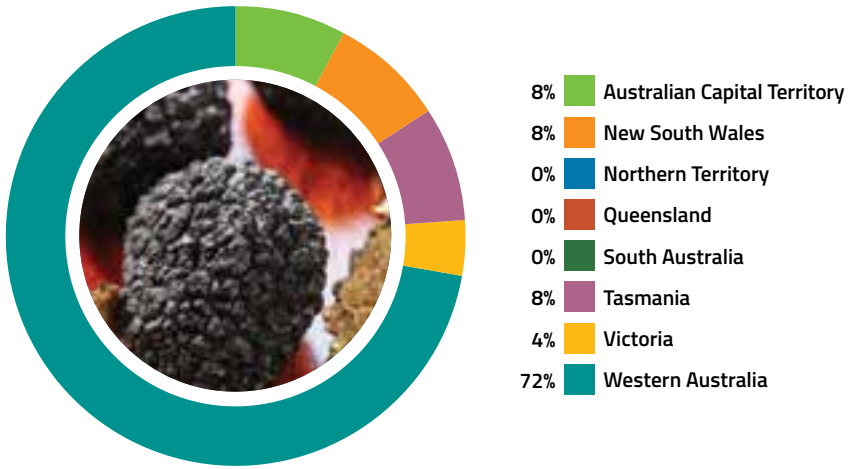


Figure 78. Distribution of truffle production by state and territory, 2016–17 (based on LVP)



VEGETABLES (INCLUDING POTATOES)

Represented by AUSVEG
ausveg.com.au

In 2016–17, gross vegetable and potato production was valued at $2.2 billion. Major crops include potatoes, carrots and lettuce. Potato production alone was valued at $510 million. Exports of vegetables, including potatoes, were worth $192 million.

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. A vegetable Industry Biosecurity Advisor, two full-time farm biosecurity officers, and a potatoes pest surveillance project officer allow the industry to participate in a range of biosecurity initiatives.

During 2018, the farm biosecurity officers visited a number of growing regions across Australia and held a series of biosecurity awareness seminars. Farm biosecurity planning resources have been reviewed and updated to reflect industry needs.

Other biosecurity initiatives include participation in technical meetings with the Department of Agriculture and Water Resources as well as engagement with other government departments, committees, bodies and PHA.

This year, graphs of the annual value of production for vegetables and potatoes are presented separately, as are the lists of High Priority Pests.

The Australian vegetable industry is covered by version 3.0 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**.

The potato industry is covered by version 2.0 of the potato biosecurity plan. In 2018, the **Potato Growers' Biosecurity Manual Version 1.0** was developed by PHA in consultation with AUSVEG.

Figure 79. Annual value of vegetable production (excluding potatoes), 2007–17

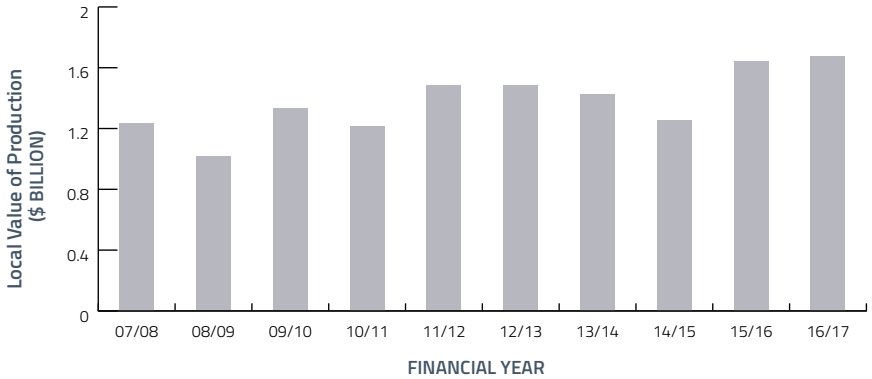


Figure 80. Distribution of vegetable production (excluding potatoes) by state and territory, 2016–17 (based on LVP)

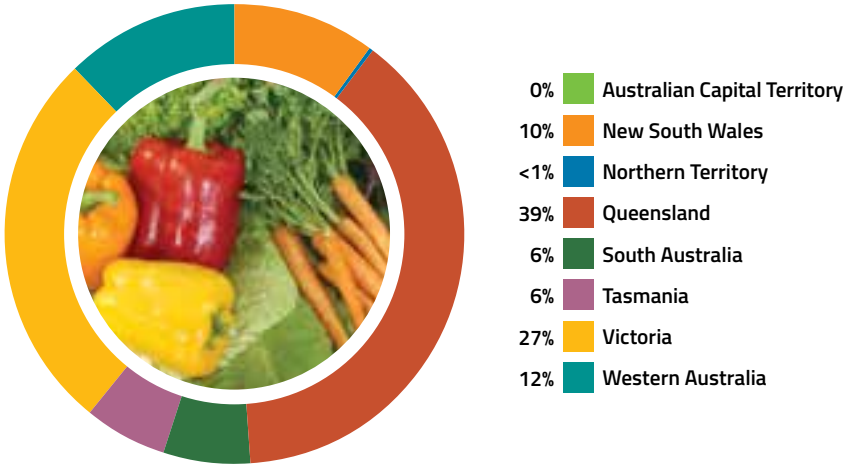


Table 42. High Priority Pests of the vegetable industry (excluding potatoes)

Scientific name	Common name
Achatina achatina	Giant African snail
Alternaria humicola	Leaf spot
Aphis fabae	Black bean aphid
Aulacophora foveicollis	Red pumpkin beetle
Bactrocera carambolae	Carambola fruit fly
Bactrocera cucurbitae	Melon fruit fly
Bactrocera dorsalis	Oriental fruit fly
Bactrocera passiflorae	Fijian fruit fly
Bactrocera trivialis	New Guinea fruit fly
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
Candidatus Liberibacter solanacearum (syn. *Candidatus* Liberibacter psyllaurous)	Zebra chip
Colletotrichum higginsianum	Anthracnose
Colletotrichum lentis (lentil affecting strain)	Lentil anthracnose, soybean anthracnose
Delia antiqua	Onion fly
Delia floralis	Summer cabbage fly
Delia florilega	Bean seed fly
Eumerus strigatus	Lesser bulb fly
Groundnut bud necrosis virus (Tospovirus)	Bud necrosis disease
Halyomorpha halys	Brown marmorated stink bug
Harpophora maydis (syn. *Cephalosporium maydis, Acremonium maydis*)	Late wilt
Heterodera carotae	Carrot cyst nematode
Heterodera ciceri	Chickpea cyst nematode
Lissachatina fulica (syn. *Achatina fulica*)	Giant African land snail
Liriomyza bryoniae	Tomato leafminer
Liriomyza huidobrensis	Serpentine leafminer
Liriomyza sativae	Vegetable leafminer
Liriomyza trifolii	American serpentine leafminer
Lygus hesperus	Western tarnished plant bug
Meloidogyne enterolobii (syn. *Meloidogyne mayaguensis*)	Root knot nematode
Meloidogyne naasi	Barley root knot nematode
Phytomyza gymnostoma	Allium leafminer
Phytophthora infestans (A2 mating type and exotic strains of A1 mating type)	Late blight
Psila rosae	Carrot rust fly
Puccinia agrophila	No common name
Puccinia opizii	Lettuce rust
Puccinia spp. (exotic species)	Rust
Rhizoctonia solani f. sp. *sasakii* (AG1) (teleomorph: *Corticium sasakii* (syn. *Thanatephorus cucumeris*))	Banded leaf and sheath spot
Rhizoglyphous setosus	Bulb mite
Thaumatotibia leucotreta (syn. *Cryptophlebia leucotreta*)	False codling moth
Trichoplusia ni	Cabbage looper
Tuta absoluta	South American tomato moth
Uromyces lineolatus	Rust
Watermelon bud necrosis virus (Tospovirus)	Watermelon bud necrosis

Figure 81. Annual value of potato production, 2007–17

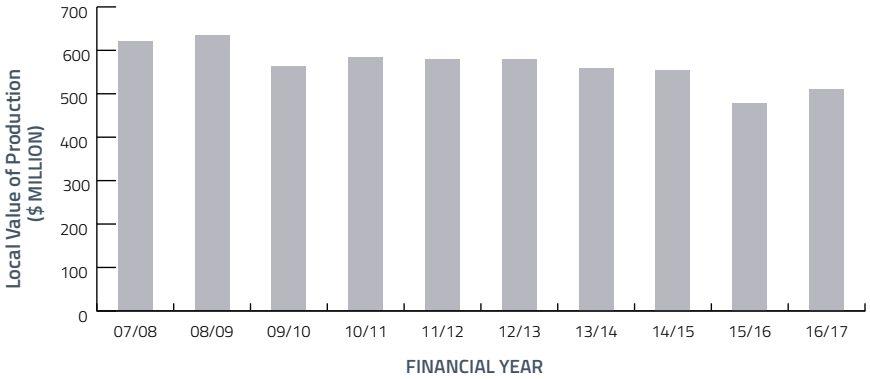


Figure 82. Distribution of potato production by state and territory, 2016–17 (based on LVP)

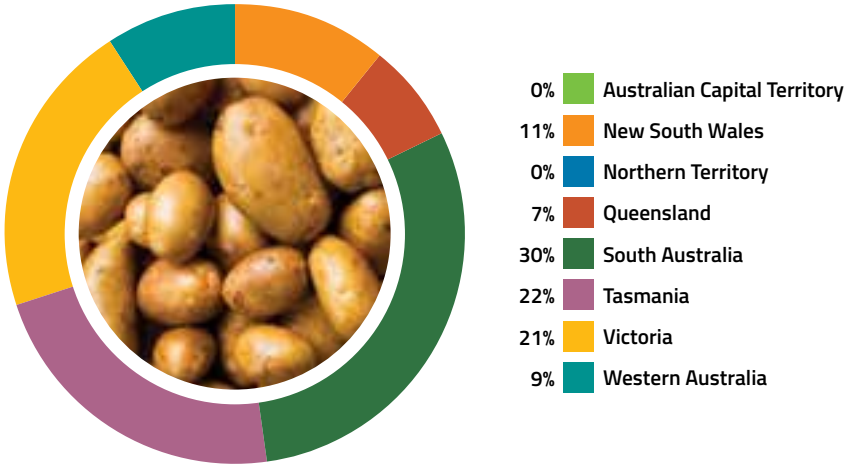


Table 43. High Priority Pests of the potato industry

Scientific name	Common name
Bactricera cockerelli (syn. *Paratrioza cockerelli*)	Tomato potato psyllid
Candidatus Liberibacter solanacearum (syn. *Candidatus* Liberibacter psyllaurous)	Zebra chip
Globodera pallida (pathotypes PA1, PA2)	Potato cyst nematode (white or pale)
Globodera rostochiensis (exotic strains)	Potato cyst nematode (golden)
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
Ralstonia solanacearum (exotic strains)	Bacterial wilt

WALNUTS

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

In 2016–17, the walnut industry was valued at $55 million (LVP), with exports valued at $15.1 million. In-shell production of 11,700 tonnes was produced from 3,600 hectares. The industry is predicted to expand to 14,000 tonnes (4,300 hectares) by 2021 as current growers expand their orchards and new growers enter the industry.

The Australian walnut industry operates in most states of Australia. Major walnut production areas are on the east coast of Tasmania; the Goulburn Valley near Shepparton, the Murray Irrigation area near Kerang and Swan Hill in Victoria; the Riverina near Griffith in NSW; and Manjimup in WA.

About 60 per cent of Australia's walnut production is exported with greatest demand for in-shell walnuts in China, Turkey and Italy.

Australia is free from the major pests and diseases that affect walnuts overseas, and the Australian Walnut Industry Association prioritises biosecurity to maintain this status. Biosecurity is included in the Australian Walnut Industry Five Year Strategic Plan – 2015 to 2020 and it is part of the industry development officer's role. The industry website maintains a biosecurity section to raise awareness of biosecurity among growers, and a representative attends PHA meetings and Australian Government Biosecurity Roundtables.

In 2018, the Australia Walnut Industry Association participated in Emergency Plant Pest Response Deed processes, including for the eradication of Khapra beetle. The association is funding projects to establish an Emergency Plant Pest Response levy and an Owner Reimbursement Cost Framework for the walnut industry.

The walnut industry is covered by **version 3.0 of the nut industry biosecurity plan**.

Table 44. High Priority Pests of the walnut industry

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

Figure 83. Annual value of walnut production, 2007–17

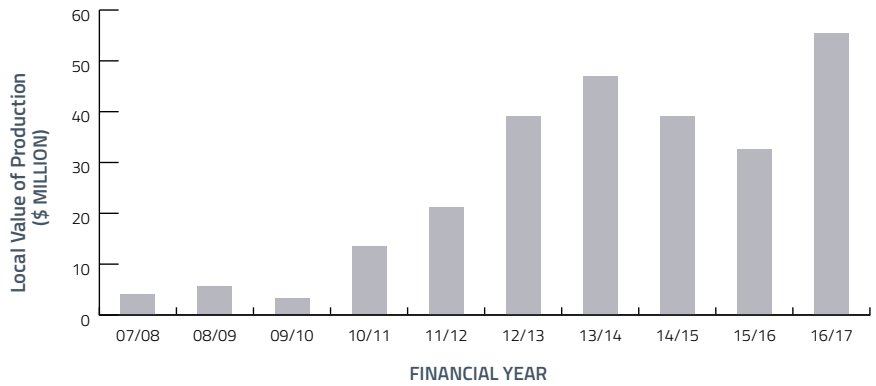
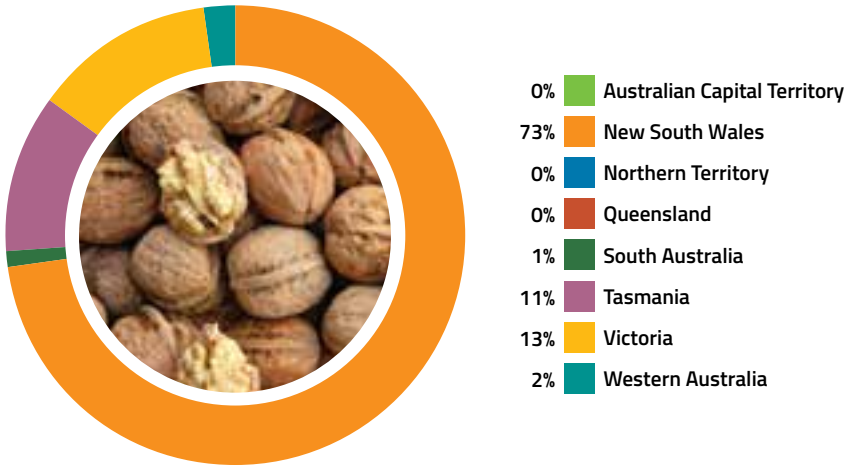


Figure 84. Distribution of walnut production by state and territory, 2016–17 (based on LVP)



WINE GRAPES

Represented by Australian Vignerons and Winemaker's Federation of Australia
australianvignerons.com.au | wfa.org.au

In 2016–17, the Australian wine industry was valued at $971 million (LVP). Grapes are made into wine by 2,400 wine producers, generating export sales of $2.56 billion in 2017, and gross sales of $5 billion.

The wine industry has a significant footprint in Australia, comprising 6,200 wine grape growers over a vineyard area of 135,133 hectares. It is estimated that the wine industry contributes over $40 billion to the Australian economy, and employs over 170,000 people.

The most grown wine grape varieties are Shiraz (30%), Cabernet Sauvignon (18%) and Chardonnay (16%). The major varieties by colour are Shiraz, Cabernet Sauvignon and Merlot for reds and Chardonnay, Sauvignon Blanc and Semillon for whites.

The Australian wine industry has been fortunate to date in avoiding many of the world's most devastating grape vine pests and as a result possesses some of the oldest vineyards in the world. Australia remains free from *Xylella fastidiosa*, and the industry continues to work hard to manage the spread of phylloxera. Australian grape and wine producers enjoy an enviable global reputation for producing high quality wines.

Throughout 2018, Australian Vignerons participated in the Emergency Plant Pest Response Deed on behalf of the grape and wine industry. In 2018, Australian Vignerons and Winemakers' Federation of Australia voted to amalgamate to form Australian Grape and Wine. The new amalgamated association will maintain a strong commitment to biosecurity and lead an industry that is resilient to pest and disease risk.

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 85. Annual value of wine grape production, 2007–17

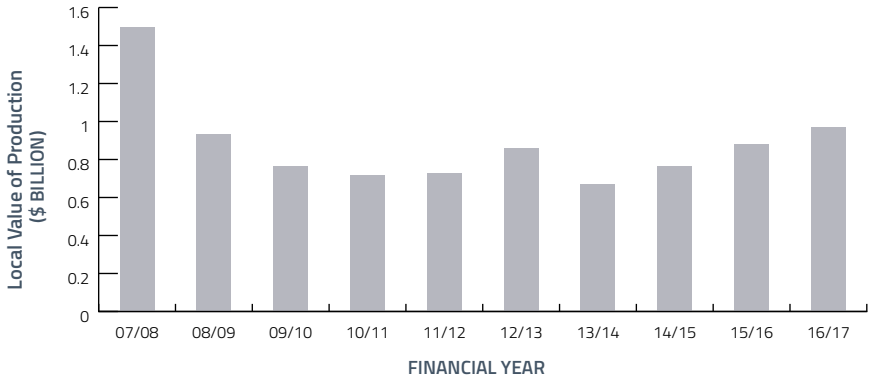


Figure 86. Distribution of wine grape production by state and territory, 2016–17 (based on LVP)

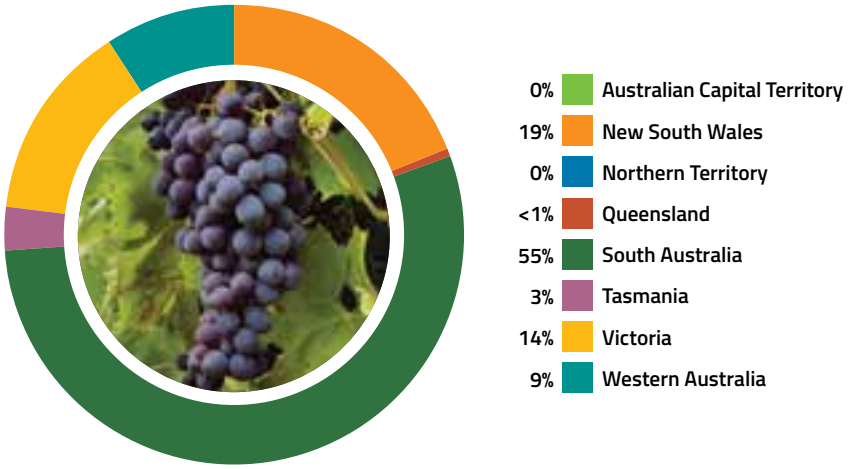


Table 45. High Priority Pests of the wine grape industry

Scientific name	Common name
Bactrocera carambolae	Carambola fruit fly
Bactrocera dorsalis	Oriental fruit fly
Candidatus Phytoplasma solani	Bois noir
Daktulosphaira vitifoliae (exotic strains)	Grapevine phylloxera
Drosophila suzukii	Spotted wing drosophila
Grapevine flavescence doree phytoplasma	Flavescence doree
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

Chapter 4

Pre-border and border biosecurity

Pre-border and border biosecurity

Australia benefits from importing a range of goods and produce from overseas. Imports provide access to a wide range of products, technology and services that enable economic growth in multiple sectors. While Australians consume mostly local products, the food that is imported is commonly produce that is out of season in the southern hemisphere.

The movement of plant produce and other goods around the world poses biosecurity risks to the importing countries. In an effort to mitigate risk, the Australian Government performs a number of activities pre-border and at the border to safeguard our biosecurity status.

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

The Australian Government's efforts to support exports is covered in this chapter. International trade is important to Australia in a global economy. Australia gains significant economic benefits as a net exporter of agricultural products, with around two-thirds of agricultural production exported to overseas markets. The amount of exported product varies between industries, with some such as the grains and cotton industries exporting much of the produce grown, and others gradually increasing exports, such as the horticulture industry.

Grain loading facilities such as this one in Newcastle allow export to overseas markets

Pre-border biosecurity

OBLIGATIONS UNDER INTERNATIONAL TRADE AGREEMENTS

Trade is covered by international agreements, known as phytosanitary agreements, that aim to prevent the spread of plant pests.

As an active trading nation, Australia has entered into multilateral and bilateral trade agreements that influence the plant biosecurity system. Biosecurity risks are managed in keeping with Australia's legislative framework for biosecurity and international obligations.

On a multilateral level, Australia's rights and obligations in relation to plant biosecurity are set out under World Trade Organization 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 World Trade Organization member countries with the right to use sanitary and phytosanitary measures to protect human, animal and plant life or health. The agreement also imposes obligations, including that sanitary and phytosanitary measures cannot be used to inhibit trade where there is no danger to human, animal or plant health.

Members can specify the level of protection that they consider fitting to protect human, animal and plant life or health within their territory. This is known as the appropriate level of protection (ALOP) or acceptable level of risk provided it is science-based, is applied consistently and considers the objective of minimising negative trade effects. Australia's ALOP is defined in section 5 of the *Biosecurity Act 2015* as providing "a high level of sanitary and phytosanitary protection aimed at reducing biosecurity 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 this level by using 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 biosecurity measures within its free trade agreements.

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

The International Plant Protection Convention

The **International Plant Protection Convention** (IPPC) was established to protect the world's plant resources from the spread of serious pests by international trade, including diseases and invasive species. The IPPC is an Article XIV statutory body of the Food and Agriculture Organization (FAO) of the United Nations, from which it receives program funding, sourced from FAO assessed contributions and donations and supplemented by voluntary contributions of contracting parties.

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), set 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 four 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
- IPPC Implementation and Capacity Development Committee responsible for facilitating implementation of the convention and its standards and recommendations.

Australia has contributed a number of technical resources to help other contracting parties better manage phytosanitary risks, including guidance on managing risks posed by sea containers and internet trade of plants and plant products. Australia has also taken a lead role in the development and implementation of the electronic generation and transmission of phytosanitary certification through the IPPC ePhyto program. Reporting and exchange of information, including pest status of parties, is available on the International Phytosanitary Portal at **ippc.int**

Australia's membership of these IPPC bodies provides an important avenue for the Department of Agriculture and Water Resources to raise and address plant health matters in regard to international trade. The department consults with peak industry groups and state and territory governments to determine Australia's position on items for the IPPC agenda.

The Plant Protection Agreement for the Asia and Pacific region

The Plant Protection Agreement is an intergovernmental treaty administered by the Asia and Pacific Plant Protection Commission (APPPC), a Regional Plant Protection Organisation (RPPO) recognised under the IPPC. The APPPC covers phytosanitary issues relating to the movement of pests in trade, pesticide use and regulation, and integrated pest management.

Through its Standards Committee, the APPPC develops Regional Standards for Phytosanitary Measures 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 and their implementation in the region.

Australia is involved in the following APPPC committees and regional working groups:

- Chair and member of the APPPC Standards Committee.
- Chair of the APPPC ePhyto Working Group.

Australia is also involved in leading a series of APPPC workshops over six years (2016–22) on surveillance management, methodologies and analysis.

Workshops on irradiation as a phytosanitary measure and risk categorisation and mitigation for semi processed products under ISPM 32 are planned for 2019.

These opportunities allow Australia to enhance its plant health engagement with the 28 member countries of the APPPC. This strengthens regional plant health and biosecurity capacity and implementation of international plant health standards.

Canberra Agreement

Australia is also a member of a second Regional Plant Protection Body, 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 and support to its members on phytosanitary measures to facilitate international trade whilst protecting the plant health status of parties. The Pacific region covers Pacific island countries, the United States, French territories, Australia and New Zealand.

In 2018, the PPPO hosted its triennial meeting and an IPPC regional workshop to consider draft ISPMs and other IPPC activities. These meetings were funded by the Department of Agriculture and Water Resources. Australia is a member of the PPPO Executive Committee.

PRE-BORDER ACTIVITIES TO MITIGATE THE RISKS OF IMPORTS

The Department of Agriculture and Water Resources has primary responsibility for pre-border activities to mitigate the risk of exotic pests and diseases reaching our border or arriving through the movement of people and goods into Australia. The department also provides assurance to the community and producers about the biosecurity status of imported commodities.

Pre-border activities include:

- regulating imports to manage risks
- assessing import risks
- conducting risk assessments to consider the level of biosecurity risk that may be associated with imports and imposing relevant risk management measures
- biosecurity risk analyses
- conducting pre-border verifications, inspections and audits on imports
- conducting pest and disease surveillance in neighbouring countries
- participating in international plant health agreements
- collaborating with international partners on multilateral or bilateral plant health issues and the development of standards
- building regional capacity through collaborative activities
- gathering intelligence to determine and address emerging biosecurity risks
- negotiating market access for Australian exports
- maintaining the Biosecurity Import Conditions database (BICON).

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 *Biosecurity Act 2015*, the *Environment Protection and Biodiversity Conservation Act 1999*, and where relevant, the *Gene Technology Act 2000* and any subordinate legislation.

Import conditions are imposed to ensure that goods entering the country do 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 goods meet these conditions and compliant goods are allowed entry.

Some imported goods require an import permit and these are issued under the *Biosecurity Act 2015*. Other goods may be allowed entry without a permit subject to standard conditions that are included in the *Biosecurity (Prohibited and Conditionally Non-prohibited Goods) Determination 2016*. Permits may also be required under the *Environment Protection and Biodiversity Conservation 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.

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

Assessing import risks

Import risk assessment is an important part of Australia's biosecurity protection. Assessments consider the level of biosecurity risk that may be associated with imports and impose relevant risk management measures.

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 standards including ISPM 2 (Framework for Pest Risk Analysis) and ISPM 11 (Pest Risk Analysis for Quarantine Pests) of the IPPC.

Table 46 details policy advice finalised by December 2018, as well as draft policy advice that is currently in progress.

Biosecurity risk analyses conducted by the Department of Agriculture and Water Resources staff are consistent with Australia's international biosecurity obligations to establish a balance between our international trade obligations and risks posed by goods.

A Biosecurity Import Risk Analysis (BIRA), under the *Biosecurity Act 2015* may be conducted where relevant risk management measures have not been established, or where they exist for a similar product and pest or disease combination, but the likelihood or consequences of entry, establishment or spread of pests or diseases could differ significantly from those previously assessed.

Regulated risk analyses conducted before 16 June 2016 were completed under the *Quarantine Act 1908* and were called an Import Risk Analysis.

The department is responsible for conducting each BIRA as well as other risk analyses but the process can involve other stakeholders including:

- departmental officers with expertise in science and regulation, pests and diseases, commercial processes or other relevant disciplines
- a Scientific Advisory Group, comprising external scientific and economic experts
- a BIRA Liaison Officer, acting as the first point of contact for stakeholders during a BIRA
- other external experts, government agencies and domestic and international stakeholders.

A review of existing biosecurity measures can be done when there is a change in biosecurity risk, and when there are technological advancements or process improvements that remove or minimise the biosecurity risk associated with a particular commodity.

These 'non-regulated' risk reviews are often driven by industry requests and usually result in more treatment options that importers can undertake to meet biosecurity requirements.

Similar methodology can be used to conduct a scientific review of existing policy, with specific adjustments and modifications to methods being explained in the individual reports.

Pre-border verifications, inspections and audits on imports

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

Regular verifications and audits are undertaken to ensure compliance of specified plant material with prescribed risk management procedures. Controls also extend to production areas and stock feed processing facilities.

The Australian Government works with national plant protection organisations in exporting countries to increase confidence in their systems' ability to effectively manage biosecurity risks pre-border. This reduces the pressure on mitigating risks at the border and provides opportunities to reduce post-border intervention.

Table 46. Australian Government import policy advice, final and in progress[16]

Policy	Country (from)	Year released
Finalised policy advice		
Apple and pear (budwood)	Generic	2002
Apples	New Zealand	2007
Apples	China	2010
Apples	New Zealand (review)	2011
Apples (Fuji)	Japan	1998
Avocado (revision)	New Zealand	2007
Baeodromus eupatorii for the biological control of the weed *Ageratina adenophora*	Source country	2014
Bananas	Philippines	2009
Candidatus Liberibacter psyllaurous (capsicum, nursery stock, potato tubers, tamarillo fruit, tomato)	New Zealand, USA	2009
Candidatus Liberibacter spp. and their vectors associated with Rutaceae	All countries	2011
Candidatus Liberibacter solanacearum (apiaceous crops, including carrot and celery)	All countries	2017
Capsicum	Korea	2009
Cherries (into Western Australia)	New Zealand	2003
Citrus	Egypt	2002
Citrus (revision)	Israel	2003
Cucumber green mottle mosaic virus pest risk analysis (host cucurbit seeds)	All countries	2017
Dactylopius tomentosus (fulgida) for the biological control of coral cactus *Cylindropuntia fulgida* var. *mamillata*	All countries	2015
Dragon fruit	Indonesia	2018
Dragon fruit	Vietnam	2017
Drosophila suzukii (spotted wing drosophila)	All countries	2013
Durian	Thailand	1999
Durian (supplement)	Thailand	2000

Policy	Country (from)	Year released
Finalised policy advice (continued)		
Eueupithecia cisplatensis for the biological control of Parkinsonia, *Parkinsonia aculeata*	Source country	2012
Eueupithecia sp. 2 for the biological control of the weed *Parkinsonia aculeata*	Source country	2014
Fresh ginger	Fiji	2015
Ginger	Fiji	2013
Grains	Various	2006, 2007, 2008
Grapes (table)	India	2016
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
Grapes (table)	Sonora, Mexico	2016
Grapes (table, into Western Australia)	USA	2016
Grapevine propagative materials	All countries	2013
Hazelnut	Chile	2011
Hops propagative materials	All countries	2010
Island cabbage	Cook Islands, Fiji, Samoa, Tonga, Vanuatu	2013
Lentil (seed and human consumption)	All countries	2002
Lettuce (reinstatement)	New Zealand	2007
Lilium spp.	Taiwan	2013
Limes	Cook Islands, Niue, Samoa, Tonga, Vanuatu	2018
Limes (Tahitian)	New Caledonia	2006
Lychee	Taiwan, Vietnam	2013
Lychee and longan	China, Thailand	2004
Maize (bulk)	USA	2003

16. Australian Government Department of Agriculture and Water Resources. Plant risk analyses. Accessed online 16 July 2019 agriculture.gov.au/biosecurity/risk-analysis/plant

Table 46. Australian Government import policy advice, final and in progress (continued)

Policy	Country (from)	Year released
Finalised policy advice (continued)		
Mandarin (Unshu)	Japan	2009
Mangoes	Philippines	1999
Mangoes	Taiwan	2006
Mangoes	India	2008
Mangoes	Philippines (additional areas)	2010
Mangoes (revisions)	India	2011
Mangoes	Pakistan	2011
Mangoes	Indonesia, Thailand, Vietnam	2015
Mangosteen	Thailand	2004
Mangosteen	Indonesia	2012
Mastrus ridens for the biological control of codling moth, *Cydia pomonella*	Source country	2013
Nectarines	China	2016
Olive (plants from approved sources)	Generic	2003
Oranges (sweet)	Italy	2005
Papaya	Fiji	2002
Peaches, plums and apricots (extention to nectarine IRA)	China	2017
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

Policy	Country (from)	Year released
Finalised policy advice (continued)		
Plectonycha correntina for the biological control of Madeira vine	Source country	2010
Pome fruit testing	China, Japan, Korea	2003
Poppy straw for processing	Turkey, Hungary, Portugal	2016
Potato propagative material (*Solanum tuberosum*)	All countries	2013
Pseudomonas syringae pv. *actindae*	New Zealand	2011
Salacca	Indonesia	2014
Seed contaminants (review of tolerances)	All countries	2000
Stone fruit	USA	2010
Stone fruit (into Western Australia)	New Zealand	2006
Strawberries	Korea	2017
Sweet corn (seed)	USA	2003
Tachardiaephagus somervillei for the biological control of yellow lac scale	All countries	2015
Taro corms (fresh)	Generic	2011
Thrips and Orthotospoviruses	All countries	2017
Tomato (truss)	Netherlands	2003
Tomato (truss, review)	New Zealand	2002
Tortricid moth, *Cydia succedana*, for the biological control of gorse, *Ulex europaeus*	Source country	2014
Wood packaging	Generic	2006
Zantedeschia spp. propagative material	All countries	2016
Draft policy advice (in progress)		
Apiaceous crop seeds (review of import conditions)	All countries	2017
Apples	USA	2009 (stop the clock provisions have been activated on this policy)
Avocados	Chile	2018
Brassicaceous crop seeds	All countries	2018

Table 46. Australian Government import policy advice, final and in progress (continued)

Policy	Country (from)	Year released
Draft policy advice (in progress) (continued)		
Capsicum spp.	Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu	2018
Chinese jujubes	China	2018
Cucurbitaceous crop seeds (review of import conditions)	All countries	2017
Cut flower and foliage	All countries	2018 (extension of consultation period for another six weeks)
Dates	Middle East, North Africa	2016
Fresh breadfruit	Fiji, Samoa, Tonga	2018
Fresh breadfruit	Fiji, Samoa, Tonga	2017
Fresh decrowned pineapple (*Ananas comosus*)	Taiwan	2018
Fresh logan fruit	Vietnam	2018
Fresh strawberries	Japan	2017
Limes	Mexico	2018
Pepino mosaic virus and pospiviriods in tomato seeds	All countries	2018
Pest risk analysis for brown marmorated stink bug (*Halyomorpha halys*)	All countries	2017
Pomegranate	India	2018
Potatoes for processing	New Zealand	2012
Xylella bacterial pathogens	All countries	2018

In 2018 Australia established import conditions for dragon fruit from Indonesia

OTHER INTERNATIONAL ACTIVITIES

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 Pests informs pre-border risk management and early detection of pests that may enter and establish in Australia.

Australia also participates in setting standards for both international and regional bodies. 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

Activities to build capacity are delivered for Asia-Pacific countries that are close 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. An example of capacity building in the Pacific is on **page 24**.

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 or inadvertent non-compliance.

Information and intelligence are 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. See also High Priority Pests and National Priority Pests in **Chapter 2**.

ENSURING AUSTRALIAN EXPORTS MEET REQUIRED STANDARDS

Many Australian plant industries export a proportion of the food and fibre that they produce. A few, notably grains and cotton, export almost everything that is grown. Just as imports are subject to restrictions to protect plant health, exports must also meet conditions, including evidence of pest freedom in the area where the produce was grown. Export trade is therefore heavily reliant on plant biosecurity.

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 phytosanitary export inspection, verification, and certification services for plants and plant products, to meet the 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 47. 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.

Table 47. Australia's export legislation, administered by the Department of Agriculture and Water Resources

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
Export Control (Plants and Plant Products – Norfolk Island) Order 2016
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
Primary Industries (Customs) Charges Act 1999
Primary Industries (Customs) Charges Regulations 2000
*Export Inspection Charges Collection Act 1985**
*Export Inspection (Establishment Registration Charges) Act 1985**
*Export Inspection (Quantity Charge) Act 1985**
*Export Inspection (Service Charge) Act 1985**

* Proposed for repeal

Meeting biosecurity conditions of importing countries

To assist Australia's exporters, the Manual of Importing Country Requirements (MICoR) 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 other relevant export information and documentation. Information in MICoR Plants is a guide only and exporters are advised to also check with the importing country 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. This is linked to endorsements and results in inspections as required, and where applicable, an export permit and phytosanitary certificate is issued. In 2017–18, the department certified 110,000 compliance certificates for grains and horticultural products, up from 99,351 in 2016–17[17].

With funding from the Agricultural Competitiveness White Paper, the Department of Agriculture and Water Resources is also working to standardise instructional material across the export certification system. This includes packages for cold treatment, fumigation, irradiation and vapour heat treatment, and processes to manage and audit accredited properties.

17. Department of Agriculture and Water Resources. Annual Report 2017–18. Accessed online 19 July 2019 agriculture.gov.au/about/reporting/annualreport/2017-18

Negotiating market access

There is a high level of investment in negotiating protocols and building export systems that increase the value of plant exports.

Australia negotiates technical market access with its trading partners for the benefit of Australia's producers. These activities are done in close consultation with industry stakeholders, while taking into consideration the required phytosanitary requirements.

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 activities to ensure Australia can continue to export its plant products.

When prioritising activities, the department consults with industry to ensure its 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 48 details market access achievements since 2000, including access to new markets, improving opportunities in existing markets and preserving existing market access.

First Australian avocados land in Japan

Australia's first avocado exports arrived in Japan in December 2018, following approval of a protocol in May for the export of Hass avocados grown in areas that are free of Queensland fruit flies.

The avocados received a ceremonious launch at the Australian embassy in Tokyo, with officials from Australia and Japan, Japanese importers and retailers, and industry representatives from Hort Innovation and Avocados Australia attending.

Avocados Australia CEO, John Tyas, said the new trade agreement was very exciting news for the Australian avocado industry and acknowledged the cumulative hard work by all agencies involved in making the trade agreement possible.

Two packhouses and ten growers have registered to export to Japan, and a number of consignments have already been sent from Western Australia.

Table 48. Market access achievements for pollinator and plant product exports from Australia since 2000

Year achieved	Country	Commodity
Market access gained and restored		
2000	South Korea	Lemons
2000	South Korea	Oranges
2003	New Zealand	Multiple products (from Goulburn Valley) – pest free area
2003	Peru	Olives, rooted cuttings
2003	USA	Tomatoes, greenhouse
2004	Brazil	Lychees, nursery stock
2004	China	Mangoes
2004	Morocco	Olives, rooted cuttings
2004	New Zealand	Mangoes, irradiated
2005	China	Citrus
2005	Japan	Cherries (from Tasmania)
2005	South Africa	Seed potatoes, microtubers
2005	South Korea	Citrus (unspecified)
2005	South Korea	Mangoes
2006	Japan	Apples
2006	New Zealand	Bananas – resumption of trade
2006	New Zealand	Papaya
2006	Thailand	Potatoes, brushed ware
2006	Thailand	Seed potatoes (from Victoria and WA)
2007	South Korea	Mangoes
2007	South Korea	Multiple products
2008	New Zealand	Lychees
2008	South Korea	Lupins
2008	USA	Cherries (mainland)
2009	India	Peanuts, processed
2009	Japan	Citrus (from Sunraysia) – seasonal freedom
2010	China	Table grapes
2010	European Union	Citrus
2010	India	Kiwifruit
2010	Japan	Citrus (grapefruit)

Table 48. Market access achievements for pollinator and plant product exports from Australia since 2000 (continued)

Year achieved	Country	Commodity
Market access gained and restored (continued)		
2010	South Korea	Cherries (from Tasmania)
2010	Taiwan	Cherries – access reinstated for non pest free areas
2011	Saudi Arabia	Lentils
2012	Bolivia	Sunflower seed, sowing
2012	Chile	Grapevine, nursery stock
2012	Egypt	Honey
2012	India	Pearl millet seed, sowing
2012	Indonesia	Table grapes, summerfruits and cherries
2012	Peru	Chia seed, sowing
2012	Peru	Paulownia, rooted cuttings
2012	Peru	Sorghum seed, sowing
2012	Peru	Wax flower, rooted cuttings
2012	Taiwan	Carrots
2012	Taiwan	Whole lupins, processing
2012	Uruguay	Hemp seeds, sowing
2012	USA	Cotton seed, stock feed
2013	China	Canola – re-opening of trade after resolving quarantine issues preventing exports since 2009
2013	China	Cherries – access after initiating a protocol and meeting Chinese requirements
2013	Ecuador	Barley – for consumption following a technical submission in 2008
2013	Ecuador	Macadamia nuts – access gained for macadamia nuts in-shell for consumption
2013	Malaysia	Creeping signal grass, sowing
2013	Peru	Teak seed, sowing
2013	Phillipines	Bana grass cuttings
2013	USA	Apples
2014	China	Grape seed
2014	Japan	Table grapes
2014	South Korea	Table grapes
2014	Thailand	Cherries
2014	Thailand	Summerfruit (apricots, plums, nectarines and peaches)
2015	India	Blueberries
2015	Mexico	Onion seed, sowing
2015	Saudi Arabia	Lentils – market access restored
2015	USA	Mangoes and lychees
2015	Vietnam	Citrus – market access restored following import suspensions for Australian fruit
2015	Vietnam	Table grapes – market access restored following suspension for all Australian fruit
2016	China	Nectarines
2016	Fiji	Honey bees (live queens)
2016	French Polynesia	Honey and other apiculture products
2016	Japan	Melon (*Cucumus melo*)
2016	Japan	Watermelons
2017	Chile	Vegetable seeds, sowing
2017	Iran	Lentils
2017	Iran	Logs without bark and sawn timber
2017	Myanmar	Plants and plant products
2017	Saudi Arabia	Honey
2017	Solomon Islands	Queen bees
2017	Vietnam	Cherries
2018	Iran	*Phaseolus vulgaris* (bean) seed
2018	Japan	Hard mature avocados
2018	Kuwait	All melons
2018	United Arab Emirates	Strawberries
Improvements in market access		
2005	New Zealand	Zucchini – removal of Queensland fruit fly from the pest list
2005	Thailand	Citrus – 2–3 degree cold disinfestation

Table 48. Market access achievements for pollinator and plant product exports from Australia since 2000 (continued)

Year achieved	Country	Commodity
Improvements in market access (continued)		
2006	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 (from Tasmania) – reinstatement of Queensland fruit fly area freedom
2007	Japan	Citrus – 2–3 degree cold disinfestation
2008	India	Mangoes, irradiated
2008	India	Oats
2008	Indonesia	Citrus – in-transit cold disinfestation
2008	Indonesia	Table grapes – in-transit cold disinfestation
2008	Japan	Cherries (from 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 Standard Operating Policy and Procedure requirement
2009	China	Citrus – revised protocol
2009	China	Mangoes – revised protocol
2010	China	Apples (from Tasmania) – improved conditions
2010	Japan	Grapefruit
2010	South Korea	Citrus
2010	USA	Cherries (from mainland) – stand alone cold treatment
2011	India	Macadamia nuts
2011	Indonesia	Citrus – in-transit cold disinfestation from non pest free areas
2011	Indonesia	Table grapes – in-transit cold disinfestation from non pest free areas
2011	USA	Citrus – 3 degree cold disinfestation
2012	India	Citrus (unspecified) – more favourable temperatures and flexible conditions
2012	India	Citrus (unspecified) – 3 degree in-transit cold treatment
2012	New Zealand	Avocado – 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	USA	Apples
2013	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
2014	Thailand	Grain and seed
2015	China	Wheat and barley – access improved with new protocol
2015	Korea	Cherries – improved inspection rates
2015	Thailand	Cherries – new temperature for cold treatment
2015	Thailand	Citrus – more varieties approved for export from non pest free area districts
2015	Thailand	Persimmons – irradiation for fruit fly control
2015	Thailand	Table grapes – new temperature for cold treatment
2016	Colombia	Kangaroo paw nursery stock
2016	Japan	Pumpkins
2016	Japan	Walnuts
2016	Korea	Blood oranges and other sweet orange varieties
2016	USA	Lychees
2016	USA	Mango
2017	Bangladesh	Lentils

Table 48. Market access achievements for pollinator and plant product exports from Australia since 2000 (continued)

Year achieved	Country	Commodity
Improvements in market access (continued)		
2017	Iran	Chickpeas
2017	Iran	Wheat
2017	Pakistan	Chickpeas
2018	India	De-hulled kiln dried oats
2018	Indonesia	Seed potatoes
2018	Iran	Rolled oats and oat flakes
2018	Thailand	Persimmons
Maintained in market access		
2004	Malaysia	Cut and dried flowers
2004	South Korea	Potatoes
2004	Thailand	Citrus
2004	Various	Citrus
2006	Indonesia	Multiple products
2007	Canada	Summerfruit
2007	China	Citrus (unspecified)
2007	India	Grain
2007	Mauritius	Citrus
2008	Mauritius	Potatoes
2009	Thailand	Multiple products
2010	New Zealand	Lychees
2010	New Zealand	Mangoes
2010	New Zealand	Papaya
2011	Taiwan	Summerfruit (peaches and nectarines)
2011	Thailand	Citrus
2011	Thailand	Multiple products
2011	Thailand	Table grapes
2011	Vietnam	Multiple products
2012	India	Pome fruit
2012	Indonesia	Multiple products
2012	South Korea	Barley (malting), processing

Year achieved	Country	Commodity
Maintained in market access (continued)		
2012	Taiwan	Summerfruit (plums)
2012	Vietnam	Multiple products
2013	All markets	All products – implementation of a new security paper for export health certificates
2013	Taiwan	Apples – revised improved export protocol
2013	Thailand	Apples
2013	Thailand	Avocado
2013	Thailand	Kiwifruit
2013	Thailand	Pears
2013	Thailand	Persimmon
2013	Thailand	Strawberries
2013	USA	Cottonseed, for stock feed – reinstated methyl bromide fumigation and new tolerance levels
2014	China	Table grapes
2015	Indonesia	Wheat – access maintained for grain for consumption
2015	Vietnam	Grains, consumption
2015	Vietnam	Nuts, consumption
2015	Vietnam	Plant based stockfeed
2015	Vietnam	Seed, sowing
2016	India	Wheat flour
2016	Korea	Mangoes
2017	Myanmar	Plants and plant products
2017	New Zealand	Fruit fly host commodities

Reinstating Tasmania's fruit fly free status

In early 2019 Tasmania's fruit fly pest free status was re-instated following the successful eradication of a 2018 incursion of Queensland fruit fly (*Bactrocera tryoni*) on Flinders Island and locations in northern Tasmania near Launceston and Devonport.

With statewide fruit fly pest free area status, Tasmania has an important trading advantage, with high biosecurity status crops such as cherries having access to lucrative export markets. In 2016–17, $32 million of fruit was exported from Tasmania, with $29 million of that from cherries alone[18].

Tasmania's pest free status was revoked in early 2018 following the detection of fruit flies. The finding led to the state's largest ever biosecurity response to eradicate the pest, supported by the government, industry and the community.

Control zones and restrictions on the movement of host produce were established at all incursion locations which were vital in stemming the further spread of fruit flies. Eradication activities were undertaken as per national fruit fly management protocols. Treated fruit arriving in Tasmania was also closely monitored.

Producers in control areas particularly felt the impacts, with significant loss of both domestic and export market opportunities. Any movement of fruit from within a control area required an appropriate treatment, such as fumigation or cold disinfestation, the facilities for which were not immediately available.

Following the re-instatement of fruit fly pest free area status, routine biosecurity measures continued in Tasmania, including monitoring of fruit fly traps, strict import conditions, targeted inspections of produce and checking passengers, luggage, freight and mail at the border.

Biosecurity Tasmania entomologist Dr Guy Westmore takes a closer look at Queensland fruit fly samples. Image courtesy of DPIPWE Tasmania

18. Department of Primary Industries, Parks, Water and Environment. Tasmanian Agri-Food Scorecard 2016–17. Accessed online 18 July 2019 dpipwe.tas.gov.au/Documents/Tasmanian%20Agri-Food%20SCORECARD%202016-17%201.0.pdf

Plant pest surveillance supports market access

Governments and industries make systematic checks for exotic pests within our borders to provide evidence that Australia does not have certain exotic pests, particularly those that could preclude market access for exporters. Nil findings are recorded and collated to provide evidence of absence of a pest from the country, state or region.

In recent years Australia's trading partners and international organisations have asked for more robust and quantitative evidence of Australia's plant health status to both justify import requirements and defend export certification. It is no longer sufficient to state a pest is 'not known to occur', or rest on the assurance of Australia being historically free of a particular pest. Reporting on the likely presence or absence of pests at a particular place and time is crucial to support market access negotiations.

To meet these challenges the Australian Government invested in improving biosecurity surveillance and analysis through the Agricultural Competitiveness White Paper, strengthening the ability of Australian industry groups and governments to collate, share, analyse and report surveillance data on plant pests, including fruit fly.

Better access to more surveillance data gives trading partners confidence in claims of pest absence and area freedom. This makes things easier for exporters, minimising delays and allowing producers to get a better price for their quality produce overseas.

Australia's plant pest surveillance programs are detailed in **Chapter 5**.

National Minimum Dataset Specifications for surveillance

To ensure consistency in the collection and sharing of surveillance data Australia uses the national minimum dataset specifications (NMDS), introduced in 2017 following agreement from the National Biosecurity Committee. To comply with NMDS, each record has its own unique identifier code, with comprehensive data captured on the location and type of surveillance activity, as well as the name and jurisdiction of the organisation entering the data.

With the use of the NMDS and real time data tools such as AUSPest*Check*™, Australia will continue to be amongst a handful of countries able to fully comply with the International Standards for Phytosanitary Measures on recording and reporting of plant health surveillance information.

Solomon Islands surveillance manages off-shore risk

In February 2018 biosecurity specialists from the Northern Australia Quarantine Strategy (NAQS) joined their Biosecurity Solomon Islands (BSI) counterparts to undertake plant health surveys of coconut and cocoa plantations.

The surveys provided an opportunity for BSI staff to gain skills and experience in field sample collection, triage and pest identification, and for the NAQS team to collect valuable information to aid the fight against the coconut rhinoceros beetle, which is not in Australia.

A survey of the country's coffee growing regions will also be completed in 2019, with NAQS scientists conducting offshore survey work in collaboration with biosecurity agencies in Papua New Guinea and Timor-Leste.

This type of regional surveillance activities help to strengthen local industries and provide Australia with an important mechanism for 'early warning' of exotic plant pests and diseases.

Australian Aid

The Department of Agriculture and Water Resources has been working to build biosecurity capacity in the Solomon Islands since 2013, with the surveys delivered under the second phase of the Australian Aid funded Solomon Islands Biosecurity Development Program (SIBDP).

Sally Cowan (NAQS) with Andrew Sale (SIBDP In-Country Liaison Officer) during the 2018 cocoa survey at Kariki Village, Western Province. Image courtesy of the Department of Agriculture and Water Resources

Barbara Waterhouse (NAQS) entering a coconut plantation in the Western Province of Solomon Islands. Image courtesy of the Department of Agriculture and Water Resources

Border biosecurity

Live animals and plants, packaging, plant material, animal products and certain food from overseas could introduce some of the world's most damaging pests and diseases into Australia. This could devastate our valuable agriculture and tourism industries and unique environment.

With increasing levels of international trade and travel, the detection of threats at the border remains an important element of the biosecurity system.

Australia has strict laws relating to the importation of certain goods, including goods brought back from overseas by travellers, to reduce the chance of an exotic pest incursion.

The Department of Agriculture and Water Resources has primary responsibility for international border biosecurity activities, to restrict the import of items that pose a risk to Australia. The department undertakes a range of measures at the border to reduce and detect biosecurity risks, including:

- raising awareness of Australia's biosecurity requirements among importers, industry operators and travellers
- 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.

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

In 2017–18, the border assessment, screening, inspection or clearance of incoming trade and passengers by the Department of Agriculture and Water Resources involved inspection of:

- 18,000 vessels
- 35,000 sea containers
- 152 million mail items
- 21,000 lines of imported food.

COLLABORATIONS TO REDUCE BORDER BIOSECURITY RISKS

Activities to deal with risks posed by cargo imports

The Australian Government works with the cargo and shipping industries to prevent pests and diseases being imported with cargo. Biosecurity restrictions on imported goods can be complex. People who wish to import goods are advised to check whether the goods will be allowed to enter. Sometimes the treatments will be more costly and time consuming than the goods are worth.

First time or infrequent importers are encouraged to use the services of a licensed customs broker to facilitate the process.

BICON, the Australian Government's Biosecurity Import Conditions database, holds information on requirements for foreign plant, animal, mineral and human commodities. People wishing to bring in goods can check the conditions of entry on the Department of Agriculture and Water Resources website.

The information available on BICON is the same information that biosecurity officers use when inspecting goods arriving in Australia. Import conditions within BICON are regularly reviewed, so importers need to check the conditions each time they travel or send goods. More information on import risk assessment is on **page 130**.

First point of entry biosecurity operators

First point of entry (FPoE) refers to sea ports and airports that accept arrivals from overseas. FPoE operators and staff are in a unique position to notice biosecurity risks and respond to them. The Australian Government works with FPoE authorities, operators and workers to reduce biosecurity risks.

Operators and authorities are required to have facilities, arrangements and systems in place to manage the risk of pests and diseases entering, spreading and establishing. The requirements for FPoE authorities and operators are listed in the First Point of Entry Biosecurity Standards for both landing places and ports. For example, seaports must keep wharves free of vegetation and manage weeds so that they do not flower and spread seed.

Rubbish, such as old tyres and packaging, must not be left lying around the wharf area as it can create pools of water and attract pests. Baits are put out in the area for rodents and feral animals. FPoE authorities and operators must manage pools of water that might harbour mosquitos, and if necessary, treat any water to prevent the breeding of insect vectors of pests and diseases.

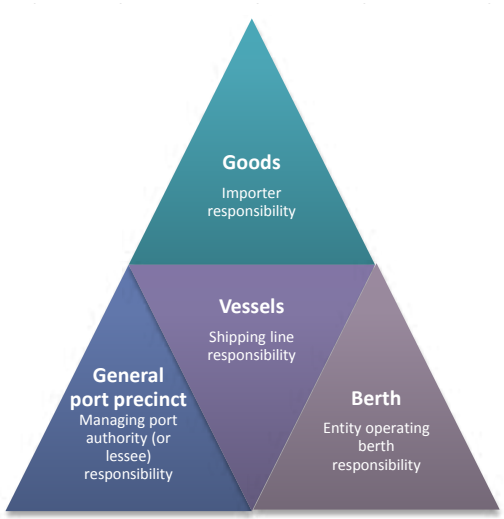
The Australian Government has set up the See. Secure. Report. Hotline (1800 798 636) for FPoE workers to report any biosecurity risks they find during day-to-day operations.

Staff are required to report any hitchhiker pests found on or in vessels and containers or non-containerised cargo. Any unwanted goods from a vessel or cargo consignment – whether packaging, weeds, soil, straw, food scraps, contaminated or spilled goods – are considered waste goods subject to biosecurity control. Staff are required to dispose of waste goods in biosecurity bins, rather than ordinary garbage bins.

Timber dunnage (loose wood, matting, or similar material that is used to keep a cargo in position in a ship's hold) and packaging can carry a variety of borers, beetles, ants and termites. Workers at FPoE are asked to report any evidence of the presence of a timber pest such as frass or sawdust piles under dunnage or imported timber, and tracks or holes in the timber that are signs that exotic timber pests are present.

The special responsibilities of FPoE authorities, operators and staff are an example of the biosecurity responsibilities of every Australian (see Figure 87).

Figure 87. Entity responsibility for biosecurity risks, first points of entry (ports)



Biosecurity at ports and other first points of entry is shared between stakeholders. Image courtesy of the Department of Agriculture and Water Resources

Strong action keeps bugs at bay

In 2018 both Australia and New Zealand were forced to take action to keep the brown marmorated stink bug (BMSB) from becoming established in either country. A voracious feeder, the stink bug is known to feed on more than 300 hosts and is one Australia's top 10 high priority plant pests.

Overseas experience has shown that if the bugs established in Australia they would cause significant issues for the general community as BMSB shelter in buildings and equipment and have a foul-smelling odour when crushed or disturbed. The BMSB would also have a significant impact on horticulture, grains and cotton crops, nursery stock and ornamental plants, and potentially damage many other plants in our environment.

BMSB's abilities to lie dormant and travel around the world hidden in cargo, to fly, and to feed on a wide range of plant hosts, has enabled it to make its way to new regions and spread rapidly around the world. In the late 1990s the bug arrived in North America from eastern Asia and has since spread to 44 states in the United States. More recently it has spread to several countries in Europe, notably Italy.

Since 2014, Australia has intercepted increasing numbers of live BMSB adults as hitchhikers on various goods being shipped to Australia in the season (from September to April). Initially associated with vehicles and machinery from the United States, stronger measures are now applied to a wider range of imported sea cargo from more countries in Europe. In 2018, for the first time, BMSB infested ships were turned away from both Australia and New Zealand.

In 2018, there were two nationally cost-shared responses under the Emergency Plant Pest Response Deed (EPPRD) between agricultural industries and governments for post-border detections of BMSB. The response to each detection was swift, with measures put in place involving risk assessment, fumigation, trapping and monitoring to prove freedom of the pest.

Brown marmorated stink bug (BMSB). Image courtesy of David R Lance, USDA APHIS PPQ

Don't be sorry, just declare it

In May 2018 a public awareness campaign was launched to help international travellers understand and meet their biosecurity obligations when coming into Australia.

More than 21 million passengers are screened for biosecurity risk material each year at Australian airports and this number is expected to grow by five per cent annually.

The 'Don't be sorry, just declare it' campaign includes a new incoming passenger video featuring eight Australian biosecurity officers and uses humour to engage passengers with this clear message. The video is available in a number of languages including English, Arabic, Cantonese, French, Hindi, Japanese, Korean and Mandarin.

The Department of Agriculture and Water Resources also released two short pre-departure videos online to remind Australians travelling overseas and international visitors to think about what they pack. Each video features commodities and scenarios frequently encountered by officers at airports and shipping terminals.

You can watch the 'Don't be sorry' videos on the department's YouTube channel.

Biosecurity officers take the lead in the new video for travellers. Image courtesy of the Department of Agriculture and Water Resources (photographer Michael Masters)

GOVERNMENT SCREENING, INSPECTION AND SURVEILLANCE ACTIVITIES

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 for biosecurity risks as they arrive at airports, seaports and mail centres. Officers operate in conjunction with the Department of Home Affairs, which polices people movements and intercepts illegal goods, such as drugs and weapons.

Some goods need to be declared at the border whether they are being brought back from overseas or arriving in the mail. The department's sophisticated risk assessment and intelligence tools are used to assess biosecurity risk and respond appropriately.

Screening passengers

In an effort to intercept risk material from being brought in from overseas, when travelling to Australia, passengers are provided with an Incoming Passenger Card by the crew on the aircraft or cruise vessel.

Image courtesy of DHA

The Incoming Passenger Card is a legal document and must be completed correctly. Passengers must declare if they are carrying certain food, plant material or animal products.

Declared goods can be taken to the clearance point where they will be assessed by a biosecurity officer.

Alternatively, goods such as food, plant material or animal items can be voluntarily disposed of in bins located in the terminal.

Biosecurity officers will assess the level of biosecurity risk associated with the declared goods. Passengers may be required to provide information or documents to assist in determining the risk. Biosecurity officers also refer to the department's import conditions database, BICON.

Some products may require treatment such as fumigation or irradiation to make them safe. Other goods may not be allowed into the country if the risk is too great.

Biosecurity officers can also inspect baggage when passengers do not declare any goods. If arriving passengers are found to have made a false declaration on the Incoming Passenger Card, they can be penalised under the *Biosecurity Act 2015*.

Screening mail

When goods arrive at the Australian border they are assessed for biosecurity risk and a decision is made on whether they can be imported.

When sending mail to Australia, the contents of packages must be accurately declared on a postal declaration. Biosecurity officers assess the risk based on the declaration and use detector dogs and x-ray machines to check packages.

Some goods may require treatment (at the importer's expense) before they are permitted into Australia. Goods that are not permitted will be forfeited to the Australian Government and destroyed. If any attempt has been made to conceal goods, the importer may be subject to an investigation and possible criminal prosecution.

Use of detector dogs

Detector dogs have been used by the Department of Agriculture and Water Resources to play a key role in helping to protect Australia from exotic pests and diseases since 1992. They are used in combination with other biosecurity strategies and detection technologies.

There are approximately 40 detector dog teams operating in international airports, seaports, mail centres and courier depots throughout Australia. Detector dogs are currently sourced exclusively from the Australian Border Force Detector Dog Breeding program and undergo rigorous testing to ensure they possess the ideal characteristics for the job. They have an extraordinary sense of smell, are co-operative and gentle with people and possess extreme hunt, food and retrieve drives.

Detector dogs are trained to find items that could bring pests or diseases into Australia such as certain food, plant material and animal products. They have a working life of about six to eight years, and on average, find between 3,000 and 3,500 biosecurity risk items during their working life.

There are two types of detector dogs which are differentiated by their method of indication to target odour:

- Passive response detector dogs are trained to sit in the presence of target odour. They are rewarded with food or praise from their handler when they find biosecurity risk material. Passive response detector dogs generally work among the public at international passenger terminals.
- Multi-purpose detector dogs are trained to offer a defined response based on the environment in which they are operating. At an international passenger terminal, they will sit beside a passenger or piece of baggage. When screening objects in mail facilities and private depots they will dig at the source of target odour.

National Border Surveillance Program

The National Border Surveillance Program commenced in late 2016 and operates under the policy direction of the Compliance Division within the Department of Agriculture and Water Resources. National border surveillance teams are located in all major Australian mainland ports (see Figure 88).

The teams' scope of work includes plant health surveillance at all Australian first points of entry (seaports and airports), premises of businesses handling imported goods of biosecurity interest or biosecurity risk material (so-called Approved Arrangements), and areas associated with or surrounding these.

The primary focus of the border surveillance program is the early detection of pest organisms that may have escaped from conveyances, containers, goods or passengers at the border, before they have the chance to spread to production areas.

Data from the surveillance is also used to inform biosecurity policy areas for the review of import conditions and requirements for Approved Arrangements.

Figure 88. Ports of Australia

Stakeholders implement biosecurity activities at ports all around Australia's coast. Red dots indicate a first point of entry. Green dots indicate where national border surveillance teams are located. Image courtesy of Ports Australia

PROTECTING OUR NORTHERN COASTLINE

The unique biosecurity threats in Australia's north – stretching from Cairns in Queensland to Broome in WA and including Torres Strait –are managed by the Department of Agriculture and Water Resources' Northern Australia Quarantine Strategy (NAQS).

The northern coastline is vast and sparsely populated. It faces biosecurity risks from countries close to Australia including Indonesia, Timor-Leste and Papua New Guinea. These countries have many pests, plant diseases and weeds not present in Australia, which could be spread by human activities as well as natural pathways.

There are three main components to NAQS: surveillance, location and cooperation.

Officers carry out surveillance for exotic pests, diseases and weeds on horticultural plants as well as native and cultivated alternative hosts. Pest checks are made for nationally agreed target species as well as those identified as High Priority Pests during biosecurity planning for industries. Reports of damage on host plants are also investigated. Increasingly, surveillance is conducted in partnership with industry and other government partners.

Each year NAQS notifies relevant authorities when it detects a pest or disease that is a new record for Australia or an extension of range. This intelligence improves national and local incursion responses and aids in determining plant pest status across the north.

In Torres Strait, department officers manage risks associated with the southward movement of people, vessels, aircraft and goods through the Strait to mainland Australia. This includes traditional visitors from Papua New Guinea under the Torres Strait Treaty – up to 30,000 movements per year.

Officers regulate plant risks associated with movements of goods and conveyances from Papua New Guinea and through the islands. Regulated pathways are from Papua New Guinea into Torres Strait, and from the Torres Strait Protected Zone to the Permanent Biosecurity Monitoring Zone, and from either zone to mainland Australia, as shown in Figure 89.

Figure 89. Biosecurity risk pathways regulated by NAQS

Image courtesy of the Department of Agriculture and Water Resources

Most importantly, the success of activities is due to the cooperation and good will of people in northern Australia. The strategy invests heavily in community engagement including the well-known campaign 'Top Watch' to create strong community support. As a result, biosecurity awareness is high and local communities comply with requirements in the Torres Strait, report unusual pests and diseases and provide access to land and country for surveillance.

Exotic fruit fly surveillance and eradication

Exotic fruit fly species represent one of the highest risks for Australia's horticultural industry. Target exotic fruit fly pests are present in Papua New Guinea, including Oriental fruit fly and melon fly. Annual incursions into the Torres Strait by these pests are associated with monsoonal weather patterns moving over Papua New Guinea. Incursions are detected by permanent traps placed on the northern islands of Torres Strait that are monitored by the NAQS team.

These seasonal incursions are eradicated each year under the Exotic Fruit Fly in Torres Strait Response Plan. The Response Plan is managed by the Queensland Department of Agriculture and Fisheries, and eradication responses are delivered by the Department of Agriculture and Water Resources and the Queensland Government. This response falls under the auspices of the Emergency Plant Pest Response Deed. That means that potentially affected industry Parties pay a share of the cost of keeping these pests out of Australia. See Chapter 6 for more on the Emergency Plant Pest Response Deed.

POST-ENTRY PLANT QUARANTINE

Imported live plant material can introduce foreign plant pests and diseases, but it can be advantageous at times for growers to import new varieties, to help maintain the competitiveness and productivity of Australian agribusiness. As a result, live plants can be imported but are subject to conditions and risk assessment processes. This includes new plant material spending time in post-entry quarantine facilities, allowing for growth and disease screening and testing to eliminate specific disease concerns.

Live plant material is defined as all live plants or plant material, other than seeds, that is imported for the purposes of growth or propagation. Import conditions vary, depending on the genus and species of the plant and the form of the imported plant material.

Plant importers begin the process by checking import conditions using the import database BICON, and, if the species is allowed into Australia, apply for an import permit. The national plant protection organisation of the country of export will need to inspect the plants and issue a phytosanitary certificate prior to export. New species that have not previously been imported will be subject to a weed risk assessment, after which the department may choose to develop import conditions for the new species. Plant material classified by departmental officers as high risk will be taken directly to the government post-entry quarantine facility at Mickleham in Victoria. Other nursery stock and restricted seeds can be grown and screened for pests at an approved facility (see Table 49).

The amount of time the plants spend in a post-entry quarantine facility depends on the biosecurity risks they pose and the specific testing required. Once all required testing and screening procedures have taken place and the plants are deemed to be free of any biosecurity concern, the department will release the goods to the importer, who covers all associated costs for services.

Table 49. Australia's post-entry plant quarantine facilities

	ACT	NSW	QLD	SA	TAS	VIC	WA	NT
Australian Government facilities						1		
State government facilities approved for high-risk plant material		1	2	1		2	1	
Scientific (S) and private (P) facilities approved for high-risk plant material	1 (S), 1 (P)	2 (P)	2 (P)	1 (S)	1 (P)		2 (P)	
Private facilities approved for medium-risk plant material		11	15	8	5	57	10	
Scientific (S) and state government (SG) facilities approved for medium-risk plant material	14 (S)	3 (S), 2 (SG)	3 (S), 1 (SG)	7 (S), 3 (SG)	3 (S)	2 (S), 2 (SG)	6 (S), 2 (SG)	

Collaboration in the north building biosecurity awareness

A project in the Northern Territory is helping build biosecurity awareness and capability in south-east Asian farming communities, with a focus on the large community of Vietnamese and Cambodian growers of horticultural crops in Darwin.

Since 2018, Biosecurity Engagement Officer Chris Pham, who is from a Vietnamese grower family, has been employed within NT Farmers to actively communicate biosecurity messages in a culturally and linguistically appropriate way, whilst acting as a conduit between growers and government.

The collaborative project is a joint initiative of the Northern Australia Quarantine Strategy (NAQS), NT Farmers and the NT Department of Primary Industry and Resources.

Surveys in late October 2018 on grower properties by NT and NAQS botanists, facilitated by Chris, plant pathologists and entomologists, provided an opportunity to engage with growers about their biosecurity practices and knowledge.

In recent years, growers have been impacted by emergency responses to cucumber green mottle mosaic virus, banana freckle and citrus canker, which has affected relationships with government. These surveys provide a platform to undertake proactive surveillance with growers outside of a response, whilst building positive relationships and biosecurity capability.

Indigenous rangers have also visited grower properties as part of their 'Biosecurity Fundamentals' training, which for many was their first opportunity to see how their biosecurity surveillance activities in remote Australia link back to the farm gate.

This project was supported by the Agricultural Competitiveness White Paper.

NT Farmers biosecurity engagement officer Chris Pham with grower Tuan Dang. Image courtesy of John Westaway

Chapter 5

Plant pest surveillance and diagnostics

Plant pest surveillance and diagnostics

Since pests can enter the country despite all the precautions in place, Australia has established a unique and highly effective post-border biosecurity system to provide additional protection against exotic pests.

Plant pest surveillance and diagnostics are intertwined activities. Surveillance is a system of making and recording checks for plant pests. Diagnostics is the ability to precisely identify a plant pest, including species that are not known to be present in Australia.

Surveillance is carried out around the country with two key aims in mind:

- to find new incursions or outbreaks before they spread too far to be eradicated
- to gather the 'evidence of absence' data needed to show our overseas trading partners that Australia is free from pests of particular concern.

Surveillance is carried out by state governments, the Australian Government and plant industries with support from the community.

Diagnostic services, which rely on scientific expertise, are primarily provided by governments, universities and research organisations, with coordination through a national network.

In 2018, strengthening surveillance capacity and collaboration was a key focus for investment through the Agricultural Competitiveness White Paper, providing benefits for agricultural industries, the community and environment.

Plant pest surveillance

Information on plant pests is highly valuable because it underpins many aspects of the biosecurity system.

Activities within the plant biosecurity surveillance system work together to achieve five key objectives:

- **Early warning.** Shows where new biosecurity measures are required to prevent the arrival or spread of a plant pest, with surveillance along high-risk pathways being a priority.
- **Early detection.** Finding a new pest or outbreak early, before it has a chance to spread and become widely established.
- **Plant pest status.** Data confirming that pests are absent from growing areas demonstrates to other countries that they can safely import Australian produce without receiving pests. This is known as 'evidence of absence' and is critical information to support access to markets within Australia and overseas.
- **Delimiting the spread of pests.** The ability to define where pests are present and where they are not is very important during an eradication response.
- **Monitoring established pests.** This includes surveillance for pests such as Queensland and Mediterranean fruit flies, and grapevine phylloxera, which are only found in some parts of Australia.

OVERSIGHT OF PLANT PEST SURVEILLANCE

National Plant Biosecurity Surveillance Strategy

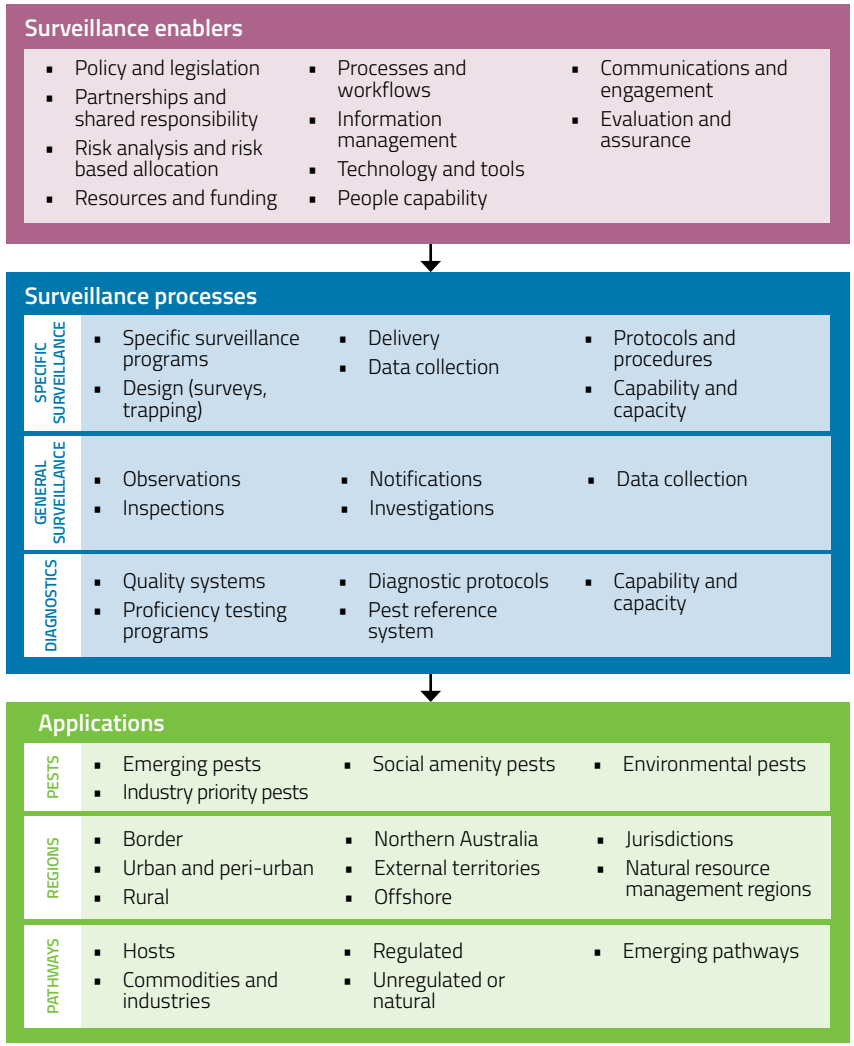
Recognising both the importance of plant health surveillance, and the challenges of maintaining an effective plant health surveillance system, the National Plant Biosecurity Surveillance Strategy 2013–20 was developed as a sub-strategy of the National Plant Biosecurity Strategy.

National Plant Biosecurity Surveillance System framework

Under the new National Plant Biosecurity Surveillance System framework developed in 2017, the Department of Agriculture and Water Resources works in partnership with peak industry bodies, state and territory governments, PHA, community and environmental stakeholders to carry out biosecurity surveillance and analysis.

The framework was developed as part of the Australian Government's investment in improving biosecurity surveillance and analysis through the Agricultural Competitiveness White Paper (see Figure 90).

Figure 90. National Plant Biosecurity Surveillance System framework



Australia's national surveillance system framework, developed in 2017. Image courtesy of the Department of Agriculture and Water Resources

Subcommittee on National Plant Health Surveillance

Plant Health Committee (PHC) established the Subcommittee on National Plant Health Surveillance to provide coordination and leadership for plant pest surveillance in Australia. The subcommittee comprises representatives from the Australian Government, state and territory governments, PHA and the CSIRO. In 2018 the key roles of the subcommittee were:

- developing the Reference Standard for National Surveillance Protocols for Plant Pests
- establishing the Plant Surveillance Network Australasia-Pacific to improve connections between surveillance practitioners and build capacity and capability for surveillance
- coordinating and overseeing the development of a website to support the network
- developing surveillance design processes to prioritise national surveillance efforts
- reviewing and providing recommendations for redesign of exotic fruit fly trapping programs
- reviewing the collection and use of information from general surveillance programs to provide evidence of pest status
- enhancing the collaboration, coordination, efficiency and effectiveness of surveillance efforts nationally.

Plant Health Surveillance Consultative Committee

Established in 2016, the Plant Health Surveillance Consultative Committee is a group that helps to guide investment in the national plant biosecurity surveillance system, including projects funded through the Agricultural Competitiveness White Paper.

The committee includes members from the Department of Agriculture and Water Resources, PHC, Grains Research and Development Corporation, Centre of Excellence for Biosecurity Risk Analysis, Hort Innovation, AUSVEG, Summerfruit Australia, Growcom, National Resource Management Regions Australia and PHA.

Enterprise Surveillance System

In 2018 the department's new Enterprise Surveillance System came into operation. The system facilitates consistent capture of surveillance and diagnostics data collected by border surveillance staff (including absence data) and supports traceability of activities across time and geography. It includes a taxonomic reference system, to support departmental systems requiring taxonomic reference data.

TARGETED SURVEILLANCE PROGRAMS

Targeted surveillance is where checks are made for particular pests. Most is done by state and territory governments (some funded by the Australian Government), but plant industries also undertake targeted surveillance for pests of concern.

The most extensive programs for targeted surveillance – in terms of the number of pests and the wide range of locations where surveillance occurs – are the National Plant Health Surveillance Program, the Northern Australian Quarantine Strategy, the National Bee Pest Surveillance Program, the Grains Farm Biosecurity Program and programs for fruit flies.

These and other surveillance activities across Australia (as shown in Table 50 on **page 158**) occur in addition to the surveillance undertaken to eradicate pests (see **Chapter 6**).

National Plant Health Surveillance Program

The National Plant Health Surveillance Program is managed by the Australian Government Department of Agriculture and Water Resources in collaboration with state and territory governments.

The program, in place since the 1990s, provides funds to state and territory governments to look for pests of particular concern. It provides important 'early detection' surveillance for Australia's 'top 40 unwanted and exotic' National Priority Plant Pests, and other biosecurity risks.

Surveillance is conducted at international entry points such as airports and seaports, where exotic pests could potentially enter Australia and spread. This includes trapping for 'hitchhiker' pests such as the brown marmorated stink bug and Asian gypsy moth, which could arrive on imported cargo and quickly move into nearby peri-urban or urban areas if not intercepted quickly.

Plants around the country are also checked for any signs of the nation's most unwanted exotic plant pest, *Xylella fastidiosa*, as part of the program's early detection activities.

Information collected from surveillance activities funded by the program also provides a critical source of the 'evidence of absence' data needed to support trade and market access for Australian producers.

INDUSTRY SURVEILLANCE STRATEGIES AND PROGRAMS

All plant industries undertake crop monitoring to support production practices and manage established pests and diseases. This type of crop monitoring underpins general surveillance for the detection of new pests. Awareness programs that outline the ways in which to report unusual pests or symptoms are delivered through various channels such as industry newsletters, web pages and apps.

Examples of industry surveillance programs (as shown in Table 50 on **page 158**) include cotton, grains, honey bees, mangoes, sugarcane and vegetables, which are often facilitated by industry biosecurity officers.

Surveillance programs for the citrus and forest industries, for which strategies were developed in 2017, are now being established, with a National Citrus Surveillance Coordinator and a National Forest Surveillance Coordinator being appointed in 2018 through funding from the Agricultural Competitiveness White Paper and industry sources.

Development of a National Temperate Fruit Biosecurity Surveillance Strategy

Much of Australia's southern region is considered to be temperate, producing a diverse range of crops including pome fruit (apples and pears), grapes (table, wine and dried), cherries, stone fruit (apricots, nectarines, peaches and plums) and almonds. Collectively, the farm gate production value of these temperate fruits is approximately $3 billion dollars annually, with an export value of $1 billion dollars[19]. Temperate fruit trees are also important in peri-urban and urban communities in Australia.

As several temperate fruit industries are interested in expanding their export markets, biosecurity practices and pest surveillance are a priority to ensure retention of current markets and to gain access to new export markets. These industries face a range of exotic pest threats which could significantly impact production systems through a combination of yield loss, quality reduction and increased need for chemical application to manage pests, or changes in the complexity of management systems. Surveillance for the early detection of exotic pests is therefore important.

In 2018, work funded by the Department of Agriculture and Water Resources through the Agricultural Competitiveness White Paper, began to develop a Temperate Fruit Biosecurity Surveillance Strategy which is expected to lead to the establishment of a Temperate Fruit Biosecurity Program. This work will include a pilot program to investigate what is needed for industry led surveillance as well as improved surveillance in urban and peri-urban communities.

19. Hort Innovation. Australian Horticulture Statistics Handbook 2017–18. Accessed online 19 July 2019 horticulture.com.au/growers/help-your-business-grow/research-reports-publications-fact-sheets-and-more/australian-horticulture-statistics-handbook/

Partnership delivering cost-effective surveillance in northern Australia

Biosecurity surveillance is essential to prevent pest and disease outbreaks. In 2017–18 the Northern Australia Quarantine Strategy (NAQS) staff collaborated with the Australian Mango Industry Association on a new pilot surveillance program.

Mangoes are big business in Queensland and the NT. All mangoes picked go through packing sheds where they are sorted and packed based on size and quality. Some centralised packing sheds pack mangoes from multiple orchards.

Undertaking surveillance for pests of biosecurity concern in the orchard is time consuming and expensive. After extensive consultation, a trial tested focusing surveillance efforts on the mangoes as they go through the packing sheds. The industry association received a grant under the White Paper on Developing Northern Australia to implement the pilot.

The pilot focused surveillance on key packing sheds across northern Australia. This delivered quality surveillance data with no disruption to normal packing operations.

Following the success of the pilot, phase two which commenced in June 2018 was extended to include orchards.

The pilot will also help build capacity to undertake surveillance that helps protect farms and the Australian economy.

Cairns-based industry development officer with the Australian Mango Industry Association, Marine Empson. Image courtesy of AMIA

National Bee Pest Surveillance Program

PHA has been coordinating surveillance activities at ports nationwide as part of the National Bee Pest Surveillance Program since 2012. The surveillance program is an early warning system to detect new incursions of exotic pest bees and bee pests. It also provides technical, evidence-based information to support Australia's pest free status claims during export negotiations and assists exporters to meet export certification requirements.

The Enhanced National Bee Pest Surveillance Program 2016–21 is funded by the $2.5 million Hort Frontiers Pollination Fund, part of the Hort Frontiers strategic partnership initiative developed by Hort Innovation. This consists of contributions from nine pollinator-dependent industry research and development levies, with co-investment from the Australian Honey Bee Industry Council, Grain Producers Australia, and contributions from the Department of Agriculture and Water Resources.

The enhanced program uses a variety of activities to detect 14 exotic bee pests and pest bees, four regionalised but significant bee pests, and continued surveillance of European honey bee (*Apis mellifera)* swarms at ports that could have hitchhiked on cargo and be carrying exotic pests.

As part of the surveillance program, sentinel hives (i.e. hives of European honey bees of a known health status) are maintained at high-risk locations around Australia.

During 2018, 138 sentinel hives were in place at 32 sea and air ports, an increase from 116 in 2017. These strategically placed sentinel hives are inspected for external bee pests (varroa mite, tropilaelaps mites, large African hive beetle, small hive beetle and braula fly). Surveillance using either sticky mats and miticides or other methods (such as sugar shaking, traps and visual inspection) have generated over 4,000 records, an increase of about 3,000 records compared to 2017.

Samples of adult bees are also collected from sentinel hives and sent to diagnostic laboratories for either virus diagnostics or tracheal dissection. Over 6,800 adult bees were dissected and inspected for tracheal mite, and CSIRO completed testing of 240 hive samples for exotic honey bee viruses. All were found to be free from exotic honey bee viruses such as deformed wing virus.

Floral sweep netting is carried out near ports for the early detection of exotic pest bees including red dwarf honey bee (*Apis florea*), the giant honey bee (*A. dorsata*), exotic and established strains of Asian honey bee (*A. cerana*) and bumble bees (*Bombus terrestris*). European honey bees collected by sweep netting are also inspected for exotic pests. Using nets to collect and identify foraging bees can also help officers to locate any exotic bee swarms.

The number of port locations and the frequency of floral sweep netting activities have increased with PHA subcontracting activities to state and territory governments. A total of 130 floral sweep surveys took place in 2018, with more planned for 2019. While bumble bees were detected at known locations in Tasmania, no other exotic pest bees were detected in Tasmania or the mainland of Australia.

Honey bees found around ports may be from swarms of local populations or newly arrived from overseas so they are captured, identified and inspected for all exotic bee pests. In 2018, 60 bee swarms were captured and reported. Of these, 29 were Asian honey bee swarms captured in Cairns where an isolated population exists, and one border capture of an Asian honey bee swarm occurred at Port Dampier. The remaining 30 swarms were European honey bees: 29 were free of exotic internal and external mites, but one found on cargo at the Port of Melbourne was infested with *Varroa destructor* and extensive follow up surveillance confirmed no presence of varroa.

An exotic pest of concern for European honey bee hives, the Asian hornet, was targeted in surveys for the first time in 2018 using a new trapping method. To date, Australia remains free of Asian hornets.

The National Bee Pest Surveillance Program is an excellent example of a strong industry–government biosecurity partnership between the industries that rely on pollination, all state and territory governments, Northern Australian Quarantine Strategy team and the Australian Government, as well as port staff and beekeepers.

Bee surveillance in Sydney. Image courtesy of Jenny Shanks

Varroa detection at the Port of Melbourne

In June 2018 a bee colony infested with one of the world's worst pest of bees, *Varroa destructor*, was detected on an incoming ship at the Port of Melbourne.

The detection was made in crates of industrial equipment that had been imported from the United States. The ship's master had advised of the presence of dead bees in the ship prior to docking.

Thanks to the quick action by officers of the Department of Agriculture and Water Resources and Agriculture Victoria's Incident Management Team, the colony was destroyed and surveillance of hives around the port was increased to ensure the pest had not spread.

The heightened level of surveillance continued for six weeks after the detection to ensure Australia remained free of varroa. During this time the Victorian State Quarantine Response Team, whose members are from the beekeeping community, conducted four rounds of surveillance in every known hive within a two kilometre radius of the detection.

On 10 August 2018, with no further detections of varroa mite, the incident concluded and Victoria's Chief Plant Health Officer, Dr Rosa Crnov, thanked the industry and public for their support during the response.

Additional sentinel hives were established around the port as a result of the response and continued to be regularly monitored for the following six months. Long-term sentinel hives will also continue to be monitored as part of the Enhanced National Bee Pest Surveillance Program.

Members of the Victorian Beekeeper State Quarantine Response Team – a trained team of industry professionals who are on standby to help conduct hive surveillance. Image courtesy of Agriculture Victoria

Biosecurity Blitz harnesses public spirit

Over four weeks in spring 2018, the Western Australian community got right behind the state's annual biosecurity surveillance campaign.

In its fourth year, the Biosecurity Blitz has become a key way for local communities to do their bit to protect valuable agricultural industries and the natural environment from harmful exotic pests by reporting unusual pests, feral animals, diseases and weeds. In 2018, a focus was on the exotic brown marmorated stink bug, weeds such as cacti and also aquatic pests.

Plant pests or weeds were reported to the Department of Primary Industries and Regional Development using either the MyPestGuide™ Reporter or PestFax Reporter mobile apps, or via WA PestWatch for aquatic pests.

The MyPestGuide™ family of reporting tools helps to bring people together who have similar pest problems by creating a collaborative network. During the 2018 Blitz, 1,600 reports were received, on top of the 1,571 reports recorded in previous years.

The Biosecurity Blitz recognises the vital role the public can play as a line of defence to protect WA's solid biosecurity reputation, which is essential to secure market access for agricultural produce in Australia and overseas.

Rick Bryant and sons Otis and Henry participating in the Biosecurity Blitz 2018 in their backyard. Image courtesy of DPIRD WA

GENERAL SURVEILLANCE PROGRAMS

All plant industries undertake crop monitoring to support production practices and manage established pests and diseases. This type of crop monitoring underpins general surveillance for the detection of new pests, and awareness programs that outline the mechanisms to report unusual pests or symptoms are delivered through various channels such as industry newsletters, webpages and apps.

PHA encourages growers to be on the lookout for serious exotic pests by including pictures of pests and symptoms in each grower biosecurity manual. Fact sheets on exotic pests are also available from the PHA website.

Along with surveillance undertaken by primary producers, all Australians are encouraged to keep an eye out for anything unusual and report unfamiliar pests or plant symptoms. General surveillance programs raise awareness about pests with growers and the wider community, and rely on people to look for and report anything unusual.

Surveillance for exotic pests is also an important component of Emergency Plant Pest responses, and is covered in Chapter 6. The community was a significant contributor to surveillance efforts following incursions of exotic plant pests such as the brown marmorated stink bug in WA and NSW in 2018.

International Plant Sentinel Network

The **International Plant Sentinel Network** acts as an early warning system to recognise new and emerging pest and pathogen risks. It does this through developing a network of both national and international partnerships between plant protection scientists, botanic gardens and arboreta around the world.

The Melbourne Royal Botanic Gardens, the Royal Botanic Gardens Sydney, the Royal Tasmanian Botanical Garden, and the National Arboretum Canberra are the Australian members of the International Plant Sentinel Network. For more information go to **plantsentinel.org**.

With funding from the Agricultural Competitiveness White Paper, the Department of Agriculture and Water Resources is working with **Botanic Gardens Australia and New Zealand** and PHA to establish a new sentinel surveillance program in the nation's botanic gardens and arboreta. These activities will not only support Australia's plant industries, but will also enhance surveillance to protect our unique flora.

Gardens and arboreta hold a range of native flora, exotic species and relatives of crop species, making them ideal sentinels to detect new plant pest or disease incursions in Australia. With millions of visitors every year they also offer another avenue to inform the community about plant biosecurity.

Plant species in botanic gardens and arboreta overseas can act as sentinels and predict potential threats to the health of Australia's unique flora. Sentinel plants can also provide valuable information which can help:

- increase understanding about 'known' pests and diseases (e.g. dispersal mechanisms, origin)
- identify new pest–host associations (e.g. suggest which species of plant may be particularly susceptible or resistant to a particular pest)
- identify potential biocontrol agents.

Measures to encourage early reporting

Along with pest surveillance, prompt reporting is vital to minimise the long-term impact of exotic pests and weeds. Many plant pests and weeds can spread rapidly, which greatly increases the challenge of containing or eradicating them. Response Plans under the Emergency Plant Pest Response Deed (EPPRD) are only agreed to and implemented if it is feasible and cost-effective to eradicate a pest. Clearly, the sooner a new pest is detected the better.

IF YOU SEE ANYTHING UNUSUAL, CALL THE EXOTIC PLANT PEST HOTLINE

1800 084 881

To encourage the reporting of findings made by general surveillance activities, 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.

A separate Department of Agriculture and Water Resources reporting hotline has been established for port workers and importers, who are urged to report anything unusual to the See. Secure. Report. Hotline (1800 798 636).

Under the terms of the EPPRD, reporting of unusual pests is mandatory. To encourage early reporting, Owner Reimbursement Costs can be payable to commercial growers for losses incurred during a response to a new pest incursion. This could include destruction of crops, enforced fallow periods and additional chemical treatments. It only applies to industries signed up to the agreement.

Establishing a surveillance network in Australia's botanic gardens and arboreta

In October 2018, PHA facilitated a two-day workshop in Melbourne as part of a project to develop a plant pest surveillance network in Australia's botanic gardens and arboreta. The project was funded by the Department of Agriculture and Water Resources through the Agricultural Competitiveness White Paper.

The living plant collections held by the nation's 150 botanic gardens and arboreta can provide valuable information about plant health status. By sharing information, resources and expertise they have the potential to provide a national early warning system for the presence of new pests or diseases.

Katherine O'Donnell from Botanic Gardens Conservation International spoke at the workshop about her work with the International Plant Sentinel Network (IPSN). The network links botanic gardens and arboreta, plant protection organisations, and plant health scientists around the world to provide an early warning system of new and emerging pest and pathogen risks.

Ongoing surveillance for pests and diseases through a national sentinel program in Australia linked with the IPSN provides opportunities to do surveillance for pest species on native and introduced plants.

Warren Worboys, Curator Horticulture, Cranbourne Gardens, with participants of a workshop to improve biosecurity surveillance. Image courtesy of Royal Botanic Gardens Victoria

PLANT PEST SURVEILLANCE PROGRAMS IN 2018

During 2018, there were 117 plant pest surveillance programs undertaken, which are detailed by jurisdiction in Table 50.

The following figures show the same surveillance programs by target host (Figure 91) and target pest type (Figure 92).

Figure 91. Surveillance programs by target host

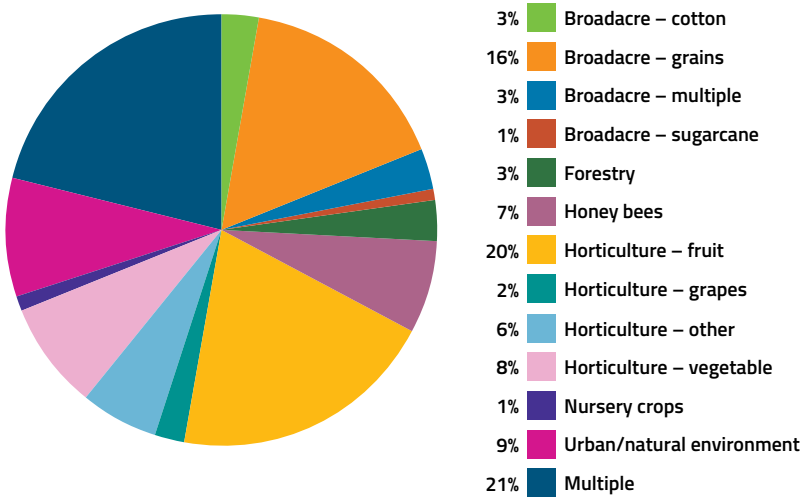


Figure 92. Surveillance programs by target pest type

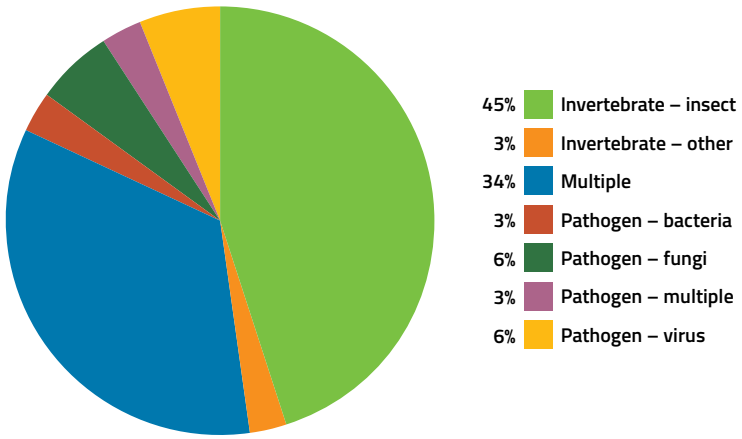


Table 50. Australia's plant biosecurity surveillance programs

Surveillance program name	Target hosts	Target pests
Australian Government		
External Territories Surveillance Program	Various environmental, production and ornamental plants	High priority exotic pests
International Plant Health Surveillance Program	Multiple surveillance programs of tropical horticultural and agricultural species	High priority exotic pests
National Bee Pest Surveillance Program	European honey bee	*Varroa destructor, V. jacobsoni, Tropilaelaps clareae, T. mercedesae, Acarapis woodi, Oplostoma fuligineus, Braula coeca,* acute bee paralysis virus, deformed wing virus, slow paralysis virus, *Apis cerana, A. dorsata, A. florea, Bombus terrestris, Vespa velutina* and new exotic swarms of *A. mellifera*
National Border Surveillance Program	Mutiple surveillance program focusing on regulatory import pathway risks	High priority exotic pests
National Plant Health Surveillance Program (delivered through states and territories)	Various	See separate states
Northern Australia Quarantine Strategy – exotic fruit fly trapping	Horticultural crops	Exotic fruit flies
Northern Australia Quarantine Strategy – pest and disease surveys	Multiple surveillance programs of tropical horticultural and agricultural species	157 high priority exotic pests, diseases and weeds
Within New South Wales		
Asian market access for citrus and cherries	Cherry and citrus production	Queensland fruit fly (*Bactrocera tryoni*), lesser Queensland fruit fly (*Bactrocera neohumeralis*), various cue lure attracted exotic fruit flies
Brown marmorated stink bug	Multiple tree and crop hosts	Brown marmorated stink bug (*Halyomorpha halys*)

Table 50. Australia's plant biosecurity surveillance programs (continued)

Surveillance program name	Target hosts	Target pests
Within New South Wales (continued)		
Citrus budwood mother tree inspections	Multiple citrus hosts	Various graft transmissable diseases and other EPPs
Citrus canker	Multiple citrus hosts	Citrus canker, *Xanthamonas citri* subsp *citri*
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*)
Endive necrotic mosaic virus	Endive and lettuce production	Endive necrotic mosaic virus (Potyvirus)
Exotic fruit flies – Riverina	Various horticultural crops (citrus, stone fruit)	Mediterranean fruit fly (*Ceratitis capitata*), other tri lure responsive 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 forests	Various exotic and endemic high priority pests
Forestry High-Risk Surveillance Program	Pine forests	Various exotic and endemic high priority pests of *Pinus* spp.
Grains Farm Biosecurity Program	In-crop and stored grains	Barley stripe rust (*Puccinia striiformis* f. sp. *hordei*), Karnal bunt (*Tilletia indica*), cabbage seedpod weevil (*Ceutorhynchus obstrictus*), hessian fly (*Mayetiola destructor*), barley stem gall midge (*Mayetiola hordei*), lupin anthracnose (*Colletotrichum lupini*)
Greater Sydney Local Land Services Periurban Surveillance Program	Multiple plant hosts in periurban landscape, including community gardens	Various, including tomato potato psyllid (*Bactericera cockerelli*), brown marmorated stink bug (*Halyomorpha halys*), Asian citrus psyllid (*Diaphorina citri*), African citrus psyllid (*Trioza erytreae*) and glassy winged sharpshooter (*Homalodisca vitripennis*)
Impatiens necrotic spot virus	Tomato crops and surrounding weeds	Impatiens necrotic spot virus
Khapra beetle	Stored grain (bulk handlers and farm), grain processing facilities, dry goods manufacturers, nut production	*Trogoderma granarium*
Khapra beetle – response	Stored grain and grain processing facility	*Trogoderma granarium*
Lupin anthracnose – response	Lupins	Lupin anthracnose (*Colletotrichum lupini*)
National Bee Pest Surveillance Program	European honey bee	*Varroa destructor*, *V. jacobsoni*, *Tropilaelaps clareae*, *T. mercedesae*, *Acarapis woodi*, *Oplostoma fuligineus*, *Braula coeca*, acute bee paralysis virus, deformed wing virus, slow paralysis virus, *Apis cerana*, *A. dorsata*, *A. florea*, *Bombus terrestris*, *Vespa velutina* and new exotic swarms of *A. mellifera*
National Plant Health Surveillance Program – exotic fruit flies	Various fruiting hosts around Ports of Sydney, Newcastle and Wollongong	*Bactrocera albistrigata*, *B. carambolae*, *B. caryae*, *B. correcta*, *B. curvipennis*, *B. dorsalis*, *B. facialis*, *B. kandiensis*, *B. kirki*, *B. melanotus*, *B. occipitalis*, *B. passiflorae*, *B. psidii*, *Z. tau*, *B. trilineola*, *B. trivialis*, *B. umbrosa*, *B. xanthodes*, *B. zonata*, *Ceratitis capitata*, *Zeugodacus cucurbitae*
National Plant Health Surveillance Program – gypsy moth	Various tree hosts around Ports of Sydney, Newcastle, Wollongong and Eden	Gypsy moth (*Lymantria* spp.)
National Plant Health Surveillance Program – multi pest surveillance	Multiple plant hosts around Ports of Sydney, Newcastle and Wollongong	Multiple, including glassy winged sharpshooter (*Homalodisca vitripennis*), *Xylella fastidiosa*, fire blight (*Erwinia amylovora*), brown marmorated stink bug (*Halyomorpha halys*), exotic mites (including *Brevipalpus* spp., *Aceria granati*), Asian citrus psyllid (*Diaphorina citri*), African citrus psyllid (*Trioza erytreae*), huanglongbing (*Candidatus* Liberibacter asiaticus), citrus canker (*Xanthomonas axonopodis* subsp. *citri*), and invasive ants (*Solenopsis* spp., *Wasmannia auropunctata*, *Anoplolepis gracilipes*)
Tomato potato psyllid	Solanaceous hosts	Tomato potato psyllid (*Bactericera cockerelli*)

Table 50. Australia's plant biosecurity surveillance programs (continued)

Surveillance program name	Target hosts	Target pests
Within the Northern Territory		
Area Freedom Surveillance Program	Horticultural crops	Queensland fruit fly (*Bactrocera tryoni*)
Major Industry Monitoring and Surveillance	Mango	Mango malformation (*Fusarium mangiferae*), mango pulp weevil (*Sternochetus frigidus*), mango seed weevil (*Sternochetus mangiferae*), mango gall midges (*Procontarinia* spp.) and red banded mango caterpillar (*Deanolis sublimbalis*)
National Bee Pest Surveillance Program	European honey bee	*Varroa destructor, V. jacobsoni, Tropilaelaps clareae, T. mercedesae, Acarapis woodi, Oplostoma fuligineus, Braula coeca, Aethina tumida,* acute bee paralysis virus, deformed wing virus and slow paralysis virus, *Apis cerana, A. dorsata, A. florea, Bombus terrestris, Vespa velutina* and new exotic swarms of *A. mellifera*
National Plant Health Surveillance Program	Citrus	Citrus canker (*Xanthomonas axonopodis* pv. *citri*), huanglongbing (*Candidatus* Liberibacter spp.) and Asiatic citrus psyllid (*Diaphorina citri*)
National Plant Health Surveillance Program	Multiple	Giant African snail (*Achatina fulica*)
National Plant Health Surveillance Program	Multiple	Glassy winged sharpshooter (*Homalodisca vitripennis*)
National Plant Health Surveillance Program	Multiple	Pierce's disease (*Xylella fastidiosa*)
National Plant Health Surveillance Program	*Musa* spp.	Banana black sigatoka (*Mycosphaerella fijiensis*)
National Plant Health Surveillance Program	Nursery stock	Red imported fire ant (*Solenopsis invicta*), electric ant (*Wasmannia auropunctata*), yellow crazy ant (*Anoplolepis gracilipes*)
National Plant Health Surveillance Program	Solanaceae	*Bactericera cockerelli, Candidatus* Liberibacter solanacearum
National Plant Health Surveillance Program	Solanaceae	Potato leafminer, pea leafminer, serpentine leafminer (*Liriomyza huidobrensis*)
National Plant Health Surveillance Program	Solanaceae, Asteraceae	American leafminer (*Liriomyza trifolii*)

Surveillance program name	Target hosts	Target pests
Within the Northern Territory (continued)		
National Plant Health Surveillance Program	Solanaceae, Cucurbitaceae, Fabaceae	Vegetable leafminer (*Liriomyza sativae*)
National Plant Health Surveillance Program – Port of Entry Program	Horticultural crops	Exotic fruit flies (*Bactrocera* spp. and *Ceratitis* spp.)
Plant Pest Diagnostic Service – broadacre cropping	Broadacre crops	All pests and pathogens that can affect broadacre crops (pastures)
Plant Pest Diagnostic Service – horticulture	Horticultural crops	All pests and pathogens that can affect horticultural crops (mango, chilli, watermelon, Cucurbitaceae)
Regional Fruit Fly Monitoring and Surveillance	Horticultural crops	Exotic fruit flies (*Bactrocera* spp. and *Ceratitis* spp.)
Within Queensland		
Area freedom surveys	Multiple	A range of pests e.g. papaya ringspot virus, banana bunchytop virus
Banana pest surveillance	Banana	A range of banana pests
Bulk handlers	Stored grains	Khapra beetle (*Trogoderma granarium*), Karnal bunt (*Tilletia indica*)
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
Endemic and exotic diseases of cotton	Cotton	Exotic strains of bacterial blight (*Xanthomonas campestris*), blue disease (suspected Luteovirus), 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

Table 50. Australia's plant biosecurity surveillance programs (continued)

Surveillance program name	Target hosts	Target pests
Within Queensland (continued)		
Exotic Fruit Fly in the Torres Strait Program	Multiple	Exotic fruit fly including *Bactrocera* and *Zeugodacus* spp.
Grains Farm Biosecurity Program	Summer grain crops	*Striga* spp. (especially *Striga 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*)
Grow Help Australia diagnostic service project	Fruit, vegetable and ornamental hosts	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
National Bee Pest Surveillance Program	European honey bee	*Varroa destructor, V. jacobsoni, Tropilaelaps clareae, T. mercedesae, Acarapis woodi, Oplostoma fuligineus, Braula coeca*, acute bee paralysis virus, deformed wing virus, slow paralysis virus, *Apis cerana, A. dorsata, A. florea, Bombus terrestris,* and new exotic swarms of *A. mellifera*
National Electric Ant Eradication Program	Amenity and environment	Electric ant (*Wasmannia auropunctata*)
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*)

Surveillance program name	Target hosts	Target pests
Within Queensland (continued)		
National Plant Health Surveillance Program	Multiple	A range of exotic timber and forest pests, including sugarcane longhorn beetle (*Dorysthenes buqueti*), Asian and citrus longhorn beetle (*Anoplophora* spp.), lychee longicorn beetle (*Aristobia testudo*), lateral-banded mango longhorn beetle (*Batocera rubus*), sawyer beetles (*Monochamus* spp.), drywood longicorn beetle (*Stromatium barbatum*), ambrosia beetles, bark beetles (*Ips* spp.), pine beetles bark beetles (*Dendroctonus* spp.), wood wasps (Siricid wasps e.g. *Uroceris gigas*). Exotic fruit flies (*Bactrocera, Zeugodacus* and *Ceratitis* spp.), gypsy moths (*Lymantria* spp.), Pierce's disease (*Xylella fastidiosa*), glassy winged sharpshooter (*Homalodisca vitripennis*)
National Red Imported Fire Ant Eradication Program	Amenity and environment	Red imported fire ant (*Solenopsis invicta*)
National Varroa Mite Eradication Program	European and Asian honey bees	*Varroa jacobsoni*
Panama TR4 Program	Banana	Panama disease (*Fusarium oxysporum* f. sp. *cubense*)
Plant Pest Diagnostic Service – broadacre cropping	Broadacre field crops	All pathogens that can affect broadacre crops (cotton, grains, pastures)
Post-Entry Quarantine inspections	Broadacre field crops (e.g. cotton, sorghum, maize, peanuts)	All pathogens that affect broadacre field crops
Silverleaf whitefly resistance monitoring	Cotton	Silverleaf whitefly (*Bemisia tabaci* B-type)
Sucking pest management in cotton	Cotton	Solenopsis mealybug (*Phenacoccus solenopsis*)
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

Table 50. Australia's plant biosecurity surveillance programs (continued)

Surveillance program name	Target hosts	Target pests
Within Queensland (continued)		
West Indian drywood termite surveys	Timber structures	West Indian drywood termite (*Cryptotermes brevis*)
Within South Australia		
Area freedom surveys	Multiple	A range of pests utilising specific and general surveillance methods
Bee surveillance – endemic disease	European honey bees	American foulbrood (*Paenibacillus* spp.)
Brown marmorated stink bug	Multiple	Brown marmorated stink bug (*Halyomorpha halys*)
Caracollina lenticula	Multiple	*Caracollina lenticula*
Conifer auger beetle	Conifer trees	Conifer auger beetle (*Sinoxylon conigerum*)
Exotic longhorn beetle trapping	Rutaceae	Citrus longicorn beetle (*Anoplophora chinensis*)
Giant pine scale	Pinaceae	Giant pine scale (*Marchalina hellenica*)
Grains Farm Biosecurity Program	In-crop and stored grains	Various, including barley stripe rust (*Puccinia striiformis* f. sp. *hordei*), Khapra beetle (*Trogoderma granarium*), Karnal bunt (*Tilletia indica*), Russian wheat aphid (*Diuraphis noxia*), Sunn pest (*Eurygaster integriceps*), wheat stem rust (*Puccinia graminis* f. sp. *tritici*), wheat stem sawfly (*Cephus cinctus*)
Grape phylloxera	*Vitus vinifera*	Grapevine phylloxera (*Daktulosphaira vitifoliae*)
Grape vine pinot gris virus	Grape vines	Grape vine pinot gris virus (Trichovirus)
Khapra beetle national response	Multiple	Khapra beetle (*Trogoderma granarium*)
Mediterranean fruit fly	Horticultural crops	Mediterranean fruit fly (*Ceratitus capitata*)
Monochamus Surveillance Program	*Pinus* spp.	Japanese pine sawyer beetle (*Monochamus alternatus*), pine wilt nematode
National Bee Pest Surveillance Program	European honey bee	*Varroa destructor, V. jacobsoni, Tropilaelaps clareae, T. mercedesae, Acarapis woodi, Oplostoma fuligineus, Braula coeca,* acute bee paralysis virus, deformed wing virus, slow paralysis virus, *Apis cerana, A. dorsata, A. florea, Bombus terrestris, Vespa velutina* and new exotic swarms of *A. mellifera*

Surveillance program name	Target hosts	Target pests
Within South Australia (continued)		
National Plant Health Surveillance Program	Multiple	Exotic invasive ants (tramp ants)
National Plant Health Surveillance Program	Rutaceae	Asiatic and African citrus psyllids (*Diaphorina citri, Candidatus* Liberibacter africanus)
National Plant Health Surveillance Program	Rutaceae	Huanglongbing (*Candidatus* Liberibacter asiaticus)
National Plant Health Surveillance Program	Rutaceae, commercially grown citrus trees	Citrus canker (*Xanthomonas axonopodis* pv. *citri*)
National Plant Health Surveillance Program	Stored grains	Khapra beetle (*Trogoderma granarium*), Karnal bunt (*Tilletia indica*)
National Plant Health Surveillance Program	*Vitus vinifera*	Glassy winged sharpshooters (*Homalodisca vitripennis* and *H. coagulata)*
Ports of Entry Trapping Program	*Eucalyptus* spp., ornamental trees	Exotic gypsy moths (*Lymantria* spp.)
Ports of Entry Trapping Program	Various fruit fly hosts	Multiple – *Bactrocera tau, B. carambolae, B. dorsalis, B. albistrigata, B. umbrosa, B. trivialis, B. facialis, B. kirki, B. melanotus, B. xanthodes, B. psidii, B. zonata, Ceratitis capitata, Zeugodacus cucurbitae*
Potato spindle tuber viroid	Solanaceae	Potato spindle tuber viroid
Queensland fruit fly	Horticultural crops	Queensland fruit fly (*Bactrocera tryoni*)
Tomato potato psyllid	Solanaceae	Tomato potato psyllid (*Bactericera cockerelli*)
Tomato yellow curl leaf virus	Solanaceae	Tomato yellow curl leaf virus
Trogoderma glabrum	Multiple	*Trogoderma glabrum*
Within Tasmania		
Bee surveillance – American foulbrood	European honey bees	American foulbrood (*Paenibacillus* spp.)
Blueberry rust surveillance	Commercial blueberry crops	Blueberry rust (*Thekopsora minima*)
Codling moth trapping surveillance	Apples, cherries	Codling moth (*Cydia pomonella*)

Table 50. Australia's plant biosecurity surveillance programs (continued)

Surveillance program name	Target hosts	Target pests
Within Tasmania (continued)		
Devonport (Stoney Rise) light trapping	Multiple	Numerous flying pests and beneficials
Fruit fly trapping surveillance	Host fruit trees, fruit and vegetables	*Bactrocera tryoni, Ceratitis capitata, B. dorsalis* and other exotic fruit flies
National Bee Pest Surveillance Program	European honey bee	*Varroa destructor, V. jacobsoni, Tropilaelaps clareae, T. mercedesae, Acarapis woodi, Oplostoma fuligineus, Aethina tumida,* acute bee paralysis virus, deformed wing virus, slow paralysis virus, *Apis cerana, A. dorsata, A. florea, Bombus terrestris, Vespa velutina* and new exotic swarms of *A. mellifera*
National Plant Health Surveillance Program – brown marmorated stink bug	Various hosts near cargo, freight, ports and in parks and gardens	Brown marmorated stink bug (*Halyomorpha halys*)
National Plant Health Surveillance Program – citrus canker	Various citrus in production nurseries	Citrus canker (*Xanthomonas citri* subsp.*citri*)
National Plant Health Surveillance Program – exotic leaf miners	Various hosts on urban pathways, community gardens and commercial potato crops	*Liriomyza bryoniae, L. cicerina, L. huidobrensis, L. sativae, L. trifolii*
National Plant Health Surveillance Program – fire blight	Commercial orchards	Fire blight (*Erwinia amylovora*)
National Plant Health Surveillance Program – gypsy moth trapping	Multiple, including forest and amenity trees	Gypsy moth, including *Lymantria dispar asiatica, L. dispar dispar, L. dispar japonica, L. umbrosa, L. albescens, L. postalba, L. xylina, L. monacha, L. pulverea, L. minomonis, L. concolor, L. dissoluta, L. sinica, L. marginata, L. atameles, L. fumida*
National Plant Health Surveillance Program – huanglongbing	Various citrus in production nurseries	Huanglongbing (citrus greening) (*Candidatus* Liberibacter asiaticus)
National Plant Health Surveillance Program – Khapra beetle	Stored grains, grain processors and animal feed outlets	Khapra beetle (*Trogoderma granarium*)
National Plant Health Surveillance Program – Pierce's disease	Various hosts at nurseries and on urban pathways	Pierce's disease (*Xylella fastidiosa*)

Dr Robert Spooner-Hart, University of Western Sydney demonstrating pest and disease identification and monitoring to olive growers. Image courtesy of the Australian Olive Association

Table 50. Australia's plant biosecurity surveillance programs (continued)

Surveillance program name	Target hosts	Target pests
Within Tasmania (continued)		
National Plant Health Surveillance Program – sharka	Various hosts at commercial orchards	Sharka (plum pox virus)
National Plant Health Surveillance Program – glassy winged sharpshooter	Various hosts at nurseries and on urban pathways	Glassy winged sharpshooter (*Homalodisca vitripennis*)
National Plant Health Surveillance Program – spotted wing drosphila	Various hosts on urban pathways	Spotted wing drosphila (*Drosophila suzukii*)
Silverleaf white fly surveillance	Nursery stock	Silver leaf white fly (*Bemisia tabaci*)
Tomato potato psyllid	Commercial potato and tomato crops, community gardens, urban pathways	Tomato potato psyllid (*Bactericera cockerelli*)
Warehouse beetle trapping surveillance	Stored grains, grain processors and animal feed outlets	Warehouse beetle (*Trogoderma variable*)
Within Victoria		
Crop Safe Program	In-field grains	American serpentine leaf miner (*Liriomyza trifolii*), maize leafhopper (*Cicadulina mbila*), turnip moth (*Agrotis segetum*), barley stem gall midge (*Mayetola hordei*), European wheat stem sawfly (*Cephus pygmeus*), cabbage seedpod weevil (*Ceuthorhynchus assimilis*), canola Verticillium wilt (*Verticillium longisporum*), Fusarium wilts of chickpea (*Fusarium oxysporum* f.sp. *ciceris*) and canola (*Fusarium oxysporum* f.sp. *conglutinans*), barley stripe rust (*Puccinia striifomis* f.sp. *hordei*), lentil rust (*Uromyces viciae-fabae*), lupin anthracnose (*Colletotrichum lupini*) and Karnal bunt (*Tilletia indica*), lentil anthracnose (*Colletotrichum truncatum*), Khapra beetle (*Trogoderma granarium*)

Surveillance program name	Target hosts	Target pests
Within Victoria (continued)		
Grains Farm Biosecurity Program	In-crop and stored grains	Various, including barley stripe rust (*Puccinia striiformis* f. sp. *hordei*), Khapra beetle (*Trogoderma granarium*), Karnal bunt (*Tilletia indica*), Sunn pest (*Eurygaster integriceps*), wheat stem rust (*Puccinia graminis* f. sp. *tritici*), wheat stem sawfly (*Cephus cinctus*)
National Bee Pest Surveillance Program	European honey bee	*Varroa destructor, V. jacobsoni, Tropilaelaps clareae, T. mercedesae, Acarapis woodi, Oplostoma fuligineus, Braula coeca,* acute bee paralysis virus, deformed wing virus, slow paralysis virus, *Apis cerana, A. dorsata, A. florea, Bombus terrestris, Vespa velutina* and new exotic swarms of *A. mellifera*
National Plant Health Surveillance Program	Citrus	Citrus canker (*Xanthomonas axonopodis* pv. *citri*), African citrus psyllid (*Trioza erytreae*), Asian citrus psyllid (*Diaphorina citri*) and huanglongbing (*Candidatus* Liberibacter asiaticus)
National Plant Health Surveillance Program	Fruit and vegetable crops	Fruit flies (*Bactrocera* spp., *Ceratitis captitata*)
National Plant Health Surveillance Program	Grapes	Pierce's disease (*Xylella fastidiosa*), glassy winged sharpshooter (*Homalodisca vitripennis*)
National Plant Health Surveillance Program	Plants and weed hosts around Melbourne ports	Japanese sawyer beetle (*Monocamus alternatus*), wood wasp (*Urocerus fantoma*), black spruce longhorn beetle (*Tetropium castaneum*), brown spruce longhorn beetle (*Tetropium fuscum*), Asian gypsy moth (*Lymantria dispar* and other *Lymantria* spp.), pine wilt nematode (*Bursaphelenchus* spp.), brown marmorated stink bug (*Halyomorpha halys*)
National Plant Health Surveillance Program	Plants and weed hosts around Victorian ports	Exotic fruit flies, various *Bactrocera* and *Ceratitis* spp.
Victorian funded containment program	Pasture and fruit trees	Green snail (*Cantareus apertus*)

Table 50. Australia's plant biosecurity surveillance programs (continued)

Surveillance program name	Target hosts	Target pests
Within Western Australia		
Agrisearch	Grain crops	Grain pests
AgWest grain testing laboratory	Grain crops	Grain pests
Asian longhorn beetle response	Maple (Acer), horse chestnut (Aesculus), birch (Betula), plane tree (Platanus), poplar (Populus), willow (Salix), elm (Ulmus)	Asian longhorn beetle (*Anoplophora glabripennis*)
Biosecurity Blitz	General surveillance, all hosts	All plant pests
Brown marmorated stink bug	General surveillance, all hosts, urban areas	Brown marmorated stink bug *(Halyomorpha halys)*
Browsing ant surveillance	Environmental, urban areas	Browsing ant (*Lepisiota frauenfeldi*)
Candidatus Liberibacter solanacearum	Tomato, potato, capsicum, chilli and eggplant crops	Tomato potato pysllid (*Bactericera cockerelli*)
Codling moth surveillance	Pome fruit	Codling moth (*Cydia pomonella*)
Crop Variety Trials	Grain crops	Grain pests
Cucumber green mottle mosaic virus (as an incident)	Cucurbits and host weeds	Cucumber green mottle mosaic virus
European wasp surveillance	Urban areas and horticultural crops	European wasp (*Vespula germanica*)
Grains Farm Biosecurity Program	In-crop and stored grains	Various, including barley stripe rust (*Puccinia striiformis* f. sp. *hordei*), Khapra beetle (*Trogoderma granarium*), Karnal bunt (*Tilletia indica*), Russian wheat aphid (*Diuraphis noxia*), Sunn pest (*Eurygaster integriceps*), wheat stem rust (*Puccinia graminis* f. sp. *tritici*), wheat stem sawfly (*Cephus cinctus*)
Medfly Area Freedom (Ord River Irrigation Area)	Many horticultural hosts	Mediterranean fruit fly (*Ceratitis capitata*)

Surveillance program name	Target hosts	Target pests
Within Western Australia (continued)		
MyCrop e-surveillance	Broadacre crops, general surveillance	All plant pests
MyPestGuide e-surveillance	All hosts, general surveillance	All plant pests
National Bee Pest Surveillance Program	European honey bee	*Varroa destructor, V. jacobsoni, Tropilaelaps clareae, T. mercedesae, Acarapis woodi, Oplostoma fuligineus, Braula coeca, Aethina tumida,* acute bee paralysis virus, deformed wing virus, slow paralysis virus, *Apis cerana, A. dorsata, A. florea, Bombus terrestris, Vespa velutina* and new exotic swarms of *A. mellifera*
National Plant Health Surveillance Program	Pome and citrus crops	Fire blight (*Erwinia amylovora*), huanglongbing (*Candidatus* Liberibacter asiaticus), citrus canker (*Xanthomonas axonopodis* pv. *citri*), citrus longicorn beetle (*Anoplophora chinensis*), red imported fire ants (*Solenopsis invicta*), Pierce's disease (*Xylella fastidiosa*), glassy winged sharpshooter (*Homalodisca vitripennis*)
National grain insect resistance monitoring	Grain crops	Grain pests
National Variety Trials	Grain crops	Grain pests
Pantry Blitz	Stored grain products	Khapra beetle (*Trogoderma granarium*)
PestFax e-surveillance	Broadacre crops, general surveillance	All plant pests
Port of Entry – Asian gypsy moth trapping	More than 600 forest, orchard, ornamental and native species	Asian gypsy moth (*Lymantria dispar*)
Port of Entry – fruit fly trapping	Horticultural hosts	Various *Bactrocera* and *Ceratitis* spp.
Queensland fruit fly surveillance	Many horticultural hosts	Queensland fruit fly (*Bactrocera tryoni*)
Sentinel stored products merchants	Stored grain products	Khapra beetle (*Trogoderma granarium*)

Diagnostics – identifying plant pests and diseases

Accurate diagnosis of plant pests and diseases fundamentally underpins all aspects of the plant biosecurity system. It is essential that diagnostic services can quickly and accurately identify both established and exotic species. The differences between species can be very minor, making identification a matter of an expert undertaking close examination, morphological comparison to reference species or using molecular techniques.

The cause of poor plant health can be difficult to pin down. There can be many different causes for a given symptom, not all of them related to insects or pathogens. The health of a plant may be affected by soil structure and nutrients, weather conditions, amount of light, other environmental and cultural conditions, as well as the activities of animals and people.

In the event of an incursion, diagnostic expertise is required to identify an initial sample, to help determine how widespread the incursion is (a critical factor in determining whether a pest is eradicable), and eventually to provide the evidence necessary to claim that the pest has been eradicated.

Diagnostic capacity also supports many of the management practices that are integral to 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, which allow access to domestic and international markets.

COORDINATION OF NATIONAL PLANT BIOSECURITY DIAGNOSTICS

Subcommittee on Plant Health Diagnostics

The Subcommittee on Plant Health Diagnostics (SPHD) provides leadership in plant pest diagnostics policy, standards and coordination for Australia. The subcommittee was established in December 2004 by the Plant Health Committee to sustain and improve the quality and reliability of plant pest diagnostics in Australia.

Key roles and responsibilities of SPHD include:

- reviewing and developing diagnostic policies, protocols and standards
- reviewing, developing and implementing strategies to address national capability and capacity issues
- endorsing National Diagnostic Protocols (NDPs) (see Figure 93 on page 168).
- coordinating and fostering the National Plant Biosecurity Diagnostic Network
- coordinating national capability building through a professional development framework
- driving the development and uptake of accreditation and quality management systems for diagnostic laboratories
- improving the surge capacity of diagnostic services to support plant pest responses.

National Plant Biosecurity Diagnostic Strategy

The **National Plant Biosecurity Diagnostic Strategy**, developed in 2012, provides the strategic vision for the overarching plant biosecurity system.

The strategy contains four recommendations to ensure that the diagnostic system meets Australia's needs. They are to:

- develop a nationally integrated plant biosecurity diagnostic network that underpins Australia's plant biosecurity system
- implement and maintain appropriate quality management systems in diagnostic laboratories
- develop and maintain diagnostic capability and capacity for all High Priority Pests
- establish a national plant biosecurity information management framework to optimise data sharing.

The implementation of the strategy continues to be led by SPHD, ensuring the diagnostic system effectively supports the broader biosecurity system.

National Plant Biosecurity Diagnostic Network

The formation of the National Plant Biosecurity Diagnostic Network (NPBDN) in 2011 was driven by SPHD with a focus on building diagnostic capability and capacity for Australia and New Zealand.

Network members comprise experts from across the diagnostic system, from entomologists and pathologists, through to response managers and policy makers. They are from a range of organisations involved in the delivery of plant pest diagnostics, including, but not limited to, state and territory governments, the Australian Government, CSIRO, PHA, universities and the New Zealand Ministry for Primary Industries.

Activities are coordinated and driven by SPHD through a Network Implementation Working Group. The network improves capacity by facilitating communication between experts and sharing of diagnostic resources, as well as offering professional development activities and a proficiency testing program. Each year the Annual Diagnosticians' Workshop brings members of the network together to share ideas and knowledge, and to identify future activities.

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

The network is supported by a website **plantbiosecuritydiagnostics.net.au** which contains resources, contact details of members, news, events and a selection of tools to assist in pest identification.

Development opportunities for diagnosticians

On 21 March 2018, 60 people attended the Annual Diagnosticians' Workshop which focused on new and emerging diagnostics. The workshop was held to coincide with the Annual Surveillance Workshop to enhance links between the surveillance personnel and diagnosticians.

The workshop was one of several professional development opportunities provided to plant pest diagnosticians of the National Plant Biosecurity Diagnostic Network. The goal of the network is to strengthen connections between diagnosticians to build national capability and capacity.

Other professional development opportunities in 2018 included workshops for network members on loop-mediated isothermal amplification and the identification of planthoppers, leafhoppers and spittlebugs.

Attendees at the Annual Diagnosticians' Workshop and Annual Surveillance Workshop

NATIONAL DIAGNOSTIC PROTOCOLS

National Diagnostic Protocols (NDPs) are documents that contain detailed information about a specific plant pest or related group of pests, to allow accurate taxonomic identification. They comply with ISPM 27, Diagnostic Protocols for Regulated Pests, and include diagnostic procedures and data on the pest, its hosts, taxonomic information, detection and identification. New protocols include diagnostic information relevant in supporting surveillance activities and the high throughput of samples.

The protocols are used in:

- 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
- emergency responses to exotic plant pests.

SPHD is responsible for endorsing the protocols, setting them as the agreed procedures for use in the event of an incursion. The use of endorsed NDPs provides confidence in diagnostic outcomes and consistency across the laboratories of the NPBDN.

The protocols are developed according to SPHD Reference Standards, which include the processes of peer review, verification and endorsement as shown in Figure 93.

These reference standards cover:

- Reference Standard 1: Glossary of Terms (Version 3.2).
- Reference Standard 2: Development of Diagnostic Protocols – Procedures for Authors (Version 6).
- Reference Standard 3: Guidelines for the Approval Process of National Diagnostic Protocols (Version 5.1).
- Reference Standard 4: Guidelines for Verification and Peer Review Reports (Version 3.2).

A list of National Diagnostic Protocols, both under development and endorsed, is presented in Table 51.

Figure 93. National Diagnostic Protocol endorsement process

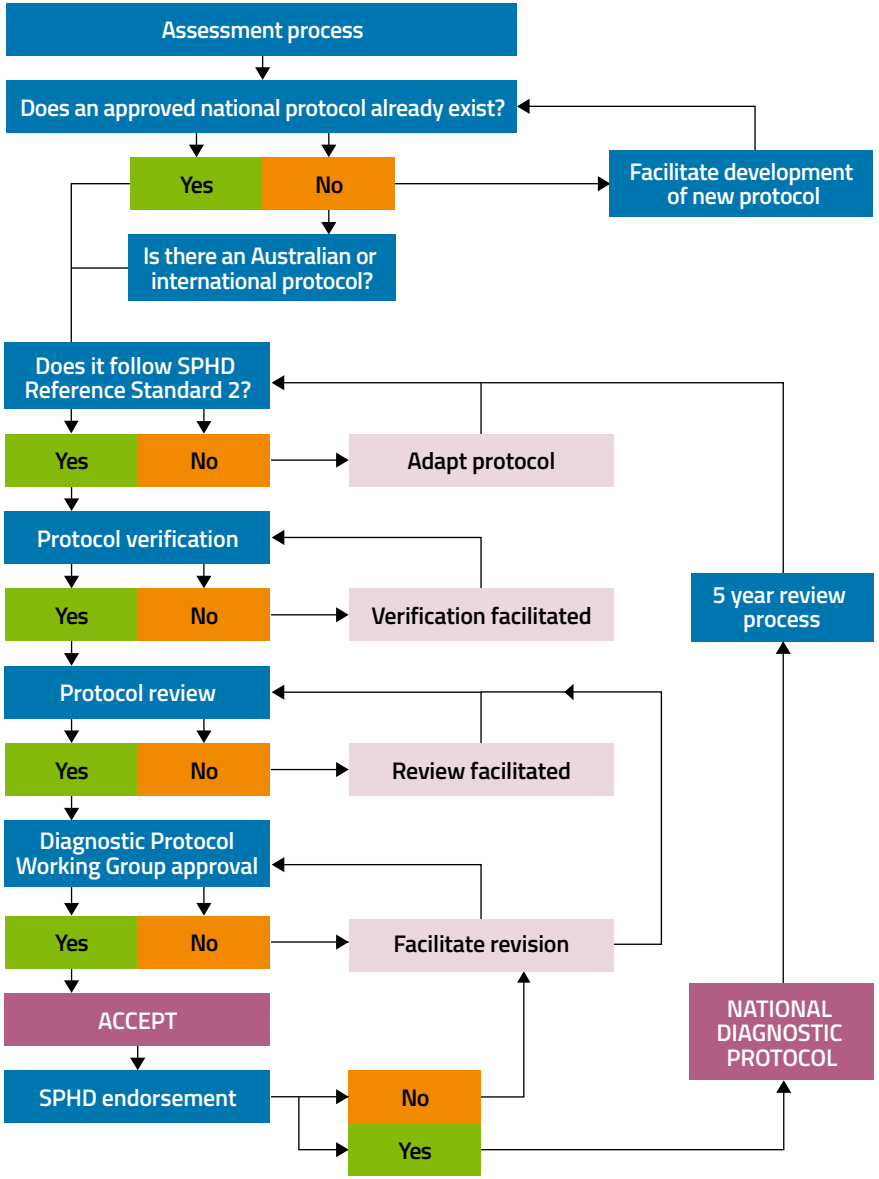


Table 51. National Diagnostic Protocols

Scientific name	Common name
Endorsed protocols	
Adoxophyes orana	Summer fruit tortrix
Bactericera cockerelli	Tomato potato psyllid
Candidatus Liberibacter asiaticus	Huanglongbing
Candidatus Liberobacter solanacearum	Zebra chip
Candidatus Phytoplasma pruni	X disease
Candidatus Phytoplasma prunorum	European stone fruit yellows
Cherry leaf roll virus (Nepovirus)	Blackline
Clavibacter michiganensis subsp. *sepedonicus*	Potato ring rot
Cryphonectria parasitica	Chestnut blight
Dendronoctonus valens	Red turpentine beetle
Diaporthe helianthi	Sunflower stem canker
Diuraphis noxia	Russian wheat aphid
Echinothrips americanus	Poinsettia thrips
Endocronartium harknessii	Pine gall rust
Fusarium oxysporum f. sp. *ciceris*	Fusarium wilt of chickpea
Guignardia bidwellii	Black rot
Homalodisca vitripennis	Glassy winged sharp shooter
Leptinotarsa decemlineata	Colorado potato beetle
Liriomyza trifolii	American serpentine leafminer
Magnaporthe grisea	Rice blast
Monilinia fructigena	Apple brown rot
Neonectria ditissima	European canker
Ophiostoma ulmi	Dutch elm disease
Phakopsora euvitis	Grapevine leaf rust
Phytophthora ramorum	Sudden oak death
Phytoptus avellanae	Hazelnut big bud mite
Plenodomus tracheiphilus	Mal secco
Plum pox virus (Potyvirus)	Plum pox virus

Scientific name	Common name
Endorsed protocols (continued)	
Potato mop top virus (Pomovirus)	Potato mop top virus
Potato spindle tuber viroid (Pospiviroidae)	PSTVd
Protopulvinaria pyriformis	Pyriform scale
Puccinia striiformis f. sp. *hordei*	Barley stripe rust
Pulvinaria iceryi	Pulvinaria scale
Roesleria subterranea	Grape root rot
Scirtothrips perseae	Avocado thrips
Synchytrium endobioticum	Potato wart
Tilletia indica	Karnal bunt
Uromyces viciae-fabae (lentil strain)	Lentil rust
Xanthomonas citri subsp. *citri*	Citrus canker
Xylella fastidiosa	Pierce's disease
Draft protocols	
Agrilus planipennis	Emerald ash borer
Banana bract mosaic virus (Potyvirus)	Banana bract mosaic virus
Burkholderia glumae	Panicle bight
Bursaphelenchus xylophilus	Pine wilt nematode
Candidatus Phytoplasma solani	Bois noir
Ceratovacuna lanigera	Sugarcane woolly aphid
Chilo spp., including *C. auricilius, C. infuscatellus, C. partellus, C. polychrysus, C. sacchariphagus* and *C. terrenellus*	Gold fringed rice borer, top borer, spotted stem borer, dark headed stripe borer, spotted borer and stem borer
Cicidula mbila	South African maize leafhopper
Citripestis sagittiferella	Citrus fruit borer
Colletotrichum truncatum (lentil strain)	Lentil anthracnose
Coryphodema tristis	South African cossid moth
Cotton leaf curl virus (Begomovirus)	Cotton leaf curl disease
Cotton leaf roll dwarf virus (Polerovirus)	Cotton leaf roll dwarf virus
Daktulosphaira vitifoli	Grape phylloxera

Table 51. National Diagnostic Protocols (continued)

Scientific name	Common name
Draft protocols (continued)	
Deanolis sublimbalis	Red banded mango caterpillar
Dendroctonus ponderosae	Mountain pine beetle
Diaphorina citri	Asian citrus psyllid
Drosophila suzuki	Spotted wing drosophila
Dysaphis plantaginea	Rosy apple aphid
Erionata thrax	Banana skipper butterfly
Erwinia amylovera	Fire blight
Furovirus and Bymovirus group	Wheat soil-borne viruses
Fusarium circinatum	Pine pitch canker
Fusarium oxysporum f. sp. *cubense*	Panama disease
Giberella fujikuroi	Bakanae
Globodera pallida and *G. rostochiensis*	Potato cyst nematode
Grapevine flavescence doree phytoplasma	Flavescence doree
Hyalensthes obsoletus	Cixiidae plant hopper
Liriomyza huidobrensis	Pea leaf minor
Lissorhoptrus oryzophilus	Rice water weevil
Lobesia botrana	European grapevine moth
Lymantria dispar	Asian gypsy moth, gypsy moth complex
Maize dwarf virus (Potyvirus)	Maize dwarf virus
Mayetiola destructor	Hessian fly
Mycosphaerella eumusae	Eumusae leaf spot
Orthaga euadrusalis	Mango web weaver
Pantoea stewartii	Stewart's wilt of maize
Pea early browning virus (Tobravirus)	Pea early browning virus
Pea enation mosaic virus (Enamovirus)	Pea enation mosaic virus
Pepino mosaic virus (Potexvirus)	Pepino mosaic virus
Peronosclerospora sacchari	Sugarcane downy mildew
Phymatotrichum omnivorum	Texas root rot
Phytophthora infestans A2	Late blight

Scientific name	Common name
Draft protocols (continued)	
Planococcus ficus	Vine mealybug
Pomacea canaliculata	Golden apple snail
Potyvirus (general)	Potyvirus
Pseudocercospora fijiensis	Black sigatoka
Pseudococcus maritimus	Grape mealybug
Pseudomonas papulans	Blister spot of apple
Puccinia psidii (exotic strains)	Guava (eucalyptus) rust
Raffaelea lauricola	Laurel wilt and vector beetle
Ralstonia solanacearum (phylotype IIB)	Moko and Bugtok
Ralstonia syzgii subsp. *celebesensis* (syn. *Ralstonia solanacearum* race 2, biovar 1)	Blood disease
Ramu stunt (Tenuivirus)	Ramu stunt
Red clover vein mosaic virus (Carlavirus)	Red clover vein mosaic virus
Sugarcane white leaf phytoplasma	Sugarcane white leaf phytoplasma
Scirpophaga excerptalis	Top shoot borer
Scirpophaga nivella	White rice borer
Scirtithrips aurantii	South African citrus thrips
Scolytines	Bark beetles
Sesamia grisescens	Stem borer
Sitobian avenae	English grain aphid
Soil-borne wheat mosaic virus (Furovirus)	Soil-borne wheat mosaic virus
Stagonospora sacchari	Leaf scorch of sugar
Sternochetus frigidus	Mango pulp weevil
Termites (group)	Termites
Tetranychus piercei	Spider mites
Tetranychus turkestani	Strawberry spider mite
Tilletia controversa	Dwarf bunt of wheat
Tilletia horrida	Kernel smut of rice
Trioza erytreae	African citrus psyllid

Table 51. National Diagnostic Protocols (continued)

Scientific name	Common name
Draft protocols (continued)	
Verticillium dahliae	Defoliating strain
Wheat spindle streak mosaic virus (Bymovirus)	Wheat spindle streak mosaic virus
Xanthomonas citri subsp. *malvacearum*	Hyper virulent bacterial blight of cotton
Xanthomonas fragariae	Angular leaf scorch of strawberry

Endorsed – the standard has been assessed and endorsed by the Subcommittee on Plant Health Diagnostics as a National Diagnostic Protocol

Draft – the standard has not yet been assessed and verified by SPHD

Biosecurity Collections staff Michelle Rossetto performing triage on sticky mats for tomato potato psyllids. Image courtesy of NSW DPI

DIAGNOSTIC SERVICES IN AUSTRALIA

Diagnostic services are distributed across every state and territory in Australia. Services are delivered by a range of agencies, including state and territory governments, the Australian Government, commercial and private diagnostic laboratories, museums, CSIRO and universities.

Australia's diagnostic facilities and their services are detailed in Table 52.

Services may be 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.

NATIONAL REFERENCE COLLECTIONS

Biological reference collections are an essential part of the plant biosecurity system, providing validated reference specimens for comparison during the identification of a plant pest. Comprehensive and well-maintained collections are a vital tool to support effective diagnostics, and they are also used for other purposes, such as biodiversity or scientific research.

Most biosecurity and biodiversity reference collections contain:

- **Exotic pest specimens** – necessary for identification since these pests are not present in Australia.
- **Common native relatives and lookalikes of exotic pests** – essential for comparison when diagnosing exotic or unknown pests, and used in the development of effective diagnostic methods.
- **Type specimens** – definitive and validated specimens of a species or strain, which is important for taxonomic research and diagnostics.
- **Historical material and records** – including vouchers and evidence of surveillance or distribution.

Diagnosticians use collections to determine the status of a pest and to support export market access. Proof of area freedom requires vouchering of specimens and records under international standards including ISPM 8, a service that is provided by Australia's collections.

During 2018, SPHD developed an implementation plan for the National Plant Pest Reference Collections Strategy. Using this plan to implement the strategy will ensure reference collections are integrated into the plant biosecurity system, coordinated with other system components, and can support Australia's trade and biosecurity activities.

Table 52. Australia's diagnostic services, their capabilities, accreditations and collections

Laboratory and location	Organisation	Diagnostic capability	Accreditation	Collections
Australian Capital Territory				
Black Mountain Laboratories, Canberra	CSIRO Health and Biosecurity	Bee pathogens		
Black Mountain Laboratories, Canberra	CSIRO Health and Biosecurity	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		Insect, nematode, mite, other arthropod (e.g. spider, centipede), earthworm and other invertebrate collections
New South Wales				
Agricultural Scientific Collections Unit, Orange Agricultural Institute, Orange	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 (e.g. mycology, virology and bacteriology)	ISO9001	
Australian Museum, Sydney	Australian Museum	Entomology		Entomology
Cereal Rust Laboratory, Cobbitty	NSW DPI, University of Sydney	Rust pathology		
CSIRO Cotton Research Unit, Narrabri	CSIRO	Entomology		
CSIRO Tropical Ecosystems Research Centre, Darwin	CSIRO	Ant identification for general public and biosecurity purposes		Tropical Ecosystems Research Centre ant collection
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	Entomology		Entomology
Operational Science, Crewe Place, Rosebery	DAWR	Pest and disease identification, collection and rearing of immature stages of arthropods. Pathology investigation to determine causal agent	DAWR 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, plant pathology and broadacre crops)		

Table 52. Australia's diagnostic services, their capabilities, accreditations and collections (continued)

Laboratory and location	Organisation	Diagnostic capability	Accreditation	Collections
New South Wales (continued)				
Wagga Wagga Agricultural Institute, Wagga Wagga	Charles Sturt University, NSW DPI	Plant pathology, nematode identification and molecular biology		
Yanco Agricultural Institute, Yanco	NSW DPI	Invertebrates and pathogens (vegetables and rice pathology)		
Northern Territory				
Entomology Laboratory, Berrimah	NT DPIR	Insects and mites, molecular biology		The Northern Territory Economic Insect Reference Collection and insect DNA collection
Herbarium, Flora and Fauna Division, Palmerston	NT Department of Environment and Natural Resources	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	Museum and Art Galleries of the Northern Territory	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 including microscopy, serology and molecular assays (conventional and real time PCR) for selected organisms. Entomology and botany including microscopy and molecular capacity		Plant pathology: herbarium specimens, desiccated virus and virus-like disease collections and nucleic acids from Australia and northern neighbouring countries. Entomology: Northern Territory Quarantine Insect Collection which comprises general entomology insect pests; WA, NT and Timor Leste Tephritidae; and WA, NT and overseas Culicoides biting midges
Plant Pathology Laboratory, Berrimah	NT DPIR	Plant pathology, virology, bacteriology, PCR, mycology and diagnostics		Northern Territory Plant Pathology Herbarium and plant pathogen nucleic acids collection
Queensland				
Bowen Research Station, Bowen	QDAF	Entomology		
Biosecurity Queensland Control Centre, Moggill	QDAF	Fire ants		Fire ant reference collection
Brisbane Airport, Brisbane	DAWR	Temperate and tropical plant pests. Plant pathology including microscopy and molecular techniques. Entomology including microscopy and limited molecular capacity	DAWR accredited quarantine containment 5.2/7.2	Insect collections
Cairns Research Station, Cairns	QDAF	Plant pest and disease triage		

Table 52. Australia's diagnostic services, their capabilities, accreditations and collections (continued)

Laboratory and location	Organisation	Diagnostic capability	Accreditation	Collections
Queensland (continued)				
Centre for Tropical Agriculture, Mareeba	QDAF	Entomology, plant pathology, molecular and bacteriology		Entomology
Ecosciences Precinct, Dutton Park	QDAF	Entomology, plant pathology, virology, bacteriology, mycology, nematology, molecular biology and exotic fruit fly screening	DAWR Approved Arrangement for Class 5.2 & 5.3. Biosecurity containment level 2 (BC2) and 3 (BC3)	Plant pathology and entomology
Gatton Research Station, Gatton	QDAF	Vegetable pests and diseases		
Maroochy Research Station, Nambour	QDAF	Plant pathology		
Northern Australia Quarantine Strategy Regional Laboratory, Cairns	DAWR	Tropical plant pests. Plant pathology including microscopy, serology and molecular assays (conventional and real time PCR) for selected organisms. Entomology including microscopy and limited molecular capacity. Botany including microscopy		Plant pathology: herbarium specimens and desiccated virus and virus-like disease collections. Entomology: extensive insect collections including overseas specimens and a large fruit fly collection
QAAFI, St Lucia, Dutton Park, Warwick, Nambour	Queensland Alliance for Agriculture and Food Innovation, University of Queensland	Plant pathology and virology		
Queensland Museum, South Brisbane, Brisbane	Queensland Museum	Acaralogy and entomology		Acarology and entomology
South Johnstone Research Station, South Johnstone	QDAF	Nematology, entomology and plant pathology		
Sugar Research Australia, Indooroopilly, Woodford, Mackay, Tully	Sugar Research Australia	Sugarcane pests and diseases		
Toowoomba Research Station, Toowoomba	QDAF	Field crop pests and diseases, molecular, entomology, virology, nematology and mycology		
University of Southern Queensland, Toowoomba	University of Southern Queensland	Plant pathology and nematology		
South Australia				
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. DAWR accredited containment facilities for insects and plants	Entomology collection, Adelaide University
School of Agriculture, Food and Wine, Waite Institute, Adelaide	University of Adelaide	Nematology and viticulture virology		

Table 52. Australia's diagnostic services, their capabilities, accreditations and collections (continued)

Laboratory and location	Organisation	Diagnostic capability	Accreditation	Collections
South Australia (continued)				
School of Earth and Environmental Sciences, Adelaide	University of Adelaide	Entomology		
South Australian Museum, Adelaide	SA Department of Premier and Cabinet	Entomology		
Tasmania				
Peracto, Devonport	Peracto	Plant pathology and nematology	Laboratory DAWR containment approved	
Plant Health Laboratories, New Town (satellite entomology laboratories at Devonport and Launceston)	DPIPWE	Entomology, plant pathology (virology, mycology, nematology and bacteriology including molecular testing), 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
Sustainable Timber Tasmania Laboratory, Derwent Park, Hobart	Sustainable Timber Tasmania	Limited pathology diagnostics, particularly focusing on testing for Phythophthora cinnamomi. Entomology, specialising in beetles for internal projects		
Tasmanian Museum and Art Gallery, Hobart	Tasmanian Museum and Art Gallery	Entomology, specialising in beetles and moths, and insect identification for the general public		Tasmanian forest insect collection, herbarium including weeds and fungi
University of Tasmania Cradle Coast Campus, Burnie	University of Tasmania and Tasmanian Institute of Agriculture	Plant pathology (mycology including molecular testing)		Limited collection of fungal pathogens
University of Tasmania Sandy Bay Campus, Hobart	University of Tasmania and Tasmanian Institute of Agriculture	Entomology, forest pathology and molecular laboratory	Laboratory DAWR containment approved	Insect reference collection
Victoria				
AgriBio, Bundoora	DJPR, La Trobe University	Entomology, mycology, virology, nematology, bacteriology, general plant pathology, fungal and insect taxonomy, high throughput molecular diagnostics and weeds	DAWR approved AS/NSZ 9001:2000/QA certification. Laboratory is NATA accredited under Biologicals. NATA accredited for potato virus testing, potato cyst nematode identification, fruit fly and phylloxera identification	Fungal, bacterial, nematode, invertebrates and limited virus collection

Table 52. Australia's diagnostic services, their capabilities, accreditations and collections (continued)

Laboratory and location	Organisation	Diagnostic capability	Accreditation	Collections
Victoria (continued)				
Forest Health Laboratory, Heidelberg	University of Melbourne	Forest pathology and entomology		
Horsham Research Centre, Horsham	DJPR	General plant pathology and virology (grains focus)		
Irymple Research Centre, Irymple	DJPR	General plant pathology and entomology		
Operational Science Laboratory, Tullamarine Airport	DJPR	Entomology and plant pathology	DAWR accredited quarantine containment 5.2/7.2	Entomology collection
Plant Post-Entry Quarantine facility, Mickleham	DAWR	General plant pathology including mycology, bacteriology, botany, virology (traditional and modern) and nematology		
Royal Botanic Gardens, Victoria	Royal Botanic Gardens, Victoria	Mycology and weeds		
Rutherglen Research Centre, Rutherglen	DJPR	Entomology		
Tatura Research Centre, Tatura	DJPR	Entomology		
Western Australia				
Department of Environmental Biology, Perth	Curtin University of Technology	Mycology		
DPIRD Diagnostic Plant Laboratories, South Perth	DPIRD	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
Northern Australia Quarantine Strategy, Broome	DAWR	Identification of quarantine intercept samples, mostly exotic pests		Small reference collection, mostly exotic invertebrates
Operational Science, DAWR, 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 invertebrate collection in Western Australia

Dorsal view of female Queensland fruit fly (Bactrocera tryoni). Image courtesy of The Australian Handbook for the Identification of Fruit Flies v3.1

HANDBOOK FOR THE IDENTIFICATION OF FRUIT FLIES

The accurate identification of fruit flies is a key component of Australia's biosecurity system that underpins the domestic movement of fruit and vegetables, maintains international market access for Australian producers and protects Australia's borders from exotic pest incursions.

A new version (v 3.1) of the Australian Handbook for the Identification of Fruit Flies was released in 2018. The volume was developed in consultation with, and input from, fruit fly entomologists, scientists, academics and diagnosticians from Australia and overseas, including government departments of agriculture or primary industries and research institutions.

The handbook consists of two integrated components: an illustrated hardcopy identification 'bench-top handbook' and an online resource.

Hardcopy handbook: The fully illustrated Australian Handbook for the Identification of Fruit Flies includes new images of all target species and revised information pages. The handbook includes 65 pests and close relatives in Dacinae (Bactrocera, Dacus, Zeugodacus, Ceratitis), Trypetinae (Anastrepha, Rhagoletis, Toxotrypana), Phytalmiinae (Dirioxa) and Drosophilidae (*Drosophila suzukii*). Introductory sections support bench-top diagnostic applications and links to the online resource provide more in-depth information (e.g. molecular diagnostic techniques).

Website: A new website **fruitflyidentification.org.au** includes:

- high-resolution diagnostic images of target species
- pages detailing information about all high priority target pests and non-pest close relatives
- a 3D rotating fly and glossary of morphological terms
- supplementary information on molecular diagnostic tools and applications
- a completely new and fully illustrated lucid key to 65 species, including all high priority target taxa and readily confused non-pest Australian species.

ONLINE SYSTEMS SUPPORTING PLANT BIOSECURITY

Digital resources are of increasing importance to plant biosecurity, providing fast download, analysis and access of information. Many online systems are used by stakeholders in the biosecurity system with some of the major ones described here.

The Biosecurity Portal

The Biosecurity Portal is hosted by PHA, bringing together a suite of online biosecurity information that can be found at **biosecurityportal.org.au**. At the end of December 2018, the Biosecurity Portal housed 31 web sites and shared workspaces, and linked to a further 19 external sites, making it a key information source for biosecurity stakeholders.

Sites fall into four categories:

- tools and databases such as the National Plant Surveillance Reporting Tool
- knowledge bases and data libraries such as the Fruit Fly Body of Knowledge
- shared spaces for committees and working groups such as the National Fruit Fly Strategy Advisory Committee and the Subcommittee on Plant Health Diagnostics
- awareness and information resources such as the Farm Biosecurity website and BeeAware.

The Australian Plant Pest Database

The Australian Plant Pest Database (APPD) at **planthealthaustralia.com.au/appd** is a key reference system for plant pests. The APPD contains information on validated specimen records of pests and diseases of plants with significance to agriculture, forestry, pasture or the environment.

Currently APPD draws information from 18 databases throughout Australia. This database is interrogated during every plant pest incursion that is detected in Australia to assist with pest status information. APPD is housed within the Atlas of Living Australia (ALA). ALA also has information relevant to plant biosecurity as it is a collaborative, national database aggregating biodiversity data from multiple data sources.

AUSPest*Check*™

AUSPest*Check*™ is a system developed by PHA for hosting surveillance data on the presence or absence of exotic and established pests around Australia. This system collates surveillance data from multiple sources and in different formats. Maps are generated in real time, providing digital representations of pest status around the country, including during plant pest incursions. During 2018, AUSPest*Check*™ facilitated two proof of concept trials for coordinating surveillance data online. Over 3 million records of surveillance checks had been included in the database by the end of the year.

All the information is integrated to allow seamless mapping and searching for information about types of pests. Standardised data can be uploaded manually using preformatted spreadsheets, or automatically uploaded from pre-existing databases or systems via a programming interface.

Other resources

Databases of agreed import policies (BICON) and export conditions (MICoR) are maintained by the Department of Agriculture and Water Resources, as described in Chapter 4.

PHA has the Pest Information Document Database on its website. This database holds factsheets, contingency plans, diagnostic protocols and other information specific to Australia's high priority exotic pests to support stakeholders in the biosecurity system.

Mobile devices such as smart phones and tablets are supplementing online systems, improving accessibility to the tools and integration into biosecurity operations. Various smart phone apps are used by Australians to contribute to biosecurity. Examples are FarmBiosecurity, which helps a user to create a biosecurity plan for their property, and MyPestGuide Reporter which sends images of plant pests or symptoms directly to the WA government diagnostics service for identification.

AUSPestCheck™ can provide a real-time picture of pest numbers and spread. In this demonstration map, red dots show where surveillance samples confirm the presence of a pest, whereas green dots denote pest absence

Chapter 6

Post-border biosecurity – eradicating new plant pests

Biosecurity Queensland inspectors Roger Winton and Jodie Bocking access Torres Strait Island communities and some remote beach sites by helicopter to conduct blocking activities. Biosecurity Queensland is responsible for exotic fruit fly control using the male annihilation technique, commonly called blocking, by installing caneite blocks impregnated with a lure and insecticide. Image courtesy of Biosecurity Queensland

Post-border biosecurity – eradicating new plant pests

Even with a highly effective biosecurity system, including strong border controls, there is still a risk that new plant pests will enter the country. Passenger arrivals and imports are increasing with time and, together with natural routes of entry such as wind and water currents, the risk of exotic pest incursions is ever present.

As a result, Australia has post-border biosecurity mechanisms in place to rapidly and effectively respond to plant pests to minimise any negative impacts.

REPORTING A PLANT PEST OR DISEASE

IF YOU SEE ANYTHING UNUSUAL, CALL THE EXOTIC PLANT PEST HOTLINE

1800 084 881

Reports of new plant pests and diseases are referred to state and territory departments of agriculture in the first instance. An Exotic Plant Pest Hotline has been set up for such reports. The national number, 1800 084 881, is directed to the state agency, and all calls are confidential and treated seriously.

A report to the Exotic Plant Pest Hotline triggers investigations by the state or territory agency to identify the pests or the unusual plant symptoms. Diagnosticians are tasked with identifying the pest and the state or territory agency will determine if the suspicious pest is indeed exotic. Information on Australia's diagnostic system is in Chapter 5.

PEST RESPONSE ARRANGEMENTS

In cases where a new pest is identified that warrants further action, state and territory agencies will take immediate steps as stipulated under Australia's pest response arrangements.

If a new pest is considered to primarily impact the environment or social amenity, and where the response is for the public good, the National Environmental Biosecurity Response Agreement (NEBRA) may be activated. NEBRA was signed by the Australian Government and state and territory governments in January 2012.

Serious exotic pests that would affect agricultural industries are dealt with under the provisions of the Emergency Plant Pest Response Deed (EPPRD), and the majority of this chapter focuses on those arrangements.

It may also be in the national interest to respond to an exotic weed of production, although at this time there is no formal national agreement in place to manage such detections.

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 37 plant industry peak bodies (Industry Parties).

PHA is the custodian of the EPPRD, bestowing on the company the dual roles of helping to ensure that responses are carried out in accordance with the provisions of the agreement and of progressively improving the provisions to meet the needs of signatories (referred to as Parties).

In this chapter, terms defined under the EPPRD are identified through capitalisation. For the full list of definitions, refer to clause 1 of the EPPRD available at **planthealthaustralia.com.au/epprd**

This chapter uses the EPPRD definition of a Plant Pest, which is: *any species, biotype or strain of invertebrate pest or pathogen injurious to Plant Health, Unprocessed Plant Products, Bees or Fungi provided that it is discrete, identifiable and genetically stable, but excludes Genetically Modified Organisms.*

Note that the EPPRD definition of a Plant Pest does not include weeds.

DEFINITION OF AN EMERGENCY PLANT PEST

For a pest to be covered by the EPPRD, it must also be an Emergency Plant Pest (EPP) as defined in the agreement. Some Plant Pests have already been formally agreed as EPPs, through the process of categorisation, and these appear in schedule 13 of the EPPRD.

A Plant Pest is considered an EPP if it meets 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 and could have an adverse economic impact regionally and nationally if established in Australia.
- A Plant Pest restricted to a defined area of Australia through the use of regulatory measures, that is not native to Australia or under a national instrument of management. The Plant Pest has been detected outside the defined area and is likely to have an adverse economic impact such that an emergency response is required to prevent an incident of regional and national importance.

The honey bee industry is also covered by the EPPRD, since a Plant Pest affecting honey bees would also affect plant industries that benefit from pollination.

DECISION MAKING UNDER THE EPPRD

The EPPRD is designed to support a rapid and effective response to the detection of an EPP, and provide certainty on the governance, decision making and funding of that response.

The EPPRD specifies Parties' roles in the decision making and operational processes of the EPP response, and how governments and Industry Parties will share the costs, based on an assessment of the relative public and private benefits of eradication.

The terms of the EPPRD ensure that no single Party is exclusively responsible for making decisions on responses to EPPs. Instead, formal committees are assembled to determine an appropriate approach to an EPP response. These committees are made up of representatives from government and Industry Parties that are Affected by the EPP. Only EPPRD signatories can take an active part in these decision-making groups.

The National Management Group (NMG) is responsible for making the key decisions on a response under the EPPRD. The group is formed when an EPP is detected and consists of representatives from PHA, the Australian Government, all state and territory governments and Industry Parties identified as affected by the EPP.

The NMG is responsible for approving a Response Plan, including the budget, if it is agreed that eradication of the EPP is technically feasible and cost-beneficial. The NMG is advised on technical matters by the Consultative Committee on Emergency Plant Pests (CCEPP).

The CCEPP is a technical committee that makes recommendations to the NMG on a response to an EPP. As with the NMG, the CCEPP is formed when an EPP, or a suspected EPP, is detected.

The CCEPP is comprised of the Australian Chief Plant Protection Officer, all state and territory Chief Plant Health Managers, and nominated representatives from the Australian Government, PHA and each Industry Party identified as Affected by the EPP.

The CCEPP is responsible for assessing the grounds for eradication and providing the technical advice needed for the NMG to make decisions. A Scientific Advisory Panel may be convened by the CCEPP, as required, to provide advice on specific technical matters.

PLANTPLAN

PLANTPLAN is the agreed technical response plan used in responding to a suspected EPP in accordance with the EPPRD. PLANTPLAN underpins the EPPRD as part of schedule 5 and is endorsed by all EPPRD Parties.

It provides nationally consistent guidelines for response procedures under the EPPRD, outlining the phases of an incursion (investigation and alert, operational, stand down and transition to management), 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 reviewed annually to address relevant findings of Incident debriefs and simulation exercises or other observations from use of the EPPRD. PHA manages the continued development of PLANTPLAN on behalf of EPPRD Parties.

PLANTPLAN is supported by several documents that provide further detail and guidance on specific topics as required. In 2018, Parties endorsed a number of new and revised supporting documents, all of which are available at **planthealthaustralia.com.au/plantplan**

CATEGORISATION OF PESTS

Investment in a Response Plan by government and Industry Parties is guided by the Cost Sharing category of the EPP. Each of the four categories is based on the public versus private benefit of eradication of the EPP, as described in Table 53.

Assessments are made by a Categorisation Group comprising nominated representatives from the Affected Industry Parties, relevant technical experts nominated by government and Industry Parties, an economic expert, a standing member representing Industry Parties and an independent chair from PHA.

The Categorisation Group makes a recommendation on an EPP category to the Relevant (Affected) Parties. Relevant Parties must unanimously agree on the EPP category for it to be included in the EPPRD.

Table 53. Emergency Plant Pest 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 ▪ 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 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.

TRANSITION TO MANAGEMENT

In some cases, EPPs are not able to be eradicated through a response under the EPPRD. In 2016, a Transition to Management (T2M) phase was incorporated into the EPPRD following approval by all EPPRD Parties.

T2M may only be initiated under certain circumstances. Its aim is to provide a formalised structure for transitioning a response under the EPPRD from the eradication of an EPP under an approved Response Plan to management of the EPP outside of the EPPRD processes.

The objectives and activities undertaken during T2M are considered on a case-by-case basis and will depend on the biology of the pest and the circumstances relating to the stage of the response. Activities might include development of control options and tools to support pest management, research to improve knowledge of the pest or communication, engagement and training activities.

Prior to the inclusion of T2M in the EPPRD, the processes of the EPPRD ceased once a decision that an EPP was not eradicable had been made. This left no clear path for decision making and Cost Sharing of any further activities that are in the national interest and were required to support the response stand down process.

Parties agreed that the T2M phase in the EPPRD would only apply in a situation where an eradication program fails. That is where a Response Plan has been agreed and implemented and the NMG has subsequently determined that it is no longer feasible to eradicate the EPP.

EVALUATING ACTIVITIES UNDER THE EPPRD

To maintain the ongoing relevance and integrity of the EPPRD, Parties undertake continual evaluation of its performance, including specific response debriefs.

The Evaluation and Lessons Management Specialist Task Group is a skills-based working group that ensures best practice is applied to all processes and systems nationally, and that lessons learnt from evaluations are effectively shared across the biosecurity sectors.

For more information on the EPPRD go to **planthealthaustralia.com.au/epprd**

Local Land Services, industry representatives, Biosecurity Queensland and NSW DPI staff worked together during Exercise Border Bridge. Image courtesy of NSW DPI

Participants undertaking a practical exercise while training for a Certificate III in Public Safety (Biosecurity Response Operations)

Managing biosecurity incidents

BIOSECURITY INCIDENT MANAGEMENT SYSTEM

Across all sectors, biosecurity incidents are managed in accordance with the **Biosecurity Incident Management System** (BIMS).

The system is an 'all hazards' approach, which:

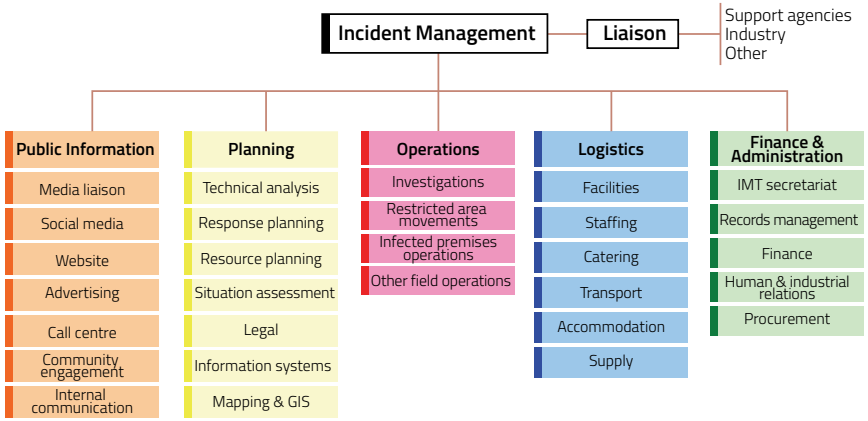
- co-exists with and complements current, sector specific and jurisdictional response arrangements
- can be applied to all biosecurity incidents, irrespective of sector or scale of response
- provides a guide for personnel working within operations centres established at national, state, territory, local and field levels.

Importantly, BIMS is consistent with contemporary incident management systems employed by other emergency response agencies across Australia and in other countries, including Australasian Inter Services Incident Management System, Australia Emergency Coordination System and the New Zealand Critical Incident Management System.

In a biosecurity incident, responses are managed by incident management teams. Figure 94 shows one example of an Incident Management Team structure. A range of positions and functions may be needed, depending on the level of the incident.

Since the system is consistent with other incident management systems, response capacity can be boosted more easily in the event of a large or long-term response. With roles consistent across the systems, people who have been involved in one response can be more readily co-opted and integrated into another.

Figure 94. Incident management team structure for biosecurity incursion responses



A range of positions and functions in the response team may need to be established, depending on the level of the incident. Image courtesy of the Department of Agriculture and Water Resources

THE NATIONAL BIOSECURITY RESPONSE TEAM

The National Biosecurity Response Team (NBRT) is a group of trained and experienced personnel, drawn from biosecurity agencies across Australia, who can be deployed to a jurisdiction to boost capacity temporarily to assist in a response to a biosecurity incident. Deployment might be in response to an animal, plant, aquatic or environmental biosecurity incident.

Members are government officers with knowledge, experience and training in emergency management, incident management or more specifically, responding to biosecurity incidents. They may be deployed in a State Coordination Centre or Local Control Centre to perform functions including incident management, liaison, public information, planning, operations and logistics.

The NBRT has two cohorts of members: a cohort of experienced functional response personnel and a cohort of highly experienced mentors. The NBRT program is managed by an Advisory Group, with standing members from the Australian Government Department of Agriculture and Water Resources, Animal Health Australia and PHA.

Animal Health Australia manages the NBRT outside of any biosecurity response activities. Members of the team participate in relevant professional development opportunities and maintain their skills in exercises and responses.

Participants at the inaugural meeting of the Biosecurity Emergency Response Training Australia Community of Practice held in Adelaide

COMMUNICATION IN AN EMERGENCY PLANT PEST RESPONSE

During an EPP response, the relevant state or territory government takes the lead in ensuring that the public and any stakeholders are kept informed about activities. Given the multiple Parties involved, messaging needs to be nationally consistent and coordinated. To help achieve this, nationally agreed talking points are developed with input from all Affected Parties.

National talking points are developed and circulated through members of the National Biosecurity Communication and Engagement Network (NBCEN) which consists of communication managers from the Australian Government, state and territory governments, and organisations including PHA and Animal Health Australia.

NBCEN's process for developing national talking points allows input from these agencies and relevant plant industry peak bodies. Agreed talking points are circulated to all members of the CCEPP which allows for consistent national messaging.

NBCEN also advances preparedness and prevention awareness activities for issues that warrant a national approach to communication and engagement activities.

The Biosecurity Incident Public Information Manual

Effective communication and engagement with those impacted by a biosecurity incident is vital. It aids response activities by informing growers of what they can do to prevent the pest or disease affecting their property, and how to comply with movement and other quarantine restrictions. It also helps the wider community to understand their role in biosecurity.

During a response, agricultural agencies and Affected industries refer to the Biosecurity Incident Public Information Manual (BIPIM), developed by NBCEN. The BIPIM is in line with the Public Information function set out in the Biosecurity Incident Management System. The use of BIPIM ensures that anyone performing a function in public information knows their role and how each of the jurisdictions work with industry to deliver consistent information to stakeholders and the public.

Having specific roles and job cards can help jurisdictions recruit additional resources promptly, when they are needed in a long-term or widespread biosecurity incident. The BIPIM is available as an AUSVETPLAN Resource document from the Animal Health Australia website **animalhealthaustralia.com.au**

A plant health inspector from the National Citrus Canker Eradication Program conducting surveillance activities on a citrus plant. Image courtesy of NT DPIR

Responses to Emergency Plant Pest incursions

Table 54 lists nine Cost Shared responses to EPPs that were ongoing or initiated in 2018 and includes descriptions of past actions and key activities undertaken for those responses. Some ongoing responses that have not progressed to a Cost Shared Response Plan, and for which significant activity occurred in 2018, are also included. In addition to the Cost Shared responses, a number of pests were detected that did not proceed to a Response Plan in 2018. Some have been assessed as requiring no further action, while others were still under investigation in 2018 and further actions may still be taken. These pest detections are listed in Table 55 (**page 192**).

In September 2018 the National Management Group agreed that T2M under the response plan for giant pine scale in Victoria and SA had been completed, bringing the response under the EPPRD to an end. During 2018, T2M activities under the response plan for tomato potato psyllid in WA continued. Extensive testing of psyllids and host plants has not detected *Candidatus* Liberibacter solanacearum.

Eradicating citrus canker in the north

The nationally coordinated citrus canker emergency response has made enormous progress towards eradicating the disease from Australia.

Citrus canker is a contagious disease caused by the bacteria *Xanthomonas citri* subsp. *citri* which can affect all citrus plants including species that are native to Australia. Of particular concern for the citrus industry, infected plants have lesions or cankers which severely impact fruit quality and yield.

In April 2018, the disease was first detected in Darwin, NT, and then in northern WA. It was found on potted lime plants, and all subsequent detections were restricted to potted plants in the home and garden sector. A nationally cost-shared response plan under the EPPRD is underway to eradicate citrus canker. A budget of up to $18.72 million is available to fund response activities until 31 December 2019. The Australian Government, state and territory governments (except Tasmania and the ACT), along with Citrus Australia and Nursery and Garden Industry Australia, are contributing to the funding and implementing the emergency response.

Since citrus canker was detected, movement controls and quarantine measures have been in place to contain the disease. NT and WA residents have been urged to report any purchased citrus plants so they can be checked for signs of infection.

By the end of 2018, the response teams in the NT had removed and disposed of more than 12,000 host plants. In WA, over 1,500 host plants had been removed from restricted areas. Surveillance has demonstrated that citrus canker is not present in any commercial citrus orchards or in any other jurisdictions. The goal is to eradicate citrus canker and to reinstate Australia's 'country freedom' status from the disease.

Table 54. Responses to plant pests under EPPRD arrangements*

Scientific name	Common name	Crops affected	Region	Past action	Situation as of 31 December 2018
Bactrocera dorsalis	Oriental fruit 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 the National Management Group (NMG) endorsed the Exotic Fruit Flies in the Torres Strait Response Plan for the period July 2015 to June 2018. Surveillance and eradication activities occur on an annual basis.	Surveillance and eradication activities in the Torres Strait were ongoing in response to sporadic fruit fly detections.
Bactrocera trivialis	New Guinea fruit fly				
Zeugodacus cucurbitae	Melon fly				
Bactericera cockerelli	Tomato potato psyllid	Tomatoes, vegetables, production nurseries	WA	Detected in Perth in February 2017. NMG endorsed a Response Plan for eradication however subsequently agreed that it was not feasible to eradicate tomato potato psyllid. A Response Plan incorporating Transition to Management activities was approved by the NMG and is aimed at managing ongoing risks and impacts of the psyllid and providing proof of freedom from the pathogen it can vector, *Candidatus* Liberibacter solanacearum (haplotypes A and B).	Transition to Management activities under the Response Plan continued in 2018. Extensive testing of psyllids and host plants had not detected *Candidatus* Liberibacter solanacearum.
Candidatus Liberibacter solanacearum haplotypes D and E	Vegetative disorder, yellows decline	Vegetables, production nurseries	NSW	Haplotypes D and E detected in July 2017 in imported parsley seed. Tracing of imported seed was undertaken. The bacterium has only been detected in unsown imported seeds and not within any host crops being grown in Australia.	Tracing and surveillance activities were ongoing in 2018.
Cryphonectria parasitica	Chestnut blight	Chestnuts	Vic	First detected in September 2010. Response Plan endorsed by the NMG in November 2010 and eradication activities undertaken. Following extensive surveillance activities sporadic detections occurred in 2014, 2016 and 2017. Infected trees and surrounding host trees were destroyed. Response Plan subsequently revised and most recent version endorsed by the NMG in 2017. A Scientific Advisory Panel convened to consider technical information on spore dispersal and latency of the pathogen and recommendations informed revision of the response strategy.	The Response Plan for eradication of chestnut blight was under review. Containment measures remained in place and surveillance activities were ongoing in 2018.

Table 54. Responses to plant pests under EPPRD arrangements* (continued)

Scientific name	Common name	Crops affected	Region	Past action	Situation as of 31 December 2018
Fusarium mangiferae *F. proliferatum* *F. pseudocircinatum* *F. sterilihyphosum* sensu lato (rediagnosed as *F. parvisorum*)	Mango malformation disease (MMD)	Mangoes, production nurseries	Qld, NT	Fusarium species associated with suspected MMD symptoms were first detected in 2007. The CCEPP agreed that three unrelated Incidents of *F. mangiferae* should be considered separately, consistent with the EPPRD. Following consideration of advice from a Scientific Advisory Panel the CCEPP made recommendations to the NMG on the EPP status and technical feasibility of eradication of *F. proliferatum, F. pseudocircinatum* and *F. parvisorum.*	The NMG agreed that the Incident of *F. mangiferae* in Qld and one Incident of *F. mangiferae* in NT had been eradicated. A third Incident of *F. mangiferae* in the NT remained under consideration by the CCEPP. A targeted surveillance program was to be undertaken to inform the course of action. The Incidents of *F. proliferatum, F. pseudocircinatum* and *F. parvisorum* were resolved by the NMG.
Halyomorpha halys	Brown marmorated stink bug (BMSB)	Various fruits and vegetables, hazelnuts, cotton, grains, production nurseries	NSW	Detected in 2017 in imported cargo at two sites in Western Sydney. Treatment, surveillance, trapping and tracing activities undertaken. A Response Plan was endorsed by the NMG in December 2017.	Treatment and surveillance activities continued under the Response Plan. The NMG agreed that BMSB had been eradicated. General surveillance and early reporting were promoted through awareness activities.
H. halys	BMSB	Various fruits and vegetables, hazelnuts, cotton, grains, production nurseries	WA	New incursion in 2018.	BMSB were detected in Perth in February 2018 in a consignment of electrical goods from Italy. A Response Plan was approved by NMG. Treatment and surveillance activities were undertaken. No further BMSB have since been detected.
Marchalina hellenica	Giant pine scale	Pine trees, production nurseries	SA, Vic	Detected in Vic and SA in October 2014. Response Plan endorsed by NMG in March 2015 and eradication activities undertaken. In October 2016 NMG agreed that it was not technically feasible to eradicate *M. hellenica.* A revised Response Plan incorporating Transition to Management was endorsed by NMG, aimed at preparing industry and the community for ongoing management of the pest and minimising future impacts.	In September 2018 the NMG agreed that Transition to Management under the Response Plan had been completed, bringing the response under the EPPRD to an end.
Phyllosticta cavendishii	Banana freckle	Bananas, production nurseries	NT	Detected in July 2013. NMG endorsed a Response Plan in October 2013 and eradication activities were undertaken. Destruction of host material continued and host free period commenced May 2015. Sentinel planting phase commenced May 2016 with the controlled reintroduction of banana plants and ongoing surveillance activities.	Surveillance activities continued to support proof of freedom from banana freckle and the response remained on track to achieve eradication.

Table 54. Responses to plant pests under EPPRD arrangements* (continued)

Scientific name	Common name	Crops affected	Region	Past action	Situation as of 31 December 2018
Varroa jacobsoni	Varroa mite	Honey and various pollination-reliant crops	Qld	Detected on Asian honey bee (*Apis cerana*) in Qld in June 2016. Response Plan endorsed by the NMG in September 2016 and eradication activities undertaken. Surveillance activities ongoing.	There were no further detections of Asian honey bee or *V. jacobsoni*. Proof of freedom surveillance activities were ongoing.
Xanthomonas citri	Citrus canker	Citrus, production nurseries	NT, WA	New incursion in 2018.	Initially detected in Darwin, NT, in April 2018. Subsequent tracing activities identified additional infected plants in northern WA. The Incident was restricted to potted plants in the home and garden sector and there have been no detections in commercial citrus orchards. NMG endorsed a Response Plan in May 2018. Eradication activities were ongoing. This included implementation of containment measures to prevent spread of the disease, surveillance and tracing activities, and destruction of all infected plants as well as host plants within surrounding Restricted Areas. Community engagement and awareness activities were also a focus of activity.

* This table may not reflect all Cost Shared responses in 2018.

Table 55. Plant Pest detections notified under the EPPRD in 2018*

Scientific name	Common name	State
New detections		
Aleurothrixus trachoides	Capsicum whitefly	Qld (Torres Strait)
Apricot latent virus	Apricot latent virus	Vic
Asian prunus virus 2	Asian prunus virus 2	Tas
Barley virus G	Barley virus G	Vic
Citrus viroid V	Citrus viroid V	Qld (Torres Strait), NSW
Citrus viroid VI	Citrus viroid VI	NSW
Columnea latent viroid	Columnea latent viroid	NSW
Cosmopolites sordidus	Banana weevil borer	Norfolk Island (external territory)
Didymella aliena	No common name	Vic
Diplodia scrobiculata	Diplodia dieback	Qld
Discus rotundatus	Rotund disc snail	Vic
Elsinoë citricola	Citrus scab	Qld
Endive necrotic mosaic virus	Endive necrotic mosaic virus	NSW
Erysiphe syringae	Lilac powdery mildew	Vic
Faba bean Breeza virus	Faba bean Breeza virus	NSW
Fusarium sp. AF-7	No common name	Qld
Halyomorpha halys	Brown marmorated stink bug	Vic (Clayton)
Halyomorpha halys	Brown marmorated stink bug	Qld (Fisherman Island)
Halyomorpha halys	Brown marmorated stink bug	NSW (Horsley Park)
Halyomorpha halys	Brown marmorated stink bug	Qld (Lytton)
Halyomorpha halys	Brown marmorated stink bug	Qld (New Chum)
Heliococcus nr *summervillei*	Pasture mealybug	Qld
Impatiens necrotic spot virus	Impatiens necrotic spot virus	NSW
Kilifia deltoides	Coconut scale	Christmas Island (external territory)
Macrophomina pseudophaseolina	No common name	Qld
Nectarine stem-pitting associated virus	Nectarine stem-pitting associated virus	Tas, Vic
Ophiostoma angusticollis	Blue stain fungus	NSW

Scientific name	Common name	State
New detections (continued)		
Ophiostoma dentifundum	No common name	NSW
Ophiostoma pallidulum	Blue stain fungus	NSW
Ozognathus cornutus	Ptinid beetle	NSW
Phodoryctis caerulea	Bean miner	Qld
Phyllosticta cavendishii	Banana freckle	Christmas Island (external territory)
Phyllosticta maculata	Banana freckle	Cocos (Keeling) Island (external territory)
Pseudocercospora opuntiae	Cactus leaf spot	NSW
Pseudomonas syringae pv *actinidiae*	PSA disease	Vic
Pterocomma populeum	Poplar bark aphid	Tas
Puccinia striiformis f. sp. *tritici* pathotype 199 E76A	Wheat stripe rust	Vic
Pyrrhocoris apterus	European firebug	Vic
Ramularia collo-cygni	Ramularia leaf spot	WA
Relative of *Candidatus* Phytoplasma noviguineense	No common name	Qld
Schizentaspidus nr *silvicola*	Circular hard scale	Qld
Trogoderma glabrum	Glabrous cabinet beetle	SA
Xerotricha conspurcara	Snail	Vic
Xyleborinus sculptilis	Bark beetle	Qld
Extensions of geographic and/or host range		
Agrobacterium tumefaciens biovar 1	No common name	Qld
Apis cerana	Asian honey bee	NT
Araecerus fasciculatus	Coffee bean weevil	WA
Ceroplastes stellifer	Stellate wax scale	Qld
Claviceps africana	Ergot of sorghum	NT
Diplodia sapinea	Diplodia blight	Vic
Nasonovia ribisnigri	Currant lettuce aphid	Vic
Neofusicoccum australe	No common name	SA

Table 55. Plant Pest detections notified under the EPPRD in 2018* (continued)

Scientific name	Common name	State
Extensions of geographic and/or host range (continued)		
Neofusicoccum luteum	No common name	Vic
Neoscytalidium dimidiatum	No common name	NT
Nothophoma quercina	Brown spot of jujube	SA, Vic
Phytophthora sp. kelmania	No common name	Qld
Phytophthora multivora	Phytophthora dieback	Qld
Sporothrix stenoceras	No common name	Vic
Tuberolachnus salignus	Giant willow aphid	Qld

* These pests may be new detections, extensions of geographic range or new host records. Some pests that are not listed in this table are still under investigation. If further action is implemented these pests may be reported in future publications.

Brown marmorated stink bug. Image courtesy of Gary Bernon, USDA APHIS, Bugwood.org

Maintaining the capacity to respond to incursions

The effective delivery of Emergency Plant Pest (EPP) responses is supported by preferentially utilising trained and experienced personnel at all levels of the response. This includes representatives from industry and government, and covers the roles on national decision-making committees through to members of control centres and field-based officers.

Provision of this training is primarily provided by state and territory governments, the Australian Government, PHA and peak plant industry bodies, and is offered in a variety of forms, from short presentations and e-learning courses, through to formal educational qualifications.

Parties also undertake simulation exercises, where responders are put through their paces under a simulated incursion scenario, on a regular basis. This provides both practice in EPP responses and improved preparedness by identifying any aspects of the system that need improvement.

Evaluation of incursions and of simulated response exercises are also critical for effective EPP responses and the ongoing relevance and integrity of response systems in Australia. Regular evaluation activities are undertaken by all stakeholders, including PHA.

In addition to emergency response training, a range of related skills-based training is offered to members of the plant biosecurity system. For example, plant pest taxonomic identification and technique-based training is available to members of the National Plant Biosecurity Diagnostic Network to address any gaps in skills or capacity (see Chapter 5).

OVERSIGHT OF BIOSECURITY EMERGENCY PREPAREDNESS TRAINING

The Training Specialist Task Group (TSTG) is a skills-based working group that guides policy and training standards for cross-sectoral biosecurity training. In its national capacity, the group identifies risks, gaps and duplication in biosecurity emergency training, and provides advice and support to trainers. It also ensures that biosecurity emergency training is consistent with contemporary emergency management practices.

The TSTG reports to the National Biosecurity Emergency Preparedness Expert Group and supports delivery of schedule 7 of the Intergovernmental Agreement on Biosecurity (see **page 20**).

QUALIFICATIONS FOR BIOSECURITY EMERGENCY RESPONSES

Three biosecurity emergency response qualifications have been developed and nationally endorsed as part of the Public Safety Training Package. These align with the emergency response role training delivered by jurisdictions, allowing people to achieve formal qualifications based on their work experience and training.

Achieving these qualifications puts 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).

Some Australian universities offer graduate and post-graduate qualifications in biosecurity. These university courses increase awareness in the biosecurity system and provide students with a good grounding for entering the biosecurity workforce.

Examples of the university courses are:

- Graduate Certificate in Plant Biosecurity (Murdoch University)
- Master of Biosecurity (Murdoch University)
- Graduate course in Biosecurity (Australian National University)
- Bachelor of Biosecurity Science (Box Hill Institute).

PRACTICAL TRAINING FOR BIOSECURITY EMERGENCY RESPONSES

National Emergency Plant Pest (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. Training is delivered through a combination of face-to-face sessions and simulation exercises. The aim is to highlight the key elements of the EPPRD and PLANTPLAN, ensuring that members can effectively fulfil their roles and obligations as EPPRD Parties.

Simulation exercises

Practical training in emergency response via simulation exercises is an important component of the National EPP Training Program. These exercises support the other forms of training delivered and test specific aspects of member's biosecurity emergency preparedness. Simulation exercises are run from a national perspective by PHA working with states and industry groups, and also on a state basis. Examples include Exercise Bee Prepared (see page 196) and Exercise Fastidious (see right) which were run by PHA.

Other training scenarios include:

Exercise Border Bridge – On 5–9 March 2018, Exercise Border Bridge was held to test how NSW and Queensland would respond to a biosecurity incident occurring across both jurisdictions. The simulation exercise was run by NSW Department of Primary Industries, Queensland Department of Agriculture and Fisheries, and the National Biosecurity Response Team Advisory Group. Both NSW and Queensland had recently introduced new biosecurity legislation at that time, so the focus of the exercise was the use of legislation, IT systems and existing arrangements to respond to a biosecurity incident.

Exercise Orange Juice – In October 2018, NSW's Department of Primary Industries (DPI) and Local Land Services (LLS) held a discussion exercise in Griffith, NSW, to test the state's preparedness for a detection of citrus canker. A focus of the exercise was the dynamic between DPI and LLS in an emergency response. Participants from both branches and key stakeholders in the NSW citrus industry considered the hypothetical scenario of citrus canker being discovered in a retail outlet in NSW. PHA, Citrus Australia, Nursery & Garden Industry Australia (including NSW & ACT branch) and NSW Farmers also attended the exercise.

Exercise Fastidious tests response to xylella

On 14–15 November 2018, Exercise Fastidious, held in Brisbane, tested elements of a response to a detection of *Xylella fastidiosa*, Australia's number one plant pest threat. The exercise was funded by Hort Innovation and conducted by PHA.

There were 59 attendees at the two-day exercise with representatives from the Australian Government, all state and territory governments, 13 industries, PHA, Hort Innovation, CSIRO and representatives from New Zealand (government and industry). They were asked to test elements of a response to a fictional detection of *Xylella fastidiosa*, with a focus on the production nursery sector and the broader implications to all industries, using the EPPRD framework and principles.

Participants considered the technical feasibility of eradication, complexes (i.e. the combination of xylella and an insect vector), and whether there are any Australian native insect vectors of the disease. They also identified gaps in Australia's preparedness to respond to xylella and developed research questions to fill some of the gaps.

Exercise Bee Prepared

Between March and October 2018, PHA facilitated workshops across the country to test varroa mite (*Varroa destructor*) response arrangements and the availability of resources.

The Australian Government and each state and territory government hosted an Exercise Bee Prepared activity to improve the readiness of governments and the beekeeping industry for a detection of varroa.

At each event, departmental staff and beekeepers worked together on a fictional scenario to develop a response strategy to eradicate varroa mite from a peri-urban environment. Working through this process highlighted ways to improve how Australia responds to exotic pest detections.

To wrap-up the exercise, the Chief Plant Health Managers and Australian Honey Bee Industry Council representatives assessed these elements at a national workshop to decide on an appropriate response and agree on a national approach.

Exercise Bee Prepared near Hobart in Tasmania in July 2018

ONLINE TRAINING IN BIOSECURITY

The e-learning platform BOLT (Biosecurity Online Training), managed by PHA, supports the National EPP Training Program.

Current courses available on BOLT are:

- **PHA Foundation Course** – provides a summary of the Australian biosecurity system and how emergency responses to plant pests are managed under the EPPRD.
- **National EPP Response Management** – introduces the purpose of the CCEPP and the NMG, the roles and responsibilities of and their members, and the decision-making process in an incident.
- **Reporting a Suspect Emergency Plant Pest** – provides information on when and how to report an exotic plant pest.
- **Bee Biosecurity Awareness** – a short awareness course that adds to the information in the Biosecurity Manual for the Honey Bee Industry. It provides an introduction to biosecurity best practice, hive inspections, surveillance, moving hives and how to report a suspect EPP.
- **Biosecurity for Beekeepers** – provides advice on keeping honey bees healthy using industry best practice. This course supports the Australian Honey Bee Industry Biosecurity Code of Practice.

In 2018, the courses were completed just over 1,160 times, with the PHA Foundation Course being completed 395 times, and the Reporting Suspect Emergency Plant Pest and Biosecurity for Beekeepers courses being completed 96 and 486 times respectively. Since BOLT was launched, courses had been completed a total of 3,895 times by the end of 2018.

BOLT courses are open to all plant biosecurity stakeholders and can be accessed through **planthealthaustralia.com.au/bolt**.

Exercise Bee Prepared in Victoria in March 2018

Chapter 7

Post-border biosecurity – controlling pests and weeds

Vegetable crops in Australia are vulnerable to weeds due to regular soil disturbance and fertiliser and irrigation use. However, timely weed control practices can successfully minimise the impact of weeds as in this example near Gatton, Queensland. Image courtesy of M. Coleman, University of New England

Post-border biosecurity – controlling pests and weeds

While many resources are invested in keeping new pests out of Australia and responding to pest detections, existing pests and weeds require biosecurity measures to prevent further spread. This chapter describes biosecurity measures that apply to pests found in certain parts of Australia, pests that are established and must be managed, and weeds.

There is a national system that coordinates domestic quarantine restrictions to prevent pest spread within Australia, but post-border control of pests and weeds is one part of the biosecurity system where agricultural industries and the Australian community have a major role to play.

Most farmers are aware that they have responsibility for controlling pests and weeds on their property and the use of on-farm biosecurity practices is on the rise. However, there is more that producers can do to prevent biosecurity incursions on their properties. This chapter details the communication initiatives to encourage on-farm biosecurity risk mitigation undertaken by PHA and Animal Health Australia, government and industries.

The chapter finishes with an overview of Australia's weed biosecurity system.

PIRSA Biosecurity SA contractor conducting baiting operations during the eradication response to the outbreak of Queensland fruit fly at Loxton. Image courtesy of PIRSA

National and state oversight of domestic quarantine

Plant pests can be spread easily from one part of Australia to another through the movement of plants, plant products, people, soil and equipment. The main concerns are newly established and regionalised pests.

To address this risk, domestic quarantine restrictions imposed on the movement of high-risk items apply in each state and territory. Restrictions operate under state and territory legislation to complement and support the national quarantine legislation that governs the import and export of goods to and from Australia.

SUBCOMMITTEE ON DOMESTIC QUARANTINE AND MARKET ACCESS

To assist with the coordination of domestic quarantine between the state and territory governments the Subcommittee on Domestic Quarantine and Market Access (SDQMA) has been established. This committee consists of senior plant health regulators from state and territory governments, representatives from the Australian Government Department of Agriculture and Water Resources, and an independent chair from PHA.

The objective of the committee is to develop, review and maintain domestic quarantine standards and conditions that allow movement of produce around the country while avoiding the risk of spreading regionalised plant pests. 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.

The subcommittee is tasked with ensuring that conditions are:

- technically justified and least trade restrictive, 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.

It 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.

RESTRICTIONS FOR INTERSTATE TRAVELLERS AND TRANSPORT OF PRODUCE

Anyone travelling within Australia, moving house across regional or state borders, or moving produce around the country is bound by restrictions on what they can and cannot carry set by state and territory governments.

Rules apply to high-risk material including plants and plant products, fruit and vegetables, honey and beekeeping equipment, soil, agricultural machinery and recreational equipment.

The website **interstatequarantine.org.au** provides information on domestic quarantine restrictions for travellers and producers. This information is also in a booklet – Australian Interstate Quarantine: A Traveller's Guide – which was updated in November 2018.

There are interstate quarantine bins at domestic airports, ferry terminals, and state or quarantine zone borders. Travellers must dispose of any restricted products at those points. Rules change as new pest incursions occur, so travellers are advised to check on the Australian Interstate Quarantine website for the latest information.

Restrictions for interstate export

Commercial trade in products being moved around Australia is managed by the individual states and territories, who provide certificates for each consignment attesting that the goods meet the receiving state or territory's entry conditions. Consignments of produce that originate from a controlled region can be shipped into a region that does not have the pest of concern, if the produce is certified to have been treated in such a way that it no longer poses a biosecurity risk. It might be growing or packing produce in a particular way, such as under cover, or being treated after harvest.

There are three types of certificates that may be issued to certify that produce for interstate trade meets the receiver's requirements:

- **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. To issue these certificates – known as an Interstate Certificate of Assurance (ICA) – a business must meet specific requirements and undergo regular audits by the state or territory government accreditation authority.
- **BioSecure HACCP Biosecurity Certificate** – where certificates are issued through a third party. In 2018, Nursery and Garden Industry Australia received approval to issue the first certificates of this type.

In 2018, states and territories updated several ICAs to mitigate the risks from Queensland and Mediterranean fruit fly, and green snail. Two new ICAs were issued for bananas from properties affected by Panama TR4, and for the treatment and inspection of cut flowers for tomato potato psyllid. The Australian Interstate Quarantine website lists all ICAs by state or territory and holds the Schedule of National Interstate Certification Assurance Documents, a complete list of ICAs.

OFFICIAL CONTROL OF QUARANTINE PLANT PESTS TO PROTECT OVERSEAS TRADE

Since 2017, the Plant Quarantine Pest and Official Control National Policy – implemented by the Chief Plant Health Managers across Australia – has helped to contain and control new plant pests and diseases, while allowing the Australian Government to continue to regulate imports to prevent pest entry. The policy also facilitates exports, so growers can continue sending their products to overseas markets.

On occasions, an exotic plant pest or disease may enter Australia that cannot be eradicated. In these circumstances, responsibility for managing the pest or disease rests with industry and the government of the state or territory in which it occurs.

When 'official control' is applied, the state or territory government has put in place measures that aim to contain and control the pest or disease. These mandatory activities include:

- containment or suppression activities (mostly involving destruction, disposal and decontamination)
- surveillance in the area where the pest or disease could establish
- movement restrictions so the pest or disease does not spread to an area that is not affected.

Official control can be applied at a regional or national level. If it is applied nationally, it must be consistent across all states and territories.

When an exotic pest or disease enters and is officially confirmed to be in Australia, the Department of Agriculture and Water Resources has an obligation to notify the International Plant Protection Convention. When other countries become aware of the presence of the pest or disease in Australia, it can trigger trade bans or restrictions on our exports, as well as requests for Australia to review its current import conditions.

If Australia can provide trading partners with evidence that the pest or disease is under official control, the department can continue to justify regulating international imports to prevent exotic pest entry.

Official control may also underpin negotiations for export with concerned trading partners to accept plants or products that have been produced in areas of Australia that are not affected by the pest or disease, or are treated to importing country standards to manage the biosecurity risk. If an established pest is not under official control, the department cannot justify continuing to prevent the pest's entry by regulating imported goods and conveyances for that pest.

While there are numerous benefits in implementing official control, there are also costs associated with containment, surveillance and movement restrictions. State and territory governments, in consultation with peak industry bodies, must determine whether official control is cost-beneficial or whether other management options are more appropriate for the plant pest.

AUSTRALIA'S REGIONALISED PESTS

When pests that have the potential to damage the environment or agriculture are detected, eradication is the ideal goal. In some cases, however, a pest cannot be eradicated. Depending on the circumstances, domestic quarantine measures may be implemented to contain the pest, minimising negative impacts.

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.

In addition to introduced pests, some regionalised pests are native to parts of Australia, notably the Queensland fruit fly which is found on the east coast but not in SA, Tasmania or WA.

Table 56 lists the 92 regionalised pests recognised by formal legislation and their current area of distribution within Australia. These are the pests that domestic quarantine measures aim to contain.

Table 56. 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 Queensland Fruit Fly Control Zone on the Victorian border as defined in *Biosecurity (Queensland Fruit Fly) Control Order 2017* under the *Biosecurity Act 2015*
Banana bunchy top virus (Babuvirus)	Banana bunchy top virus	Present within the Banana Bunchy Top Virus Control Zone on the far north coast as defined in the *Biosecurity (Banana Bunchy Top Virus) Control Order 2017* under the *Biosecurity Act 2015*
Daktulosphaira vitifoliae	Grapevine phylloxera	Present within the Grapevine Phylloxera Infested Areas, comprising the Sydney and the Albury-Corowa regions as defined in the *Biosecurity Regulation 2017* under the *Biosecurity Act 2015*
Panonychus citri	Citrus red mite	Present within the Citrus Red Mite Biosecurity Zone, comprising the Cumberland and Northumberland counties as defined in the *Biosecurity Regulation 2017* under the *Biosecurity Act 2015*
Ralstonia solanacearum	Bacterial wilt of potatoes	Endemic in NSW excluding the Seed Protected Area, comprising specific areas within the Central Tablelands and Northern Tablelands as defined in the *Biosecurity Regulation 2017* under the *Biosecurity Act 2015*
Spongospora subterranea	Powdery scab of potatoes	Endemic in NSW excluding the Seed Protected Area, comprising specific areas within the Central Tablelands and Northern Tablelands as defined in the *Biosecurity Regulation 2017* under the *Biosecurity Act 2015*

Table 56. Australia's regionalised pests (continued)

Scientific name	Common name	Area of regionalisation
		Northern Territory
Aleuroidicus 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
Cryptosporiopsis citri	Cryptosporiopsis leaf spot	Darwin, Darwin rural area, Batchelor, Daly River, Litchfield region
Cucumber green mottle mosaic virus	Cucumber green mottle mosaic virus	Darwin rural area, Katherine, Alice Springs (Ti Tree)
Fusarium oxysporum f. sp. *cubense* (tropical race 4)	Panama disease	Darwin rural area
Fusarium oxysporum f. sp. *niveum*	Fusarium wilt of watermelon	Darwin, Darwin rural area, Katherine
Idioscopus clypealis	Mango leaf hopper	Tiwi Islands, Darwin rural area
Idioscopus nitidulus	Mango leaf hopper	Darwin, Palmerston, Darwin rural area, Adelaide River, Pine Creek, Katherine
Monomorium dichroum	Monomorium dichroum	Darwin
Parlatoria blanchardi	Date palm scale	Alice Springs
Phakopsora cherimoliae	Phakopsora rust	Darwin rural area
Pineapple mealy bug wilt associated virus (PMWaV-1, PMWaV-3)	No common name	One property only (Darwin Correctional Facility Shoal Bay)

Bunched flowers are a symptom of mango malformation disease. Image courtesy of Barry Conde, NT DPIR

Preserved specimen of a yellow crazy ant queen. Image courtesy of NSW DPI

Table 56. Australia's regionalised pests (continued)

Scientific name	Common name	Area of regionalisation
Northern Territory (continued)		
Pseudocercospora purpurea	Cercospora spot	Darwin rural area
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
Uredo morifolia	Mulberry rust	Dundee Downs, Palmerston, Noonamah, 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 Twyford (near Mossman), west of Dimbula and south to Feluga
Banana bunchy top virus (Babuvirus)	Bunchy top	Noosa south to the NSW border
Chilo terrenellus (Pagenstecher)	Sugarcane stem borer	Detected on a number of occasions in sugarcane on two of the three Torres Strait islands closest to PNG (Saibai and Dauan)
Cucumber green mottle mosaic virus	Cucumber green mottle mosaic virus	Confined to three quarantined properties in central and south-east Queensland
Cryptotermes brevis	West Indian drywood termite	Greater Brisbane, Wide Bay–Burnett, Rockhampton, Bowen, Townsville
Deanolis sublimbalis	Red banded mango caterpillar	Far northern Cape York Peninsula
Eumetopina flavipes (Muir)	Island sugarcane planthopper	Torres Strait island archipelago and the northern peninsula area of Cape York
Fiji disease virus	Fiji disease virus	Sugarcane biosecurity zones 4, 5 and 6

Table 56. Australia's regionalised pests (continued)

Scientific name	Common name	Area of regionalisation
Queensland (continued)		
Fusarium oxysporum f. sp. *Cubense* (race 1, race 2, subtropical 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 (north of Bundaberg) Races 1, 2 and subtropical race 4 are no longer in regulation, although the General Biosecurity Obligation (GBO) applies Race 4 (tropical) detected in 2015 and 2017 on two separate properties. A containment program remains in place
Idioscopus clypealis	Mango leaf hopper	Cape York Peninsula and Mareeba area, south to Atherton, and along the coast from Wangetti to Gordonvale. Managed under the GBO
Idioscopus nitidulus	Mango leaf hopper	Cape York Peninsula. Managed under the GBO
Liriomyza sativae	Vegetable leafminer	Northern Peninsula area of Cape York Peninsula
Mycosphaerella fijiensis	Black sigatoka	Some northern and eastern Torres Strait Islands
Papaya ringspot virus (Potyvirus)	Papaya ringspot virus	South-east Queensland as far north as Bundaberg area
Planoccoccus lilacinus	Coffee mealybug	Boigu Island, Torres Strait Islands
Procontarinia spp.	Mango leaf gall midge	Torres Strait and northern tip of Cape York Peninsula
Pseudococcus cryptus	Cryptic mealybug	Islands in the Torres Strait and isolated places in North Queensland, including Cairns, not widely distributed
Pseudococcus jackbeardsleyi	Jack Beardsley mealybug	Torres Strait Islands and the Cape York Peninsula
Pseudocercospora purpurea	Cercospora leaf spot	Mareeba Shire Council and Tablelands Regional Council
Sugarcane mosaic virus (strain A) (Potyvirus)	Sugarcane mosaic virus	Sugarcane biosecurity zones 4, 5 and 6
Sugarcane striate mosaic-associated virus (Carlavirus)	Sugarcane striate mosaic virus	Sugarcane biosecurity zone 2 and 6
Tetranychus piercei	Spider mite	Weipa, Cape York Peninsula
Thrips palmi	Melon thrips	South-east Queensland as far north as Bundaberg area. North Queensland coastal areas from Ayr to Mossman and Atherton Tablelands
Wasmannia auropunctata	Electric ant	Far north Queensland, Cairns hinterland and Bingle Bay
South Australia		
Achroia grisella	Lesser wax moth	Endemic across all of SA
Galleria mellonella	Greater wax moth	Endemic across all of SA
Ascosphaera apis	Chalkbrood	Endemic across all of SA
Aethina tumida	Small hive beetle	Limited known distribution within all of SA not known to occur on Kangaroo Island
Paenibacillus larvae	American foulbrood	Endemic across most of SA not known to occur on Kangaroo Island
Melissococcus pluten	European foulbrood	Endemic across most of SA not known to occur on Kangaroo Island
Nosema apis	Nosema	Endemic across all of SA
Nosema ceranae	Nosema	Endemic across most of SA not known to occur on Kangaroo Island
Grapevine pinot gris virus	Grapevine pinot gris virus	Limited distribution – further surveillance required to define spread
Diuraphis noxia	Russian wheat aphid	Endemic within SA's cereal growing regions
Cucumber green mottle mosaic virus	Cucumber green mottle mosaic virus	Known to be present on three properties on the Northern Adelaide Plains. Under active eradication
Chortoicetes terminifera	Australian plague locust	Endemic within all of SA

Table 56. Australia's regionalised pests (continued)

Scientific name	Common name	Area of regionalisation
Victoria		
Bactrocera tryoni	Queensland fruit fly	Permanent fruit fly zones (refer to specific gazetted orders)
Cornu apertus (syn. *Cantareus apertus*)	Green snail	Management of green snail linked and infested lands (refer to specific gazetted orders)
Daktulosphaira vitifoliae	Grapevine phylloxera	Phylloxera Infested Zone and Phylloxera Free Zone (refer to specific gazetted orders)
Globodera rostochiensis	Potato cyst nematode	Management of potato cyst nematode linked and infested lands, and Plant Protection District (refer to specific gazetted orders)
Western Australia		
Achroia grisella	Lesser wax moth	Regulations or controls for movement and control in specified areas
Aethina tumida	Small hive beetle	Kimberley Region. Host material restricted from movement to rest of state
Bemisia tabaci (B biotype)	Silverleaf whitefly	Perth and Carnarvon. Host material restricted from movement to Kununurra
Brontispa longissima	Palm leaf beetle	Broome. Host material restricted from movement to rest of state
Cornu apertus (syn. *Cantareus apertus*)	Green snail	Regulations or controls for movement and control in specified areas
Ceratitis capitata	Mediterranean fruit fly	Absent from east Kimberley region (Ord River Irrigation Area). Regulations or 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 and Carnarvon. Host material restricted from movement to rest of state
Cryptolestes ferrugineus	Flat grain beetle	Regulations or controls for movement and control in specified areas
Cryptolestes pusillus	Flat grain beetle	Regulations or controls for movement and control in specified areas
Ephestia elutella	Tobacco moth	Regulations or controls for insecticide resistant strains

Scientific name	Common name	Area of regionalisation
Western Australia (continued)		
Ephestia kuehniella	Mediterranean flour moth	Regulations or controls for insecticide resistant strains
Fusarium oxysporum f. sp. *cubense* (race 1)	Panama disease	Carnarvon. Host material restricted from movement to rest of the state
Galleria mellonella	Larger wax moth	Regulations or controls for movement and control in specified areas
Hylotrupes bajulus	European house borer	Regulations or controls for movement and control in specified areas
Oryzaephilus surinamensis	Sawtooth grain beetle	Regulations or controls for insecticide resistant strains
Pentalonia nigronervosa	Banana aphid	Carnarvon. Host material restricted from movement to rest of the state
Plodia interpunctella	Indian meal moth	Regulations or controls for insecticide resistant strains
Potato spindle tuber viroid	Potato spindle tuber viroid (PSTVd)	Carnarvon
Rhyzopertha dominica	Lesser grain borer	Regulations or controls for insecticide resistant strains
Sitophilus granarius	Granary weevil	Regulations or controls for insecticide resistant strains
Sitophilus oryzae	Rice weevil	Regulations or controls for insecticide resistant strains
Sitotroga cerealella	Angoumois grain moth	Regulations or controls for insecticide resistant strains
Thrips palmi	Melon thrips	Kimberley (low pest prevalence area)
Tribolium castaneum	Rust red flour	Regulations or controls for insecticide resistant strains
Tribolium confusum	Confused flour beetle	Regulations or controls for insecticide resistant strains
Trogoderma variabile	Warehouse beetle	Regulations or controls for movement and control in specified areas

PREVENTING THE SPREAD OF FRUIT FLIES

Australia is fortunate to be free of some of the most damaging fruit fly species that occur overseas. Some of these – like the Oriental fruit fly, Natal fruit fly, melon fly and peach fruit fly – would cause considerable damage to crop production in Australia should they establish here. To ensure we remain free of these devastating pests Australia has an extensive system of surveillance and an ongoing response in the Torres Strait.

Two fruit fly species in Australia are significant pests economically – Queensland fruit fly and the Mediterranean fruit fly. They are the focus of pest management programs and quarantine restrictions to prevent Queensland fruit fly from spreading into Tasmania, WA and SA and Mediterranean fruit fly spreading from WA.

Given the widespread ramifications of fruit flies, it is in everyone's interest to prevent exotic fruit flies from reaching or becoming established in Australia and to tackle fruit fly management collectively.

The National Fruit Fly Strategy is a collaborative approach to managing pest species developed by PHA in 2008. A cost-benefit analysis undertaken in 2012 by the Australian Bureau of Agricultural and Resource Economics and Sciences estimated that, if fully implemented, the national strategy could generate benefits of between $29 and $38 million per year.

The National Fruit Fly Council oversees and monitors implementation of the strategy, continuing the work begun by the National Fruit Fly Strategy Advisory Committee which performed this role from May 2014 to September 2015. The Council includes representatives from governments, industry and Hort Innovation. It has an independent chair and is supported by a National Manager and a secretariat from PHA.

The Council aims to help 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. It focuses its efforts across four areas:

- systems for the prevention, detection, eradication and management of fruit flies
- maximising market access, including activities that assist in securing entry conditions for horticultural produce into markets
- legislation and regulation that supports fruit fly management, is harmonised across Australia and is consistent with international standards
- research and development to ensure that innovative solutions and technically justifiable approaches are available to meet the requirements of the three areas above.

Regular meetings of the Council provide an important opportunity to identify priority areas for action and to promote coordination of activities between its members. It is also working to improve the general awareness of fruit fly as important pests, of how they can be managed, and of the Council's role in a nationally coordinated system.

The website **preventfruitfly.com.au** provides information for backyard growers and commercial producers. It is supported by an e-newsletter and Twitter to keep stakeholders informed.

Mediterranean fruit fly. Image courtesy of Scott Bauer, USDA Agricultural Research Service, Bugwood.org

Farmers are expected to stay informed about and appropriately manage the pests and diseases that could affect or be carried by their crops and livestock

Community involvement in domestic quarantine

THE BIOSECURITY OBLIGATIONS OF ALL AUSTRALIANS

Abiding by international and domestic border restrictions is one role that all Australians must play in maintaining Australia's biosecurity status. In addition, everyone has an obligation to do what they can to avoid spreading plant pests and weeds, to keep a lookout for anything unusual and report unfamiliar pests. In two states, NSW and Queensland, governments have included these obligations in legislation.

The introduction of a general biosecurity obligation or duty makes explicit the role that everyday Australians have to play in the biosecurity system. A biosecurity risk exists when dealing with any pest, disease or contaminant. This includes moving an animal, plant, turf, soil, machinery and equipment that could carry a pest, disease or contaminant.

People in the two eastern states are now required by law to take all reasonable and practical steps to prevent or minimise the risk of causing a biosecurity 'event' and limit the consequences of such an event. A biosecurity event is caused by a pest, disease or contaminant that is, or is likely to become, a significant problem for human health, social amenity, the economy or the environment.

Australians are not expected to know about all biosecurity risks but are expected to know about those associated with their day-to-day work and hobbies. For example:

- Those who live or work in a biosecurity zone (for example a builder or developer in a fire ant biosecurity zone) are expected to know what can and cannot move in to and out of the zone, and any other precautions required.
- Residential gardeners are expected to know the basics about reducing the risks of spreading a pest or disease, and the problem pests in their local area. They will not be expected to know about all of the biosecurity risks to plants.
- Farmers are expected to stay informed about and appropriately manage the pests and diseases that could affect or be carried by their crops and livestock, as well as weeds and pest animals that could be on their property.
- Land owners are expected to stay informed about and appropriately manage the weeds and pest animals (such as wild dogs) that could be on their property.
- Transporters of agricultural produce are expected to check whether the transportation of goods could spread diseases or pests and, if so, to manage the risks appropriately.

To learn more about the new laws, go to the Queensland and NSW government websites.

THE ROLE OF LOCAL GOVERNMENT

As the community's closest tier of government, local government is a key stakeholder in biosecurity management. Local government's involvement in biosecurity varies from state to state and even from region to region, but generally includes:

- management of pest species on land owned by local governments
- on-going support for local community groups in the area of natural resource management including the management of post-border invasive species
- developing and enforcing pest management local laws under the *Local Government Act 1995*
- providing tools, management plans, staff support and training on post-border biosecurity issues
- delivering environmental education programs and other information relating to biosecurity in the community
- regional collaboration between local governments to deal with regional biosecurity issues
- providing field trial sites for biological control of certain weeds.

CONTROLLING PESTS THROUGH AREA WIDE MANAGEMENT

Area wide management is an approach to pest management that operates in a geographic area. It can be applied to many pests but is currently a widespread technique for managing pest species of fruit flies. Area wide management often requires cooperation from Australian communities to be effective.

Recent years have seen the southward spread of Queensland fruit fly into southern NSW and northern Victoria. Areas previously free from this pest or experiencing only very low numbers are now having to manage the pest. Given the deregistration of several agricultural chemicals previously used for fruit fly control, in some regions area wide management is a necessary management strategy.

As a result, regional groups are taking a proactive approach to managing fruit flies in local areas. Area wide management can involve a range of techniques such as trapping, protein baiting, orchard hygiene (particularly picking up fallen fruit), sterile insect release, cover spraying and scouting.

Area wide management is only effective if all stakeholders take steps to reduce fly populations. This includes efforts by residents of urban areas and regional towns who need to reduce fruit flies in their gardens.

National Fruit Fly Symposium helps set direction

On 14–15 August 2018, the National Fruit Fly Symposium was held in Melbourne and was attended by around 90 people including representatives from Australia's horticultural industries, researchers, pest control advisers and government agencies.

Attendees considered current progress and future priorities for managing fruit flies, in the lead up to a review of the National Fruit Fly Strategy. They were also updated on:

- current fruit fly research, development, management and extension activities
- future opportunities and market access aspirations for Australian horticulture
- recent activities to improve community engagement in fruit fly control and to get better extension of R&D outcomes
- priority areas for future investment and effort, including research, market access, pest management and policy.

Participants were confident that a suitable range of tools was available to manage fruit flies, and supported ongoing efforts to protect Australia from exotic fruit flies. They also recognised the importance of Australia's favourable pest status and minimising the spread and impact of fruit flies across the country.

Around 90 people representing horticultural industries, researchers, pest control advisors and government agencies attended the National Fruit Fly Symposium

On-farm biosecurity

On-farm biosecurity is a set of measures producers can use to protect a property from the entry and spread of pests, diseases and weeds. On-farm risk mitigation establishes another layer of protection for a farm, allowing producers to mitigate new pest problems as well as boosting biosecurity for their region, their industry and supporting market access for produce.

On-farm biosecurity measures are most effective when integrated into everyday activities. Often measures are procedural, such as changing vehicles between zones on a property, providing footwear for visits to production areas, disinfecting pruning shears and ensuring that farm inputs are clean and disease free. These measures and information about the pests of their crop are included in biosecurity manuals (see page 61).

Increasingly, growers are appreciating the benefits of on-farm biosecurity. The rate of uptake of on-farm biosecurity risk mitigation varies between and within industries. Increasing this uptake is the remit of a number of programs, described in the following pages.

THE FARM BIOSECURITY PROGRAM

Recognising the increasing number of mixed farming enterprises in Australia, PHA and Animal Health Australia (AHA) work together in a joint communication and awareness program, 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 and tools, including biosecurity manuals, templates for record keeping, farm biosecurity gate signs to download or order, industry specific information, videos outlining best practice, a personal profile builder, a biosecurity planner and a planning app.

Resources produced by Farm Biosecurity are structured around the six biosecurity essentials:

- farm inputs
- people, vehicles and equipment
- production practices
- feral animals and weeds
- farm outputs
- train, plan and record.

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.

The Farm Biosecurity Producer of the Year Award was established by PHA, AHA and the Department of Agriculture and Water Resources to recognise the contribution of producers who demonstrate outstanding, proactive on-farm biosecurity practices.

Banana growers recognised in biosecurity awards

In March 2018 the Australian Biosecurity Awards were presented at the ABARES Outlook Conference in Canberra. The winners of the inaugural Farm Biosecurity Producer of the Year Award were Mackay Farming Group from Tully, Queensland, and Rum Jungle Organics, from Batchelor in the NT.

Mackay Farming Group owns Bolinda Estate, a banana farming business located in Tully struck by Panama disease tropical race 4 (TR4) in July 2017. Because of their sound biosecurity practices on farm they were well positioned to deal with this non-eradicable fungal disease which can spread in soil, water and infected plant material.

When Bolinda Estate was placed under quarantine following a positive test result for TR4, the existing biosecurity measures they had in place allowed them to keep the business going with only a few hours down-time by isolating sections of the property.

Rum Jungle Organics principally grew bananas, but after the discovery of banana freckle in 2013, all banana trees on their property had to be destroyed and disposed of as part of the National Banana Freckle Eradication Program.

This resulted in owners Alan Peterson and Julie-Ann Murphy having virtually no farm income for four years. They undertook a complete review of their biosecurity practices and after being allowed to re-plant a new crop of bananas, the plants are now producing fruit and they can once again sell top quality fruit at the local markets.

(L to R) Biosecurity award winners Gavin and Cameron Mackay from Mackay Farming Group; Alan Peterson from Rum Jungle Organics; Greg Fraser from PHA; Julie Anne Murphy from Rum Jungle Organics; Jim Pekin from Australian Banana Growers' Council.

BIOSECURITY EXTENSION AND ENGAGEMENT PROGRAMS

Through the leadership of their peak bodies, plant industries are becoming increasingly involved in biosecurity communication and engagement. Biosecurity extension and engagement programs are funded by PHA member industries to improve the management of, and preparedness for, biosecurity risks at the farm level. Biosecurity officers associated with some of these programs are often funded by grower levies and so tend to work with producers of particular crops.

Some state governments have additional outreach programs with officers who work with groups of producers and others along the supply chain to strengthen the state's biosecurity system. For example, the NSW Local Land Services brings together agricultural production advice including biosecurity, natural research management and emergency management for farmers, landholders and the community.

Grains Farm Biosecurity Program

The Grains Farm Biosecurity Program is funded by grain producers and managed by PHA and Grain Producers Australia, in partnership with the governments of five grain-producing states. Grains Biosecurity Officers are responsible for raising awareness of biosecurity management practices among grain growers and others along the supply chain. The officers engage growers at field days and conferences, giving presentations and demonstrations and running training sessions on biosecurity management practices that growers can use to protect their farms.

Since it began in 2007, thousands of in-crop and stored grain pest and disease surveys have been undertaken with industry, improving on-farm biosecurity as well as raising awareness in grain growing regions. Data from these surveys has and continues to be captured within the national reporting tool AUSPest*Check*™. Media, newsletter and Ground Cover articles are distributed year round to raise awareness of seasonal biosecurity risks for grain growers. Biosecurity officers also undertake surveillance for exotic pests of grains and have assisted in various recent incursion responses such as Russian wheat aphid, Khapra beetle and lupin anthracnose.

Recognition for grains farm biosecurity efforts

In March 2018, the Grains Farm Biosecurity Program (GFBP) won an Australian Biosecurity Award, recognising their significant ongoing contribution to Australia's biosecurity integrity.

The biosecurity frontline personnel are the grains biosecurity officers, located in NSW, Queensland, SA, Victoria and WA. Each officer is responsible for raising awareness of biosecurity among grain growers and others along the supply chain in their region, and helping the industry during emergency responses and pest incursions. The faces have changed over the years but, collectively, grains biosecurity officers have attended more than a thousand events and handed out many thousands of farm biosecurity signs, pest fact sheets, manuals and other biosecurity material.

Since 2007 when it began, the grains biosecurity officers have delivered hundreds of training sessions in clubs and halls all over the country to raise awareness of the importance of biosecurity and provide growers with information to protect their properties. They have written articles for Ground Cover magazine and other publications, and worked with individual growers to develop farm biosecurity plans to assist in managing the risk of diseases, pests and weeds.

More information about the program is available from **planthealthaustralia.com.au/gfbp**

(L to R) Victoria's grains biosecurity officer Jim Moran, PHA's Executive Director and CEO Greg Fraser, and GPA's Barry Large at the Australian Biosecurity Awards. Image courtesy of Steve Keough Photography

National Citrus Biosecurity Program

As part of a partnership program funded by Hort Innovation and the Department of Agriculture and Water Resources (through the Agricultural Competitiveness White Paper), a National Citrus Biosecurity Program was initiated in 2017 to improve biosecurity planning, preparedness and awareness in the citrus industry.

During 2018, a National Citrus Biosecurity Coordinator was appointed to work with government and industry to improve surveillance for exotic pests and raise awareness of pest threats among citrus growers and others along the supply chain.

The program has re-established the First Detectors Network, a group of growers and crop scouts who monitor their crops regularly for any sign of exotic pests. The coordinator is also investigating ways to improve awareness and surveillance in peri-urban and urban communities.

Should an exotic pest enter Australia, early detection of incursions helps to limit their spread and minimise the costs of eradication. Improved surveillance also helps to provide ongoing evidence to demonstrate area freedom from pests, to support new market access requests and the maintenance of existing markets.

The Huanglongbing Taskforce was also established in 2018 to identify and coordinate research and extension needed to manage huanglongbing, the most serious High Priority Pest for the citrus industry.

The program is guided by the framework provided by the National Citrus Biosecurity Surveillance Strategy 2018–28, developed by PHA in consultation with Citrus Australia and the Department of Agriculture and Water Resources in 2017. The strategy is aligned with the National Plant Biosecurity Strategy and National Plant Biosecurity Surveillance Strategy, as described in **Chapter 1**.

National Citrus Biosecurity Coordinator Jeff Milne. Image courtesy of Citrus Australia

National Forest Biosecurity Surveillance Program

In 2018, activities to initiate a National Forest Biosecurity Program commenced with the appointment of the National Forest Biosecurity Coordinator co-funded by the Department of Agriculture and Water Resources (through the Agricultural Competitiveness White Paper) and the Australian Forest Products Association. The coordinator is to oversee the establishment of the program which aims to enhance national forest pest surveillance.

The need for a nationally coordinated program comprising stakeholders from industry and government is crucial due to the ever increasing volumes of trade and movement of people and commodities into and within Australia. Climate change is also causing pest pressures and distribution to change worldwide. Improved surveillance will help to provide ongoing evidence to demonstrate freedom from pests and to support early detection of pests.

The National Forest Biosecurity Surveillance Strategy 2018–23 and its Implementation Plan guide the program, in consultation with industry, government and the R&D sector. The forest surveillance strategy is aligned with the National Plant Biosecurity Strategy and National Plant Biosecurity Surveillance Strategy, as described in Chapter 1.

The program started with an assessment of the high-risk pathways for entry of forest pests into Australia and a pilot of High-Risk Site Surveillance in Queensland, NSW and Victoria. The National Forest Biosecurity Surveillance Program is overseen by a National Forest Biosecurity Surveillance Group, with the coordinator working directly with industry, state governments, environmental groups and other forest industry stakeholders.

Vegetable and potato officer Callum Fletcher speaking to growers in Carnarvon, WA, while Vegetables WA Vietnamese industry extension officer, Truyen Vo, translates. Image courtesy of AUSVEG

Vegetable and Potato Farm Biosecurity Program

The Vegetable and Potato Farm Biosecurity Program is an extension and engagement program funded by vegetable growers and managed by PHA and AUSVEG to enhance biosecurity management practices of producers and others along the supply chain in that industry.

It focuses on increasing the awareness and adoption of farm biosecurity among vegetable and potato growers and is increasingly being used as a platform for driving strategically important biosecurity initiatives.

Two dedicated biosecurity officers develop extension and training material, write articles on biosecurity themes for industry magazines, engage with producers at field days, and liaise with growers during pest incursions. In 2018 the officers undertook an urban biosecurity pilot program after many of the recent exotic pest incursions were located at seaports, airports and other urban hotspots across Australian cities.

Throughout 2018, the officers took part in a variety of forums, biosecurity meetings and working groups. Their involvement also precipitated a number of initiatives with industry and researchers to extend surveillance capabilities and improve general surveillance reporting outcomes.

National Bee Biosecurity Program

The National Bee Biosecurity Program is funded by the Australian Honey Bee Industry Council, with support from the state governments, and managed by PHA. It aims to help beekeepers to manage pests that are already in Australia, and to prepare for incursions by exotic pests, through training and education. If there is an exotic pest incursion, the biosecurity officers are available to provide expert support to industry, and to help design and implement response measures.

Bee biosecurity officers are employed in five states, and actively promote adoption of the Australian Honey Bee Industry Biosecurity Code of Practice. 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 for exotic pest threats to the honey bee industry.

Victorian bee biosecurity officer Jess Millar (right) and Agriculture Victoria senior apiary officer Joe Riordan (left) inspecting bee hives in an almond orchard. Image courtesy of Jess Millar

MANAGING PESTS ON-FARM

Australian farmers manage pests with a variety of methods tailored to the type of pest, the crop and agroecological conditions. Most growers use an integrated pest management approach, which means that they combine chemical, cultural, mechanical and biological controls in a flexible way that can change over time.

Chemical control

For the management of many plant pests, pesticides are the fastest and easiest option for control and most growers use at least one type of chemical to maintain productive agriculture. Pesticide availability in Australia is regulated by the **Australian Pesticides and Veterinary Medicines Authority** (APVMA), an independent statutory authority. As the national regulator of agricultural and veterinary chemicals, the APVMA regulates pesticides in line with responsibilities described in the *Agricultural and Veterinary Chemicals (Administration) Act 1992* and the *Agricultural and Veterinary Chemicals Code Act 1994*.

The APVMA exists to ensure that Australia has access to safe and effective agricultural and veterinary chemicals to control pests and diseases on animals and plants. It also monitors and enforces compliance with the Agvet Code and other legislation and keeps a record and register of approved agricultural and veterinary constituents, registered products and approved labels. More information is available from **apvma.gov.au**

All agricultural chemicals sold or used in Australia must be registered with the APVMA. National registration 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 actual use of chemicals is regulated by state and territory governments.

A recent report[20] 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. Table 57 illustrates the amount and type of agricultural chemicals used for controlling plant pests in Australia. This total expenditure on pesticides for plants represents over seven per cent of the gross value of production for all crops in Australia[21]. Although many pesticide products are formulated and packaged in Australia, almost all the active constituent chemicals are manufactured overseas. In the event of an exotic pest incursion, the required chemicals might not be immediately available. PHA facilitates a program to help ensure the availability of pesticides in the event of an incursion, through its emergency permits initiative.

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 tillage methods and changing soil pH levels, irrigation practices and fallow periods, which make the environment less favourable for the survival, growth and reproduction of pest species. These practices can provide significant relief from some pests when used effectively.

Biological control

Biological control is a method of controlling pests using natural enemies. Natural enemies of pests are known as biological control agents and include predators, parasitoids and pathogens. Biological control has been highly successful in many instances, with a number of pest problems permanently solved by importation and successful establishment of biological control agents. Successes tend to be confined to particular ecosystems or pest situations, and when they are effective, can provide long-term and even permanent results.

20. Australian Bureau of Agricultural and Resource Economics and Sciences, Agricultural commodities and trade data, Agricultural Commodities Statistics March 2017. Accessed online 22 July 2019 agriculture.gov.au/SiteCollectionDocuments/abares/data/agricultural-commodities-statistics.xlsx
21. Australian Pesticide and Veterinary Medicines Authority, Gazette No 6 March 2018. Accessed online 22 July 2019 apvma.gov.au/node/29176

Table 57. Sales of plant chemicals in Australia, 2016–18

		Herbicide	Insecticide	Fungicide	Mixed function pesticide	Miticide	Molluscicide	Nematicide	Total
2016	No. of products	3,301	1,445	939	149	131	54	18	**6,037**
	Value of product sales ($ million)	1,717	337	254	32	19	12	4	**2,375**
2017	No. of products	3,363	1,482	967	148	131	54	15	**6,160**
	Value of product sales ($ million)	1,683	484	343	39	36	16	2	**2,603**
2018	No. of products	3517	1515	1021	145	131	52	16	**6,397**
	Value of product sales ($ million)	1,714	413	269	37	20	14	2	**2,469**

Australia's weed biosecurity system

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 threats posed by weeds.

A weed is a plant that requires some form of action to reduce its negative effects on the economy, the environment and human health or amenity.

Weeds displace native species, contribute to land degradation and reduce productivity in addition to the considerable costs of control.

It has been estimated that the cost to the Australian economy from the agricultural impacts of weeds is over $4 billion annually[22]. An estimated 2,300 species currently impact the natural environment nationally, and a further 1,000 species have a direct impact on plant production.

There are far more potential weed species that have not yet entered the country or become established in Australia. In addition, many weeds display a 'lag phase' in which impacts do not become apparent, potentially for decades. As such, many future problem weeds may already be here.

Australia's weed biosecurity system aims to:

- prevent entry of high-risk plant species
- eradicate or contain those in the early stages of invasion
- mitigate the impacts of established weeds.

As with plant pest biosecurity, responsibility for weeds is shared between all levels of government, industry and the community. Legislation across the country sets out the various roles of governments in managing weeds across Australia.

Within Australia, state and territory government departments of primary industries and environment, along with Natural Resource Management authorities, have responsibility for weed biosecurity policy and management.

At the local level, weed surveillance is undertaken by most local councils, which report new weed incursions in their areas. Weed management is a component of on-farm biosecurity activities. Producers of both crops and livestock manage weeds on individual properties to reduce their impacts 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.

22. Sinden JA et al, 2004. The economic impact of weeds in Australia: Report to the CRC for Australian Weed Management, Technical Series No. 8, Adelaide

COORDINATION OF WEED MANAGEMENT

The Environment and Invasives Committee (EIC) provides an intergovernmental mechanism for identifying and resolving weed issues at a national level. It comprises members from the Australian Government and all state and territory governments, plus observers from CSIRO, PHA and the New Zealand Government.

EIC oversees the administration of the Australian Weeds Strategy 2017–27, which is the overarching policy for weed management in Australia. It outlines goals and actions required to keep Australia's economic, environmental and social assets secure from the impacts of weeds. The strategy is reviewed every 10 years to ensure it remains relevant to Australia's needs.

The strategy provides information on where improvements can be made at the national level that will result in benefits across Australia. It draws attention to areas that require national collaboration and will drive the development of consistent and coordinated national approaches by providing clarity around priorities, roles and responsibilities.

The strategy is available at **agriculture.gov.au/SiteCollectionDocuments/pests-diseases-weeds/consultation/aws-final.pdf**

PREVENTING THE ENTRY OF NEW WEEDS

A large percentage of weed species (at least 50 per cent and possibly up to 70 per cent) were originally imported for use as garden ornamentals. However, many of these species were imported a long time ago and modern improvements to biosecurity arrangements have significantly reduced this risk.

The Department of Agriculture and Water Resources develops and implements quarantine policies for plant imports and for the past decade plant imports have been subject to a Weed Risk Assessment. A Permitted Seeds List has also been developed, so that all species not currently in Australia or on the Permitted Seeds List are subject to a risk assessment prior to importation. Australia's Weed Risk Assessment system has been adapted for use in other parts around the world.

Weeds are also an integral part of the Northern Australia Quarantine Strategy, which involves surveillance activities in Australia's north and neighbouring countries.

ERADICATION AND CONTAINMENT OF NEWLY ESTABLISHED WEEDS

Eradication and containment of weeds is only possible if weed incursions are detected early, and a response is mounted before the weeds have a chance to spread too far.

The Australian, state and territory governments manage and coordinate nationally cost-shared invasive weed eradication programs through the Consultative Committee on Exotic Plant Incursions.

The Caring for our Country program coordinates national surveillance, containment and eradication of weed incursions that threaten production or the environment, or impact on trade or communities. Phase two of this program, from July 2013–18, integrates the Natural Heritage Trust, the National Landcare Program, the Environment Stewardship Program and the Working on Country Indigenous ranger programs.

National Tropical Weeds Eradication Program

The National Tropical Weeds Eradication Program commenced in 2003 and targets weed species native to tropical America that are in north Queensland (and one in northern NSW). The program is managed by Biosecurity Queensland and is cost-shared by the Australian, Queensland, NSW, NT and WA governments.

In 2018 the program targeted eradication of:

- limnocharis (*Limnocharis flava*), a wetland plant
- miconia (*Miconia calvescens, M. nervosa, M. racemosa*), rainforest tree and shrubs
- mikania vine (*Mikania micrantha*).

Tropical weed eradication field staff pulling a small miconia tree out of a riparian area in north Queensland. Image courtesy of Brenton Congoo, QDAF

Limnocharis, miconia and mikania vine are all considered serious weeds in other countries, while *Miconia nervosa* and *M. racemosa* have exhibited invasive characteristics in north Queensland. The combined impacts of these weeds on agriculture and the environment in tropical and subtropical areas of Australia would be significant if allowed to spread unchecked. The national eradication program involves targeted weed surveys and weed control, extensive community engagement to identify infested areas and research components. Regular reviews are undertaken to track the progress of the program towards eradication milestones and targets.

During 2018, field teams traversed over 7,000 hectares of rainforest, wetland and riparian areas in north Queensland to search out and remove all seedlings of these species before they were able to mature and produce seed. By removing 99.5 per cent of plants before they become reproductive, in combination with soil seed bank depletion over the past 16 years, all of the target species are on track for complete eradication from the Australian mainland.

Over 80 per cent of the eradication program resources are directed at *Miconia calvescens*, a highly invasive rainforest tree which has been spread by birds from gardens into the nearby Wet Tropics World Heritage Area. Known as the 'purple plague' in Tahiti and Hawaii, the seed of this plant can survive for up to 20 years in undisturbed rainforest, and quickly germinates after cyclones to turn patches of rainforest into monocultures of miconia. Only seven mature plants were detected by teams during 6,000 hectares of surveillance in dense tropical rainforest in 2018.

Eradication of red witchweed

In July 2013, red witchweed (*Striga asiatica*) was detected in sugarcane on six properties in Queensland. Reaching agreement on a national approach to the eradication response was complex, since weeds are not covered under the existing industry and government response agreements, and both plant and livestock industries were considered likely to be affected. Nonetheless, the response to red witchweed has been undertaken according to the principles and arrangements set out in the national eradication agreements.

In April 2016, the Agriculture Ministers' Forum endorsed a 10-year response plan of up to $5.8 million to eradicate red witchweed. The eradication response is led by the Queensland Government and is being funded by Meat and Livestock Australia, Grain Producers Australia and CANEGROWERS.

MANAGING ESTABLISHED WEEDS

Combating weeds is an integral part of most farming systems. Problem weeds and their management differ greatly among 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 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.

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 common in Australia.

Local councils are responsible for weed management on land that they own, control or manage, 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, organise volunteers to restore and maintain local bushland.

Weeds of National Significance

Thirty two Weeds of National Significance (WoNS, see Table 58) have been agreed by the Australian Government, state and territory governments based on assessments of their invasiveness, potential for spread and environmental, social and economic impacts. Consideration was also given to their ability to be successfully managed. A list of 20 WoNS was endorsed in 1999 and a further 12 were added in 2012.

Weeds designated to be of national significance are those that require coordination among all levels of government, as well as organisations and individuals with weed management responsibilities.

A national focus on WoNS continues through the work of the Environment and Invasives Committee and government agencies report to this committee on progress against any remaining actions under the strategic plans.

Table 58. Weeds of National Significance

Scientific name	Common name
Acacia nilotica subsp. *indica*	Prickly acacia
Alternanthera philoxeroides	Alligator weed
Andropogon gayunus	Gamba grass
Annona glabra	Pond apple
Anredera cordifolia	Madeira vine
Asparagus aethiopicus, A. africanus, A. asparagoides (Western Cape form), *A. declinatus, A. plumosus* and *A. scandens.* Excludes *A. officinalis* and *A. racemosis*	Asparagus weeds
Asparagus asparagoides	Bridal creeper
Cabomba caroliniana	Cabomba
Chrysanthemoides monilifera	Bitou bush, boneseed
Cryptostegia grandiflora	Rubber vine
Cytisus scoparius, Genista monspessulana, G. linifolia	Brooms (scotch, montpellier, flaxleaf)
Dolichandra unguis-cati	Cat's claw creeper
Eichhornia crassipes	Water hyacinth
Hymenachne amplexicaulis	Hymenachne
Jatropha gossypiifolia	Bellyache bush
Lantana camara	Lantana
Lycium ferocissimum	African boxthorn
Mimosa pigra	Mimosa
Nassella neesiana	Chilean needle grass
Nassella trichotama	Serrated tussock
Opuntia spp. (except *O. ficus-indica*), *Cylindropuntia* spp., *Austrocylindropuntia* spp.	Opuntioid cacti
Parkinsonia acuteata	Parkinsonia
Parthenium hysterophorus	Parthenium weed

Table 58. Weeds of National Significance (continued)

Scientific name	Common name
Prosopis spp.	Mesquite
Rubus fruticosus aggregate	Blackberry
Sagittaria platyphylla	Sagittaria
Salix spp., except *S. babvlonica, S. x calendendron* and *S. x reichardtii*	Willows
Salvinia molesta	Salvinia
Senecio madagas cariensis	Fireweed
Solanum elaeagnifolium	Silverleaf nightshade
Tamarix aphylla	Athel pine
Ulex europaeus	Gorse

Common water hyacinth (Eichhornia crassipes). Image courtesy of Ted D. Center, USDA Agricultural Research Service, Bugwood.org

Plant Sure scheme to weed out invaders

A pilot project in NSW is testing a voluntary accreditation scheme that will allow the ornamental plant industry to promote environmentally safe plants and help consumers to avoid buying plants that pose a weed risk.

The Plant Sure project has received seed funding from the NSW Environmental Trust to design and develop a scheme in collaboration with the nursery, gardening and horticulture sectors, as well as government agencies and peak environmental community groups.

The project, led by the Nursery and Garden Industry NSW and ACT, involves people working together to reduce the supply and trade of 'high-risk' ornamental plants that may become invasive.

Plant Sure will be a voluntary scheme, with education and engagement strategies that use branding and marketing to discourage the use of 'weedy' ornamental plants in the trade.

Partners will work with the entire supply chain, from breeders and growers to sellers and installers of ornamental plants, and the people that influence plant choice.

Phase 1 of the project, now complete, reviewed 18 different voluntary schemes in Australia and overseas to determine which model might be most suitable. From this, a purpose-built set of tools were developed to assess the risk of invasiveness of ornamental plant species and cultivars. These will be trialed with NSW partners initially, then refined and expanded for use nationally.

Image courtesy of NSW Office of Environment and Heritage

Chapter 8

Plant biosecurity RD&E

Student Saeedeh Noushini analysing samples in a gas chromatograph. This technique is used to investigate the volatile gases produced by Queensland fruit flies; these volatiles are key for reproduction. Image courtesy of ARC Centre for Fruit Fly Biosecurity Innovation

Plant biosecurity research, development and extension

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

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

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

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

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

The data for 2018 provides an overview of all plant, weed and pollinator RD&E in Australia, with a summary of where it was carried out, the size, the topic, pest and crop types[23]. Surveillance programs that include some research or extension activities are also included, as are some training and awareness programs.

Biosecurity Behaviour and Market Research Knowledge Base

The Biosecurity Behaviour and Market Research Knowledge Base was established in 2018 on the Biosecurity Portal **portal.biosecurityportal.org.au**. The site presents published research papers on audience behaviour and attitudes related to biosecurity practice and emergency responses in Australia.

The site serves to inform stakeholder engagement activities to enhance biosecurity preparedness and risk management. Public and private entities can contribute to the site, in consultation with the National Biosecurity Communication and Engagement Network.

23. Every year, the methods used to collect data for this chapter improve incrementally. While every effort is made to secure accurate data for inclusion in Table 59 on page 236, we acknowledge that it is not complete.

National Plant Biosecurity RD&E Strategy

The National Plant Biosecurity RD&E Strategy provides an overarching framework to guide and strengthen cross-sectoral biosecurity RD&E for Australia's plant industries and those dependent on them.

The strategy's objective is to enable the effective management of economic, environmental and social risks posed by established pests as well as those that may enter, emerge, establish or spread within Australia.

Devised in 2013 by PHA in collaboration with stakeholders around Australia, the strategy is a component of the National Primary Industries RD&E Framework. It is overseen by the Agriculture Senior Officials' Committee (AGSOC) whose goal is to implement cross-jurisdictional cooperative and coordinated approaches to matters of national interest such as plant biosecurity research.

The National Plant Biosecurity RD&E Strategy Implementation Committee, which reports to the AGSOC Research and Innovation Committee, is chaired and supported by PHA to drive the agenda and to host workshops focusing on particular biosecurity issues.

In August 2018, a workshop at Charles Sturt University in Wagga Wagga was held to investigate the research and policy gaps around pasture and animal feed biosecurity which was attended by governments, industry and RDCs. The committee also began work on inventories of capacity and capability in nematology and bacteriology to be completed in 2019.

The implementation committee includes representatives from the Australian Government, state governments, PHA, the Council of Rural Research and Development Corporations, Hort Innovation, Grains Research and Development Corporation, Wine Australia, CSIRO and the Plant Biosecurity Research Initiative.

The committee is funded by Hort Innovation, the Victorian Department of Jobs, Precincts and Regions, Cotton Research and Development Corporation, Dairy Australia, Grains Research and Development Corporation, Meat and Livestock Australia, Sugar Research Australia, AgriFutures Australia, Wine Australia and Forest and Wood Products Australia.

Workshop prioritises xylella action

On 15 February 2018 the Department of Agriculture and Water Resources convened a workshop to consider the priority actions identified at the International Symposium on *Xylella fastidiosa* held in May 2017.

Attendees included representatives from peak industry bodies, Vinehealth Australia, Hort Innovation, AgriFutures Australia, the Australian Seedbank Partnership, Australian National Botanic Gardens and PHA, along with state, federal and New Zealand biosecurity agencies.

During the workshop there was strong support for urgent action on key priority areas, including:

- the improvement of diagnostics
- the investigation into potential native insect vectors
- the appointment of a national coordinator for xylella.

Following the workshop three xylella related R&D concepts which aligned with these nationally agreed priorities were tabled at a Plant Biosecurity Research Initiative meeting on 16 February 2018.

Leaf symptoms of Xylella fastidiosa. Image courtesy of Christine Horlock, QDAF

Australian Government agencies and statutory authorities

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

AUSTRALIAN CENTRE FOR INTERNATIONAL AGRICULTURAL RESEARCH

aciar.gov.au

The Australian Centre for International Agricultural Research (ACIAR) works to achieve more productive and sustainable agricultural systems for the joint benefit of developing countries and Australia through international agricultural research partnerships. The research focuses on fields where Australia has special research competence and develops enduring research collaborations as a trusted science partner.

ACIAR's biosecurity projects adopt various approaches and are spread across several program areas, including horticulture, agricultural systems, crop improvement and management and forestry. This research provides a unique opportunity to learn about the biology and management of exotic pests and diseases, preparing for potential exotic incursions, and to develop and share best practice in biosecurity management.

AUSTRALIAN RESEARCH COUNCIL

arc.gov.au

The Australian Research Council (ARC) is an independent agency within the Australian Government's Education and Training portfolio. The ARC's purpose is to grow knowledge and innovation for the benefit of the Australian community by funding the highest quality research, assessing the quality, engagement and impact of research and providing advice on research matters. The ARC plays a leading role in supporting and developing 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

csiro.au/research

As the national science agency, CSIRO pushes the boundaries of what is possible in innovation, science and technology. CSIRO delivers impact nationally and globally through collaboration with industry, governments and communities. CSIRO feeds into the plant biosecurity system via its Health and Biosecurity and Agriculture and Food business units, together with its National Research Collections.

The Health and Biosecurity unit delivers research-based solutions to manage the devastating impacts of invasive alien species such as pests, weeds and diseases. It also helps protect Australia from pests and diseases by assessing the risks they pose, prioritising the pathways of entry and providing new technologies for surveillance and early response through sensor networks and autonomous platforms. The Agriculture and Food unit takes an integrated gene-to-plate approach to improve crop quality and yield.

CSIRO is the custodian of a number of plant and plant pest specimen collections that contribute to national and international biological knowledge that underpin a significant part of the country's taxonomic, genetic, agricultural and ecological research. They include the Australian Tree Seed Centre, Australian National Insect Collection and Australian National Herbarium amongst others.

PLANT INNOVATION CENTRE

The Plant Innovation Centre was launched at the Mickleham Post-Entry Quarantine facility near Melbourne's Tullamarine Airport in November 2017.

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

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

CSIRO's Dr Louise Morin testing the leaf smut fungus Kordyana brasiliensis ahead of its release on the environmental weed wandering trad (Tradescantia fluminensis). Image courtesy of CSIRO

QDAFs Dr Murray Sharman joined DAWR and Timor-Leste Quarantine staff in three surveys to study the virus threats present in Timor-Leste. Image courtesy of CRDC

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.

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

Priority areas are framed and guided by the Australian Government's Rural RD&E Priorities outlined in the Agricultural Competitiveness White Paper, and its national Science and Research Priorities.

Following extensive consultation in July 2015, the Australian Government announced four Rural RD&E Priorities:

- advanced technology
- biosecurity
- soil, water and managing natural resources
- adoption of R&D.

In 2018, 15 rural RDCs covered most Australian agricultural industries, with seven focusing on plant production.

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

AGRIFUTURES AUSTRALIA

agrifutures.com.au

AgriFutures Australia invests in research, leadership, innovation and learning to support industries that do not have their own research and development corporation, new and emerging industries, and the issues that affect the whole of agriculture. Primarily funded by the Australian Government, the vision of the organisation is to grow the long-term prosperity of Australian rural industries.

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

- incursion risk analysis
- biosecurity planning
- pest management
- weed management
- resistance breeding
- adoption of knowledge.

COTTON RESEARCH AND DEVELOPMENT CORPORATION

crdc.com.au

The Cotton Research and Development Corporation (CRDC) is a partnership between the Australian Government and cotton growers that invests in world-leading RD&E to benefit Australia's cotton industry and the wider community. A key driving force behind the cotton industry's continued success is CRDC's investment in innovation and transformative technologies to deliver impact.

CRDC invests across five strategic areas, as outlined in the Strategic RD&E Plan 2018–23. A key focus area under the goal of increasing the productivity and profitability of cotton farms is the protection of Australian cotton from endemic and exotic biotic threats. CRDC supports RD&E that contributes to:

- investigating and monitoring the economic, environmental and social impacts of biotic threats
- investigating and delivering new and improved tools, systems and strategies for the surveillance, prevention and sustainable and responsible management of biotic threats
- working collaboratively with growers and consultants to deliver industry-led biosecurity preparedness activities and address identified knowledge gaps.

FOREST AND WOOD PRODUCTS AUSTRALIA

fwpa.com.au

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

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

GRAINS RESEARCH AND DEVELOPMENT CORPORATION

grdc.com.au

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

GRDC's primary source of income is through a levy on grain growers, which is matched by the Australian Government. GRDC's research portfolio covers 25 leviable crops, spanning temperate and tropical cereals, oilseeds and pulses, which are worth over $13 billion a year in farm production.

The GRDC investment scheme 'Protecting Your Crop' is identified as part of the GRDC's five year RD&E plan which 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
- biosecurity and stewardship of genetic and pesticide technologies.

Sugar Research Australia far north Queensland staff screening sugarcane varieties for yellow spot. Image courtesy of Sugar Research Australia

HORT INNOVATION

horticulture.com.au

Hort Innovation is a not-for-profit, grower-owned RDC for Australia's $9.5 billion horticulture industry that invests in research, development and marketing programs.

Hort Innovation's key functions include:

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

SUGAR RESEARCH AUSTRALIA

sugarresearch.com.au

Sugar Research Australia (SRA) 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 receives the statutory levies paid by growers and milling businesses, and matching funds from the Australian Government. SRA's own team of in-house researchers conducts research in the areas of plant breeding, trait development, biosecurity and farming systems.

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

WINE AUSTRALIA

wineaustralia.com/research

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

THE PLANT BIOSECURITY RESEARCH INITIATIVE

pbri.com.au

The Plant Biosecurity Research Initiative (PBRI) supports cross-sectoral investment for plant biosecurity RD&E, delivering vital projects and attracting further co-investment. PBRI partners, listed below, work collaboratively with industry, state and federal biosecurity stakeholders.

The PBRI partners, listed below, work collaboratively with industry, state and federal biosecurity stakeholders.

- Australia's seven plant research and development corporations:
  - AgriFutures Australia
  - Cotton Research and Development Corporation
  - Forest and Wood Products Australia
  - Grains Research and Development Corporation
  - Hort Innovation
  - Sugar Research Australia
  - Wine Australia
- Plant Health Australia
- Department of Agriculture and Water Resources
- Council of Rural Research and Development Corporations

In 2017–18, the plant RDCs collectively invested $118 million into biosecurity RD&E, double the previous year. A coordinated approach ensures that this effort is aligned to broader national goals and delivered efficiently, avoiding duplication of effort.

Xylella is a good example of a biosecurity threat that could impact multiple plant industries. In 2018, the PBRI funded a xylella coordinator position to improve awareness of this threat amongst industry and to coordinate research in Australia, identifying any research gaps that need addressing.

Australia and NZ join forces on plant biosecurity research

In November 2018, a memorandum of understanding was signed between the Australian Plant Biosecurity Research Initiative (PBRI) and **Better Border Biosecurity, New Zealand** (B3 NZ) to strengthen collaboration on plant biosecurity research.

B3 NZ acts as the pre-eminent research provider for science-based plant border biosecurity solutions in New Zealand, providing a single point of access to the NZ science system for plant border biosecurity research. This unincorporated joint venture integrates investment and expertise from five science agencies working with five end user partners.

The main aspects of the new collaboration are:

- cross-sectoral projects on pre-border, at-border and immediate post-border biosecurity research
- government, industry, research or academic players, including partners of PBRI and B3
- formation of a joint Australia–New Zealand plant biosecurity network to support the professional development of post-graduate and post-doctoral students.

A workshop was held in December 2018 to share Australian and New Zealand research on xylella and brown marmorated stink bug, and to discuss potential collaboration and investment opportunities. More information can be found at **pbri.com.au**

State and territory governments

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

University and private research institutes

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

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

COLLABORATIVE RESEARCH ARRANGEMENTS

Some state and territory governments have formed partnerships with universities. These partnerships allow for the sharing of facilities, staff and equipment (such as next generation sequencers) and encourage the specialist agricultural training of students. Collaborative research arrangements also ensure that state and territory government plant biosecurity priorities are funded and supported by researchers. It also provides a larger pool of expertise for the government agencies to work with.

AgriBio – a partnership between the Victorian Department of Jobs, Precincts and Regions and La Trobe University

Queensland Alliance for Agriculture and Food Innovation – a partnership between the Queensland Department of Agriculture and Fisheries and the University of Queensland

Tasmanian Institute of Agriculture – a partnership between the Tasmanian Department of Primary Industries, Parks, Water and Environment and the University of Tasmania

Waite Research Institute – a partnership between the South Australian Research and Development Institute and the University of Adelaide

A partnership also exists between the Northern Territory Department of Primary Industry and Resources and Charles Darwin University.

CENTRE FOR CROP AND DISEASE MANAGEMENT

ccdm.com.au

The Centre for Crop and Disease Management is a leading Australian research centre committed to reducing the economic impact of crop disease in the grains industry.

Established in 2014, the centre is co-supported by the Grains Research and Development Corporation (GRDC) and Curtin University.

The centre is home to more than 65 researchers and support staff, who through laboratory based research and the development of integrated farm management strategies, work to deliver real benefits to growers and industry Australia-wide.

The research has and continues to pave the way for key changes in how growers, breeders, agronomists and life science companies adapt and manage crops to ensure better outcomes and stronger outputs.

From now until 2022, the focus of its research falls into three key themes:

- fungicide resistance management and disease impacts
- cereal diseases
- canola and pulse diseases.

CENTRE FOR FRUIT FLY BIOSECURITY INNOVATION

fruitflyittc.edu.au

The Centre for Fruit Fly Biosecurity Innovation is an Australian Research Council funded Industrial Transformation Training Centre dedicated to providing the Australian horticulture industries new, sustainable and environmentally friendly tools to control fruit fly pests. The centre coordinates research and research training across three universities and four partner organisations.

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

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

CENTRE OF EXCELLENCE FOR BIOSECURITY RISK ANALYSIS

cebra.unimelb.edu.au

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

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

CEBRA collaborates with organisations in New Zealand and the United States, and has international linkages with other nations, including Canada and the United Kingdom. CEBRA has collaborated with a wide range of state and national agencies.

CEBRA was created in 2013 by deeds between the Australian Government Department of Agriculture and Water Resources, New Zealand's Ministry for Primary Industries and the University of Melbourne which will expire in 2021.

AUSTRALIAN PLANT BIOSECURITY SCIENCE FOUNDATION

apbsf.org.au

The Australian Plant Biosecurity Science Foundation (APBSF) is a not-for-profit entity established to follow the Plant Biosecurity Cooperative Research Centre (PBCRC) which finished operations in June 2018, supported by unspent funds from PBCRC.

The foundation supports plant biosecurity RD&E and capacity building, particularly where there is a need for investment in environmental capacity building. It also invests in commercial IP developed by and inherited from PBCRC.

The mission is to invest, co-invest, collaborate and partner in RD&E delivery and capacity building activities that will assist in safeguarding Australia, its plant industries and regional communities through enhanced plant biosecurity.

Research to protect Australian wheat from overseas threat

Toxins produced by plant pathogens play a key role in the development of disease.

The fungus which causes yellow (or tan) spot disease (*Pyrenophora tritici-repentis*) is known to produce three toxins, with different isolates of the fungus varying in the ability to make each one. Fungi that produce ToxA, which causes cell death, are already found in Australia. On the other hand, ToxB producing fungi have not yet been found in Australia but are a problem for wheat growers in countries like Canada, the United States, Azerbaijan, Algeria, Syria and Turkey.

Researchers at the Centre for Crop and Disease Management came up with a method to produce ToxA and ToxB in the lab so they could compare the impact of both on Australian cereals. They tested 122 varieties of bread wheat,16 durum and 20 triticale varieties to determine how sensitive they were to the toxins. The results revealed which varieties are sensitive to ToxA and ToxB in the lab, and could be translated into the paddock.

By understanding the impacts of each of the toxins – one that currently impacts Australian cereal crops and one that doesn't – the researchers hope to give breeders the ability to select for traits that will breed out sensitivity to yellow spot. The researchers also hope that the same method could be applied to screen wheat varieties against newly discovered toxins.

Elyce Iagallo and Pao Theen See researching yellow spot of wheat. Image courtesy of the Centre for Crop and Disease Management

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.

CRC FOR HONEY BEE PRODUCTS

crchoneybeeproducts.com

The CRC for Honey Bee Products was established in November 2017 to bring together industry and research expertise from across Australia for five years. The research work is trans-disciplinary across four programs, driving innovation within the industry to meet export demands.

The CRC aims to help resolve industry problems that limit both the value and expansion of the Australian honey bee products industry. The four areas of focus are honey bee hive sites, honey bee products, honey bee health, and honey bee chain of custody. The CRC has 22 industry and community partners.

PLANT BIOSECURITY CRC

pbcrc.com.au

The Plant Biosecurity CRC operated between 2012 and June 2018 with the goal of strengthening the plant biosecurity scientific capacity of Australia. The CRC funded 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.

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

The CRC was funded through the Australian Government's Cooperative Research Centres Program and 27 participating government, industry and research organisations in Australia and New Zealand.

In May 2018, the Plant Biosecurity CRC National Science Exchange was held in Melbourne as an opportunity to look back at its work. Papers from the science exchange are available on the website, along with information on 160 research projects and publications.

Australia and New Zealand consider future innovations

In March 2018, the inaugural Biosecurity Innovation Exchange was held in partnership with the New Zealand Ministry for Primary Industries. The event brought together innovators from both countries, other government agencies and the research and commercial sectors to talk about biosecurity technologies and share ideas.

Some of the ideas discussed included using bionic noses to sniff out insect pests in containers, a rapid test to detect plant diseases in cuttings, or machines that help make smart, risk-based biosecurity decisions.

Australia and New Zealand face similar biosecurity challenges. In Australia alone, the volume of people and goods entering the country is forecast to significantly increase by 2025, bringing increased biosecurity risks and other challenges.

The event committed to progressing key themes including:

- gamification and citizen science
- next generation sequencing
- bionic technologies and sensors.

Special guests Kyle Langford and Sam Newton from the Oracle Team USA America's Cup Sailing team provided an inspiring example of innovation.

Since the event, work has been progressing on key initiatives, including gamification to engage the community with biosecurity. The Department of Agriculture and Water Resources has also launched an interactive online biosecurity innovation hub and e-newsletter call The Seed at **haveyoursay.agriculture.gov.au/biosecurity-innovation**

(L to R) Kyle Langford (Oracle Team USA America's Cup Sailing team) Roger Smith (Biosecurity New Zealand), Lee Cale (DAWR), Sam Newton (Oracle Team USA America's Cup Sailing team), Lyn O'Connell (DAWR), Matt Koval (DAWR) and Chris Cairns (Master of Ceremonies) after the keynote sessions at the Biosecurity Innovation Exchange. Image courtesy of the Department of Agriculture and Water Resources

Plant biosecurity RD&E projects in 2018

In 2018, a substantial amount of RD&E that benefits plant biosecurity occurred across Australia. PHA received data from over 90 organisations who were asked to provide information relevant to plant or pollinator (e.g. honey bee) biosecurity RD&E projects which they either funded or in which they were involved.

Research projects covered the spectrum of crops and pest types relevant to Australian plant production industries and the natural environment. Figures 95–99 present the research projects by pest type, research type, project value, biosecurity area and affected crop type to give some indication of how research budgets are spent in Australia.

Table 59 on page 236 lists 665 plant biosecurity related research projects undertaken during 2018, listed by crop type as shown in Figure 99. Although projects have simply been listed by project title in the table, other information (e.g. an abstract) was sourced to help to categorise the research.

In this year's report, the projects related to extension have been separated from the R&D projects for the first time to highlight work in the area of communication, training and awareness. Forty five out of the 665 RD&E projects are categorised as extension activities.

Figure 96. RD&E projects by research type or location

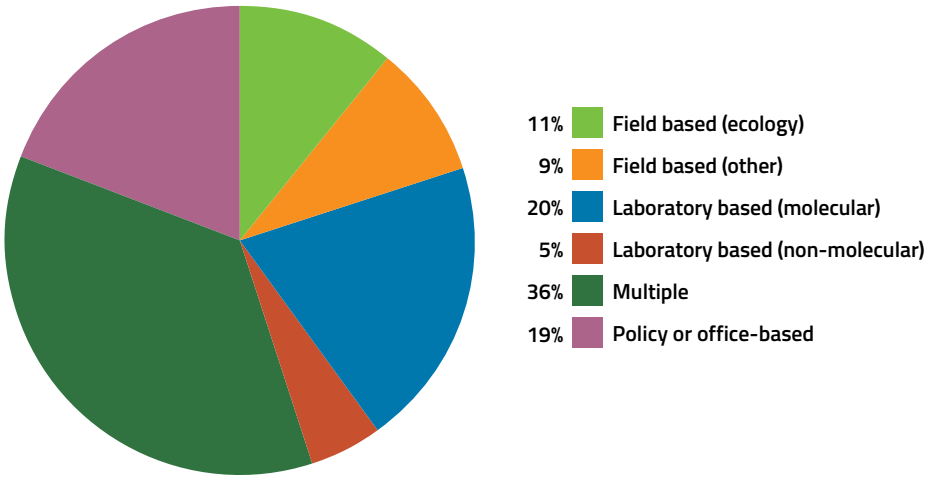


Figure 95. RD&E projects by pest type

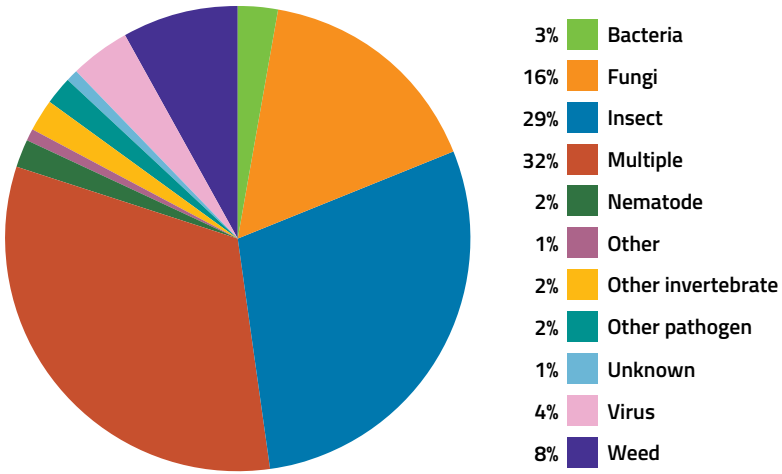


Figure 97. RD&E projects by project value

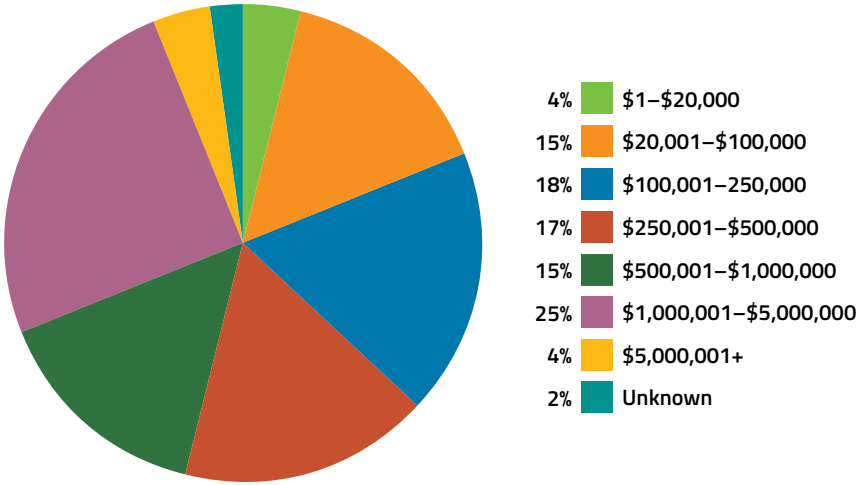


Figure 98. RD&E projects by biosecurity areas*

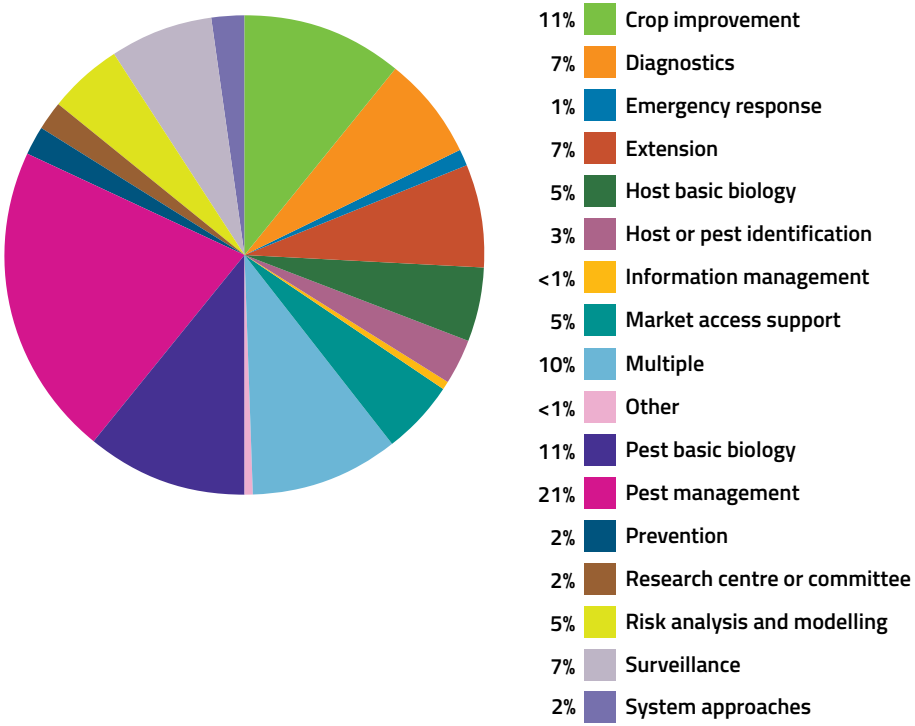


Figure 99. RD&E projects by crop type**

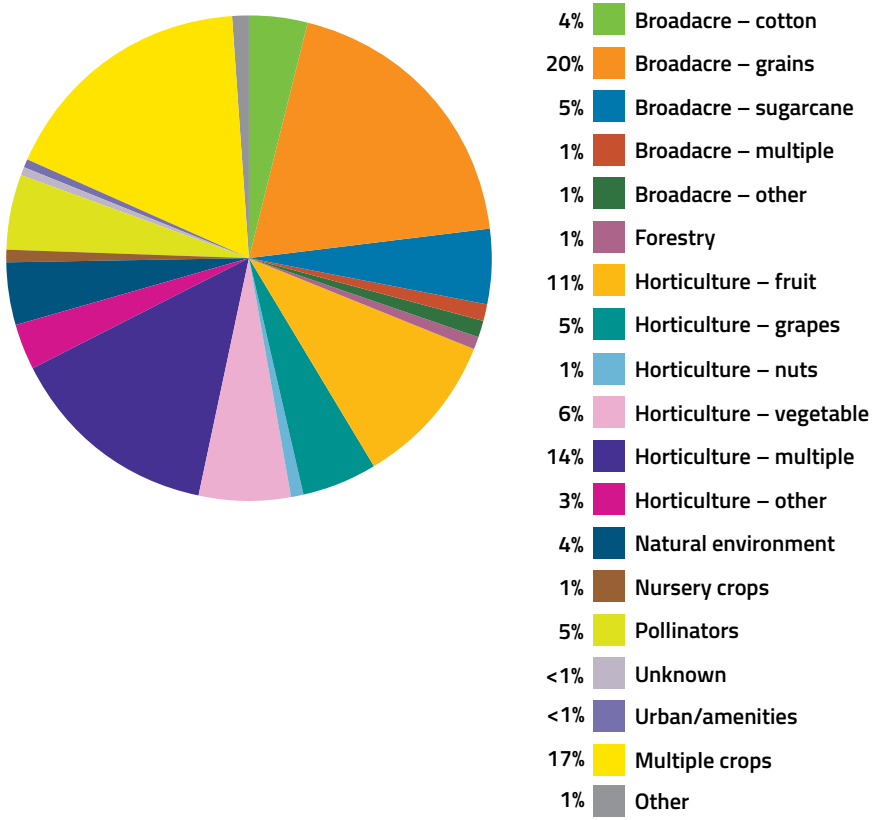


FIGURE LEGENDS

Figure 98* Titles and abstracts were used to categorise the research.

Figure 99** The definitions for 'crop type' are generally based on the Hort Innovation, AgriFutures Australia and Grains Research and Development Corporation crop groupings.

Table 59. Plant biosecurity RD&E projects

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Broadacre – cotton		
Application of molecular tools to monitor for resistance alleles in Helicoverpa	CSIRO	CRDC, Monsanto (USA)
Assessing the potential of a new monitoring tool ('Zappa trap') for managing sucking pests on cotton	NSW DPI	CRDC, NSW DPI
Biology of *Amarathus hybridus, A. mitchelli* and *A. powelii* (PhD)	University of Queensland	CRDC
Cotton disease management	Western Sydney University	Converte Pty Ltd
Developing the weed control threshold (PhD)	NSW DPI	CRDC, NSW DPI
Electrophysiological and molecular identification of novel biopesticides (PhD)	Western Sydney University	CRDC
Enhancing integrated pest management in cotton systems	CSIRO	CRDC, CSIRO
Evaluation of relative damage caused by two-spotted mite, bean spider mite and strawberry mite in cotton	NSW DPI	CRDC, NSW DPI
Identifying sensors for better IPM in cotton	University of Southern Queensland	CRDC, University of Southern Queensland, QDAF
Improved management of silverleaf whitefly on cotton farms	QDAF	CRDC, QDAF
Improving the management of cotton diseases in Australian cotton farming systems	QDAF	CRDC, Wine Australia, QDAF
Innovative solutions to cotton diseases	NSW DPI	CRDC, NSW DPI
IPM technical lead and pest management for high yield research	QDAF	CRDC, QDAF
IPM to support management of emerging cotton pests 1	NSW DPI	CRDC, NSW DPI
IPM to support management of emerging cotton pests 2	CSIRO	CRDC, CSIRO

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Broadacre – cotton (continued)		
Large scale biosecurity scenario to support cotton industry preparedness	PHA	CRDC, PHA, NSW DPI, QDAF
Managing Verticillium risk for cotton	NSW DPI	Wine Australia, CRDC
Mirid and mealybug management best practice	QDAF	CRDC, QDAF
Monitoring to manage resistance to *Bt* toxins	CSIRO	CRDC, CSIRO
Ready to use soil test to manage black root rot risks	Microbiology Laboratories Australia	CRDC
Science leadership for cotton development in northern Australia	CSIRO	CRDC, Ord River District Co-operative Ltd, QDAF, CSIRO
Silverleaf whitefly resistance monitoring	QDAF	CRDC, QDAF
Surveillance and monitoring for endemic and exotic virus diseases of cotton	QDAF	CRDC, QDAF
Sustainable resistance management of mites, aphids and mirids in Australian cotton	NSW DPI	CRDC
The sustainable chemical control and resistance management of aphids, mites and mirids in Australian cotton	NSW DPI	CRDC
Transformation of *Verticillium dahliae*, causal agent of Verticillium wilt of cotton	NSW DPI	CRDC, NSW DPI
Understanding the ecology of reniform nematodes in cotton	QDAF	CRDC, QDAF
Broadacre – grains		
A 'focus farms' study to optimise weed resistance management practices in Western Australia	University of Western Australia	GRDC
A simple and innovative test for real-time detection of resistance in weeds	University of Western Australia	GRDC

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Broadacre – grains (continued)		
Accelerating the utilisation and deployment of durable adult plant resistance to leaf rust in barley	University of Sydney, University of Queensland	GRDC
An integrated approach to manage pests and resistance to phosphine in stored grain	QDAF, NSW DPI, GrainCorp	PBCRC
Aphid and insecticide resistance management in oil seed and pulse crops	CESAR	GRDC
Ascochyta blight of pulses – integrating development of novel selection methods, mining germplasm for resistance and pathogen surveillance	Curtin University, Griffith University	GRDC
Assessing collections of wild chickpea relatives for resistance to root-lesion nematodes	University of Southern Queensland, CSIRO, University of California Davis (USA), University of Cukuorva (Turkey)	GRDC
Australian Cereal Rust Control Progam – continued monitoring of cereal rust pathogens in Australia	University of Sydney	GRDC
Australian Cereal Rust Control Program – delivering genetic tools and knowledge required to breed wheat and barley with resistance to leaf rust, stripe rust and stem rust	CSIRO	GRDC
Australian Cereal Rust Control Program – delivering genetic tools and knowledge required to breed wheat and barley with resistance to leaf rust, stripe rust and stem rust	University of Sydney	GRDC
Australian Cereal Rust Control Program – wheat and barley breeding support	University of Sydney	GRDC
Australian wheat and barley molecular marker program – genetic analysis	University of Adelaide	GRDC

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Broadacre – grains (continued)		
Biology and management of snails and slugs in grain crops	SARDI	GRDC
Barley rust genetics	University of Sydney	AusAID
Cell wall structure and dynamics in emerging fungal pathogens of crops	University of Adelaide	ARC
Centre for Crop Disease Management	Curtin University	GRDC
Cereal and pulse cultivar resistance ratings for the southern region	DJPR	GRDC, DJPR
Cereals and rust diseases – molecular interactions for plant defence and food security	University of Sydney	ARC
Characterising structural variation in the canola genome	University of Western Australia	ARC
Combining monitoring and incursion surveillance for grains	NSW DPI	PBCRC
Comparison of biological and physiological behaviour of phosphine resistant and susceptible strains of two species of stored product insects (PhD)	Murdoch University	Government of Iraq
Conduct integrative taxonomic revision of Australian Trogoderma species	CSIRO	DEE
Demonstrate the efficacy of microbial products for Australian wheat varieties for increased productivity and profitability	Western Sydney University	CHR Hansen Pty Ltd
Developing new diagnostic tools for Trogoderma species by using solid phase micro extraction, gas chromatography/mass spectrometry and visible near infrared hyperspectral (PhD)	Murdoch University	Government of Iraq
Developing tools for in-field surveillance of pathogens	SARDI	PBCRC

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Broadacre – grains (continued)		
Developing whole-genome sequence resources for fungal pathogens of lupin	University of Western Australia	Curtin University
Development and implementation of biosensors for Botrytis grey mould causal species affecting temperate legumes	Griffith University	NSW DPI, GRDC
Development of gene deployment strategies – using evolutionary principles to optimise the deployment of genetic resistance in crops	CSIRO	GRDC
Development of genetic tools for Australian barley crops against leaf rust	University of Sydney	GRDC
Development of rapid phenotyping and genotyping tools for selection of key agronomic and quality traits in the Australian peanut breeding program	University of Southern Queensland, Peanut Company of Australia	Peanut Company of Australia
Development of tools to accelerate nematode resistance gene deployment	University of Adelaide, University of Southern Queensland, SARDI	GRDC
Diagnostic services for pulse germplasm enhancement and breeding program	DJPR	GRDC, DJPR
Disease screening service (fee for service)	DJPR	Fee for Services
DNA marker development and their use in monitoring and eradication of phosphine resistance in stored grain pests (PhD)	University of Queensland	PBCRC
Drought tolerance by ACC deaminase producing Actinobacteria	Flinders University, CSIRO	Australia India Strategic Research Fund
Effective control of barley yellow dwarf virus in wheat	University of Tasmania	GRDC

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Broadacre – grains (continued)		
Effective genetic control of *Septoria tritici* blotch	NSW DPI	GRDC
Effective genetic control of *Stagonospora nodorum* blotch	WA DPIRD	GRDC
Emerging foliar diseases of canola	University of Western Australia	GRDC
Engineering rust resistance	CSIRO	Two Blades Foundation (USA)
Enhancing resistance to wheat stripe rust disease	Australian National University	ARC
Establishing the international mungbean improvement network	Asian Vegetable Research and Development Centre, QDAF	ACIAR
Evaluating chlorine dioxide (PhD)	Kansas State University (USA)	PBCRC
Field trials with actinobacterial endophytes	Flinders University, SARDI	IndigoAg (USA)
Fungal pathogenomics and bioinformatics	Curtin University	GRDC
Fungicide resistance group	Curtin University	GRDC
Genetic control of nematode species affecting major crops – germplasm enhancement for nematode control in cereals and pulses	University of Southern Queensland, GRDC	GRDC
Genetic control of nematode species affecting major crops grown within the Australian farming system and quantification of the effects that rotational crops have on nematode numbers in the soil	University of Adelaide, University of Southern Queensland	GRDC
Germplasm enhancement for yellow spot resistance	DJPR	GRDC, WA DPIRD, NSW DPI, SARDI, QDAF, University of Western Australia, DJPR
Grain crop disease management in Victoria	DJPR	GRDC, DJPR
Grain e-surveillance project	WA DPIRD	Royalties for Regions, WA DPIRD

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Broadacre – grains (continued)		
Grain weeds advisory committee	Rural Directions Pty Ltd	GRDC
Harvest weed seed control for the southern region	Southern Farming Systems	GRDC
How do effector proteins from necrotrophic fungi cause disease in plants	Australian National University	ARC
Identification and utilisation of novel sources of resistance to crown rot and the root lesion nematodes in adapted spring and durum wheat	International Wheat and Maize Improvement Centre	GRDC
Identification of sources of resistance to wheat blast and their deployment in wheat varieties adapted to Bangladesh	International Wheat and Maize Improvement Centre	ACIAR
Impacts of host resistance on disease-induced yield loss	DJPR	GRDC, WA DPIRD, NSW DPI, SARDI, QDAF, University of Western Australia, DJPR
Improve genetic solutions management yellow spot in wheat	WA DPIRD, University of Southern Queensland	GRDC
Improved diagnostic methods for Khapra beetle	WA DPIRD, Murdoch University	WA DPIRD
Improved disease management in South Australian field crops through surveillance, diagnostics and epidemiology knowledge	SARDI	GRDC
Improved farming systems	Curtin University	GRDC
Improved resistance to oat pathogens and abiotic stress management	SARDI	GRDC
Improving grower surveillance management, epidemiology knowledge and tools to manage crop disease	University of Southern Queensland, GRDC, QDAF	GRDC

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Broadacre – grains (continued)		
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	DJPR	GRDC
Improving management of Phytophthora root rot of chickpea	Western Sydney University	NSW DPI
Improving monitoring and management of Etiella in lentils	SARDI	SA Grain Industry Trust
Improving weed management in pulse crops through herbicide tolerance – part A	SARDI	GRDC
Improving weed management in pulse crops through herbicide tolerance – part B	SARDI	GRDC
Insect tolerant chickpea for Bangladesh	CSIRO	ACIAR
Integrated genetic solutions to crown rot in wheat	University of Sydney, QDAF, CSIRO, University of Southern Queensland	GRDC
Low weed seed bank persistence under sustained integrated weed management	University of Western Australia	GRDC
Maintaining a barley pre-breeding capability in Queensland	QDAF, University of Queensland	GRDC, QDAF
Managing crop disease – improving chickpea pathogen resistance	NSW DPI	GRDC
Managing crop diseases – improving crown rot resistance in durum	University of Southern Queensland, NSW DPI, SARDI	GRDC

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Broadacre – grains (continued)		
Managing on-farm biosecurity risk through pre-emptive breeding – the case of rust in field pea and lentil	Curtin University	GRDC
Mechanisms of antifungal resistance in blackleg disease of canola	University of Melbourne	ARC
Mechanisms, evolution and inheritance of resistance	University of Adelaide	GRDC
Mitigating the effects of stripe rust on wheat production in south Asia and eastern Africa	University of Sydney	ACIAR
Mitigating the effects of wheat blast in Bangladesh and beyond	International Wheat and Maize Improvement Centre	ACIAR
National barley foliar pathogen variety improvement program	QDAF, Australian National University, SARDI, DJPR, WA DPIRD, NSW DPI, University of Adelaide, University of Southern Queensland, University of Tasmania	GRDC, WA DPIRD, NSW DPI, SARDI, QDAF, University of Western Australia, DJPR
National Brassica germplasm improvement program – phase II	NSW DPI	GRDC
National chickpea pathology program (*Ascochyta rabiei*)	Griffith University	GRDC
National coordination of invertebrate pest research and insecticide resistance management	University of Melbourne	GRDC
National crown rot epidemiology and management program	NSW DPI, University of Southern Queensland, SARDI, DJPR, WA DPIRD	GRDC, WA DPIRD, NSW DPI, SARDI, QDAF, University of Western Australia, DJPR
National improved molecular diagnostics for disease management	GRDC, SARDI, WA DPIRD, NSW DPI, DJPR, University of Southern Queensland	GRDC, WA DPIRD, NSW DPI, SARDI, QDAF, University of Western Australia, DJPR
National nematode epidemiology and management program	GRDC, DJPR, NSW DPI, SARDI, WA DPIRD, University of Southern Queensland	GRDC, DJPR
National pathogen management modelling and delivery of decision support	GRDC, WA DPIRD, Marcroft Grains Pathology Pty Ltd, NSW DPI, SARDI, DJPR, University of Southern Queensland, QDAF	GRDC, WA DPIRD, NSW DPI, SARDI, QDAF, University of Western Australia, DJPR
National variety trials disease screening	DJPR	GRDC
National variety trials service agreement	GRDC, University of Southern Queensland, QDAF	GRDC
Net blotch of barley	Curtin University	GRDC
New discriminatory diagnostic protocols for exotic Khapra beetle (*Trogoderma granarium*) to aid early detection and future-proof market access	WA DPIRD	Royalties for Regions
New knowledge to improve the timing of pest management decisions in grain crops	CSIRO	GRDC
New tools and germplasm for Australian pulse and oilseed breeding programs to respond to changing virus threats	QDAF, NSW DPI	GRDC
New uses for existing chemistry	Southern Farming Systems	GRDC
Non-chemical method for stored grain (PhD)	Murdoch University	PBCRC
Non-chemical technologies to protect grain (PhD)	Kansas State University (USA)	PBCRC
Northern NSW integrated disease management	NSW DPI	GRDC
Northern pulse and grains integrated pest management	QDAF	GRDC
Pathways to registration – minor use	AKC Consulting Pty Ltd	GRDC
Phosphine resistance	Murdoch University	WA DPIRD
Podborer resistant cowpea with two different *Bt* genes	CSIRO and collaborators in Nigeria, Burkina Faso and Ghana	African Agricultural Technology Foundation
Powdery mildrew of barley	Curtin University	GRDC

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Broadacre – grains (continued)		
Pre-emptive APVMA emergency permit development for grains industry	PHA	GRDC
Pre-emptive chickpea pre-breeding for biotic stresses and germplasm enhancement for abiotic stresses	International Centre for Agricultural Research in the Dry Areas	GRDC
Proof of concept for approaches designed to increase disease resistance to fungal pathogens in canola	University of Melbourne	GRDC
Protein trafficking pathways in fungal rust pathogens of plants	Australian National University	ARC
Pulse breeding Australia – faba bean breeding	University of Adelaide, SARDI, University of Sydney, NSW DPI	GRDC
Pulse pathology and genetics	Curtin University	GRDC
Rapid detection and diagnosis of plant pathogens	Australian National University	Hermon Slade Foundation
Sclerotinia stem rot of canola	Curtin University	GRDC
Scoping the requirements of a national Grains Biosecurity Surveillance Strategy	PHA	DAWR
Septoria nodorum blotch of wheat	Curtin University	GRDC
Smart-trap design and deployment strategies (PhD)	Kansas State University (USA)	PBCRC
Smart use of fertilisers to minimise and manage the risk of pest infestations in growing canola	University of Western Australia	GRDC
Snail biocontrol revisited – phase 2	CSIRO	GRDC
Spring research in response to Russian wheat aphid incursion	SARDI	GRDC
Stem rust effectors and non-host resistance	CSIRO	Two Blades Foundation (USA)
Surveillance of herbicide resistant weeds in Australian grain cropping	Charles Sturt University, University of Western Australia	GRDC

Lars Kamphuis and Mark Derbyshire taking a closer look at Sclerotinia stem rot of canola. Image courtesy of the Centre for Crop and Disease Management

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Broadacre – grains (continued)		
Survey potential emerging pulse root diseases	SARDI	SA Grain Industry Trust
The evolution of stripe rust virulence	Australian National University	ARC
The functional characterisation of a novel immune response in plants	Australian National University	ARC
The role of weedy hosts in disease incidence and emergence in barley	QDAF	GRDC
Two new phytotoxins in *Septoria nodorum* blotch – biosynthesis and functions	University of Western Australia	ARC
Understanding the mechanisms of dust-induced insect death and biological effect (PhD)	Murdoch University	PBCRC
Virus threats – new tools and germplasm for Australian pulse and oil seeds breeding programs	DJPR	GRDC, WA DPIRD, NSW DPI, SARDI, QDAF, University of Western Australia, DJPR
Weed surveillance	QDAF	GRDC
Yellow spot of wheat	Curtin University	GRDC
Yield loss response curves for host resistance to leaf, crown and root diseases in wheat and barley	WA DPIRD, QDAF	GRDC
Zea mays model and *Phytophthora cinnamomi*	Deakin University	DAWR
Broadacre – sugarcane		
A novel polyphasic framework to resolve the yellow canopy syndrome paradox	Western Sydney University	SRA, QDAF
Bio-prospecting for beneficial endophytes of sugarcane	AgResearch Ltd	SRA
Delivering solutions for chlorotic streak disease	SRA	SRA

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Broadacre – sugarcane (continued)		
Delivery of remote sensing technology to combat canegrubs in Queensland cane fields	SRA	SRA, QDAF
Development of commercial molecular biological assays for improved sugarcane soil health and productivity	SRA	SRA
Development of new ratoon stunting disease diagnostics	SRA	SRA
Diagnostic laboratory for ratoon stunting disease	SRA	SRA
Identifying new-generation insecticides for canegrub control as contingency for loss of amenity with existing product	SRA	SRA, QDAF
Improving sugarcane pest management through cross industry deployment of smart sensors, diagnostics and forecasting	SRA	SRA, DAWR
Integrated disease management of sugarcane streak mosaic in Indonesia	SRA	ACIAR
International and domestic quarantine for sugarcane germplasm	SRA	SRA
Investigation of biotic causes of yellow canopy syndrome	University of Queensland	SRA
Keeping our chemicals in their place – in the field	James Cook University	SRA
Leaf sucrose – the link to diseases, physiological disorders such as yellow canopy syndrome and sugarcane productivity	SRA	SRA, QDAF
Management of sugarcane soldier flies	SRA	SRA

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Broadacre – sugarcane (continued)		
Managing threats from exotic borers through accurate identification	SRA	SRA
Mesostigmatid mites as predators of nematodes in sugarcane soils – ecology, food preferences and biocontrol potential (PhD)	University of the Sunshine Coast	SRA
Molecular assay of major soil-borne pathogens for better exploitation of commercial varieties	SRA	SRA
Moth borers – how are we going to manage them when they arrive?	SRA	SRA
New approaches to identify and integrate Pachymetra resistance genes from Erianthus into SRA breeding program	SRA	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 Paupa New Guinea biosecurity threats	SRA	SRA, QDAF, Ramu-AI (Papua New Guinea)
Soil diagnostic assay laboratory – nematodes and pachymetra root rot	SRA	SRA
Solving the yellow canopy syndrome	SRA	SRA, QDAF
Strategies to manage soil-borne fungi and mitigate sugarcane yield decline	CSIRO	SRA

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Broadacre – multiple		
Benchmarking and managing soil herbicide residues for improved crop production – developing antigen for clorpyralid	Monash University	GRDC
Conventional insecticide resistance in Helicoverpa	NSW DPI	CRDC, NSW DPI
Down to earth defence – unlocking soil-derived defences for plant protection	Western Sydney University	ARC
Molecular mechanism of action of plant immune receptors	University of Queensland	ARC
Time to prime – using silicon to activate grass resistance under higher CO_2	Western Sydney University	ARC
Broadacre – other		
Herbicide resistance in rice	Charles Sturt University	AgriFutures Australia
Improved subterranean clover seed production from multiple disease resistance	University of Western Australia	AgriFutures Australia
Potential exotic virus threats to lucerne seed production in Australia	University of Queensland	AgriFutures Australia, University of Queensland
Rice pest and disease biosecurity II	NSW DPI	AgriFutures Australia, NSW DPI

Image courtesy of the Ricegrowers' Association of Australia

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Forestry		
A model system for the discovery and development of biocontrol agents against forest pests	University of the Sunshine Coast	FWPA, DAWR, University of the Sunshine Coast, NSW DPI, Forestry Tasmania
Asian gypsy moth – national surveillance program	QDAF	QDAF
Biological control of galling pests of eucalypt plantations in the Mekong region	University of the Sunshine Coast, QDAF	ACIAR
Dispersal modelling of invasive forestry pest species	DJPR	DJPR
Giant pine scale biology and ecology (PhD)	La Trobe University	FWPA, Australian Forest and Products Association (16 companies)
Giant pine scale chemical control	HVPlantations	FWPA, Australian Forest and Products Association (16 companies)
Management strategies for Acacia plantation diseases in Indonesia and Vietnam	University of Tasmania, University of the Sunshine Coast, NSW DPI, Vietnamese Academy of Forest Sciences (Vietnam), Gadjah Mada University (Indonesia), Forest Research and Development Agency (Indonesia)	ACIAR
National forestry biosecurity surveillance program	PHA	DAWR (Agricultural Competitiveness White Paper)
The Industry Plantation Management Group – applied research and extension	WA Plantation Resources	WA Plantation Resources
Horticulture – fruit		
Agrichemical residue monitoring program for Australian citrus exports – stage 2	Citrus Australia	Hort Innovation
Alternative quarantine treatment for bananas infested with coffee bean weevil	QDAF	Hort Innovation

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Horticulture – fruit (continued)		
An inventory of Colletotrichum species infecting tropical and subtropical fruit crops in Australia based on molecular phylogenetics	QDAF	DEE
Auscitrus horticultural project	NSW DPI	Collaborative Research
Avocado industry biosecurity capacity building	University of Queensland	Hort Innovation
Banana bunchy top virus control data	University of Queensland	Hort Innovation
Banana industry R&D coordination	ABGC	Hort Innovation
Biological control of yellow scale insect *Aonidiella orientalis* Newstead	Murdoch University	Government of Iraq
Breeding tools for enhanced fruit quality for the Australian papaya industry	Griffith University	Hort Innovation
Cherry export readiness and market access	Cherry Growers Australia	Hort Innovation
Clean seed program for the papaya industry	QDAF	Hort Innovation
Coordination of banana industry R&D (Panama tropical race 4)	ABGC	Hort Innovation
Developing diagnostic protocols for Ralstonia on bananas	University of Queensland	PHA
Developing US market access based on irradiation and methyl bromide	NSW DPI	Hort Innovation
Development of area wide management approaches for fruit flies in mango for Indonesia, Philippines, Australia and the Asia-Pacific region	QDAF	ACIAR
Development of effective and sustainable disease management for blueberry production in Australia	NSW DPI	Hort Innovation
Development of plant biosecurity surveillance protocols for the citrus and mango industries in northern Australia	PHA	DAWR

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Horticulture – fruit (continued)		
Diagnosis and control of *Botrytis cinerea* on postharvest blueberry fruit (PhD)	Murdoch University	Government of Iraq
Disinfestation of blueberries against Mediterranean fruit fly for market access to Japan	Kalang Consultancy Services Pty Ltd, Murdoch University	Hort Innovation
Enhancing Australia's capability and capacity to diagnose *Fusarium oxysporum* f. sp. *cubense* tropical race 4	NSW DPI	PBCRC
Evaluation of *Beauveria bassiana* for rust thrips control in Australian bananas	James Cook University	Department of Industry, Innovation and Science
Feasibility of biocontrol of European blackberry with the sawfly	DJPR, CSIRO	Australian Government, Meat and Livestock Australia, DJPR
Field triage capability and capacity for citrus pests	PHA	DAWR
Fusarium wilt tropical race 4 research program – 1	QDAF	Hort Innovation
Fusarium wilt tropical race 4 research program – 2	University of Queensland	QDAF, Hort Innovation
Generation of data for pesticide applications in horticulture crops	Peracto Pty Ltd	Hort Innovation
Implementation of recommendations from the avocado industry nursery voluntary accreditation scheme review	NGIA	Hort Innovation
Improved management of charcoal rot strawberry	QDAF	Hort Innovation
Improved plant protection for the banana industry	QDAF	Hort Innovation
Improvement of bananas for small holder farmers in the Great Lakes region of Africa	University of Queensland	International Institute for Tropical Agriculture (Nigeria)

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Horticulture – fruit (continued)		
Improving avocado orchard productivity through disease management -1	Murdoch University	Hort Innovation
Improving avocado orchard productivity through disease management - 2	University of Queensland	Hort Innovation
Improving biosecurity preparedness of the Australian citrus industry	PHA, Citrus Australia	Hort Innovation
Integrated crop management strategies for papaya in the Phillipines and Australia	QDAF	ACIAR
Integrated disease management strategies for the productive, profitable and sustainable production of high quality papaya fruit in the southern Philippines and Australia	QDAF	ACIAR
Integrated management of Fusarium wilt of bananas in the Philippines and Australia	QDAF	ACIAR
International industry analysis for diphenylamine decontamination, alternative treatments and review of current best practice	University of Melbourne	Hort Innovation
Investigating tree mortality during early field establishment	University of Queensland	Hort Innovation
Management of banana pests and diseases in north Queensland	ABGC	Hort Innovation
Melon industry biosecurity	Dianne Fullelove and Associates Pty Ltd	PHA
Mite and insect disinfestation of lychee fruit using high pressure water sprays	Australian Lychee Growers' Association	Lychee levy funds, DAWR
Monitoring mangoes through the supply chain to the USA	NT DPIR	Hort Innovation

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Horticulture – fruit (continued)		
Multi-scale monitoring tools for managing Australian tree crops – industry meets innovation	QDAF	University of Queensland, University of Central Queensland, University of New England, University of Sydney, Avocados Australia, Simpson Farms, Australian Mango Industry Association, Australian Macadamia Society, QDAF, AGTRIX Ltd, Hort Innovation
National banana bunchy top virus program – phase 3 – NSW	The Trustee for The Lagom Trading Trust	Hort Innovation
National banana bunchy top virus program – phase 3 – Queensland	Barry Sullivan	Hort Innovation
National citrus biosecurity surveillance program	PHA, Citrus Australia	DAWR (Agricultural Competitiveness White Paper)
National passionfruit breeding program	Southern Cross University	Hort Innovation
Opportunities and strategies to improve biosecurity, market access and trade for selected mango markets	Griffith University	ACIAR
Pest status and management of six-spotted mite (*Eotetranychus sexmaculatus*) in WA avocado orchards	Western Australian Agriculture Authority	Hort Innovation
Pineapple model and *Phytophthora cinnamomi*	Deakin University	Deakin University
Post-harvest oil treatment on fruit trials	Australian Lychee Growers' Association	Lychee levy funds, DAWR
Precise recognition for automated harvesting and grading of strawberries	Griffith University	ARC

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Horticulture – fruit (continued)		
Protecting Australia's citrus genetic material	Australian Citrus Propagation Association Incorporation	Hort Innovation
Protecting Australia's citrus genetic material	Auscitrus, NSW DPI	Hort Innovation
Reversing the impact of banana blood disease in Indonesia	University of Queensland	Plant Biosecurity Science Foundation
Review host status of cherries for codling moth	Applied Horticultural Research Pty Ltd	Hort Innovation
Review of national biosecurity plans (avocados and mangoes)	PHA	Hort Innovation
Review of the national biosecurity plan for the banana industry	PHA	Hort Innovation
Review of the national biosecurity plan for the cherry industry and development of a biosecurity manual for cherry producers	PHA	Hort Innovation
Scoping for the requirements of a national surveillance strategy for temperate fruit industries	PHA	DAWR (Agricultural Competitiveness White Paper)
Strengthening the banana industry diagnostic capacity	University of Queensland	Hort Innovation
Structured packing shed surveillance project	PHA	DAWR
The cause and management of crown rot of banana	QDAF	Hort Innovation
The influence of soil physicochemical conditions on growth and infectivity of the banana disease-causing fungus *Fusarium oxysporum* f. sp. *cubense*	James Cook University	Hort Innovation, QDAF
US market access project continuation	Australian Lychee Growers' Association	Hort Innovation
Horticulture – grapes		
Area wide IPM support for Queensland fruit fly in table grapes	Australian Table Grape Association	Hort Innovation
Biosecurity management activties for the winegrape industry	Australian Wine Research Initiative	Australian Vignerons

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Horticulture – grapes (continued)		
Building capacity in area wide IPM for Queensland fruit fly in table grapes	SunRise 21 Inc	Hort Innovation
Characterisation of the microbiome associated with grapevines and evaluation of endophytic microorganisms as biological control agents of grapevine trunk disease pathogens (PhD)	Charles Sturt University	Wine Australia, Charles Sturt University
Coonawarra rootstock trial	Vinehealth Australia, Treasury Wine Estates, Coonawarra Vignerons	Vinehealth Australia, Treasury Wine Estates, Coonawarra Vignerons
Delivering a collaborative monitoring program with industry to manage and facilitate trade	NSW DPI, QDAF, WA DPIRD	PBCRC
Determining thresholds for bunch rot tolerance in wine and detection of unwanted fungal aromas	Charles Sturt University	Wine Australia
Do viral infections in the Gingin clone of chardonnay influence vine phenotype, performance and consequent wine quality?	WA DPIRD	Wine Australia
Enabling technologies and genetic resources	CSIRO	Wine Australia
Enhanced biological control of light brown apple moth in vineyards (PhD)	University of Adelaide	Wine Australia, University of Adelaide
Entomopathogenic fungi as potential biocontrol agents of grape phylloxera (PhD)	Charles Sturt University	Wine Australia, Charles Sturt University
Field trials with new scion–rootstock combinations and evaluation of new technology for improved water efficiency and reduced costs	CSIRO	Wine Australia

Professor Andre Drenth on survey for blood disease in Java. Image courtesy of University of Queensland

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Horticulture – grapes (continued)		
Genetic structure, survival mechanisms and spread of grapevine downy mildew populations in Western Australian and Australian vineyards (PhD)	Murdoch University	Wine Australia
Genetic transformation of grapevine to test significant abiotic stress and pest resistance genes	CSIRO	Wine Australia
Grapes e-surveillance project	WA DPIRD	Royalties for Regions, WA DPIRD
Grapevine trunk disease management for vineyard longevity in diverse climates in Australia	SARDI	Wine Australia
Integrated management of established grapevine phylloxera	DJPR	Wine Australia
Isolation and characterisation of phytotoxins produced by the Botryosphaeriaceae and their role in grapevine trunk diseases (PhD)	Charles Sturt University	Wine Australia
Managing fungicide resistance in Australian viticulture	SARDI	Wine Australia
New technologies for dynamic canopy and disease management	CSIRO	Wine Australia
Regional evaluation of new germplasm – pathway to adoption	CSIRO	Wine Australia
Review of the biosecurity plan and manual for the viticulture industry	PHA	Wine Australia, Hort Innovation
Rootstock genetics and improvement – new improved rootstocks with durable resistance to root knot nematodes and phylloxera	CSIRO	Wine Australia
Sampling strategies for sensitive, accurate and cost-effective detections of phylloxera for quantifying area freedom status	Vinehealth Australia, SARDI, University of Adelaide, PIRSA, DJPR, NSW DPI, PFRNZ, Rho Environmetrics	PBCRC, Wine Australia, Vinehealth Australia, SARDI

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Horticulture – grapes (continued)		
Scion genetics and improvement – development of new disease-resistant varieties in grapevines	CSIRO	Wine Australia
Spore trapping technologies for Botrytis and powdery mildew DNA testing	SARDI, Australian Wine Research Initiative	Wine Australia
Surveillance of South Australia for phylloxera	Vinehealth Australia	Vinehealth Australia
The molecular diversity of viruses infecting Australian grapevines (PhD)	Adelaide University, DJPR	Wine Australia
Understanding the basis of agrochemical resistance in biotrophic grapevine pathogens	Australian Wine Research Initiative	Wine Australia
Updating PMapp, a smartphone application for assessing powdery mildew	University of Adelaide	Wine Australia
Horticulture – nuts		
An integrated disease management program for the Australian almond industry	DJPR	Hort Innovation
An integrated pest management program for the Australian almond industry	DJPR	Hort Innovation
Biology, species and genetic diversity of macadamia lace bugs (Heteroptera: Tingidae: *Ulonemia* spp.)	University of NSW	Australian Macadamia Society, Hort Innovation
Control of Carpophilus beetle in almonds using attract and kill system	DJPR	Hort Innovation, DJPR
Macadamia integrated disease management	University of Queensland	Hort Innovation
Pathogens and other factors contributing to dark staining on pistachio shells	Ag Etc Pty Ltd	Hort Innovation

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Horticulture – vegetable		
A strategic approach to weed management for the Australian vegetable Industry	University of New England	Hort Innovation
Alternaria on tomato	University of Queensland	University of Queensland
Area wide management of vegetable diseases – virus and bacteria	NSW DPI	Hort Innovation, NSW DPI
Area wide management of vegetable diseases – virus and bacteria	QDAF	Hort Innovation, QDAF, DJPR, WA DPIRD, University of Tasmania
Characterisation of a Carlavirus of french bean	QDAF	Hort Innovation
Developing improved crop protection options in support of intensification of sweetpotato production in Papua New Guinea	Charles Sturt University, University of Southern Queensland	ACIAR
Developing the national potato biosecurity surveillance strategy	PHA	DAWR
Development of an onion white root rot forecasting model for Tasmania	University of Tasmania	Hort Innovation
Diagnostic capability to detect *Candidatus* Liberibacter solanacearum	DJPR, PFRNZ	Hort Innovation
Evaluation of natural product extracts for control of vegetable pests (PhD)	Murdoch University	Government of Iraq
Extension of the PreDicta Pt potato diagnostic service	SARDI	Hort Innovation
Fungus resistant crop development	Australian National University	ARC
Identification and taxonomy of economic crop diseases and their management using biological approaches	University of Queensland	Rural Development Administration (Republic of Korea)
Improved certification for certified seed potatoes	DJPR	DJPR

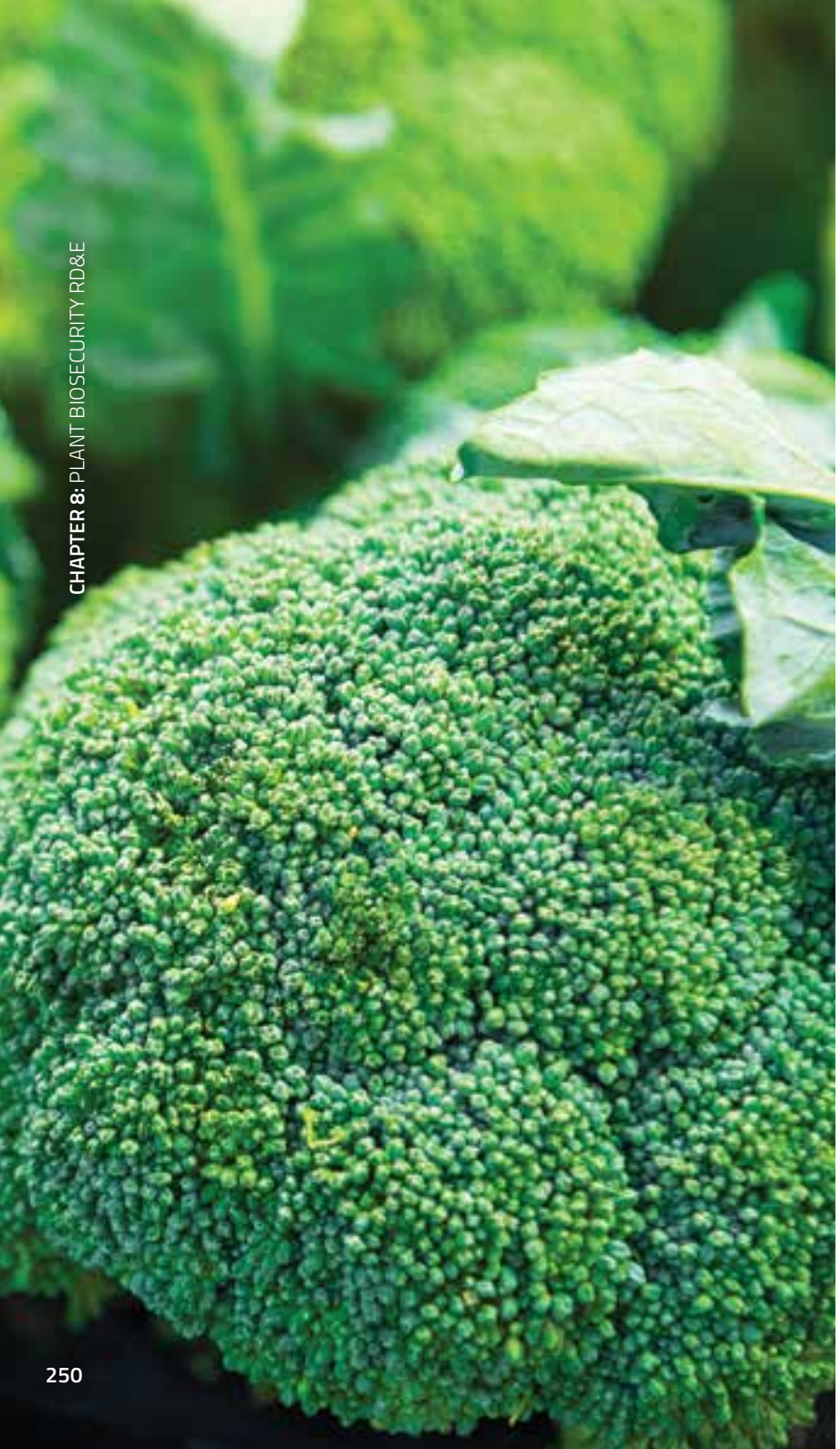


Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Horticulture – vegetable (continued)		
Improved knowledge of factors contributing to carrot rot	Peracto Pty Ltd	Hort Innovation
Improved management of pumpkin brown etch	Applied Horticultural Research Pty Ltd	Hort Innovation
Innovating new virus diagnostics and planting bed management in the Australian sweetpotato industry	Australian Sweetpotato Growers, QDAF	Hort Innovation
Integrated pest management of nematodes in sweetpotatoes	QDAF	Hort Innovation, QDAF
Integrated pest management of nematodes in sweetpotatoes	QDAF	Hort Innovation, QDAF, Australian Sweetpotato Growers, Central Queensland University, University of Southern Queensland
Minor use permits for the onion industry	Hort Innovation	Onions Australia
Novel approaches for root knot nematode control	Central Queensland University, QDAF, Henderson RDE, Australian Sweetpotato Growers	QDAF, Australian Sweetpotato Growers
Program approach for pest and disease potato industry investments	RMCG Consultancy	Hort Innovation
Resolving the critical disease threat to the Western Australian cucurbit industry	WA DPIRD	Royalties for Regions
Review of bacterial blackleg diseases and R&D gaps with a focus on the potato industry	Crop Doc Consulting	Hort Innovation
Review of the biosecurity plan for the sweetpotato industry	PHA	Hort Innovation
Review of the biosecurity plan for the vegetable industry	PHA	Hort Innovation
Review of the national biosecurity plan for the onion industry and development of a biosecurity manual for onion producers	PHA	Hort Innovation

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Horticulture – vegetable (continued)		
Review of the national biosecurity plan for the potato industry and development of a biosecurity manual for potato producers	PHA	Hort Innovation
Strengthened biosecurity for the vegetable industry – phase 2	AUSVEG	Hort Innovation
Supporting commercial sweetpotato production and marketing in the Papua New Guinea highlands	Central Queensland University, QDAF, Australian National University, Enterprises, Fresh Produce Development Agency (PNG), National Agricultural Research Institute (PNG), Henderson RDE, Australian Sweetpotato Growers	ACIAR
The more the merrier – investigating copy number variation in brassicas	University of Western Australia	ARC
Tomato potato psyllid and Liberibacter ecology	PFRNZ	PBCRC
Tomato potato psyllid pest area freedom project	AUSVEG	PHA (through DAWR)
Tomato potato psyllid transition to management research project	WA DPIRD	Cost-sharing under the EPPRD
Horticulture – multiple crops		
A novel regulator of growth signalling in Drosophila	Monash University	ARC
Adaptive area wide management of Queensland fruit fly using SIT – guidelines for efficient and effective pest suppression and stakeholder adoption	CSIRO, DJPR	Hort Innovation, RDCs, CSIRO, DAWR (Rural Research and Development for Profit)
Assessment of alternative approaches to establishing measures for assurance about regulatory compliance of consignments of seeds imported for purposes of sowing	CEBRA	DAWR

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Horticulture – multiple crops (continued)		
Biochemistry of ejaculate mediated sexual inhibition in Queensland fruit flies (PhD)	Macquarie University	Hort Innovation
Biogeographic histories and evolutionary relationships among Australian Dacini fruit flies (Diptera: Tephritidae)	Queensland University of Technology	DEE
Biology, behavior, and population structure of *Fopius arisanus*	NSW DPI	Charles Sturt University
Biotic mortality factors of Australian fruit fly across different regions	Western Sydney University	ARC
Chemical relationships between Queensland fruit flies and their natural enemies (PhD)	Macquarie University	ARC
Combining SIT in Queensland fruit fly IMP programs (PhD)	Macquarie University	Hort Innovation
Comparisons of new sexing strains of Queensland fruit fly	Macquarie University	International Atomic Energy Agency Co-operative Research Program (Austria)
Creating a novel lure and kill device for Queensland fruit fly	Queensland University of Technology, QDAF, DJPR	PBCRC, DJPR
Crop hygiene – Hort Indexing	DJPR	Fee for Services
Detection and prediction of herbicide residues for the protection of crop plantations	Monash University	Yitpi Foundation
Developing an emergency response and long-term management strategy for cassava mosaic virus in Cambodia and Vietnam	International Center for Tropical Agriculture	ACIAR
Developing and implementing high throughput diagnostic tests for *Candidatus* Liberibacter solanacearum	SARDI, DJPR	Hort Innovation

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Horticulture – multiple crops (continued)		
Development and production optimisation of a male-only selecting temperature-sensitive-lethal, strain of *Bactrocera tryoni* (Queensland fruit fly)	University of Adelaide	SARDI
Dynamics of the Queensland fruit fly microbiome under mass-rearing (PhD)	Macquarie University	Hort Innovation
Essential market access data packages	QDAF	Hort Innovation
Establishment of the Queensland fruit fly SITplus facility in southern Australia	SARDI	Hort Innovation
Evaluate volatiles from the infected insects as indicators for diagnostic insect health (PhD)	Murdoch University	Government of Iraq
Evaluation of fumigation and cold treatment for fruit fly on post-harvest citrus	Murdoch University	Korean Quarantine Department
Evaluation of mating, dispersion and migration between different treated fruit flies by using stable isotope technology (PhD)	Murdoch University	Government of Iraq
Fruition® trap and Natflav 500 testing	Griffith University	AgNova Technologies Pty Ltd
Genetic consequences of domestication in the Queensland fruit fly (PhD)	Macquarie University	Hort Innovation
Genetics of fruit fly thermal tolerance and pupal colour	Macquarie University	Hort Innovation
Genomic tools to improve molecular diagnostics and control of fruit fly pests	DJPR, La Trobe University	DJPR
Gut bacteria-mediated physiology in Queensland fruit fly (PhD)	Macquarie University	Hort Innovation

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Horticulture – multiple crops (continued)		
Heritability of stress tolerance in Queensland fruit fly (PhD)	Macquarie University	Hort Innovation
Implementing brown sugar flotation for assuring freedom from fruit fly	Applied Horticultural Research Pty Ltd	Hort Innovation
Implementation of RapidAIM – real-time monitoring for the presence and location of fruit fly	CSIRO	Hort Innovation
Improved detection and identification of xanthomonads affecting vegetable crops (PhD)	La Trobe University, DJPR	PBCRC
Improved larval diets for mass-rearing of Queensland fruit fly (PhD)	Macquarie University	Hort Innovation
Improved post-harvest market access treatment for horticultural commodities	PFRNZ, QDAF, NSW DPI	PBCRC, PFRNZ, NSW DPI, QDAF
Improving the biosecurity preparedness of Australian horticulture for the exotic spotted wing drosophila (*Drosophila suzukii*)	PHA	Hort Innovation
Improving the national exotic fruit fly grid	CEBRA	DAWR
Increasing yield and quality in tropical horticulture with better pollination, fruit retention and nutrient distribution	University of the Sunshine Coast	Hort Innovation
Industrial transformation training centre – Centre for Fruit Fly Biosecurity Innovation	Macquarie University, Western Sydney University, Queensland University of Technology	ARC
Integrated crop management strategies for root and tuber crops – strengthening national and regional capacities in Papua New Guinea, Fiji, Samoa, Solomon Islands and Tonga	University of Queensland	ACIAR

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Horticulture – multiple crops (continued)		
Integrated pest and disease management – PIPs II	DJPR	Hort Innovation, DJPR
Interactions of entomopathogens and Australian fruit fly	Western Sydney University	ARC
Inventory of Colletotrichum fungal species	QDAF	DEE
Investigate the use of smart traps in fruit fly surveillance	Hort Innovation	DAWR
Investigation into deployment, dispersal and transformation of fruit fly lures (PhD)	Macquarie University	Hort Innovation
LAMP assay for the detection of fruit flies	DJPR	DJPR
Larval diets for high-productivity mass-rearing	Macquarie University	Hort Innovation
Male only sterile Queensland fruit fly, SITplus	SARDI	Hort Innovation
Management and detection of bacterial leaf spot in capsicum and chilli crops	QDAF	Hort Innovation
Mating frequency of Queensland fruit fly – a potential constraint on SIT (PhD)	Macquarie University	Hort Innovation
Mediterranean fruit fly (*Ceratitis capitata*) responses to lethal stressors (PhD)	Murdoch University	Government of Iraq
Mediterranean fruit fly eradication from Carnarvon using area wide management and SIT	WA DPIRD	Hort Innovation
Mediterranean fruit fly eradication from Carnarvon using area wide management and SIT	WA DPIRD	Hort Innovation, Royalties for Regions
Methoprene and dietary yeast as pre-release supplements for Queensland fruit fly SIT (PhD)	Macquarie University	Hort Innovation
Methyl bromide disinfestation of Queensland fruit fly	NSW DPI	Hort Innovation

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Horticulture – multiple crops (continued)		
Microbial gut symbionts and domestication	NSW DPI, Macquarie University, Western Sydney University	Macquarie University
Models for border inspection for pelleted seeds – how much assurance?	CEBRA	Ministry for Primary Industries (New Zealand)
Molecular basis of response to sub-lethal stresses	Murdoch University	PBCRC
Molecular basis of sexual performance in Queensland fruit fly (PhD)	Macquarie University	ARC
Molecular characterisation of specimens in the Victorian Plant Pathogen Herbarium to support market access into Asian markets – powdery mildews	DJPR, La Trobe University	DJPR
National biosecurity plan for the summerfruit industry	PHA	Hort Innovation
National Centre for Post-harvest Disinfestation Research on Mediterranean Fruit Fly (Australian Medfly R&D Centre)	Murdoch University	AgriFutures Australia, Hort Innovation, Kalang Consultancy Services Pty Ltd, QDAF, WA DPIRD
New insecticide testing for fruit fly	Griffith University	Ministry for Primary Industries (New Zealand)
Next generation national fruit fly diagnostics and handbook	Queensland University of Technology, QDAF, WA DPIRD, PHA	PBCRC
Non-host status and detection methods for Queensland fruit fly	DJPR	DJPR
Nutritional immunology of Queensland fruit flies (PhD)	Macquarie University	Hort Innovation
Olfactory relationship between fruit flies and associated bacteria (PhD)	Macquarie University	ARC
Optimising the Fruition® trap for improved control of pest fruit flies in eastern Australia	Griffith University	AgNova Technologies Pty Ltd

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Horticulture – multiple crops (continued)		
Pheromones as potential fruit fly lures (PhD)	Macquarie University	ARC
Pilot testing efficacy of post-harvest disinfestation treatments	DJPR	DJPR
Piloting new techniques to control and eradicate Mediterranean fruit fly	WA DPIRD	Royalties for Regions, WA DPIRD
Plant biosecurity diagnostic and surveillance web-based bioinformatics toolkit	Murdoch University	PBCRC
Plant pest surveillance project	DJPR	Hort Innovation
Planthoppers in Cixiidae	NSW DPI	DEE
Post factory pilot of SITplus fly production	Macquarie University	Hort Innovation
Potential impacts of climate change on habitat suitability for the Queensland fruit fly (PhD)	Macquarie University	Hort Innovation
Predator–prey interactions in Queensland fruit flies (PhD)	Macquarie University	Hort Innovation
Preparedness for exotic fruit flies	PHA	DAWR
Probiotic diets to increase Queensland fruit fly male performance as part of the SIT (PhD)	Western Sydney University, NSW DPI	PBCRC
Psyllid microflora – implications for Liberibacter disease surveillance and pest control (PhD)	La Trobe University, DJPR	PBCRC
Quality control procedures for Queensland fruit fly mass-rearing (PhD)	Macquarie University	Hort Innovation
Queensland fruit fly behaviour (PhD)	Macquarie University	Hort Innovation
Risk evaluation and improvements to diagnostics of south-east Australian fruit flies	DJPR	DJPR

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Horticulture – multiple crops (continued)		
Semiochemical-mediated enhancement of sterile male Queensland fruit fly	NSW DPI	Universities
Sex selection genes from fruit fly species for use in SITplus	Macquarie University	Hort Innovation
SITplus – developing and optimising production of a male-only, temperature-sensitive-lethal, strain of Queensland fruit fly	SARDI	Hort Innovation
SITplus – dietary sterilisation of male Queensland fruit fly	CSIRO	Hort Innovation
SITplus – improved population management system for Queensland fruit fly	PFRNZ	Hort Innovation
SITplus – Port Augusta Queensland fruit fly sterile insect technique factory pilot operation	PIRSA	Hort Innovation
Synthesis and analysis of zingerone analogues as fruit fly attractants (PhD)	Macquarie University	Hort Innovation
Taxonomy of anthracnose diseases	DJPR	University of Melbourne
The evolution of generalism – why so many polyphagous fruit flies?	Queensland University of Technology	ARC
The phenology of fruit fly in subtropical Australia	Queensland University of Technology	Queensland University of Technology
The science underpinning ISPM 37	Queensland University of Technology	Queensland University of Technology
Horticulture – other		
Basic research on the cocoa pod borer in Papua New Guinea to permit effective pest management	NSW DPI	ACIAR

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Horticulture – other (continued)		
A trial of Vapormate® fumigant for the disinfestation of Australian wildflowers	Cedar Hill Flowers	DAWR
An integrated pest and disease management extension program for the olive industry	Western Sydney University	Hort Innovation
Bogia coconut syndrome in Papua New Guinea and related phytoplasma syndromes – developing biological knowledge and a risk management strategy	Charles Sturt University, University of Southern Queensland	ACIAR
Defining the biotic constraints to fresh taro from Samoa gaining market access to Australia	PFRNZ, Samoan Ministry of Agriculture and Fisheries, Scientific Research Organisation of Samoa	ACIAR
Development of a biosecurity plan for the Australian coffee industry	PHA	AgriFutures Australia
Development of a biosecurity plan for the tea tree Industry	PHA	Australia Tea Tree Industry Association
Development of a risk management system for systemic downy mildew of poppy	University of Tasmania	ARC
Epidemiology, impact and management of myrtle rust in lemon myrtle plantations (PhD)	University of Queensland	PBCRC
Fusarium oxysporum on ginger	University of Queensland	AgriFutures Australia, QDAF
Improved capacity for integrated disease management of couch smut (*Ustilago cynodontis*) in turf	University of Queensland	Hort Innovation
Improved management strategies for cocoa in Papua New Guinea	University of Sydney	ACIAR
Improved tissue culture production of ginger clean planting material	QDAF	AgriFutures Australia, QDAF
Integrated pest management of phytophagous mites on turfgrass	IPM Technologies	Hort Innovation
Minor use permit renewals	Peracto Pty Ltd	Hort Innovation
Olive industry minor use program	Hort Innovation	Hort Innovation
Pest and disease management and research services for the mushroom industry	University of Tasmania	Hort Innovation
Pests and diseases of truffles and their tree hosts in Australia	WA DPIRD	AgriFutures Australia, Australian Truffle Growers' Association, WA DPIRD, Truffle Producers Western Australia, Australian National University, Truffle and Wine Co.

The unique fauna and flora of the lower slopes of Australia's sub-Antarctic Macquarie Island have suffered historically due to human exploitation and rabbit grazing. The University of New England is now addressing the effects of the invasion of weeds on the island. Image courtesy of B.M. Sindel

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Natural environment		
A predictive framework for invaded communities	Monash University	ARC
Activities to support the development of the national priority list of exotic environmental pests and diseases	University of Melbourne	DAWR, ABARES
Biocontrol solutions for sustainable management of weed impacts to agriculture	CSIRO, DJPR, NSW DPI, QDAF	GRDC, CSIRO, DJPR, NSW DPI, QDAF, PIRSA, Seqwater, Shire of Ravensthorpe, NSW Weed Biocontrol Taskforce, North-West Local Land Services, NSW DP&E, Bundaberg Regional Council, Gladstone Regional Council, HQPlantations, Goulburn–Murray Water Corporation, Murrumbidgee Irrigation Ltd, Coleambally Irrigation Cooperative, Goulburn Broken Catchment Management Authority, Murray Local Local Land Services, USDA Agricultural Research Service (USA), Australian Biological Control Laboratory, Wyong Shire Council, NSW National Parks Service, Central Murray County Council, Murrumbidgee Landcare Inc, NQ Dry Tropics
Changes in the ecology and control of introduced non-native plants following pest herbivore eradication in the sub-Antarctic (*Stellaria media*)	University of New England	Australian Antarctic Division

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Natural environment (continued)		
Development of a bioherbicide for control of prickly Acacia	University of Queensland, BioHerbicides Australia	Meat and Livestock Australia, BioHerbicides Australia
Development of a biosecurity plan for Acacia species	PHA	DAWR
Ecological impact of myrtle rust (*Puccinia psidii*) in native and managed ecosystems (PhD)	NSW DPI, Macquarie University	NSW DP&E, PBCRC, DEE
Eradication of inkweed, a new priority weed incursion on King Island	King Island Natural Resource Management Group	National Landcare Program
Evaluating progress of detector dogs for hawkweed eradication	Monash University	Parks Victoria
Evaluating the deployment of autonomous vehicles for weed eradication	Murdoch University	Chevron (USA)
Evolution of chemical warfare in plants	Monash University	ARC
Identification of termites through frass	Murdoch University	DAWR
Improving and developing tools to manage Parkinsonia and Mesquite in the Pilbara Region	Pilbara Mesquite Management Committee	DAWR
Information gap theory as a tool to assist in biosecurity decision making (PhD)	Murdoch University	Murdoch University, Chevron (USA)
Integrating emerging Parkinsonia biocontrol technologies on the Barkly Lakes	Australian Agricultural Company Ltd	(Northern) Territory Natural Resource Management
Invasion and impact – predicting the causes and consequences of plant invasions	University of Canberra	ARC
Mixed models to analyse pre-border and border surveillance to assist with decision making	Murdoch University	Murdoch University, Chevron (USA)

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Natural environment (continued)		
Multi-scale seed dispersal models for improved regional weed management	Monash University	ARC
National review and proposed action plan for myrtle rust	PBCRC	PBCRC, DEE
Phosphonate bark painting of Wollemi pine	Royal Botanic Gardens and Domain Trust, NSW Office of Environment and Heritage	NSW DP&E, Royal Botanic Gardens Sydney
Plant ecophysiology – prospecting for weed control using a native parasitic plant, from laboratory to field implementation	University of Adelaide	ARC, SA Water, Forestry SA, DEWNR SA, PIRSA, Nature Foundation SA, Lirabenda Endowment Fund, Adelaide and Mount Lofty Ranges and South Australian Murray Darling Basin Natural Resources Management Boards
Research and access potential pests and pathogens that could significantly impact biodiversity in NSW	University of Melbourne	Macquarie University, NSW Office of Environment and Heritage
Resolving the reproductive mode of the invasive yellow crazy ant (*Anoplolepis gracilipes*)	James Cook University	Skyrail Rainforest Foundation
Role of mycorrhizae in invasion	University of Wollongong	University of Wollongong
Sea spurge genomics in Australia	CSIRO	Australian National University
Weed control for soil handling practices associated with native ecosystem rehabilitation	Charles Darwin University	NT DPIR
Western Australia bitou management	CSIRO	Freemantle Port Authority

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Nursery crops		
A review of diagnostic technologies to benefit the Australian nursery industry	DJPR	Hort Innovation, DJPR
Building the resilience and on-farm biosecurity capacity of the Australian production nursery industry	QDAF	Hort Innovation
Improving pest management for the nursery industry	NGIA	Hort Innovation
Integrated disease management in pyrethrum	University of Tasmania	Hort Innovation
National nursery industry biosecurity program	NGIA	Hort Innovation
Pollinators		
A world without bees – simulating important agricultural insect pollinators	Monash University	ARC
Assessing pathogen risks to honey bees and native bees in NSW (PhD)	Western Sydney University	Western Sydney University
Bee pollination projects	Western Sydney University	Syngenta Australia Ltd
Developing the use of sensors to model bee colony dynamics and to monitor bee health productivity and performance	Macquarie University, USDA Agricultural Research Service (USA)	USDA Agricultural Research Service (USA)
Enhanced national bee pest surveillance program	PHA	Hort Innovation, AHBIC, Grain Producers Australia, DAWR
Enhancing and safeguarding pollination services for almond production in Australia	Western Sydney University	Olam International Pty Ltd
Ensuring lucerne seed production in the absence of bees	University of Western Australia	AgriFutures Australia
External attractant trap for small hive beetle	QDAF	AgriFutures Australia, QDAF, Queensland Beekeepers Association, Wheen Bee Foundation

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Pollinators (continued)		
Geospatial assessment of impacts of climate change on the bee industry and associated ecosystem services in Western Australia using multi-agent modelling of socio-ecological systems – a case study of hive migration patterns	University of Western Australia	CRC for Honey Bee Products
Healthy bee populations for horticultural pollination services	Western Sydney University	Hort Innovation
Honey bee disease diagnostics	University of Western Australia	CRC for Honey Bee Products
Honey bee nutrition – early detection of malnutrition and colony collapse	University of Western Australia	CRC for Honey Bee Products
Improving the health of hives used in pollination	University of Adelaide	AgriFutures Australia
Managing flies for crop pollination	Western Australian Agriculture Authority, University of New England	Hort Innovation
Modelling for year round high-value honey production sites	University of Western Australia	CRC for Honey Bee Products
Molecular marker identification for disease resistance and implementation into a bee breeding program	University of Western Australia	CRC for Honey Bee Products
National bee pest surveillance program enhancements	PHA	DAWR
Native pollinators in the Riverina Local Land Services region	University of New England	Australian Melon Association Inc
Pollination harmony	University of Western Australia	CRC for Honey Bee Products
Quantifying the role of wild insect pollinator biodiversity in the provision of pollination ecosystem services	University of New England	Ian Potter Foundation

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Pollinators (continued)		
Securing pollination for productive agriculture – guidelines for effective pollinator management and stakeholder adoption	AgriFutures Australia	Hort Innovation, University of Sydney, University of Adelaide, University of New England, Australian National University, SA DPIRD, SA Department of Environment, Water and Natural Resources, O'Connor NRM, Native Vegetation Council, Trees for Life, CSIRO, Lucerne Australia, South Australia Apiarist Association, Apple and Pear Growers Association of South Australia, Costa Group, Australian Melon Association, Australian Mango Industry Association, Terrestrial Ecosystems Research Network, Greening Australia, Almond Board of Australia, Adelaide and Mount Lofty Ranges Natural Resources Management Board, Natural Resource Northern and Yorke, Raspberries and Blackberries Australia
Selection and development of Australian hygienic honey bee lines	Bee Scientifics	AgriFutures Australia, Wheen Bee Foundation, Bee Scientifics
Stingless bees as effective managed pollinators for Australian horticulture	Western Sydney University	Hort Innovation
Systematics and host associations of the Australian gasteruption wasps (Honours)	Flinders University	DEE

University of New England research aims to increase the profitability and security of pollinator dependent crops by improving the health, diversity and abundance of pollinating bees on farms. It also aims to manage the biosecurity risks posed by the varroa mite. Image courtesy of J. Jones.

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Pollinators (continued)		
The mechanisms underlying crop pollinator effectiveness in agro-ecosystems	University of New England	ARC
The storage of beneficial and plant pathogenic fungi in honey bee hives and its influenece on honey bee health and longevity	University of Adelaide	University of Adelaide
Varroa mite host switch	Australian National University	ARC
Unknown crop		
Biodiversity, systematics and taxonomy of Australian microgastrine parasitoid wasps (Honours)	University of Adelaide	DEE
Taxonomy, phylogeny and host associations in Labeninae parasitoids from south-east Australia (Hymenoptera: Ichneumonidae) (Honours)	University of Adelaide	DEE
Urban, amenities		
A risk-return prioritisation tool for global trade inspections	CSIRO	PBCRC
Multiple crops		
Access to industry priority uses of agvet chemicals	Agaware Consulting Pty Ltd	AgriFutures Australia, DAWR
Agriculture weed surveillance in the south-west to protect industry profitability	WA DPIRD	Royalties for Regions, WA DPIRD
Anticipating, combating and exploiting the evolution of pesticide resistance in Australian agricultural pests and disease vectors	Australian National University	ARC
A scientific trial to measure the in-paddock and economic benefits of biofumigation on soil health, and on disease pest and weed levels on a range of annual crops under Tasmanian conditions	University of Tasmania	DPIPWE

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Multiple crops (continued)		
AUSPest*Check*™ trial	PHA	DAWR
Australian psyllids, implications for conservation and biosecurity	University of Adelaide	DEE
Biocontrol feasibility for giant pine scale	DJPR	DJPR
Biological control of silverleaf nightshade	DJPR	DAWR (Rural Research and Development for Profit), AgriFutures Australia, PIRSA, GRDC
Biological control stocktake for brown marmorated stink bug	DAWR, CSIRO	DAWR
Biopesticide use and insect resistance in Australian agriculture	University of Adelaide	ARC
Black spot of field peas and native legumes in Australia	University of Adelaide, Royal Botanic Gardens and Domain Trust, SARDI	University of Adelaide, Royal Botanic Gardens and Domain Trust
Centre for Biopesticides and Semiochemicals – novel insecticides and synergists from endemic and exotic flora	Western Sydney University	CRDC
Collaborative planning and shared decision making amongst stakeholders	QDAF	PBCRC
Commercial development and evaluation of a machine vision-based weed spot sprayer	University of Southern Queensland	CRDC, University of Southern Queensland, SRA, Hort Innovation
Compliance based inspection scheme – continuous sampling plan sensitivity analysis	CEBRA, University of New England	DAWR
Decision making for eradication and quarantine zones	Queensland University of Technology, QDAF, NSW DPI	PBCRC
Deployment of validated genome-informed bacterial diagnostics	NSW DPI	PBCRC
Developing an alternative herbicide management strategy to replace PSII herbicides in the wet tropics area	SRA, James Cook University	SRA, QDAF

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Multiple crops (continued)		
Developing a national systems approach for meeting AM17001 biosecurity requirements to access key Asian markets	CSIRO	Hort Innovation
Developing models for the spread and management of national priority plant pests	CEBRA	DAWR
Development of effective insect surveillance plans utilising economic portfolio theory (PhD)	Murdoch University	Murdoch University, Chevron (USA)
Development of new tools and strategies for IPM (biopesticides and semiochemicals)	NSW DPI	CRDC, NSW DPI
Development of proof of freedom guidelines	CEBRA	DAWR
Diagnosis of emerging pathogens	NSW DPI	Private industry
Diagnosis of water samples for Phytophthora species	DJPR	DJPR
Discovering the pathways and mechanisms underlying bio-insecticide control of the global migratory pest, diamondback moth, *Plutella xylostella*	University of Adelaide	ARC
Disease resistance genes from skeleton weed	CSIRO	Australian National University
Elucidating trifluralin resistance in Australian major weed *Lolium rigidum*	University of Western Australia	ARC, NuFarm Australia
Embedding Global Eradication and Response Database into the biosecurity landscape – uptake and legacy (phase 2)	PFRNZ	PBCRC
Enabling improved plant biosecurity practices in Cambodia, Laos and Thailand	PBCRC, RedClaw	ACIAR

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Multiple crops (continued)		
Enhanced surveillance strategies in horticultural industries based on knowledge of natural dispersal pathways – phase 2	DJPR, DPIPWE	PBCRC, DJPR, DAWR, PHA
Establishing a program of plant pest surveillance in Australian botanic gardens and arboreta	PHA	DAWR
Establishment of the Australian–Indonesia Bilateral Plant Biosecurity Initiative	PBCRC	PBCRC, Crawford Fund
Evaluation of stressed weeds with herbicide, adjuvant and biostimulant blends	Monash University	Axieo Operations Pty Ltd
Evolutionary aerial robotics	CSIRO	CSIRO
Forging an effective fight against Phytophthora in NSW	Royal Botanic Gardens and Domain Trust, NSW Office of Environment and Heritage	Royal Botanic Gardens and Domain Trust, NSW Office of Environment and Heritage
From individuals to mass organisation – aggregation, synchronisation and collective movement in locusts	University of Adelaide	ARC
General surveillance	CSIRO	DAWR
Historical pest genomes inform debate about how rapid evolution proceeds	Australian National University	ARC
Horticulture funding for the PBCRC	PBCRC	Hort Innovation
How do MACPF and CDC proteins punch giant holes in lipid membranes?	Monash University	ARC
Identification of immune receptor and signalling proteins from plants	Australian National University	ARC

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Multiple crops (continued)		
Identifying the biochemical and molecular bases of 2,4-D herbicide resistance in the economically important weed *Raphanus raphanistrum* (wild radish)	University of Western Australia	ARC, Nufarm Australia
Identify new Trojan female mutations in vinegar flies to support screening of clover root weevil	Monash University	New Zealand Ministry of Business, Innovation and Employment
iMapPESTS – sentinel surveillance for agriculture	SARDI	Hort Innovation
Implementation of a multi-target surveillance system	Murdoch University	Chevron (USA)
Improve biosecurity capabilities for demonstrating pest area freedom	PHA	DAWR
Improved management options for cucumber green mottle mosaic virus	NT DPIR	Hort Innovation
Improving diagnostics and biosecurity for graft transmissible diseases in citrus	NSW DPI, Queensland Alliance for Agriculture and Food Innovation, University of Queensland, WA DPIRD, Auscitrus	Hort Innovation
Improving grower-led surveillance	CSIRO	DAWR
Improving plant biosecurity in the Pacific Islands	Kalang Consulting, Magee Consultancy, Pacific NPPOs, Pacific Horticultural and Agricultural Market Access, Pacific Agribusiness Research for Development Initiative, Crawford Fund, Biosecurity and Agrisystems Protection Consultants	ACIAR, DAWR
Improving the efficacy of pseudomonad biocontrol bacteria	Macquarie University	ARC
Industry liason officer	PHA	DAWR

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Multiple crops (continued)		
Innovative technologies project – remote sensing for presence or absence	CSIRO	DAWR
Intelligent image retrieval from distorted and partial queries for rapid mobile identification of pests threatening food and the environment	Griffith University	ARC
Invasion pathway analysis for Australia – insects	Monash University	Invasive Species Council
Invasive grass LAMP platform	NSW DPI	DAWR
Making Green Guard® greener – enhancing the efficacy of a biopesticide	University of Sydney, University of Adelaide	ARC
Manipulating plant root exudation for soil-borne disease control	University of Tasmania	ARC
Molecular Diagnostic Centre – national disease surveillance	SARDI	GRDC
Molecular mechanism of plant immune receptors	University of Queensland	ARC
Monitoring diamond back moth for forecasting and adaptive management of outbreak and insecticide resistance risk	SARDI	GRDC
National plant biosecurity RD&E strategy implementation committee	PHA	Hort Innovation, DJPR, CRDC, Dairy Australia, GRDC, Meat and Livestock Australia, Wine Australia, SRA, AgriFutures Australia, FWPA, PHA, state governments
National priority plant pests true host list and risk pathways	QDAF	DAWR
National tree genomics program – genotype prediction toolbox	Western Sydney University	Hort Innovation

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Multiple crops (continued)		
National weed biological control project	DJPR	DEE, Meat and Livestock Australia, DJPR, NSW DPI, CSIRO, QDAF
National Working Party on Pesticide Applications	PHA	CropLife Australia, GRDC, Hort Innovation, Wine Australia, CRDC, SRA
Natural dispersal subproject – metabarcoding of trapped insects	DJPR	PBCRC, Hort Innovation
Novel insecticides and synergists from endemic and exotic flora (PHD)	Western Sydney University	CRDC
Odorant recognition in insect olfactory system to control insect behaviour	Murdoch University	ARC
Pathways and risk assessment framework for high impact species	CSIRO, QDAF, PFRNZ, WA DPIRD, Lincoln University (New Zealand)	PBCRC
Physical management options for herbicide resistant weeds – targeted tillage	University of Western Australia, University of Sydney	University of Sydney
Phytophthora cinnamomi and native vegetation	Deakin University	DEE, Parks Victoria
Plant and associated microbiome responses to indoleamines and potential applications in agriculture	La Trobe Univeristy	La Trobe University
Plant Biosecurity Research Initiative	Projects led by individual RDCs	Hort Innovation, CRDC, GRDC, Wine Australia, SRA, Agrifutures Australia, FWPA
Pollination systems as indicators of fire regime impacts – a study of thresholds	University of New England	NSW Office of Environment and Heritage (Save our Species grant)
Prevention and control of West Indian drywood termite	QDAF	QDAF

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Multiple crops (continued)		
Provision of a revised economic allocation theory model – Barrow Island biosecurity	University of Melbourne	Murdoch University, Chevron (USA)
RD&E program for control, eradication and preparedness for vegetable leafminer	AUSVEG, CESAR, NAQS, University of Melbourne, PHA	Hort Innovation
Reduced herbicide usage through application technology	Edith Cowan University	GRDC
Research to inform yellow crazy ant management in the wet tropics	James Cook University	Wet Tropics Management Authority
Resolve the taxonomy of native Australian longhorn beetle	CSIRO	DAWR
Responding to emerging pest and disease threats to horticulture in the Pacific Islands	University of Queensland	ACIAR
Revision of bristle fly genus Rutilia	CSIRO	DEE
Risk assessment and evaluation for plant pest disease pathways in northern Australia	QDAF	DAWR
Risks associated with the spread of myrtle rust spores, through the movement of bees and beehives in New Zealand	PFRNZ	Biosecurity New Zealand, PFRNZ
Sampling for proof of freedom guidelines	University of Melbourne	DAWR
Seed bank biology of emerging weeds	University of Adelaide	GRDC
Semiochemical management for occasional pests of cotton and grains	University of New England	CRDC
Single model irregular region retrieval for rapid plant disease detection	Griffith University	ARC
Structure based investigations into new modes of action for herbicides	University of Western Australia	ARC

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Multiple crops (continued)		
Sustainable productivity improvements in Allium and solanaceous vegetable crops in Indonesia and subtropical Australia	QDAF	ACIAR
Systematics and biology of braconid wasps	University of Adelaide	DEE
Systematics, biodiversity and host associations of Australian psyllids – implications for conservation and biosecurity	University of Adelaide	University of Adelaide
Testing an iterative approach to selecting successful biological control agents	University of Queensland	CSIRO
Testing incentive based drivers for importer compliance	CEBRA, University of New England	DAWR
The effect of SeroX on *Verticillium dahliae* microsclerotial inoculum	NSW DPI	Innovate Ag Pty Ltd
The role of reproductive parasites in the biology of invasive pest thrips (PhD)	Western Sydney University	Western Sydney University
TraitCapture – genomic modelling for plant phenomics under environmental stress	Australian National University	ARC
Treatment of stressed weeds with herbicide, adjuvant and oxidative hydrothermal dissolution liquor blends	Monash University	Greenpower Energy Limited
Weed biocontrol	DJPR	Goulburn Murray Water, Murrumbidgee Irrigation, Coleambally Irrigation, Goulburn Broken CMA, Wyong Shire, OEH NPWS, Central Murray Council, NQ Dry Tropics, Murray Local Land Services, Murrumbidgee Landcare, PIRSA, GRDC

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Multiple crops (continued)		
What are the roles of disturbance and biotic resistance in the establishment of *Solenopsis geminata*?	James Cook University	Ecological Society of Australia
When is hybridisation helpful or harmful to invaders?	Monash University	ARC
Wind spread of plant viral pathogens into northern Australia (PhD)	University of Western Australia, WA DPIRD, CSIRO	PBCRC
Xylella coordinator	Wine Australia	Wine Australia, Hort Innovation, PBRI
Yellow crazy ant biology and novel control methodologies	James Cook University	Kuranda Envirocare Inc
Other crops		
AgWhite – aquatic weed control tools for maintaining water flow in irrigation channels	DJPR	DAWR, United Phosphorus Ltd (India), Goulburn–Murray Water, Murrumbidgee Irrigation, Ord Irrigation, Coleambally Irrigation, Sun Water Ltd
Best practice management of Sagittaria	DJPR	DAWR (Rural Research and Development for Profit), AgriFutures Australia, Goulburn Murray Water Corporation, Goulburn Broken CMA, Coleambally Irrigation Cooperative, Murrumbidgee Irrigiation
Developing a foundation for the long-term management of basal stem rot of oil palm in Papua New Guinea and Solomon Islands	University of Queensland	ACIAR
Generation of efficacy and crop safety data with various pesticides in carobs	WA DPIRD	AgriFutures Australia

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Research and development		
Other crops (continued)		
Solutions and understanding African whitefly	CSIRO	Australian Government Department of Education
Transcriptome analysis of Phytophthora–plant interactions – characterisation of plant inhibitor proteins targeting Phytophthora extracellular effectors	Australian National University	ARC

California arrowhead (Sagittaria montevidensis). Image courtesy of Juan Campá, MGAP, Bugwood.org

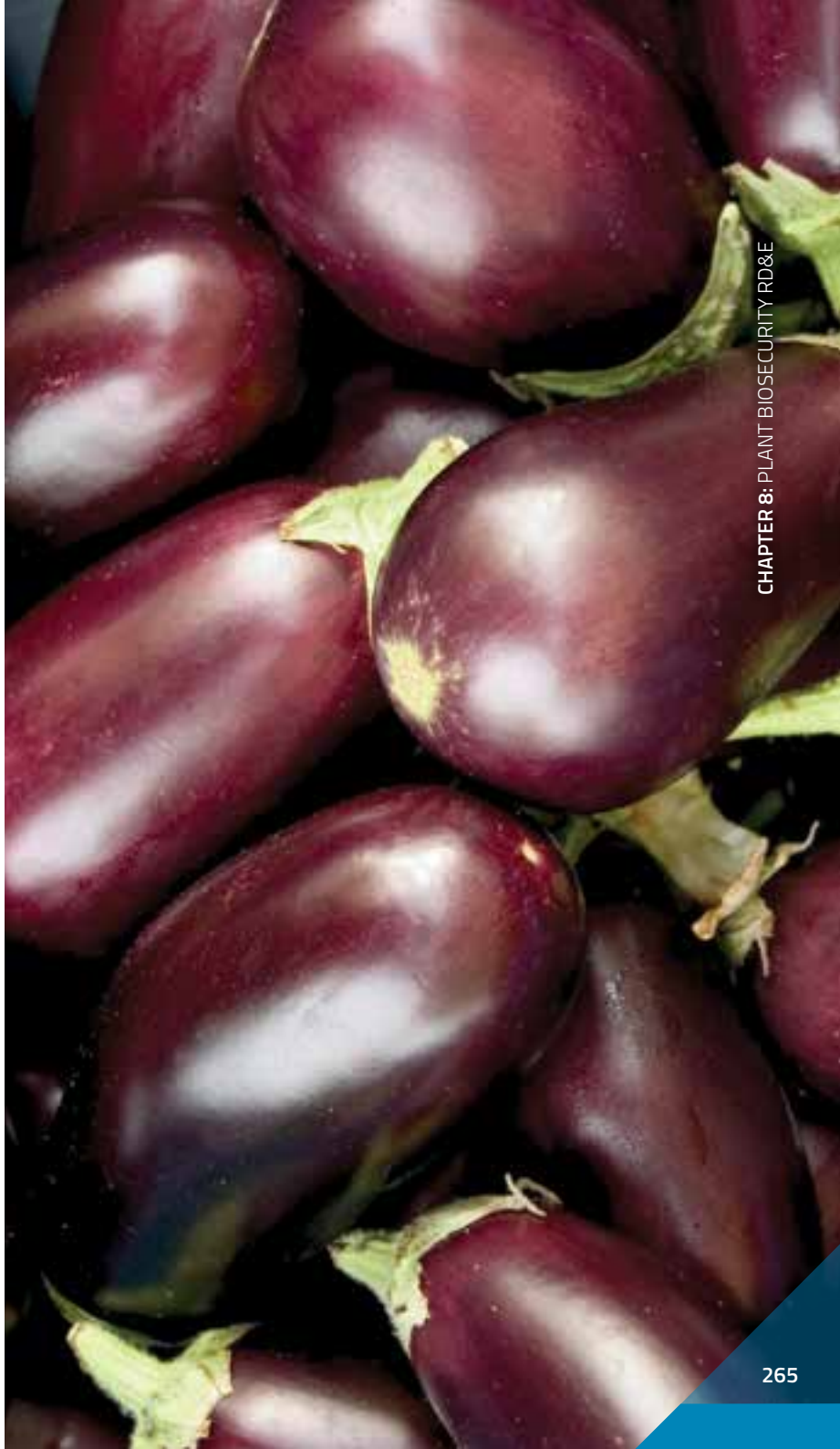


Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Extension		
A comprehensive review of grapevine pinot gris virus	Vinehealth Australia	Wine Australia
A multi-faceted approach to soil-borne disease management	Applied Horticultural Research Pty Ltd	Hort Innovation
An integrated pest, disease and weed management program for the Australian apple and pear industry	University of Tasmania, DJPR	Hort Innovation, DJPR, WA DPIRD, University of Tasmania, NSW DPI, QDAF
Australian lychee industry communication program	Australian Lychee Growers' Association	Hort Innovation
Communication and adoption program for the Australian chestnut industry	Chestnuts Australia	Hort Innovation, Chestnuts Australia
Cultural management for weed control and maintenance of crop yield	University of Western Australia	GRDC
Development of a spatiotemporal database and enhanced floristic vegetation mapping	University of Western Australia	CRC for Honey Bee Products
Engagement in resilience in indigenous communities	PFRNZ	PBCRC
Extension and engagement	Curtin University	GRDC
Farm biosecurity project	AUSVEG	PHA
Field surveillance capability	DJPR	DAWR
General pathology diagnostic, training and technical advice – Tully	SRA	SRA
General pathology diagnostic, training and technical advice – Woodford	SRA	SRA
General pest management – central Queensland	SRA	SRA
General pest management – north Queensland	SRA	SRA
General pest management – south Queensland	SRA	SRA
Grain storage extension	QDAF	GRDC

Project title	Organisation undertaking the research	Funding source or body
Extension		
Grains farm biosecurity program	PHA	Grain Producers Australia
Improved soil-borne disease diagnostic capacity for the Australian vegetable industry	SARDI	Hort Innovation
Improving biosecurity resources and better understanding bee health in Australia	PHA	AgriFutures Australia
Improving on-farm grain storage management through technical training	QDAF	GRDC
Integrated management of yellow sigatoka	ABGC	Hort Innovation
Integrated pest management of redberry mite (*Acalitus essigi*) on blackberries	University of Tasmania	Hort Innovation
Managing *Bt* resistance and induced tolerance in Bollgard III using refuge crops	CSIRO	CRDC
Maximising productivity of Eucalyptus and Acacia plantations for growers in Indonesia and Vietnam	CSIRO Forestry and Forest Products	ACIAR
Melon industry biosecurity project	PHA	DAWR
National bee biosecurity program	PHA	AHBIC
National biosecurity or disease extension and central Queensland regional extension	QDAF	CRDC, QDAF
National cotton extension development and delivery – stewardship of biotechnologies	CRDC	CRDC
National Fruit Fly Council	PHA	Hort Innovation
National tomato potato psyllid program coordinator	AUSVEG	Hort Innovation
Nursery production visual training resources	EHR Consultants	PHA
Perceptions towards biosecurity threats across Vietnamese farming communities in Australia (PhD)	Charles Darwin University	PBCRC

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Extension		
R&D extension for the truffle industry	Australian Truffle Growers' Association	AgriFutures Australia, Australian Truffle Growers' Association
Responsible visitation campaign	Vinehealth Australia	PIRSA, South Australian Wine Industry Association, Wine Federation Australia, Vinehealth Australia
SITplus – raising Queensland fruit fly SIT to world standard	Macquarie University	Hort Innovation
Strengthened biosecurity for the vegetable industry – phase 2	AUSVEG	Hort Innovation
Strengthening and enabling effective pollination for Australia	PFRNZ, PHA	Hort Innovation, PFRNZ
Sustainable vegetable systems in north-west Vietnam	NSW DPI, University of Adelaide	University of Adelaide
Understanding and adoption of critical success factors for DPI aquatic biosecurity communications materials to achieve required behavioural change in target communities	Monash University	NSW DPI
Understanding and managing insects on pistachio orchards	Ag Dynamics Pty Ltd	Hort Innovation
Understanding the environmental drivers of flora and honey bee product production – development of remote sensing approaches for predicting flowering events	University of Western Australia	CRC for Honey Bee Products
Variety evaluation and tree certification devices for the apple and pear industry	Apple and Pear Australia Limited	Hort Innovation
Vegetable and potato biosecurity officer program	PHA	AUSVEG
What's all the buzz? Managing competing interests in developing Western Australia's beekeeping industry	University of Western Australia	CRC for Honey Bee Products

Appendices

Organisation contact details

Organisation	Website	Phone
AgriFutures Australia	**agrifutures.com.au**	+61 2 6923 6900
Almond Board of Australia	**australianalmonds.com.au**	+61 8 8584 7053
Apple and Pear Australia	**apal.org.au**	+61 3 9329 3511
Atlas of Living Australia	**ala.org.au**	+61 2 6218 3431
Australasian Plant Pathology Society	**appsnet.org**	+61 7 4632 0467
Australian Banana Growers' Council	**abgc.org.au**	+61 7 3278 4786
Australian Blueberry Growers' Association	**abga.com.au**	+61 490 092 273
Australian Entomological Society	**austentsoc.org.au**	+61 3 9895 4462
Australian Forest Products Association	**ausfpa.com.au**	+61 2 6285 3833
Australian Ginger Industry Association	**australianginger.org.au**	
Australian Government – Australian Centre for International Agricultural Research	**aciar.gov.au**	+61 2 6217 0500
Australian Government – Australian Pesticides and Veterinary Medicines Authority	**apvma.gov.au**	+61 2 6210 4701
Australian Government – Australian Research Council	**arc.gov.au**	+61 2 6287 6600
Australian Government – Department of Agriculture and Water Resources	**agriculture.gov.au**	+61 1800 900 090
Australian Government – Department of Agriculture and Water Resources, Australian Bureau of Agricultural and Resource Economics and Sciences	**agriculture.gov.au/abares**	+61 1800 900 090
Australian Government – Department of Agriculture and Water Resources, Northern Australia Quarantine Strategy	**agriculture.gov.au/biosecurity/australia/naqs**	+61 1800 900 090
Australian Government – Department of Agriculture and Water Resources, Trade and Market Access Division	**agriculture.gov.au/market-access-trade**	+61 1800 900 090
Australian Government – Department of Environment and Energy	**environment.gov.au**	+61 1800 803 772
Australian Government – Department of Foreign Affairs and Trade	**dfat.gov.au**	+61 2 6261 1111
Australian Grape and Wine (previously Australian Vignerons and Winemakers' Federation Australia)	**wfa.org.au**	+61 8 8133 4300
Australian Honey Bee Industry Council	**honeybee.org.au**	+61 402 467 780
Australian Lychee Growers' Association	**australianlychee.com.au**	+61 417 639 927

Organisation	Website	Phone
Australian Macadamia Society	**australianmacadamias.org**	+61 2 6622 4933
Australian Mango Industry Association	**industry.mangoes.net.au**	+61 7 3278 3755
Australian Melon Association	**melonsaustralia.org.au**	+61 413 101 646
Australian National University	**anu.edu.au**	+61 2 6125 5111
Australian Olive Association	**australianolives.com.au**	+61 478 606 145
Australian Plant Biosecurity Science Foundation	**apbsf.org.au**	
Australian Processing Tomato Research Council	**aptrc.asn.au**	
Australian Society for Microbiology	**theasm.org.au**	+61 1300 656 423
Australian Society of Agronomy	**agronomyaustralia.org**	
Australian Sweetpotato Growers	**aspg.com.au**	
Australian Table Grape Association	**australiangrapes.com.au**	+61 3 5021 5718
Australian Tea Tree Industry Association	**teatree.org.au**	+61 2 4017 1336
Australian Truffle Growers' Association	**trufflegrowers.com.au**	
Australian Walnut Industry Association	**walnut.net.au**	
AUSVEG	**ausveg.com.au**	+61 3 9882 0277
Avocados Australia	**avocado.org.au**	+61 7 3846 6566
CANEGROWERS	**canegrowers.com.au**	+61 7 3864 6444
Canned Fruits Industry Council of Australia	**fgv.com.au**	+61 3 5825 3732
Central Queensland University	**cqu.edu.au**	+61 7 4930 9777
Centre for Crop and Disease Management	**ccdm.com.au**	
Centre for Fruit Fly Biosecurity Innovation	**fruitflyittc.edu.au**	
Centre of Excellence for Biosecurity Risk Analysis	**cebra.unimelb.edu.au**	
Charles Darwin University	**cdu.edu.au**	+61 8 8946 7766
Charles Sturt University	**csu.edu.au**	+61 1800 275 278
Cherry Growers Australia	**cherrygrowers.org.au**	+61 3 6231 1229
Chestnuts Australia	**chestnutsaustralia.com.au**	
Citrus Australia	**citrusaustralia.com.au**	+61 3 5023 6333
Commonwealth Scientific and Industrial Research Organisation	**csiro.au**	+61 1300 363 400
Cotton Australia	**cottonaustralia.com.au**	+61 2 9669 5222

Organisation	Website	Phone
Cotton Research and Development Corporation	**crdc.com.au**	+61 2 6792 4088
Council of Australasian Weed Societies	**caws.org.au**	
CRC for Honey Bee Products	**crchoneybeeproducts.com**	
Deakin University	**deakin.edu.au**	+61 3 9244 6100
Department of Agriculture and Fisheries, Queensland	**daf.qld.gov.au**	+61 7 3404 6999
Department of Jobs, Precincts and Regions, Victoria	**djpr.vic.gov.au**	+61 3 9651 9999
Department of Primary Industries and Regional Development, Western Australia	**dpird.wa.gov.au**	+61 1300 374 731
Department of Primary Industries and Regions, South Australia	**pir.sa.gov.au**	+61 8 8226 0995
Department of Primary Industries, New South Wales	**dpi.nsw.gov.au**	+61 1800 808 095
Department of Primary Industries, Parks, Water and Environment, Tasmania	**dpipwe.tas.gov.au**	+61 1300 368 550
Department of Primary Industry and Resources, Northern Territory	**dpir.nt.gov.au**	+61 8 8999 2006
Dried Fruits Australia	**driedfruitsaustralia.org.au**	+61 3 5023 5174
Edith Cowan University	**ecu.edu.au**	+61 13 43 28
Flinders University	**flinders.edu.au**	+61 8 8201 3911
Forest and Wood Products Australia	**fwpa.com.au**	+61 3 9927 3200
Forestry Corporation of NSW	**forestrycorporation.com.au**	+61 2 9872 0111
Grain Producers Australia	**grainproducers.com.au**	+61 448 493 386
Grains Research and Development Corporation	**grdc.com.au**	+61 2 6166 4500
Griffith University	**griffith.edu.au**	+61 7 3735 7111
Growcom	**growcom.com.au**	+61 7 3620 3844
Hazelnut Growers of Australia	**hazelnuts.org.au**	+61 2 6379 1616
Horticulture Innovation Australia	**horticulture.com.au**	+61 2 8295 2300
International Plant Protection Convention	**ippc.int**	
James Cook University	**jcu.edu.au**	+61 1800 246 446
La Trobe University	**latrobe.edu.au**	+61 1300 528 762
Macquarie University	**mq.edu.au**	+61 2 9850 7111
Monash University	**monash.edu**	+61 3 9902 6000

Organisation	Website	Phone
Murdoch University	**murdoch.edu.au**	+61 8 9360 6000
Nursery and Garden Industry Australia	**ngia.com.au**	+61 2 8861 5100
Onions Australia	**onionsaustralia.org.au**	+61 8 8725 8862
Passionfruit Australia	**passionfruitaustralia.org.au**	+61 427 833 281
Pistachio Growers' Association	**pgai.com.au**	+61 428 922 576
Plant Biosecurity CRC	**pbcrc.com.au**	
Plant Biosecurity Research Initiative	**pbri.com.au**	+61 3 9516 9716
Plant Breeding Institute, University of Sydney	**sydney.edu.au/agriculture/plant_breeding_institute/index.shtml**	+61 2 9352 8800
Plant Health Australia	**planthealthaustralia.com.au**	+61 2 6215 7700
Plant Innovation Centre	**agriculture.gov.au**	+61 1800 900 090
Queensland University of Technology	**qut.edu.au**	+61 7 3138 2000
Raspberries and Blackberries Australia	**raba.com.au**	
Ricegrowers' Association of Australia	**rga.org.au**	+61 2 6953 0433
Strawberries Australia	**strawberriesaustralia.com.au**	+61 428 375 711
Sugar Research Australia	**sugarresearch.com.au**	+61 7 3331 3333
Summerfruit Australia	**summerfruit.com.au**	+61 2 6059 0816
Transport Canberra and City Services, Australian Capital Territory	**tccs.act.gov.au**	+61 13 22 81
University of Adelaide	**adelaide.edu.au**	+61 8 8313 4455
University of Canberra	**canberra.edu.au**	+61 2 6201 5111
University of Melbourne	**unimelb.edu.au**	+61 13 63 52
University of New England	**une.edu.au**	+61 2 6773 3333
University of New South Wales	**unsw.edu.au**	+61 2 9385 1000
University of Queensland	**uq.edu.au**	+61 7 3365 1111
University of Sydney	**sydney.edu.au**	+61 286 278 111
University of Tasmania	**utas.edu.au**	+61 362 262 999
University of Western Australia	**uwa.edu.au**	+61 8 6488 6000
University of Western Sydney	**westernsydney.edu.au**	+61 2 9852 5222
University of Wollongong	**uow.edu.au**	+61 2 4221 3555
Weeds of National Significance	**environment.gov.au/biodiversity/invasive/weeds/weeds/lists/wons.html**	+61 1800 803 772
Wine Australia	**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 focused 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.
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.

Term	Definition
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 insects, mites, snails, nematodes, pathogens (diseases) and weeds that have the potential to adversely affect food, fibre, ornamental crops, bees and stored products, as well as environmental flora and fauna.
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.
PLANTPLAN	The national contingency planning framework for the management of plant pest emergencies in Australia.
Plant production industries	All plant industries in the agricultural, horticultural and forestry sectors.
Quarantine	The system of measures that are used to minimise risks associated with the entry or exit 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 Emergency Plant Pest 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.

Mount Buller, Victoria

Acronyms

Acronym	Full name
ABARES	Australian Bureau of Agriculture and Resource Economics and Sciences
ABS	Australian Bureau of Statistics
ABGC	Australian Banana Growers' Council
ACIAR	Australian Centre for International Agricultural Research
ACT	Australian Capital Territory
AGSOC	Agriculture Senior Officials' Committee
AHA	Animal Health Australia
AHBIC	Australian Honey Bee Industry Council
ALA	Atlas of Living Australia
ALOP	Appropriate Level of Protection
APBSF	Australian Plant Biosecurity Science Foundation
APEC	Asia-Pacific Economic Cooperation
APPPC	Asia and Pacific Plant Protection Commission
APPD	Australian Plant Pest Database
APVMA	Australian Pesticides and Veterinary Medicines Authority
ARC	Australian Research Council
AusAID	Australian Agency for International Development, Department of Foreign Affairs and Trade
ASEAN	Association of Southeast Asian Nations
BICON	Biosecurity Import Conditions
BIMS	Biosecurity Incident Management System
BIPIM	Biosecurity Incident Public Information Manual
BIRA	Biosecurity Import Risk Analysis
BOLT	Biosecurity Online Training
BSI	Biosecurity Solomon Islands
CCEPP	Consultative Committee on Emergency Plant Pests
CEBRA	Centre of Excellence for Biosecurity Risk Analysis, University of Melbourne
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
DPIRD	Department of Primary Industries and Regional Development, Western Australia

Acronym	Full name
DAWR	Australian Government Department of Agriculture and Water Resources
DJPR	Department of Jobs, Precincts and Regions, Victoria
DEE	Australian Government Department of the Environment and Energy
DFAT	Australian Government Department of Foreign Affairs and Trade
DPIPWE	Department of Primary Industries, Parks, Water and Environment, Tasmania
EIC	Environment and Invasives Committee
EPP	Emergency Plant Pest
EPPRD	Emergency Plant Pest Response Deed
EPSD	Environment Planning and Sustainable Development Directorate, Australian Capital Territory
EXDOC	Export Documentation System
FAO	Food and Agriculture Organization
FPoE	First Point of Entry
FWPA	Forest and Wood Products Australia
GBO	General Biosecurity Obligation
GPA	Grain Producers Australia
GRDC	Grains Research and Development Corporation
GVP	Gross Value of Production
HACCP	Hazard Analysis Critical Control Point
Hort Innovation	Horticulture Innovation Australia Limited
ICA	Interstate Certification Assurance
IGAB	Intergovernmental Agreement on Biosecurity
IPPC	International Plant Protection Convention
ISPM	International Standards for Phytosanitary Measures
LVP	Local Value of Production
MICoR	Manual of Importing Country Requirements
NAQS	Northern Australia Quarantine Strategy
NBC	National Biosecurity Committee
NBCEN	National Biosecurity Communication and Engagement Network
NBRT	National Biosecurity Response Team
NDP	National Diagnostic Protocol

Acronym	Full name
NEBRA	National Environmental Biosecurity Response Agreement
NGIA	Nursery and Garden Industry Australia
NMDS	National Minimum Dataset Specifications
NMG	National Management Group
NPBDN	National Plant Biosecurity Diagnostic Network
NSW	New South Wales
NSW DPI	Department of Primary Industries, New South Wales
NSW DP&E	Department of Planning and Environment, New South Wales
NT	Northern Territory
NT DPIR	Department of Primary Industries and Resources, Northern Territory
PBCRC	Plant Biosecurity Cooperative Research Centre
PFRNZ	Plant and Food Research, New Zealand
PHA	Plant Health Australia
PHC	Plant Health Committee
PIRSA	Department of Primary Industries and Regions, South Australia
PNG	Papua New Guinea
PPPO	Pacific Plant Protection Organisation
QAAFI	Queensland Alliance for Agriculture and Food Innovation
QDAF	Department of Agriculture and Fisheries, Queensland
R&D	Research and Development
RD&E	Research Development & Extension
RDC	Research and Development Corporation
RPPO	Regional Plant Protection Organisation
SA	South Australia
SARDI	South Australian Research and Development Institute
SIBDP	Solomon Islands Biosecurity Development Program
SDQMA	Subcommittee on Domestic Quarantine and Market Access
SIT	Sterile Insect Technology
SNPHS	Subcommittee on National Plant Health Surveillance
SPHD	Subcommittee on Plant Health Diagnostics
SPS	Sanitary and Phytosanitary
SRA	Sugar Research Australia

Acronym	Full name
TCCS	Transport Canberra and City Services
TSTG	Training Specialist Task Group
T2M	Transition to Management
WA	Western Australia
WoNS	Weeds of National Significance
R&D	Research and Development
RD&E	Research Development & Extension
RDC	Research and Development Corporation
RPPO	Regional Plant Protection Organisation
RSPM	Regional Standards for Phytosanitary Measures
SA	South Australia
SAP	Scientific Advisory Panel
SARDI	South Australian Research and Development institute
SDQMA	Subcommittee on Domestic Quarantine and Market Access
SIT	Sterile Insect Technology
SNPHS	Subcommittee on National Plant Health Surveillance
SPHD	Subcommittee on Plant Health Diagnostics
SPS	Sanitary and Phytosanitary
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TCCS	Transport Canberra and City Services
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