The National Plant Biosecurity **Status Report**

2019

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Given that there are continuous changes in trade patterns, pest distributions, control measures and agricultural practices, this report can only provide a snapshot in time. Therefore, all information contained in this report has been collected for the 12 month period from 1 January 2019 to 31 December 2019, and should be validated and confirmed with the relevant organisations/authorities before being used. A list of contact details (including websites) is provided in the Appendices.

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The National Plant Biosecurity

Status Report

2019

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Foreword

2019 was a challenging year for agricultural industries in Australia. Extreme climatic events impacted production across the nation, with drought and bushfires causing devastation to crops and the natural environment.

Fortunately, our crops and native plants are largely protected from the consequences of pests that affect plants overseas by a highly effective biosecurity system. The system relies on the efforts of a wide variety of stakeholders, with governments, growers, scientists and community members working in a co-ordinated manner. This allows us to address the biosecurity challenges posed by globalisation, the increased movement of people and goods, and climate change.

By working together, we can effectively prevent, respond to, eradicate and recover from plant pest incursions, thereby maintaining the productivity and profitability of our plant industries.

Each year, the National Plant Biosecurity Status Report is published by Plant Health Australia. This 12th edition of the report provides a comprehensive overview of Australia's plant biosecurity system and the activities performed by all major stakeholders during the 2019 calendar year. It also describes over 680 plant and pollinator biosecurity research, development and extension projects. This research is fundamental to the development and adoption of new technologies which will significantly enhance our capability to detect and respond to exotic pests in the future.

Over 100 organisations provided data and images for this report. PHA thanks all of the contributors, whose cooperation make the publication of this edition of the National Plant Biosecurity Status Report possible.

Steve McCutcheon
Chairman
Plant Health Australia

Introduction

Australia's plant resources

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 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 the wide range of climatic zones in Australia (see Figure 1), there are many types of natural ecosystems and crop species grown. Each ecosystem and crop has a set of pests that pose a threat.

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 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, timber and pasture for livestock production, and vegetables are grown in many areas.

Plant industries make a significant contribution to agricultural production and exports. In 2017–18, around 378 million hectares was farmed by 85,000 crop and livestock businesses.[1] Plant industries represented a gross value of $33 billion (Figure 2) and plant exports were worth more than $27 billion, mainly grains (such as wheat, barley and canola), 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.

Protection of plants in the environment and those planted for social amenity from the risks and negative effects of pests, weeds and diseases entering, emerging, establishing or spreading in Australia, is also a high priority.

Figure 1. Australia's varied climatic zones

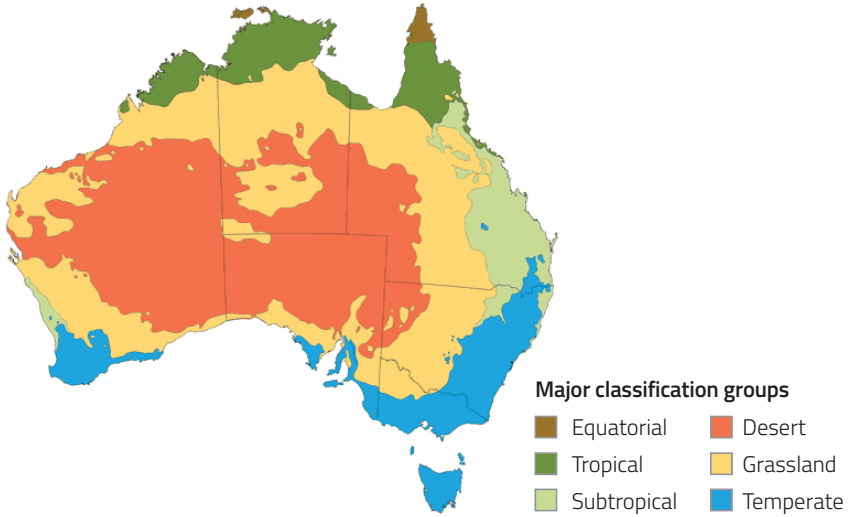


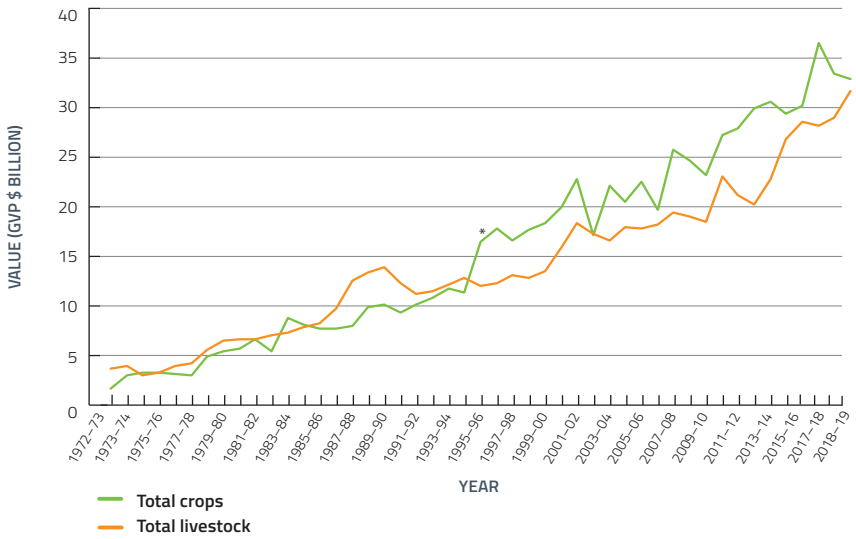
Image courtesy of the Bureau of Meteorology

We have a unique, biodiverse natural environment with more than 500 national parks covering more than 28 million hectares representing four per cent of the total land area. A further six per cent or more of Australia is protected and includes 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]

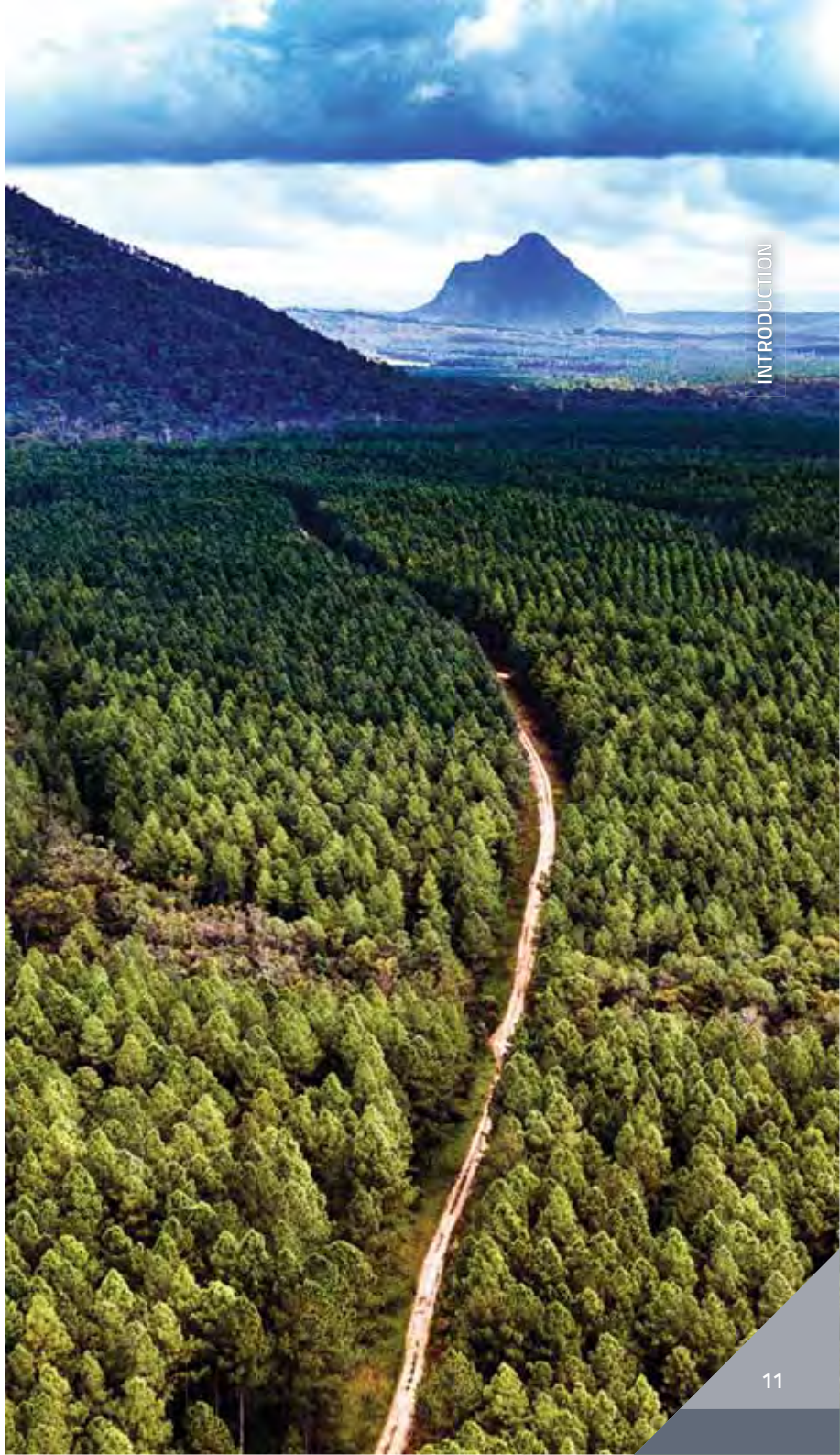
The definition of a pest used in this report covers insects, mites, snails, nematodes, pathogens (diseases) and weeds that have the potential to adversely affect food, fibre, ornamental crops, bees and stored products, as well as environmental flora and fauna. Exotic pests are those not currently present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

1. Australian Bureau of Statistics. 7121.0 - Agricultural Commodities, Australia, 2017–18 – Statistics. Accessed online 3 March 2020 www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/7121.02017-18?OpenDocument
2. Commonwealth of Australia. Conserving Australia: Australia's National parks, conservation reserves and marine protected areas. Accessed online 11 February 2020 aph.gov.au/Parliamentary_Business Committees/Senate/Environment_and_Communications/Completed_inquiries/2004-07/nationalparks/report/index
3. Australian Bureau of Statistics. Australian environmental–economics accounts, 2017, Cat. No. 4655.0. Accessed online 11 February 2020 abs.gov.au/AUSSTATS/abs@.nsf/Lookup/4655.0Main+Features12017

Figure 2. Gross value of plant and animal production industries in Australia, 1972-2019*



** Includes forestry from 1995–96*



Features of 2019

2019 was a very challenging year for plants grown in Australia, whether they be for plant industries, in natural environments or in urban settings. While the year began with devastating flooding in the far north gulf country, the balance of the year for a large portion of the country was the driest on record, with nationally averaged rainfall 40 per cent below average for the year at 277.6 mm (Figure 3), and the warmest on record, with the annual national mean temperature 1.52 degrees above average (Figure 4).[4]

The drought had a great impact on the growth of dryland crops and pastures and the amount of water available for irrigated crops, limiting grazing resources for livestock. Crop pollinators too, like European honey bees, were hit by a lack of flowers on which to forage. Water allocation prices reflected both the scarcity of irrigation water and the changing willingness to pay as new higher-value industries enter the market, such as nut crops.

In December 2019, the Australian Bureau of Agricultural and Resource Economics and Sciences forecasted the total crop production in 2019–20 to be the lowest since 2007–08.[5] The value of agricultural exports was forecasted to fall by eight per cent to $45 billion. The main drivers of this were lower crop and livestock production and a diversion of grain to the domestic market for feed and human consumption.

A key feature of 2019 was the widespread incidence of fires, with more than 100 fires impacting the south east of the country. Starting in September 2019, fires in most states of Australia had a devastating impact on coastal bushland areas and some agricultural enterprises, continuing into January 2020.

4. Bureau of Meteorology. Australia's climate in 2019. Accessed online 24 February 2020 www.bom.gov.au/climate/current/annual/aus/

5. Australian Bureau of Agricultural and Research Economics and Sciences. Agricultural commodities December quarter 2019. Accessed online 16 March 2020 www.agriculture.gov.au/abares/research-topics/agricultural-commodities/australian-crop-report

Figure 3. 2019 annual rainfall compared to historical rainfall observations

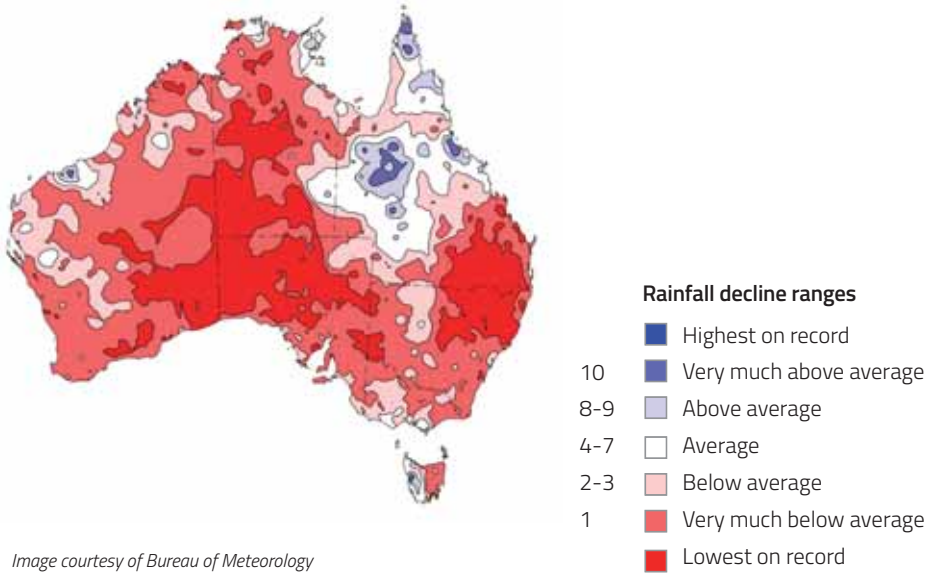


Image courtesy of Bureau of Meteorology

Figure 4. 2019 annual mean temperatures compared to historical temperature observations

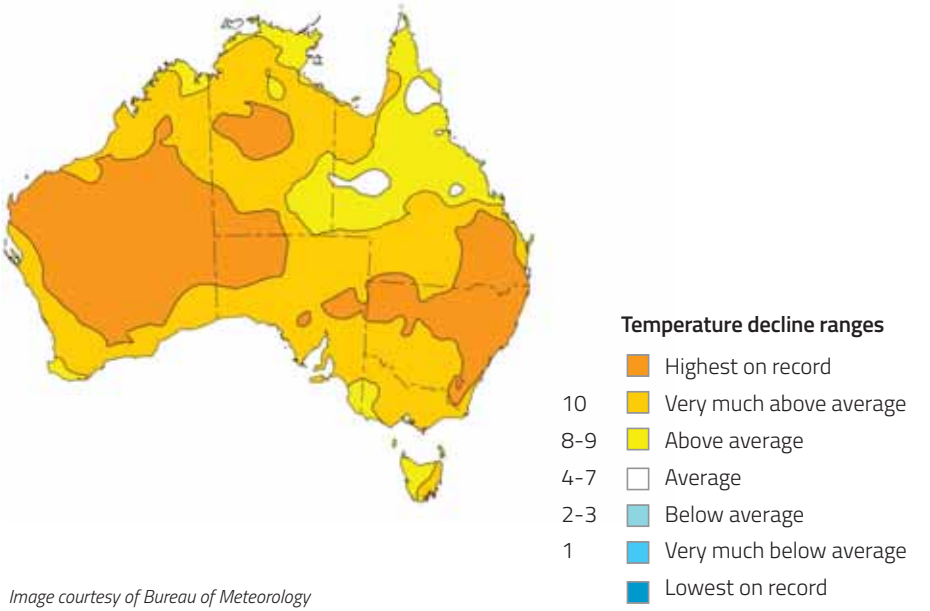


Image courtesy of Bureau of Meteorology

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 in Australia.[6]

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,[7] 1 million tonnes by air,[8] and 20.5 million international travellers arriving,[9] [10] including 8.7 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 2019, Australian biosecurity officers intercepted more than 290,000 items of biosecurity concern across the country, including approximately 40,000 items sniffed out by biosecurity detector dogs.[11]

Some 399 high priority pests have been identified for Australia's plant industries through biosecurity planning by Plant Health Australia (PHA). The high priority plant pests for the environment were identified and listed for the first time in 2019 (see Chapter 2). Just as important as keeping exotic pests out of Australia is the management of established or regionalised pests that are already present.

6. 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
7. Department of Infrastructure, Transport, Cities and Regional Development. Australian Sea Freight 2016–17. Accessed online 11 February 2020 www.bitre.gov.au/sites/default/files/documents/asf_2016_17.pdf
8. Department of Infrastructure, Transport, Cities and Regional Development. Aviation Statistics. Accessed online 11 February 2020 bitre.gov.au/statistics/aviation
9. Australian Bureau of Statistics. Overseas Arrivals and Departures, Australia November 2019. Accessed online 11 February 2020 www.abs.gov.au/ausstats/abs@.nsf/mf/3401.0
10. Austrade. Latest International Visitor Survey Results, September 2019. Accessed online 11 February 2020 www.tra.gov.au/International/international-tourism-results
11. Office of the National Data Commissioner. Biosecurity by numbers December 2019. Accessed online 11 February 2020 www.datacommissioner.gov.au/media-hub/biosecurity-numbers

International Year of Plant Health

The International Year of Plant Health for 2020 was launched globally by the Food and Agriculture Organization in Rome on 2 December 2019.

The theme for the year, 'Protecting plants, protecting life', underlines the need for everyone to understand and take seriously their role in protecting Australia's biosecurity.

The aim is to raise global awareness of how protecting plant health can help end hunger, reduce poverty, protect the environment, and boost economic development. The focus for Australia is on preventing the spread of pests and diseases because they have the greatest impact on crops, the environment and our way of life.

Australia's Chief Plant Protection Officer chairs a steering committee for the year in Australia, comprised of departmental staff and representatives from PHA, peak industry bodies and other key stakeholders.

Throughout the year many activities and events are being organised to recognise and champion the importance plant health all around the country. The website **planthealthyear.org.au** was launched in late 2019 as a central hub of information for the celebration of the year in Australia.

Plant biosecurity highlights in 2019

Below is a timeline of some key plant biosecurity related events during 2019 that involved a broad range of stakeholders across Australia working to protect our plant resources. These events are referenced throughout the report.

JAN

Multi-pronged attack on hawkweed yields results
See page 215

FEB

Banana freckle freedom declared
See page 189

New preparedness program for *Xylella fastidiosa*
See page 44

Building skills through the Diagnostic Residential Program
See page 166

MAR

Australian Biosecurity Awards
See page 208

Annual Diagnostician's Workshop
See page 167

Annual Surveillance Workshop
See page 152

Exercise Crown and Anchor
See page 185

Market access for almonds into Chile
See page 137

APR

Biosecurity Pathways and Surveillance Strategy workshop
See page 156

Inspector General of Biosecurity report on environmental biosecurity risk management
See page 56

MAY

Workshop Sugar Rush
See page 188

Pacific Plant Biosecurity Partnership visit
See page 137

New cherry growers' biosecurity manual
See page 209

Preparedness for vegetable leaf miner
See page 46

Inspector General of Biosecurity report on brown marmorated stink bug
See page 26

Inspector General of Biosecurity report on pest and disease interceptions and incursions
See page 26

JUN

National workshop prioritises action on Khapra beetle
See page 43

JUL

Release of Invasive Ant Biosecurity Plan
See page 43

AUG

Exercise Blueprint
See page 187

Plant Biosecurity Research Symposium
See page 225

SEP

New measures to stop the arrival of unwanted pests with cut flower imports
See page 136

Citrus surveillance triage workshop
See page 153

OCT

Forest pest surveillance in NSW
See page 154

Regional fruit fly initiative recognised
See page 205

First cancellation of a tourist visa for biosecurity breach
See page 144

NOV

WA declared free of citrus canker
See page 193

Botanic Gardens Biosecurity Network launched
See page 157

DEC

Launch of the International Year of Plant Health
See page 13

National Xylella Action Plan 2019-29 published
See page 43

Chapter 1

Australia's plant biosecurity system

Australia's plant biosecurity system

It takes great effort to keep exotic pests out of Australia. With a total coastline stretching almost 60,000 km, our borders are best protected from plant pests by collaborative partnerships, and by coordination of activities.

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. 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 5).

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.

As global trade increases, biosecurity risks change, and pests can enter the country faster and in more complex unpredictable 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 (see Chapter 4). To do this, complementary measures are applied across the biosecurity continuum, pre-border, at the border and post-border.

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.

Key stakeholders with important roles to prevent the spread of pests include state government agencies, peak industry bodies and their growers, local councils, grower groups, transporters, research organisations, gardeners, anyone who visits a farm or a natural area where plant health is at risk, (including utility providers such as electricity and water service staff), and international and domestic travellers.

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 5. Key components of Australia's plant biosecurity system

PRE-BORDER

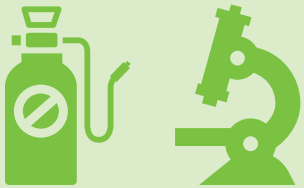
- Analysing pest risks associated with proposed imports
- Inspecting, verifying and auditing overseas exporters
- Undertaking pest surveillance overseas
- Developing international standards
- Building capacity overseas
- Anticipating pest threats by gathering global pest intelligence
- Negotiating export 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 INTERGOVERNMENTAL AGREEMENT ON BIOSECURITY

For governments, Australia's partnership approach to biosecurity is documented in the Intergovernmental Agreement on Biosecurity (IGAB).

The IGAB sets out commitments for the Australian, state and territory governments by outlining the agreed national goals and objectives and clarifying roles, responsibilities and governance arrangements. It is signed by the Prime Minister, premiers and chief ministers.

The IGAB is an important part of Australia's biosecurity architecture. Its role is to:

- strengthen Australia's biosecurity system
- enhance national collaboration among Australian governments
- support our biosecurity system to meet current and future challenges.

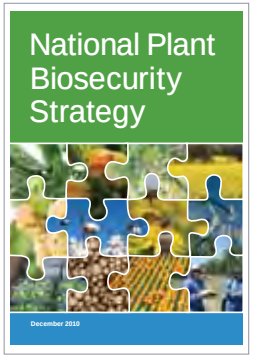
The latest agreement came into effect on 3 January 2019, replacing the previous IGAB which started in 2012. A review of the IGAB was undertaken in 2016–17, with agriculture ministers agreeing, or agreeing in principle, to all 42 recommendations in 2018.

Agriculture ministers 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 is a comprehensive ten-year plan that outlines a set of aims and activities to strengthen Australia's plant biosecurity system by 2020. The strategy has provided the focus and strategic direction for national plant biosecurity activities since 2010, and driven the way governments, plant industries and the community work closely together.



PHA developed the strategy by drawing together the views of stakeholders across Australia, aligning them with the original IGAB to ensure consistency. Ten strategies were formulated to respond to the challenges facing the system.

A review of the strategy in 2014 assessed progress against each recommended activity and produced an implementation plan for the remaining tasks to be completed. Towards the end of 2019, PHA commenced work on the development of a new ten year National Plant Biosecurity Strategy.

Key goals of the National Plant Biosecurity Strategy (2010)

Strategy 1	Adopt nationally consistent plant biosecurity legislation, regulations and approaches where possible within each state and territory government's overarching legislative framework
Strategy 2	Establish a nationally coordinated surveillance system
Strategy 3	Build Australia's ability to prepare for, and respond to, pest incursions
Strategy 4	Expand Australia's biosecurity training capacity and capability
Strategy 5	Create a nationally integrated diagnostic network
Strategy 6	Enhance national management systems for established pests
Strategy 7	Establish an integrated national approach to plant biosecurity education and awareness
Strategy 8	Develop a national framework for plant biosecurity research
Strategy 9	Adopt systems and mechanisms for the efficient and effective distribution, communication and uptake of plant biosecurity information
Strategy 10	Monitor the integrity of the plant biosecurity system

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 6 (on page 22) shows the structure of Australian government biosecurity committees that are tasked with national coordination of plant biosecurity.

Agriculture Senior Officials' Committee

The Agriculture Senior Officials' Committee (AGSOC) is responsible for primary industry policy issues. The committee comprises the heads of primary industry government departments from the Australian Government, Australian states and territories and the New Zealand Government. AGSOC provides for cross-jurisdictional cooperative and coordinated approaches to matters of national interest. It also supports the Agriculture Ministers' Forum (AGMIN) in achieving its objectives.

National Biosecurity Committee

The National Biosecurity Committee (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 provides advice to the AGSOC on national biosecurity matters and progress towards implementing the IGAB and priority reform areas.

The Secretary of the Australian Government Department of Agriculture[12] is a member of AGSOC and chairs the NBC. The Australian Government is also represented by the Department of Agriculture's Deputy Secretary responsible for biosecurity (or a delegate), and a Deputy Secretary from the Department of the Environment and Energy (or a delegate). Other 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. PHA, Animal Health Australia (AHA), and the Australian Local Government Association are observers.

Plant Health Committee

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

In 2019, 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 PHC also facilitates a consistent national approach to legislative outcomes and standards within the plant biosecurity sector.

Environment and Invasives Committee

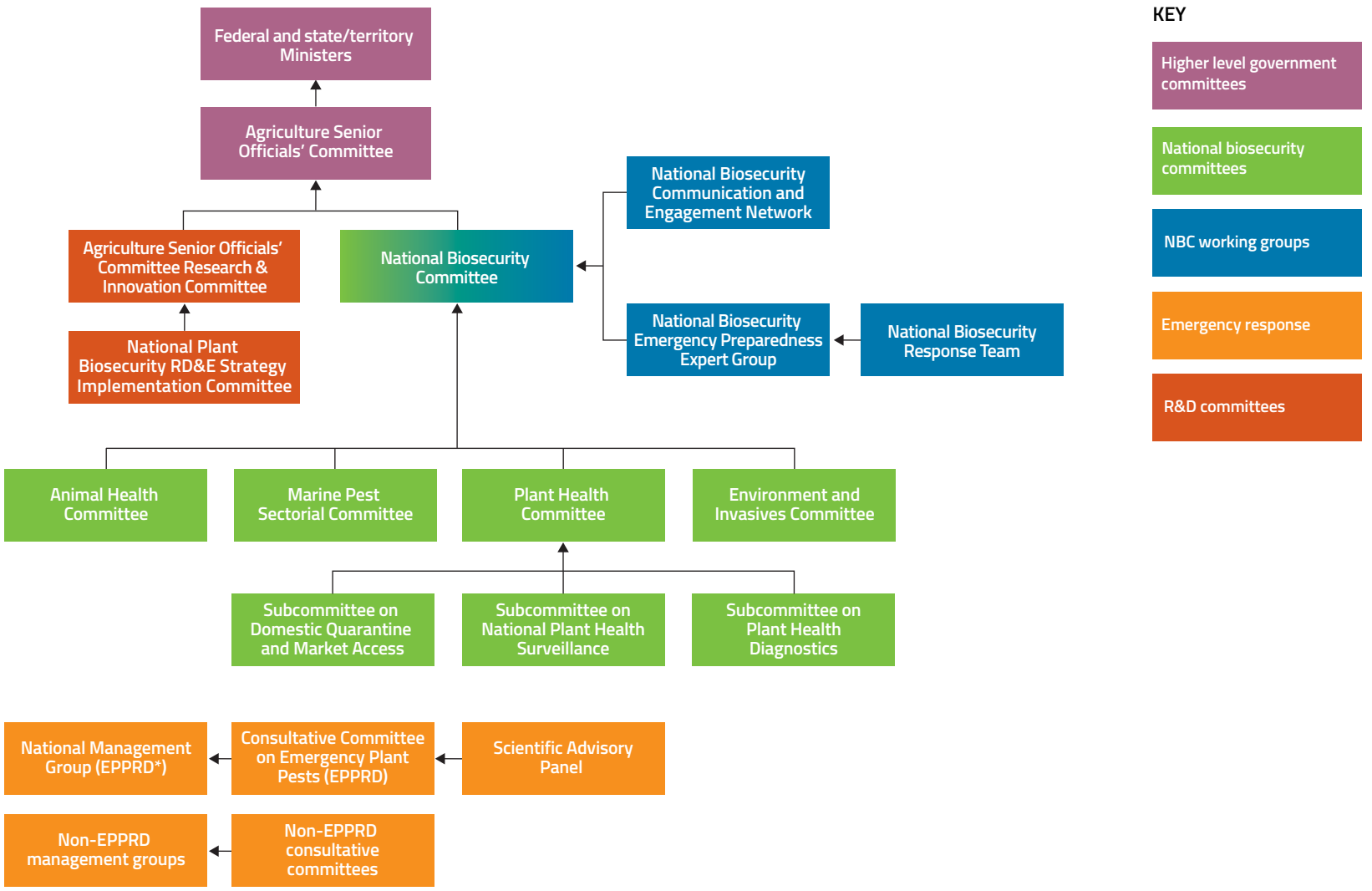
The Environment and Invasives Committee (EIC) provides national policy leadership on the identification, prevention and management of invasive plant, vertebrate and invertebrate species that adversely impact the environment, economy and community. Membership comprises representatives from the Australian state and territory primary industry and environment departments. Representatives from the Commonwealth Scientific and Industrial Research Organisation (CSIRO), PHA, AHA, Wildlife Health Australia, the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES), and the Centre for Invasive Species Solutions are observers on the committee.

The EIC is also advised by a community sector Environment Biosecurity Advisory Group, which includes the Invasive Species Council, WWF Australia, Bush Heritage Australia, Natural Resource Management Regions Australia and the Australian Local Government Association.

There are also several committees with government and industry representatives that oversee 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.

12. On 5 December 2019 the Prime Minister announced changes to the Australian Public Service. The Department of Agriculture, Water and the Environment would be established from 1 February 2020. The content in this document is written under the Australian Government's structure in 2019.

Figure 6. National government biosecurity committees and working groups with plant focus



*Emergency Plant Pest Response Deed (EPPRD)

BIOSECURITY LEGISLATION

Australia's biosecurity system operates under Commonwealth, state and territory legislation administered by the respective government agencies. Plant and environmental (where applicable) biosecurity legislation, current as at 31 December 2019, is listed in Table 1.

The Department of Agriculture administers a range of Commonwealth 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.

There is also legislation 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.

Tasmania introduced a new *Biosecurity Act* in 2019. The new legislation aligns with Queensland's *Biosecurity Act 2014*, and NSW's *Biosecurity Act 2015* both of which introduced 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. More information about the general biosecurity obligation or duty is on page 204.

BIOSECURITY EMERGENCY RESPONSE AGREEMENTS

Emergency Plant Pest Response Deed

The Emergency Plant Pest Response Deed (EPPRD) is a formal, legally binding agreement between PHA, the Australian Government, all state and territory governments, and 37 plant industry peak bodies (as at 31 December 2019). PHA is the custodian of the EPPRD which came into effect in October 2005. More information about the EPPRD and emergency responses is in Chapter 6.

National Environmental Biosecurity Response Agreement

If a new pest is considered to primarily impact the environment or social amenity and is not able to be dealt with under the EPPRD, then the National Environmental Biosecurity Response Agreement (NEBRA) may be activated.

The NEBRA establishes national emergency response arrangements, including for cost-sharing, for responding to biosecurity incidents such as pests and diseases that primarily impact 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.

Table 1. Plant and environmental biosecurity legislation across Australia

Jurisdiction	Administering authority	Legislation
Commonwealth	Department of Agriculture	▪ *Biosecurity Act 2015*, except to the extent administered by the Health Minister ▪ *Biosecurity (Consequential Amendments and Transitional Provisions) Act 2015*, except to the extent administered by the Health Minister ▪ *Biosecurity Legislation Amendment (Miscellaneous Measures) Act 2018* ▪ *Biosecurity (Exposed Conveyances – Exceptions from Biosecurity Control) Determination 2016* ▪ *Biosecurity Regulation 2016* ▪ *Biosecurity (Prohibited and Conditionally Non-prohibited Goods) Determination 2016*
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 Industry and Resources	▪ *Plant Health Act 2008* ▪ *Plant Health Regulations 2011*
Queensland	Department of Agriculture and Fisheries	▪ *Biosecurity Act 2014* ▪ *Biosecurity Regulation 2016*
SA	Department of Primary Industries and Regions	▪ *Plant Health Act 2009* ▪ *Plant Health Regulations 2009*
Tasmania	Department of Primary Industries, Parks, Water and Environment	▪ *Biosecurity Act 2019*
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*

PLANT BIOSECURITY STATUTORY LEVIES

The Department of Agriculture collects, administers and disburses agricultural levies and charges on behalf of Australia's primary industries.[13]

Many of Australia's primary industries rely on the levy system and the support it provides for research and development (R&D), marketing and promotion, chemical residue testing, and plant health programs.

The rural research and development corporations (RDCs, see Chapter 8) are funded primarily by statutory R&D levies (or charges) on various commodities, with matching funding from the Australian Government. Much of the biosecurity R&D listed in Chapter 8 is funded via the levy system.

In addition to income from levies and charges being directed to R&D, marketing and promotion, plant industries can also direct revenue to biosecurity preparedness and emergency plant pest responses. Each industry decides the proportion of a levy or charge that is directed to each of these activities.[14]

Plant biosecurity levies include the PHA levy and the Emergency Plant Pest Response (EPPR) levy which can be utilised as follows.

Plant Health Australia (PHA) levy

The PHA levy can be used by industries to meet membership subscriptions to PHA and may also be used to undertake specific plant biosecurity projects, such as preparation of biosecurity manuals, holding workshops or training sessions and developing pest fact sheets.

Emergency Plant Pest Response (EPPR) levy

EPPR levies enable industries to raise funds in relation to Emergency Plant Pests (EPPs) under the EPPRD. This includes meeting their financial obligations to cost-shared national response plans in the event of an incursion (see Chapter 6). Once established, EPPR levies are generally set at zero and can be activated when needed, following industry agreement to a cost-shared response plan.

13. Australian Government Department of Agriculture. Biosecurity levies. Accessed online 18 February 2020 www.agriculture.gov.au/ag-farm-food/levies/biosecurity-levies
14. Australian Government Department of Agriculture. Rural Research and Development Corporations. Accessed online 16 March 2020 www.agriculture.gov.au/ag-farm-food/innovation/research_and_development_corporations_and_companies#operating-arrangements

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.

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 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 phytosanitary agreements that aim to prevent the spread of plant pests.

Under the Agricultural Competitiveness White Paper, Stronger Farmers, Stronger Economy,[15] 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.

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

Department of Agriculture

agriculture.gov.au

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 Department of Agriculture focuses on maintaining a strong and resilient biosecurity system that will protect Australia from new biosecurity challenges, whatever they may be.

The millions of people, mail parcels, baggage, ships, animals, plants and cargo containers that enter Australia every year are screened and inspected by departmental 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 the department promotes a shared responsibility with clients, stakeholders and the general public, all of whom have a role to play.

The department 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 the department, ABARES provides current scientific and economic advice to decision makers to support the plant biosecurity system.

Primary representatives and advisors for plant and environmental biosecurity

Australia's **Chief Plant Protection Officer** 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. The role of the Chief Plant Protection Officer is to:

- promote a shared vision for plant health that protects and enhances Australia's valuable plant resources and production capacity
- be the official contact point for the International Plant Protection Convention.

Australia's **Chief Environmental Biosecurity Officer** position was established in 2018 to ensure the country'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.

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

Department of the Environment and Energy

environment.gov.au

The Department of the Environment and Energy 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 the department. Imports of live plants are managed by the Department of Agriculture. The import of live plants and animals should not be inconsistent with the *Biosecurity Act 2015*.

The department 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) and manages permits for the import of CITES listed species (plants or animals).

Advice is also provided to the Department of Agriculture on environmental issues in relation to risk assessments.

Department of Foreign Affairs and Trade

dfat.gov.au

The Department of Foreign Affairs and Trade helps make Australia stronger, safer and more prosperous by promoting and protecting our interests internationally and contributing to global stability and economic growth. The department helps progress Australia's international trade interests, including by promoting Australia's strong biosecurity system to trading partners. Other agencies within the portfolio include:

- **Austrade** – Australia's trade and investment promotion agency. Its global network of advisers are experts in connecting Australian businesses to the world to help them go further, faster.
- **Australian Centre for International Agricultural Research (ACIAR)** – a statutory authority that is part of the Australian Government's development cooperation programs. ACIAR encourages research collaboration between scientists in Australia and partner countries to jointly use their skills for the benefit of developing countries and Australia.

Department of Home Affairs

homeaffairs.gov.au

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 Department of Agriculture 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 position was established to enhance the integrity of Australia's biosecurity systems through independent evaluation of the performance of these programs across the continuum: pre-border, at the border and post-border. The position is independent of the Department of Agriculture and its Minister. However, the Inspector-General may:

- consider requests for particular reviews
- review the performance of functions and the exercise of powers by the Director of Biosecurity (Secretary, Department of Agriculture)
- make recommendations for improvement to the overall system.

The Inspector-General role does not cover the assessment and review of issues related to human biosecurity, international trade and market access opportunities.

On 24 July 2019, the former Inspector-General of Biosecurity, Dr Helen Scott-Orr, completed her term as the inaugural Inspector-General of Biosecurity appointed under the *Biosecurity Act 2015*. During 2018–19, Dr Scott-Orr completed nine reviews.

On 29 March 2019, the Minister appointed Mr Rob Delane as the next Inspector-General, who commenced in the role on 25 July 2019.

A review program – set annually in consultation with the Minister for Agriculture and the Director of Biosecurity – is published on the Inspector-General's website at **igb.gov.au**. Reviews relevant to plant biosecurity in 2019 are:

- environmental biosecurity risk management in Australia (12 April 2019)
- effectiveness of biosecurity measures to manage the risks of brown marmorated stink bugs entering Australia (28 May 2019)
- pest and disease interceptions and incursions in Australia (29 May 2019)
- implementation of Inspector-General of Biosecurity recommendations (29 July 2019)
- effectiveness of Approved Arrangements in managing biosecurity risks in Australia (6 August 2019).

Other Australian Government organisations

For a list of Australian Government organisations that support plant biosecurity research, development and extension, such as the CSIRO, see Chapter 8.

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

National Biosecurity Statement

Industry, environmental groups and governments worked collaboratively to enhance the understanding of biosecurity across our community through the development of a National Biosecurity Statement. National feedback was sought on the statement in 2018 and it was finalised late that year. The statement's intent is to set out a national vision and define roles and responsibilities within the biosecurity system.

Nature makes Australia unique – biosecurity keeps it that way.

Biosecurity protects Australian livelihoods and is vital to strengthening and supporting our environment and economy, including tourism, trade and agriculture. It underpins many aspects of our way of life.

Australia prides itself on its unique natural environment, high-quality produce and trusted international reputation. We Australians benefit from this and have a duty to protect our land and seas from the arrival of new pests, weeds and diseases.

We are also obliged to limit the damaging and costly impacts of the pests, weeds and diseases already here and to avoid adding to that burden.

Our biosecurity system works both at the border and here at home to prevent and respond to the arrival and spread of harmful pests and diseases that could disrupt much of what we love about this country.

Due to our clean and green reputation we are regarded as a responsible and reliable trading nation. Strong biosecurity measures help us to continue to grow safe and sought-after Australian produce for ourselves and the rest of the world.

The arrival and spread of damaging invasive species could have wide-ranging short- and long-term consequences for industry, land use and community needs.

A single incursion could harm human health and the environmental resources we all need and use – including water supply, soil and ecosystems.

Australia's national biosecurity system relies on partnerships between the Australian and state, territory and local governments, industry, environmental bodies, land managers and the broader public. This system is facing new challenges arising from a significant increase in global trade and travel.

Maintaining Australia's resilient and world-leading approach requires continuous research and innovation and a constant commitment to prevention and response.

What you can do

Each one of us has a role to play in keeping Australia safe from harmful pests and diseases.

- If you see something unusual, report it.
- Know your legal responsibilities when travelling and moving goods.
- Recognise your role in promoting and raising awareness of biosecurity.

Everyone can share the vision of an effective and sustainable national biosecurity system. We should:

- strive for prevention and early action to ensure a very low risk of new harmful pests and diseases entering, establishing and spreading
- minimise the impact of established pests and diseases on our environment, economy, industries and communities
- maintain and grow domestic and international travel and trade access
- protect and restore Australia's unique biodiversity, ecosystems, natural resources and landscapes.

We all share the risks. We all share the benefits. We must all share the responsibility of protecting our unique natural environment.

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 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, plant pest incursions in their jurisdiction, including communicating with communities.
- **Responding to emergency pest and diseases** by maintaining the capacity and capability to deliver responsibilities under the Emergency Plant Pest Response Deed (see Chapter 6), 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 partnership with industry and community volunteers. There are 104 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.
- **Providing 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 working on national committees to ensure that they are in line with other governments around Australia.

State and territory governments coordinate their activities through the IGAB, the PHC and subcommittees, through PHA and through the EPPRD.

Australian Capital Territory

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

The ACT Government manages plant biosecurity through the EPSDD, together with the Transport Canberra and City Services (TCCS) Directorate. EPSDD 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 the release of the ACT Biosecurity Strategy 2016–26, 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.

There were no major plant health incidents in the ACT in 2019. Poor health in urban oak trees was investigated and has been attributed to environmental stress, as diagnostic tests on leaves have not detected any causal pest or disease agent.

The ACT Parks and Conservation Service has continued the biological control of Sirex wood wasps in ACT Government softwood pine plantations. The program works by attracting wasps to 'trap trees' and inoculating their larvae with a parasitic nematode. The industry funded National Sirex Coordination Committee oversees the program across Australia and ensures that resources are directed towards high-risk plantations. Since the introduction of this nationally coordinated model there have not been significant outbreaks of Sirex wasp populations in the ACT or elsewhere in Australia.

New South Wales

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

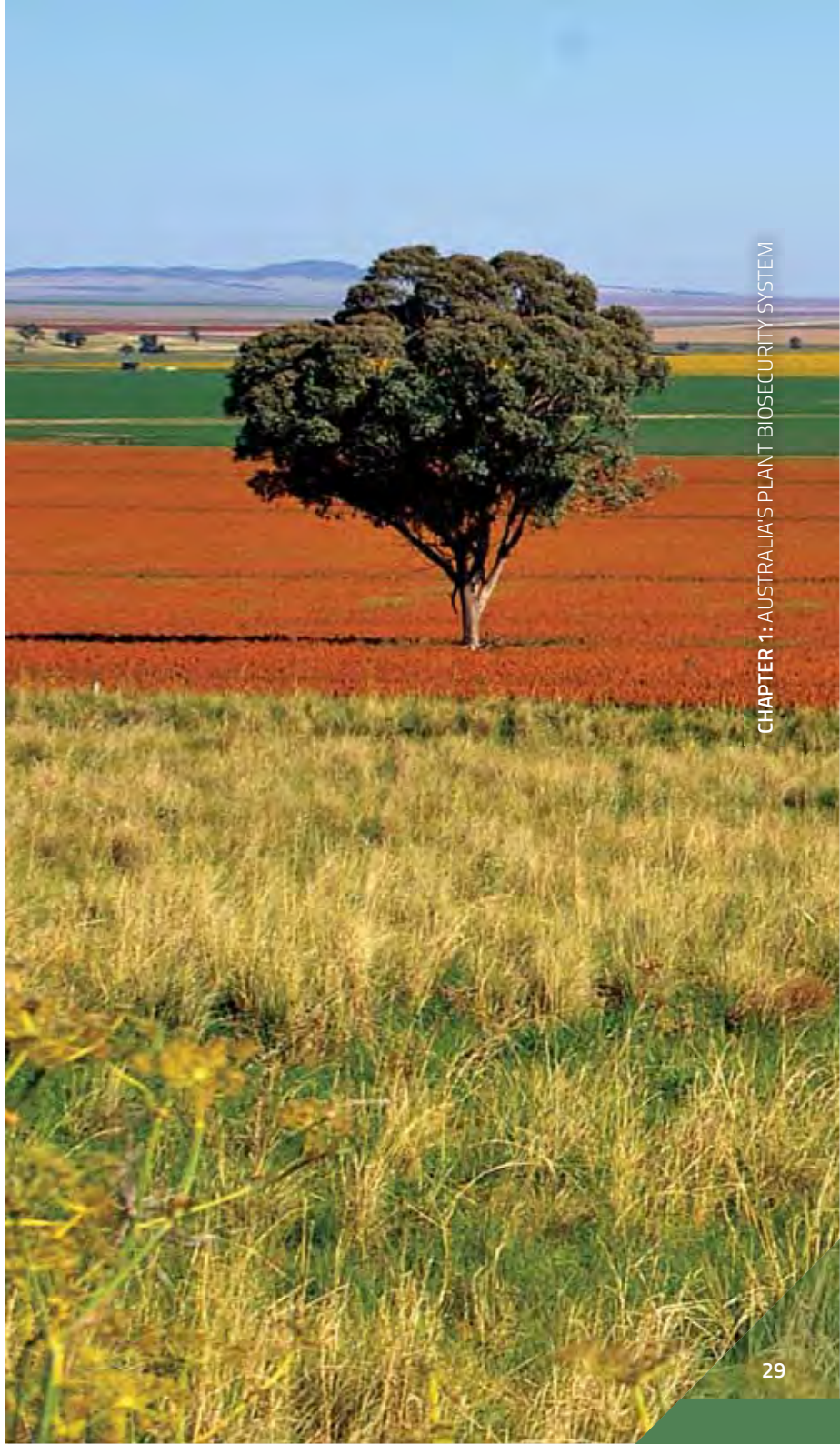
NSW DPI is the principal agency responsible for plant biosecurity in the state, ensuring that policies, management and procedures are in place to minimise the impact of existing, invasive and Emergency Plant Pests. NSW DPI maintains rapid response mechanisms for pest incursions in order to protect trade 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 the 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.

Surveillance and diagnostic 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 2019 were 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 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 education, engagement, surveillance and compliance
- 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 exotic pests
- preparing effective response mechanisms in the event of an incursion
- developing, implementing and reviewing NT's plant health policy and legislation.

In 2015, browsing ant was detected in the NT. The NT Government, through the National Browsing Ant Eradication Program, is on track to eradicate browsing ant by the end of 2021.

In 2018, citrus canker was detected in the NT. The NT Government is currently in the process of eradicating this pest under the National Citrus Canker Eradication Program. It is anticipated that the NT will declare freedom from citrus canker in 2020.

In 2019, the NT declared freedom from banana freckle (see page 189).

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: Department of Agriculture and Fisheries (DAF)
daf.qld.gov.au

Biosecurity Queensland is the lead agency within the DAF, 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; minimising the impacts of new plant pest incursions on Queensland's plant industries, environment and communities; facilitating market access for Queensland's plant-based industries; and managing risks associated with the use of agriculture and veterinary chemicals.

The Plant Biosecurity and Product Integrity program is responsible for the implementation of programs for the prevention and preparedness, detection, diagnosis, response, control, containment and eradication of high priority plant pests.

Other DAF business groups also contribute to managing the risk of plant pest threats. 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:

- **DAF Agri-Science Queensland**, which provides science, research, 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 plant 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 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 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*.

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.

PIRSA prepares for and responds to a range of plant pests but, given SA's freedom from fruit flies of economic significance, PIRSA has a major focus 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.

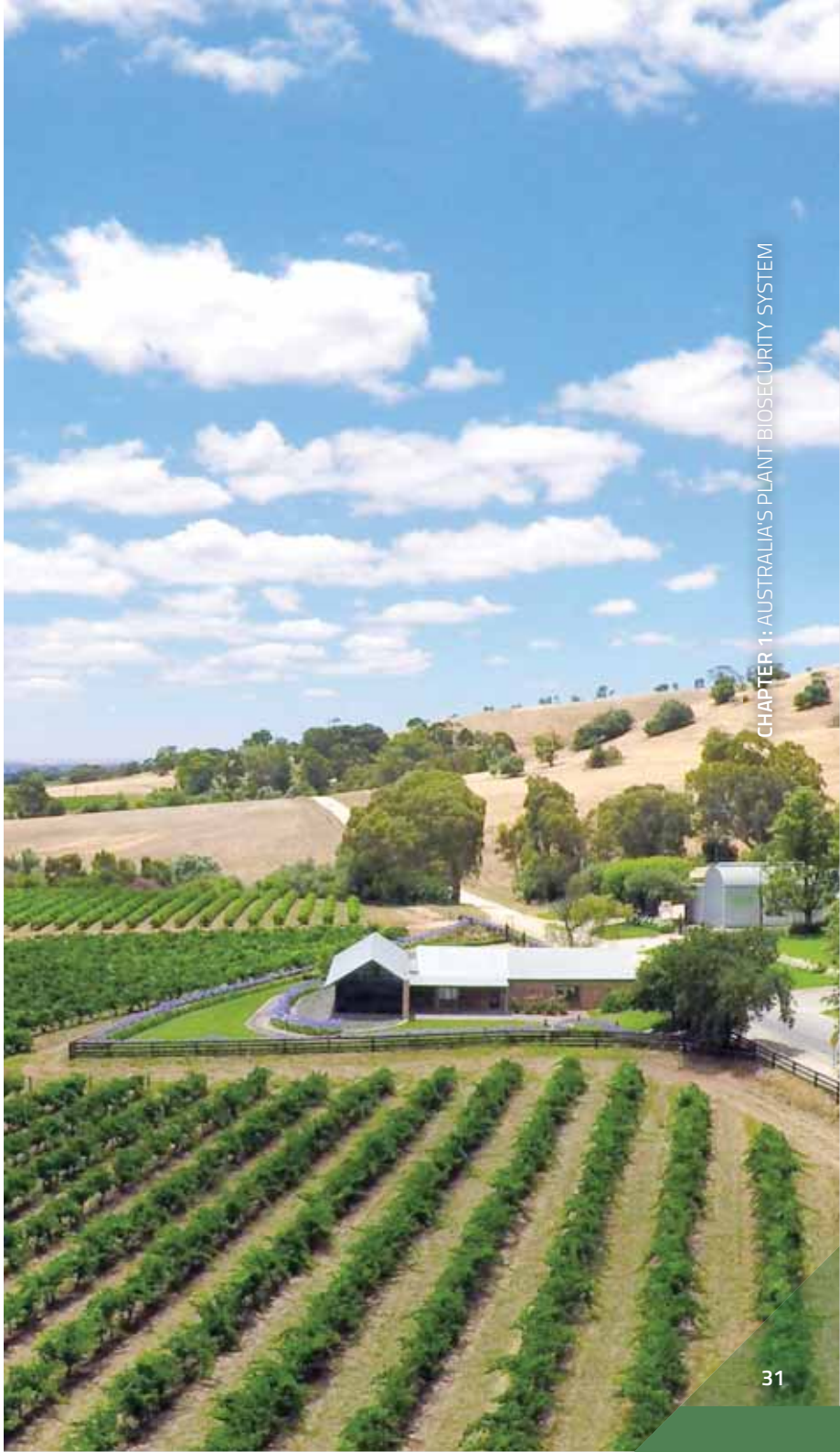
The South Australian Government has, in partnership with Hort Innovation and the SITplus consortium, constructed and commissioned the National Sterile Insect Technology Facility in Port Augusta, capable of producing 50 million sterile Queensland fruit flies per week.

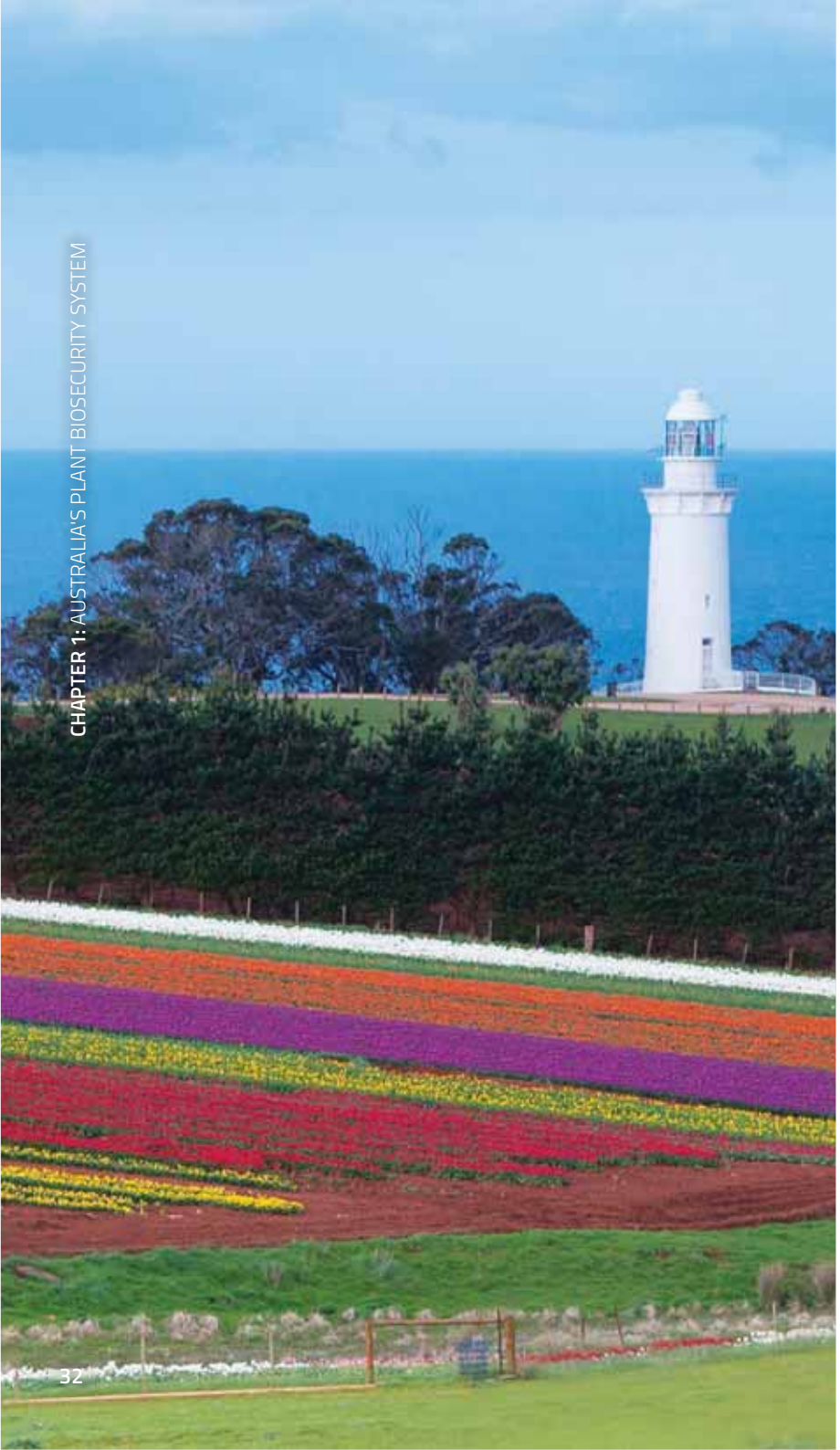
The South Australian Research and Development Institute (SARDI) is the principal research institute and provides Biosecurity SA with plant diagnostic, pathology and entomology advice.

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.





Tasmania

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

DPIPWE'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, a plant biosecurity surveillance unit that manages the policy and smaller operational aspects of surveillance, and delivers on communication services specific to plant biosecurity.

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.

Tasmania's new biosecurity legislation, the *Biosecurity Act 2019,* received Royal Assent on 26 August 2019. Work is underway to implement the changes, which will be rolled out in a way that minimises the impact on businesses and the community.

Until those changes are made, the regulations made under the many separate pieces of legislation (including the *Plant Quarantine Act 1997*) that were previously used to manage biosecurity will remain in place as the main compliance tools. This is until the provisions of the new act are proclaimed.

Full implementation will take three to four years and will involve consultation and ongoing participation between government, industry and community.

Victoria

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

Within DJPR, Agriculture Victoria provides a clear identity to the agricultural services and initiatives delivered. There are five branches within Agriculture Victoria, including the Biosecurity and Agriculture Services (BAS) Branch, which has the responsibility for delivering biosecurity and product integrity programs across the agriculture, horticulture, forest and amenity plant sectors. Activities are guided by the BAS Strategy which aims to minimise the impact of emergency plant and apiary pest incidents on production systems and the environment, and maintain access to local and overseas markets.

The Chief Plant Health Officer Unit, within BAS, is responsible for the development, review and monitoring of policies, protocols and procedures in accordance with national and international obligations. They are also the lead for preparedness and response activities and policy relating to plant and apiary pests.

The Plants, Chemicals and Invasives Unit within BAS 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. 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. 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.

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 Western Australia (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 is largely regulatory and market access focused, 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*, designed to prevent declared pests and diseases from entering the state and manage those that are already present. The act provides for a modern biosecurity system to control the entry, establishment, spread and impact of harmful organisms (pests and diseases), 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.

Throughout 2019, WA responded to several biosecurity incidents and increased surveillance and preparedness activities to strengthen readiness for future incursions.

- An increase in the detection of European wasp nests resulted in the declaration of an incident response on 25 March 2019: 3,769 traps were deployed and 166 nests were destroyed in a surveillance area spanning over 1,300 km^2. The incident closed on 5 July 2019 with plans to target high-risk areas as a priority in the 2020 season.
- Ongoing concern about brown marmorated stink bug saw additional surveillance for the pest carried out with 44 traps placed strategically across the metropolitan area, concentrating on high-risk locations. This will continue to be a high priority for WA.
- The response to citrus canker closed in 2019, with the state being officially declared free of citrus canker in November 2019 (see page 193).
- To improve WA's preparedness for myrtle rust, a workshop was held in late 2019. The workshop included guest speakers from New Zealand and Queensland. Using their experience and lessons learnt, the workshop focused on the development of an agreed incident response framework, and draft surveillance and mitigation plans.
- The *Biosecurity and Agriculture Management Regulations Amendment Regulations (No 2) 2019* were published in 27 June 2019.

Non-government roles

PLANT HEALTH AUSTRALIA

www.planthealthaustralia.com.au

PHA is the national coordinator of the government–industry partnership for plant biosecurity in Australia. The not-for-profit company 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.

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 on 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, the Australian Government and all state and territory governments, a total of 59 as at 31 December 2019. 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, 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.

PHA's main activities are funded from annual subscriptions paid by members. The number of plant biosecurity partnerships are increasing over time, and the model is proving highly successful.

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 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 (see Chapter 6).

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 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 7.

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 on 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.

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 preparedness for particular industries. Examples of such projects include industry funded biosecurity outreach officers, response simulations, and biosecurity manuals to inform growers.

Table 2. Plant Health Australia members

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

**Winemakers' Federation of Australia and Australian Vignerons amalgamated into Australian Grape and Wine Inc in February 2019*

***Formerly Nursery and Garden Industry 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 avocados, 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 (see Table 2).

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 39 industry members) of PHA's plant industry members are also signatories to the EPPRD. Importantly, plant industry bodies represent growers in an incursion, which can be a significant commitment. They also contribute to scientific advisory panels when information is needed to make decisions in emergency responses. More information about the role of industries during incursions is in Chapter 6.

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.

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 incursion.

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 (see 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, the Ag Institute of Australia 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, and are often funded through cooperative funding organisations like research and development corporations (RDCs) and the Plant Biosecurity Research Initiative (PBRI), a joint initiative of the seven plant-based RDCs, PHA and the Department of Agriculture. Research includes methods to identify pests (diagnostics), effective management techniques and work to breed resistant crop varieties. More on plant biosecurity RD&E is in Chapter 8.

THE 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.

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.[16] 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.

Identifying exotic pest threats, the ways in which they might enter Australia, and prioritising them according to their potential impact, allows the most serious risks to be targeted. Biosecurity activities – such as surveillance, pathway analysis, border screening, inspection and planning – can then help increase the chance of identifying, containing and successfully eradicating pests should they arrive. This chapter describes the priority pest threats to the major plant production industries and to the environment, as well as describing the biosecurity and risk mitigation planning activities.

16. 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

National priority pests

NATIONAL PRIORITY PLANT PESTS

The National Priority Plant Pests (2019) is a list of Australia's most serious exotic plant pest threats. The list shown in Table 3 was reviewed by the Plant Health Committee and endorsed in August 2019, with the top ten shown in Table 4.

To be considered a national priority:

- a pest must:
  - be injurious to plants, plant products, bees or impact social amenity
  - be exotic to Australia, or have limited distribution and be under official control
  - have potential to cause significant negative impact on national economies, the environment or community
  - have potential to enter, establish and spread in Australia
- there must be a clear benefit from, or requirement for, nationally coordinated action or approach.

The National Priority Plant Pest list 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 priority 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, 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
  - identification of pesticides for use in incursions
  - identifying possible biological control agents
  - identifying R,D&E needs
  - gaps in the regulatory system.

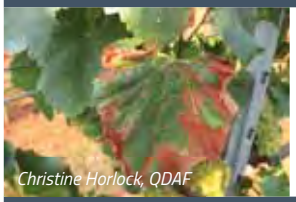
Table 3. Australia's National Priority Plant Pests

National priority plant pests (2019)			
1	*Xylella fastidiosa* and exotic vectors	22	Panama tropical race 4
2	Khapra beetle	23	Cyst nematodes of cereals (exotic species)
3	Spotted wing drosophila	24	Plum pox virus
4	Exotic, economic fruit fly (lure and non-lure responsive)	25	Exotic drywood termites
5	Karnal bunt	26	Wheat stem sawfly (exotic species)
6	*Candidatus* Liberibacter asiaticus (and other strains) complex	27	Barley stripe rust (exotic strains)
7	Exotic invasive ants	28	Hessian fly (*Mayetiola* spp.)
8	Gypsy moths	29	Exotic subterranean termites
9	Brown marmorated stink bug	30	Phytoplasmas 16SrI group
10	Internal and external mites of bees (*Apis* spp.)	31	Armyworm (exotic species)
11	Guava (Eucalyptus) rust (exotic strains)	32	Exotic Tobamovirus
12	Exotic invasive snails	33	*Bursaphelenchus* spp. and exotic sawyer beetle vectors
13	*Candidatus* Liberibacter solanacearum complex	34	Exotic longhorn beetles (*Anoplophora* spp.)
14	Airborne *Phytophthora* spp.	35	Grape phylloxera
15	Ug99 wheat stem rust	36	Exotic stem borers of sugarcane and cereals
16	Citrus canker	37	Potato late blight (exotic strains)
17	Exotic bees (*Apis* spp.)	38	Pine pitch canker
18	Fire blight	39	Grapevine leaf rust
19	Potato cyst nematode (exotic strains)	40	Exotic Begomovirus and vectors
20	Leaf miners (exotic species)	41	Dutch elm disease
21	Texas root rot	42	Banana phytoplasma diseases

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

Table 4. The top 10 National Priority Plant Pests

1. *Xylella fastidiosa* and exotic vectors


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. Spotted wing drosophila


John Davis

Spotted wing drosophila (*Drosophila suzukii)* is a major horticultural pest affecting many crops particularly soft-skinned fruit. SWD attacks healthy ripening fruit as well as damaged fruit, reducing crop yields and impacting upon fruit quality. If introduced into Australia, SWD is likely to spread rapidly, primarily through the human movement of infested produce.

4. Exotic, economic fruit fly (lure and non-lure responsive)

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 oriental fruit fly (*Bactrocera dorsalis*, pictured left) are kept out by ongoing biosecurity measures.

5. 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.

6. *Candidatus* Liberibacter asiaticus (and other strains) complex


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.

7. Exotic invasive ants


Scott Bauer, USDA Agricultural Research Service, Bugwood.org

Invasive (tramp) ants are a diverse group of aggressive, invasive ant species that can rapidly establish and spread if introduced. Several species of invasive 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 in Australia.

8. 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.

9. 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.

10. Internal and external mites of bees (*Apis* spp)


Scott Bauer, USDA Agricultural Research Service, Bugwood.org

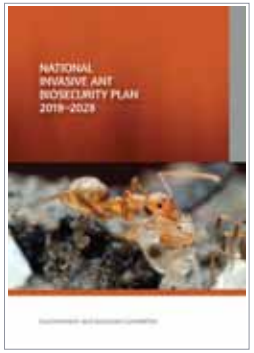
Mites of bees such as Varroa mite (*Varroa destructor*) would pose a serious threat to bees, reducing the numbers of unmanaged European honey bees and the pollination services they provide by 90 to 100 per cent if it established in Australia. Other exotic mites like tracheal mite (*Acarapsi woodi*) and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

NATIONAL ACTION PLANS

The Department of Agriculture are developing national action plans for the National Priority Plant Pests. The plans identify the capabilities required to prepare for these pests if they enter Australia.

The national action plans are 'living' documents to be regularly reviewed. Once finalised, the plans will be available on the Department of Agriculture website.

To date, two plans have been finalised:



- **The National Invasive Ant Biosecurity Plan 2018–28**[17] provides a nationally agreed approach to enhance Australia's capacity to manage the ongoing threat of invasive ants establishing in Australia and the impacts caused by those species already established.

- **The National Xylella Action Plan 2019–29**[18] provides a nationally agreed approach to enhance Australia's capacity to prevent the introduction of Xylella (and exotic vectors), and to improve detection and the ability to respond to an incursion should it enter Australia.

17. Environment and Invasives Committee (2019). National Invasive Ant Biosecurity Plan 2018–28. Accessed online 12 February 2020 www.environment.gov.au/system/files/resources/cd1170d3-7e62-4340-b0d1-c366e495e238/files/invasive-ant-biosecurity-2019.pdf
18. Plant Health Committee (2019). National Xylella Action Plan 2019–29. Accessed online 12 February 2020 www.agriculture.gov.au/sites/default/files/documents/National-Xylella-Action-Plan-2019-2029.pdf

National workshop prioritises action on Khapra beetle

On 13-14 June 2019, the Department of Agriculture, Water and the Environment convened a workshop to increase Australia's preparedness for Khapra beetle by identifying activities to enhance Australia's capacity to manage the threat posed by this devasting pest. Khapra beetle is the number two National Plant Priority Pest and strong preventative and response measures are needed to protect Australia and industry from an incursion.

Participants included representatives from peak industry bodies from the grain, rice and seed industries, GRDC and PHA, along with state, federal and New Zealand biosecurity agencies.

During the workshop, there was strong support for a more coordinated national approach and the development of a national preparedness action and implementation plan for Khapra beetle, similar to those developed for Xylella fastidiosa and invasive ants.

Aspects of the behaviour and biology of the pest were discussed, particularly its hitchhiking habits, lifecycle, and resistance to many pest treatments. Several discussions were about the beetle's extraordinary ability to enter a hibernation-like state called diapause, making it hard to detect and treat.

Attendees were informed about the need for morphological and molecular expertise to identify Khapra beetle, and the decline in this former field within Australia. Also highlighted were several recent border interceptions, what led to them, and how such interceptions might be avoided in the future.

Outcomes from the workshop include:

- increased awareness the pest threat
- activities to raise awareness, potential areas for research, and the findings from the response to interception or detection of the pest
- where and how industry, jurisdictions, and the public could do surveillance for the pest
- recognition that fumigation to control Khapra beetle is untenable in the long-term or ineffective due to product packaging, requiring further research
- the need to review import conditions for host commodities and non-host commodity pathways to ensure these conditions reflect current understanding of pest risk and emerging pathways.

New program to prepare for *Xylella fastidiosa*

A national initiative began in 2019 to help Australia prepare for a potential incursion of our top – or most unwanted – exotic plant pest, *Xylella fastidiosa.*

The bacteria infects xylem vessels of host plants and is transmitted by sap sucking insects, with the potential to impact many crops and plants in our environment. Over 560 plant species, including grapevines, coffee, olives, citrus, berries, tree nuts and some ornamental and native species are now recognised as hosts of Xylella.

Due to the potential impacts on horticulture crops in Australia, Hort Innovation and Wine Australia are jointly funding the National Xylella Preparedness Program.

In February 2019, Craig Elliott was appointed as coordinator of the program to help work out how the bacteria could be detected, contained and eradicated as quickly, effectively and cost efficiently as possible.

Craig has been liaising with industries at risk and government biosecurity managers to raise awareness of the issue and address existing gaps.

"For winemakers and grape growers alone, the potential impact has been estimated at between $2 billion and $8 billion in production loses and management costs over a 50-year period.

He visited the wine industry in California to see how they are managing the disease by restricting the spread of the main insect vector and searching for resistant or tolerant varieties. He also met with European researchers examining Xylella, its insect vectors and ways to detect and contain it .

"The key is prevention, so growers are encouraged to review their biosecurity measures across their business and supply chains," he said.

Hort Innovation is also funding work to update Australia's diagnostic protocols for Xylella, including trialling field diagnostics kits, and tapping into international work underway to help be better prepared for the disease.

A National Xylella Action Plan 2019–29 was approved in late 2019. The plan provides a nationally agreed approach to enhance Australia's capacity to prevent the introduction of Xylella and exotic vectors and prepare for a response, should it be detected in Australia. It also sets out the actions to achieve this outcome.

NATIONAL PRIORITY LIST OF EXOTIC ENVIRONMENTAL PESTS, WEEDS AND DISEASES

In August 2019 the Department of Agriculture released a draft list of priority exotic environmental pests, weeds and diseases.

Development of the list was led by the Australian Bureau of Agricultural and Resource Economics and Sciences and other areas of the Department of Agriculture, in collaboration with over 100 experts.

Over 40 species were assessed as being a high risk to Australia, including the top five or six highest risk species for each of eight thematic groups: aquatic animal diseases, freshwater invertebrates, marine pests, native animal diseases, plant pathogens, terrestrial invertebrates, vertebrates, and weeds and freshwater algae.

The list includes some pests which pose a threat to plants in Australia, with a significant overlap between pests that threaten plants in the environment and the high priority pests of plant industries. Pests in common with the National Priority Plant Pests list include gypsy moths, invasive ants and Xylella.

The Chief Environmental Biosecurity Officer is the custodian of the National Priority List of Exotic Environmental Pests, Weeds and Diseases, and is responsible for coordinating amendments and reviews of the list, with oversight by the Environment and Invasives Committee.

Following approval by the National Biosecurity Committee, the inaugural National Priority List of Exotic Environmental Pests, Weeds and Diseases is expected to be announced by the Chief Environmental Biosecurity Officer in mid-2020.

Plant industry biosecurity preparedness

There are a number of ways that industries and governments can prepare for and reduce the risks posed by exotic pests. Developing a biosecurity plan enables governments and industries to identify the exotic pests that pose the greatest risk to an industry, and the activities that will help to mitigate the risks associated with the pests.

Developing a contingency plan is another aspect of preparedness, as they identify the information needed during a response to an exotic pest incursion.

BIOSECURITY PLANNING FOR PLANT INDUSTRIES

One of the first steps to reduce the biosecurity risks to an industry is to develop a biosecurity plan for the crop(s) produced. Each of PHA's plant industry members has developed a biosecurity plan in partnership with governments, and they are listed in Table 5. Biosecurity planning is a requirement for Emergency Plant Pest Response Deed signatories, and plans are generally funded by a research and development corporation (RDC) or plant industry peak body.

The first step in developing a biosecurity plan is to identify and prioritise exotic pests. Experts from industry and government are brought together to form a Technical Expert Group who assess each pest's likelihood of entry, establishment and spread, as well as the economic impact if it established in Australia.

The exotic pests that pose the greatest risk with the largest potential economic impact are deemed to be High Priority Pests. Table 6 lists all of the High Priority Pests identified in the 35 biosecurity plans developed by PHA. The same pests are also listed in the plant industry profiles throughout Chapter 3.

Having identified the pests that pose the greatest risk, the next step is to develop and agree on effective biosecurity measures to protect against them. This involves the industry, governments, the relevant research and development corporation(s) and PHA working in partnership with each other. Agreed risk mitigation activities are aligned to overarching strategies in the National Plant Biosecurity Strategy and the Intergovernmental Agreement on Biosecurity.

Each 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 review and prioritise the activities in individual plans on an annual basis. This ensures that by the end of a plan's timeframe activities have been completed, providing a significant boost in biosecurity preparedness. 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 2019 new biosecurity plans were produced for the tea tree and sweetpotato industries, and revised biosecurity plans were produced for the mango and summerfruit industries.

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

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

Biosecurity plans		
Apple and Pear BP (Version 3.0)	Lychee IBP (Version 1.0)	Rubus IBP (Version 1.0)
Avocado IBP (Version 2.01)	Mango BP (Version 3.1)	Strawberry IBP (Version 2.0)
Banana BP (Version 3.1)	Melon IBP (Version 1.0)	Sugarcane IBP (Version 3.0)
Blueberry BP (Version 1.0)	Nursery IBP (Version 3.0)	Summerfruit IBP (Version 2.1)
Cherry BP (Version 3.1)	Olive BP (Version 2.0)	Sweetpotato BP (Version 1.0)
Citrus BP (Version 3.0)	Onion BP (Version 3.1)	Tea Tree BP (Version 1.1)
Coffee BP (Version 1.0)	Papaya IBP (Version 1.0)	Tomato BP (Version 1.0)
Cotton BP (Version 3.2)	Passionfruit IBP (Version 1.0)	Tree nut BP (Version 3.0)
Cut flower BP (Version 1.0)	Pineapple BP (Version 2.0)	Truffle BP (Version 1.0)
Ginger IBP (Version 1.0)	Plantation forest IBP (Version 2.0)	Vegetable BP (Version 3.1)
Grains IBP (Version 3.0)	Potato BP (Version 3.1)	Viticulture IBP (Version 3.0)
Honey bee IBP (Version 1.1)	Rice IBP (Version 3.0)	

Preparedness for vegetable leaf miner

A collaborative R,D&E program is helping Australia prepare for vegetable leaf miner *(Liriomyza sativae)*, serpentine leaf miner *(L. huidobrensis)* and American serpentine leaf miner *(L. trifolii)*.

Leaf miners are small flies that damage a wide range of plants including horticultural and broadacre crops. The larvae feed inside of plant leaves and stems creating tunnels or mines, reducing yield and quality. Serpentine and American serpentine leaf miners are widespread exotic pests. The vegetable leaf miner is widespread overseas and was first detected at the tip of Cape York in 2015. To date it has not spread much further south of its original detection.

The Hort Innovation funded project is being led by research company cesar in partnership with PHA, AUSVEG, Northern Australia Quarantine Strategy and the University of Melbourne. The program aims to improve Australia's preparedness for these three leaf miner species by undertaking the following:

- reviewing chemical and biological control options
- developing an interactive tool to guide surveillance and awareness raising activities to forecast the risk of establishment and spread
- developing statistically sound visual surveillance methods and new diagnostic tests for damaged plants
- securing minor use permits for at risk crops
- developing contingency plans to guide actions in the event of a detection
- holding workshops in high risk locations to improve awareness of the pest amongst growers.

Vegetable leaf miner damage to siratro leaf on Thursday Island, Queensland. Image courtesy of Elia Pirtle, cesar

Table 6. High Priority Pest threats

Scientific name	Common name	High priority pest of
Abaca bunchy top virus (Babuvirus)	Abaca bunchy top virus	Banana
Acanthocoris scabrator	Squash bug	Mango
Acarapis woodi	Tracheal mite	Honey bee
Achatina achatina	Giant African snail, giant Ghana snail	Sweetpotato, Vegetable
Agrotis segetum	Turnip moth, cutworm, black cutworm	Sweetpotato
Aleurocanthus woglumi	Citrus blackfly	Mango
Aleurolobus barodensis	Sugarcane whitefly	Sugarcane
Alternaria humicola	Leaf spot	Vegetable
Amritodus atkinsoni	Mango leafhopper	Mango
Amyelois transitella	Navel orangeworm	Tree nut
Anastrepha ludens	Mexican fruit fly	Citrus, Summerfruit
Anastrepha obliqua	West Indian fruit fly	Mango
Anastrepha serpentina	Sapodilla fruit fly, sapote fruit fly	Summerfruit
Anastrepha striata	Guava fruit fly	Summerfruit
Anisogramma anomala	Eastern filbert blight, hazelnut blight	Tree nut, Truffle
Anthonomus grandis	Boll weevil	Cotton
Aphis fabae	Black bean aphid	Potato, Vegetable
Aphis gossypii (exotic strains)	Cotton aphid	Nursery and Garden, Potato
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 (exotic mating types)	Ascochyta blight	Grains
Aspidiella hartii	Yam scale, rhizome scale	Ginger
Aulacophora foveicollis	Red pumpkin beetle	Vegetable
Austropuccinia psidii sensu lato (exotic variants) (syn. *Puccinia psidii*)	Myrtle rust, guava rust, Eucalyptus rust	Cutflower, Nursery and Garden, Plantation forest, Tea tree
Avocado sunblotch viroid (asymptomatic strains)	Avocado sunblotch	Avocado
Avocado sunblotch viroid (symptomatic strains)	Avocado sunblotch	Avocado

Table 6. High Priority Pest threats (continued)

Scientific name	Common name	High priority pest of
Bactericera cockerelli *	Tomato potato psyllid	Tomato
Bactrocera albistrigata	White striped fruit fly	Mango
Bactrocera carambolae	Carambola fruit fly	Avocado, Citrus, Mango, Papaya, Passionfruit, Tomato, Vegetable, Viticulture
Bactrocera correcta	Guava fruit fly	Mango
Bactrocera curvipennis	Banana fruit fly	Mango
Bactrocera dorsalis (syn. *B. invadens, B. papayae, B. philippinensis*)	Oriental fruit fly	Apple and Pear, Avocado, Banana, Cherry, Citrus, Coffee, Lychee, Mango, Melon, Papaya, Passionfruit, Summerfruit, Tomato, Vegetable, Viticulture
Bactrocera facialis	Tropical fruit fly, Tongan fruit fly	Avocado, Mango, Passionfruit, Tomato
Bactrocera kandiensis	Fruit fly	Avocado, Citrus, Mango, Passionfruit
Bactrocera kirki	Fijian fruit fly	Avocado, Mango, Passionfruit
Bactrocera latifrons	Solanum fruit fly	Melon
Bactrocera melanotus	Fruit fly, Cook Islands fruit fly	Avocado, Mango, Passionfruit
Bactrocera occipitalis	Fruit fly, Bezzi fruit fly	Citrus, Mango
Bactrocera oleae	Olive fly	Olive
Bactrocera passiflorae	Fijian fruit fly	Avocado, Mango, Papaya, Passionfruit, Vegetable
Bactrocera psidii	South Sea guava fruit fly	Mango, Passionfruit
Bactrocera trilineola	Vanuatu fruit fly	Mango
Bactrocera trivialis	New Guinea fruit fly	Citrus, Mango, Vegetable
Bactrocera tuberculata	Fruit fly	Mango
Bactrocera xanthodes	Pacific fruit fly	Avocado, Mango, Passionfruit
Bactrocera zonata	Peach fruit fly	Mango
Banana bunchy top virus (Babuvirus) (Asian subgroup)	Bunchy top	Banana
Barley mild mosaic virus (Bymovirus)	Barley mild mosaic virus	Grains
Batocera rubus	Lateral-banded mango longhorn beetle	Mango
Batocera rufomaculata	Red-spotted longhorn beetle	Mango
Bean common mosaic virus (Potyvirus), peanut stripe strain	Bean common mosaic virus	Grains
Belonolaimus longicaudatus	Sting nematode	Sweetpotato
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	Melon, Nursery and Garden, Tomato, Vegetable
Botrytis squamosa	Leaf blight	Onion
Burkholderia caryophylli (syn. *Pseudomonas caryophylli*)	Bacterial wilt of carnation	Cutflower
Bursaphelenchus spp. including *B. xylophilus*	Pinewood nematode species complex	Plantation forest
Cacoecimorpha pronubana	Carnation tortrix	Cutflower
Caliothrips fasciatus	Bean thrips	Citrus
Calonectria brassicae (syn. *C. gracile*)	No common name	Tea tree
Calonectria pteridis	Blight, leaf spot, cutting and root rot	Tea tree
Candidatus Liberibacter africanus	Huanglongbing (African strain)	Citrus
Candidatus Liberibacter americanus	Huanglongbing (American strain)	Citrus
Candidatus Liberibacter asiaticus	Huanglongbing (Asiatic strain)	Citrus, Nursery and Garden
Candidatus Liberibacter solanacearum (syn. *Candidatus* Liberibacter psyllaurous)	Zebra chip	Potato, Tomato, Vegetable
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, Ceratocystis blight	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. *C. 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	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. *C. hilare*)	Green stink bug	Tree nut
Chromatomyia horticola	Pea leaf miner	Cutflower
Chrysoporthe austroafricana	Eucalyptus canker disease	Plantation forest
Chlumetia transversa	Mango shoot borer	Mango
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 (syn. C. allii-cepae, *Heterosporium allii, Mycosphaerella allii*)	Leaf spot	Onion
Colletotrichum higginsianum	Anthracnose	Vegetable
Colletotrichum kahawae subsp. *kahawai* (syn. *C. coffeanum*)	Coffee berry disease	Coffee
Colletotrichum lentis (lentil strain)	Lentil anthracnose, soybean anthracnose	Vegetable
Colletotrichum truncatum (lentil strain)	Lentil anthracnose	Grains
Conopomorpha sinensis	Lychee fruit borer	Lychee
Conotrachelus aguacatae	Small avocado seed weevil	Avocado
Conotrachelus perseae	Small seed weevil	Avocado
Coptotermes formosanus	Formosan subterranean termite	Plantation forest
Coptotermes gestroi	Asian subterranean termite	Plantation forest
Cotinis mutabilis	Fig beetle	Pineapple
Cotton leaf curl virus complex (Begomovirus)	Cotton leaf curl disease	Cotton
Cotton leafroll dwarf virus (Polerovirus)	Cotton blue disease	Cotton
Croesia curvalana	Blueberry leaftier	Blueberry
Cryphonectria parasitica	Chestnut blight	Tree nut
Cryptosporella umbrina	Brown rose canker	Cutflower
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
Dasineura amaramanjarae	Mango gall midge	Mango
Deanolis sublimbalis (syn. *Noorda albizonalis*)	Red banded mango caterpillar	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	Plantation forest
Dendroctonus valens	Red turpentine beetle	Plantation forest
Diabrotica barberi	Northern corn root worm	Grains
Diabrotica undecimpunctata	Southern corn root worm	Grains
Diabrotica virgifera	Western corn root worm	Grains
Diaphorina citri	Asian citrus psyllid	Citrus, Nursery and Garden

Image courtesy of Cotton Australia

Table 6. High Priority Pest threats (continued)

Scientific name	Common name	High priority pest of
Diaporthe helianthi	Sunflower stem canker	Grains
Diaprepes abbreviatus	Citrus weevil, West Indian weevil, sugarcane rootstalk borer	Sweetpotato
Dickeya dianthicola (syn. *Erwinia chrysanthemi* pv. *dianthicola*)	Slow wilt	Cutflower
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
*Diuraphis noxia**	Russian wheat aphid	Grains
Ditylenchus destructor	Potato tuber nematode	Sweetpotato
Drosophila suzukii	Spotted wing drosophila	Apple and Pear, Blueberry, Cherry, Rubus, Summerfruit, Viticulture
Dryocosmus kuriphilus	Oriental chestnut gall wasp	Tree nut
Dysaphis plantaginea	Rosy apple aphid	Apple and Pear
Dysdercus spp. including *D. honestus, D. maurus, D. suturellus* (American species)	Cotton stainer	Cotton
Dysmicoccus neobrevipes	Grey pineapple mealybug	Banana, Pineapple
East Asian passiflora virus (Potyvirus)	East Asian passiflora virus	Passionfruit
Echinothrips americanus	Poinsettia thrips	Nursery and Garden
Elasmopalpus lignosellus	Lesser corn stalk borer	Sweetpotato
Eldana saccharina	African sugarcane stalkborer	Sugarcane
Elytroteinus subtruncatus	Fijian ginger weevil	Ginger
Endocronartium harknessii	Western gall rust	Plantation forest
Epichoristodes acerbella	South African carnation tortrix, South African carnation miner	Cutflower
Ericaphis fimbriata (with blueberry scorch Carlavirus)	Blueberry aphid	Blueberry
Erionota thrax	Banana skipper butterfly	Banana
Erwinia amylovora	Fire blight	Apple and Pear
Erwinia herbicola (exotic strains)	Avocado blast	Avocado
Erwinia herbicola pv. *gypsophilae*	Bacterial gall	Cutflower
Erwinia papayae	Bacterial crown rot	Papaya
Erwinia spp.	Mushy canker	Papaya
Erwinia tracheiphila	Cucurbit bacterial wilt	Melon
Euscepes postfasciatus (syn. *E. batatae*)	West Indian sweetpotato weevil	Sweetpotato
Eumerus strigatus	Lesser bulb fly	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	Cutflower, Tomato
Frankliniella invasor	Thrips	Banana
Frankliniella tritici	Eastern flower thrips	Cutflower
Fusarium circinatum	Pitch canker	Plantation forest
Fusarium oxysporum f. sp. *chrysanthemi*	Fusarium wilt of chrysanthemum	Cutflower
Fusarium oxysporum f. sp. *ciceris*	Fusarium wilt of chickpea	Grains
Fusarium oxysporum f. sp. *cubense* (exotic vegetative compatibility groups)	Fusarium wilt, Panama disease	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. *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
Fusarium oxysporum f. sp. *radicis-cucumerinum*	Fusarium root and stem rot of melons	Melon
Fusarium oxysporum f. sp. *vasinfectum* (exotic races)	Fusarium wilt	Cotton
Fusarium spp. (*F. ananatum* and *F. guttiforme* syn. *F. subglutinans* f. sp. *ananas*)	Fusariosis, Fusarium stem rot, pineapple eye rot, fruitlet core rot	Pineapple

Table 6. High Priority Pest threats (continued)

Scientific name	Common name	High priority pest of
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	Tree nut
Globodera pallida	Pale potato cyst nematode	Potato
Globodera rostochiensis (pathotypes RO2, RO3, RO4 and RO5)	Golden potato cyst nematode	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
Gymnoconia nitens	Orange rust (short-cycled)	Rubus
Halyomorpha halys	Brown marmorated stink bug	Apple and Pear, Cherry, Rubus, Summerfruit, Tree nut, Truffle, Vegetable
Haplothrips chinensis	Chinese thrips	Cutflower
Harpophora maydis	Late wilt	Grains, Vegetable
Heilipus lauri	Large seed weevil	Avocado
Helicoverpa armigera (carrying Bt resistance alleles)	Cotton bollworm	Cotton
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. *H. coagulata*)	Glassy winged sharpshooter	Cherry, Citrus, Nursery and Garden, Summerfruit, Viticulture
Homalodisca vitripennis (with *Xylella fastidiosa*)	Glassy winged sharpshooter	Blueberry
Homoeosoma electellum	Sunflower moth	Grains
Hoplostoma fuligineus	Large hive beetle	Honey bee
Hyalesthes obsoletus	Cixiidae planthopper	Viticulture
Hylesia nigricans	Burning moth	Plantation forest
Hypocryphalus dilutus	Ambrosia beetle	Mango
Hypothenemus hampei	Coffee berry borer	Coffee
Hypothenemus obscurus	Tropical nut borer	Tree nut
Idioscopus nagpurensis	Mango leafhopper	Mango
Ips typographus	Spruce bark beetle	Plantation forest
Leptinotarsa decemlineata	Colorado potato beetle	Potato
Leptoglossus clypealis	Leaf footed bug	Tree nut
Leptoglossus occidentalis	Western conifer seed bug	Tree nut
Leptoglossus zonatus	Western leaf footed bug	Tree nut
Lettuce infectious yellows virus (Crinivirus)	Lettuce infectious yellows virus	Nursery and Garden
Liriomyza bryoniae	Tomato leaf miner	Melon, Tomato, Vegetable
Liriomyza congesta	Pea leaf miner	Cutflower
Liriomyza huidobrensis	Serpentine leaf miner	Cutflower, Melon, Nursery and Garden, Potato, Tomato, Vegetable
Liriomyza sativae	Vegetable leaf miner, American leaf miner	Melon, Onion, Potato, Tomato, Vegetable
Liriomyza trifolii	American serpentine leaf miner	Cutflower, Melon, Potato, Tomato, Vegetable
Lissachatina fulica (syn. *Achatina fulica*)	Giant African snail	Banana, Nursery and Garden, Sweetpotato, Tomato, Vegetable
Lissorhoptrus oryzophilus	Rice water weevil	Rice
Lobesia botrana	European grapevine moth	Viticulture

Table 6. High Priority Pest threats (continued)

Scientific name	Common name	High priority pest of
Lygus hesperus	Western plant bug	Cotton, Strawberry, Vegetable
Lygus lineolaris	Tarnished plant bug	Cotton, Nursery and Garden, Strawberry
Lymantria dispar	Asian gypsy moth	Apple and Pear, Nursery and Garden, Plantation forest, Summerfruit, Tree nut
Lymantria mathura	Rosy gypsy moth, pink gypsy moth	Apple and Pear
Lymantria monacha	Nun moth	Apple and Pear, Plantation forest, Truffle
Magnaporthe grisea	Rice blast	Grains, Rice
Mayetiola destructor	Hessian fly	Grains
Mayetiola hordei	Barley stem gall midge	Grains
Meloidogyne enterolobii (syn. *M. mayaguensis*)	Root knot nematode	Onion, Potato, Sweetpotato, Vegetable
Meloidogyne naasi	Barley root knot nematode	Vegetable
Monilinia fructigena	Brown rot	Apple and Pear, Blueberry, Cherry
Monilinia mali	Monilinia leaf blight, blossom wilt	Apple and Pear
Monilinia polystroma (syn. *Monilia polystroma*)	Asiatic brown rot	Apple and Pear, Summerfruit
Monilinia vaccinii-corymbosi	Mummy berry, cotton ball disease	Blueberry
Monochamus spp. including *M. alternatus, M. galloprovincialis, M. titillator, M. scutellatus*	Longhorn beetles	Plantation forest
Monosporascus cannonballus	Monosporascus root rot	Melon
Mungbean yellow mosaic virus (Begomovirus)	Mungbean yellow mosaic virus	Grains
Mycosphaerella eumusae	Eumusae leaf spot	Banana
Nemorimyza maculosa	Chrysanthemum leaf miner	Cutflower
Neonectria ditissima (syn. *N. galligena* and *Nectria galligena*)	European canker	Apple and Pear, Cherry
Nysius huttoni	Wheat bug	Grains
Oligonychus ilicis	Southern red mite	Coffee, Nursery and Garden
Oligonychus perseae	Persea mite	Avocado
Orgyia thyellina	White spotted tussock moth	Plantation forest
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
Peanut clump virus (Pecluvirus)	Peanut clump virus	Grains
Pennisetia hylaeiformis	Raspberry crown borer	Rubus
Pennisetia marginata	Raspberry crown borer	Rubus
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	Cutflower
Phyllosticta spp. including *P. cavendishii, P. sydowiana*	Banana freckle	Banana
Phytomyza gymnostoma	Allium leaf miner	Vegetable
Phytophthora fragariae var. *fragariae*	Red steele root rot	Strawberry

Table 6. High Priority Pest threats (continued)

Scientific name	Common name	High priority pest of
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	Plantation forest
Phytophthora ramorum	Sudden oak death	Avocado, Blueberry, Cutflower, Nursery and Garden, Plantation forest, Tea tree, Tree nut, 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, sharka	Cherry, Summerfruit
Polychrosis viteana	American berry moth	Viticulture
Polyocha depressella	Root borer	Sugarcane
Pomacea canaliculata	Golden apple snail	Nursery and Garden, Rice
Popillia japonica	Japanese beetle	Rubus
Potato spindle tuber viroid (Pospiviroidae) (exotic strains)	Potato spindle tuber viroid	Potato, Vegetable
Prays oleae	Olive moth	Olive
Procontarinia allahabadensis	Mango gall midge	Mango
Procontarinia fructiculi	Gall midge	Mango
Procontarinia frugivora	Mango fruit gall midge	Mango
Procontarinia mangiferae (syn. *Dasineura mangiferae, Erosomyia mangiferae, E. indica, Mangodiplosis mangiferae, Rhabdophaga mangiferae*)	Mango blossom gall midge	Mango
Procontarinia matteiana	Mango leaf gall midge	Mango
Procontarinia pustulata	Mango leaf gall midge	Mango
Procontarinia schreineri	Mango gall midge	Mango
Prostephanus truncatus	Larger grain borer	Grains
Pseudocercospora fijiensis (syn. *Mycosphaerella fijiensis*)	Black Sigatoka	Banana
Pseudococcus cryptus (syn. *P. citriculus*)	Citrus mealybug, citriculus mealybug, cryptic mealybug	Coffee
Pseudococcus jackbeardsleyi	Jack Beardsley mealybug	Banana
Pseudococcus maritimus	Grape mealybug	Viticulture
Pseudomonas avellanae (syn. *P. syringae* pv. *avellanae*)	Bacterial canker	Truffle
Pseudomonas syringae pv. *syringae* (exotic races)	Bacterial canker	Avocado, Nursery and Garden
Pseudotheraptus wayi	Coconut bug	Lychee
Psila rosae	Carrot rust fly	Vegetable
Puccinia agrophila	No common name	Vegetable
Puccinia allii ('Koike's race')	Rust of garlic and chives	Onion
Puccinia apii	Rust of celery	Vegetable
Puccinia graminis f. sp. *tritici* (exotic pathogenic races)	Stem rust of wheat	Grains
Puccinia mixta	Rust of chives	Onions
Puccinia nitida	Rust of dill	Vegetable
Puccinia opizii	Rust	Vegetable
Puccinia porri	Rust of leek	Onion
Puccinia spp. (exotic species)	Rusts	Vegetable
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
Raffaelea lauricola	Laurel wilt	Avocardo
Ralstonia solanacearum phylotype IIB (banana infecting strains)	Moko	Banana
Ralstonia solanacearum, race 4 (exotic strains)	Bacterial wilt	Ginger
Ralstonia syzigii (syn. *R. solanacearum* race 4, *Pseudomonas solanacearum*)	Bacterial wilt	Potato
Ralstonia syzygii subsp. *celebesensis* (syn. *R. solanacearum* race 2, biovar 1)	Blood disease	Banana
Raspberry ringspot virus (Nepovirus)	Raspberry ringspot virus	Rubus, Strawberry

Table 6. High Priority Pest threats (continued)

Scientific name	Common name	High priority pest of
Rastrococcus invadens	Mango mealybug	Banana, Mango
Rastrococcus spinosus	Mango mealybug	Banana, Coffee
Rhagoletis pomonella	Apple maggot	Apple and Pear
Rhipiphorothrips cruentatus	Grapevine thrips	Mango
Rhizoctonia solani f. sp. *sasaki* (AG 1) (teleomorph *Corticium sasakii* (syn. *Thanatephorus cucumeris*)	Banded leaf and sheath spot	Grains, Vegetable
Rhizoglyphus setosus	Bulb mite	Cutflower, Vegetable
Rhodococcus fascians	Leafy gall	Cutflower
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 (Waika virus)	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	Cutflower
Spodoptera frugiperda	Fall armyworm	Cotton, Cutflower, Vegetable
Spodoptera littoralis	Cotton leafworm	Cutflower
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
Strymon megarus (as a vector of Fusariosis)	Pineapple fruit borer	Pineapple
Sugarcane streak mosaic virus (Poacevirus)	Sugarcane streak mosaic	Sugarcane
Sweet potato chlorotic stunt virus (Crinivirus)	Sweet potato chlorotic stunt virus	Sweetpotato
Sweet potato mild mottle virus (Ipomovirus)**	Mild mottle of sweet potato	Sweetpotato
Sweet potato mild speckling virus (Potyvirus)**	Sweet potato mild speckling virus	Sweetpotato
Teratosphaeria gauchensis	Coniothyrium eucalyptus canker	Plantation forest
Teratosphaeria zuluensis	Coniothyrium eucalyptus canker	Plantation forest
Tetranychus piercei	Banana spider mite	Banana
Thaumatotibia leucotreta (syn. *Cryptophlebia leucotreta*)	False codling moth	Citrus, Cotton, Grains, Mango, Pineapple, 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 brown rugose fruit virus (Tobamovirus)	Tomato brown rugose fruit virus (ToBRFV)	Vegetable
Tomato mottle mosaic virus (Tobamovirus)	Tomato mottle mosaic virus (ToMMV)	Vegetable
Tomato ringspot virus (Nepovirus)	Tomato ringspot virus	Rubus, Strawberry
Tomicus piniperda	Pine shoot beetle	Plantation forest
Toxotrypana curvicauda (syn. *Anastrepha curvicauda*)	Papaya fly	Mango, Papaya
Trichoplusia ni	Cabbage looper	Vegetable
Trioza erytreae	African citrus psyllid	Citrus
Trogoderma granarium	Khapra beetle	Grains, Rice, Tree nut
Tropilaelaps clareae	Tropilaelaps mite	Apple and Pear, Honey bee, Tree nut
Tropilaelaps mercedesae	Tropilaelaps mite	Apple and Pear, Honey bee, Tree nut
Tuta absoluta	South American tomato moth, tomato leaf miner	Tomato, Vegetable
Unknown	Ramu stunt disease	Sugarcane

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	Plantation forest
Urocystis cepulae	Onion smut	Onion
Uromyces lineolatus	Rust	Vegetable
Varroa destructor	Varroa mite	Apple and Pear, Honey bee, Tree nut
Varroa jacobsoni	Varroa mite	Honey bee
Veronicella cubensis	Cuban slug	Sweetpotato
Verticillium dahliae (defoliating strain)	Verticillium wilt	Cotton, Olive, Tree nut
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 (subsp. not specified)	Pierce's disease, blueberry leaf scorch, olive leaf scorch, olive quick decline, phony peach, plum leaf scald	Blueberry, Cherry, Nursery and Garden, Summerfruit, Viticulture
Xylella fastidiosa subsp. *fastidiosa*	Pierce's disease, blueberry leaf scorch, olive leaf scorch	Coffee, Tree nut
Xylella fastidiosa subsp. *multiplex*	No common name	Olive, Tree nut
Xylella fastidiosa subsp. *pauca*	Pierce's disease, blueberry leaf scorch, olive quick decline	Citrus, Coffee, Olive
Xylella fastidiosa subsp. *piercei*	No common name	Tree nut
Xylosandrus compactus	Black twig borer	Mango, Tea tree
Zea mosaic virus (Potyvirus)	Zea mosaic virus	Grains
Zeugodacus curcubitae (syn. *Bactrocera cucurbitae*)	Melon fruit fly	Avocado, Mango, Melon, Papaya, Passionfruit, Tomato, Tropicals, Vegetable

Legend

f. sp. forma specialis
pv. pathovar
sp. species
spp. multiple species
subsp. subspecies
syn. synonym
**established in Australia*
***with Sweet potato feathery mottle virus and Sweet potato chlorotic stunt virus*

Review of environmental risk management

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 Department of Agriculture manages environmental biosecurity concerns. The report was published on 12 April 2019 and is available from **igb.gov.au**

The review found that Australia's framework for managing environmental biosecurity challenges has improved considerably in recent years, with the respective roles of the agriculture and environment departments in implementing pre-border and border biosecurity risk management measures much clearer.

The report praised the appointment of the Chief Environmental Biosecurity Officer but noted that there remained a need to engage with agricultural and environmental agencies in all jurisdictions, non-government organisations and communities to develop a greater acceptance of the shared responsibility for better biosecurity outcomes.

The government was advised to source a high level of scientific expertise and innovation, both nationally and internationally, to ensure that novel and more efficient solutions to new biosecurity threats can be rapidly developed and applied as needed.

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 an incursion occurs, experts are brought together to collate information on a particular pest or pest group, its biology and available control measures. This includes identifying gaps in diagnostics, surveillance and R&D for the pest. Each contingency plan provides guidelines and options for steps to be considered and undertaken when developing a response plan for the pest.

Table 7 (on page 58) provides a list of 101 contingency plans that have been developed to date. These plans make a considerable contribution to Australia's preparedness for serious exotic plant pest threats. Most contingency plans are located on PHA's website in the Pest Information Document Database at **planthealthaustralia.com.au/pidd**

Environmental biosecurity preparedness

Environmental biosecurity is distinct from agricultural biosecurity, which focuses on pests that could have an economic impact on Australia's agricultural productivity. Although distinct, there is 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.

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 used for production pests: preparedness, response, management, and actions taken to address the issues.

In 2019 the development of Environmental Risk Mitigation Plans for Acacia and mangroves were commissioned by the Chief Environmental Biosecurity Officer, with the work being progressed by PHA. The Environmental Risk Mitigation Plan for Australian Acacia Species is the first developed by PHA specifically considering all environmental stakeholders and will provide a template for similar work in the future. In 2019 PHA identified potential biosecurity risks and risk pathways to selected mangrove ecosystems to enable the development of a risk mitigation plan in 2020.

In May and October of 2019, Environmental Biosecurity Roundtables were held in Canberra and Melbourne, respectively. The roundtables are held to facilitate discussion on environmental biosecurity issues, to identify potential solutions to shape future actions and share information. They are an initiative of the Department of Agriculture and the Department of the Environment and Energy.

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 leaf miners	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
Anoplolepis gracilipes, Linepithema humile, Solenopsis invicta and *Wasmannia auropunctata*	Tramp ants – yellow crazy, Argentine, fire and electric ants	2015 draft	DJPR	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	2015	PIRSA	State
Bactericera cockerelli and *Candidatus* Liberibacter solanacearum	Zebra chip complex	2011	Hort Innovation, PHA	National – vegetable and potato industries
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	2010	PHA	National – production nurseries
Brachyponera chinensis, Camponotus pennsylvanicus, Lasius neglectus, Myrmica rubra, Nylanderia fulva, Solenopsis richteri, Tapinoma sessile, Technomyrmex spp. (excluding T. *difficilis* and *T. vitensis* that are already established), *Tetramorium tsushimae*	Asian needle, carpenter, invasive garden, European fire, tawny crazy or raspberry ant, black imported fire, odorous house, white footed (about 100 species) and Japanese pavement ants	2019	QDAF, GIA	National – production nurseries
Braula coeca	Braula fly	2012	PHA	National – honey bee industry
Burkholderia glumae	Panicle blight	2009	PHA	National – rice industry
Candidatus Liberibacter africanus, *Ca.* L. americanus, *Ca.* L. asiaticus, *Diaphorina citri* and *Trioza erytreae*	Huanglongbing and vectors	2009 (under review)	PHA, Hort Innovation	National – citrus and nursery industries
Candidatus Liberibacter africanus, *Ca.* L. americanus, *Ca.* L. asiaticus, *Diaphorina citri* and *Trioza erytreae*	Huanglongbing and vectors	2013	QDAF, GIA	National – production nurseries
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
Cephus cinctus and *Thaumatotibia leucotreta*	Wheat stem sawfly and false codling moth	2015	PHA	National – grains industry

Table 7. Contingency plans (continued)

Scientific name	Common name	Year	Location of document	Scope
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	2002	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 leaf miners	2008	PHA	National – grains industry
Chrysanthemum stem necrosis virus (Tospovirus), *Impatiens necrotic ringspot virus* (Tospovirus), *Pelargonium flower break virus* (Carmovirus) and *Tomato spotted wilt virus* (Tospovirus)	Thrips-transmitted viruses	2011	PHA	National – production nurseries
Colletotrichum truncatum (lentil strain)	Lentil anthracnose	2008	PHA	National – grains industry
Curvularia spicifera (syn. *Bipolaris spicifera)*	Leaf blotch of cereals	2009	PHA	National – grains industry
Daktulosphaira vitifolii	Grape phylloxera	Updated bi-annually	PIRSA	State – viticulture industry
Deanolis sublimbalis	Red banded mango caterpillar	2008	PHA	State
Diatraea spp.	Sugarcane borer	2008	SRA, PHA	National – sugarcane industry
Diuraphis noxia	Russian wheat aphid	2012	PHA	National – grains industry
Dorysthenes buqueti	Sugarcane longhorn stemborer	2009	SRA, PHA	National – sugarcane industry
Echinothrips americanus	Poinsettia thrips	2010	PHA	National – production nuseries
Eldana saccharina	African sugarcane moth borer	2002	SRA	National – sugarcane industry
Eoreuma loftini	Mexican rice borer	2008	SRA, PHA	National – sugarcane industry
Erwinia amylovora	Fire blight	2007	PHA	National – apple and pear industry
Erwinia amylovora	Fire blight	2014	PHA	National – production nurseries
Erwinia papayae	Bacterial crown rot	2011	PHA	National – papaya industry
Eumetopina flavipes	Island sugarcane planthopper	2009	SRA, PHA	National – sugarcane industry
Eurogaster integriceps	Sunn pest	2008	PHA	National – grains industry
Fulmekiola serrata	Oriental sugarcane thrips	2009	SRA, PHA	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	2008	PHA	National – rice industry
Halyomorpha halys	Brown marmorated stink bug	2016	GIA	National – production nurseries

Table 7. Contingency plans (continued)

Scientific name	Common name	Year	Location of document	Scope
Halyomorpha halys	Brown marmorated stink bug	2017	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	2017	PHA, GIA	National – production nurseries
Liriomyza bryoniae, L. cicerina, L. huidobrensis, L. sativa, L. trifolii and *Chromatomyia horticola*	Agromyzid leaf miners	2009	PHA	National
Liriomyza bryoniae, L. huidobrensis, L. sativa, L. trifolii and *Chromatomyia horticola*	Agromyzid leaf miners	2008	QDAF, Hort Innovation	National
Liriomyza huidobrensis	Serpentine leaf miner	2009	PHA	National – production nurseries
Lissachatina fulica (syn. *Achatina fulica*)	Giant African land snail	2015	GIA	National – ornamentals, vegetables, legumes
Lissorhoptrus oryzophilus	Rice water weevil	2009	PHA	National – rice industry
Lygus lineolaris	Tarnished plant bug	2011	PHA	National – production nurseries
Lymantria dispar dispar	Gypsy moth (Asian and European strains)	2009	PHA	National – production nurseries
Magnaporthe grisea	Rice blast	2008	PHA	National – rice industry
Maize dwarf mosaic virus (Potyvirus)	Maize dwarf mosaic virus	2011	PHA	National – grains industry
Mayetiola destructor	Hessian fly	2005	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
Ophiostoma spp.	Dutch elm disease	2016	QDAF, GIA	National – production nurseries
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
Phyllophaga spp.	May beetle	2008	PHA	National – grains industry
Phytophthora ramorum	Sudden oak death	2019	PHA, GIA	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	2009	PHA	National – rice industry
Psila rosae	Carrot rust fly	2009	DPIRD, Hort Innovation	National - vegetable industry

Table 7. Contingency plans (continued)

Scientific name	Common name	Year	Location of document	Scope
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	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, PHA	National – sugarcane industry
Sesamia spp.	Sugarcane and maize borers	2001	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
Tilletia barclayana	Kernel smut of rice	2008	PHA	National – rice industry
Tilletia contraversa	Dwarf bunt of wheat	2007	PHA	National – grains industry
Tilletia indica	Karnal bunt	2006 draft	PHA	National – grains industry
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
Varroa destructor and *V. jacobsoni*	Varroa mites	2012	PHA	National – honey bee industry
Verticillium longisporum	Verticillium wilt of canola	2011	PHA	National – grains industry
Wasmannia auropunctata	Electric ant	2013	QDAF, TACC	State
Xanthomonas translucens pv. *translucens* and *X. translucens* pv. *undulosa*	Bacterial leaf streak	2011	PHA	National – grains industry
Xylella fastidiosa	Pierce's disease	2011	PHA	National – production nurseries
Xylella fastidiosa	Pierce's disease	2016	GIA, QDAF	National – 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

Chapter 3

Plant industry profiles

Image courtesy of Apple and Pear Australia

Plant industry profiles

The following pages profile plant industries that are members of Plant Health Australia, their economic value, and where the major growing regions are for each industry within the states and territories.

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 is up to 2017–18, the latest year for which the data is 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 2017–18.[19]

Each profile also provides details of the industry's key exotic pest threats and the biosecurity initiatives that they have undertaken in 2019. All of these industries are signatories to the Emergency Plant Pest Response Deed, apart from the Australian Blueberry Growers' Association and Passionfruit Australia.

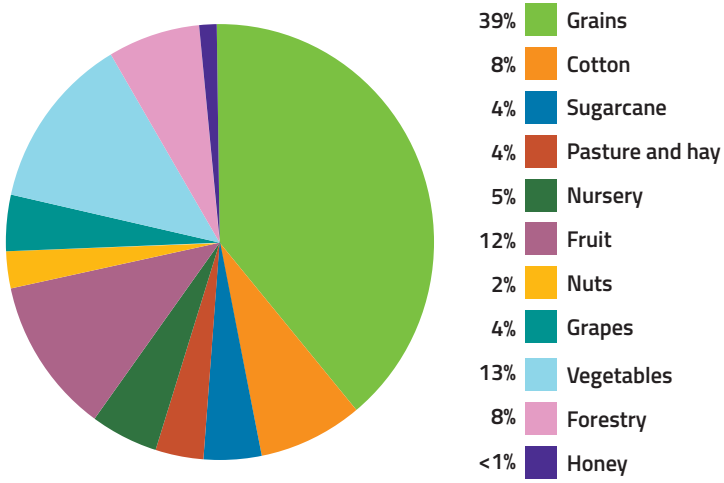
Figure 7 shows the contribution of each of the main plant production industries (including honey and beeswax) to total plant gross value of production in 2017–18 (the latest year for which this breakdown is available).[20] [21]

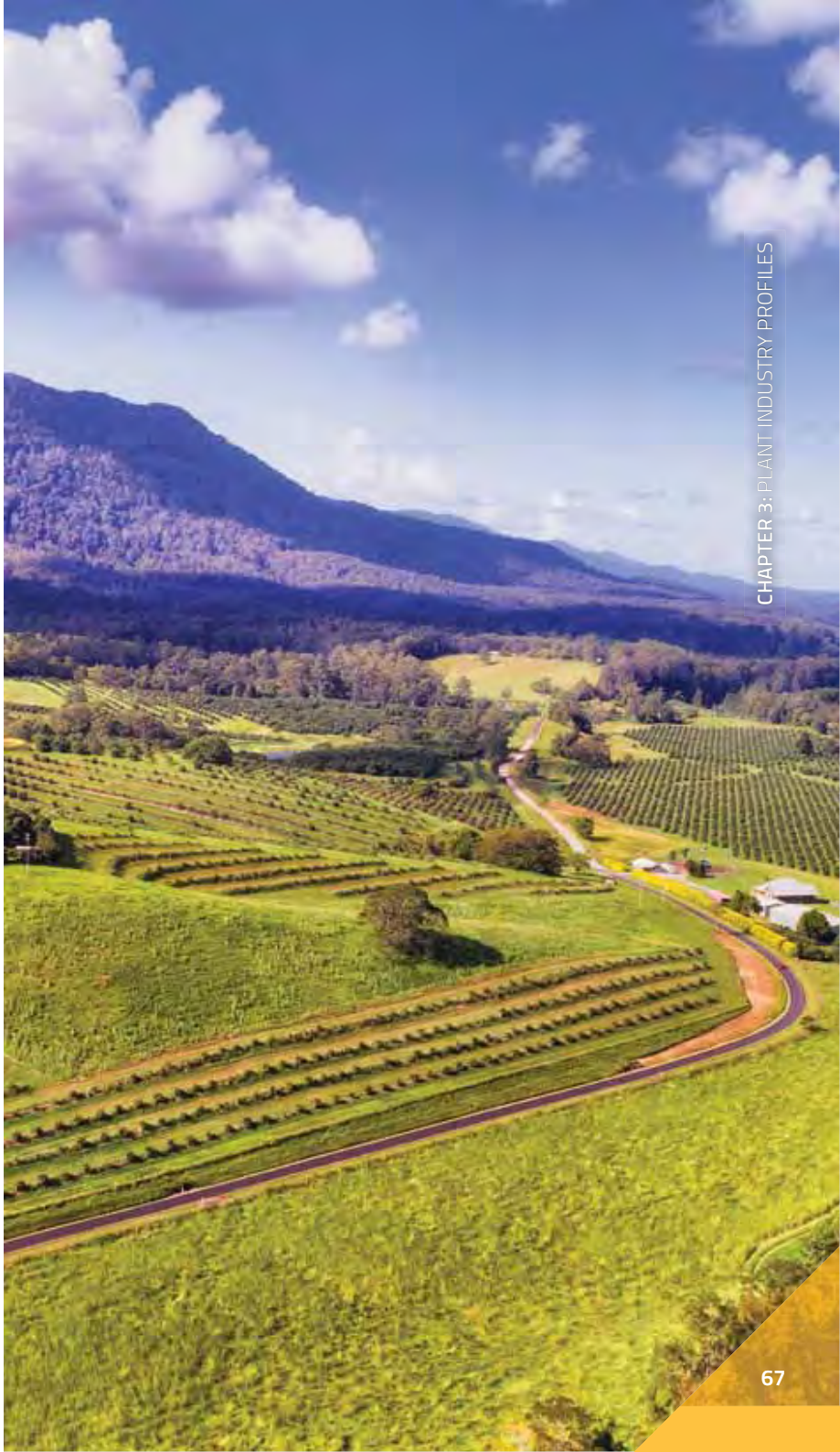
19. Hort Innovation (2019). Australian Horticulture Statistics Handbook 2017–18, Accessed online 12 February 2020

20. Australian Bureau of Agricultural and Resource Economics and Sciences. Agricultural Commodities March Quarter 2020– Statistics. Accessed online 21 April 2020. agriculture.gov.au/abares/research-topics/agricultural-commodities/mar-2020

21. Australian Bureau of Statistics 7503.0 - Value of Agricultural Commodities Produced, Australia, 2017-18. Acesses online 21 April 2020. abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/7503.02017-18?OpenDocument

Figure 7. Comparative value of Australia's plant production industries, based on gross value of production, 2017–18





ALMONDS

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

In 2017–18, almond production was valued at $441 million (LVP), with exports valued at $440 million.

The domestic market for almonds continues to grow strongly at around 10 per cent per year due to an increasing move to plant-based diets and the health benefits of nuts. The industry has focused on export market development, 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 continue to increase rapidly, making it the major destination for Australian almonds.

The industry has been expanding rapidly since 2016 with an additional 20,000 hectares being planted, bringing the total industry orchard area to 50,000 hectares. The orchards are concentrated along the Murray Valley in Victoria (53%), SA (21%), and NSW (24%), with an orchard in WA (2%).

The 2019 production was 104,000 tonnes, however when current plantings reach full maturity the industry's productive capacity will be approximately 160,000 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 more than 200,000 hives required during the pollination season. The almond blossoms provide one of the first natural sources of food for bees each spring.

Table 8. High Priority Pests of the almond industry

Scientific name	Common name
Amyelois transitella	Navel orangeworm
Chinavia hilaris (syn. *C. hilare*)	Green stink 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
Tropilaelaps mercedesae	Tropilaelaps mite
Varroa destructor	Varroa mite
Verticillium dahliae (exotic defoliating strain)	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 Michael Holmes

Figure 8. Annual value of almond production, 2007–18

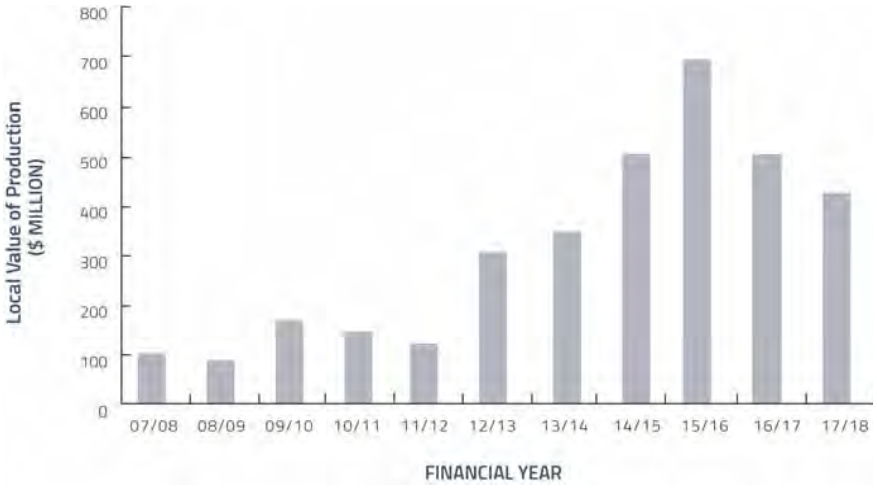


Figure 9. Distribution of almond production by state and territory, 2017–18 (based on LVP)

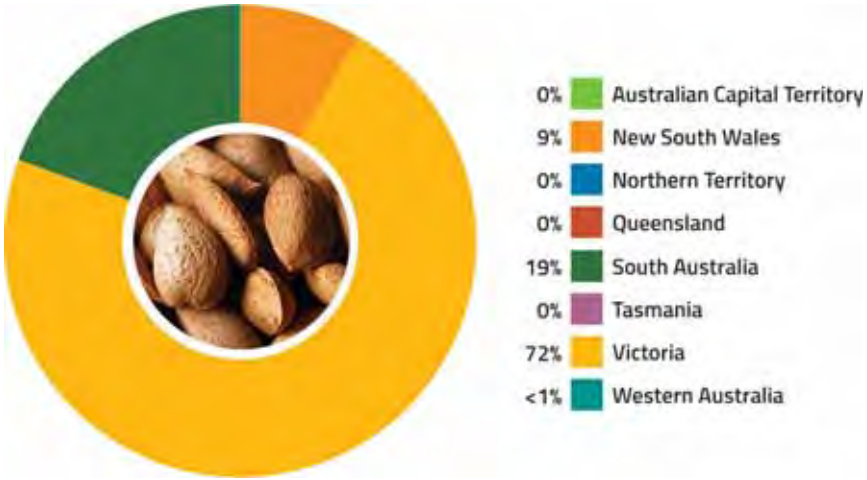


Image courtesy of Apple and Pear Australia

APPLES AND PEARS

Represented by Apple and Pear Australia
apal.org.au

In 2017–18, apple and pear production was valued at $494 million (LVP), with exports valued at $31 million. The total planted area was 9,375 hectares for apples 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, with the remainder of the gross production 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 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.

Table 9. High Priority Pests of the apple and pear industry

Scientific name	Common name
Bactrocera dorsalis (syn. *B. invadens, B. papayae, B. philippinensis*)	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	Spotted wing drosophila
Dysaphis plantaginea	Rosy apple aphid
Erwinia amylovora	Fire blight
Halyomorpha halys	Brown marmorated stink bug
Lymantria dispar	Asian gypsy moth
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 (syn. *Monilia polystroma*)	Asiatic brown rot
Neonectria ditissima (syn. *N. galligena and Nectria galligena*)	European canker
Rhagoletis pomonella	Apple maggot
Tropilaelaps clareae	Tropilaelaps mite
Tropilaelaps mercedesae	Tropilaelaps mite
Varroa destructor	Varroa mite

Figure 10. Annual value of apple and pear production, 2007–18

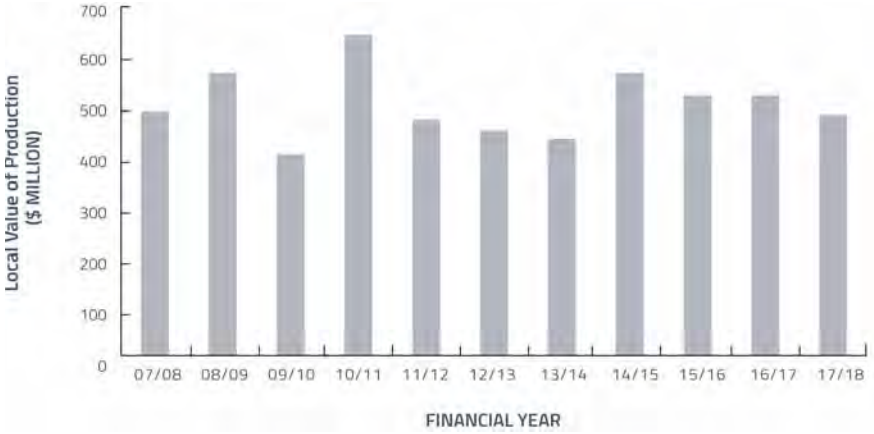


Figure 11. Distribution of apple and pear production by state and territory, 2017–18 (based on LVP)

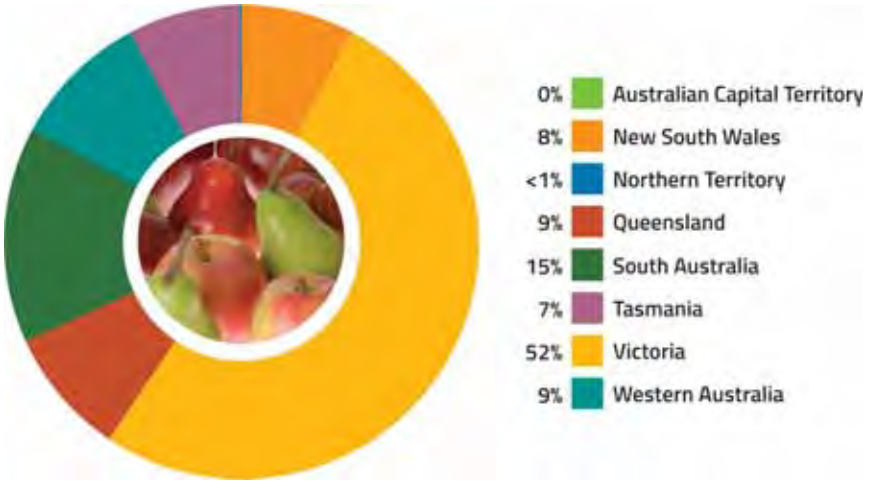


Image courtesy of Avocados Australia

AVOCADOS

Represented by Avocados Australia
avocado.org.au

In 2017–18, avocado production was valued at $350 million (LVP), with exports valued at $11.6 million, which were mainly shipped to Malaysia and Singapore.

Australians' love of avocados has grown steadily each year since the 1990s. Consumption in 2018–19 reached 3.8 kilograms per person, up from 1.2 kilograms in 1997–98.

Queensland dominates Australia's avocado production, followed by WA, NSW, SA and Victoria, with a small amount of production in Tasmania and one known orchard in the NT. 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 81 per cent production, with Shepard accounting for about 16 per cent. Other varieties such as Reed, Sharwil, Gwen, Wurtz and Fuerte make up the balance.

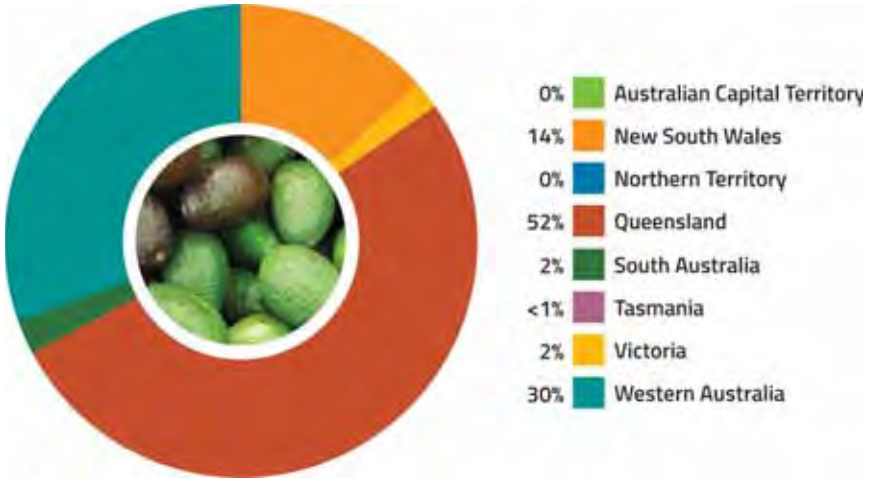
Avocado leaf and flower spike. Image courtesy of Avocados Australia

Table 10. High Priority Pests of the avocado industry

Scientific name	Common name
Avocado sunblotch viroid (asymptomatic strains)	Avocado sunblotch
Avocado sunblotch viroid (symptomatic strains)	Avocado sunblotch
Bactrocera carambolae	Carambola fruit fly
Bactrocera dorsalis (syn. *B. invadens, B. papayae, B. philippinensis*)	Oriental fruit fly
Bactrocera facialis	Tropical fruit fly, Tongan fruit fly
Bactrocera kandiensis	Fruit fly
Bactrocera kirki	Fijian fruit fly
Bactrocera melanotus	Fruit fly, Cook Islands fruit fly
Bactrocera passiflorae	Fijian fruit fly
Bactrocera xanthodes	Pacific fruit fly
Conotrachelus aguacatae	Small avocado seed weevil
Conotrachelus perseae	Small seed weevil
Erwinia herbicola (exotic strains)	Avocado blast
Heilipus lauri	Large seed weevil
Oligonychus persea	Persea mite
Phytophthora kernoviae	Phytophthora blight
Phytophthora mengei	Trunk canker
Phytophthora ramorum	Sudden oak death
Pseudomonas syringae pv. *syringae* (exotic races)	Bacterial canker
Raffaelea lauricola	Laurel wilt
Scirtothrips perseae	Avocado thrips
Sphaceloma perseae	Avocado scab
Stenoma catenifer	Avocado seed moth
Xanthomonas campestris (avocado strain)	Bacterial canker
Zeugodacus curcubitae (syn. *Bactrocera cucurbitae*)	Melon fruit fly

Figure 12. Annual value of avocado production, 2007–18

Figure 13. Distribution of avocado production by state and territory, 2017–18 (based on LVP)



BANANAS

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

In 2017–18, banana production was valued at $434 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 2019 there were two major biosecurity threats challenging the banana industry:

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

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 the Queensland Department of Agriculture and Fisheries (QDAF), by the end of 2019, the disease was 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. The ABGC and QDAF are working collaboratively to determine how the Panama TR4 Program will function into the future.

A control program for banana bunchy top virus has been operating in NSW and south-east Queensland since 2009. The ABGC is delivering Phase 4 of the project to contain the virus to a limited area through targeted surveillance and destruction of infected plant material to supress the incidence of bunchy top disease on commercial farms. The project also aims to increase the responsibility of growers to manage their own bunchy top disease on farms.

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 and other banana diseases in the north Queensland commercial production area and work with growers to assist them to control the disease.

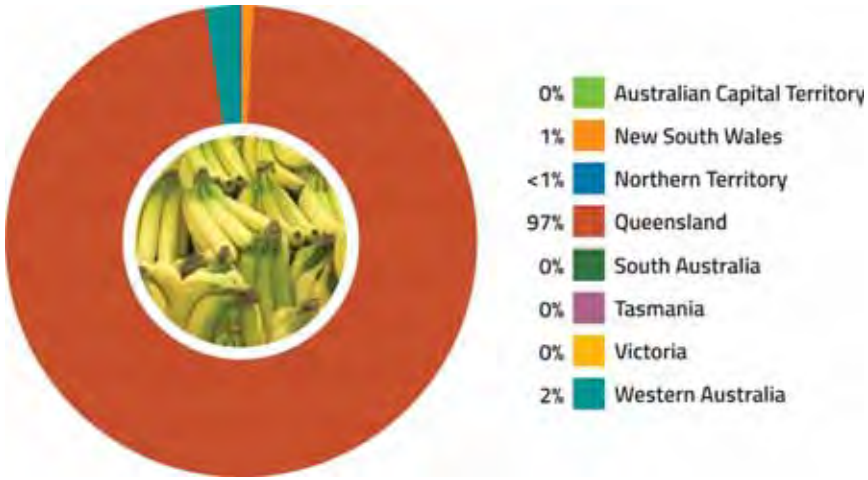
The ABGC also employs two staff members who have a combined responsibility for coordinating biosecurity related research and development as well as strategy development and implementation.

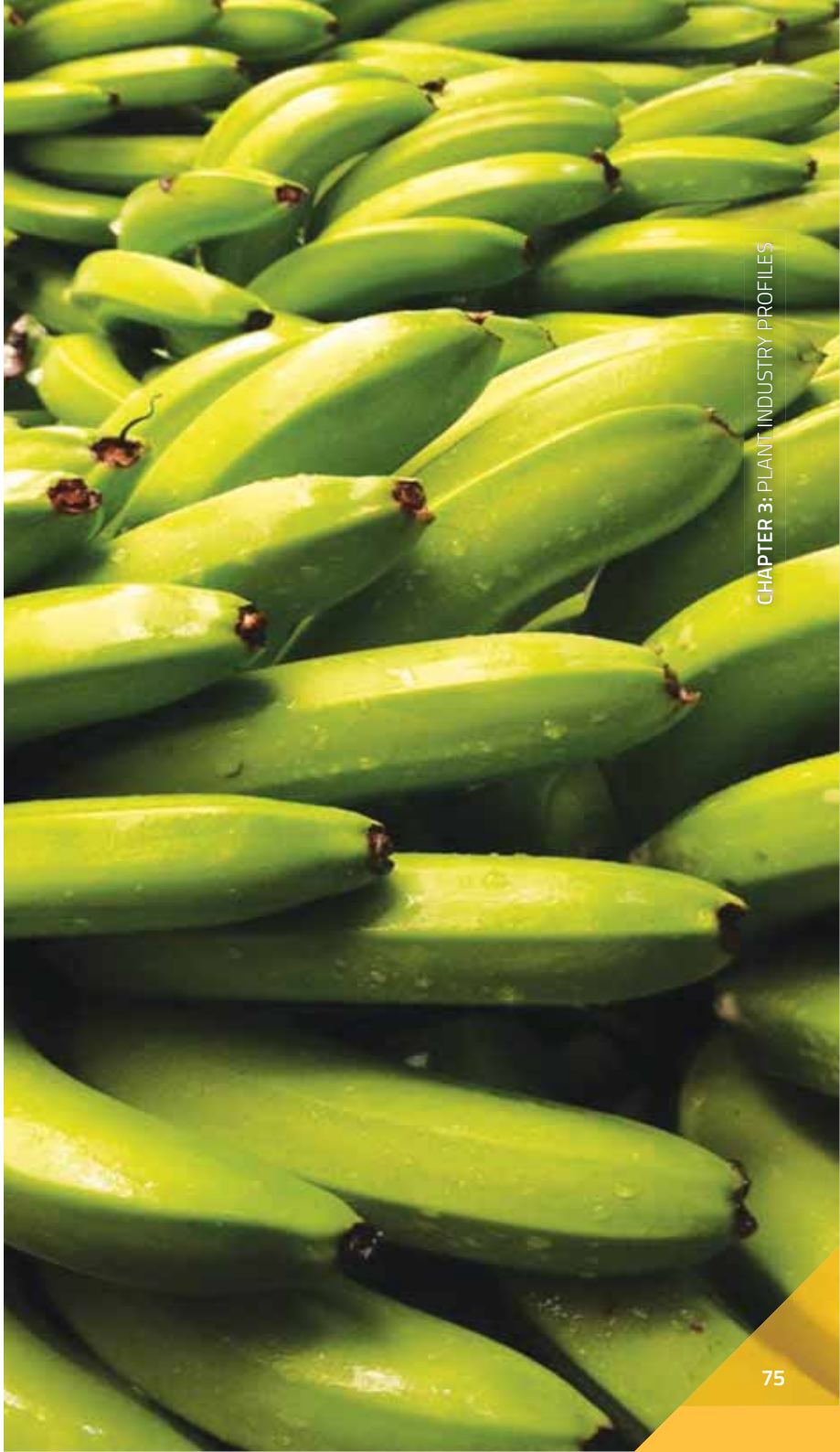
Table 11. High Priority Pests of the banana industry

Scientific name	Common name
Abaca bunchy top virus (Babuvirus)	Abaca bunchy top virus
Bactrocera dorsalis (syn. *B. invadens, B. papayae, B. philippinensis*)	Oriental fruit fly
Banana bunchy top virus (Babuvirus) (Asian subgroup)	Bunchy top
Dysmicoccus neobrevipes	Grey pineapple mealybug
Erionata thrax	Banana skipper butterfly
Frankliniella invasor	Thrips
Fusarium oxysporum f. sp. *cubense* (exotic vegetative compatibility groups)	Fusarium wilt, Panama disease
Lissachatina fulica (syn. *Achatina fulica*)	Giant African snail
Mycosphaerella eumusae	Eumusae leaf spot
Phyllosticta spp. including *P. cavendishii, P. sydowiana*	Banana freckle
Pseudocercospora fijiensis (syn. *Mycosphaerella fijiensis*)	Black Sigatoka
Pseudococcus jackbeardsleyi	Jack Beardsley mealybug
Ralstonia solanacearum phylotype IIB (banana infecting strains)	Moko
Ralstonia syzygii subsp. *celebesensis* (syn. *R. solanacearum* race 2, biovar 1)	Blood disease
Rastrococcus invadens	Mango mealybug
Rastrococcus spinosus	Mango mealybug
Teranychus piercei	Spider mite

Figure 14. Annual value of banana production, 2007–18

Figure 15. Distribution of banana production by state and territory, 2017–18 (based on LVP)





BLUEBERRIES

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

In 2017–18, blueberry production was valued at approximately $244 million (LVP). The industry is expanding, with an average 15,000 tonnes of blueberries being produced per annum. The majority of blueberries are consumed domestically, with less than five per cent exported to markets including Hong Kong, Singapore and Thailand.

Around 300 growers produce blueberries on more than 2,500 hectares in all states. The major production area 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.

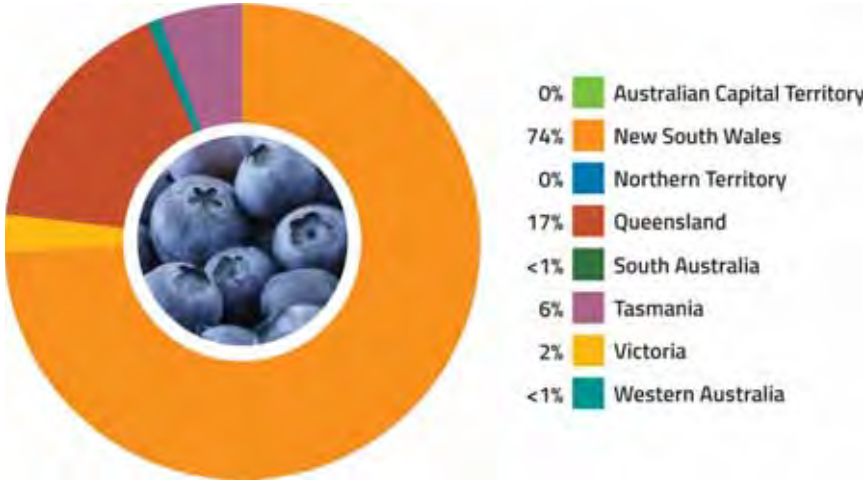
There are three varieties of blueberries grown in Australia: northern highbush, southern highbush and rabbiteye. Northern highbush are grown in the cooler climate areas such as Victoria, Tasmania and the southern highlands of NSW, whereas southern highbush and rabbiteye varieties are grown in NSW and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

Figure 16. Annual value of blueberry production, 2011–18

Table 12. 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, cotton ball disease
Phytophthora ramorum	Sudden oak death
Xylella fastidiosa (subsp. not specified)	Pierce's disease, blueberry leaf scorch, olive leaf scorch, olive quick decline, phony peach, plum leaf scald

Figure 17. Distribution of blueberries production by state and territory, 2017–18 (based on LVP)



CANNED FRUITS

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

In 2017–18 production of canned fruit was valued at $19.3 million (LVP), with exports valued at $6.7 million.

Fruit production of the varieties represented by Canned Fruits Industry Council of Australia (apples, apricots, peaches, pears and plums) occurs 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 Valley 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 has developed plans and manuals for the pome fruit (apple and pear) and stone fruit (summerfruit) industries with PHA and governments.

Image courtesy of the Canned Fruits Industry Council of Australia

Figure 18. Annual value of canned fruit production, 2007–2018

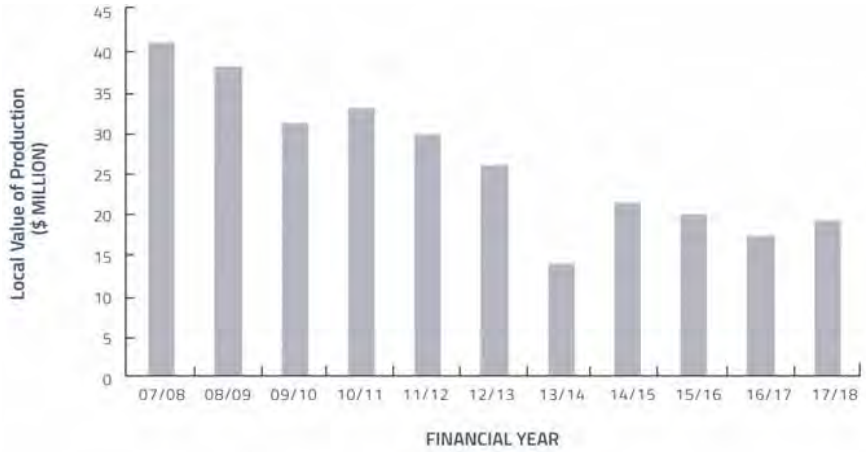


Figure 19. Distribution of canned fruit production by state and territory, 2017–18 (based on LVP)

CHERRIES

Represented by Cherry Growers Australia
cherrygrowers.org.au

In 2017–18 production of cherries was valued at $159 million (LVP), and exports were valued at $62.2 million. National production in 2018–19 reached approximately 16,000 tonnes, of which 32 per cent was exported. Production 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 focusing 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 an 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 over the past two years, with approximately 90 growers (greater than 2,000 hectares) registered for protocol markets. National expansion is underpinned by ongoing research and strong biosecurity principles.

Table 13. High Priority Pests of the cherry industry

Scientific name	Common name
Bactrocera dorsalis (syn. *B. invadens, B. papayae, B. philippinensis*)	Oriental fruit fly
Drosophila suzukii	Spotted wing drosophila
Halyomorpha halys	Brown marmorated stink bug
Homalodisca vitripennis (syn. *H. coagulata*)	Glassy winged sharpshooter
Monilinia fructigena	Brown rot
Neonectria ditissima (syn. *N. galligena* and *Nectria galligena*)	European canker
Planotortrix octo	Greenheaded leaf roller
Plum pox virus (Potyvirus)	Plum pox virus, sharka
Xylella fastidiosa (subsp. not specified)	Pierce's disease, blueberry leaf scorch, olive leaf scorch, olive quick decline, phony peach, plum leaf scald

Figure 20. Annual value of cherry production, 2007–18

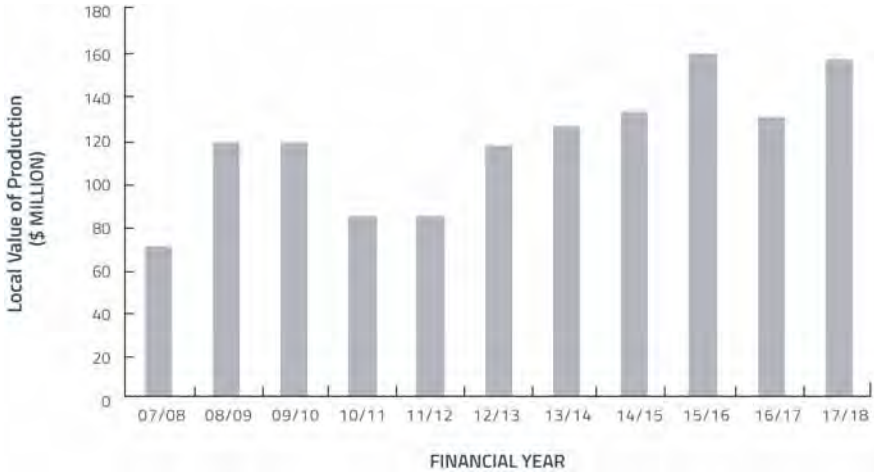
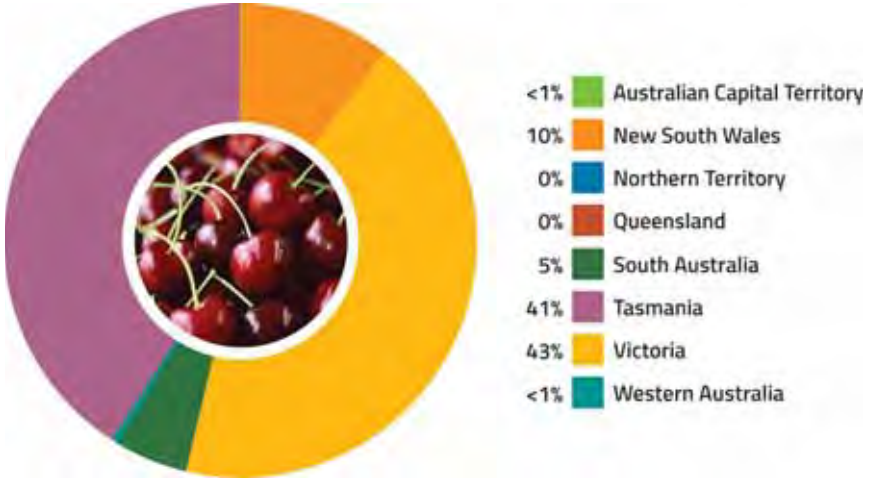


Figure 21. Distribution of cherry production by state and territory, 2017–18 (based upon LVP)



CHESTNUTS

Represented by Chestnuts Australia
chestnutsaustralia.com.au

In 2017–18 chestnut production was valued at $9.4 million (LVP).

Around 1,480 hectares are planted with 275,000 chestnut trees. In 2019, approximately 1,100 tonnes of chestnuts were produced. It is estimated that with more trees being planted in NSW, production will increase to approximately 1,300 tonnes with a value of $12 million by 2021. The industry is primarily focused on the domestic market with approximately two per cent exported, mainly to Asian markets.

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, and are grown primarily in Victoria and NSW.

Throughout 2019, 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 and the National Management Group. More about the response to chestnut blight is in Chapter 6.
The Australian chestnut industry is fortunately 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 tree 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.

Table 14. 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 22. Annual value of chestnut production, 2009–18

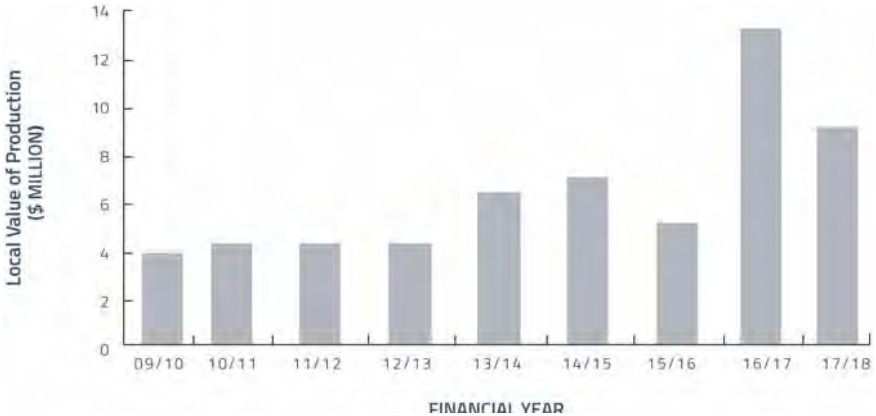
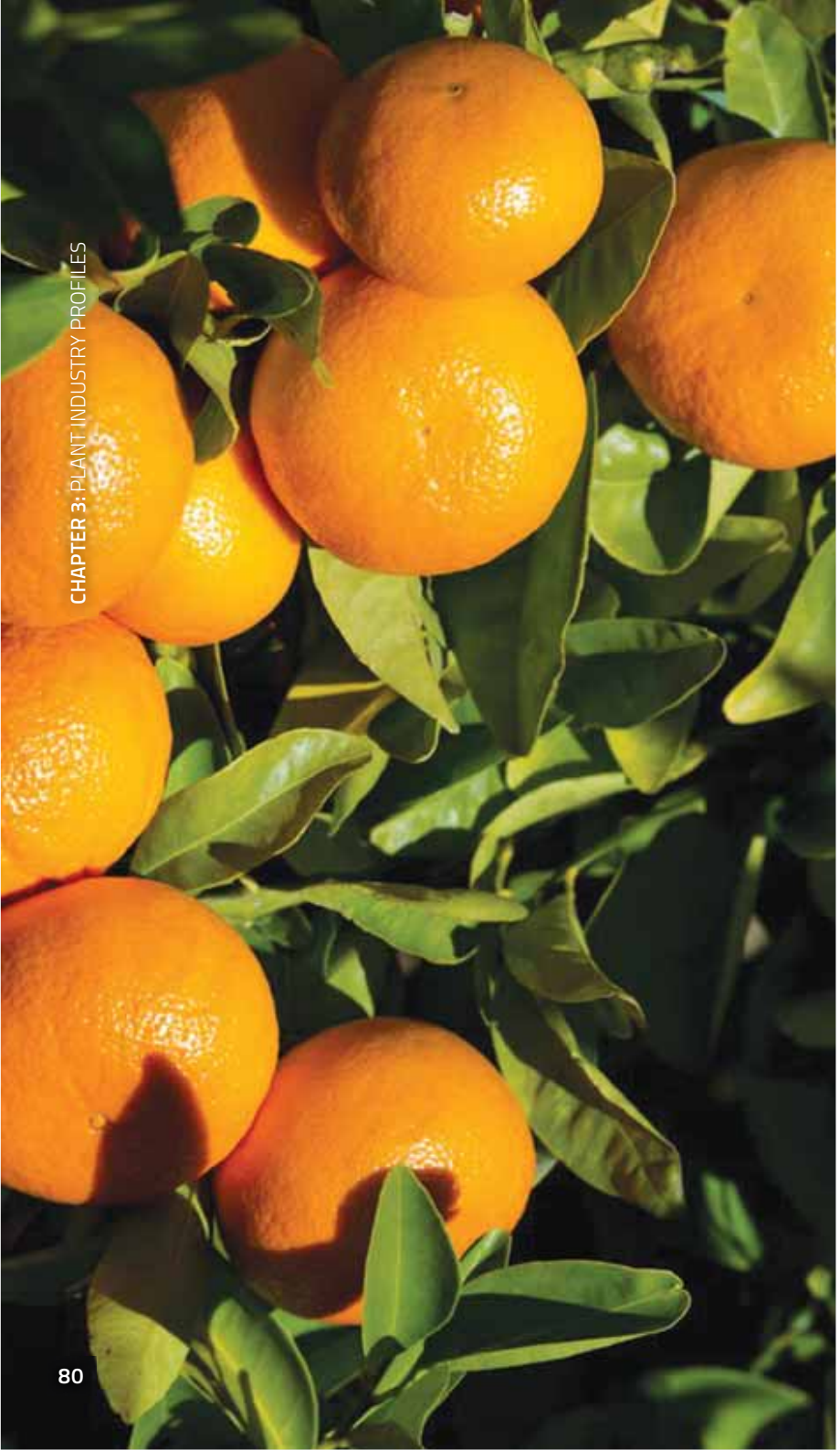


Figure 23. Distribution of chestnut production by state and territory, 2017–18 (based on LVP)



CITRUS

Represented by Citrus Australia
citrusaustralia.com.au

In 2017–18 production of oranges, mandarins, lemons, limes and grapefruit was valued at $786 million (LVP), with exports valued at $428 million.

The citrus industry is Australia's largest fresh fruit exporting industry by volume, with major export markets in 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 the far north of Queensland; Riverland in SA; the Murray Valley in Victoria–NSW and the Midlands and south-west of WA. There are a small number of commercial orchards in Darwin and the Katherine region of the NT.

A 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.

In 2019, Citrus Australia formed a Citrus Pest and Disease Prevention Committee as a result of growing concern from industry following the 2018 citrus canker outbreak in the NT and north-west WA. The objective is to prepare industry for future exotic plant pest responses.

The citrus industry is supported by a biosecurity plan, the Biosecurity Manual for Citrus Producers Version and the National Citrus Biosecurity Surveillance Strategy 2018–28
See page 207 for information about the National Citrus Biosecurity Program.

Table 15. High Priority Pests of the citrus industry

Scientific name	Common name
Anastrepha ludens	Mexican fruit fly
Bactrocera carambolae	Carambola fruit fly
Bactrocera dorsalis (syn. *B. invadens, B. papayae, B. philippinensis*)	Oriental fruit fly
Bactrocera kandiensis	Fruit fly
Bactrocera occipitalis	Fruit fly, Bezzi fruit fly
Bactrocera trivialis	New Guinea fruit fly
Caliothrips fasciatus	Bean thrips
Candidatus Liberibacter africanus	Huanglongbing (African strain)
Candidatus Liberibacter americanus	Huanglongbing (American strain)
Candidatus Liberibacter asiaticus	Huanglongbing (Asiatic strain)
Citripestis sagittiferella	Citrus fruit borer
Citrus leprosis virus (unassigned)	Citrus leprosis disease
Citrus tristeza virus (Closterovirus) (mandarin stem-pitting strain)	Mandarin stem-pitting
Diaphorina citri	Asian citrus psyllid
Frankliniella bispinosa	Florida flower thrips
Homalodisca vitripennis (syn. *H. coagulata*)	Glassy winged sharpshooter
Spiroplasma citri	Stubborn
Thaumatotibia leucotreta (syn. *Cryptophlebia leucotreta*)	False codling moth
Trioza erytreae	African citrus psyllid
Xanthomonas citri subsp. *citri* (syn. *X. axonopodis* pv. *citri*)	Citrus canker
Xylella fastidiosa subsp. *pauca*	Pierce's disease, blueberry leaf scorch, olive quick decline

Figure 24. Annual value of citrus production, 2007–18

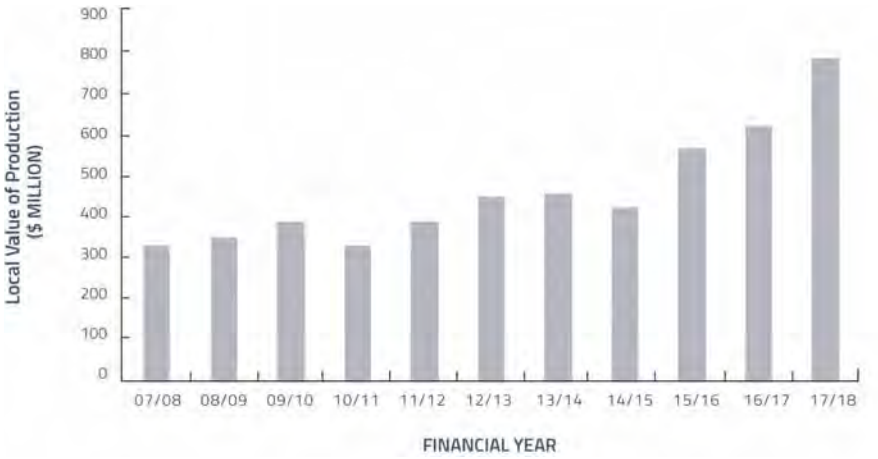
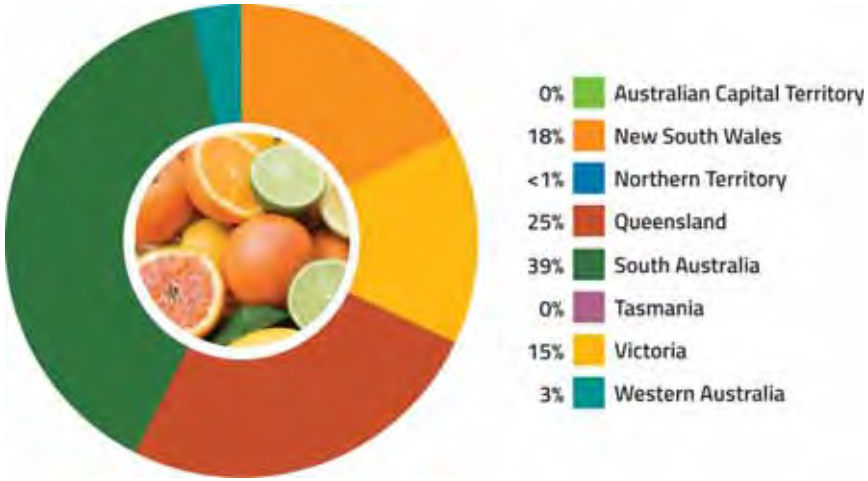


Figure 25. Distribution of citrus production by state and territory, 2017–18 (based on LVP)



COTTON

Represented by Cotton Australia
cottonaustralia.com.au

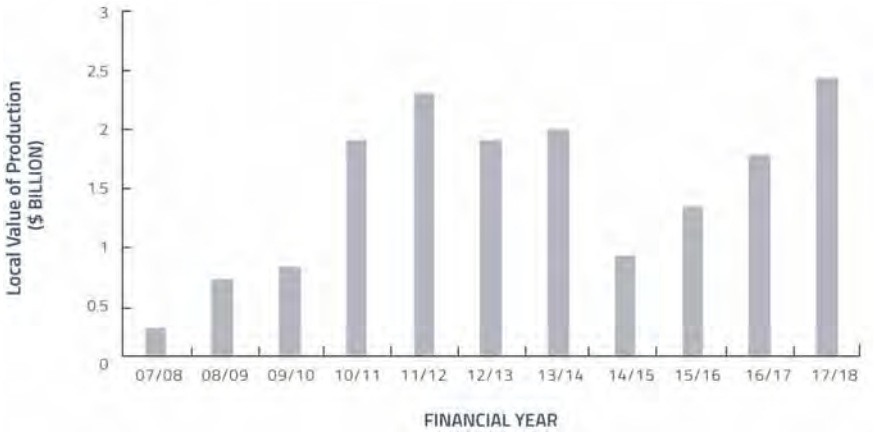
In 2017–18, cotton production was valued at $2.5 billion (LVP). The cotton industry is an integral part of the Australian economy, worth on average more than $2 billion per annum. Almost the entire Australian cotton crop is exported, with the majority sold to China and the remainder mainly to spinning 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 price on the world market. Australian cotton yields are high by international standards, at nearly three times the world average. [22]

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.

Figure 26. Annual value of cotton production, 2007–18

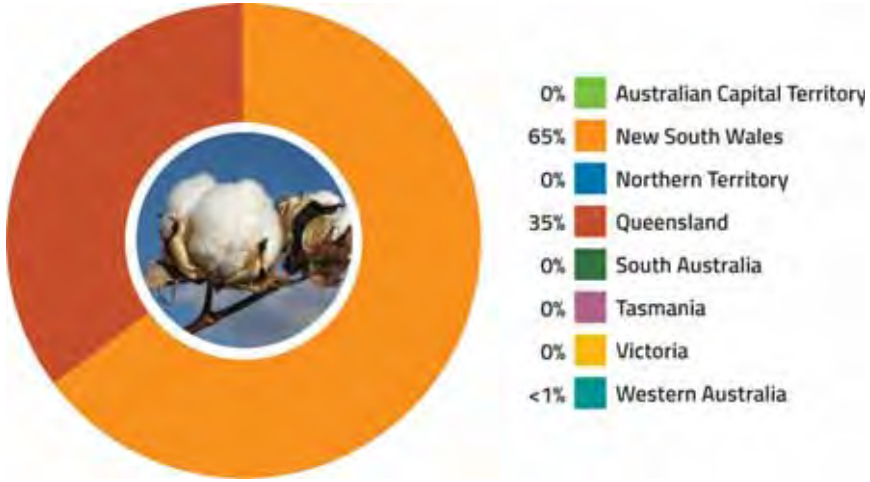


22. Cotton Australia (2018). Australian Cotton Industry Statistics

Table 16. High Priority Pests of the cotton industry

Scientific name	Common name
Anthonomus grandis	Boll weevil
Cotton leaf curl virus complex (Begomovirus)	Cotton leaf curl disease
Cotton leafroll dwarf virus (Polerovirus)	Cotton blue disease
Dysdercus spp. (including *D. honestus, D. maurus, D. suturellus* (American species)	Cotton stainer
Fusarium oxysporum f. sp. *vasinfectum* (exotic races)	Fusarium wilt
Helicoverpa armigera (carrying Bt resistance alleles)	Cotton bollworm
Lygus hesperus	Western plant bug
Lygus lineolaris	Tarnished plant bug
Spodoptera frugiperda	Fall armyworm
Thaumatotibia leucotreta (syn. *Cryptophlebia leucotreta*)	False codling moth
Verticillium dahliae (defoliating strain)	Verticillium wilt
Xanthomonas citri subsp. *malvacearum* (syn. *X. axonopodis* pv. *malvacearum*)	Bacterial blight, angular leaf spot

Figure 27. Distribution of cotton production by state and territory, 2017–18 (based on LVP)



DRIED FRUITS (GRAPES)

Represented by Dried Fruits Australia
driedfruitsaustralia.org.au

In 2017–18, dried grape production (sultana types, currants and raisins) had an estimated value of $34 million (LVP) with exports valued at $19.8 million. The 2020 crop is estimated to be 15,000 tonnes. Export sales of dried vine fruits to Europe and Asia are expected to increase to 5,000 or more tonnes in coming years. In Australia, grapes for the dried fruit industry are predominantly grown in the Sunraysia region which spans north western Victoria and south-western NSW around the Murray River, and also in the SA Riverland.

The dried fruit industry regularly distributes biosecurity information and guidelines from PHA to its members via a quarterly publication, The Vine, and through the email newsletter Currant News. The viticulture biosecurity manual has been distributed to growers of dried fruit through the major industry processors. The industry also undertakes Emergency Plant Pest Response training in order to understand the roles and responsibilities of their officers in the event of a pest incursion.

During 2019, producers voted to introduce a biosecurity levy to enable the dried vine fruits industry value chain to be a contributing participant in national biosecurity related activities and projects such as surveillance and emergency scenarios.

Table 17. High Priority Pests of the dried fruit industry

Scientific name	Common name
Bactrocera carambolae	Carambola fruit fly
Bactrocera dorsalis (syn. *B. invadens, B. papayae, B. philippinensis*)	Oriental fruit fly
Candidatus Phytoplasma solani	Bois noir
Daktulosphaira vitifoliae (exotic strains)	Grapevine phylloxera
Drosophila suzukii	Spotted wing drosophila
Grapevine flavescence dorée phytoplasma	Flavescence dorée
Guignardia bidwellii	Black rot
Homalodisca vitripennis (syn. *H. coagulata*)	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 (subsp. not specified)	Pierce's disease, blueberry leaf scorch, olive leaf scorch, olive quick decline, phony peach, plum leaf scald

Figure 28. Annual value of dried fruit production, 2007–18

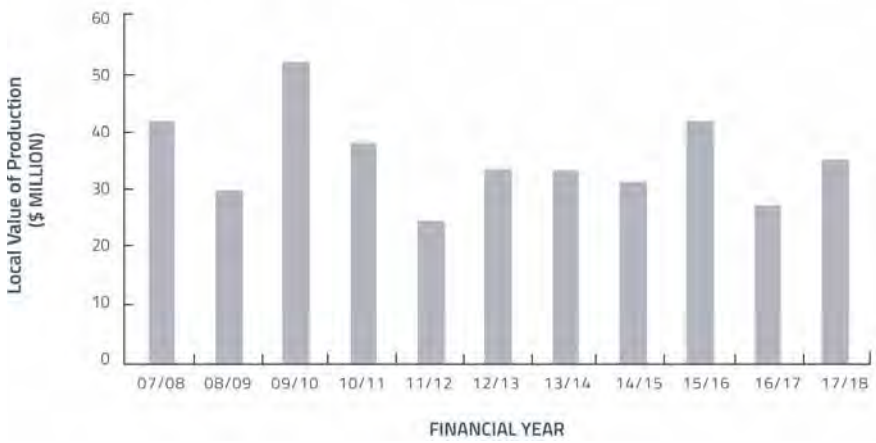
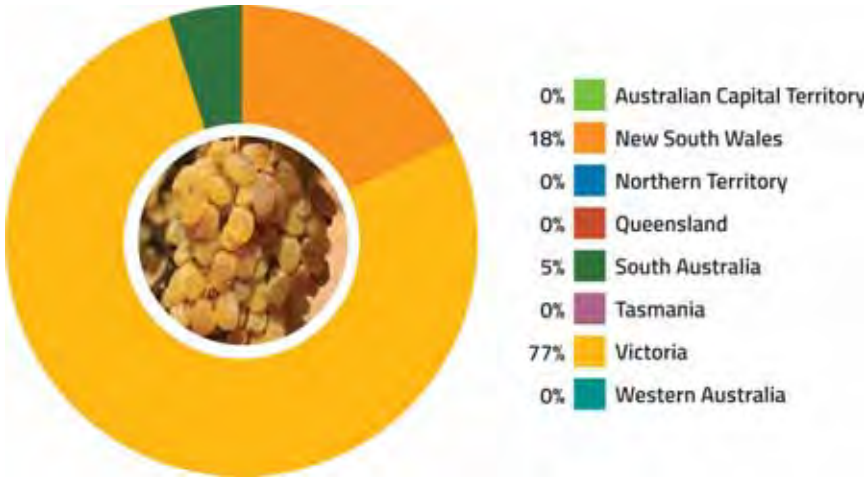


Figure 29. Distribution of dried fruit production by state and territory, 2017–18 (based on LVP)



FORESTRY

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

In 2017–18, plantation forestry production was valued at $2.3 billion (LVP),[23] with wood product exports valued at $3.6 billion. 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 131 million hectares of native forest on public and private land and two million hectares of plantation forestry.

Of this 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.

Currently, a funding partnership between the Department of Agriculture 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 (see page 154).

The forestry industry developed the plantation forest biosecurity plan, the Biosecurity Manual for the Plantation Timber Industry and the National Forest Biosecurity Surveillance Strategy 2018–23.

Table 18. High Priority Pests of the plantation forestry industry

Scientific name	Common name
Austropuccinia psidii sensu lato (exotic variants) (syn. *Puccinia psidii*)	Myrtle rust, guava rust, Eucalyptus rust
Bursaphelenchus spp. including *B. xylophilus*	Pinewood nematode species complex
Chrysoporthe austroafricana	Eucalyptus canker disease
Coptotermes formosanus	Formosan subterranean termite
Coptotermes gestroi	Asian subterranean termite
Dendroctonus ponderosae	Mountain pine beetle
Dendroctonus valens	Red turpentine beetle
Endocronartium harknessii	Western gall rust
Fusarium circinatum	Pitch canker
Hylesia nigricans	Burning moth
Ips typographus	Spruce bark beetle
Lymantria dispar	Asian gypsy moth
Lymantria monacha	Nun moth
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
Teratosphaeria gauchensis	Coniothyrium eucalyptus canker
Teratosphaeria zuluensis	Coniothyrium eucalyptus canker
Tomicus piniperda	Pine shoot beetle
Urocerus gigas	Giant wood wasp

Figure 30. Annual value of plantation forestry production, 2007–18

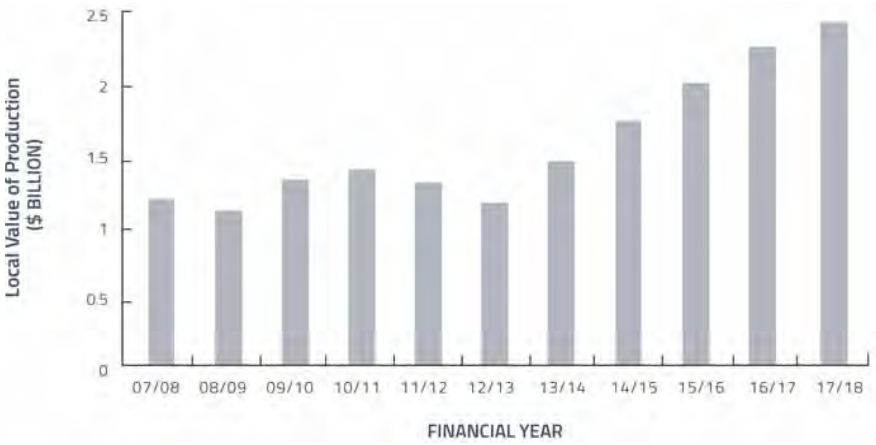
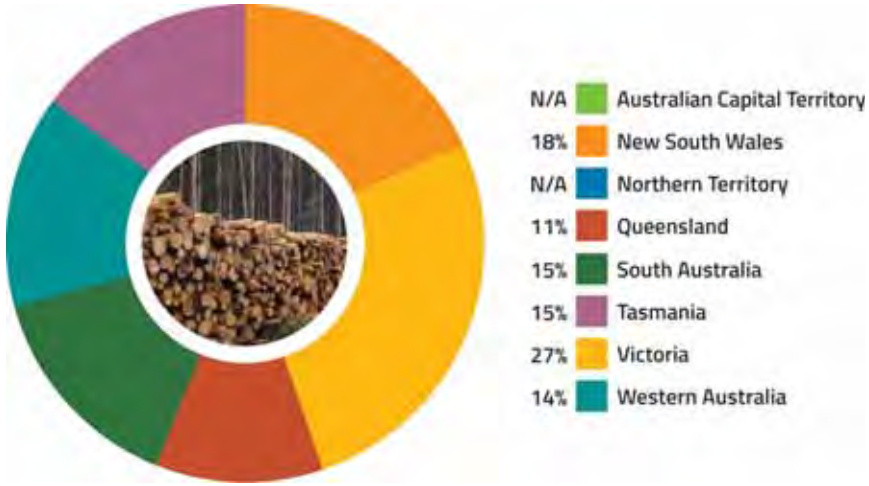


Figure 31. Distribution of plantation forestry production by state and territory, 2017–18 (based on LVP) [24]



23. Forestry LVP data consists of hardwood (plantation) and softwood logs

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

GINGER

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

In 2017–18, ginger production was valued approximately $55 million. Land under cultivation was about 270 hectares, producing around 9,850 tonnes of ginger.

Production takes place in Australia's subtropical and tropical regions and there are approximately 50 commercial ginger growers, most of them based in Queensland. Key Queensland growing districts are Gatton, Glasshouse Mountains, Beerwah, Yandina, Mary Valley, Maryborough and Bundaberg. Growers can also be found in northern NSW and far north Queensland.

There are two varieties grown commercially: Jumbo (also known as Canton) and Queensland, with 25 per cent sold to the processing sector and 75 per cent sold to the fresh market. Currently no ginger is exported.

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

Figure 32. Annual value of ginger production, 2010–18

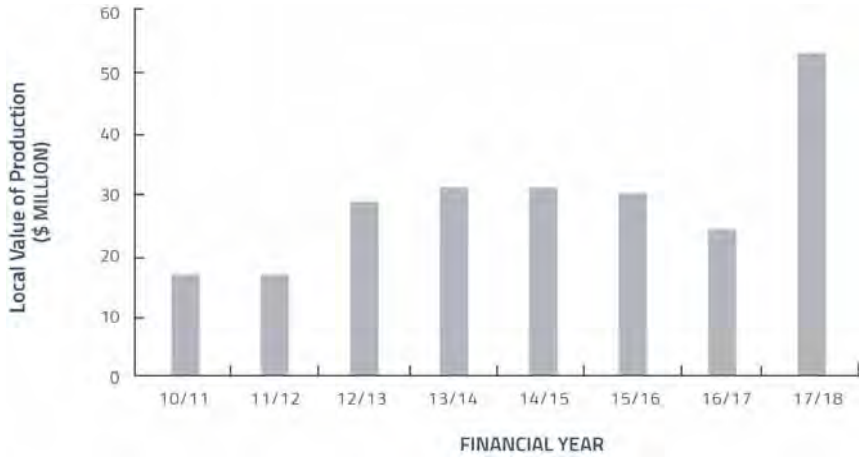


Table 19. High Priority Pests of the ginger industry

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

Figure 33. Distribution of ginger production by state and territory, 2017–18 (based on LVP)

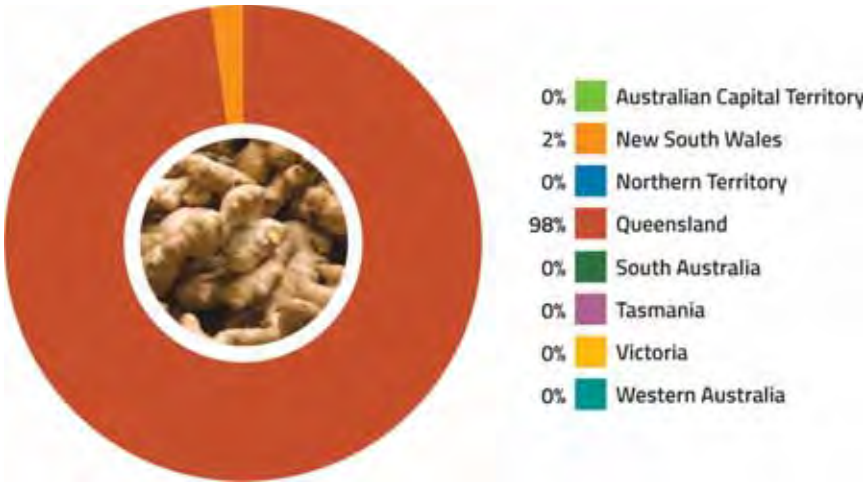


Image courtesy of the Australian Ginger Industry Association

GRAINS

Represented by Grain Producers Australia
grainproducers.com.au

In 2017–18, grain production was valued at $11.4 billion with exports valued at $11.14 billion. The grains industry accounted for 21 per cent of Australian agriculture's gross value of production and 23 per cent of agriculture's export income, making it Australia's largest plant industry.[25]

Most of Australia's grain is produced across the region known as the wheat belt, which stretches from central Queensland through NSW, Victoria, Tasmania, SA and southern WA. Due to the wide-ranging soil types 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 domestic and overseas).

Grain Producers Australia (GPA) funds a biosecurity outreach program, the Grains Farm Biosecurity Program, managed by PHA and delivered by grains biosecurity officers in each grain producing state. The program raises awareness to help improve practices on farm and boost preparedness to manage biosecurity threats. See more on page 206.

Throughout 2019, the grain industry through GPA worked with PHA to develop a strategy for post border grain biosecurity. The program will focus on surveillance and building capacity to respond to potential biosecurity threats. It is expected to be implemented in 2020.

The grains industry developed a biosecurity plan, the Biosecurity Manual for Grain Producers, the Farm Biosecurity Manual for the Organic Grains Industry, and the National Grain Biosecurity Surveillance Strategy 2019–29.

Image courtesy of WA Grains Biosecurity Officer, Jeff Russell

Figure 34. Annual value of grains production, 2007–18

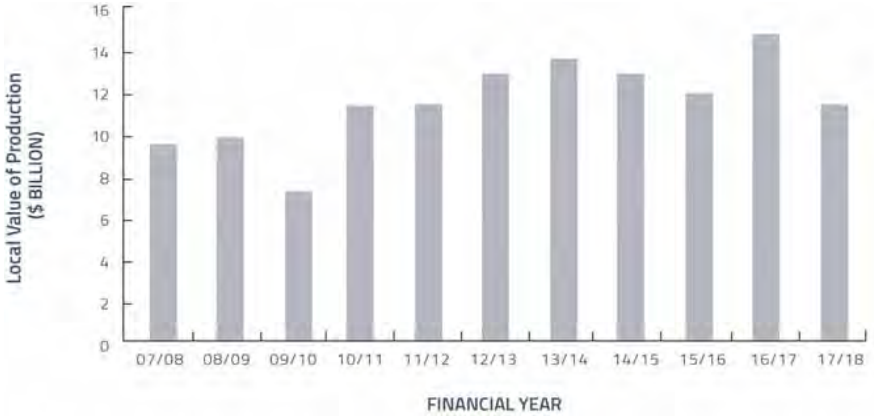
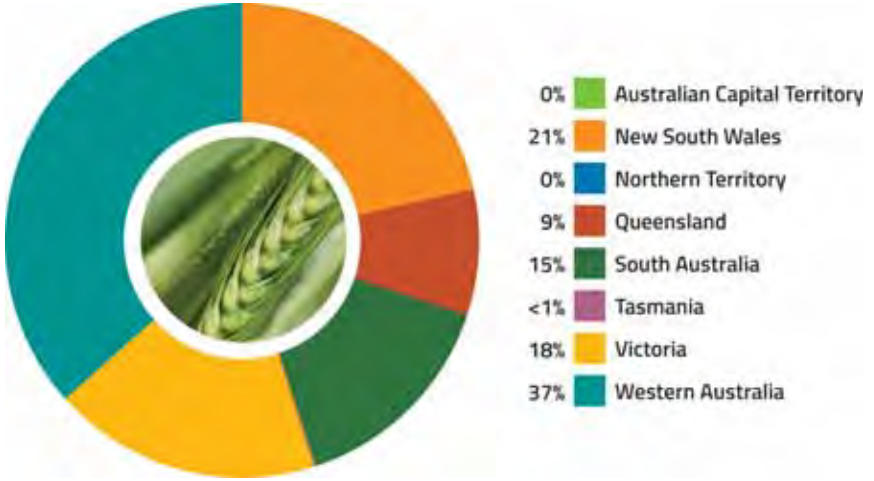


Figure 35. Distribution of grains production by state and territory, 2017–18 (based on LVP)



25. Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra. Agricultural Commodities December Quarter 2019 – Statistics. Accessed online 11 February 2020 agriculture.gov.au/sites/default/files/documents/Agricultural-Commodities-December-2019.pdf

Table 20. High Priority Pests of the grains industry

Scientific name	Common name
Ascochyta rabiei (exotic mating types)	Ascochyta blight
Barley mild mosaic virus (Bymovirus)	Barley mild mosaic virus
Bean common mosaic virus (Potyvirus), peanut stripe strain	Bean common mosaic virus
Cephus cinctus	Wheat stem sawfly
Cephus pygmeus	European wheat stem sawfly
Ceutorhynchus assimilis (syn. *C. obstrictus*)	Cabbage seedpod weevil
Ceutorhynchus napi	Rape stem weevil
Ceutorhynchus pallidactylus	Cabbage stem weevil
Chickpea chlorotic dwarf virus (Mastrevirus)	Chickpea chlorotic dwarf virus
Chickpea chlorotic stunt virus (Polerovirus)	Chickpea chlorotic stunt virus
Chilo orichalcociliellus	Coastal stem borer
Chilo partellus	Spotted stem borer
Colletotrichum truncatum (lentil affecting strain)	Lentil anthracnose
Cylindrocopturus adspersus	Sunflower stem weevil
Diabrotica barberi	Northern corn rootworm
Diabrotica undecimpunctata	Southern corn rootworm
Diabrotica virgifera	Western corn rootworm
Diaporthe helianthi	Sunflower stem canker
*Diuraphis noxia**	Russian wheat aphid
Eurygaster integriceps	Sunn pest
Fusarium oxysporum f. sp. *ciceris*	Fusarium wilt of chickpea
Fusarium oxysporum f. sp. *glycines*	Fusarium wilt of soybean
Fusarium oxysporum f. sp. *lupini*	Fusarium wilt of lupin
Fusarium virguliforme	Sudden death syndrome
Groundnut bud necrosis virus (Tospovirus)	Bud necrosis disease
Groundnut ringspot virus (Tospovirus)	Groundnut ringspot virus
Harpophora maydis	Late 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
Homoeosoma electellum	Sunflower moth
Magnaporthe grisea	Rice blast
Mayetiola destructor	Hessian fly
Mayetiola hordei	Barley stem gall midge
Mungbean yellow mosaic virus (Begomovirus)	Mungbean yellow mosaic virus
Nysius huttoni	Wheat bug
Pantoea stewartii	Stewart's wilt of maize
Peanut clump virus (Pecluvirus)	Peanut clump virus
Peronosclerospora philippinensis	Philippine downy mildew of maize
Peronosclerospora sorghi	Downy mildew of sorghum
Plasmopara halstedii	Downy mildew of sunflower
Prostephanus truncatus	Larger grain borer
Puccinia graminis f. sp. *tritici* (exotic pathogenic races)	Stem rust of wheat
Puccinia striiformis f. sp. *hordei*	Barley stripe rust
Rhizoctonia solani f. sp. *sasakii* (AG1) teleomorph *Corticium sasakii* (syn. *Thanatephorus cucumeris*)	Banded leaf and sheath spot
Riptortus dentipes	Pod sucking bug
Schizaphis graminum	Greenbug
Soil-borne wheat mosaic virus (Furovirus)	Soil-borne wheat mosaic virus
Thaumatotibia leucotreta (syn. *Cryptophlebia leucotreta*)	False codling moth
Tilletia indica	Karnal bunt
Trogoderma granarium	Khapra beetle
Zea mosaic virus (Potyvirus)	Zea mosaic virus

**established in Australia*

HAZELNUTS

Represented by Hazelnut Growers of Australia
hazelnuts.org.au

In 2017–18, hazelnut production was valued at $3.7 million (LVP).

The industry has expanded, with major on-farm investment from a northern hemisphere confectionary manufacturer giving renewed confidence to Australian growers. Approximately 1.3 million trees are planted on 2,500 hectares, with approximately 350 tonnes of hazelnuts produced in 2019. 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 3,300 tonnes of hazelnut product annually, primarily from Turkey. Imported produce is mainly in kernel form for use by mass market confectioners.

In 2019, 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 (2015–20) and the industry peak body is represented at PHA meetings and government Biosecurity Roundtables.

Table 21. High Priority Pests of the hazelnut industry

Scientific name	Common name
Anisogramma anomala	Eastern filbert blight, hazelnut blight
Chinavia hilaris (syn. *C. hilare*)	Green stink bug
Halyomorpha halys	Brown marmorated stink bug
Lymantria dispar	Gypsy moth (Asian and European strains)
Phytophthora ramorum	Sudden oak death

Figure 36. Annual value of hazelnut production, 2010–18

Figure 37. Distribution of hazelnut production by state and territory, 2017–18 (based on LVP)

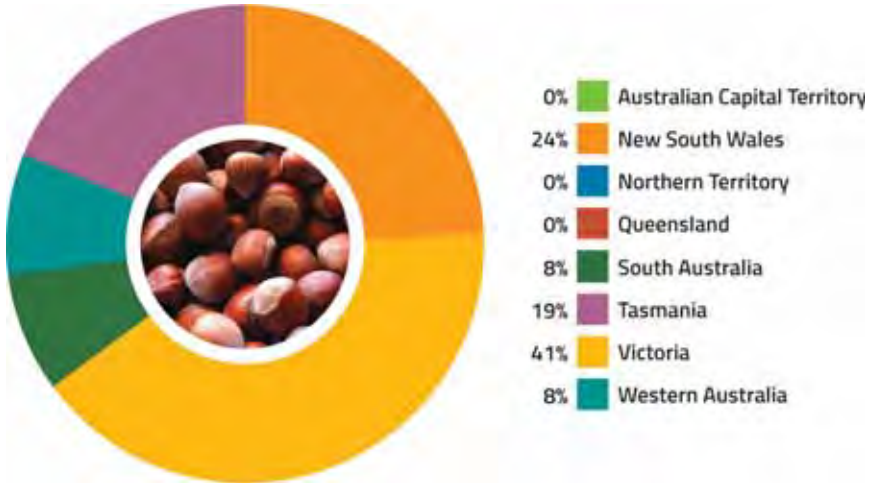


Image courtesy of the Hazelnut Growers of Ausrralia Inc

HONEY BEES

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

In 2017–18, honey and beeswax production was valued at $126 million (LVP).

Around 30,000 registered beekeepers operate nearly 669,000 hives. Of these, 1,868 operate commercially with 50 or more hives. Apiaries range in size from one hive to several thousand.

The industry has products other than honey. Australia exports live bees 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 miticides used overseas to treat Varroa mites.

Australia's bees are further valued for their pollination services. The economic value of managed and feral honey bees as pollinators was estimated to lie between $8.35 to $19.97 billion in 2014–15.[26]

AHBIC works in partnership with other industries and governments to protect the health of bees with several biosecurity initiatives. One is 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. More about this government and industry partnership is on page 154.

Another was to work with PHA and state and territory governments to develop the Australian Honey Bee Industry Biosecurity Code of Practice, which was endorsed nationally 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.

The honey bee industry also funds the National Bee Biosecurity Program, a partnership between industry and government, which employees Bee Biosecurity Officers (BBO) in all Australian states. BBOs provide training and education to help beekeepers to implement biosecurity measures and ensure they are complying with the Code of Practice and relevant legislation (see page 207).

Following the detection of Varroa mites *(Varroa jacobsoni)* on Asian honey bees in Townsville in June 2016, the Australian Government Department of Agriculture established the National Varroa Mite Eradication Program, of which AHBIC has been a part. No bees or Varroa mites associated with this incident in Townsville have been found since November 2016.

Suspect Varroa mites *(Varroa jacobsoni)* were again detected on Asian honey bees at the Port of Townsville in May 2019. Genetic testing of bees indicated that it was a new incident. AHBIC has been involved with the eradication of this second detection, which is expected to move to Proof of Freedom Phase in February 2020.

26. Karasinski, J (2018). The economic valuation of Australian managed and wild bee pollinators in 2014–15 Curtin University. Accessed online 12 February 2020 aussiepollination.com.au

Figure 38. Annual value of honey bee and beeswax production, 2007–18

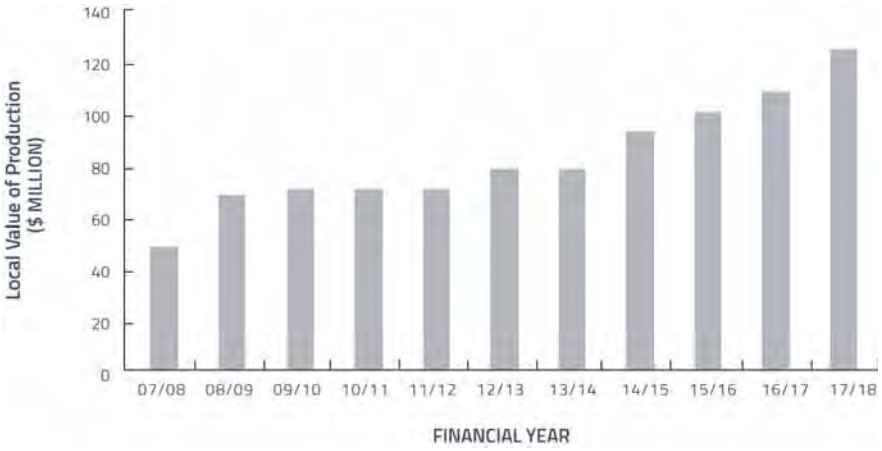


Figure 39. Distribution of honey and beeswax production by state and territory, 2017–18 (based on LVP)

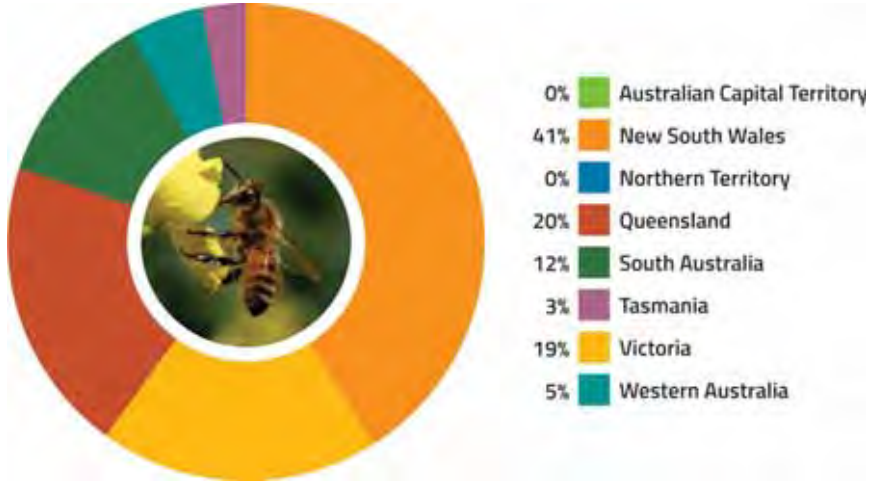


Table 22. High Priority Pests of the honey bee industry

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

LYCHEES

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

In 2017–18, lychee production of 2,733 tonnes was valued at $24 million (LVP), with 466 tonnes exported valued at $5.2 million.

Higher volumes of lychee exports occur during the lead up to the Chinese New Year. Kwai Mai Pink is the preferred export variety due to availability, taste, quality and price. Salathiel, with a good flesh to seed ratio, is in high demand in Singapore and yields good returns for growers willing to persist with this variety. Exports of Australian lychees to the United States are increasing each year, with 10 tonnes exported in the 2018–19 season. This figure is expected to double in the 2019–20 season.

The new Chinese varieties of Chompogo, Erdon Lee and Baitangying are now appearing in the domestic markets: even though quantities are small, these varieties will continue to increase as current plantings mature.

Following the 2016 signing of the memorandum of understanding between the Australian Department of Agriculture and Taiwan Agriculture Research Institute, six Taiwanese lychee varieties have now been planted on an orchard in central Queensland. This is a long-term project, as it will be a number of years before Taiwan is able to apply for Plant Breeder's Rights for these new varieties.

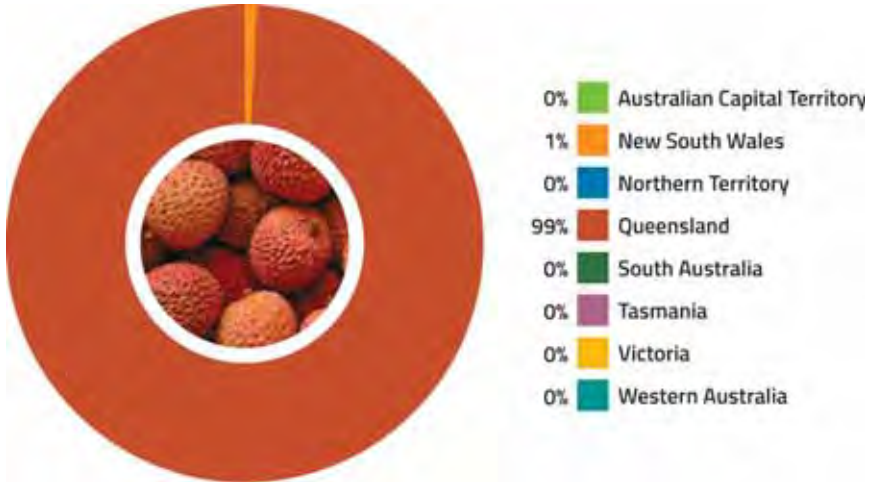
Lychees are produced as a single annual crop with the harvest period from late October (north Queensland) to March (northern NSW). This gives the Australian lychee season one of the world's longest production period, as well as a counter-seasonal supply to most other lychee producing countries.

Table 23. High Priority Pests of the lychee industry

Scientific name	Common name
Aristobia testudo	Lychee longicorn beetle
Bactrocera dorsalis (syn. *B. invadens, B. papayae, B. philippinensis*)	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 40. Annual value of lychee production 2009–18

Figure 41. Distribution of lychee production by state and territory, 2017–18 (based on LVP)



MACADAMIAS

Represented by the Australian Macadamia Society
australian-macadamias.org

In 2017–18, macadamia production was valued at $242 million (LVP) with exports valued at $266 million. Annual macadamia production has more than tripled in the last 10 years. The export value of the Australian industry grew by 23 per cent in the 12 months to June 2019.

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, South Africa and Kenya are currently the world's largest producers of macadamia. China, the rest of Africa and South America are also significant producers. There are now approximately 800 macadamia growers with 28,000 hectares of crop 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. Collectively Bundaberg and the Northern Rivers region produce more than 75 per cent of the Australian crop. Production is growing fastest in Bundaberg in Queensland and the Clarence Valley in NSW. New plantings are also being developed in Mackay and Maryborough in Queensland and in the Richmond and Clarence Valleys in NSW.

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 being funded through Hort Innovation, and the society recently distributed over 500 farm biosecurity signs to macadamia growers. The macadamia industry is also one of the contributors to the Varroa mite incursion response being managed by the Queensland Government.

Table 24. 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
Tropilaelaps 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 42. Annual value of macadamia production 2007–18

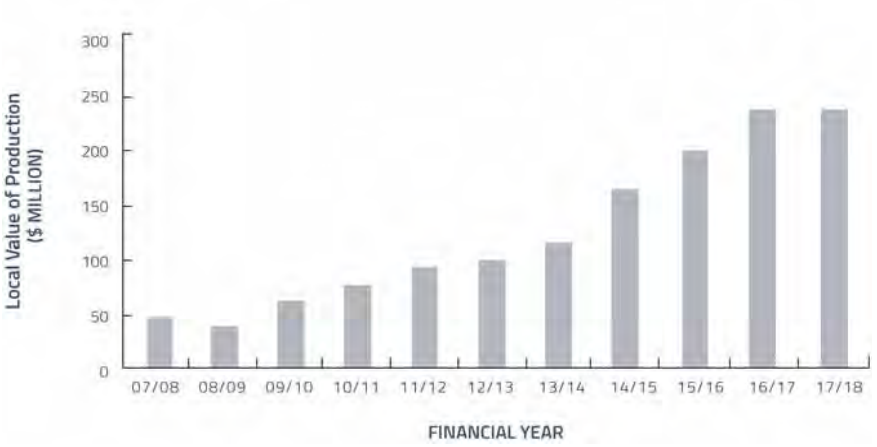
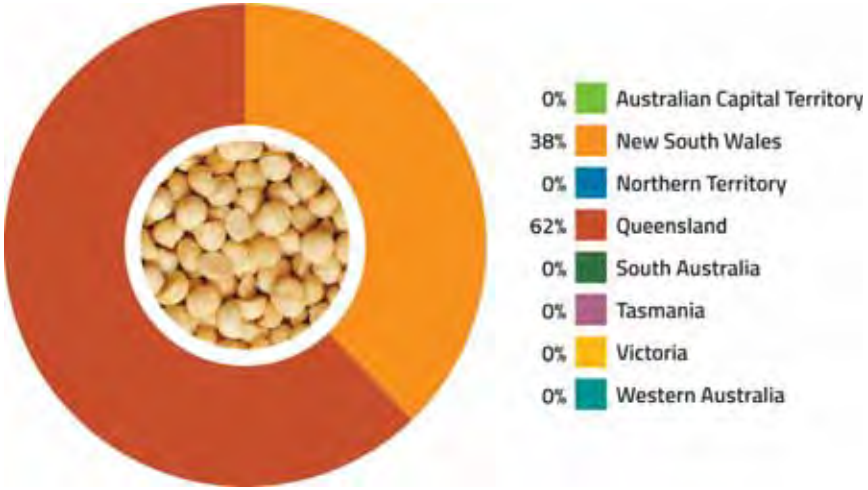


Figure 43. Distribution of macadamia production by state and territory, 2017–18 (based on LVP)



MANGOES

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

In 2017–18, mango production was valued at $127 million (LVP), with exports valued at $28.7 million.

Over the last four years the average production volume has been 70,000 tonnes per year. 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. Most mangoes are grown in Queensland and the NT with smaller but significant production in regions throughout WA.

An Industry Development Officer is part-funded through the PHA levy to promote and facilitate biosecurity practices in the mango industry. In 2019 the mango industry updated their biosecurity plan with PHA and governments.

Figure 44. Annual value of mango production, 2007–18

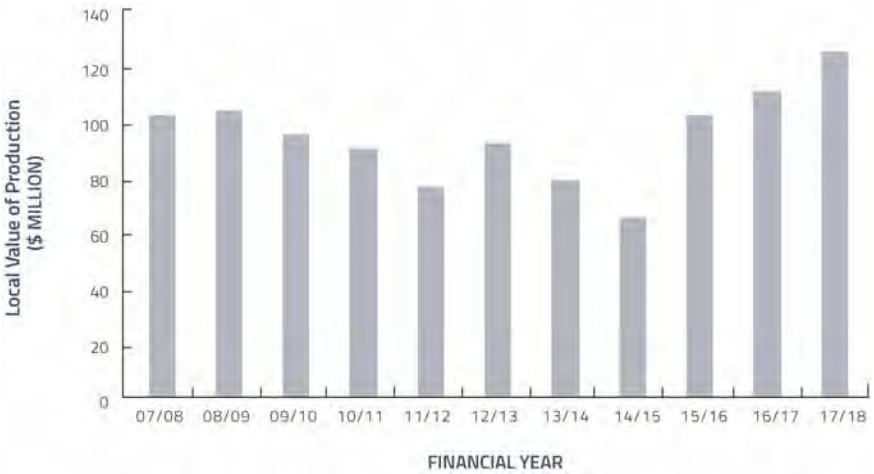


Figure 45. Distribution of mango production by state and territory, 2017–18 (based on LVP)

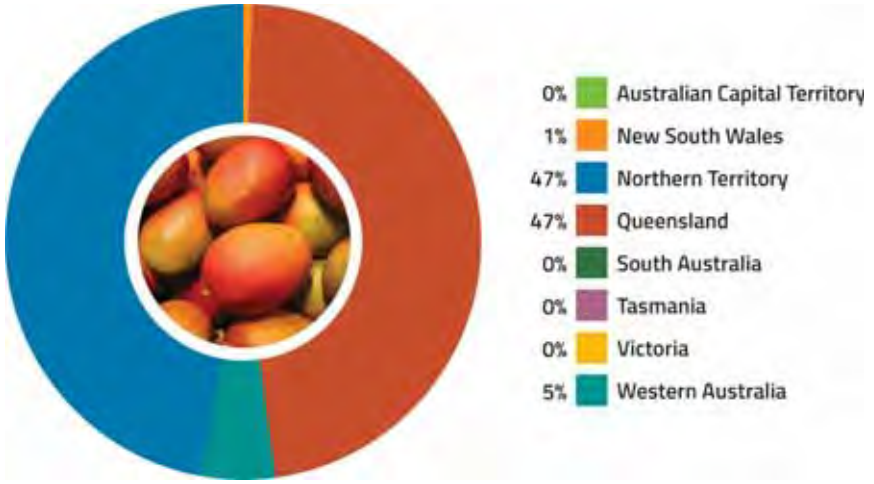


Table 25. High Priority Pests of the mango industry

Scientific name	Common name
Acanthocoris scabrator	Squash bug
Aleurocanthus woglumi	Citrus blackfly
Amritodus atkinsoni	Mango leafhopper
Anastrepha obliqua	West Indian fruit fly
Bactrocera albistrigata	White striped fruit fly
Bactrocera carambolae	Carambola fruit fly
Bactrocera correcta	Guava fruit fly
Bactrocera curvipennis	Banana fruit fly
Bactrocera dorsalis (syn. *B. invadens, B. papayae, B. philippinensis*)	Oriental fruit fly
Bactrocera facialis	Tropical fruit fly, Tongan fruit fly
Bactrocera kandiensis	Fruit fly
Bactrocera kirki	Fijian fruit fly
Bactrocera melanotus	Fruit fly, Cook Islands fruit fly
Bactrocera occipitalis	Fruit fly, Bezzi fruit fly
Bactrocera passiflorae	Fijian fruit fly
Bactrocera psidii	South Sea guava fruit fly
Bactrocera trilineola	Vanuatu fruit fly
Bactrocera trivialis	New Guinea fruit fly
Bactrocera tuberculata	Fruit fly
Bactrocera xanthodes	Pacific fruit fly
Bactrocera zonata	Peach fruit fly
Batocera rubus	Lateral-banded mango longhorn beetle
Batocera rufomaculata	Red-spotted longhorn beetle
Ceratocystis fimbriata sensu lato	Mango sudden decline syndrome, Ceratocystis blight
Ceratocystis manginecans	Mango sudden decline syndrome
Chlumetia transversa	Mango shoot borer
Dasineura amaramanjarae	Mango gall midge
Deanolis sublimbalis (syn. *Noorda albizonalis*)	Red-banded mango caterpillar
Hypocryphalus dilutus	Ambrosia beetle
Idioscopus nagpurensis	Mango leafhopper
Parasa lepida	Blue-striped nettle grub
Procontarinia allahabadensis	Mango gall midge
Procontarinia fructiculi	Gall midge
Procontarinia frugivora	Mango fruit gall midge
Procontarinia mangiferae (syn. *Dasineura mangiferae, Erosomyia mangiferae, E. indica, Mangodiplosis mangiferae, Rhabdophaga mangiferae*)	Mango blossom gall midge
Procontarinia matteiana	Mango leaf gall midge
Procontarinia pustulata	Mango leaf gall midge
Procontarinia schreineri	Mango gall midge
Rastrococcus invadens	Mango mealybug
Rhipiphorothrips cruentatus	Grapevine thrips
Sternochetus frigidus	Mango pulp weevil
Thaumatotibia leucotreta (syn. *Cryptophlebia leucotreta*)	False codling moth
Toxotrypana curvicauda (syn. *Anastrepha curvicauda*)	Papaya fly
Xylosandrus compactus	Black twig borer
Zeugodacus curcubitae (syn. *Bactrocera cucurbitae*)	Melon fruit fly

MELONS

Represented by the Australian Melon Association
melonsaustralia.org.au

In 2017–18, melon production was valued at $147 million (LVP), with exports valued at $31.6 million. The main destinations for melon exports are New Zealand, United Arab Emirates, Malaysia, Hong Kong and Singapore.

The Australian melon industry consists of approximately 200 growers producing around 215,000 tonnes of melons annually, with the majority of production in Queensland, NT, WA and NSW. 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 has a research and development (R&D) levy, a PHA levy and an Emergency Plant Pest Response levy, currently set at zero. The industry contributes funds to a Varroa mite emergency response and the Torres Strait Fruit Fly Strategy.

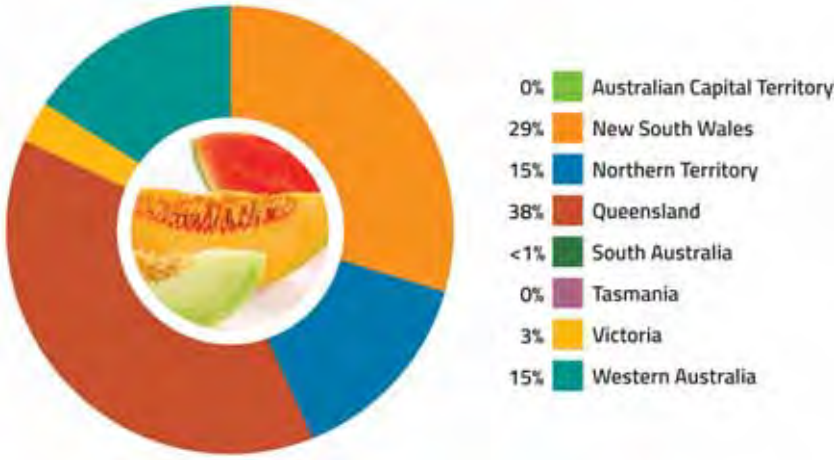
A Melon Farm Biosecurity Program is funded through the PHA levy to engage with growers on their biosecurity issues. In 2019 a melon farm biosecurity planner and 20 pest- and practice-specific fact sheets were developed and distributed to growers. A workshop in 2019 helped prepare growers and industry leaders to manage an emergency response and what would be required to allow their businesses to continue to operate in an incursion.

Table 26. High Priority Pests of the melon industry

Scientific name	Common name
Bactrocera dorsalis (syn. *B. invadens, B. papayae, B. philippinensis*)	Oriental fruit fly
Bactrocera latifrons	Solanum 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
Erwinia tracheiphila	Cucurbit bacterial wilt
Fusarium oxysporum f. sp. *melonis* (exotic races)	Fusarium root and stem rot of melons
Fusarium oxysporum f. sp. *niveum* (exotic races)	Fusarium root and stem rot of melons
Fusarium oxysporum f. sp. *radicis-cucumerinum*	Fusarium root and stem rot of melons
Liriomyza bryoniae	Tomato leaf miner
Liriomyza huidobrensis	Serpentine leaf miner
Liriomyza sativae	Vegetable leaf miner, American leaf miner
Liriomyza trifolii	American serpentine leaf miner
Monosporascus cannonballus	Monosporascus root rot
Zeugodacus curcubitae (syn. *Bactrocera cucurbitae*)	Melon fruit fly

Figure 46. Annual value of melon production, 2010–18

Figure 47. Distribution of melon production by state and territory, 2017–18 (based on LVP)



OLIVES

Represented by the Australian Olive Association
australianolives.com.au

In 2017–18 Australian olive production was valued at $63 million (LVP), with 125,000 tonne of fresh olives produced from 20,568 hectares of groves.

In 2019 production of olive oil was nearly 20,000 tonnes, or 20.8 million litres, up from 10.3 million litres in 2018, reflecting seasonal factors and olive trees tending to bear fruit biennially. Depending on seasonal conditions, production is typically between 85–95 per cent extra virgin olive oil.

During 2018–19 the olive industry exported around 2,384 tonne of olive products worth $16.5 million. Olive oil accounted for 96 per cent of the exports, with table olives accounting for the rest. There are no measurable fresh olive exports. Major export markets for Australia are United States, China, NZ, Japan and Spain.

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

Since the global financial crisis in 2013 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.

Table 27. High Priority Pests of the olive industry

Scientific name	Common name
Bactrocera oleae	Olive fly
Prays oleae	Olive moth
Verticillium dahliae (exotic defoliating strain)	Verticillium wilt
Xylella fastidiosa subsp. *multiplex*	No common name
Xylella fastidiosa subsp. *pauca*	Pierce's disease, blueberry leaf scorch, olive quick decline

Figure 48. Annual value of olive production, 2007–18

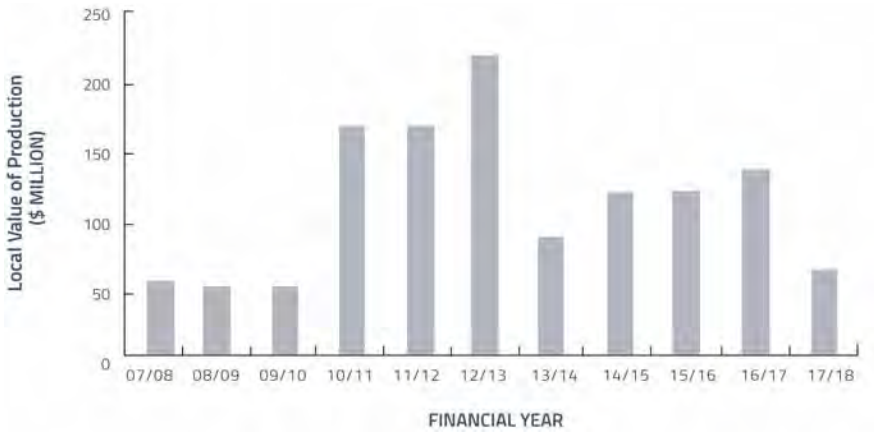


Figure 49. Distribution of olive production by state and territory, 2017–18 (based on LVP)

ONIONS

Represented by Onions Australia
onionsaustralia.org.au

In 2017–18, onion production was valued at $192 million (LVP) with fresh exports valued at $21.7 million.

Onions are grown in most states, but SA and Tasmania together produce 66 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 plantings 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 to September, harvesting from August to March, and storage supplies the market for the winter months.

Table 28. High Priority Pests of the onion industry

Scientific name	Common name
Botrytis squamosa	Leaf blight
Cladosporium allii (syn. *C. allii-cepae, Heterosporium allii, Mycosphaerella allii*)	Leaf spot
Delia antiqua	Onion fly
Delia florilega	Bean fly
Dickeya spp. (onion infecting exotic pathovars) syn. *Erwinia chrysanthemi*	Bacterial soft rot
Liriomyza sativae	Vegetable leaf miner, American leaf miner
Meloidogyne enterolobii (syn. *M. mayaguensis*)	Root knot nematode
Puccinia allii ('Koike's race')	Rust of garlic and chives
Puccinia mixta	Rust of chives
Puccinia porri	Rust of leek
Thrips tabaci (exotic strains, biotypes)	Onion thrip
Urocystis cepulae	Onion smut
Xanthomonas axonopodis pv. *allii*	Xanthomonas leaf blight

Figure 50. Annual value of onion production, 2007–18

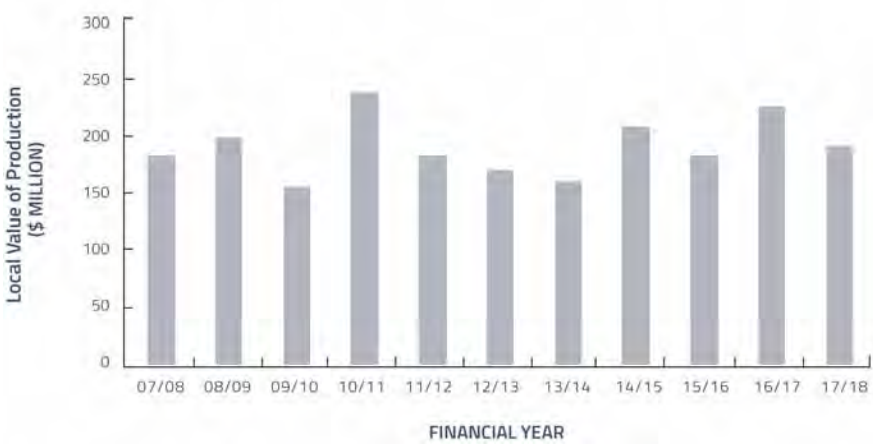
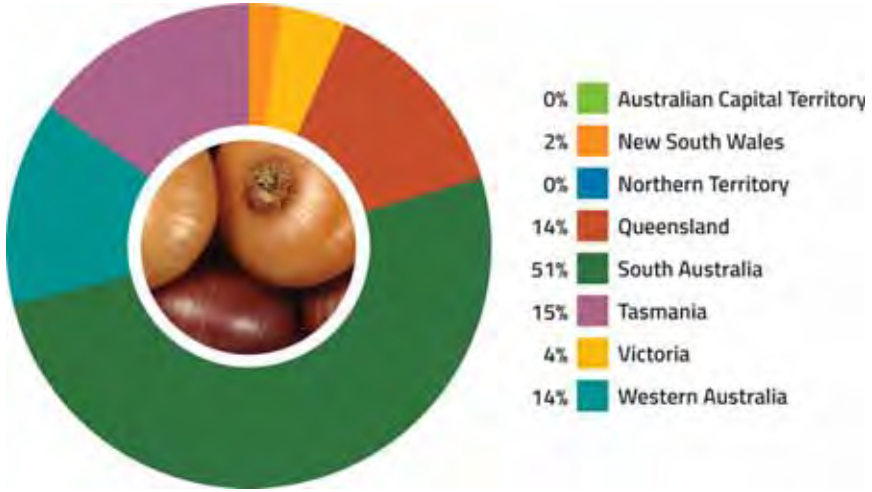


Figure 51. Distribution of onion production by state and territory, 2017–18 (based on LVP)



PASSIONFRUIT

Represented by Passionfruit Australia
passionfruitaustralia.org.au

In 2017–18, passionfruit production of 4,790 tonnes of fruit was valued at $17 million (LVP). At present, there is a minimal amount of passionfruit exported.

There is currently around 280 hectares of passionfruit under cultivation in Australia with around 375,000 passionfruit vines. About 60 per cent 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 market supply time is 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 Program 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.

Table 29. High Priority Pests of the passionfruit industry

Scientific name	Common name
Bactrocera carambolae	Carambola fruit fly
Bactrocera dorsalis (syn. *B. invadens, B. papayae, B. philippinensis*)	Oriental fruit fly
Bactrocera facialis	Tropical fruit fly, Tongan fruit fly
Bactrocera kandiensis	Fruit fly
Bactrocera kirki	Fijian fruit fly
Bactrocera melanotus	Fruit fly, Cook Islands 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
Zeugodacus curcubitae (syn. *Bactrocera cucurbitae*)	Melon fruit fly

Figure 52. Annual value of passionfruit production, 2007–18

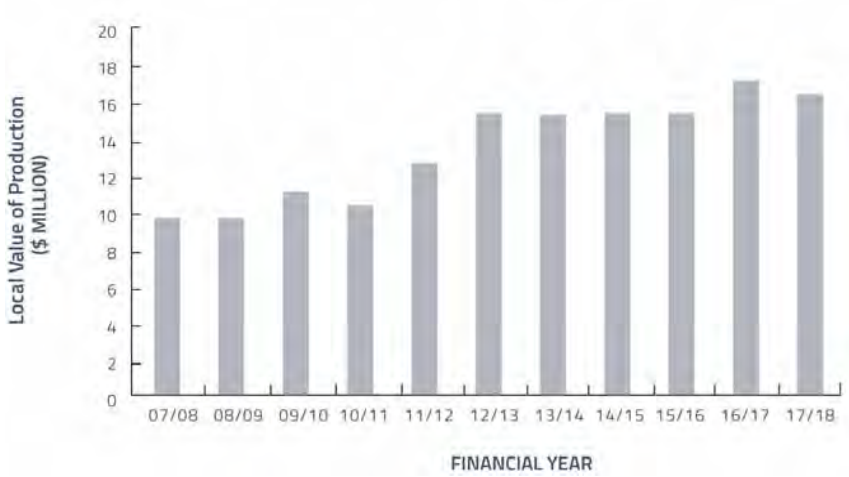
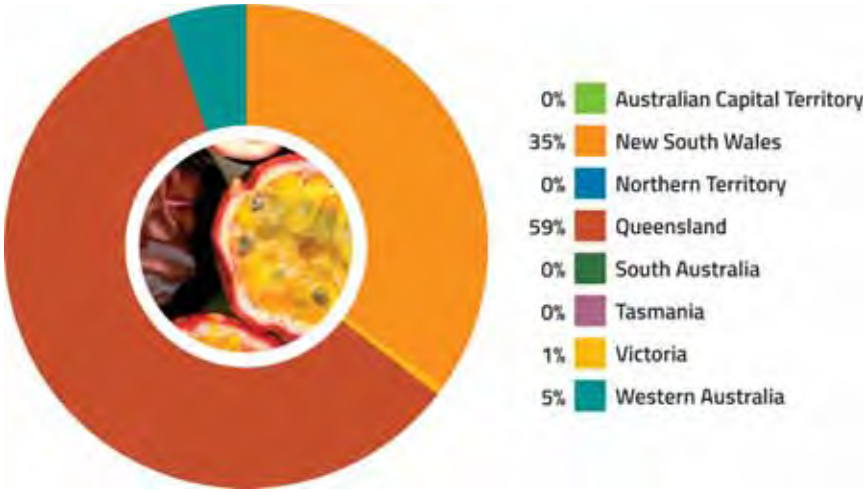


Figure 53. Distribution of passionfruit production by state and territory, 2017–18 (based on LVP)



PINEAPPLES

Represented by GROWCOM
growcom.com.au

In 2017–18, pineapple production was valued at $49 million (LVP). The industry estimates that in 2019 around 43,400 tonnes of fresh fruit and 23,500 tonnes of processed fruit were marketed. The farm gate value for fresh fruit is $1,584 per tonne and the average price for processed fruit is $352 per tonne.

There are approximately 75 commercial pineapple enterprises, all but one based in Queensland. Key growing districts are in Wamuran, Elimbah, Glasshouse Mountains, Beerwah, Yandina, Maryborough, Hervey Bay, Childers, Bundaberg, Cawarral, Yeppoon, Rollingstone, Mutarnee, Bilyana and Mareeba, with one commercial farm located just outside Darwin in the NT.

Australia produces less than one per cent of the world's fresh pineapple 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, accounting for 91 per cent of processed fruit.

Approximately 69 per cent of pineapple varieties grown are Smooth Cayenne. The remaining 31 per cent of plantings are hybrid varieties that appeal more to the fresh market and this proportion is expected to increase.

Figure 54. Annual value of pineapple production, 2007–18

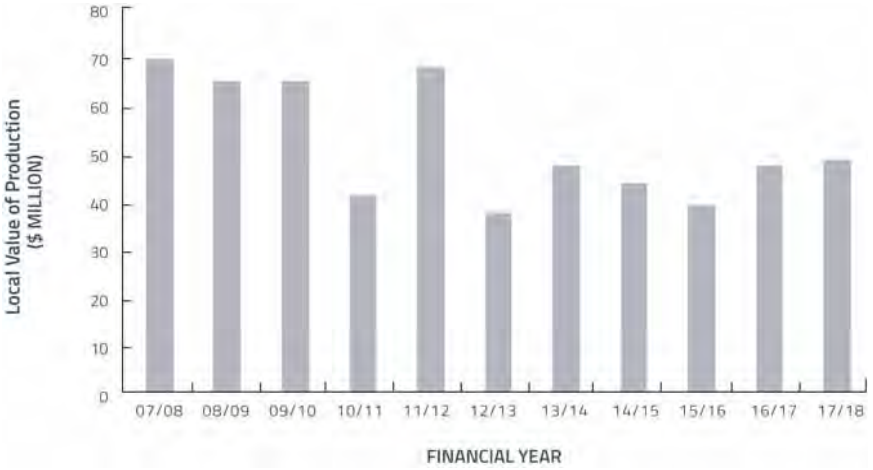


Figure 55. Distribution of pineapple production by state and territory, 2017–18 (based on LVP)

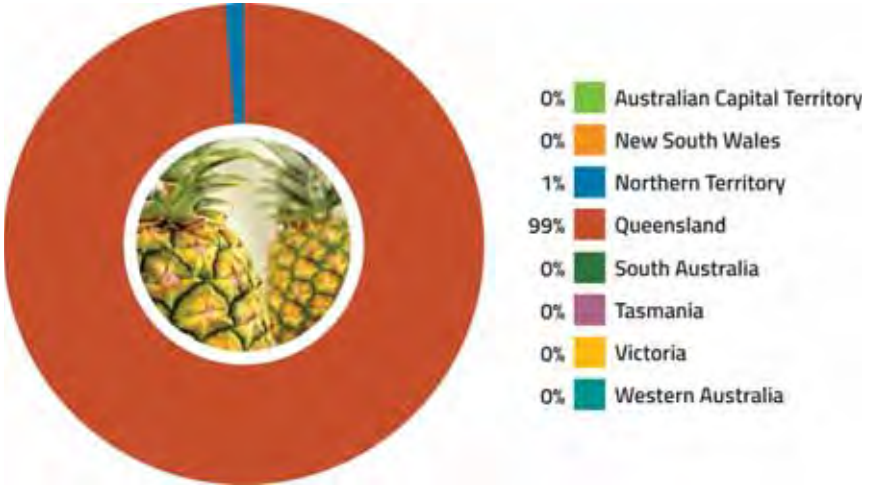


Table 30. High Priority Pests of the pineapple industry

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
Fusarium spp. (*F. ananatum* and *F. guttiforme* syn. *F. subglutinans* f. sp. *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

PISTACHIOS

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

In 2017–18, pistachio production was valued at $42 million (LVP), with exports valued at $1.4 million.

In 2019, there was 1,300 hectares under cultivation, producing a record 2,300 tonnes of pistachio nuts. 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. 180 hectares of new orchards were planted in 2018, 200 in 2019, and an estimated 240 are expected in 2020, a total of 1,165 new hectares since 2014. These new orchards are not yet in production. There are five large pistachio orchards and another five orchards of 10 to 15 hectares. 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 and to 10,000 tonnes by 2030.

In 2019, the Pistachio Growers' Association participated in responses to pest incursions. 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: Understanding and managing insects on pistachio orchards (PS16000) and Pathogens and other factors contributing to dark staining on pistachio shells (PS16002). The industry is represented at PHA meetings and government Biosecurity Roundtables.

Table 31. High Priority Pests of the pistachio industry

Scientific name	Common name
Amyelois transitella	Navel orange worm
Chinavia hilaris (syn. *C. hilare*)	Green stink 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 56. Annual value of pistachio production 2008–18

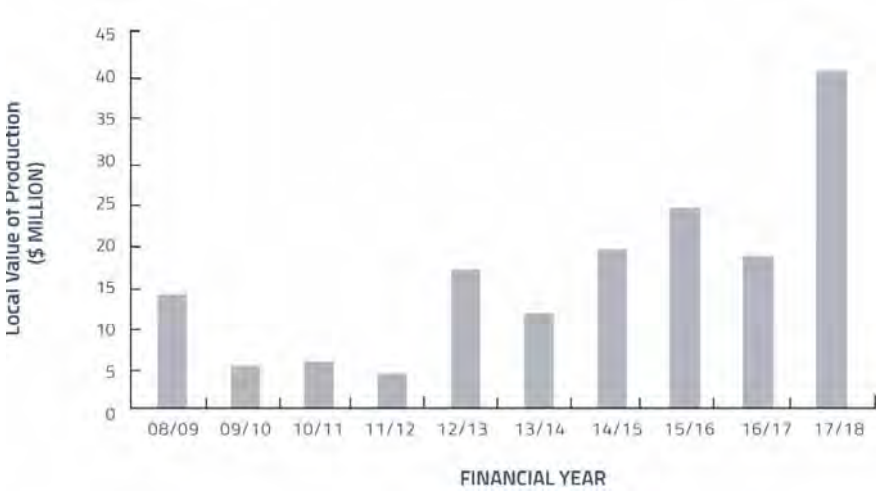
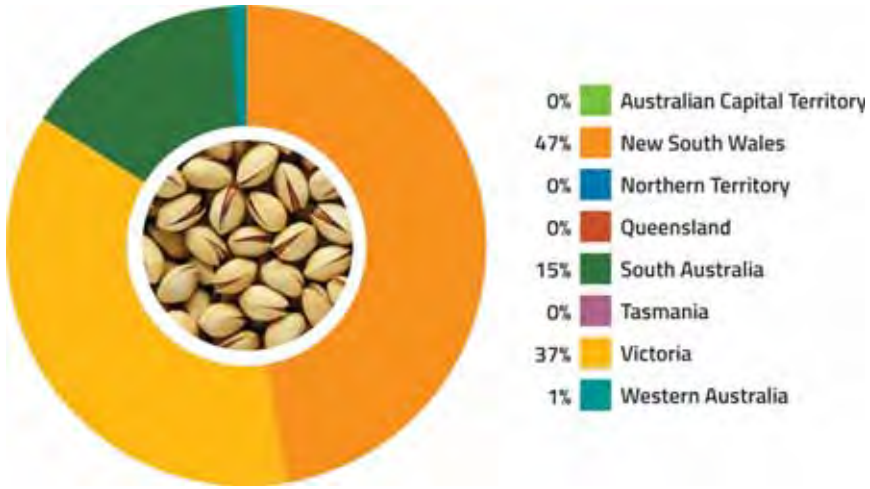


Figure 57. Distribution of pistachios by state and territory, 2017–18 (based on LVP)



PROCESSING TOMATOES

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

In 2017–18, Australian processing tomato production was valued at approximately $20.3 million (LVP). A total of 211,961 tonnes of tomatoes were delivered to three processors, a seven per cent decline from the previous year. All of the 2,347 planted hectares were harvested, despite a severe outbreak of bacterial speck disease early in the season due to weather conditions.

Heinz varieties make up the bulk of crops grown in Australia. Most crops are transplanted, and for the first time, 100 per cent of the production area was irrigated using sub-surface drip lines.

Australia consumes around 605,000 tonnes of processed tomatoes, with local production supplying approximately one third of this demand. The majority of imports come from Italy and the United States.

Figure 58. Annual value of processing tomato production, 2007–18

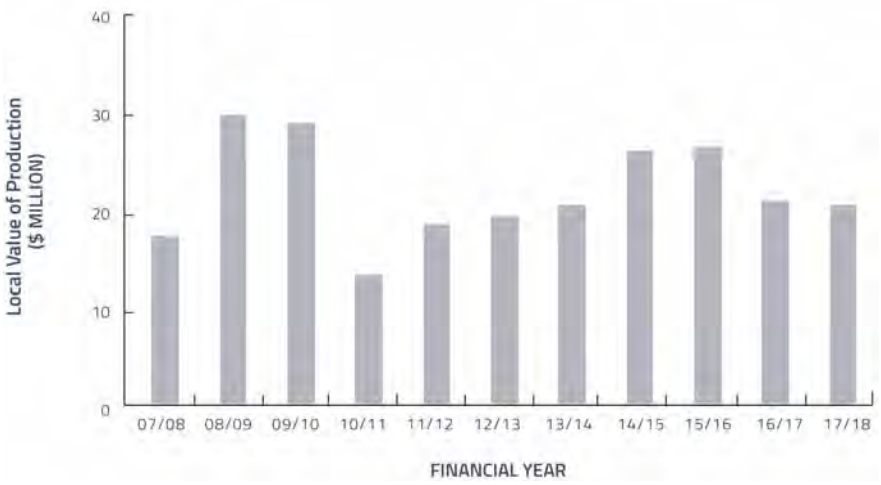


Table 32. High Priority Pests of the processing tomato industry

Scientific name	Common name
*Bactericera cockerelli**	Tomato potato psyllid
Candidatus Liberibacter solanacearum (syn. *Candidatus* Liberibacter psyllaurous)	Zebra chip
Frankliniella intonsa	Flower thrips
Liriomyza bryoniae	Tomato leaf miner
Liriomyza huidobrensis	Serpentine leaf miner
Liriomyza sativae	Vegetable leaf miner, American leaf miner
Liriomyza trifolii	American serpentine leaf miner
Lissachatina fulica (syn. *Achatina fulica*)	Giant African snail
Tuta absoluta	South American tomato moth, tomato leaf miner

**established in Australia*

Figure 59. Distribution of processing tomato production by state and territory, 2017–18 (based on LVP)

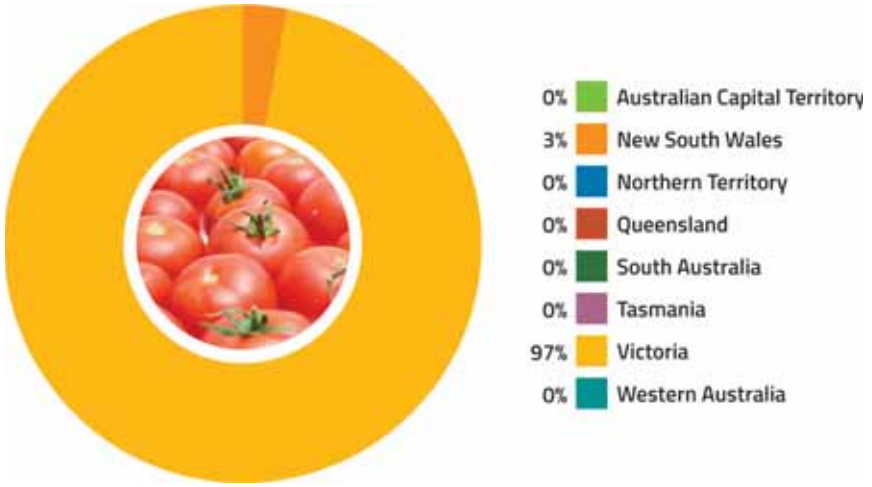


Image courtesy of Greenlife Industry Australia

PRODUCTION NURSERIES

Represented by Greenlife Industry Australia
greenlifeindustry.com.au

In 2017–18, nursery production (propagation stock, vegetable and forestry seedlings, bedding plants, indoor plants, fruit and landscape trees and shrubs) was valued at $1 billion (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) will occur in 2020 across the entire supply chain. Greenlife member nurseries supply 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, Nursery Garden Industry Australia, NGIA (now Greenlife Industry Australia) developed the Australian Plant Production Standard 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 an eLearning portal.

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

Greenlife Industry Australia 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 2019. This allows certified producers to self-certify consignments of nursery stock for interstate market access and issue BioSecure HACCP Biosecurity Certificates.

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.

Figure 60. Annual value of production nurseries, 2007–18

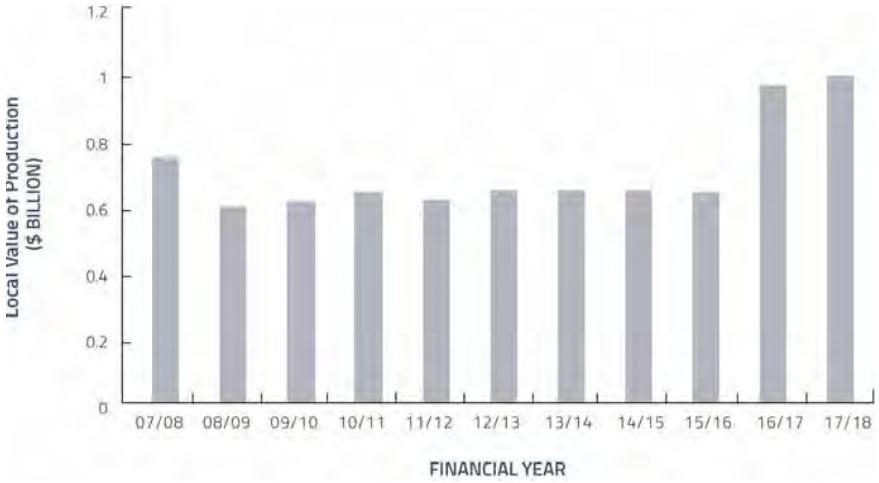


Figure 61. Distribution of production nurseries by state and territory, 2017–18 (based on LVP)

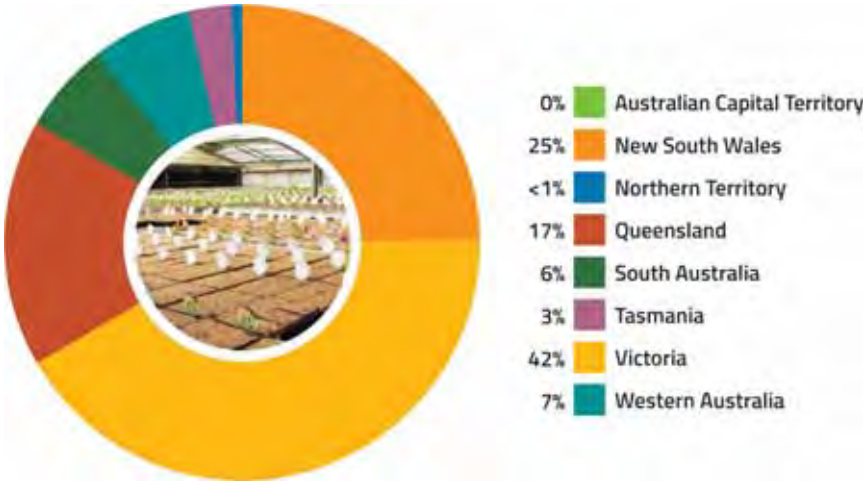


Table 33. High Priority Pests of the production nursery industry

Scientific name	Common name
Aphis gossypii (exotic strains)	Cotton aphid
Austropuccinia psidii sensu lato (exotic variants) (syn. *Puccinia psidii*)	Myrtle rust, guava rust, Eucalyptus rust
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 asiaticus	Huanglongbing (Asiatic strain)
Diaphorina citri	Asian citrus psyllid
Echinothrips americanus	Poinsettia thrips
Homalodisca vitripennis (syn. *H. coagulata*)	Glassy winged sharpshooter
Lettuce infectious yellows virus (Crinivirus)	Lettuce infectious yellows virus
Liriomyza huidobrensis	Serpentine leaf miner
Lissachatina fulica (syn. *Achatina fulica*)	Giant African snail
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
Xylella fastidiosa (subsp. not specified)	Pierce's disease, blueberry leaf scorch, olive leaf scorch, olive quick decline, phony peach, plum leaf scald

Image courtesy of Greenlife Industry Australia

RICE

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

In 2017–18, rice production was valued at $228 million (LVP), with the export value estimated at $368m.[27]

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 NSW over 938 farms produced a total of 625,812 tonnes of rice.

In the Riverina, the major varieties grown are temperate Japonica varieties planted in October and November that are 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.

Figure 62. Annual value of rice production, 2007–18

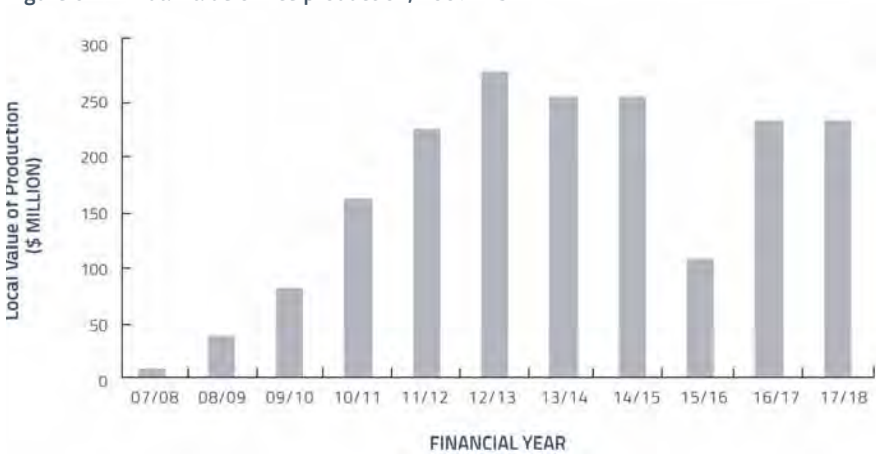
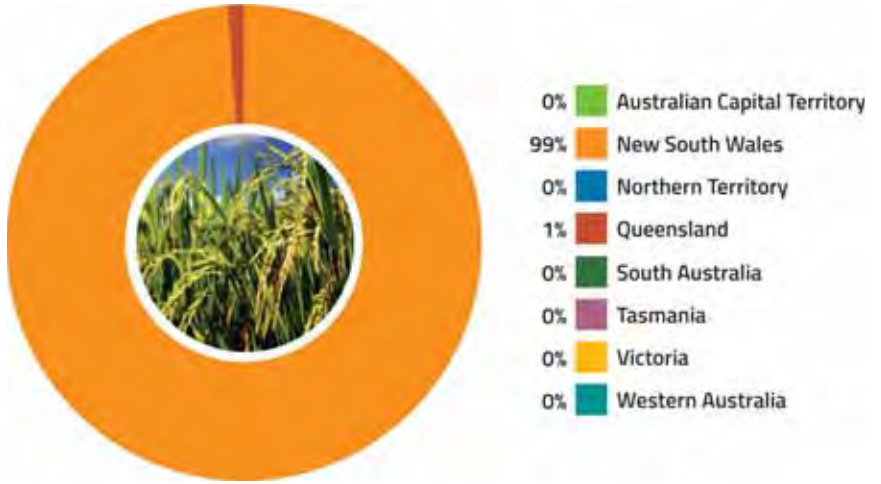


Table 34. High Priority Pests of the rice industry

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
Trogoderma granarium	Khapra beetle

Figure 63. Distribution of rice production by state and territory, 2017–18 (based on LVP)



27. Australian Bureau of Agricultural Resource Economics and Sciences. Agricultural commodities: June quarter 2019 Accessed online 25 March 2020 agriculture.gov.au/abares/research-topics/agricultural-commodities/jun-2019

RUBUS

Represented by Raspberries and Blackberries Australia (RABA)
freshberries.com.au

In 2017–18, the rubus industry was valued at $176 million (LVP), with fresh exports valued at less than $100,000.

Raspberry, blackberry and hybrid brambles (including silvanberries, boysenberries, loganberries, youngberries and marionberries) are collectively referred to as rubus or cane berries. Raspberries are the most popular accounting for 85 per cent of fresh production, followed by blackberries at 14 per cent and other hybrid brambles consisting of one per cent fresh production.

While most raspberries, blackberries and brambleberries produced are consumed locally, berries are also exported to Singapore, Hong Kong, India, Indonesia and Pacific Island countries. There is approximately 700 hectares of land under cultivation with rubus varieties: production is largely under protected cropping (white plastic tunnels) to protect from wind and rain. New plantings continue in response to increasing demand from consumers. Production is expanding in newer areas such as Gin Gin, north of Perth in WA, and Stanthorpe, south-east of Brisbane.

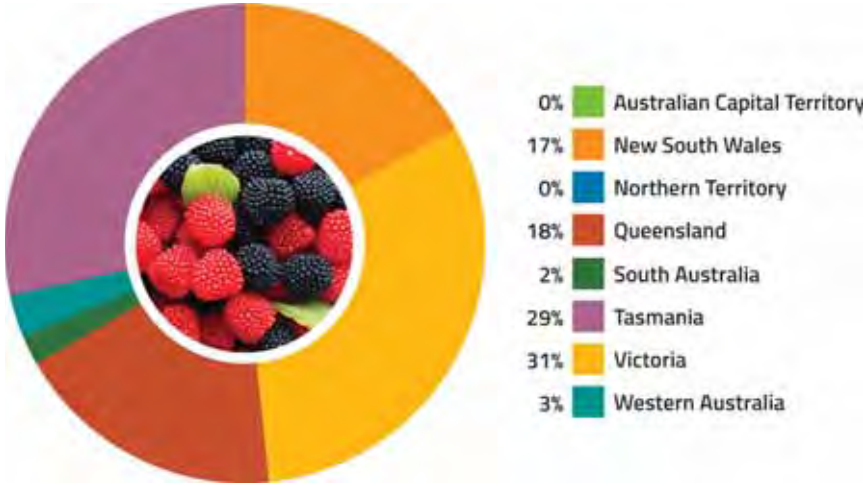
Traditionally rubus are a cool temperate crop with peak production in early summer to autumn. However, year-round supply is possible from subtropical NSW and south-east Queensland production sites where harvest occurs late autumn to spring. Hydroponic systems, new low-chill rubus varieties and production methods to simulate winter extend the harvest season and productivity.

Table 35. High Priority Pests of the rubus industry

Scientific name	Common name
Arthuriomyces peckianus	Orange rust (long-cycled)
Cercosporella rubi	Rosette
Cherry leaf roll virus (Nepovirus) (exotic strains)	Blackline
Drosophila suzukii	Spotted wing drosophila
Euschistus conspersus	Consperse stink bug
Gymnoconia nitens	Orange rust (short-cycled)
Halyomorpha halys	Brown marmorated stink bug
Heterocrossa rubophaga	Raspberry bud moth
Pennisetia hylaeiformis	Raspberry crown borer
Pennisetia marginata	Raspberry crown borer
Popillia japonica	Japanese beetle
Raspberry ringspot virus (Nepovirus)	Raspberry ringspot virus
Strawberry latent ringspot virus (Sadwavirus)	Strawberry latent ringspot virus
Tomato ringspot virus (Nepovirus)	Tomato ringspot virus

Figure 64. Annual value of rubus berry production, 2009–18

Figure 65. Distribution of rubus berry production by state and territory, 2017–18 (based on LVP)



STONE FRUIT

Represented by Summerfruit Australia
summerfruit.com.au

In 2017–18, stone fruit production (fresh apricots, nectarines, peaches and plums) was valued at $207 million (LVP), with exports valued at $65.1 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 (161,000 tonnes nationally) with the remaining production spread between NSW, Queensland, SA, WA and Tasmania.

Increased summerfruit exports have been driven by demand from China. Market access to mainland China for nectarines (in May 2016) and apricots, peaches and plums (in November 2017) allowed an expansion of exports. During the 2018–19 export season, a record 23,013 tonnes were exported (an increase of 30 per cent), with 12,000 tonnes going to China and Hong Kong. Other major markets were United Arab Emirates, Saudi Arabia, Singapore and Malaysia.

In 2019, Summerfruit Australia was involved in a number of responses to pest incursions affecting the stone fruit industry, including detections of brown marmorated stink bug in cargo, Varroa mite and exotic fruit fly. The industry also updated their biosecurity plan with PHA and governments.

Table 36. High Priority Pests of the stone fruit industry

Scientific name	Common name
Anastrepha ludens	Mexican fruit fly
Anastrepha serpentina	Sapodilla fruit fly, sapote fruit fly
Anastrepha striata	Guava fruit fly
Bactrocera dorsalis (syn. *B. invadens, B. papayae, B. philippinensis*)	Oriental fruit fly
Drosophila suzukii	Spotted wing drosophila
Halyomorpha halys	Brown marmorated stink bug
Homalodisca vitripennis (syn. *H. coagulata*)	Glassy winged sharpshooter
Lymantria dispar	Asian gypsy moth
Plum pox virus (Potyvirus)	Plum pox virus, sharka
Xylella fastidiosa (subsp. not specified)	Pierce's disease, blueberry leaf scorch, olive leaf scorch, olive quick decline, phony peach, plum leaf scald

Figure 66. Annual value of stone fruit production, 2007–18

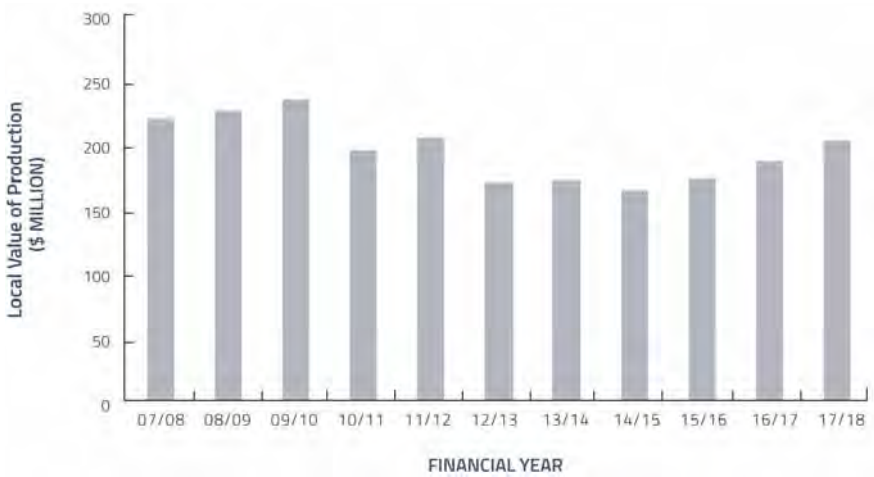
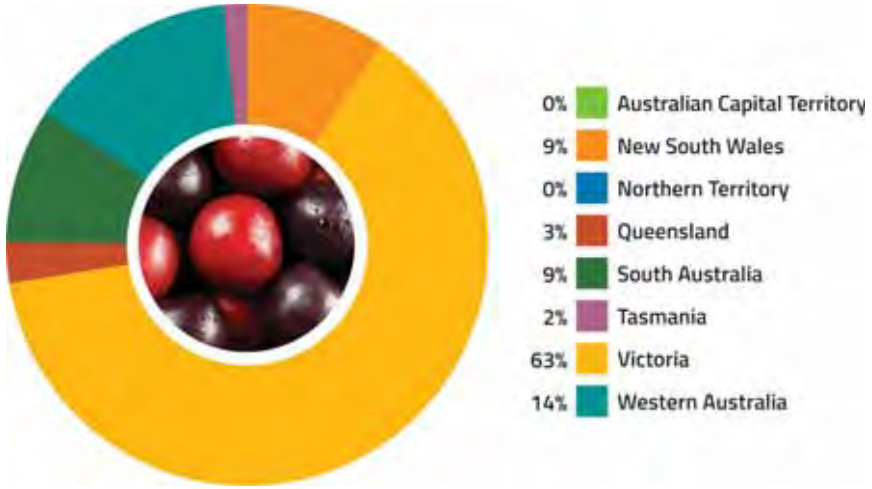


Figure 67. Distribution of stone fruit production by state and territory, 2017–18 (based upon LVP)



STRAWBERRIES

Represented by Strawberries Australia
strawberriesaustralia.com.au

In 2017–18, strawberry production was valued at $303 million (LVP) with exports valued at $29.7 million. The increase in production over recent years is due primarily to rising per capita consumption, driven by higher planting numbers, improved varieties and better cool chain management.

Although primarily focused on the domestic market, in 2017–18 the industry exported approximately five per cent of production to United Arab Emirates, New Zealand, Singapore, Thailand and Hong Kong.

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, the varieties grown are predominantly from California in the United States, with some Australian bred varieties. In subtropical regions, Australian bred varieties are increasingly being grown, with some varieties imported from Florida in the 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.

Table 37. 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
Tomato black ring virus (Nepovirus)	Tomato black ring virus
Tomato ringspot virus (Nepovirus)	Tomato ringspot virus
Xanthomonas fragariae	Strawberry angular leaf spot

Figure 68. Annual value of strawberry production, 2007–18

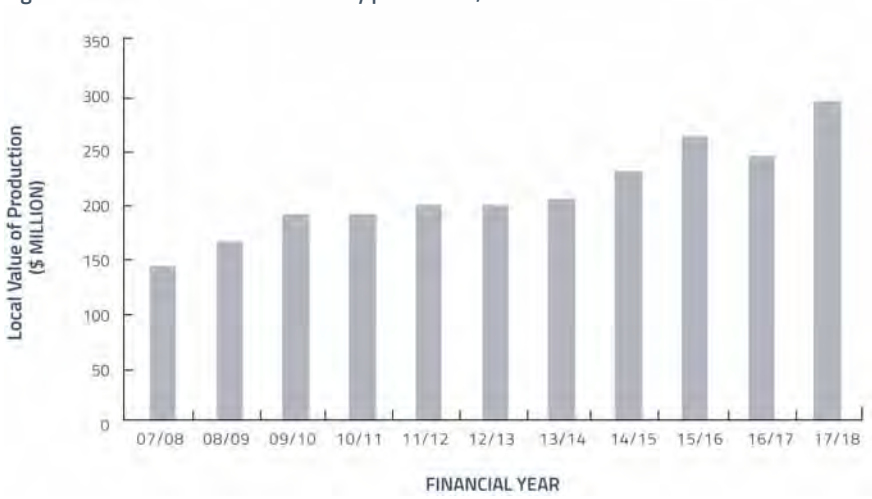


Figure 69. Distribution of strawberry production by state and territory, 2017–18 (based upon LVP)

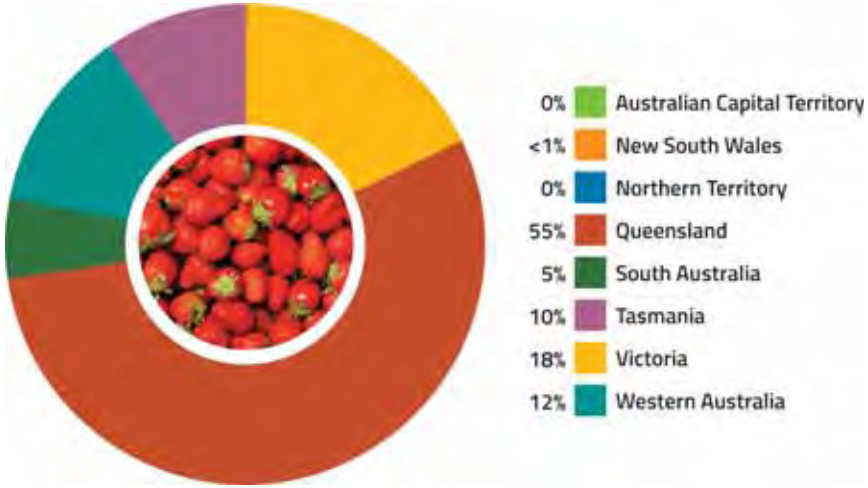


Image courtesy of CANEGROWERS

SUGARCANE

Represented by CANEGROWERS
canegrowers.com.au

In 2017–18, sugarcane production was valued at $1.25 billion (LVP).

In 2018, the industry produced 32.5 million tonnes of cane, and 4.72 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.

Figure 70. Annual value of sugarcane production, 2007–18

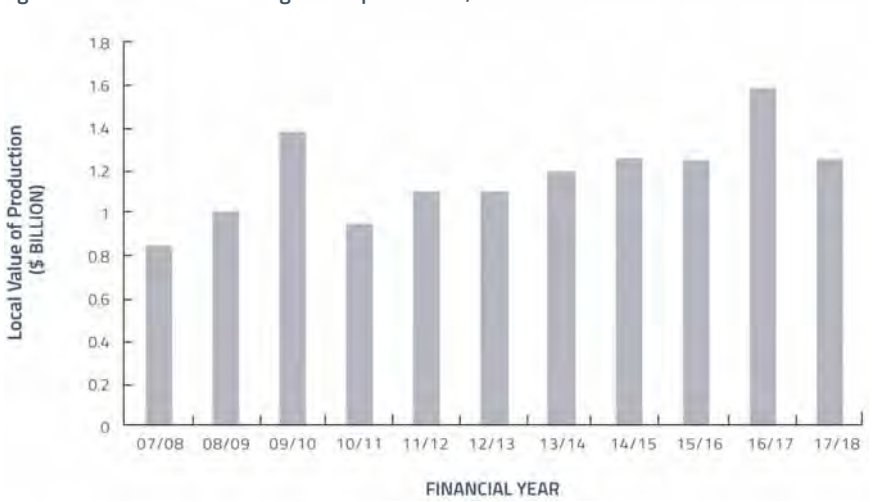


Figure 71. Distribution of sugarcane production by state and territory, 2017–18 (based upon LVP)

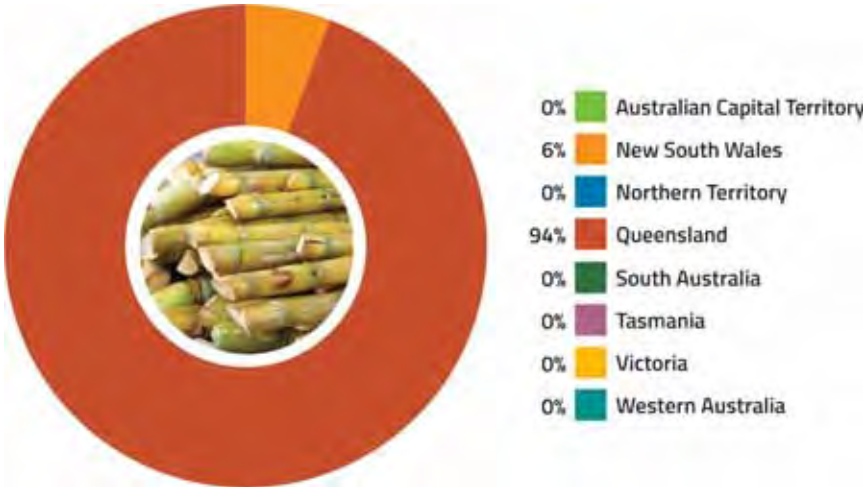


Table 38. High Priority Pests of the sugarcane industry

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	Sugarcane stem 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
Perkinsiella vastatrix	Sugarcane planthopper
Perkinsiella vitiensis	Sugarcane planthopper
Peronosclerospora philippinensis	Philippine downy mildew of maize
Peronosclerospora sacchari	Sugarcane downy mildew
Polyocha depressella	Root borer
Pyrilla perpusilla	Sugarcane pyrilla
Scirpophaga excerptalis	Top shoot borer
Sesamia grisescens	Stem borer
Stagonospora sacchari	Leaf scorch
Sugarcane streak mosaic virus (Poacevirus)	Sugarcane streak mosaic
Unknown	Ramu stunt disease
White leaf phytoplasma	White leaf
Xanthomonas albilineans (exotic strains, serological groups 2 or 3)	Leaf scald

SWEETPOTATOES

Represented by Australian Sweetpotato Growers
aspg.com.au

In 2017–18, sweetpotato production was valued at $99 million (LVP), with exports valued at $1.6 million. The main export markets are United Arab Emirates, Hong Kong and Singapore.

Sweetpotatoes are available all year round in Australia with total production of around 96,000 tonnes. There are around 80 commercial producers with farm sizes ranging from 10 to 200 hectares, with most in the 15 to 80 hectare range.

Queensland is the biggest producer with 88 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.

Four 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) and white (white skin, white flesh) making up the remainder. The majority of sweetpotato production is consumed domestically, with around 1.5 per cent exported.

Commercial growers purchase pathogen-tested planting material several times every year, a measure that has doubled marketable yield per hectare. This scheme supports biosecurity by constraining what was previously a pest movement risk between farms. The pathogen testing scheme is reinforced by a major research program into nematode diagnostics and management, as well as ongoing development of diagnostics for viruses and other endemic and exotic pests.

In 2019, the sweetpotato industry developed a biosecurity plan with PHA and governments.

Figure 72. Annual value of sweetpotato production, 2011–18

Table 39. High Priority Pests of the sweetpotato industry

Scientific name	Common name
Achatina achatina	Giant African snail, giant Ghana snail
Agrotis segetum	Turnip moth, cutworm, black cutworm
Belonolaimus longicaudatus	Sting nematode
Diaprepes abbreviatus	Citrus weevil, West Indian weevil, sugarcane rootstalk borer
Ditylenchus destructor	Potato tuber nematode
Elasmopalpus lignosellus	Lesser corn stalk borer
Euscepes postfasciatus (syn. *E. batatae*)	West Indian sweetpotato weevil
Lissachatina fulica (syn. *Achatina fulica*)	Giant African snail
Meloidogyne enterolobii (syn. *M. mayaguensis*)	Root knot nematode
Sweet potato chlorotic stunt virus (Crinivirus)	Sweet potato chlorotic stunt virus
Sweet potato mild mottle virus (Ipomovirus)*	Mild mottle of sweet potato
Sweet potato mild speckling virus (Potyvirus)*	Sweet potato mild speckling virus
Veronicella cubensis	Cuban slug

**with Sweet potato feathery mottle virus (SPFMV) and Sweet potato chlorotic stunt virus (SPCSV)*

Figure 73. Distribution of sweetpotato production by state and territory, 2017–18 (based upon LVP)

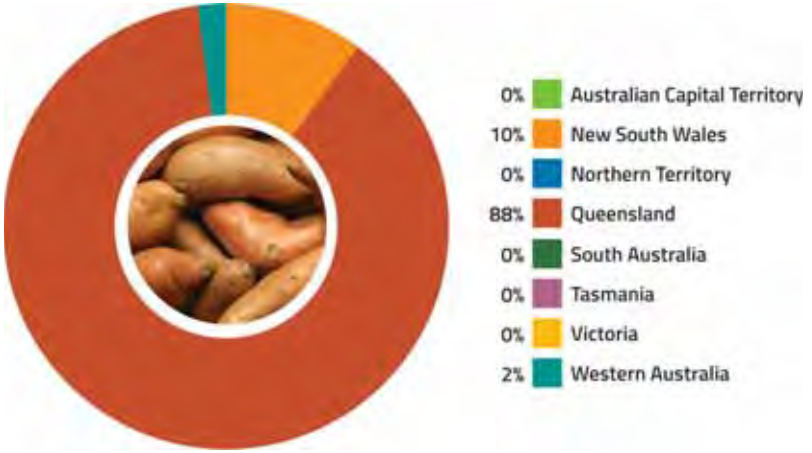


TABLE GRAPES

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

In 2017–18 table grape production was valued at $399 million (LVP), with 177,416 tonnes produced. Exports of 110,280 tonnes predominantly to China, Indonesia, Japan, Hong Kong and the Philippines were valued at $384 million.

In the 12 months ending June 2019, the table grape industry exported 146,000 tonnes, valued at $555 million, which was 30 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 2019–20 season is forecast to see approximately 200,000 tonnes produced, with a 35:65 split between the domestic and export markets.

Table 40. High Priority Pests of the table grape industry

Scientific name	Common name
Bactrocera carambolae	Carambola fruit fly
Bactrocera dorsalis (syn. *B. invadens, B. papayae, B. philippinensis*)	Oriental fruit fly
Candidatus Phytoplasma solani	Bois noir
Daktulosphaira vitifoliae (exotic strains)	Grapevine phylloxera
Drosophila suzukii	Spotted wing drosophila
Grapevine flavescence dorée phytoplasma	Flavescence dorée
Guignardia bidwellii	Black rot
Homalodisca vitripennis (syn. *H. coagulata*)	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 (subsp. not specified)	Pierce's disease, blueberry leaf scorch, olive leaf scorch, olive quick decline, phony peach, plum leaf scald

Figure 74. Annual value of table grape production, 2007–18

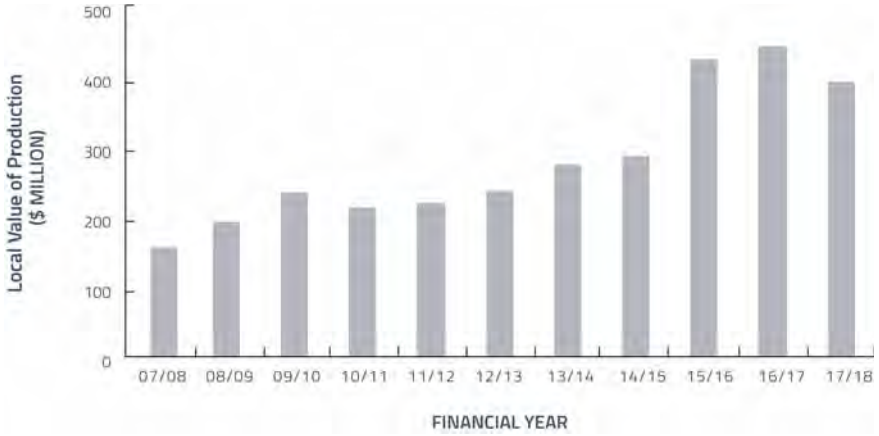
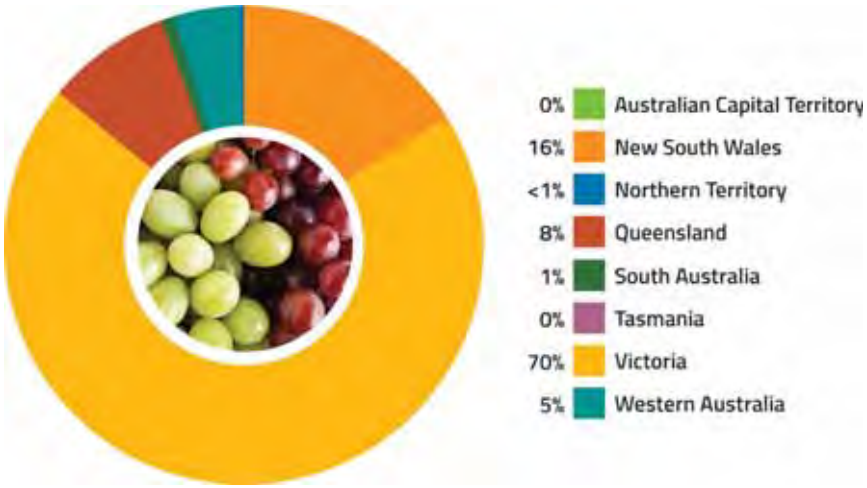


Figure 75. Distribution of table grape production by state and territory, 2017–18 (based upon LVP)



TEA TREE

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

In 2017–18, tea tree production was valued at $41 million (LVP), with the vast majority exported.

In 2019, there were about 140 tea tree growers in Australia and about 4,600 hectares under plantation production. Industry growth has stabilised, with an 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. Three quarters of plantations are 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. Most oil (90 per cent) is exported through an established supply chain to over 70 countries, particularly North America and Europe.

Domestic consumption is estimated to be around 95,000 kilograms 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 and tea tree oil.

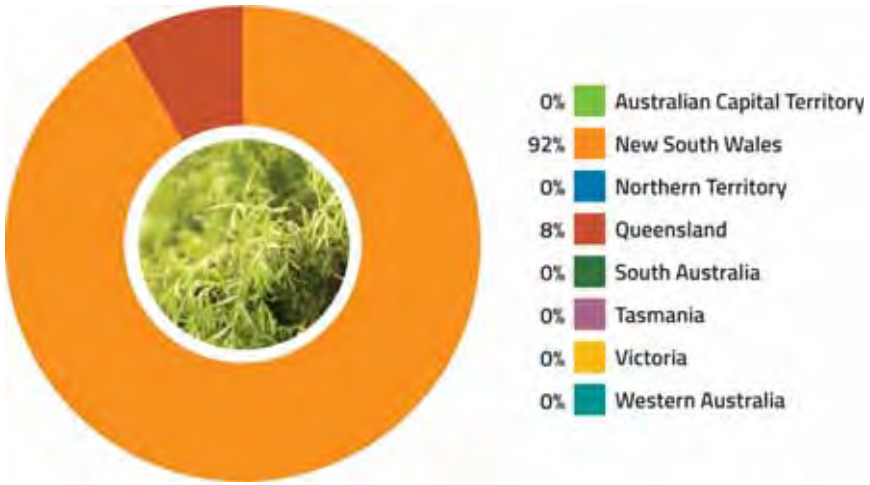
In 2019, the tea tree industry developed a biosecurity plan with PHA and governments.

Table 41. High Priority Pests of the tea tree industry

Scientific name	Common name
Austropuccinia psidii sensu lato (exotic variants) (syn. *Puccinia psidii*)	Myrtle rust, guava rust, Eucalyptus rust
Calonectria brassicae (syn. *C. gracile*)	No common name
Calonectria pteridis	Blight, leaf spot, cutting and root rot
Phytophthora ramorum	Sudden oak death
Xylosandrus compactus	Black twig borer

Figure 76. Annual value of tea tree production, 2013–18

Figure 77. Distribution of tea tree production by state and territory, 2017–18 (based upon LVP)



TRUFFLES

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

In 2017–18, Australian truffle production was valued at $7 million (LVP). Most of the harvest is exported, with markets in more than 40 different countries, primarily in Europe, United States and Asia.

There is estimated to be 450 to 500 truffle orchards, or truffières, around the country, of which around 30 to 40 per cent have harvested truffles. The Australian Truffle Growers' Association has 170 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 75 per cent of the harvest. There is increasing production in Tasmania, ACT, NSW and Victoria. A small number of newer farms in SA and southern Queensland will produce in the next few years.

Australian *T. melanosporum* are recognised for their excellent quality and are highly sought after in overseas markets, particularly in the northern hemisphere, where Australian produce is available when local product is out of season. The two other species of truffle with limited commercial production in Australia are *T. aestivum* and *T. borchii.*

Figure 78. Annual value of truffle production, 2012–18

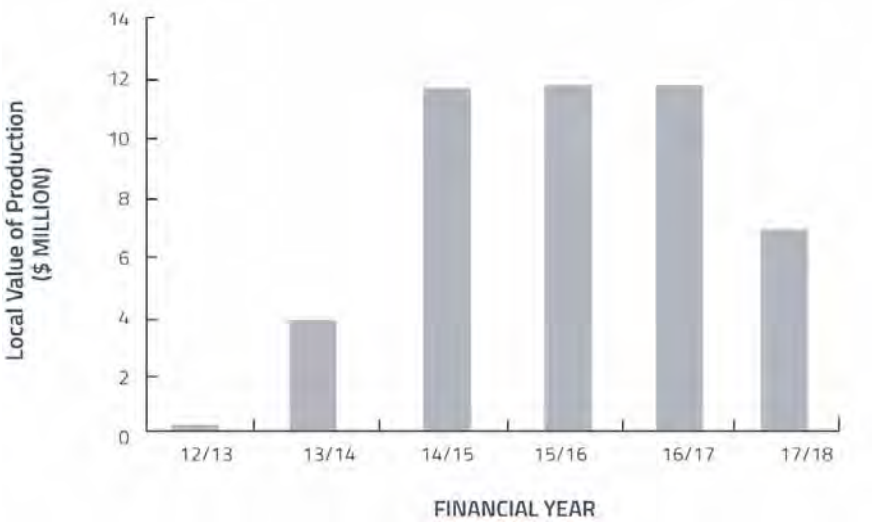


Figure 79. Distribution of truffle production by state and territory, 2017–18 (based on LVP)

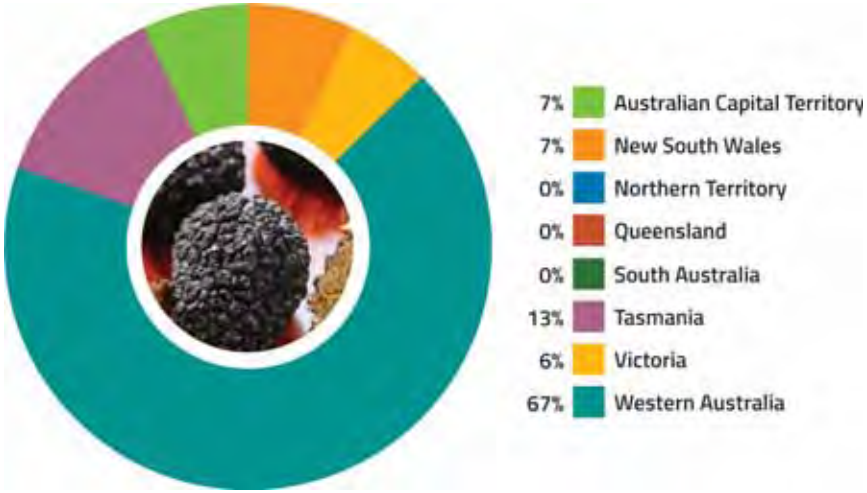


Table 42. High Priority Pests of the truffle industry

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

VEGETABLES (INCLUDING POTATOES)

Represented by AUSVEG
ausveg.com.au

In 2017–18, vegetable and potato production was valued at $2.3 billion (LVP). Major crops include potatoes, carrots and lettuce. Potato production alone was valued at $558 million (LVP). Exports of vegetables, including potatoes, were valued at $255 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 potato pest surveillance project officer allow the industry to participate in a range of biosecurity initiatives.

During 2019, the farm biosecurity officers visited numerous growing regions across Australia including Greater Sydney in NSW; Darwin in the NT; Bowen, Ayr, Mareeba and Atherton in Queensland; Mornington Peninsula and Cranbourne in Victoria; Adelaide Plains and Riverland in SA; Devonport in Tasmania; and Perth and Albany in WA. They held a series of regional biosecurity awareness seminars and visited more than 80 individual farms. The farm biosecurity officers were also involved in biosecurity initiatives including participation in technical meetings with the Australian Government Department of Agriculture as well as engagement with state government departments, relevant committees, other industry bodies and PHA. They also facilitated a Melbourne-based pilot program that focused on exotic plant pest awareness in urban environments. The program enabled the farm biosecurity officers to engage with community gardeners and others involved in urban farming, in order to raise awareness of exotic plant pests and reporting protocols .

In 2019 the development of a national potato biosecurity surveillance strategy for the Australian potato industry commenced. This involved significant engagement with potato growers, processors, seed suppliers and certifiers, industry bodies, the Australian Government and governments in WA, NSW, SA, Tasmania, Victoria and Queensland.

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

Figure 80. Annual value of vegetable production (excluding potatoes), 2007–18

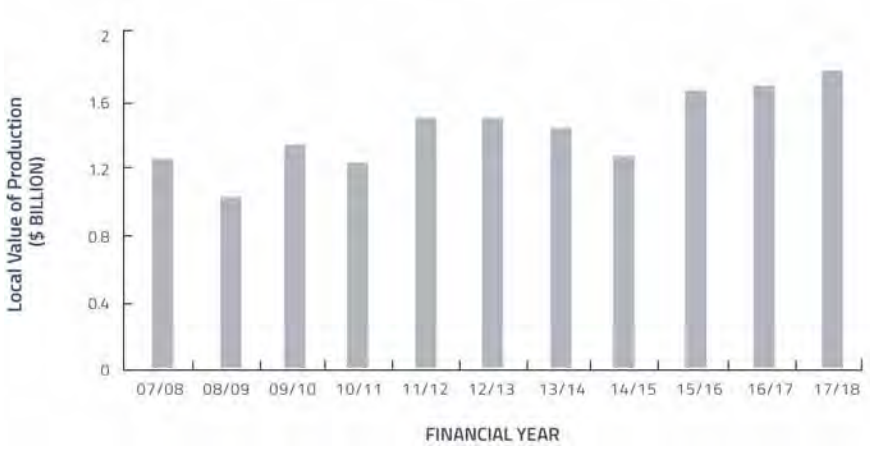


Figure 81. Distribution of vegetable production (excluding potatoes) by state and territory, 2017–18 (based upon LVP)

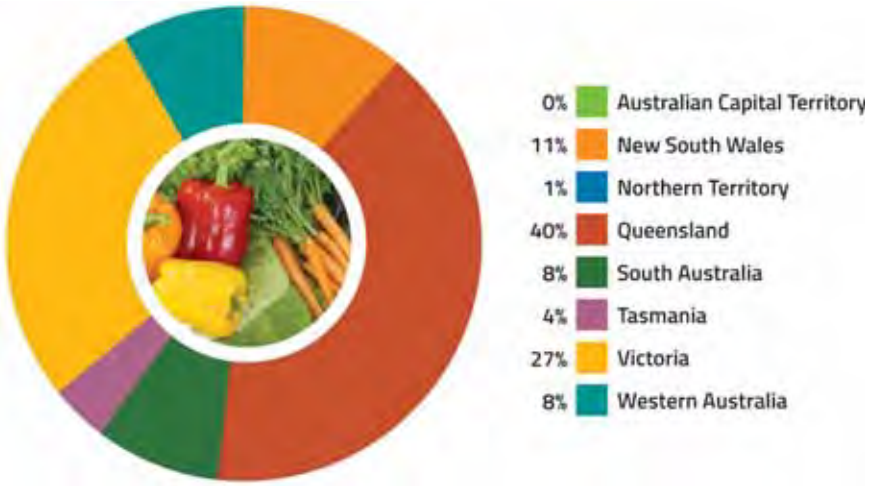


Table 43. High Priority Pests of the vegetable industry (excluding potatoes)

Scientific name	Common name
Achatina achatina	Giant African snail, giant Ghana snail
Alternaria humicola	Leaf spot
Aphis fabae	Black bean aphid
Aulacophora foveicollis	Red pumpkin beetle
Bactrocera carambolae	Carambola fruit fly
Bactrocera dorsalis (syn. *B. invadens, B. papayae, B. philippinensis*)	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 fly
Eumerus strigatus	Lesser bulb fly
Groundnut bud necrosis virus (Tospovirus)	Bud necrosis disease
Halyomorpha halys	Brown marmorated stink bug
Harpophora maydis	Late wilt
Heterodera carotae	Carrot cyst nematode
Heterodera ciceri	Chickpea cyst nematode
Liriomyza bryoniae	Tomato leaf miner
Liriomyza huidobrensis	Serpentine leaf miner
Liriomyza sativae	Vegetable leaf miner, American leaf miner
Liriomyza trifolii	American serpentine leaf miner
Lissachatina fulica (syn. *Achatina fulica*)	Giant African land snail
Lygus hesperus	Western plant bug
Meloidogyne enterolobii (syn. *Meloidogyne mayaguensis*)	Root knot nematode
Meloidogyne naasi	Barley root knot nematode
Phytomyza gymnostoma	Allium leaf miner
Phytophthora infestans (A2 mating type and exotic strains of A1 mating type)	Late blight
Potato spindle tuber viroid (Pospiviroidae) (exotic strains)	Potato spindle tuber viroid
Psila rosae	Carrot rust fly
Puccinia agrophila	No common name
Puccinia apii	Rust of celery
Puccinia nitida	Rust of dill
Puccinia opizii	Rust
Puccinia spp. (exotic species)	Rusts
Rhizoctonia solani f. sp. *sasakii* (AG1) (teleomorph: *Corticium sasakii* (syn. *Thanatephorus cucumeris*)	Banded leaf and sheath spot
Rhizoglyphous setosus	Bulb mite
Spodoptera frugiperda	Fall armyworm
Thaumatotibia leucotreta (syn. *Cryptophlebia leucotreta*)	False codling moth
Tomato brown rugose fruit virus (Tobamovirus)	Tomato brown rugose fruit virus (ToBRFV)
Tomato mottle mosaic virus (Tobamovirus)	Tomato mottle mosaic virus (ToMMV)
Trichoplusia ni	Cabbage looper
Tuta absoluta	South American tomato moth, tomato leaf miner
Uromyces lineolatus	Rust
Watermelon bud necrosis virus (Tospovirus)	Watermelon bud necrosis
Zeugodacus curcubitae (syn. *Bactrocera cucurbitae*)	Melon fruit fly

Figure 82. Annual value of potato production, 2007–18

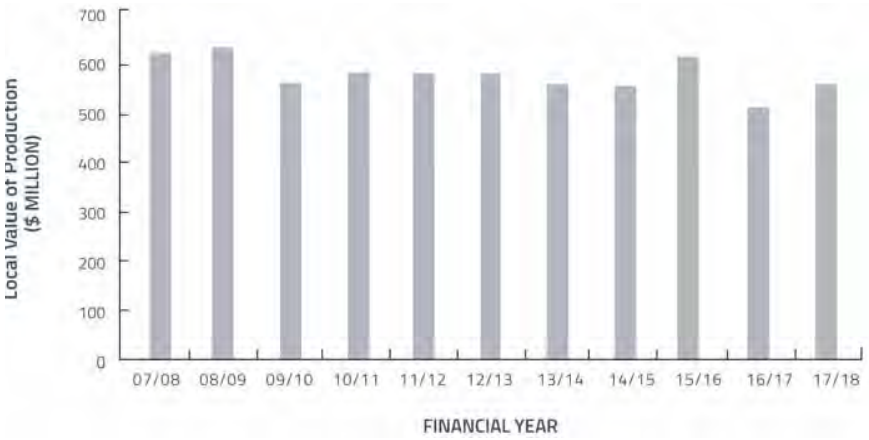


Figure 83. Distribution of potato production by state and territory, 2017–18 (based on LVP)

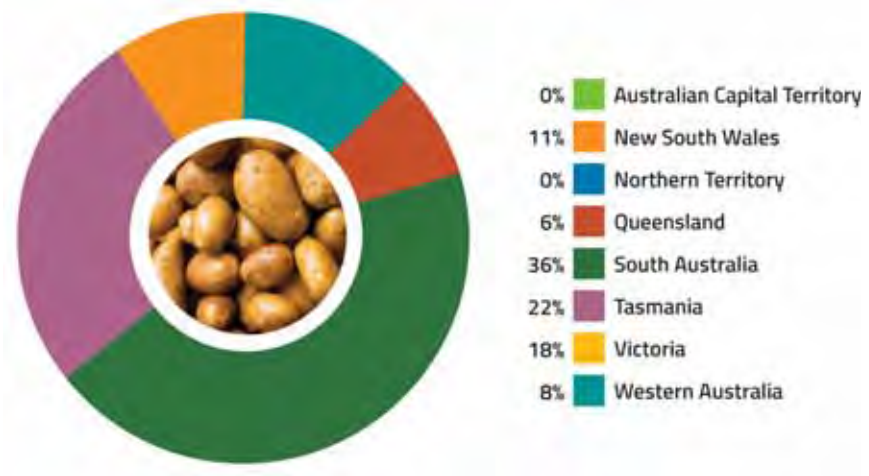


Table 44. High Priority Pests of the potato industry

Scientific name	Common name
Aphis fabae	Black bean aphid
Aphis gossypii (exotic strains)	Cotton aphid
Candidatus Liberibacter solanacearum (syn. *Candidatus* Liberibacter psyllaurous)	Zebra chip
Globodera pallida	Pale potato cyst nematode
Globodera rostochiensis (pathotypes RO2, RO3, RO4 and RO5)	Golden potato cyst nematode
Leptinotarsa decemlineata	Colorado potato beetle
Liriomyza huidobrensis	Serpentine leaf miner
Liriomyza sativae	Vegetable leaf miner, American leaf miner
Liriomyza trifolii	American serpentine leaf miner
Meloidogyne enterolobii (syn. *M. mayaguensis*)	Root knot nematode
Phytophthora infestans (A2 mating type and exotic strains of A1 mating type)	Late blight
Potato spindle tuber viroid (Pospiviroidae) (exotic strains)	Potato spindle tuber viroid
Ralstonia syzygii (syn. *R. solanacearum* race 4, *Pseudomonas solanacearum*)	Bacterial wilt

WALNUTS

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

In 2017–18, the walnut industry was valued at $55 million (LVP), with exports valued at $22.7 million. In-shell production of 11,800 tonnes was produced from 3,890 hectares.

About 60 per cent of Australia's walnut production is exported with greatest demand for in-shell walnuts in China, Turkey and Italy. 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. The industry is predicted to grow to 14,000 tonnes (4,300 hectares) by 2021 as current growers expand their orchards and new growers enter the industry.

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 2019, the Australia Walnut Industry Association participated in responses to pest incursions. The association has funded projects to establish an Emergency Plant Pest Response (EPPR) levy and an Owner Reimbursement Cost Framework for the walnut industry. Consultation was undertaken on the EPPR levy and the request to implement the levy, set at zero, is currently with the Minister for Agriculture.

Table 45. 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 84. Annual value of walnut production, 2007–18

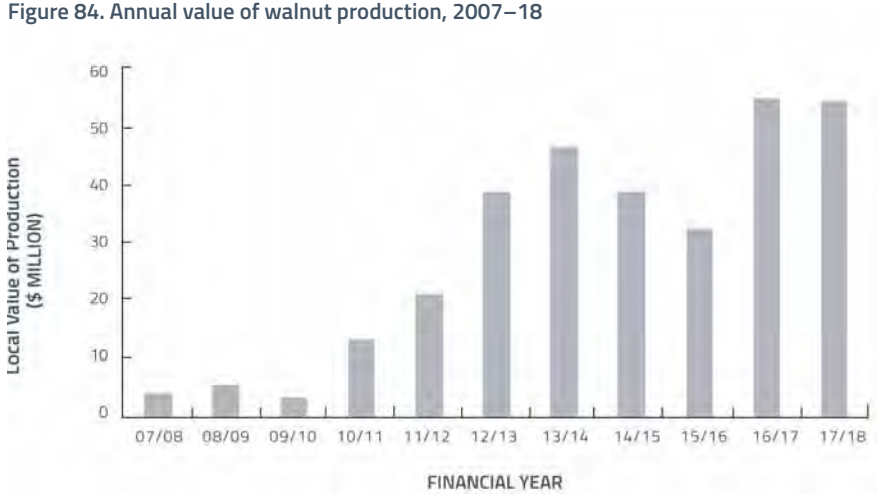
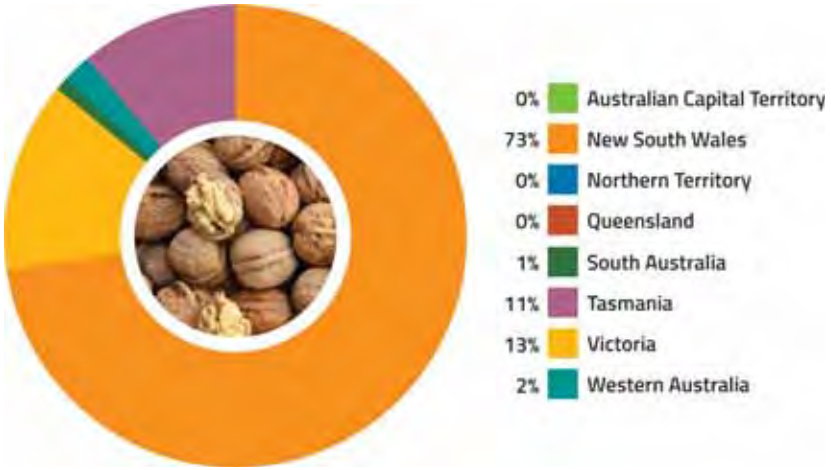


Figure 85. Distribution of walnut production by state and territory, 2017–18 (based on LVP)



WINE GRAPES

Represented by Australian Grape and Wine
agw.org.au

In 2017–18, the Australian wine industry was valued at $943 million (LVP) and the value of wine exports grew 20 per cent to $2.76 billion as a result of 10 percent increase in volume exported and a nine per cent increase in price per litre

The wine industry has a significant footprint in Australia, with more than 6,000 wine grape growers, a vineyard area of 146,128 hectares, and 2,400 Australian wine producers blending grapes into wine. 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.

Australian Grape & Wine promotes biosecurity within the wine sector and the viticulture industry more broadly, and since its inception in February 2019 has convened a Wine Biosecurity Committee as a mechanism for coordinating and prioritising biosecurity work across the wine sector and promoting leadership.

Australian Grape & Wine includes regular biosecurity updates via their member newsletter, as well as working with Vinehealth Australia to develop biosecurity alerts in the event of serious endemic pest events or exotic pest incursions impacting the sector. Recognising the potential impacts on horticulture crops in Australia, in 2019 Hort Innovation and Wine Australia jointly funded the national Xylella preparedness initiative (see page 44).

Figure 86. Annual value of wine grape production, 2007–18

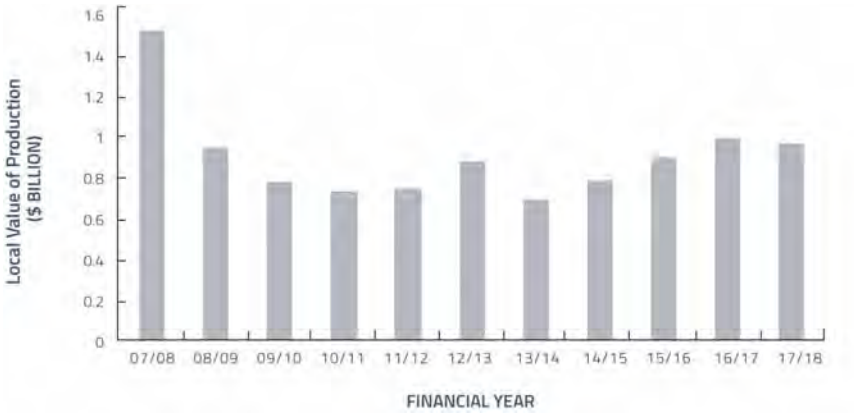
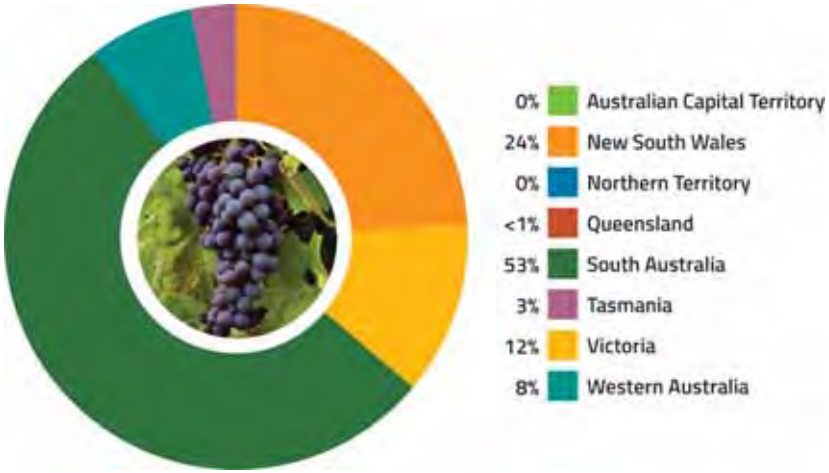


Table 46. High Priority Pests of the wine grape industry

Scientific name	Common name
Bactrocera carambolae	Carambola fruit fly
Bactrocera dorsalis (syn. *B. invadens, B. papayae, B. philippinensis*)	Oriental fruit fly
Candidatus Phytoplasma solani	Bois noir
Daktulosphaira vitifoliae (exotic strains)	Grapevine phylloxera
Drosophila suzukii	Spotted wing drosophila
Grapevine flavescence dorée phytoplasma	Flavescence dorée
Guignardia bidwellii	Black rot
Homalodisca vitripennis (syn. *H. coagulata*)	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 (subsp. not specified)	Pierce's disease, blueberry leaf scorch, olive leaf scorch, olive quick decline, phony peach, plum leaf scald

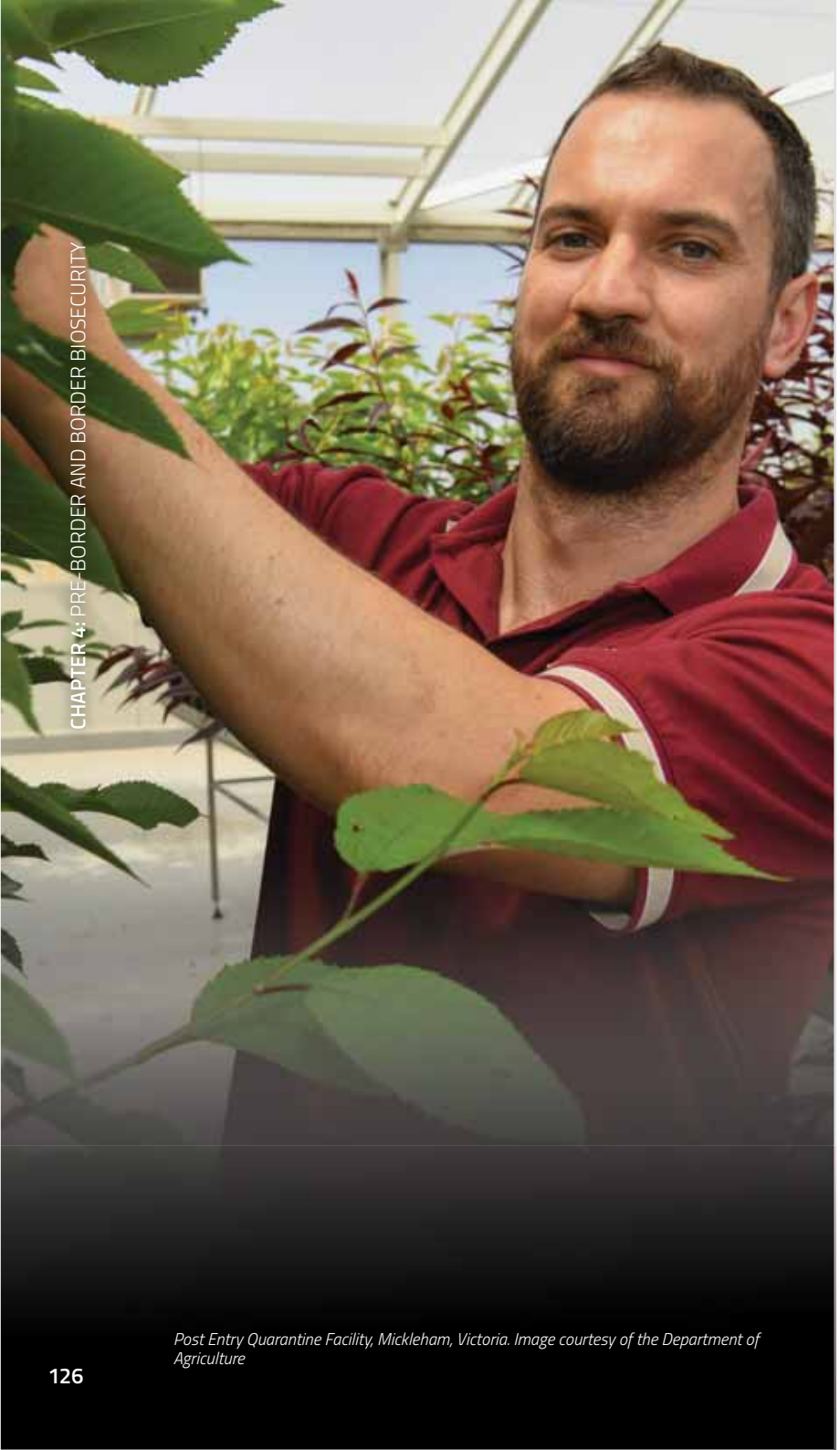
Figure 87. Distribution of wine grape production by state and territory, 2017–18 (based on LVP)



Chapter 4

Pre-border and border biosecurity

Image courtesy of Department of Agriculture



Post Entry Quarantine Facility, Mickleham, Victoria. Image courtesy of the Department of Agriculture

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 importing countries. To mitigate the risks, the Australian Government performs a number of activities pre-border and at the border to safeguard our biosecurity status and maintain trade.

The Department of Agriculture 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.

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. The Australian Government's efforts to support exports is covered in this chapter.

Pre-border biosecurity

OBLIGATIONS UNDER INTERNATIONAL TRADE AGREEMENTS

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 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.

Port Brisbane. Image courtesy of the Department of Agriculture

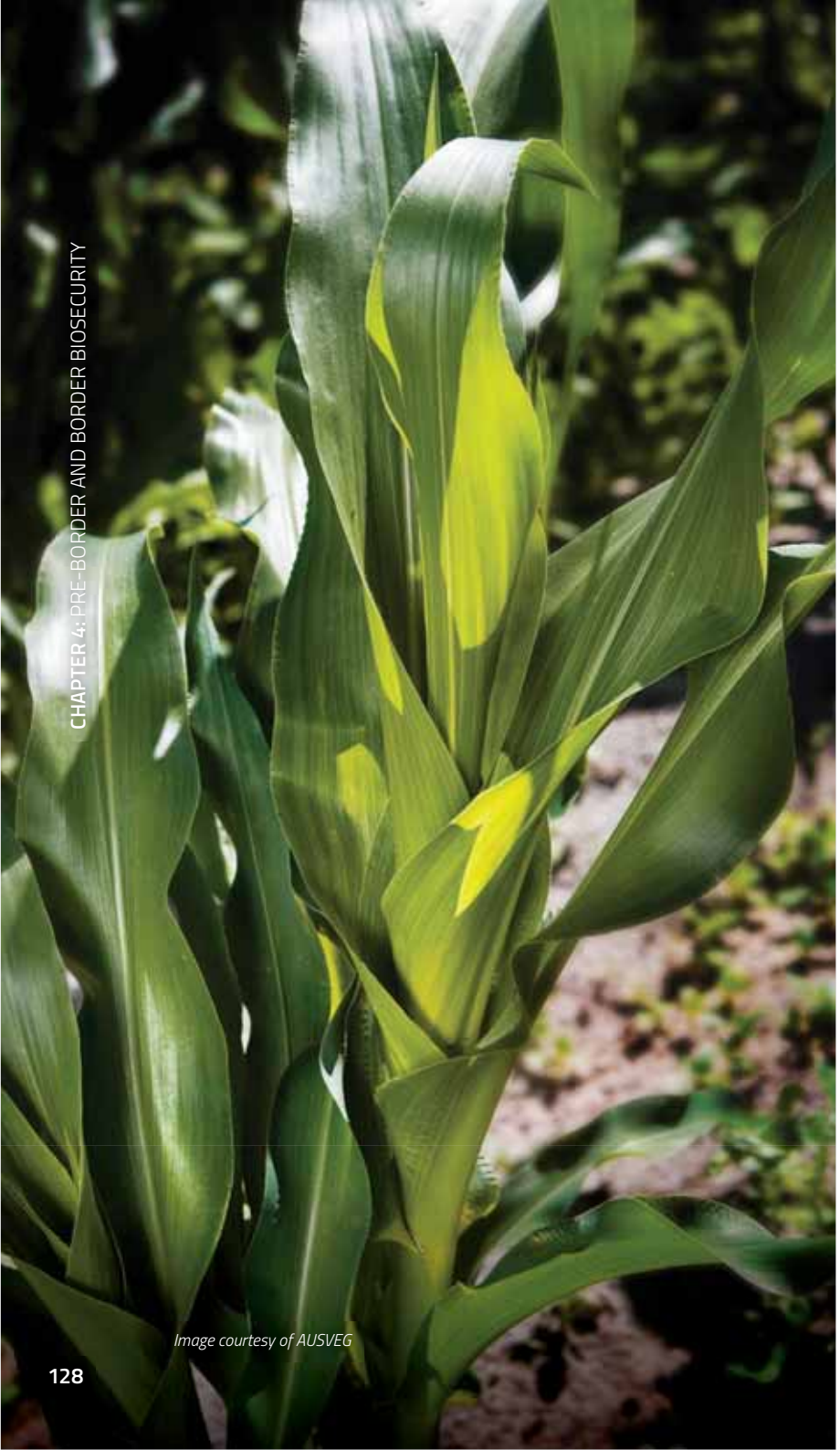


Image courtesy of AUSVEG

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, 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 the 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 to raise and address plant health matters related to international trade. The department consults with peak industry groups and state and territory governments as appropriate, 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 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.

A workshop on irradiation as a phytosanitary measure was held in 2019. The proposed workshop on risk categorisation and mitigation for semi-processed products under ISPM 32 has been rescheduled to 2021.

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 2019, the PPPO hosted an IPPC regional workshop to consider draft ISPMs and other IPPC activities. A meeting of the PPPO Executive Committee was also held with Australia attending as a member.

PRE-BORDER ACTIVITIES TO MITIGATE THE RISKS FROM IMPORTS

The Department of Agriculture 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 (BICON) database
- establishing offshore risk management schemes in partnership with industry and National Plant Protection Organisations (NPPOs)
- education and awareness activities.

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 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 the Convention on International Trade in Endangered Species (CITES) 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 Biosecurity Import Risk Analyses (BIRAs), pest risk assessments and policy reviews. BIRAs have a timeframe for completion which is regulated by legislation and the process includes mandated public consultation periods and a formal appeal process.

A risk analysis 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.

Risk analyses 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.

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

Table 47 details policy advice finalised by December 2019, as well as draft policy advice that is currently in progress.

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
- 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 usually undertaken because of a change in biosecurity risk such as a change in pest status or new scientific information. The reviews can also be initiated by requests from an industry body or country, and usually result in more treatment options for importers 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.

In 2019, the Department of Agriculture announced final import policy advice for avocados from Chile, breadfruit from Fiji, Samoa and Tonga, dates from the Middle East and North Africa, longans from Vietnam, pineapple (decrowned) from Taiwan and brassicaceous vegetable seeds from all countries. There were also final pest risk analyses released for brown marmorated stink bug (*Halyomorpha halys*), cut flowers and foliage (Part 1), and mealybugs and the viruses they transmit from all countries.

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 47. Australian Government import policy advice, final and in progress [28]

Year	Commodity	Country (from)
Finalised policy advice		
1998	Apples (Fuji)	Japan
1998	Pears (Ya)	China
1999	Durian	Thailand
1999	Mangoes	Philippines
1999	Pears	Korea
2000	Durian (supplement)	Thailand
2000	Seed contaminants (review of tolerances)	All countries
2002	Apple and pear (budwood)	Generic
2002	Citrus	Egypt
2002	Grapes (table)	USA
2002	Lentil (seed and human consumption)	All countries
2002	Papaya	Fiji
2002	Pineapple	Philippines, Solomon Islands, Sri Lanka, Thailand
2002	Tomato (truss, review)	New Zealand
2003	Cherries (into Western Australia)	New Zealand
2003	Citrus (revision)	Israel
2003	Grapes (table, revisions)	USA
2003	Maize (bulk)	USA
2003	Olive (plants from approved sources)	Generic
2003	Pears (Asian)	China
2003	Pineapple (modification)	Philippines, Solomon Islands, Sri Lanka, Thailand
2003	Pome fruit testing	China, Japan, Korea
2003	Sweet corn (seed)	USA
2003	Tomato (truss)	Netherlands
2004	Lychee and longan	China, Thailand
2004	Mangosteen	Thailand
2004	Persimmon	Israel, Japan, Korea
2005	Grapes (table)	Chile
2005	Oranges (sweet)	Italy
2005	Pears	China
2006	Grains	Various
2006	Grapes (table, revisions)	USA
2006	Limes (Tahitian)	New Caledonia
2006	Mangoes	Taiwan
2006	Permitted seeds	All countries
2006	Stone fruit (into Western Australia)	New Zealand
2006	Wood packaging	Generic

28. Australian Government Department of Agriculture. Plant risk analyses. agriculture.gov.au/biosecurity/risk-analysis/plant

Table 47. Australian Government import policy advice, final and in progress (continued)

Year	Commodity	Country (from)
Finalised policy advice (continued)		
2007	Apples	New Zealand
2007	Avocado (revision)	New Zealand
2007	Grains	Various
2007	Lettuce (reinstatement)	New Zealand
2008	Grains	Various
2008	Mangoes	India
2009	Bananas	Philippines
2009	*Candidatus* Liberibacter psyllaurous (capsicum, nursery stock, potato tubers, tamarillo fruit, tomato)	New Zealand, USA
2009	Capsicum	Korea
2009	Mandarin (Unshu)	Japan
2010	Apples	China
2010	Hops propagative material	All countries
2010	Mangoes	Philippines (additional areas)
2010	Phalaenopsis orchids (nursery stock)	Taiwan
2010	*Plectonycha correntina* for the biological control of Madeira vine	Source country
2010	Stone fruit	USA
2011	Apples	New Zealand (review)
2011	*Candidatus* Liberibacter spp. and their vectors associated with Rutaceae	All countries
2011	Grapes (table)	China
2011	Grapes (table)	Korea
2011	Hazelnut propagative material	Chile
2011	Mangoes (revisions)	India
2011	Mangoes	Pakistan
2011	*Pseudomonas syringae* pv. *actindae*	New Zealand
2011	Taro corms (fresh)	Generic
2012	*Eueupithecia cisplatensis* for the biological control of the weed *Parkinsonia aculeata*	Source country
2012	Mangosteen	Indonesia
2012	Pineapple (de-crowned)	Malaysia
2013	*Drosophila suzukii* (spotted wing drosophila)	All countries
2013	Ginger	Fiji
2013	Grapevine propagative material	All countries
2013	Island cabbage	Cook Islands, Fiji, Samoa, Tonga, Vanuatu
2013	*Lilium* spp.	Taiwan
2013	Lychee	Taiwan, Vietnam
2013	*Mastrus ridens* for the biological control of codling moth, *Cydia pomonella*	Source country
2013	Potato propagative material (*Solanum tuberosum*)	All countries
2014	*Baeodromus eupatorii* for the biological control of the weed *Ageratina adenophora*	Source country
2014	*Cydia succedana* for the biological control of gorse, *Ulex europaeus*	Source country
2014	*Eueupithecia* spp. (two) for the biological control of the weed *Parkinsonia aculeata*	Source country
2014	Grapes (table)	Japan
2014	Salacca	Indonesia
2014	Tortricid moth, *Cydia succedana*, for the biological control of gorse, *Ulex europaeus*	Source country
2015	*Dactylopius tomentosus* (fulgida) for the biological control of coral cactus *Cylindropuntia fulgida* var. *mamillata*	All countries
2015	Fresh ginger	Fiji
2015	Mangoes	Indonesia, Thailand, Vietnam
2015	*Phytophthora* spp. host propagative material	All countries
2015	*Tachardiaephagus somervillei* for the biological control of yellow lac scale	All countries

Table 47. Australian Government import policy advice, final and in progress (continued)

Year	Commodity	Country (from)
Finalised policy advice (continued)		
2016	Grapes (table)	India
2016	Grapes (table)	Sonora, Mexico
2016	Grapes (table, into Western Australia)	USA
2016	Nectarines	China
2016	Poppy straw for processing	Turkey, Hungary, Portugal
2016	*Zantedeschia* spp. propagative material	All countries
2017	*Candidatus* Liberibacter solanacearum (apiaceous crops, including carrot and celery)	All countries
2017	*Cucumber green mottle mosaic virus* pest risk analysis (host cucurbit seeds)	All countries
2017	Dragon fruit	Vietnam
2017	Peaches, plums and apricots (extention to nectarine IRA)	China
2017	Strawberries	Korea
2017	Thrips and Orthotospoviruses	All countries
2018	*Cecidochares connexa* for the biological control of *Chromolaena odorata*	Source country
2018	Dragon fruit	Indonesia
2018	*Kordyana brasiliensis* for the biological control of *Tradescantia fluminensis*	Source country
2018	Limes	Cook Islands, Niue, Samoa, Tonga, Vanuatu
2019	Avocado	Chile
2019	Brassicaceous vegetable seeds	All countries
2019	Breadfruit	Fiji, Samoa, Tonga
2019	Brown marmorated stink bug (*Halyomorpha halys)*	All countries
2019	Dates	Middle East and North Africa region
2019	Longan	Vietnam
2019	Mealybugs and viruses they transmit	All countries
2019	Pineapple (de-crowned)	Taiwan
Draft policy advice (in progress)		
2009	Apples (stop the clock provisions have been activated on this policy)	USA
2012	Potatoes for processing	New Zealand
2017	Apiaceous crop seeds (review of import conditions)	All countries
2017	Cucurbitaceous crop seeds (review of import conditions)	All countries
2017	Strawberries	Japan
2018	*Capsicum* spp.	Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga, Vanuatu
2018	Chinese jujubes	China
2018	Cut flower and foliage (extension of consultation period for another six weeks)	All countries
2018	Limes	Mexico
2018	*Pepino mosaic virus* and pospiviriods in tomato seeds	All countries
2018	Pomegranate	India
2018	*Xylella* bacterial pathogens	All countries
2019	*Puccinia spegazzinii* for the biological control of *Mikania micrantha*	Source country

Regulating bulk grain imports to safeguard Australia's biosecurity status

In June 2019 Australia received its first imports of wheat since 2007, as the drought impacted production in major grain growing areas of eastern Australia. The Department of Agriculture issued ten permits for single shipments of Canadian wheat after receiving applications to import bulk grain from the United States and Canada.

Applications require a thorough risk assessment, and site and desk audits of the proposed import pathway. It must be determined that the risks along the entire import pathway can be managed to an acceptable level, otherwise a permit will not be issued.

The department had engaged extensively with stakeholders since mid-2018 about the best way to meet industry's needs while maintaining Australia's freedom from pests and diseases. Out-of-date protocols established in the drought of 1994–5 for managing the biosecurity risks associated with imported grains were updated to align with the *Biosecurity Act 2015*.

Importing grain is a commercial decision by importers. The responsibility of the department is to protect Australia's biosecurity by ensuring appropriate risk reduction measures are in place.

With Australia's climate predicted to become more variable over time, and the associated likely impacts to grain production, imports are expected to become more frequent in future. The advice is that applying for a permit is a complex and extensive process that may require investment in new infrastructure. Businesses considering importing should assess their need for grain and plan early.

The first shipment of Canadian bulk wheat being inspected by biosecurity staff upon arrival at Port Kembla in June 2019. Image courtesy of the Department of Agriculture

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, limits their spread, and reduces 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.

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 targeted campaigns, and to support identification and management of non-compliance, enabling resources to be focused on the areas of greatest risk. See also High Priority Pests and National Priority Plant 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, sugar and cotton, export almost everything that is grown. Just as imports are subject to restrictions to protect plant health, exports must also meet conditions, such as 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 regulates the provision of 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, hay and straw, specific prescribed grains, and other plants or plant products for which a phytosanitary certificate, or any other official certificate, is required by an importing country authority.

More specific legislation relating to the export of plants and plant products is listed in Table 48. Strong linkages are maintained with exporters through industry consultative committees (e.g. 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.

Post Entry Quarantine Facility staff member, Mickleham, Victoria. Image courtesy of the Department of Agriculture

Table 48. Australia's export legislation, administered by the Department of Agriculture

Legislation
Export Charges (Collection) Act 2015
Export Charges (Collection) Regulation 2015
Export Charges (Imposition – Customs) Act 2015
Export Charges (Imposition – Customs) Regulation 2015
Export Charges (Imposition – Excise) Act 2015
Export Charges (Imposition – General) Act 2015
Export Charges (Imposition – General) Regulation 2015
Export Control Act 1982
Export Control (Fees) Order 2015
Export Control (Hardwood Wood Chips) Regulations 1996
Export Control (Orders) Regulations 1982
Export Control (Organic Produce Certification) Orders
Export Control (Plants and Plant Products) Order 2011
Export Control (Plants and Plant Products – Norfolk Island) Order 2016
Export Control (Prescribed Goods – General) Order 2005
Export Control (Regional Forest Agreements) Regulations
Export Control (Unprocessed Wood) Regulations
*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**
Primary Industries (Customs) Charges Act 1999
Primary Industries (Customs) Charges Regulations 2000

* Proposed for repeal

New measures to stop the arrival of unwanted pests with cut flower imports

The Department of Agriculture has been working with domestic and overseas stakeholders to implement new measures to ensure that imported fresh cut flowers and foliage do not compromise Australia's biosecurity status.

A review in 2017 found inspection failure rates for consignments of cut flowers and foliage from some countries were unacceptably high. As a result, the department made significant changes to the import conditions for fresh cut flowers and foliage in March 2018. An improvement in compliance was seen from most countries under the changes, including a significant reduction in the total number and diversity of pests being intercepted.

In September 2019, mandatory import permits were introduced to address the risks posed by a small number of high-volume exporting countries who were not complying with the requirements. Importers must now seek approval prior to importing from these countries. The importer's supply chain management system must meet Australia's biosecurity requirements before a permit will be issued by the department, and importation can be suspended or cancelled at any time.

Monitoring the compliance of all other countries continues and import permits may be mandated for other markets should the need arise. The same approach may be used to reduce the biosecurity risks from long-standing trade arrangements for other imported plant commodities.

Compliance of imported fresh cut flowers is improving under changed import conditions, including a significant reduction in the total number and diversity of pests being intercepted at the border. Image courtesy of the Department of Agriculture

Meeting biosecurity conditions of importing countries

To assist Australia's exporters, the Manual of Importing Country Requirements (MICoR) provides information on the specific requirements of importing countries that must be met to export plants and plant products from Australia. This includes 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 and issue of export documentation for primary produce prescribed under the *Export Control Act 1982* and associated legislation.

The system provides certification for plant and plant product 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.

With funding from the Agricultural Competitiveness White Paper, the Department of Agriculture has developed new policies to improve regulation across the export certification system. This includes standards for cold treatment, fumigation, irradiation, dipping in dimethoate and vapour heat treatment, and processes to manage and audit accredited properties and treatment facilities.

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 conducted 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.

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 on the industry's priorities for new or improved market access requests is provided through Hort Innovation's Trade Assessment Panel.

Table 49 (see page 138) details market access achievements since 2000, including access to new markets, improving opportunities in existing markets, and preserving existing market access.

In 2019 Australia gained market access for almonds to Chile and walnuts to India, for beet and carrot seeds to Ecuador and for radish and beet seeds to Mexico. Improved market access was gained for table grapes to New Zealand. Australia maintained market access for: ware potatoes to Korea; summerfruit, table grapes and cherries to China; and for key fruit and vegetables to Europe through new phytosanitary conditions applied by the European Union.

Visit by biosecurity partners from the Pacific

In May and June 2019 biosecurity specialists from Papua New Guinea and the Pacific islands came to Australia to strengthen their skills and build professional networks in their region.

The Pacific Plant Biosecurity Partnership is a joint initiative of the Australian Centre for International Agricultural Research and the Crawford Fund, involving biosecurity organisations in Australia and New Zealand.

The 19 participants took part in a week of workshops, lectures, group activities and networking to give them the opportunity to practice real-time critical analysis and negotiation skills while taking part in market access simulations. They were each hosted for several weeks in various organisations before doing a course in communication, engagement and advocacy.

Participants from the Pacific taking part in a course in communication, engagement and advocacy in Brisbane. Image courtesy of the Crawford Fund

Table 49. Market access achievements for pollinator and plant product exports from Australia since 2000

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

Table 49. Market access achievements for pollinator and plant product exports from Australia since 2000 (continued)

Year achieved	Country	Commodity
Market access gained and restored (continued)		
2014	Grape seed	China
2014	Summerfruit (apricots, plums, nectarines and peaches)	Thailand
2014	Table grapes	Japan
2014	Table grapes	South Korea
2015	Blueberries	India
2015	Citrus – market access restored following import suspensions for Australian fruit	Vietnam
2015	Lentils – market access restored	Saudi Arabia
2015	Mangoes and lychees	USA
2015	Onion seed, sowing	Mexico
2015	Table grapes – market access restored following suspension for all Australian fruit	Vietnam
2016	Honey bees (live queens)	Fiji
2016	Honey and other apiculture products	French Polynesia
2016	Melon (*Cucumus melo*)	Japan
2016	Nectarines	China
2016	Watermelons	Japan
2017	Cherries	Vietnam
2017	Honey	Saudi Arabia
2017	Lentils	Iran
2017	Logs without bark and sawn timber	Iran
2017	Plants and plant products	Myanmar
2017	Queen bees	Solomon Islands
2017	Vegetable seeds, sowing	Chile
2018	All melons	Kuwait
2018	Hard mature avocados	Japan
2018	*Phaseolus vulgaris* (bean) seed	Iran
2018	Strawberries	United Arab Emirates
2019	Almonds	Chile
2019	Beet seeds	Ecuador
2019	Beet seeds	Mexico
2019	Carrot seeds	Ecuador
2019	Radish seeds	Mexico
2019	Walnuts	India
Improvements in market access		
2005	Citrus – 2–3 degree cold disinfestation	Thailand
2005	Zucchini – removal of Queensland fruit fly from the pest list	New Zealand
2006	Carrots – freedom from nematode	South Korea
2006	Citrus – 3 degree cold disinfestation	South Korea
2006	Mangoes – new phytosanitary requirements	Malaysia
2006	Multiple products (from Tasmania) – reinstatement of Queensland fruit fly area freedom	Taiwan
2006	Tomatoes – improved conditions	New Zealand
2007	Citrus – 2–3 degree cold disinfestation	Japan
2008	Cherries (from Tasmania) – revised protocol	Japan
2008	Citrus – in-transit cold disinfestation	Indonesia
2008	Mangoes, irradiated	India
2008	Mangoes – reduced inspection rate	Japan
2008	Multiple products – 2–3 degree cold disinfestation	Taiwan
2008	Multiple products – removal of Standard Operating Policy and Procedure requirement	United Arab Emirates
2008	Oats	India
2008	Table grapes – in-transit cold disinfestation	Indonesia
2009	Citrus – revised protocol	China
2009	Mangoes – revised protocol	China
2010	Apples (from Tasmania) – improved conditions	China

Table 49. Market access achievements for pollinator and plant product exports from Australia since 2000 (continued)

Year achieved	Country	Commodity
Improvements in market access (continued)		
2010	Cherries (from mainland) – stand alone cold treatment	USA
2010	Citrus	South Korea
2010	Grapefruit	Japan
2011	Citrus – 3 degree cold disinfestation	USA
2011	Citrus – in-transit cold disinfestation from non pest free areas	Indonesia
2011	Macadamia nuts	India
2011	Table grapes – in-transit cold disinfestation from non pest free areas	Indonesia
2012	Apples	USA
2012	Avocado – in-transit cold treatment	New Zealand
2012	Citrus (unspecified) – 3 degree in-transit cold treatment	India
2012	Citrus (unspecified) – in-transit cold treatment	New Zealand
2012	Citrus (unspecified) – more favourable temperatures and flexible conditions	India
2012	Pears – in-transit cold treatment	New Zealand
2012	Table grapes – in-transit cold treatment	New Zealand
2013	All products – FTA negotiations concluded in December 2013	South Korea
2013	Apples	Taiwan
2013	Canola	China
2013	Citrus – some import limitations removed by Thailand	Thailand
2013	Fruit – revised protocol including favourable cold treatment conditions	Phillipines
2013	Grain and seed	Iran
2013	Grain and seed	Libya
2013	Hay	Qatar
2013	Plants and plant products	Hong Kong
2013	Soybeans – removal of a five per cent tariff	Indonesia
2013	Wheat	Kenya
2014	Grain and seed	Thailand
2015	Cherries – improved inspection rates	Korea
2015	Cherries – new temperature for cold treatment	Thailand
2015	Citrus – more varieties approved for export from non pest free area districts	Thailand
2015	Persimmons – irradiation for fruit fly control	Thailand
2015	Table grapes – new temperature for cold treatment	Thailand
2015	Wheat and barley – access improved with new protocol	China
2016	Blood oranges and other sweet orange varieties	Korea
2016	Kangaroo paw nursery stock	Colombia
2016	Lychees	USA
2016	Mango	USA
2016	Pumpkins	Japan
2016	Walnuts	Japan
2017	Chickpeas	Iran
2017	Chickpeas	Pakistan
2017	Lentils	Bangladesh
2017	Wheat	Iran
2018	De-hulled kiln dried oats	India
2018	Persimmons	Thailand
2018	Rolled oats and oat flakes	Iran
2018	Seed potatoes	Indonesia
2019	Table grapes	New Zealand

Table 49. Market access achievements for pollinator and plant product exports from Australia since 2000 (continued)

Year achieved	Country	Commodity
Maintained in market access		
2004	Citrus	Thailand
2004	Citrus	Various
2004	Cut and dried flowers	Malaysia
2004	Potatoes	South Korea
2006	Multiple products	Indonesia
2007	Citrus	Mauritius
2007	Citrus (unspecified)	China
2007	Grain	India
2007	Summerfruit	Canada
2008	Potatoes	Mauritius
2009	Multiple products	Thailand
2010	Lychees	New Zealand
2010	Mangoes	New Zealand
2010	Papaya	New Zealand
2011	Citrus	Thailand
2011	Multiple products	Thailand
2011	Multiple products	Vietnam
2011	Summerfruit (peaches and nectarines)	Taiwan
2011	Table grapes	Thailand
2012	Barley (malting), processing	South Korea
2012	Multiple products	Indonesia
2012	Multiple products	Vietnam
2012	Pome fruit	India
2012	Summerfruit (plums)	Taiwan

Year achieved	Country	Commodity
Maintained in market access (continued)		
2013	All products – implementation of a new security paper for export health certificates	All markets
2013	Apples	Thailand
2013	Apples – revised improved export protocol	Taiwan
2013	Avocado	Thailand
2013	Cottonseed, for stock feed – reinstated methyl bromide fumigation and new tolerance levels	USA
2013	Kiwifruit	Thailand
2013	Pears	Thailand
2013	Persimmon	Thailand
2013	Strawberries	Thailand
2014	Table grapes	China
2015	Grains, consumption	Vietnam
2015	Nuts, consumption	Vietnam
2015	Plant based stockfeed	Vietnam
2015	Seed, sowing	Vietnam
2015	Wheat – access maintained for grain for consumption	Indonesia
2016	Mangoes	Korea
2016	Wheat flour	India
2017	Fruit fly host commodities	New Zealand
2017	Plants and plant products	Myanmar
2019	Cherries, summerfruits, table grapes – treatment options	China
2019	Citrus, Mangifera, *Prunus* spp., Solanaceae	European Union
2019	Ware potatoes	Korea

Melbourne docks. Image courtesy of the Department of Agriculture

Plant pest surveillance supports market access

Governments and industries conduct systematic checks for 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 which concluded in June 2019, strengthening the ability of Australian industry groups and governments to collate, share, analyse and report surveillance data on plant pests, including fruit flies.

Better access to more surveillance data gives trading partners confidence in claims of pest absence and area freedom. For exporters this minimises delays and allows 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.

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 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 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, travellers, and senders of mail
- 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. Between January and October 2019 over 235,000 biosecurity risk items were intercepted at Australia's international airports: 50,000 at Melbourne, over 34,000 at Perth and over 80,000 at Sydney.[29] In the same period, around 87 million mail items moved through mail centres: the most common risk items intercepted were seeds, meat and other animal products such as pet treats.

Melbourne airport biosecurity compliance. Image courtesy of Michael Masters

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 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 seaports and airports where international arrivals are permitted. 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, operators at seaports must manage vegetation to ensure weed species do not flower and spread seed.

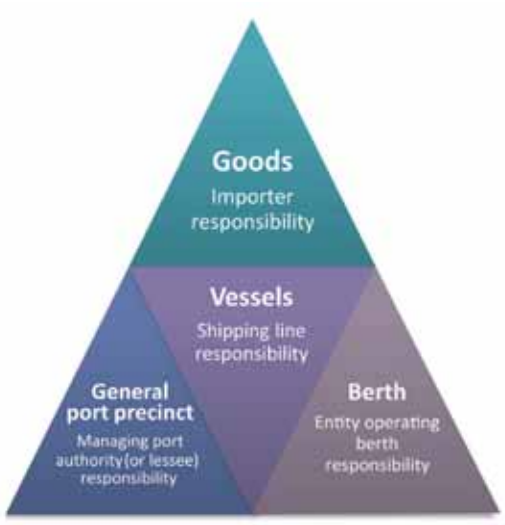
A map of the points of entry for vessels is available from the Department of Agriculture website **agriculture.gov.au/biosecurity/avm/vessels/first-point-entry-and-non-first-point-entry**

The See. Secure. Report. Hotline (1800 798 636) is for FPoE workers to report any biosecurity risks they find during day-to-day operations.

The special responsibilities of FPoE authorities, operators and staff are an example of the biosecurity responsibilities of every Australian (see Figure 88 on page 144).

29. Australian Government Department of Agriculture. Christmas biosecurity risks unwrapped. Accessed online 7 April 2020 awe.gov.au/news/media-releases/christmas-biosecurity-risks-unwrapped

Figure 88. 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

GOVERNMENT SCREENING AND INSPECTION

The Department of Agriculture employs more than 4000 staff,[30] some 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 and the Australian Border Force, which police people movements and intercept 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. 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 inspection 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. Any goods that present an unacceptable level of biosecurity risk will be managed according with the *Biosecurity Act 2015*.

Depending on the risk, you may:

- pay for the goods to be treated to reduce the biosecurity risk (for example, fumigation, gamma irradiation)
- pay to export the goods from Australia
- destroy the goods.

The first two options are subject to fees and special conditions may apply.
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. A stronger approach to enforcement of the *Biosecurity Act 2015* led to the first tourist visa cancellation for a biosecurity breach in October 2019.[31] This was quickly followed by more in November.[32] The visitor's visas were cancelled for failing to declare food concealed in luggage, or knowingly providing false or misleading information.

30. Australian Government. Transparency Portal. Accessed online 31 March 2020 transparency.gov.au
31. Australian Government Department of Agriculture. Biosecurity Matters, Edition 4, 2019. Accessed online 4 April 2020 agriculture.gov.au/biosecurity/australia/reports-pubs/biosecurity-matters/2019-04
32. Australian Government Department of Agriculture. Biosecurity Matters, Edition 5, 2019. Accessed online 4 April 2020 agriculture.gov.au/biosecurity/australia/reports-pubs/biosecurity-matters/2019-05

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 the mail article declaration. The department applies risk profiles to all international mail to target high biosecurity risks. Biosecurity officers assess the risk based on the declaration and use detector dogs and x-ray machines to screen packages.

Some goods may require treatment (at the importer's expense) before they are permitted into Australia. Goods that are not permitted will either be exported back to the sender overseas or 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 are used by the Department of Agriculture and play a key role in helping to protect Australia from exotic pests and diseases. 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 need to have an extraordinary sense of smell, be cooperative 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. In 2019, detector dogs intercepted more than 56,000 biosecurity risk items in airports and mail centres.[33]

The department's dogs are multipurpose and deploy across a wide range of environments. They will offer a different behaviour when target material is detected, based on the type of item they are screening.

- When screening at international passenger terminals they will sit beside the item or person of interest to indicate that they have found something. This is called a passive response and is a safe, non-intrusive method of indicating to people.
- When screening mail or cargo items, dogs will offer a focused dig at the source of the target odour. This is called an active response and allows the team to pinpoint the exact item from amongst many.

33. Australian Government Department of Agriculture. Pawsome detector dog achievements in 2019. Accessed online 7 April 2020 awe.gov.au/news/media-releases/pawsome-detector-dog-achievements-2019

Around 40 detector dog teams operate in international airports, seaports, mail centres and courier depots throughout Australia. Image courtesy of the Department of Agriculture

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. National border surveillance teams are located in the ports of Brisbane, Sydney, Melbourne, Adelaide, Perth, Darwin and Cairns.

The teams' scope of work includes site assessments and 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[34]), and areas associated with or surrounding these.

An assessment is made of the biosecurity risk a site poses based on the type, quantity and origin of the goods it receives and factors such as the type of vegetation present, presence of dunnage or other rubbish piles, level of weed control and maintenance of surfaces. The aim is to detect 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. Surveillance contributes to Australia's area freedom determinations by looking for the National Priority Plant Pests in the border vicinity.

Data from border surveillance is also used to inform policy when reviewing import conditions and requirements for Approved Arrangements. More about pest surveillance is in Chapter 5.

Figure 89. Biosecurity risk pathways regulated by NAQS

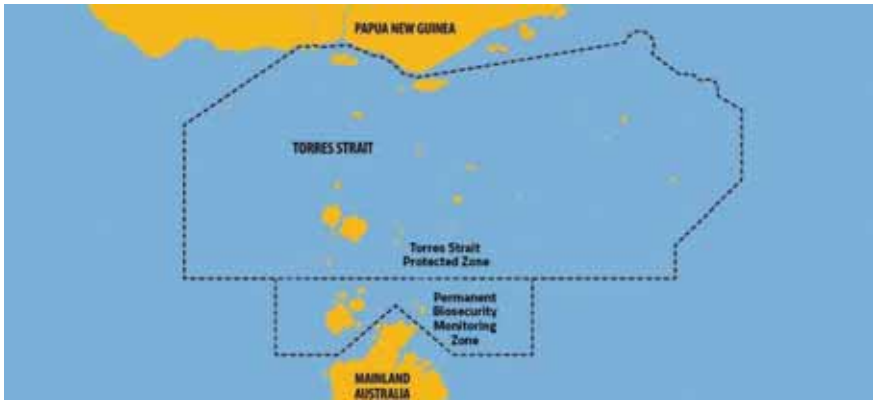


Image courtesy of the Department of Agriculture

34. Approved Arrangements, previously Quarantine Approved Premises and Compliance Agreements, are voluntary arrangements entered into with the Department of Agriculture. These arrangements allow operators to manage biosecurity risks and/or perform the documentary assessment of goods in accordance with departmental requirements, using their own sites, facilities, equipment and people, and without constant supervision by the department and with occasional compliance monitoring or auditing.

PROTECTING OUR NORTHERN COASTLINE

The unique biosecurity threats in Australia's north – stretching from Cairns in Queensland to Broome in WA and including the Torres Strait – are managed by the Department of Agriculture's 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 that are not present in Australia, which could spread to Australia by human activities or 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 staff notify relevant authorities when a pest, disease or weed is found that is a new record for Australia or is an extension to a pest's known range or host. This intelligence improves national and local incursion responses and aids in determining plant pest status across the north.

In the 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 the movement 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.

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 – including Oriental fruit fly and melon fly – are present in Papua New Guinea and are one of the biggest biosecurity risks to Australia's horticultural industries. 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 throughout the Torres Strait islands 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 is managed by the Queensland Department of Agriculture and Fisheries and 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

While imported live plant material can introduce foreign plant pests and diseases, 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, subject to conditions and risk assessment processes. These include 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, applying for an import permit. The national plant protection organisation of the country of export will inspect the plants and issue a phytosanitary certificate prior to export. New species that have not previously been imported will also 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 50).

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 50. 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 Approved Arrangement sites for medium-risk plant material***	–	11	15	7	7	53	10	–
Scientific (S) and state government (SG) Approved Arrangement sites for medium-risk plant material***	11 S	4 S 2 SG	3 S 1 SG	7 S 3 SG	3 S	2 S 2 SG	6 S 2 SG	–

** Note the table represents Australia's post-entry plant quarantine facilities as at 28 January 2020, however the number of approved facilities is subject to change over time.*

*** Note these figures represent facilities and organisations as a whole and does not include the individual Approved Arrangement sites that may be associated with them.*

**** Note these figures represent individual Approved Arrangement sites and not facilities or organisations as a whole.*

NAQS rangers conduct fruit fly surveillance in northern Australia. Image courtesy of Kerry Trapnell

Chapter 5

Plant pest surveillance and diagnostics

Post border biosecurity – 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 critical components of the system.

Surveillance is a system of checking and recording the presence or absence of plant pests, while diagnostics is used to precisely identify a plant pest, including species that are not known to be present in Australia.

The information derived from surveillance and diagnostics provides the basis on which decisions about the status of pest presence, absence and distribution are made. This underpins the profitability, productivity and sustainability of Australia's plant industries and helps protect our landscapes and natural environment from plant pests.

Surveillance is carried out around the country by state governments, the Australian Government and plant industries, with increasing support from the community, and aims to:

- to find new incursions or outbreaks before they spread too far to be eradicated
- to gather the 'evidence of absence' data needed to show overseas trading partners that Australia is free from pests of particular concern
- to monitor the amount or distribution of pests at a national, regional or property level.

Diagnostic services, which rely on scientific expertise, are primarily provided by governments, universities and research organisations, coordinated via a national network.

Definitive identification of pest species, types and strains is done:

- to allow appropriate response to an incursion
- to support pest management
- to provide evidence for pest status (pest presence or absence).

Plant pest surveillance

Information on the presence or absence of plant pests is highly valuable because it underpins many aspects of the biosecurity system. An effective surveillance system enables early detection of plant pests and diseases, supports pest freedom claims and facilitates market access.

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 and help to justify our import conditions to other countries. 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 under the National Plant Biosecurity Strategy to guide national efforts to improve and reform surveillance arrangements. The development of a new ten-year strategy, and an implementation plan for its delivery, commenced in 2019, and will provide a foundation for continued reform and improvement.

National Plant Biosecurity Surveillance System framework

Under the National Plant Biosecurity Surveillance System framework developed in 2017, the Department of Agriculture 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 provides an overview of the national system and is used to identify areas for improvement and reform. It 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 on page 152).

Subcommittee on National Plant Health Surveillance

The Subcommittee on National Plant Health Surveillance of the Plant Health Committee (PHC) provides 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 2019 the key roles of the subcommittee were:

- developing the Reference Standard for National Surveillance Protocols for Plant Pests, including a process for review of National Surveillance Protocols as they are developed
- stablishing 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
- designing processes to prioritise national surveillance efforts
- 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

The Plant Health Surveillance Consultative Committee, established in 2016, 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, Plant Health Committee, 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.

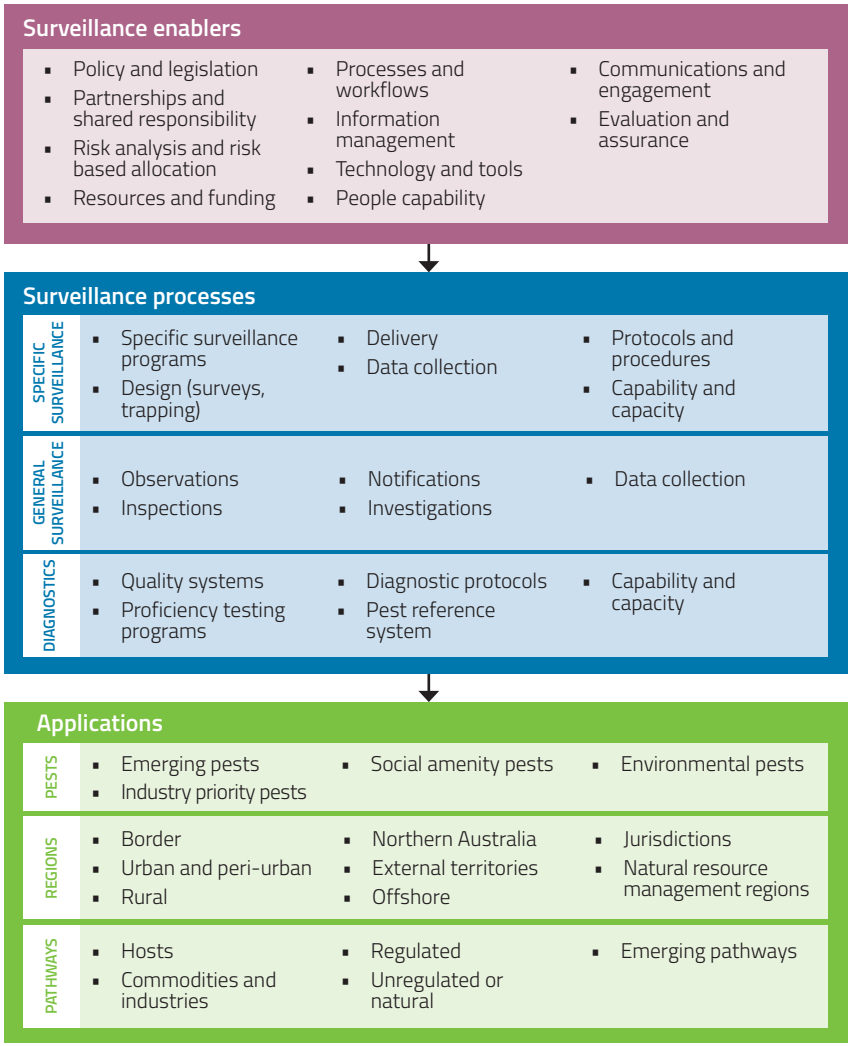
Annual Surveillance Workshop 2019

More than 60 people working in pest surveillance attended the Annual Surveillance Workshop on 13–14 March in Brisbane, becoming part of the newly established Plant Surveillance Network Australasia–Pacific. Attendees came from several plant industries, the Australian Government, state governments, research agencies and New Zealand.

Topics included industry led surveillance, general surveillance, plant pest interception information and pathways for pest movement. These annual workshops are an important way for a wide range of stakeholders to meet, share knowledge and learn about new initiatives in surveillance.

Attendees at the 2019 Annual Surveillance Workshop.

Figure 90. National Plant Biosecurity Surveillance System framework



Australia's national surveillance system framework, developed in 2017. Image courtesy of the Department of Agriculture

GOVERNMENT SURVEILLANCE PROGRAMS

Targeted surveillance is where checks or surveys are made for particular pests, and records are captured. Most targeted surveillance is done by governments, 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 National Border Surveillance Program (see page 146), the Northern Australia Quarantine Strategy (see page 146) and surveillance programs for fruit flies (see page 158). There are also programs that are partnerships between industry and government(s) such as the National Bee Pest Surveillance Program (see page 154) and the Grains Farm Biosecurity Program (see page 206).

These and other surveillance activities across Australia (as shown in Table 51 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 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 around 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 by the program also provides a critical source of the 'evidence of absence' data needed to support trade and market access for Australian producers.

Citrus surveillance and pest triage workshop

A citrus surveillance and pest workshop in Mildura in September built the skills of 50 industry and government personnel in triaging priority pests and diseases in the field to reduce the number of samples needing to be sent to diagnostic laboratories. The workshop also covered collection and packaging of samples for transport to diagnostic laboratories.

Attendees from all Australian states and territories, the citrus industry and the New Zealand Ministry for Primary Industries took part in the workshop run by Plant Health Australia. It was supported with funding from the Australian Government Department of Agriculture and in-kind support from Citrus Australia, Agriculture Victoria and NSW Department of Primary Industries.

Participants put their training into practice and conducted surveillance for pests and diseases in two orchards. They were also given a demonstration of the loop mediated isothermal amplification (LAMP) diagnostic technique and visited a fruit packing shed in Mildura.

The workshop helped to share knowledge and information between industry and government personnel on techniques to improve surveillance for citrus pests and sample collection for pest identification. It also increased understanding of the importance of surveillance for early detection and determining pest status.

Surveillance officers taking part in the citrus surveillance and pest triage workshop. Image courtesy of Plant Health Australia.

Forest pest surveillance in NSW

Forest biosecurity surveillance programs for the early detection of exotic forest pests that threaten native forests, plantations and amenity trees in NSW, Victoria and Queensland are now underway.

NSW Department of Primary Industries Forestry, for example, conducts surveillance at high-risk sites around major ports, such as Port Botany and Port Kembla, that have been determined to be likely entry points for exotic pests. Host trees of target pests are visually assessed for damage, and traps with pest-specific lures are installed from October to March to capture pest insects.

The pests targeted include those of *Pinus* species, but also of hardwood species such as eucalypts that can impact on amenity trees and native forests. Surveillance is designed to increase the chance of detecting pests soon after they arrive and before they spread too far, increasing the chance of eradication (if necessary).

Biosecurity surveillance for exotic forest pests and diseases at Port Botany, showing location of hosts surveyed and insect traps monitored (left), and an insect trap hanging in a tree (right).
Image courtesy of NSW DPI Forestry

INDUSTRY SURVEILLANCE STRATEGIES AND PROGRAMS

Examples of industry surveillance programs (as shown in Table 51 on page 158) include those for grains, cotton, honey bees, mangoes, sugarcane and vegetables, and they are often facilitated by industry biosecurity officers. Surveillance programs for the citrus (see page 207) and forest industries (see below), for which specific national strategies were released in 2018, are being established.

National Forest Biosecurity Program

Activities to initiate a National Forest Biosecurity Program continued in 2019 with the National Forest Biosecurity Coordinator overseeing the establishment of a government–industry partnership to enhance forest pest surveillance.

An assessment of the high-risk pathways for the entry of forest pests into Australia and a pilot of high-risk site surveillance in Queensland, NSW and Victoria is being used to identify the requirements for a risk-based national program of surveillance for forest 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 program is overseen by a National Forest Biosecurity Surveillance Group, with the coordinator working directly with industry, state governments, environmental groups and other stakeholders.

In 2019 the coordinator role was co-funded by the Department of Agriculture (through the Agricultural Competitiveness White Paper) and the Australian Forest Products Association (see page 84).

National Bee Pest Surveillance Program

The National Bee Pest Surveillance Program is an example of a strong biosecurity partnership between the industries that rely on pollination, all state and territory governments, the Northern Australian Quarantine Strategy team and the Australian Government, as well as port staff and beekeepers.

The program, led by PHA, has coordinated surveillance activities at ports nationwide since 2012. It is an early warning system to detect new incursions of a wide range of pests and diseases of honey bees. It also provides technical, evidence-based information to support pest free status for export negotiations and assists exporters meet export certification requirements.

The 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.

From 1 January to 30 November 2019, 176 sentinel hives of European honey bees were located at 32 sea and airports, an increase from 138 in the previous year. These strategically placed sentinel hives are inspected for bee pests including Varroa mite, bee viruses, Tropilaelaps mites, large African hive beetle, small hive beetle and braula fly.

Floral sweep netting is also 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.

With catchboxes also deployed at many ports, there were 1,345 inspections for the presence of European honey bee (EHB, *Apis mellifera*) or Asian honey bee (AHB, *Apis cerana*) in 2019. EHB swarms were captured on five occasions, and despite these catchboxes not being particularly suitable for AHB, this species was captured twice. There were 19 other swarm captures at Australian ports.

Development of new surveillance strategies

The following surveillance strategies funded by the Department of Agriculture's Agricultural Competitiveness White Paper began or were developed in 2019 to support plant industries.

- **National Grain Biosecurity Surveillance Strategy 2019–29** – provides a framework for continued freedom from the impacts of exotic pests and demonstration of pest status claims. It supports ongoing market access and enhances the productivity and international competitiveness of the Australian grain industry.
- **National Temperate Fruit Biosecurity Surveillance Strategy** – was developed in consultation with plant industries and most state governments. It covers a diverse range of crops including pome fruit (apples and pears), grapes (table, wine and dried), cherries, stone fruit (apricots, nectarines, peaches and plums), berries (strawberries, blueberries, blackberries and raspberries) and almonds.
- **National Tropical Plant Industries Biosecurity Surveillance Strategy** – was developed following extensive consultation with plant industries and governments. Northern Australia presents unique biosecurity challenges due to its high plant diversity, sparse population, extensive coastline and isolated growing regions.
- **National Potato Industry Biosecurity Surveillance Strategy** – was developed to guide a coordinated approach to surveillance for the detection of new pests and the collection of data and information on the presence or absence of pests to support international and domestic market access.

Sentinel hives of European honey bees are located at sea and airports and are routinely inspected for bee pests. Image courtesy of Jenny Shanks

Biosecurity Pathways and Surveillance Strategy workshop

For surveillance to be effective and efficient there must be a strong understanding of which pests should be targeted for surveillance, and the pathways along which they are likely to be found. Industry and government representatives met in Brisbane for a Biosecurity Pathways and Surveillance Strategy workshop on 2–3 April.

Participants gained a greater understanding of the biosecurity risks posed by the range of routes via which pests can get into and travel through northern Australia.

The surveillance activities that are already occurring within many plant production industries were discussed, and how the information gained can be better used to minimise the risk of exotic pests and pathogens becoming established in Australia. The workshop also focused on the establishment of a collaborative surveillance strategy for northern plant-based industries.

Mango production in Bowen, Queensland. Image courtesy of Trevor Dunmall

GENERAL SURVEILLANCE PROGRAMS

General surveillance programs raise awareness about pests with growers and the wider community and rely on people to look for and report anything unusual.

Growers need to undertake routine crop monitoring to inform production practices and manage established pests and diseases. Biosecurity manuals, industry newsletters, fact sheets, webpages and apps developed by industry, PHA and governments all encourage the reporting of unusual pest or diseases symptoms.

IF YOU SEE ANYTHING UNUSUAL, CALL THE EXOTIC PLANT PEST HOTLINE

1800 084 881

Findings made by general surveillance activities can be reported to state or territory government agriculture departments via the the Exotic Plant Pest Hotline, 1800 084 881.

Surveillance for exotic pests is also an important component of Emergency Plant Pest responses and is covered in Chapter 6.

International Plant Sentinel Network

The International Plant Sentinel Network is a Euphresco initiative that acts as an early warning system to recognise new and emerging pest and pathogen risks. It does this through a network of national and international partnerships between plant protection scientists, botanic gardens and arboreta.

The Australian National Botanic Gardens (Canberra), National Arboretum Canberra, Royal Botanic Garden Sydney, Royal Botanic Gardens Victoria, and Royal Tasmanian Botanical Gardens were the Australian members of the International Plant Sentinel Network in 2019. For more information go to **plantsentinel.org**

Gardens and arboreta hold a range of native flora, exotic plants and relatives of crops, making them ideal sentinels to detect new plant pest or disease incursions in Australia. With millions of visitors every year, they're also an invaluable way to inform the community about plant biosecurity.

Australian plants in botanic gardens and arboreta overseas can act as sentinels and identify potential threats to the health of our unique flora.

Sentinel plants also provide 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.

In 2019 a surveillance network of staff and volunteers in botanic gardens and arboreta was established to raise awareness of biosecurity and to undertake surveillance for key pests.

The Royal Botanic Gardens Melbourne is part of the International Plant Sentinel Network.

Botanic Gardens Biosecurity Network

A new hub of biosecurity information for botanic gardens was launched in November 2019 to build biosecurity knowledge and capacity to protect botanic gardens from plant pests and diseases.

Botanic gardens are the most visited destinations by overseas tourists in Australia, with a high likelihood that exotic pests and diseases will establish there.

The Botanic Gardens Biosecurity Network is a community of practice bringing together botanic gardens staff, friends, volunteers and biosecurity experts. The aim is to empower people in the botanic gardens to spread knowledge about biosecurity through communications and hands-on surveillance activities.

The network will publish practical information and advice for staff of botanic gardens, community interest groups and members of the public to develop their knowledge and skills. This information will enable people to look out for and protect their botanic and home gardens from exotic plant pests and diseases.

Visit the website **extensionaus.com.au/botanicgardensbiosecurity**

Members of the Friends of the Royal Botanic Gardens Melbourne learning about surveillance for plants pests in November 2019.

PLANT PEST SURVEILLANCE PROGRAMS IN 2019

During 2019, there were 112 plant pest surveillance programs undertaken, which are detailed by jurisdiction in Table 51.

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

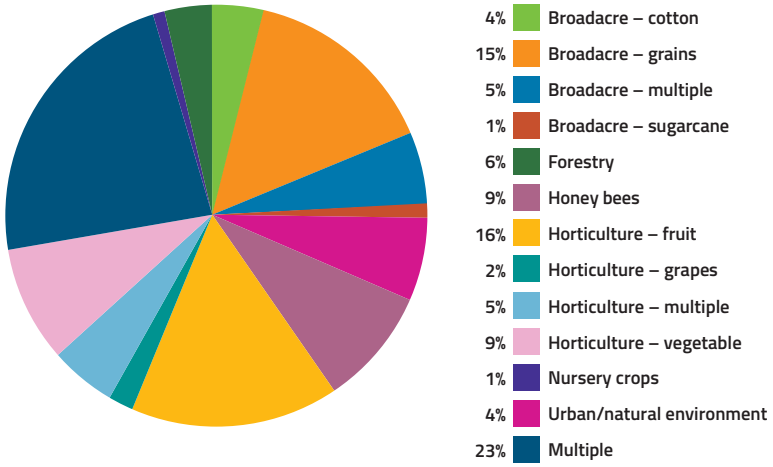


Figure 92. Surveillance programs by target pest type

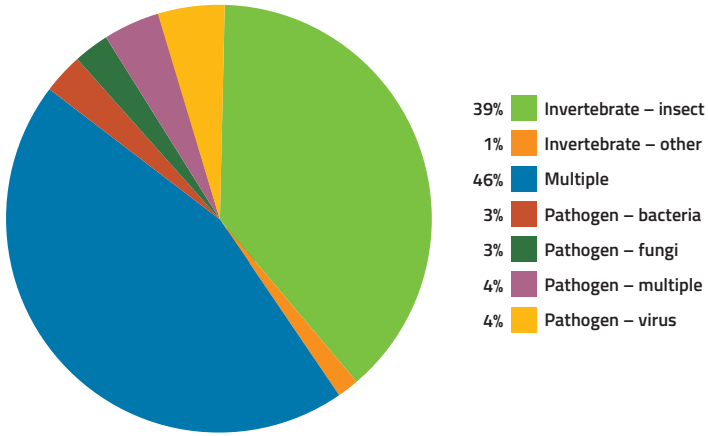


Table 51. Australia's plant biosecurity surveillance programs

Surveillance program name	Target hosts	Target pests	Type of surveillance*
Australian Government			
External Territories Surveillance Program	Various environmental, production and ornamental plants	High priority exotic pests	General and targeted
International Plant Health Surveillance Program	Multiple surveillance programs of tropical horticultural, environmental and agricultural species	High priority exotic pests	General and targeted
National Bee Pest Surveillance Program	Bee swarms at first points of entry	*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*	General (noting other stakeholders conduct the targeted surveillance required under this program)
National Border Surveillance Program	Mutiple surveillance programs focusing on regulatory import pathway risks	High priority exotic pests	General and targeted
National Plant Health Surveillance Program (delivered through states and territories)	Various	High priority exotic pests	General and targeted
Northern Australia Quarantine Strategy – exotic fruit fly trapping	Various	Exotic fruit flies including *Bactrocera dorsalis, B. latifrons, B. trivialis, B. umbrosa, Zeugodacus atrisetosa, Z. cucurbitae , Z. decipiens*	Targeted
Northern Australia Quarantine Strategy – fall armyworm	Wild and cultivated gramineous hosts	Fall armyworm (*Spodoptera frugiperda*)	General and targeted
Northern Australia Quarantine Strategy – pest and disease surveys	Multiple surveillance programs of tropical horticultural, environmental and agricultural species	123 high priority exotic pests, diseases and weeds	General and targeted

Table 51. Australia's plant biosecurity surveillance programs (continued)

Surveillance program name	Target hosts	Target pests	Type of surveillance*
Within New South Wales			
Area wide management – vegetable diseases	Multiple hosts including Cucurbitaceace and Brassicaceae	Various endemic and exotic high priority pests including cucumber green mottle mosaic virus	Targeted
Asian market access for citrus and cherries	Cherries and citrus	Queensland fruit fly (*Bactrocera tryoni*), lesser Queensland fruit fly (*Bactrocera neohumeralis*), various cue lure attracted exotic fruit flies	Targeted
CGMMV Pest Free Place of Production	Cucurbits	Cucumber green mottle mosaic virus	Targeted
Citrus budwood mother tree inspections	Multiple citrus hosts	Various graft transmissable diseases and other high priority pests	Targeted
Citrus canker	Multiple citrus hosts	Citrus canker, *Xanthamonas citri* subsp *citri*	Targeted
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*)	Targeted
Exotic fruit flies – Riverina	Various horticultural crops (citrus, stone fruit)	Mediterranean fruit fly (*Ceratitis capitata*), other tri lure responsive exotic fruit flies	Targeted
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*)	Targeted
Forestry Corporation of NSW Forest Health Surveillance	General forests	Various exotic and endemic high priority pests	Targeted
Forest High-Risk Surveillance Program	Multiple	Various exotic and endemic high priority pests of *Pinus* spp.	Targeted
Grains Farm Biosecurity Program	In-crop and stored grains	Barley stripe rust (*Puccinia striiformis* f. sp. *hordei*), Karnal bunt (*Tilletia indica*), hessian fly (*Mayetiola destructor*), barley stem gall midge (*Mayetiola hordei*)	General
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*)	Targeted
Khapra beetle	Stored grain (bulk handlers and farm), grain processing facilities, dry goods manufacturers	*Trogoderma granarium*	Targeted
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*	Targeted

Table 51. Australia's plant biosecurity surveillance programs (continued)

Surveillance program name	Target hosts	Target pests	Type of surveillance*
Within New South Wales (continued)			
National Plant Health Surveillance Program – multi pest surveillance	Multiple	Multiple including *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, B. trilineola, B. trivialis, B. umbrosa, B. xanthodes, B. zonata, Ceratitis capitata, Zeugodacus cucurbitae, Z. tau,* gypsy moth (*Lymantria* spp.), 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*)	Targeted
National tomato potato psyllid and zebra chip surveillance	Solanaceous hosts	Tomato potato psyllid (*Bactericera cockerelli*)	Targeted
Onion diseases – Riverina	Onions, garlic	White rot (*Sclerotium cepivorum*), onion smut (*Urocystis cepulae*), onion rust (*Puccinia allii*)	Targeted
Within the Northern Territory			
Area Freedom Surveillance Program	Horticultural crops	Queensland fruit fly (*Bactrocera tryoni*)	Targeted
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*)	General and targeted
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*	Targeted
National Plant Health Surveillance Program – multi pest surveillance	Multiple	Multiple including citrus canker (*Xanthomonas axonopodis* pv. *citri*), huanglongbing (*Candidatus* Liberibacter spp.), Asian citrus psyllid (*Diaphorina citri*), giant African snail (*Achatina fulica*), glassy winged sharpshooter (*Homalodisca vitripennis*), Pierce's disease (*Xylella fastidiosa*), banana black Sigatoka (*Mycosphaerella fijiensis*), red imported fire ant (*Solenopsis invicta*), electric ant (*Wasmannia auropunctata*), yellow crazy ant (*Anoplolepis gracilipes*), *Bactericera cockerelli, Candidatus* Liberibacter solanacearum, potato leafminer, pea leafminer, serpentine leafminer (*Liriomyza huidobrensis*), American leafminer (*Liriomyza trifolii*), vegetable leafminer (*Liriomyza sativae*), exotic fruit flies (*Bactrocera* spp. and *Ceratitis* spp.)	Targeted
Plant Pest Diagnostic Service – broadacre cropping	Broadacre crops	All pests and pathogens that can affect broadacre crops (pastures)	General
Plant Pest Diagnostic Service – horticulture	Horticultural crops	All pests and pathogens that can affect horticultural crops (mango, chilli, watermelon, Cucurbitaceae)	General
Regional Fruit Fly Monitoring and Surveillance	Horticultural crops	Exotic fruit flies (*Bactrocera* spp. and *Ceratitis* spp.)	Targeted

Table 51. Australia's plant biosecurity surveillance programs (continued)

Surveillance program name	Target hosts	Target pests	Type of surveillance*
Within Queensland			
Area freedom surveys	Multiple	A range of pests including papaya ringspot virus and banana bunchy top virus	Targeted
Area wide management of vegetable diseases	Multiple vegetable hosts	Multiple viruses and bacterial pests	General and targeted
Banana pest surveillance	Banana	A range of banana pests	General
Endemic and exotic diseases of cotton	Cotton	Exotic strains of bacterial blight (*Xanthomonas campestris*), blue disease (suspected Luteovirus), cotton bunchy top virus, cotton leaf curl virus (Begomovirus), cotton leafroll dwarf virus (Polerovirus), Texas root rot (*Phymatotrichum omnivorum*), exotic strains Verticillium wilt (*Verticillium dahliae*), exotic strains Fusarium wilt (*Fusarium oxysporum* f. sp. *vasinfectum*) and all other exotic viruses. Endemic cotton diseases, including *Fusarium* spp. and *Verticillium* spp.	Targeted
Endemic and exotic grains virus surveys	Grains and cotton	Various viruses, especially aphid transmitted Polerovirus complex	Targeted
Exotic Fruit Fly in the Torres Strait Program	Multiple	Exotic fruit fly including *Bactrocera* and *Zeugodacus* spp.	Targeted
Forest High-Risk Surveillance Program	Multiple	Various exotic and endemic high priority pests of *Pinus* spp.	Targeted
General forest pest surveillance	Multiple	General forest pests	General
Grain bulk handling companies	Stored grains	Endemic and exotic stored grain pests	General
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	General
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*	Targeted
National Grain Insect 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*)	Targeted
National Plant Health Surveillance Program – multi pest surveillance	Multiple	Multiple, 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*)	Targeted
Panama TR4 Program	Banana	Panama disease (*Fusarium oxysporum* f. sp. *cubense*)	Targeted
Plant Pest Diagnostic Service – broadacre cropping	Broadacre field crops	All pathogens that can affect broadacre crops (cotton, grains, pastures)	General

Table 51. Australia's plant biosecurity surveillance programs (continued)

Surveillance program name	Target hosts	Target pests	Type of surveillance*
Within Queensland (continued)			
Post-Entry Quarantine inspections	Broadacre field crops (e.g. cotton, sorghum, maize, peanuts)	All pathogens that affect broadacre field crops	General
Silverleaf whitefly resistance monitoring	Cotton	Silverleaf whitefly (*Bemisia tabaci* B-type)	Targeted
Sucking pest management in cotton	Cotton	Solenopsis mealybug (*Phenacoccus solenopsis*)	Targeted
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	General and targeted
Surveys and associated diagnostics of the incidence and severity of diseases of cereal and pulses within the Northern Region	Cereals and pulses	Various pests and diseases of cereals and pulses in the Northern Region	General and targeted
Tomato potato psyllid	Solanaceae	Tomato potato psyllid (*Bactericera cockerelli*)	Targeted
West Indian drywood termite surveys	Timber structures	West Indian drywood termite (*Cryptotermes brevis*)	Targeted
Within South Australia			
Area freedom surveys	Multiple	Multiple pests	General and targeted
Bee surveillance – endemic disease	European honey bees	American foulbrood (*Paenibacillus* spp.)	General and targeted
Brown marmorated stink bug	Multiple	Brown marmorated stink bug (*Halyomorpha halys*)	General and targeted
Conifer auger beetle	Conifers	Conifer auger beetle (*Sinoxylon conigerum*)	General and targeted
Exotic longhorn beetle trapping	Rutaceae	Citrus longicorn beetle (*Anoplophora chinensis*)	General and targeted
Giant pine scale	Pinaceae	Giant pine scale (*Marchalina hellenica*)	General and targeted
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*)	General and targeted
Grape phylloxera	*Vitus vinifera*	Grapevine phylloxera (*Daktulosphaira vitifoliae*)	General and targeted
Grape vine pinot gris virus	Grape vines	Grape vine pinot gris virus (Trichovirus)	General and targeted
Mediterranean fruit fly	Horticultural crops	Mediterranean fruit fly (*Ceratitis capitata*)	General and targeted
Monochamus Program	*Pinus* spp.	Japanese pine sawyer beetle (*Monochamus alternatus*), pine wilt nematode	General and targeted
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*	General and targeted
National Plant Health Surveillance Program – multi pest surveillance	Multiple	Multiple including exotic invasive ants (tramp ants), Asian and African citrus psyllids (*Diaphorina citri, Candidatus* Liberibacter africanus), huanglongbing (*Candidatus* Liberibacter asiaticus), citrus canker (*Xanthomonas axonopodis* pv. *citri*), Khapra beetle (*Trogoderma granarium*), Karnal bunt (*Tilletia indica*), glassy winged sharpshooters (*Homalodisca vitripennis* and *H. coagulata*)	General and targeted
Ports of Entry Trapping Program	*Eucalyptus* spp., ornamental trees	Exotic gypsy moths (*Lymantria* spp.)	General and targeted

Table 51. Australia's plant biosecurity surveillance programs (continued)

Surveillance program name	Target hosts	Target pests	Type of surveillance*
Within South Australia (continued)			
Ports of Entry Trapping Program	Various fruit fly hosts	*Multiple – Bactrocera albistrigata, B. carambolae, B. dorsalis, B. facialis, B. kirki, B. melanotus, B. psidii, B. tau, B. trivialis, B. umbrosa, B. xanthodes, B. zonata, Ceratitis capitata, Zeugodacus cucurbitae*	General and targeted
Potato spindle tuber viroid	Solanaceae	Potato spindle tuber viroid	General and targeted
Queensland fruit fly	Horticultural crops	Queensland fruit fly (*Bactrocera tryoni*)	General and targeted
Tomato potato psyllid	Solanaceae	Tomato potato psyllid (*Bactericera cockerelli)*	General and targeted
Tomato yellow curl leaf virus	Solanaceae	Tomato yellow curl leaf virus	General and targeted
Trogoderma glabrum	Multiple	*Trogoderma glabrum*	General and targeted
Within Tasmania			
Bee surveillance – American foulbrood	European honey bees	American foulbrood (*Paenibacillus* spp.)	General
Blueberry rust surveillance	Commercial blueberry crops and wholesale nurseries	Blueberry rust (*Thekopsora minima*)	Targeted
Codling moth trapping surveillance	Apples, cherries	Codling moth (*Cydia pomonella*)	Targeted
Devonport (Stoney Rise) light trapping	Multiple	Numerous flying pests and beneficials	General
Fruit fly trapping surveillance	Host fruit trees, fruit and vegetables	*Bactrocera dorsalis, B. tryoni, Ceratitis capitata* and exotic fruit flies	Targeted
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*	Targeted
National Plant Health Surveillance Program – multi pest surveillance	Multiple	Brown marmorated stink bug (*Halyomorpha halys*), citrus canker (*Xanthomonas citri* subsp. *citri*), *Liriomyza bryoniae, L. cicerina, L. huidobrensis, L. sativae, L. trifolii,* gypsy moth, including *Lymantria albescens, L. atameles, L. concolor, L. dispar asiatica, L. dispar dispar, L. dispar japonica, L. dissoluta, L. fumida, L. marginata, L. minomonis, L. monacha, L. postalba, L. pulverea, L. sinica, L. umbrosa, L. xylina, huanglongbing* (*Candidatus* Liberibacter asiaticus), *Bactericera cockerelli, Diaporia citri, Trioza erytreae, Bactericera trigonica, Trioza apicallis,* Khapra beetle (*Trogoderma granarium*), Pierce's disease (*Xylella fastidiosa*), glassy winged sharpshooter (*Homalodisca vitripennis*)	Targeted
Silverleaf white fly surveillance	Nursery stock	Silver leaf white fly (*Bemisia tabaci*)	Targeted
Tomato potato psyllid	Commercial potato and tomato crops, community gardens, urban pathways	Tomato potato psyllid (*Bactericera cockerelli*)	Targeted
Warehouse beetle trapping surveillance	Stored grains, grain processors and animal feed outlets	Warehouse beetle (*Trogoderma variable*)	Targeted

Table 51.Australia's plant biosecurity surveillance programs (continued)

Surveillance program name	Target hosts	Target pests	Type of surveillance*
Within Victoria			
Area Freedom surveillance for market access	Blueberries, port area, processed tomatoes and potatoes	Blueberry rust (*Thekopsora minima*), red imported fire ant (*Soelenopsis invicta*), tomato yellow leaf curl virus, tomato potato psyllid (*Bactericera cockerelli*)	Targeted
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*)	General
Grains Farm Biosecurity Program	In-crop and stored grains	Multiple 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)*	Targeted
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*	Targeted
National Plant Health Surveillance Program – multi pest surveillance	Multiple	Multiple including citrus canker (*Xanthomonas axonopodis* pv. *citri*), fruit flies (*Bactrocera* spp., *Ceratitis capitata*), Pierce's disease (*Xylella fastidiosa*), glassy winged sharpshooter (*Homalodisca vitripennis*), plum pox virus, 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*), exotic fruit flies, various *Bactrocera* and *Ceratitis* spp.	Targeted
Victorian funded containment program	Pasture and fruit trees	Green snail (*Cantareus apertus*)	Targeted
Within Western Australia			
Agrisearch	Grain crops	Grain pests	General
AgWest grain testing laboratory	Grain crops	Grain pests	General
Biosecurity Blitz	All hosts	All plant pests	General
Brown marmorated stink bug	All hosts, urban areas	Brown marmorated stink bug (*Halyomorpha halys*)	General and targeted
Browsing ant surveillance	Environmental, urban areas	Browsing ant (*Lepisiota frauenfeldi*)	General
Candidatus Liberibacter solanacearum	Tomato, potato, capsicum, chilli and eggplant crops	Tomato potato pysllid (*Bactericera cockerelli*)	General
Codling moth surveillance	Pome fruit	Codling moth (*Cydia pomonella*)	Targeted

Table 51.Australia's plant biosecurity surveillance programs (continued)

Surveillance program name	Target hosts	Target pests	Type of surveillance*
Within Western Australia (continued)			
European wasp surveillance	Urban areas and horticultural crops	European wasp (*Vespula germanica*)	General and targeted
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*)	General and targeted
Medfly Area Freedom (Ord River Irrigation Area)	Many horticultural hosts	Mediterranean fruit fly (*Ceratitis capitata*)	Targeted
MyCrop e-surveillance	Broadacre crops, general surveillance	All plant pests	General and targeted
MyPestGuide e-surveillance	All hosts, general surveillance	All plant pests	General and targeted
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 (two strains), slow paralysis virus (two strains), *Apis cerana, A. dorsata, A. florea, Bombus terrestris, Vespa velutin* and new exotic swarms of *A. mellifera*	Targeted
National grain insect resistance monitoring program	Grain crops	Grain pests	Targeted
National Plant Health Surveillance Program – multi pest surveillance	Pome and citrus crops	Multiple including Asian citrus psyllid (*Diaphorina citri*), citrus canker (*Xanthomonas axonopodis* pv. *citri*), citrus longicorn beetle (*Anoplophora chinensis*), glassy winged sharpshooter (*Homalodisca vitripennis*), Xylella (*Xylella fastidiosa*), brown marmorated stink bug (*Halyomorpha halys*)	Targeted
National Variety Trials	Grain crops	Grain pests	General
Pantry Blitz	Stored grain products	Khapra beetle (*Trogoderma granarium*)	General
PestFax e-surveillance	Broadacre crops	All plant pests	General
Port of Entry – Asian gypsy moth trapping	More than 600 forest, orchard, ornamental and native species	Asian gypsy moth (*Lymantria dispar*)	Targeted
Port of Entry – fruit fly trapping	Horticultural hosts	Various *Bactrocera* and *Ceratitis* spp.	Targeted
Queensland fruit fly surveillance	Many horticultural hosts	Queensland fruit fly (*Bactrocera tryoni*)	Targeted
Sentinel stored products merchants	Stored grain products	Khapra beetle (*Trogoderma granarium*)	General and targeted

Legend
f. sp. forma specialis
pv. pathovar
sp. species
spp. multiple species
syn. synonym

** General surveillance is a range of crop monitoring and awareness activities outside of specific surveys that can be used to detect the presence or absence of pests, including the presence of new or unusual pests or symptoms. Targeted surveillance is where checks or surveys are made for particular pests, and records are captured.*

Building skills through the Diagnostic Residential Program

In 2019 ten members of the National Plant Biosecurity Diagnostic Network from various states and universities took part in the Diagnostic Residential Program. This takes the total number of people who have benefited from the program since its inception to 55.

Plant biosecurity diagnosticians spend 5–14 days in a laboratory or workplace in Australia or overseas that is conducting relevant activities. Residential placements provide opportunities for diagnosticians to share ideas and practices, and to gain essential skills and knowledge relevant to their role and the diagnostic network.

In February 2019 Stefan Harasymow of the WA Department of Industries and Regional Development travelled to the Queensland Department of Agriculture and Fisheries in Brisbane to work with Senior Plant Pathologist Dr Kathy Crew to improve his skills in transmission electron microscopy of plant viruses.

Dr Kathy Crew, Senior Plant Pathologist with Queensland Department of Agriculture and Fisheries (L) with Stefan Harasymow, Laboratory Scientist with Department of Primary Industries and Regional Development WA (R). Image courtesy of Ms Sari Nurulita.

Diagnostics – identifying plant pests and diseases

Accurate diagnosis of plant pests and diseases 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 determine. 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 a new pest incursion, diagnostic expertise is critical to identify the initial sample, to help determine how widespread the pest is and the appropriate response to it, and eventually to provide the evidence necessary to claim the pest has been eradicated.

Diagnostics 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 supports quarantine processes such as maintaining pest free areas, which allow access to domestic and international markets.

OVERSIGHT OF NATIONAL PLANT BIOSECURITY DIAGNOSTICS

National Plant Biosecurity Diagnostic Strategy

The National Plant Biosecurity Diagnostic Strategy, developed in 2012, 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.

Review of this strategy commenced in 2019 in conjunction with review of the National Plant Biosecurity Surveillance Strategy and, once finalised, will guide the improvement and coordination of plant biosecurity diagnostics in Australia.

Subcommittee on Plant Health Diagnostics

The Subcommittee on Plant Health Diagnostics (SPHD) provides leadership in plant pest diagnostics policy, standards and coordination for Australia. This subcommittee of the Plant Health Committee was established to sustain and improve the quality and reliability of plant pest diagnostics.

The implementation of the National Plant Biosecurity Diagnostics Strategy is led by SPHD, ensuring the diagnostic system effectively supports the broader biosecurity system.

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 Network

The National Plant Biosecurity Diagnostic Network (NPBDN) was formed to help build and maintain diagnostic capability and capacity for Australia and New Zealand.

Network members comprise experts from across the diagnostic system, from entomologists and plant pathologists, through to response program managers and policy makers. They are from a range of organisations 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 via a network implementation working group and a coordinator who was appointed in 2019. The network facilitates communication between experts and sharing of diagnostic resources, and offers 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, identifying and addressing gaps, and providing surge capacity during incursions.

The network is supported by a website **plantbiosecuritydiagnostics.net.au** which contains resources, member expertise and contact details, news, events and various tools to assist in pest identification.

Annual Diagnosticians' Workshop 2019

The Annual Diagnosticians' Workshop held in Sydney in March 2019 attracted more than 60 participants keen to network and share their experiences and knowledge.

Participants heard about the challenges faced by diagnostic laboratories during emergency responses, tricks and tips for the development of lucid identification keys, insights into specific diagnostic activities and some key diagnostic capability challenges in the biosecurity system.

They were also introduced to a new major diagnostic research project for *Xylella fastidiosa* and feedback from an international Xylella workshop.

Participants in the Annual Diagnosticians' Workshop, Sydney, March 2019

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 International Standards for Phytosanitary Measures (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 to 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 4)
- Reference Standard 2: Development of Diagnostic Protocols – Procedures for Authors (Version 7)
- 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 4).

The International Plant Protection Convention (IPPC) has diagnostic protocols that are recognised internationally. Where an IPPC diagnostic protocol exists, it should be used in preference to NDPs, unless it is shown that the NDP has improved procedures for Australian conditions. NDPs may also contain additional information to aid diagnosis. IPPC protocols are available on the IPPC website **ippc.int/en/core-activities/standards-setting/ispms**.

Figure 93. National Diagnostic Protocol endorsement process

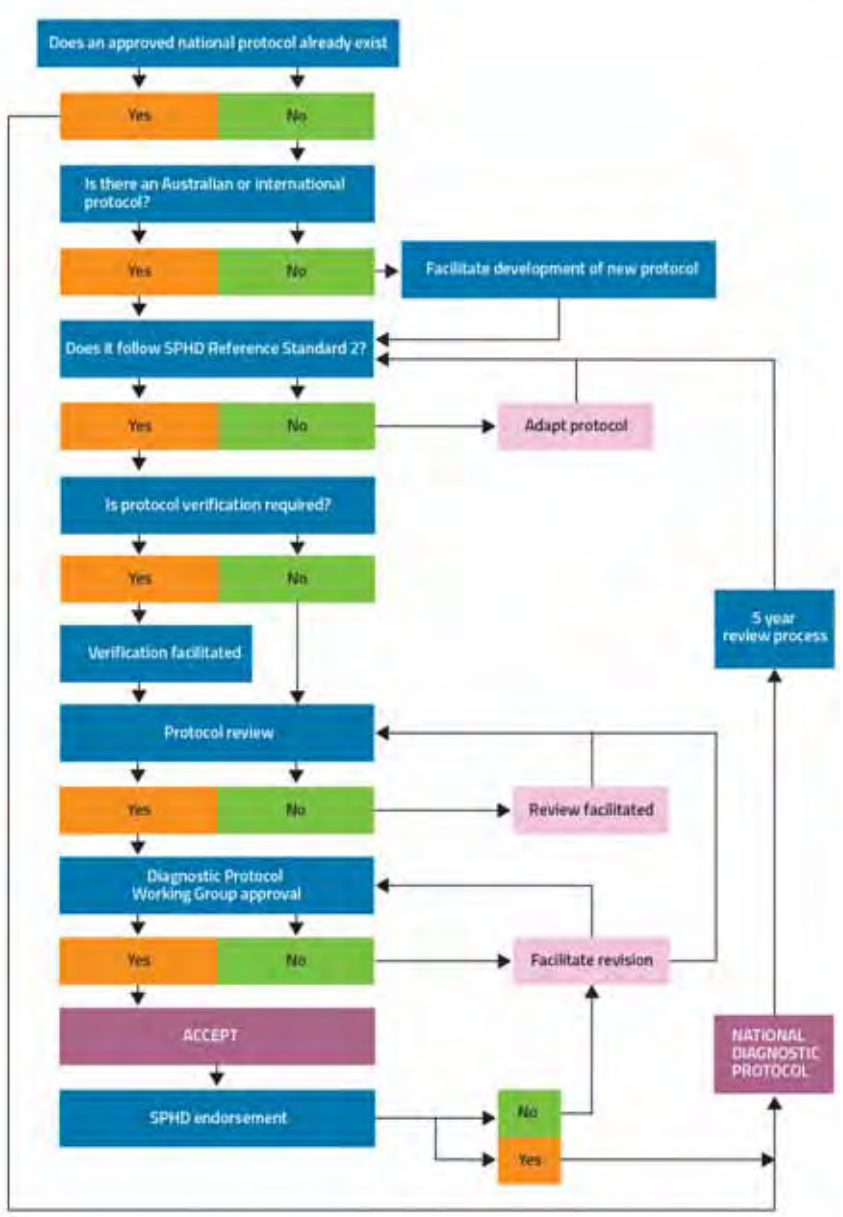


Table 52. National Diagnostic Protocols

Scientific name	Common name	NDP* number
Endorsed protocols		
Adoxophyes orana	Summer fruit tortrix	30
Bactericera cockerelli	Tomato potato psyllid	20
Candidatus Liberibacter asiaticus	Huanglongbing	25
Candidatus Liberibacter solanacearum	Zebra chip	18
Candidatus Phytoplasma pruni	X disease	17
Candidatus Phytoplasma prunorum	European stone fruit yellows	12
Cherry leaf roll virus (Nepovirus)	Blackline	10
Clavibacter michiganensis subsp. *sepedonicus*	Potato ring rot	8
Cryphonectria parasitica	Chestnut blight	11
Dendronoctonus valens	Red turpentine beetle	24
Diaporthe helianthi	Sunflower stem canker	40
Diuraphis noxia	Russian wheat aphid	28
Echinothrips americanus	Poinsettia thrips	4
Endocronartium harknessii	Pine gall rust	32
Fusarium oxysporum f. sp. *ciceris*	Fusarium wilt of chickpea	36
Guignardia bidwellii	Black rot	13
Homalodisca vitripennis	Glassy winged sharpshooter	23
Leptinotarsa decemlineata	Colorado potato beetle	22
Liriomyza trifolii	American serpentine leafminer	27
Monilinia fructigena	Apple brown rot	1
Neonectria ditissima	European canker	21
Ophiostoma ulmi	Dutch elm disease	37
Phakopsora euvitis	Grapevine leaf rust	29
Phytophthora ramorum	Sudden oak death	5
Phytoptus avellanae	Hazelnut big bud mite	39
Plenodomus tracheiphilus	Mal secco	26
Plum pox virus (Potyvirus)	Plum pox virus	2
Potato mop top virus (Pomovirus)	Potato mop top virus	15
Potato spindle tuber viroid (Pospiviroidae)	PSTVd	7
Protopulvinaria pyriformis	Pyriform scale	33
Puccinia striiformis f. sp. *hordei*	Barley stripe rust	38
Pulvinaria iceryi	Pulvinaria scale	34
Pyricularia oryzae	Rice blast	14
Roesleria subterranea	Grape root rot	35
Scirtothrips perseae	Avocado thrips	3
Synchytrium endobioticum	Potato wart	16
Tilletia indica	Karnal bunt	19
Uromyces viciae-fabae (lentil strain)	Lentil rust	31
Xanthomonas citri subsp. *citri*	Citrus canker	9
Xylella fastidiosa	Pierce's disease	6
Draft protocols		
Agrilus planipennis	Emerald ash borer	
Aphidoidea	Exotic aphid group	
Banana bract mosaic virus (Potyvirus)	Banana bract mosaic virus	
Broad bean mottle virus (Bromovirus)	Broad bean mottle virus	
Broad bean stain virus (Comovirus)	Broad bean stain virus	
Broad bean true mosaic virus (Comovirus)	Broad bean true mosaic virus	
Burkholderia glumae	Panicle bight	
Bursaphelenchus xylophilus	Pine wilt nematode	
Bymovirus group	Soil-borne Gramineae virus	
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	

** National Diagnostic Protocol reference number*

Table 52. National Diagnostic Protocols (continued)

Scientific name	Common name
Draft protocols (continued)	
Clavibacter michiganensis subsp. *nebraskensis*	Goss's bacterial wilt and blight of corn
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
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 group	Soil-borne Gramineae virus
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
Hordieivirus group	Virus of *Gramineae*
Hyalensthes obsoletus	Cixiidae plant hopper
Liriomyza huidobrensis	Pea leafminer
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
Orthaga euadrusalis	Mango web weaver
Pantoea stewartii	Stewart's wilt of maize
Pea early browning virus (Tobravirus)	Pea early browning virus

Scientific name	Common name
Draft protocols (continued)	
Pea enation mosaic virus (Enamovirus)	Pea enation mosaic virus
Pecluvirus group	Soil-borne peanut virus
Pepino mosaic virus (Potexvirus)	Pepino mosaic virus
Peronosclerospora sacchari	Sugarcane downy mildew
Phymatotrichum omnivorum	Texas root rot
Phytophthora infestans A2	Late blight
Planococcus ficus	Vine mealybug
Pomacea canaliculata	Golden apple snail
Potyvirus (general)	Potyvirus
Pseudocercospora spp.	Black Sigatoka, yellow Sigatoka, eumusae
Pseudococcus maritimus	Grape mealybug
Pseudomonas papulans	Blister spot of apple
Pseudopezicula tetraspora	Angular leaf scorch grape
Puccinia psidii (exotic strains)	Guava (Eucalyptus) rust
Raffaelea lauricola	Laurel wilt and vector beetle
Ralstonia solanacearum (phylotype IIB)	Moko, bugtok
Ralstonia syzgii subsp. *celebesensis* (syn. *R. solanacearum* race 2, biovar 1)	Blood disease
Ramu stunt (Tenuivirus)	Ramu stunt
Red clover vein mosaic virus (Carlavirus)	Red clover vein mosaic virus
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
Stagonospora sacchari	Leaf scorch of sugar
Sternochetus frigidus	Mango pulp weevil
Sugarcane white leaf phytoplasma	Sugarcane white leaf phytoplasma
Termites (group)	Termites

Table 52. National Diagnostic Protocols (continued)

Scientific name	Common name
Draft protocols (continued)	
Tetranychus spp.	Spider mites
Tilletia controversa	Dwarf bunt of wheat
Tilletia horrida	Kernel smut of rice
Trioza erytreae	African citrus psyllid
Trogoderma granarium	Khapra beetle
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
Xanthomonas vasicola pv. *musacearum*	Banana bacterial wilt
Xylophilus ampelinus	Bacterial blight of grapevine

Ledgend

Endorsed – the protocol has been assessed and endorsed by the Subcommittee on Plant Health Diagnostics as a National Diagnostic Protocol

Draft – the protocol is under development, an old draft, or in the pre endorsement review process

f. sp. forma specialis

pv. pathovar

spp. multiple species

subsp. subspecies

Botanic gardens are often visited by overseas tourist, and are a likely entry point for exotic pests and diseases

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, the CSIRO and universities.

Australia's diagnostic facilities and their services are detailed in Table 53.

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 identifying 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 are 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, Determination of Pest Status in an Area, a service that is provided by Australia's collections.

The National Plant Pest Reference Collections Strategy[35] and implementation plan were developed by SPHD in 2018. Implementation of 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.

In 2019, a project in line with the implementation plan began to:

- determine if specimens of the National Priority Plant Pests were present in Australian reference collections
- determine a prioritised approach to address any key gaps
- develop nationally agreed standards for curation and the vouchering of specimens.

Biological reference collections provide validated reference specimens for comparison to identify a plant pest. Image courtesy of Agriculture Victoria

35. Plant Health Australia (2018). National Plant Pest Reference Collections Strategy. Accessed online 17 April 2020 from planthealthaustralia.com.au/wp-content/uploads/2019/06/Plant-Pest-Reference-Collections-Strategy.pdf.

Table 53. 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	Fungi identification		
Black Mountain Laboratories, Canberra	National Research Collections Australia, CSIRO (Australian National Herbarium)	Fungi identification, weeds and seeds		Herbarium and fungi collections
Black Mountain Laboratories, Canberra	National Research Collections Australia, CSIRO (Australian National Insect Collection)	Insect, nematode and mite identification, molecular biology		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)	National Association of Testing Authorities (NATA) accreditation (ISO/IEC 17025:2005)	Fungi, bacteria 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		
Elizabeth Macarthur Agricultural Institute, Menangle	NSW DPI	Invertebrates and pathogens (virology, bacteriology and mycology)	NATA accreditation (ISO/IEC 17025:2005); DA AA Site (biosecurity containment BC2 and BC3)	Fungi, bacteria and nucleic acids
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, Mascot	DA	Pest and disease identification, collection and rearing of immature stages of arthropods. Pathology investigation to determine causal agent	DA 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)		
Wagga Wagga Agricultural Institute, Wagga Wagga	Charles Sturt University, NSW DPI	Plant pathology and molecular biology		
Yanco Agricultural Institute, Yanco	NSW DPI	Invertebrates and pathogens (vegetables and rice pathology)		

Table 53. Australia's diagnostic services, their capabilities, accreditations and collections (continued)

Laboratory and location	Organisation	Diagnostic capability	Accreditation	Collections
Northern Territory				
CSIRO Tropical Ecosystems Research Centre, Darwin	CSIRO	Ant identification for general public and biosecurity purposes		Tropical Ecosystems Research Centre ant collection
Entomology Laboratory, Berrimah	NT DPIR	Insects and mites, molecular biology		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
Natural Sciences, Museum and Art Gallery of the Northern Territory, Darwin	Museums and Art Galleries of the Northern Territory	Mollusc, insect, fish and other faunal identifications for the general public, commercial and biosecurity purposes	Registration for exchange (export and import) of scientific specimens	Mollusc, insect, arachnid and myriapod collections of the Northern Territory fauna with some interstate and overseas material. Also extensive reference collections and expertise covering fish, terrestrial vertebrates and marine invertebrates
Northern Australia Quarantine Strategy Regional Laboratory, Darwin	DA	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	Registered for exchange of scientific specimens (Australian native non-CITES specimens)	Northern Territory Plant Pathology Herbarium and plant pathogen nucleic acids collection
Queensland				
Biosecurity Queensland Control Centre, Moggill	QDAF	Fire ants		Fire ant reference collection
Bowen Research Station, Bowen	QDAF	Entomology		
Cairns Research Station, Cairns	QDAF	Plant pest and disease triage		
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	DA Approved Arrangement for Class 5.2 and 5.3. Biosecurity containment levels BC2 and BC3	Plant pathology and entomology
Gatton Research Station, Gatton	QDAF	Vegetable pests and diseases		

Table 53. Australia's diagnostic services, their capabilities, accreditations and collections (continued)

Laboratory and location	Organisation	Diagnostic capability	Accreditation	Collections
Queensland (continued)				
Maroochy Research Station, Nambour	QDAF	Plant pathology		
Northern Australia Quarantine Strategy Regional Laboratory, Cairns	DA	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
Queensland Alliance for Agriculture and Food Innovation, St Lucia, Dutton Park, Warwick, Nambour	Queensland Alliance for Agriculture and Food Innovation, University of Queensland	Plant pathology and virology		
Queensland Museum, South 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. DA 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		
School of Earth and Environmental Sciences, Adelaide	University of Adelaide	Entomology		
South Australian Museum, Adelaide	SA Department of Premier and Cabinet	Entomology		

Table 53. Australia's diagnostic services, their capabilities, accreditations and collections (continued)

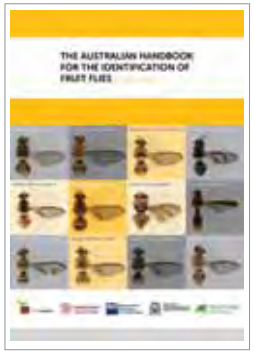
Laboratory and location	Organisation	Diagnostic capability	Accreditation	Collections
Tasmania				
Peracto, Devonport	Peracto	Plant pathology and nematology	Laboratory DA containment approved	
Plant Diagnostic Services, New Town (satellite entomology laboratories at Devonport and Launceston)	DPIPWE	Entomology, plant pathology (virology, mycology, nematology and bacteriology including molecular testing), TASAG ELISA testing services (virology)	Laboratories DA 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	International Seed Testing Association 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, 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, Tasmanian Institute of Agriculture	Entomology, forest pathology and molecular laboratory	Laboratory DA containment approved	Insect reference collection
Victoria				
AgriBio, Bundoora	DJPR, La Trobe University	Commercial diagnostic laboratory for general plant pathology, pathogen identification, entomology, mycology, virology, nematology, bacteriology, fungal and insect taxonomy, high throughput molecular diagnostics and weeds	DA 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	Victorian Plant Pathogen Herbarium: 43,000 specimens of fungi, bacteria, nematodes and a limited number of viruses. Victorian Agricultural Insect Collection (VAIC): 200,000 invertebrate specimens. Victorian Agricultural Insect Tissue Collection: DNA collection associated with VAIC
Horsham Research Centre, Horsham	DJPR	General plant pathology and virology (grains focus)		Fungal, bacterial and virus pathogen working collections pertaining to temperate grain crops
Irymple Research Centre, Irymple	DJPR	General entomology		
Operational Science Laboratory, Tullamarine Airport	DJPR	Entomology and plant pathology	DA accredited quarantine containment 5.2/7.2	Entomology collection
Plant Post-Entry Quarantine facility, Mickleham	DA	General plant pathology including mycology, bacteriology, botany, virology (traditional and modern) and nematology		

Table 53. Australia's diagnostic services, their capabilities, accreditations and collections (continued)

Laboratory and location	Organisation	Diagnostic capability	Accreditation	Collections
Victoria (continued)				
Royal Botanic Gardens, Victoria	Royal Botanic Gardens, Victoria	Mycology and weeds		Herbarium, including fungi 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	DA	Identification of quarantine intercept samples, mostly exotic pests		Small reference collection, mostly exotic invertebrates
Operational Science, DA, Perth International Airport	DA	Identification of quarantine intercept samples, mostly exotic pests including arthropods, fungi, bacteria and viruses	DA 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	Diagnostic laboratory for commercial and research purposes		
Western Australian Museum, Kewdale	Western Australian Museum	Insect identification for general public		Largest invertebrate collection in Western Australia
Western Australian State Agricultural Biotechnology Centre	Murdoch University	Commercial and research molecular biology laboratory for plant pathogen identification		

Entire fly dorsal classic with wing (B. frauenfeldi). 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.

The latest version of the Australian Handbook for the Identification of Fruit Flies (v 3.1) 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.

The Australian Handbook for the Identification of Fruit Flies – The fully illustrated handbook 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 diagnostics, and links to the online resource provide more in-depth information (e.g. molecular diagnostic techniques).

The Fruit Fly Identification Australia website – The companion 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 2019, the Biosecurity Portal housed and linked to 40 websites and shared workspaces making it a key information source for biosecurity stakeholders.

Sites fall into four categories:

- tools and databases such as the Australian Plant Pest Database
- 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.

AUSPESTCHECK™

AUSPest*Check*™ is a system developed by PHA for coordinating and hosting surveillance data on the presence or absence of exotic and established pests around Australia. This system can collate surveillance data from multiple industry and government sources and provide registered participants information of pest status around the country, using alerts, tables, maps and graphics. During 2019, AUSPest*Check*™ facilitated two proof of concept trials for coordinating surveillance data online. Well over 3 million surveillance records have been added in the database to establish the system.

All the information is integrated to allow mapping and searching for information about plant pests. Standardised data are uploaded either manually using preformatted spreadsheets, or automatically from pre-existing databases or systems via an application programming interface.

Other resources

Databases of agreed import policies (BICON) and export conditions (MICoR) are maintained by the Department of Agriculture, 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 include the MyPestGuide™ Reporter, which sends images of plant pests or symptoms directly to government diagnostic services for identification.

Chapter 6

Post-border biosecurity – eradicating new plant pests

Post-border biosecurity – managing plant biosecurity emergencies

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 commodity imports are increasing and, together with natural means of entry such as wind and water currents, the risk of exotic pest incursions is ever present.

Australia has post-border mechanisms to rapidly and effectively respond to plant pests to minimise negative impacts. These include nationally collaborative and coordinated means to:

- report suspect plant pests of concern through the Exotic Plant Pest Hotline 1800 084 881
- manage plant biosecurity incidents on the ground through the all hazards approach identified under the Biosecurity Incident Management System (BIMS)
- determine the national response and associated shared funding to plant biosecurity incidents under the Emergency Plant Pest Response Deed (EPPRD)
- prepare for potential plant biosecurity incidents through training and awareness activities.

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.*
This definition does not include weeds.

Other defined terms from the EPPRD appearing in this chapter are identified through capitalisation, with the current version of the EPPRD available at **planthealthaustralia.com.au/epprd**

National plant biosecurity response arrangements

In cases where a new pest is detected that warrants further action, operational responsibility for responding to the incident resides with the relevant jurisdiction. There are, however, national arrangements and agreements that support government and industry collaboration when responding to a biosecurity incident.

Serious exotic plant pests that would affect agricultural industries are dealt with under the provisions of the EPPRD, the focus of this chapter.

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 (as at 31 December 2019). It supports the rapid and effective response to the detection of an Emergency Plant Pest (EPP) by providing prior agreement on the governance (decision making) and funding of a national response.

PHA is the custodian of the EPPRD which came into effect in October 2005. The company has the dual roles of helping to ensure that responses are carried out in accordance with the provisions of the agreement and progressive improvement to meet the needs of signatories.

Plant industry cropping sectors

The vast majority of Australia's plant cropping sectors – extending across broadacre, horticulture, nursery production, forestry, edible fungi and honeybees – are represented by a peak industry body under the EPPRD.

During 2019 no new cropping sectors signed up to the EPPRD, though changes to the representative peak industry body occurred for the wine grape cropping sector (now Australian Grape and Wine) and nursery crop producers (now Greenlife Industry Australia).

Emergency Plant Pests

For a plant pest to be covered by the EPPRD, it must be an Emergency Plant Pest (EPP) as defined in the agreement.

In brief, a plant pest may be considered an EPP if it could have an adverse economic impact regionally and nationally if it were to establish in Australia, and meets one of the following:

- a known exotic plant pest not yet present in Australia
- a variant from of a plant pest that is established in Australia but can be distinguished by appropriate investigative methods
- a serious plant pest of unknown or uncertain origin which may be an entirely new plant pest
- an established plant pest that is restricted to a defined area of Australia through the use of regulatory measures, that is not native to Australia, 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.

Signatories have already agreed that some high priority plant pests (see page 46) are EPPs, and they are documented in schedule 13 of the agreement.

Decision making under the EPPRD

The EPPRD specifies government and industry roles and responsibilities in the decision making and operational processes of responding to an EPP, including how the cost of responding will be shared, based on the relative public and private benefit of eradication.

The terms of the EPPRD identify two key committees to support effective decision making when responding to an EPP. Only those parties that are signatories to the EPPRD have membership rights, with both committees comprising representatives from the Australian Government, all state and territory governments, industry parties affected by the EPP, and PHA. This composition reflects the partnership approach embedded throughout the EPPRD.

The National Management Group (NMG) makes the key policy and financial decisions about a response under the EPPRD. The NMG approves response plans, including all funding requirements, if it is agreed that eradication of the EPP is technically feasible and cost-beneficial.

The NMG is advised on technical matters related to the response by a Consultative Committee on Emergency Plant Pests (CCEPP). A scientific advisory panel may also be convened by the CCEPP, as required, to advise on specific matters.

Categorisation of EPPs

Investment in a response plan by governments and industries is guided by the relative public and private benefit of eradication. This is known as 'categorisation' of the EPP, with four categories and the process for categorisation described in the EPPRD.

If the NMG agrees to implement and fund a response plan for an EPP which has not been categorised, then costs will be shared 50 per cent by government parties and 50 per cent by industry parties until categorisation has occurred.

Transition to management

Following the implementation of a response plan, the NMG (on the advice of the CCEPP) may conclude that it is no longer feasible to eradicate the EPP. In such incidents the NMG may agree to proceed with a short (maximum 12 months) 'transition to management' phase. During this phase, certain activities may be agreed upon and funded to support transition from the 'emergency response' phase to ongoing management outside of EPPRD processes.

The objectives and activities undertaken in the transition to management phase are considered on a case-by-case basis and 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.

Owner Reimbursement Costs

Following a response under the EPPRD, growers impacted by the response plan actions and who are covered by the provisions of the EPPRD, may be eligible to receive reimbursement of specific costs or losses. These are referred to as Owner Reimbursement Costs (ORCs) and are funded by both government and industry through the EPPRD arrangements.

Review and evaluation

To maintain the ongoing relevance and integrity of the EPPRD, the implementation of the agreement is subject to continual review and improvement. This encompasses a formal review of the agreement every five years (next review to occur in 2020), an annual review of PLANTPLAN, individual incident debriefs (for completed or current responses), and findings arising from training activities.

PHA manages the continual improvement to the EPPRD and PLANTPLAN on behalf of the signatories. No significant amendments to the EPPRD were made during 2019. A new version of PLANTPLAN was issued in December 2019, with focused improvements identified through debriefs undertaken between 2017 and 2019.

PLANTPLAN

PLANTPLAN provides nationally consistent guidelines for response procedures, outlining the phases of an incursion (investigation and alert, operational, stand down and transition to management) and key roles and responsibilities of industry and government participants during each of these phases. It incorporates best practice in EPP responses and is consistent with the Biosecurity Incident Management System (BIMS; see page 185). PLANTPLAN is part of schedule 5 of the EPPRD and is endorsed by all EPPRD signatories.

PLANTPLAN is supported by several documents that provide further detail and guidance on specific topics as required. In 2019, parties endorsed a number of new and revised supporting documents, all of which are available at **planthealthaustralia.com.au/plantplan**

NATIONAL ENVIRONMENTAL BIOSECURITY RESPONSE AGREEMENT

If a new pest is considered to primarily impact the environment or social amenity and is not able to be dealt with under the EPPRD, then the National Environmental Biosecurity Response Agreement (NEBRA) may be activated. The NEBRA is a non-legally binding arrangement signed by all Australian governments, which came into effect in January 2012.

During 2019 the governments continued with their review of the agreement, including public consultation, and a new version is expected to be available in 2020.

Preparing for plant biosecurity incidents

A range of preparedness activities are undertaken by industry, government and PHA to maintain and improve response capability and capacity. The following section describes some of the key systems and training activities to prepare for emergency responses.

REPORTING A PLANT PEST OR DISEASE

The state and territory governments collectively maintain a national hotline to facilitate reporting of potential new plant pests or diseases in Australia. It is referred to as the Exotic Plant Pest Hotline (1800 084 881), with callers directed to the relevant state or territory department of agriculture.

IF YOU SEE ANYTHING UNUSUAL, CALL THE EXOTIC PLANT PEST HOTLINE

1800 084 881

A report through the hotline triggers investigations by the receiving jurisdiction to identify the potential pest or the cause of unusual plant symptoms. Each call is treated seriously and confidentially. Information on Australia's diagnostic system in described in Chapter 5.

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. This ensures greater interoperability, with response capacity able to be boosted more easily.

Exercise Crown and Anchor

In March 2019 Exercise Crown and Anchor was run in Canberra to test the ability of the Commonwealth and adjoining jurisdictions to respond to a biosecurity incident originating in a 'Commonwealth Place'.

The simulation exercise was part of the annual program of professional development created for and run by the NBRT.

The exercise presented two fictional scenarios:

- a Varroa mite detection in Jervis Bay Territory
- a red imported fire ant detection on the grounds of Canberra International Airport.

The scenarios were used to investigate who would lead the response, what legislation would be applicable and how the different agencies could work together.

Exercise participants conducted activities which would be undertaken in a Local Control Centre during a response as well as undertaking field trips to experience the complexities of working in unfamiliar environments.

National Biosecurity Response Team members learn about the complexities of conducting surveillance on beehives during Exercise Crown and Anchor, March 2019. Image courtesy of Plant Health Australia

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 group of personnel with experience in a functional response and another of highly experienced mentors. The NBRT program is managed by an advisory group, with standing members from the Australian Government Department of Agriculture, Animal Health Australia and PHA. Animal Health Australia manages the administration of the NBRT.

Members of the NBRT participate in professional development opportunities and maintain their skills in exercises and responses through workshops organised by the advisory group. They can also apply for sponsorship from the NBRT to attend external workshops and conferences that will benefit their NBRT roles.

When numerous live, adult brown marmorated stink bugs hitchhiked their way to Australia in a shipping container packed with electrical components, Hager Electro's warehouse manager Sione (John) Matakaiongo (pictured) immediately raised the alarm. In 2019, Hager Electro were joint winners with Greater Sydney Local Land Services of an Australian Biosecurity Award. Image courtesy of the Department of Agriculture

NATIONAL COMMUNICATION ARRANGEMENTS

During an EPP response, the relevant state or territory government takes the lead in ensuring that the public and stakeholders are kept informed of activities. 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.

National Biosecurity Communication and Engagement Network

The National Biosecurity Communication and Engagement Network (NBCEN) advances preparedness and prevention activities nationally that relate to communication and engagement during a response. The network consists of communication managers from the Australian Government, state and territory governments, and organisations including PHA and Animal Health Australia. Industry personnel receive network communications during a response that is relevant to them.

The NBCEN also has a key role in developing national talking points during a response, which allows for consistent national messaging.

Biosecurity Incident Public Information Manual

During a response, agricultural agencies and industry organisations refer to the Biosecurity Incident Public Information Manual (BIPIM), developed by the NBCEN. The BIPIM is in line with the Public Information function set out in BIMS.

The use of the 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 personnel 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**

TRAINING IN BIOSECURITY EMERGENCY RESPONSES

The effective delivery of EPP responses is supported by preferentially using trained and experienced personnel at all levels of the response. This includes representatives from industries and governments, covering roles on national decision-making committees through to being members of control centres and field-based officers.

This training is provided by state and territory governments, the Australian Government, PHA and peak plant industry bodies. It is offered in a variety of forms, from short presentations and e-learning courses, through to formal educational qualifications. Joint training may also be delivered with Animal Health Australia.

Parties also undertake simulation exercises on a regular basis, where responders are put through their paces under a simulated incursion scenario. This provides practice in EPP responses and improves preparedness by identifying aspects of the system that need improvement.

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 gaps in skills or capacity (see Chapter 5).

Qualifications for biosecurity emergency responses

Updated biosecurity emergency response qualifications as part of the Public Safety Training Package were released in July 2019. 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:

- PUA30919 – Certificate III in Public Safety (Biosecurity Emergency Response Operations)
- PUA40419 – Certificate IV in Public Safety (Biosecurity Emergency Response Leadership)
- PUA50219 – Diploma of Public Safety (Biosecurity Emergency 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 (Advanced) (Australian National University)
- Bachelor of Biosecurity Science (Box Hill Institute).

Exercise Blueprint for the cotton industry

The enthusiasm of the participants at Exercise Blueprint, held in Toowoomba in August 2019, highlighted the desire of the cotton industry to be ready for a real-life exotic pest incursion.

Exercise Blueprint used a fictional detection of cotton blue disease on a cotton farm near Dalby, Queensland, in a range of discussions and activities to find out how the industry would respond to an incursion of this exotic pest.

The main aims of the exercise were to identify:

- how industry will be engaged in a response
- the communication channels industry use to ensure the right messages reach their stakeholders.

Attendees came from a wide range of cotton industry sectors including Cotton Australia, CottonInfo, Cotton Research Development Corporation (CRDC), growers, agronomists, gin operators, researchers, extension officers, the Australian Government Department of Agriculture, Queensland Department of Agriculture and Fisheries and NSW Department of Primary Industries.

The exercise was funded by CRDC to improve the biosecurity preparedness of the cotton industry.

Exercise Blueprint participants attempt to identify cotton blue disease in a crop. Image courtesy of Plant Health Australia

Workshop Sugar Rush tests industry's preparedness

In May 2019, PHA ran a biosecurity workshop for the sugar industry in Townsville. The workshop was funded by Sugar Research Australia with the aim of assessing and improving the biosecurity preparedness of the industry.

Through a series of activities, the participants at the workshop investigated how the sugar industry would respond to an incursion of Ramu shoot borer (*Sesamia grisescens*) in the Burdekin growing region in Queensland.

The sugar industry has a wide range of stakeholders: the workshop was attended by cane growers, millers, productivity boards, peak bodies, researchers and staff from the Queensland Government.

On the day, participants worked through exercises to learn:

- what their role would be in an emergency plant pest response
- what information they would want to know and how best to communicate it
- how a response plan is put together and what information needs to go into it.

The workshop provided an introduction to biosecurity for many of the attendees, and scope to apply what they had learnt to other cane growing regions.

A Sugar Rush participant tries to determine whether a sugarcane pest is an EPP. Image courtesy of Plant Health Australia.

National EPP Training Program

PHA conducts the National EPP Training Program on behalf of its members, delivering training to industry and government representatives, growers and other biosecurity stakeholders. The aim is to ensure that members can effectively fulfil their roles and obligations under the EPPRD.

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. During 2019 the cotton and sugarcane industries participated in Exercise Blueprint (see page 187) and Workshop Sugar Rush (see page 188).

Online training in plant biosecurity

PHA offers online training through the e-learning platform BOLT (Biosecurity Online Training). Courses available during 2019 included:

- **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 the committees and their members, and the decision-making process in an incident.
- **Bee Biosecurity Awareness** – is a short awareness course that adds to the information in the Biosecurity Manual for Beekeepers. 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.

Two tailored courses – called **Pest Reporting and Responses** – were released in 2019 to inform growers and researchers about reporting suspect EPPs.

In 2019, the BOLT courses were completed just over 1300 times, with the PHA Foundation Course being completed 423 times. Since their launch in mid and late 2019, the two new reporting courses were completed a combined total of 149 times. Since BOLT was launched in 2013, 5390 users had registered on the site in order to enrol in plant biosecurity courses.

BOLT courses are open to all plant biosecurity stakeholders and can be accessed through **planthealthaustralia.com.au/bolt**

Notifications and responses in 2019

This section highlights the notifications of plant pest incidents and the nationally coordinated responses that were managed under the EPPRD during 2019.

Information on national responses to pests or weeds that are not managed under the EPPRD but may have flow-on implications for Australia's plant industries (such as red imported fire ants or red witchweed) may be found on the Australian Government's Outbreak website **outbreak.gov.au**

NATIONAL RESPONSE PLANS

During 2019 two new response plans were implemented under the EPPRD in response to a new detection of *Varroa jacobsoni* in Queensland (unrelated to the 2016 incursion), and seasonal incursions of three exotic fruit flies onto the Torres Strait Islands (Queensland).

Area freedom from banana freckle was recognised nationally in February 2019 which – together with responses relating to brown marmorated stink bug, tomato potato psyllid and *Candidatus* Liberibacter solanacearum (haplotypes D and E) drawing to a close – saw the number of active response plans under the EPPRD decreasing to six as at 31 December 2019.

A short summary of national response plans in place during 2019, together with a description of key activities undertaken during the year, is in Table 54 on page 190.

OTHER PLANT PEST NOTIFICATIONS

A number of plant pests were reported during 2019 that did not proceed to a response plan in 2019. Some were assessed as requiring no further action: others were still under investigation in 2019 and further actions may be taken in 2020. These pest detections are listed in Table 55 (see page 192).

Banana freckle freedom declared

In February 2019 Australia was declared free of banana freckle (*Phyllosticta cavendishii*) after an eradication campaign that had been underway since the disease was first detected in the Northern Territory in 2013.

Australia's banana industry is worth some $600 million annually. The action of the commercial banana growers, backyard growers and community in the NT, helped stop the disease from spreading to the broader industry in other states.

The disease was successfully eradicated through a multi-million-dollar program under the EPPRD.

The banana industry, through the Australian Banana Growers' Council, was one of the first cropping sectors in Australia to commit to the partnership approach to emergency responses by signing the EPPRD in 2004.

The national banana industry was the principle funder of the banana freckle response, investing half of the costs, with the Australian Government, state and territory governments, and the nursery and garden industry also contributing financially and in-kind to the response.

The disease banana freckle in the Cavendish strain of bananas makes the fruit unappealing to buyers. Image courtesy of Juliane Henderson.

Table 54. Responses to plant pests under EPPRD arrangements*

Scientific name	Common name	Crops affected	Region	Past action	Situation as of 31 December 2019
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. The NMG agreed that annual incursions of *Bactrocera dorsalis, B. trivialis* and *Zeugodacus cucurbitae* in the Torres Strait between 1 July 2015 and 30 June 2018 have been eradicated from Australia following successful implementation of the Response Plan. A new Response Plan was endorsed by the NMG for the period July 2018 to June 2021.
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 implemented. Extensive testing of psyllids and host plants did not detect the potential vectored pathogen *Candidatus* Liberibacter solanacearum (haplotypes A and B).	In 2019 the NMG agreed that Transition to Management under the Response Plan had been completed, bringing the response under the EPPRD to an end.
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 and surveillance undertaken. The bacterium has only been detected in unsown imported seeds and not within any host crops being grown in Australia.	In 2019 the NMG agreed that *Candidatus* Liberibacter solanacearum haplotypes D and E had been eradicated from Australia following successful completion of the Response Plan.
Cryphonectria parasitica	Chestnut blight	Chestnuts	Victoria	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 implemented. Containment measures in place and surveillance activities ongoing in 2018.	In 2019 the NMG agreed that it was no longer feasible to eradicate chestnut blight and endorsed a revised Response Plan for Transition to Management.

Table 54. Responses to plant pests under EPPRD arrangements* (continued)

Scientific name	Common name	Crops affected	Region	Past action	Situation as of 31 December 2019
Halyomorpha halys	Brown marmorated stink bug (BMSB)	Various fruits and vegetables, hazelnuts, cotton, grains, production nurseries	WA	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.	In 2019 the NMG agreed that BMSB had been eradicated following successful completion of the Response Plan.
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.	In 2019 the NMG agreed that banana freckle had been eradicated from Australia following successful completion of the Response Plan.
Varroa jacobsoni (2016 Incident)	Varroa mite	Honey and various pollination-reliant crops	Queensland	Detected on Asian honey bee (*Apis cerana*) in Queensland in June 2016. Response Plan endorsed by the NMG in September 2016 and eradication activities undertaken. Proof of freedom surveillance activities ongoing.	There were no further detections of Asian honey bee or *V. jacobsoni* related to this incursion. Proof of freedom surveillance activities were ongoing in 2019.
Varroa jacobsoni (2019 Incident)	Varroa mite	Honey and various pollination-reliant crops	Queensland	New incursion in 2019.	Detected on Asian honey bee (*Apis cerana*) in Queensland in May 2019. The detection was a new entry into Australia and not related to the 2016 incursion. A Response Plan was endorsed by the NMG in July 2019. The Asian honey bee nest and mites were destroyed. Surveillance activities are ongoing with no further detections of Varroa mite.
Xanthomonas citri subsp. *citri*	Citrus canker	Citrus, production nurseries	NT, WA	Initially detected in Darwin, NT, in April 2018 with tracing activities identifying additional infected plants in northern WA. The Incident is restricted to potted plants in the home and garden sector. NMG endorsed a Response Plan in May 2018. Eradication activities ongoing, including containment, surveillance and tracing, destruction of infected plants and surrounding host plants, and community engagement and awareness activities.	The response remained on track to achieve eradication. Activities were ongoing in the NT with host plant destruction in Restricted Areas nearing completion and surveillance activities ongoing. WA completed destruction and proof of freedom surveillance activities, and the NMG agreed that citrus canker had been eradicated from WA. In 2019 the NMG endorsed a revised Response Plan which included activities to successfully achieve eradication by 2020. No natural spread of the disease has been observed and there have been no detections in commerical citrus orchards.

** This table may not reflect all Cost Shared responses in 2019.*

Table 55. Plant Pest detections notified under the EPPRD in 2019

Scientific name	Common name	State
New detections		
Colletotrichum liriopes	Anthracnose of *Liriope* spp.	Qld
Dickeya fangzhongdai	Soft rot	Vic
Dinoderus ocellaris	Bamboo beetle	Qld
Epiphyllum badnavirus 1 (Badnavirus)	Epiphyllum badnavirus 1	Vic
Epiphyllum carlavirus 1 (Carlavirus)	Epiphyllum carlavirus 1	Vic
Ernocladius sp.	Pygmy borer	NT
Fusarium phyllophilum	No common name	Vic
Grapevine rupestris vein feathering virus (Marafivirus)	Grapevine rupestris vein feathering virus	SA, WA
Grosmannia radiaticola	Blue stain fungus	SA
Halyomorpha halys	Brown marmorated stink bug	NSW (Banksmeadow), Vic (Dandenong South, Port Melbourne), WA (Bibra Lake, Fremantle Wharf)
Nisotra basselae	Sliperi beetle	Qld
Diaporthe sp. *on rockmelon*	No common name	Qld
Pectobacterium parmentieri	Black leg of potato	SA, Tas, Vic
Pectobacterium polaris	No common name	Vic
Phytophthora sp. on *Tristaniopsis laurina*	No common name	Qld
Phytopythium chamaehyphon	No common name	NSW
Pitaya virus X (Potexvirus)	Pitaya virus X	Vic
Pseudocercospora platanigena	Stigmina leaf spot	NSW
Pseudoidium sp.	Powdery mildew	Qld
Pseudomonas savastanoi pv. *nerrii*	No common name	WA
Puccinia striiformis f. sp. *tritici* pathotype 198 E16 A+ J+ T+	Wheat stripe rust	NSW, Tas, Vic
Puccinia vincae	Periwinkle rust	SA
Ralstonia sp.	No common name	ACT
Rattail cactus necrosis associated virus (Tobamovirus)	Rattail cactus necrosis associated virus	Vic
Schlumbergera badnavirus 1 (Badnavirus)	Schlumbergera badnavirus 1	WA
Schlumbergera begomovirus 1 (Begomovirus)	Schlumbergera begomovirus 1	WA
Schlumbergera tobamovirus 1 (Tobamovirus)	Schlumbergera tobamovirus 1	Vic
Schlumbergera virus X (Potexvirus)	Schlumbergera virus X	Vic
Stemphylium astragali	No common name	Vic
Stemphylium beticola	No common name	Vic, WA
Stemphylium eturmiunum	No common name	NSW, Qld, SA, Vic
Tarsonemus sp.	Tarsonemid mite	Qld
Tetranychus piercei	Banana spider mite	Cocos (Keeling) Island (external territory)
Tomato necrotic spot virus (Ilarvirus)	Tomato necrotic spot virus	WA
Urocystis cepulae	Onion smut	SA
Velataspis dentata	Dentate scale	Qld
Vryburgia trionymoides	Exotic mealybug	Qld
Watermelon crinkle leaf associated virus 1 (unassigned Phenuiviridae)	Watermelon crinkle leaf associated virus 1	NSW
Xanthomonas gardneri	Bacterial leaf spot	NT
Xanthomonas sp. on *Musa* sp.	No common name	Qld
Zygocactus virus X (Potexvirus)	Zygocactus virus X	WA
Extensions of geographic and/or host range		
Amphorophora rubi	Large blackberry aphid	Tas
Cactus virus X (Potexvirus)	Cactus virus X	Vic, WA
Candidatus Phytoplasma aurantifolia	Phytoplasma	NT
Diaporthe masirevicii	No common name	Qld
Dickeya dianthicola	Blackleg of potato	Tas
Endive necrotic mosaic virus (Potyvirus)	Endive necrotic mosaic virus	WA
Exserohilum rostratum	No common name	NT
Fusarium foetens	No common name	Vic
Fusarium oxysporum f.sp. *cucumerinum*	Fusarium wilt of cucumber	NT
Fusarium pseudograminearum	No common name	Vic

Table 55. Plant Pest detections notified under the EPPRD in 2019 (continued)

Scientific name	Common name	State
Extensions of geographic and/or host range		
Fusarium sambucinum	No common name	Tas
Fusarium subglutinans	No common name	Tas, Vic
Fusarium tricinctum	No common name	Vic
Heliococcus summervillei	No common name	Qld
Marchalina hellenica	Giant pine scale	SA
Megaspidiotus fimbriatus	No common name	Vic
Neofusicoccum parvum	No common name	Vic
Neopestalotiopsis rosae	No common name	Vic, WA
Ozognathus cornutus	Ptinid beetle	WA
Pectobacterium carotovorum subsp. *brasiliense*	Black leg	SA, Tas, Vic, WA
Ranunculus white mottle virus (Ophiovirus)	Ranunculus white mottle virus	NSW
Rotylenchulus reniformis	Reniform nematode	Qld
Tetranychus evansi	Tomato red spider mite	SA
Tobacco rattle virus (Tobravirus)	Tobacco rattle virus	WA
Tomato leaf curl virus (Begomovirus)	Tomato leaf curl virus	WA

Ledgend
f.sp. forma specialis
pv. pathovar
subsp. subspecies
sp. species
spp. multiple species

Sampling plants for citrus canker. Image courtesy of WA DPIRD

Western Australia regains freedom from citrus canker

Citrus canker (*Xanthomonas citri* subsp. *citri*) is a tropical disease affecting commercial citrus species such as oranges, limes, lemons and mandarins. Affected plants develop lesions on the leaves, fruit and stems, and drop fruit before it has a chance to ripen, decreasing fruit yields and damaging trees.

Citrus canker was detected in a plant wholesaler in the NT in April 2018, and subsequently found on three properties in northern Western Australia in May 2018. Prior to this outbreak, Australia had been free of citrus canker since 2009, following a successful five year eradication program in Queensland.

The Department of Primary Industries and Regional Development in WA declared an emergency response on 26 April 2018 and immediately began delimiting surveys and tracing surveillance in the state, covering an area of 360,000 km^2 from the NT border to Exmouth in the south.

During the emergency response, 682 properties were inspected with seven positive samples found on three infected premises in WA. To eradicate the disease, more than 1,500 plants were destroyed, and three restricted areas were declared to minimise its spread.

After the initial response phase, follow up surveillance was conducted for a period of 12 months. During this time over 5,000 properties were inspected with no new citrus canker found.

In November 2019, WA was officially declared to be free of citrus canker and restrictions on the movement of citrus both intrastate and interstate were lifted. Surveillance for citrus canker and other pests of concern will continue.

All jurisdictions except the NT have now demonstrated that they are free from citrus canker. On-the-ground response teams remain in place in the NT and are well positioned to finish eradication activities and demonstrate proof of freedom by the end of 2020.

Chapter 7

Post-border biosecurity – controlling pests and weeds

Post-border biosecurity – controlling plant 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.

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 Plant Health Australia (PHA), government and industries.

The chapter finishes with an overview of Australia's weed biosecurity system.

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

The coordination of domestic quarantine between the state and territory governments is assisted by the Subcommittee on Domestic Quarantine and Market Access (SDQMA). This committee consists of senior plant health regulators from state and territory governments, representatives from the Australian Government Department of Agriculture, 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 spread of 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 SDQMA 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, as well as adopting international treatment practices, which not only provide for domestic trade, but also present a potential pathway to support international market access.

RESTRICTIONS ON INTERSTATE TRAVELLERS CARRYING 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 legislation. 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 Australian Interstate Quarantine website found at **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 – the electronic version of which was updated in August 2019.

There are interstate quarantine bins at some high-risk 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.

SA has enforced on-the-spot fines for travellers entering the state if caught with restricted fresh fruit and fruiting vegetables at the Yamba Quarantine Station or roadblocks. Commercial operators cannot carry fresh fruit and fruiting vegetables into SA without a Plant Health Certificate or Plant Health Assurance Certificate.

Nursery industry biosecurity program pays off

In September 2019 the National Biosecurity Committee recognised the achievements of the first national third-party accreditation system for biosecurity, the Australian nursery industry's BioSecure HACCP program.

The on-farm plant protection and biosecurity program was developed by Nursery & Garden Industry Australia (now Greenlife Industry Australia) with funding from Hort Innovation and continues to be supported by the industry levy through the Hort Innovation Nursery Fund.

The system allows certified production nurseries to self-certify consignments of nursery stock for interstate market access and issue BioSecure HACCP Biosecurity Certificates. The system allows businesses to generate these certificates electronically, adding to business efficiencies and securing market access records.

Lockyer Valley production nursery, Pohlmans Nursery, is one business that is benefitting from adopting the BioSecure HACCP program. The business produces more than 1,200 different types of plants on 150 acres in the fertile Lockyer Valley in Queensland, employing more than 200 staff.

The plant protection and biosecurity program helps them to better manage endemic and exotic pests, disease and weed risks. It has enabled the business to establish an internal plant protection and quarantine process for imported and exported plant material, underpinned by reliable plant data to support decision-making.

Staff now use smartphones and tablets to monitor and survey plants on a routine basis. This has led to greater staff engagement and a team that is likely to communicate and act as soon as an issue is detected.

By adopting the BioSecure HACCP risk management approach, Pohlmans Nursery has halved pesticide use and reduced stock losses by more than two per cent, whilst maintaining a system that supports the safe trade of plants.

Greenlife Industry Australia

Restrictions on interstate movement of commercial consignments

Commercial trade in products being moved around Australia is managed by the states and territories, who regulate the provision of certificates 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.

Four types of certificates are issued by the exporting state or territory to certify that produce for interstate trade meets the receiver's requirements:

- **Plant Health Certificate** – issued by a government officer from the state or territory of origin.
- **Plant Health Assurance Certificate** – is supplied by an approved business under an Interstate Certification Assurance (ICA) scheme. To issue these certificates a business must meet specific requirements and undergo regular audits by the state or territory government accreditation authority.
- **BioSecure HACCP Biosecurity Certificate** – is issued through a third party. In 2018, Nursery and Garden Industry Australia (now Greenlife Industry Australia) received approval to issue the first certificates of this type.
- **Area Freedom Certificate** – is issued by a government officer when an area is known to be free of a particular pest.

In 2019, states and territories updated several ICAs for a variety of produce to mitigate the risk of spreading Queensland and Mediterranean fruit fly, and blueberry rust. 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. The site also refers users to BioSecure HACCP Biosecurity Certificates, where they exist.

Mangosteens at a market in Cairns. Image courtesy of Sue Pederick, Primary Industries and Regions SA

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 at the international border. 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 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 mainland states on the east coast, but not in SA, Tasmania or WA.

Table 56 lists the 96 regionalised pests recognised by state and territory governments and their current area of distribution within Australia.

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	Present 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	Present 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, Alice Springs
Brontispa longissima	Palm leaf beetle	Darwin, Palmerston, Darwin rural area
Citripestis eutrapera	Mango fruit borer	Darwin, Darwin rural area, Katherine
Cosmopolites sordidus	Banana weevil borer	Darwin rural area
Cryptosporiopsis citri	Cryptosporiopsis leaf spot	Darwin, Darwin rural area, Batchelor, Daly River, Litchfield region
Cucumber green mottle mosaic virus (Tobamovirus)	Cucumber green mottle mosaic virus	Darwin rural area, Katherine, Alice Springs (Ti Tree)
Fusarium oxysporum f. sp. *cubense* (tropical race 4)	Panama disease	Darwin, 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 (Ampelovirus PMWaV-1, PMWaV-3)	Pineapple mealy bug wilt associated virus	One property only (Darwin Correctional Facility Shoal Bay)
Pseudocercospora purpurea	Cercospora spot	Darwin rural area
Selenothrips rubrocinctus	Red banded thrips	Darwin, Palmerston, Darwin rural area, Adelaide River, Pine Creek, Katherine

Table 56. Australia's regionalised pests (continued)

Scientific name	Common name	Area of regionalisation
Northern Territory (continued)		
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. A genetically distinct population of AHB is the focus of a *Varroa jacobsoni* (Varroa mite) eradication in Townsville
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 Papua New Guinea (Saibai and Dauan)
Cucumber green mottle mosaic virus (Tobamovirus)	Cucumber green mottle mosaic virus	Confined to three quarantined businesses; one in north Queensland and two in the Wide Bay region
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 applies. Race 4 (tropical) detected in 2015, 2017 and 2018 on three 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 General Biosecurity Obligation
Idioscopus nitidulus	Mango leaf hopper	Cape York Peninsula. Managed under the General Biosecurity Obligation
Liriomyza sativae	Vegetable leafminer	Some islands in Torres Strait and at Seisia in the northern peninsula area of Cape York
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
Planococcus 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
Aethina tumida	Small hive beetle	Limited known distribution within all of SA, but not known to occur on Kangaroo Island
Ascosphaera apis	Chalkbrood	Endemic across all of SA
Chortoicetes terminifera	Australian plague locust	Endemic within all of SA
Cucumber green mottle mosaic virus (Tobamovirus)	Cucumber green mottle mosaic virus	Known to be present on at least five properties on the Northern Adelaide Plains
Diuraphis noxia	Russian wheat aphid	Endemic within SA cereal growing regions
Galleria mellonella	Greater wax moth	Endemic across all of SA
Grapevine pinot gris virus	Grapevine pinot gris virus	Established in SA
Melissococcus pluten	European foulbrood	Endemic across most of SA, but not known to occur on Kangaroo Island
Nosema apis	Nosema	Endemic across all of SA
Nosema ceranae	Nosema	Endemic across most of SA, but not known to occur on Kangaroo Island
Paenibacillus larvae	American foulbrood	Endemic across most of SA, but not known to occur on Kangaroo Island

Table 56. Australia's regionalised pests (continued)

Scientific name	Common name	Area of regionalisation
Victoria		
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	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
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
Western Australia (continued)		
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 (Pospiviroidae)	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

Legend
f. sp. forma specialis
spp. multiple species
syn. synonym

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's 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 Council helps drive the delivery of a national system that prevents fruit flies being a constraint to sustainable production or a barrier to trade and market access. The Council includes representatives from governments, plant industries and Hort Innovation. It has an independent chair and is supported by a manager and a secretariat from PHA.

The Council focuses on 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.

The Council oversees and monitors implementation of the National Fruit Fly Strategy. In 2019 work began to review progress on the strategy and to update it to better reflect current and emerging national fruit fly management issues.

Regular meetings of the Council provide an important opportunity to identify priority areas for action and to promote coordination of activities between 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 is established in parts of WA. Other states and territories require fruit and fruiting vegetables to be treated before they are allowed to enter their jurisdictions.

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 avoid spreading plant pests and weeds, including keeping a lookout for anything unusual and reporting unfamiliar pests.

The introduction of a general biosecurity obligation or duty makes explicit the role that all 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 or equipment that could carry a pest, disease or contaminant.

People in Queensland, NSW and Tasmania 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 are not 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.

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:

- managing 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.

The general biosecurity duty or obligation means that Australians are expected to know about the biosecurity risks related to their day-to-day work and hobbies, like gardening.

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. Measures used on farm establish another layer of protection, allowing producers to minimise 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 209).

Increasingly, growers are appreciating the benefits of on-farm biosecurity. The rate of uptake of on-farm biosecurity varies between and within industries. Increasing this uptake is the remit of several programs, described in the following sections.

The Goulburn Murray Valley Regional Fruit Fly Project won two Victorian Regional Achievement and Community Awards. From left to right: Merran Socha, Adrian Conti, Ross Abberfield (holding the award), Russell Fox,. Cr Libro Mustica, Cr Dinny Adem and Michael Carrafa. Image courtesy of Dannika Bonser

Regional fruit fly initiative recognised

A regional fruit fly project in Victoria's Goulburn Murray Valley was recognised with two Victorian Regional Achievement and Community Awards in October 2019.

Control of Queensland fruit flies is a high priority in Victoria where they pose a significant threat to the state's horticulture industry, affecting production and disrupting trade, and impacting produce grown in community and home gardens.

The Goulburn Murray Valley Regional Fruit Fly Project is an initiative bringing together members of the local horticulture industry associations, agronomists, Agriculture Victoria, government agencies, industry, growers and the community. The project uses the 'No Flies On Us' message to strengthen management of Queensland fruit fly in its region.

There are similar groups in Greater Sunraysia and the Yarra Valley who have developed comprehensive regional plans. They align with an overarching action plan for managing fruit fly in Victoria.

The Managing Fruit Fly in Victoria Action Plan 2015–20 takes a collaborative and coordinated approach to managing fruit fly across the state, focusing on the large fruit growing regions and emphasising that everyone has a role to play in the management of fruit fly.

Agriculture Victoria's $7.8 million Regional Grants Program funds the implementation of regional plans and the appointment of three regional coordinators.

Some of the highlights include:

- working with landholders to manage fruit fly 'hotspots', including an urban trapping program in Sunraysia and host tree removal on public land and private urban land
- advertising, community signage, school programs, community and industry workshops, field days and one-on-one discussions, that have all contributed to raising awareness of fruit fly impacts and management options
- providing smaller community grants of up to $5,000 to allow groups to tackle Queensland fruit fly in individual towns or localities in innovative ways
- building capability within industry and community to take ownership of fruit fly management, resulting in collaboration and outcomes which would be hard to replicate using a purely government-based approach to management.

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 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.

NSW Grains Biosecurity Officer, Bill Gordon, at AgQuip in August 2019. Image courtesy of Pip Cotter (former NSW DPI Plant Biosecurity Officer)

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 PHA for inclusion in 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 post-border incidents such as Russian wheat aphid and lupin anthracnose.

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 the 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 2019, the officers completed a pilot urban biosecurity program after many of the recent exotic pest incursions were located at seaports, airports and other urban hotspots across Australian cities.

Throughout 2019, 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 Citrus Biosecurity Program

As part of a partnership program funded by Hort Innovation and the Department of Agriculture (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 2019, the National Citrus Biosecurity Coordinator worked 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 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 has also worked with the Urban Plant Health Network 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 National Citrus Biosecurity Coordinator is a member of the Citrus Pest and Disease Prevention Committee (CPDPC), an industry initiative established in 2018 to identify and coordinate research and extension needed to manage High Priority Pests for the citrus industry. The CPDPC and the National Citrus Biosecurity Program are working to establish a network of traps for Asian citrus psyllid, the vector of huanglongbing.

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. The strategy is aligned with the National Plant Biosecurity Strategy and National Plant Biosecurity Surveillance Strategy, as described in Chapter 1. Read more about pest and disease surveillance in the citrus industry on page 153.

National Bee Biosecurity Program

The National Bee Biosecurity Program is managed and administered by PHA on behalf of the Australian Honey Bee Industry Council. The program aims to help beekeepers manage pests and diseases that are already in Australia, and to prepare for incursions by exotic pests. Underpinning the program is the Australian Honey Bee Industry Biosecurity Code of Practice which provides a framework for Australian beekeepers to engage in best-practice biosecurity.

Bee Biosecurity Officers (BBOs) are employed in all six states. The officers help beekeepers to understand their biosecurity obligations under the Code of Practice, and provide advice on pest and disease management practices. Extension and education-based activities include attending industry field days, presentations at beekeeper club meetings, delivery of workshops and visits to apiaries. The program is funded by industry via the honey levy, with state governments also contributing extensive in-kind resources.

Farm biosecurity programs for horticultural industries

Each year the number of industries establishing farm biosecurity programs continues to grow. Many industries now recognise the importance of tailoring information to raise awareness of on-farm biosecurity and improve management decisions to mitigate the biosecurity risks to their crop(s).

In 2019 PHA worked with melon, avocado, mango, grape and wine industry representatives to develop capability and deliver farm biosecurity information to producers.

National Citrus Biosecurity Coordinator Jeff Milne speaks with growers in Mundubbera, Queensland. Image courtesy of Citrus Australia

Strawberry grower awarded for on-farm biosecurity

The plant category of the 2019 Farm Biosecurity Producer of the Year Award went to Victoria's Yarra Valley strawberry grower Luciano Corallo.

The award is supported by Plant Health Australia and Animal Health Australia, and is part of the annual Australian Biosecurity Awards run by the Department of Agriculture.

Luciano Corallo was nominated because he has demonstrated a commitment to ensuring his farm is a leader in industry best practice, quality assurance and biosecurity.

He takes a preventative approach to disease and pest management, actively participating in surveillance and hosting biosecurity workshops on-farm to share his knowledge with the industry.

Luciano takes part in the Queensland fruit fly awareness program in the Yarra Valley, with the farm hosting remotely accessed camera- based fruit fly traps as part of a sentinel detection network for the region.

Left: Victorian strawberry producers Heather and Luciano Corallo, winners of the 2019 Farm Biosecurity Producer of the Year Award. Right: (L to R) Karen Thomas of the Port Phillip and Westernport Catchment Management Authority, who nominated the Corallos for the award, Luciano and Heather Corallo

The Farm Biosecurity Program

Plant Health Australia (PHA) and Animal Health Australia (AHA) work together in a joint communication and awareness program, Farm Biosecurity, to provide 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 purchase, 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 to recognise the contribution of producers who demonstrate outstanding, proactive on-farm biosecurity practices.

BIOSECURITY MANUALS FOR PRODUCERS

To help improve farm biosecurity, PHA in partnership with plant industries and governments, has released 21 crop-specific biosecurity manuals, listed in Table 57. In 2019 a biosecurity manual for cherry producers was developed.

These documents 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 exotic and established pests. Each manual also raises awareness of the exotic High Priority Pests identified in the biosecurity plan for 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.

New Cherry Growers' Biosecurity Manual

A revised version of the Cherry Growers' Biosecurity Manual released in May 2019 provides an up-to-date guide for growers and their consultants and advisors to improve biosecurity on farm.

The manual was produced by PHA in collaboration with Cherry Growers Australia and government representatives from state departments of primary industries and agriculture.

The manual includes fact sheets on high priority exotic pests and diseases of cherries that were identified during an update to the Biosecurity Plan for the Cherry Industry.

This project was funded by Hort Innovation, using the cherry research and development levy and contributions from the Australian Government.

Table 57. Biosecurity manuals for producers

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

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 of animals and plants. It also monitors and enforces compliance with the Agricultural and Veterinary Chemicals Code and other legislation. Records are kept 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.

It is estimated that up to 73 per cent ($20.6 billion) [36] of Australia's total value of crop production is attributable to the use of crop protection products. Table 58 illustrates the amount and type of agricultural chemicals used for controlling plant pests in Australia. This total expenditure on pesticides for plants represents over six per cent of the gross value of production for all crops in Australia. [37] [38]

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.

Table 58. Sales of plant chemicals in Australia, 2016-19 [39]

		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	3,517	1,515	1,021	145	131	52	16	**6,397**
	Value of product sales ($ million)	1,714	413	269	37	20	14	2	**2,469**
2019	No. of products	3,643	1,570	1,088	145	134	51	17	**6,648**
	Value of product sales ($ million)	1,507	358	242	32	25	13	3	**2,180**

Australia's weed biosecurity system

The scope of Australia's plant biosecurity system covers more than just invertebrates and pathogens, with a range of prevention, surveillance, eradication and ongoing management activities in place to address the threats posed by weeds. It has been estimated that the annual cost to the Australian economy from the agricultural impacts of weeds is almost $5 billion. [40]

A weed is a plant that requires some form of action to reduce its negative effects on the economy, the environment, human health or amenity. Weeds reduce the establishment, growth and yields of field crops, pastures and forestry, and can invade natural environments, outcompeting native plants and disrupting ecosystem processes.

Around 20 naturalisations of garden plants are recorded each year, albeit a small number from the large pool of over 30,000 plant species that have been imported for cultivation in Australia.

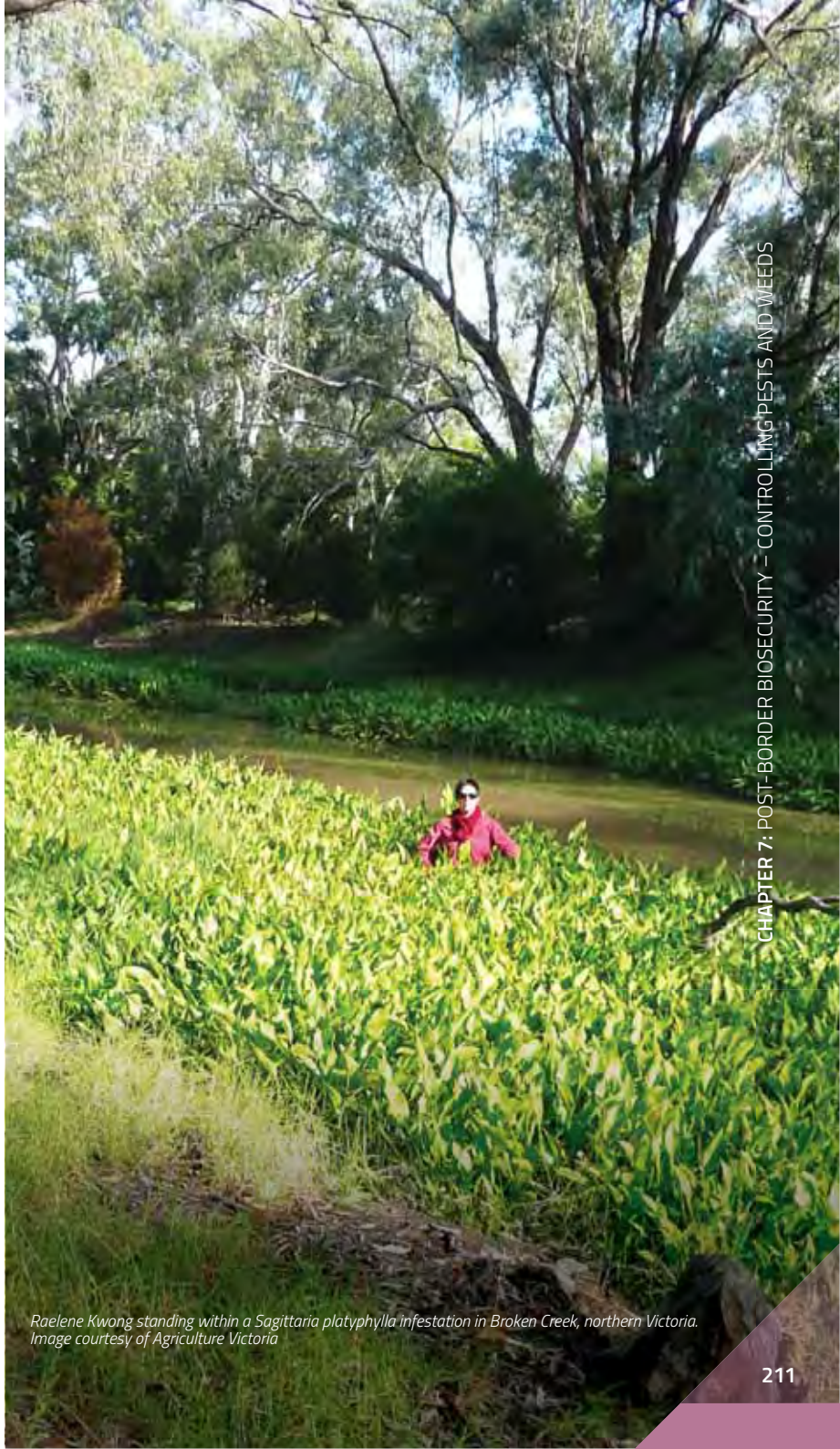
Australia's weed biosecurity system aims to:

- prevent entry of high weed risk species
- detect and eradicate or contain significant weeds in the early stages of invasion
- mitigate the impacts of established weeds.

Responsibility for weed biosecurity is shared between government, industry and the community. Legislation sets out the various roles of governments in managing weeds across Australia. State and territory government departments of primary industries and environment, along with local governments or natural resource management authorities, have responsibility for weed biosecurity policy and management.

Weed management is also a component of on-farm biosecurity. 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.

36. CropLife Australia, 2018. Economic activity attributable to crop protection products. Deloitte Access Economics Pty Ltd. agriculture.gov.au/SiteCollectionDocuments/abares/data/agricultural-commodities-statistics.xlsx
37. Australian Pesticide and Veterinary Medicines Authority, Gazette No 5 March 2020. Accessed online 31 March 2020, apvma.gov.au/node/64531
38. Australian Bureau of Agricultural and Research Economics and Sciences. Agricultural commoditiesDecember quarter 2019. Accessed online 16 March 2020, agriculture.gov.au/abares/researchtopics/agricultural-commodities/australian-crop-report
39. Australian Pesticide and Veterinary Medicines Authority, Gazette No 5 March 2020. Accessed online 31 March 2020, apvma.gov.au/node/64531
40. McLeod R (2018) Annual Costs of Weeds in Australia. eSYS Development Pty Limited. Published by the Centre for Invasive Species Solutions, Canberra, Australia



Raelene Kwong standing within a Sagittaria platyphylla infestation in Broken Creek, northern Victoria. Image courtesy of Agriculture Victoria

Two weevil species under consideration for the biological control of Sagittaria platyphylla are the fruit-feeding weevil (left) and crown-boring weevil (right). Image courtesy of Agriculture Victoria

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, all state and territory governments, and observers from the CSIRO, PHA, the Centre for Invasive Species Solutions, Wildlife Health Australia, AHA, and ABARES.

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 clarifying priorities, roles and responsibilities.

The strategy is available at **agriculture.gov.au/pests-diseases-weeds/pest-animals-and-weeds/review-aus-pest-animal-weed-strategy/aus-weeds-strategy**

PREVENTING THE ENTRY OF NEW WEEDS

Around 65 per cent of current weed species were originally imported for use as garden ornamentals, with introductions for potential pasture species being another key source. However, most of these species were imported decades ago and modern improvements to biosecurity arrangements have significantly reduced this risk.

The Department of Agriculture develops and implements biosecurity policies for plant imports (seeds, tissue culture or any other material for propagation) into Australia. Since 1997, new plant species have been subject to a Weed Risk Assessment process that determines the weed potential of any proposed new plant imports.

If a plant species is not listed in the department's Biosecurity Import Conditions database (BICON) as being permitted to enter Australia, it will require a weed risk assessment to determine its potential weed risk. Australia's Weed Risk Assessment system was developed following extensive consultation and collaboration of weed experts and has been adapted for use in other parts around the world.

All propagative material entering the country must meet standard biosecurity import conditions, including verification of the botanical name (species). In order to prevent the entry of weeds that may be present as a contaminant, consignments must also be inspected by a biosecurity officer before permission is given for it to enter.

Generally, larger seed lots (more than 10 kilograms) undergo purity analysis under a strict regime of statistical sampling and analysis at a laboratory accredited by the International Seed Testing Association. If any weed species are detected either by visual inspection or purity analysis, the seed lot may be denied entry until the weed seeds have been removed.

Seed consignments imported for other uses, such as for human consumption, may also be directed for mandatory treatment if weed seeds are found. Treatments devitalise the seeds to ensure they are unable to grow and spread, should they be inadvertently released in the environment.

WEED SURVEILLANCE

Weeds are also an integral part of the Northern Australia Quarantine Strategy (see page 146), which involves surveillance activities in Australia's north and neighbouring countries. Elsewhere, state and local government weed officers conduct surveillance as part of routine inspections of properties for declared plants.

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 through state herbaria. An example is the Weeds at the Early Stage of Invasion program run by the Victorian Government.

Surveillance also extends to online trade, with governments sharing information between jurisdictions when declared plants are found to be advertised for sale.

Host specificity testing of candidate biological control agents being undertaken by biocontrol scientists Nathan Harms (left) and Jackie Steel (right) within Agriculture Victoria's quarantine insectary. Image courtesy of Agriculture Victoria

Increased support for weed biocontrol

Biocontrol is considered the only cost-effective approach to manage abundant and widespread weeds across different land uses, with benefits outweighing R&D costs by over 23:1. It is a sustainable approach that requires little further investment once biocontrol agents are widely established, have built-up their populations and had a negative impact on the weed.

Investment in research on weed biocontrol has increased in recent years. An example is the Australian Government's Rural Research and Development for Profit that includes significant co-investments from other governments and industries.

Three projects on biocontrol of priority weeds have been funded from 2015 to 2022. The projects have brought together biocontrol expertise from four Australian and multiple international research agencies to support the development and deployment of new agents or fast-tracking of agent releases on 19 priority weed targets for primary industry and agricultural water assets: African boxthorn, African lovegrass, cabomba, clidemia, cylindropuntia, European blackberry, fleabane, giant rat's tail grass, gorse, Hudson pear, mother of millions, navua sedge, ox-eye daisy, parkinsonia, parthenium, prickly acacia, sagittaria, silverleaf nightshade and sowthistle.

Activities have spanned three stages:

- identification of potential biocontrol agents
- risk and efficacy assessment of agents
- mass-rearing and field release of approved agents in Australia.

This approach is ensuring that Australia has a sustained pipeline of weed biocontrol agents for the future.

The weed purple Viper's bugloss (Echium vulgare) is similar to Paterson's curse (Echium plantagineum)

ERADICATION AND CONTAINMENT OF WEEDS

Eradication of weeds is only possible if incursions are detected early, and a response is mounted before they have a chance to spread too far.

The National Tropical Weeds Eradication Program continued in 2019, targeting six weed species native to tropical America that have been detected in north Queensland (and one also in northern NSW). The program is managed by Biosecurity Queensland and is cost-shared by the Australian, Queensland, NSW, NT and WA governments. The species are:

- limnocharis (*Limnocharis flava*), a wetland plant
- miconia (*Miconia calvescens, M. nervosa, M. racemosa*), rainforest tree and shrubs
- mikania vine (*Mikania micrantha*).

The National Red Witchweed (*Striga asiatica*) Eradication Program also continues. The response is led by the Queensland Government and is being funded by the Australian, Queensland, NSW and NT governments, Meat and Livestock Australia, Grain Producers Australia and Canegrowers. Since July 2013 there has an 85 per cent reduction in the soil seedbank and a 99.99 per cent decline in plant detections, indicating good progress towards eradication.

Hawkweeds, *Hieracium* species, are also the subject of eradication programs in NSW, Victoria and Tasmania.

Weed containment programs occur at state, regional and local levels under a jurisdictions' legislation, aimed at preventing further spread of significant weeds that cannot be eradicated. A state-level example is the ongoing detection and treatment of parthenium weed (*Parthenium hysterophorus*) incursions from established populations in Queensland into NSW. Similarly, the NT has on-going responses to detect and treat new cross-border incursions of parthenium, rubber vine (*Cryptostegia grandiflora*) and Siam weed (*Chromalaena odorata*).

Local or regional government organisations lead coordinated control programs for declared weeds across multiple properties, where control is generally the legal responsibility of each land owner.

MANAGING ESTABLISHED WEEDS

The management of established weeds is a shared responsibility between landholders, community, industry and government. At the national level, the Australian Government administers a number of programs to assist with the management of established weeds for the benefit of the environment, agricultural productivity and local communities. Through these programs, the Australian Government invests in RD&E activities, national coordination and the development and implementation of policy and associated programs.

The National Landcare Program provides a range of measures to support natural resource management and sustainable agriculture, and to protect Australia's biodiversity. Now in the second phase of the program, the Australian Government aims to work in partnership with governments, industry, communities and individuals to manage established weeds for the protection and improvement of soil, water, vegetation and biodiversity on-farm, as well as reduce off-farm impacts on natural resources.

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 take an integrated approach of chemical and non-chemical control methods. Weeds are commonly managed using a combination of competition with other plants, herbicide applications, soil tillage, slashing, grazing, weed seed capture and/or burning. No-till production systems, which use herbicides to control weeds, are now common in Australia.

Plant industry research funding bodies, such as the Grains Research and Development Corporation, invest considerably in RD&E to improve weed management systems, particularly for herbicide resistant weeds. Co-investment by industries and governments is often used for the biological control of high priority weeds, which is particularly important in rangeland grazing systems and natural ecosystems where intensive weed control measures are cost-prohibitive.

Weed management in natural ecosystems is undertaken by volunteers, groups, contractors and private and government owners of conservation parks and reserves, undertaking sensitive restoration activities to maintain local bushland. For example, in Indigenous Protected Areas and other areas under management by traditional owners in the NT, indigenous ranger groups are employed to reduce the impact of established weeds across extensive areas of country. On the northern coastline, these ranger groups also conduct surveillance for new incursions in collaboration with the states and territories and the Northern Australian Quarantine Strategy.

Cocker spaniel Sally diligently sniffs the landscape for hawkweed at the protected Blue Lake Ramsar site in Kosciuszko National Park. Image courtesy of NSW National Parks and Wildlife Service

Multi-prong attack on hawkweed yields results

Eradicating a weed from an invaded range is a deceptively difficult task: the infestation must be delimited (all plants found), reproduction halted, above ground biomass controlled, and the seedbank exhausted.

The NSW Hawkweed Eradication Program – the largest weed eradication program in NSW – aims to eradicate mouse-ear and orange hawkweed from Kosciuszko National Park and surrounds. The program integrates cutting-edge airborne surveillance technology with traditional on-the-ground weed detection methods.

From the air, drones able to detect the unique orange hawkweed flowers capture high resolution images of the landscape. Helicopters transport equipment and eradication teams into and out of remote and hard to access areas. Working together on the ground, humans visually scan the terrain for hawkweed and detector dogs sniff out and locate plants.

Over an increasing large search area, the number of new hawkweed detections is decreasing. In 2018–19, the area of orange hawkweed discovered decreased by 60 per cent compared to the previous season and has dropped by nearly 97 per cent since 2010–11. Less than one square metre, or 160 plants, of mouse-ear hawkweed was found in 2018–19, indicating eradication of this species is on target.

Research to further enhance the program covers:

- behavioural change to improve weed hygiene practices of park users
- modelling wind data to determine hawkweed seed dispersal patterns
- multispectral imagery to improve detection of hawkweed
- hawkweed ecology and seed longevity
- time to eradication modelling.

The program is being delivered by the NSW Environmental Trust, Department of Primary Industries, South East Local Land Services and a range of other partners, along with a large group of technical experts and volunteers.

Chapter 8

Plant biosecurity RD&E

Identifying fruit fly from large samples collected in male fruit fly lure traps from north Queensland. Image courtesy of Queensland Department of Agriculture and Fisheries

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, the Cooperative Research Centre for Honey Bee Products, 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, data 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 2019 provides an overview of plant, weed and pollinator biosecurity RD&E in Australia, with a summary of where it was carried out, the size, the topic, pest and crop types.[41] Surveillance programs that include some research or extension activities are also included, as are some training and awareness programs.

41. 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 232, 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.

Developed in 2013 by PHA in collaboration with stakeholders around Australia, the strategy sits under the National Primary Industries RD&E Framework. The framework is overseen by the Agriculture Senior Officials' Committee (AGSOC) Research and Innovation Committee 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 implementation of the strategy.

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 (lead coordinator role across the RDCs), the Victorian Department of Jobs, Precincts and Regions (on behalf of the state and territory governments), Cotton Research and Development Corporation, Dairy Australia, Grains Research and Development Corporation, Sugar Research Australia, AgriFutures Australia, Wine Australia and Forest and Wood Products Australia.

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 but also through the Department of Industry, Innovation and Science, the Department of Education, 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. Working to build capacity in biosecurity science in our neighbouring countries also contributes to earlier knowledge of the spread of pests and diseases and contributes to Australia's preparedness for incursions and pre-border security.

Dr Richard Markham (right) and Stewart Lindsay (left) inspect the Queensland Department of Agriculture and Fisheries banana collection in South Johnstone, Queensland, part of ACIAR project on the integrated management of Fusarium wilt of bananas in the Philippines and Australia. Image courtesy of ACIAR

AUSTRALIAN RESEARCH COUNCIL

arc.gov.au

The Australian Research Council (ARC) is a Commonwealth entity and advises the Australian Government on research matters, administers the National Competitive Grants Program, a significant component of Australia's investment in research and development, and has responsibility for Excellence in Research for Australia (ERA).

The ARC's purpose is to grow knowledge and innovation for the benefit of the Australian community through funding the highest quality research, assessing the quality, engagement and impact of research and providing advice on research matters.

In seeking to achieve its purpose, the ARC supports the highest-quality fundamental and applied research and research training through national competition across all disciplines. Clinical and other medical research is primarily supported by the National Health and Medical Research Council. In addition, the ARC encourages partnerships between researchers and industry, government, community organisations and the international community.

The outcomes of ARC-funded research deliver cultural, economic, social and environmental benefits to all Australians.

The ARC is the primary source of advice to the government on investment in the national research effort. The ARC:

- supports the highest quality research and research training through national competition in all fields of science, social sciences and the humanities
- brokers partnerships between researchers and industry, government, community organisations and the international community.

One of the purposes of the PIC@PEC facility is to develop in-house R&D capability to conduct applied trials. Image courtesy of Department of Agriculture

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION

csiro.au/research

As Australia's national science agency, CSIRO is solving the greatest challenges through innovative 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.

CSIRO's Health and Biosecurity business unit delivers research-based solutions to manage the impacts of invasive pests, weeds and diseases. It also assesses the risks they pose, prioritises the pathways of entry and provides new technologies for surveillance and early response through sensor networks and autonomous platforms. The Agriculture and Food business unit takes an integrated gene-to-plate approach to improving 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 @ POST-ENTRY QUARANTINE (PIC@PEQ)

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 in-house R&D capability to conduct applied trials that address operational issues with a focus on implementing into service delivery
- further engage with the scientific research community
- develop closer collaborative links with the education sector.

Outcomes will improve the capacity to address current and anticipated plant biosecurity risks, ensuring the nation has a modern and effective plant biosecurity system in place to secure Australia's border.

The centre's research team consists of a small group of departmental scientists who collaborate with external scientists and other biosecurity stakeholders to deliver on the agreed projects.

David Trohdal, Research and Development Agronomist, NSW DPI. Image courtesy of Rice Extension

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.

In 2019, the Department of Agriculture released a discussion paper to modernise and improve the RDC system. An advisory panel will make recommendations in the first half of 2020 to the Department of Agriculture for implementation. Fifteen rural RDCs cover 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 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. Protecting Australian cotton from endemic and exotic biotic threats is a key focus area under the goal of increasing the productivity and profitability of cotton farms. 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 to create enduring profitability for Australian grain growers. Activities drive the discovery, development and delivery of innovation to the benefit of grain growers, the grains industry value chain and the wider community.

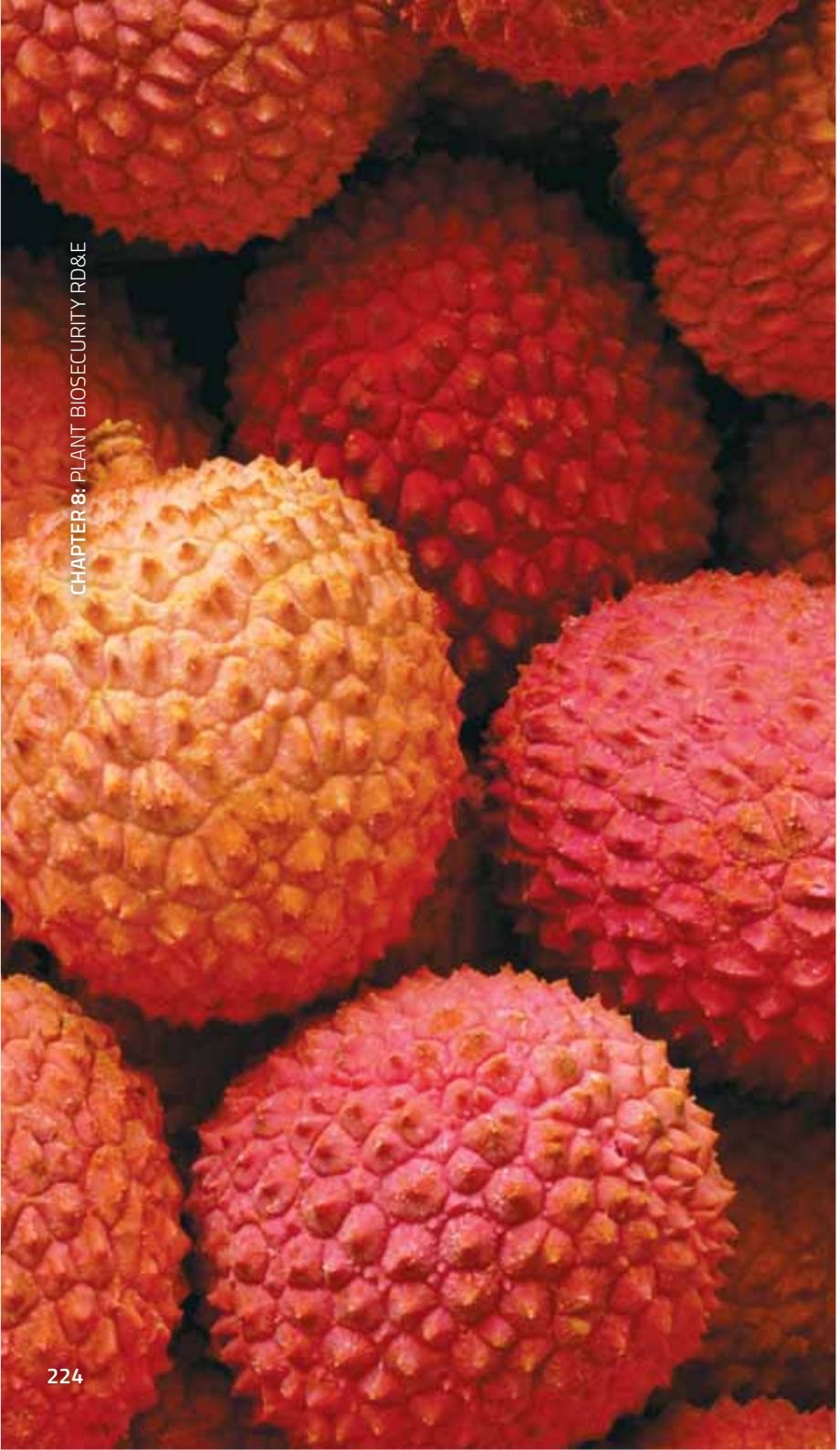
GRDC's primary source of income is through a levy on grain growers, which is matched by the Australian Government. The research portfolio covers 25 leviable crops, spanning temperate and tropical cereals, oilseeds and pulses, which are worth over $13 billion a year in farm production.

The GRDC investment objective 'Optimise input costs' in addition to an overarching core biosecurity framework are identified as part of the GRDC's five year RD&E plan.

The following key investment targets are related to crop protection and biosecurity:

- develop and implement management options to minimise the cost of effectively and sustainably managing vertebrate and invertebrate pests, weeds and diseases
- maintain and/or improve the price of Australian grain through differentiation based on functionality, food safety and traceability, sustainability of production, reduced downgrading, new and/or enhanced grain classification processes, and optimal management of biosecurity issues
- reduce the gap between actual and potential grain yield through more informed and timely decision-making on planting time, crop or variety choice, weed management, pest and disease control, and crop nutrition.

Launched at the Hart Field Day in South Australia in September 2019, the $21 million RD&E partnership iMapPESTS Sentinel is a mobile surveillance unit designed to sample air for fungal spores and insects. Image courtesy of iMapPESTS



HORT INNOVATION

horticulture.com.au

Hort Innovation is a not-for-profit, grower-owned RDC for Australia's $13.2 billion horticultural industry. Hort Innovation invests around $110 million into research and development (R&D) and marketing programs annually to benefit the industry and the wider community. It exists to drive a prosperous and healthy Australia, by providing the best knowledge and solutions to create a world-class horticulture sector. 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 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 research, development and adoption 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 team of in-house researchers conducts research in the areas of plant breeding, trait development, biosecurity, plant health 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

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. The PBRI partners that work collaboratively with industry, state and federal biosecurity stakeholders include;

- 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
- Council of Rural Research and Development Corporations

In 2018–19, the plant RDCs collectively invested $135.4 million into biosecurity RD&E. A coordinated approach ensures that this effort is aligned to broader national goals and delivered efficiently, avoiding duplication of effort.

Plant Biosecurity Research Initiative Symposium

The inaugural Plant Biosecurity Research Symposium held in Brisbane in August 2019 was an opportunity to share plant biosecurity RD&E in Australia and New Zealand. The symposium, attended by 220 delegates, showcased research on pests, diseases and weeds affecting plant productions systems and surrounding environments

The focus was on research funded by the member organisations of Plant Biosecurity Research Initiative and Better Border Biosecurity (B3) New Zealand.

Themes included:

- Preparedness: Biosecurity threats and the risk to business – what have we learnt and are we prepared?
- Diagnostics: Identifying biosecurity threats
- Surveillance: Monitoring for early detection and area freedom
- Sustainable pest, disease and weed management
- Trans-Tasman biosecurity – collaboration and opportunities
- Capability building: Future expertise in biosecurity across sectors – are we prepared?
- Industry resilience: Coping with future shocks – business continuity
- Cross-sectorial RD&E priorities.

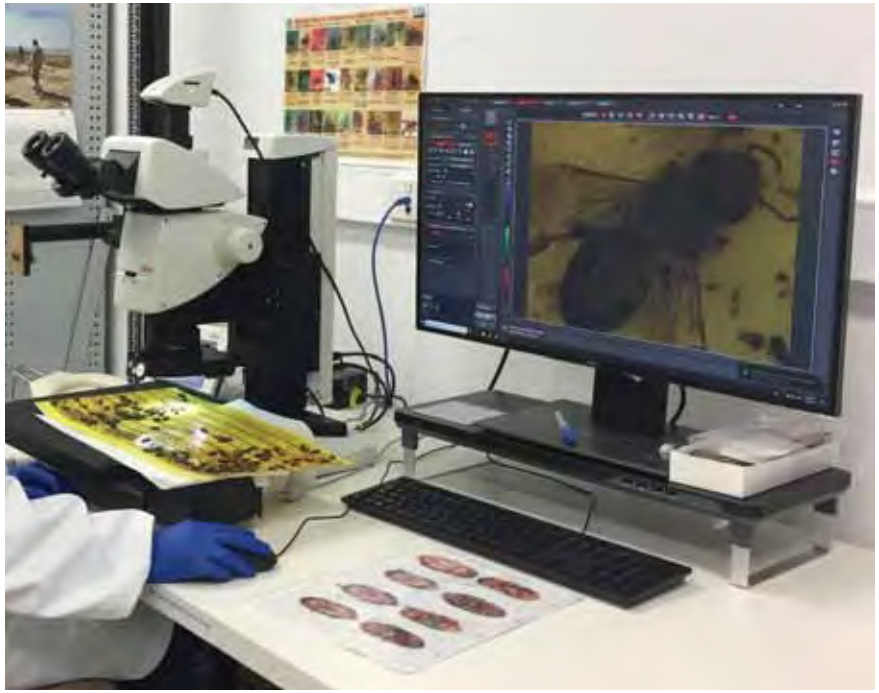
The presentations by growers and industry representatives were a highlight of the symposium, describing the lessons learnt during biosecurity incursions, what the impacts are and how to better prepare using the best available knowledge.

International speaker at the symposium Dr Baldissera Giovani from Euphresco and Dr Jo Luck, Program Director, Plant Biosecurity Research Initiative. Image courtesy of Tony Steeper

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 researchers in other departments in some states. Research projects are funded by the state, territory and Australian Governments, and some are commissioned by commercial clients.



Stereo microscope set up for examining bee sticky mats for pest mites by the diagnostic entomologists of Agriculture Victoria based at AgriBio, Centre For AgriBioscience. Image courtesy of Agriculture Victoria

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.

Graham Centre for Agriculture Innovation – a partnership between NSW Department of Primary Industries and Charles Sturt University.

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 (CCDM) focuses on reducing the economic impact of disease in the Australian grains industry. Established in 2014 the centre is co-supported by Curtin University and the GRDC. In 2019 CCDM rolled out its new strategic direction that will guide its research efforts and focus through until mid-2022.

The new direction includes three key research themes:

- fungicide resistance management and disease impacts
- cereal diseases
- canola and pulse diseases.

Five Foundation Projects will also support CCDM's research outputs:

- bioinformatics
- physiological impacts of disease
- genomic analysis of co-infection
- communication and engagement
- improving the return on investments in crop protection.

2019 also saw the centre grow to more than 75 researchers and professional support staff who, through laboratory-based research, field work and the development of integrated farm management strategies, work to deliver real impact and in-field solutions for Australian growers.

Barley researcher Elzette Wentzel planting net blotch field trials. Image courtesy of Carole Kerr, Centre for Crop and Disease Management

CENTRE FOR FRUIT FLY BIOSECURITY INNOVATION

fruitflyittc.edu.au

The Centre for Fruit Fly Biosecurity Innovation is an ARC 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 $3.7m from the ARC'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, South Africa and the United Kingdom. CEBRA collaborates 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 (now known as Department of Agriculture), 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 was established to follow the Plant Biosecurity Cooperative Research Centre (PBCRC), which finished operations in June 2018, and is 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, international linkages, non-levy payer, cross-sectoral and strategic plant biosecurity research. It also invests in commercial IP developed by and inherited from the PBCRC. It is hoped in the long term that a return is realised from this IP and the Foundation will manage and invest those funds in plant biosecurity science.

COOPERATIVE RESEARCH CENTRE FOR HONEY BEE PRODUCTS

crchoneybeeproducts.com

The Cooperative Research Centre (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 problems that limit the value and expansion of the Australian honey bee products industry. The four focus areas are honey bee hive sites, honey bee products, honey bee health and honey bee chain of custody. The CRC has 25 industry and community partners and is presently running 30 projects.

Plant biosecurity RD&E projects in 2019

In 2019, 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 94–98 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 232 lists 681 plant biosecurity related research projects undertaken during 2019. Fifty of these projects are categorised as extension activities, highlighting the extensive work being performed in the area of communication, training and awareness. Although projects have simply been listed by project title in the table, other information (e.g. an abstract) was sourced to help categorise the research.

Figure 94. RD&E projects by pest type

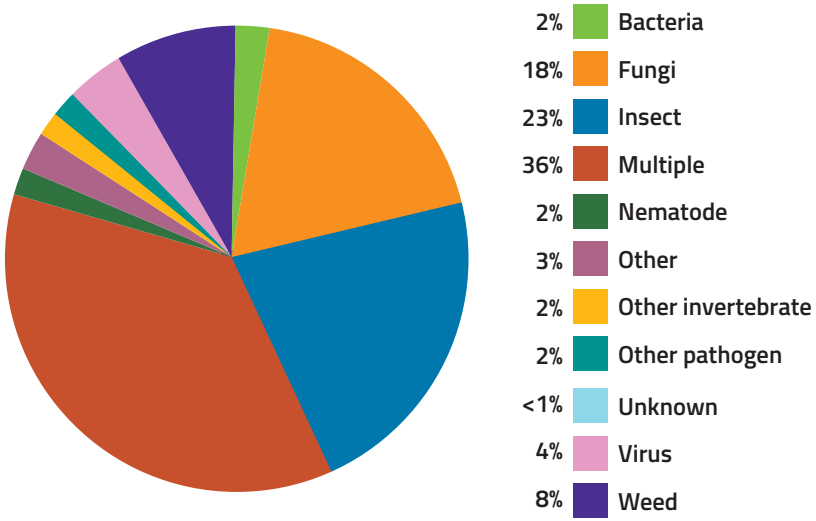


Figure 95. RD&E projects by research type or location

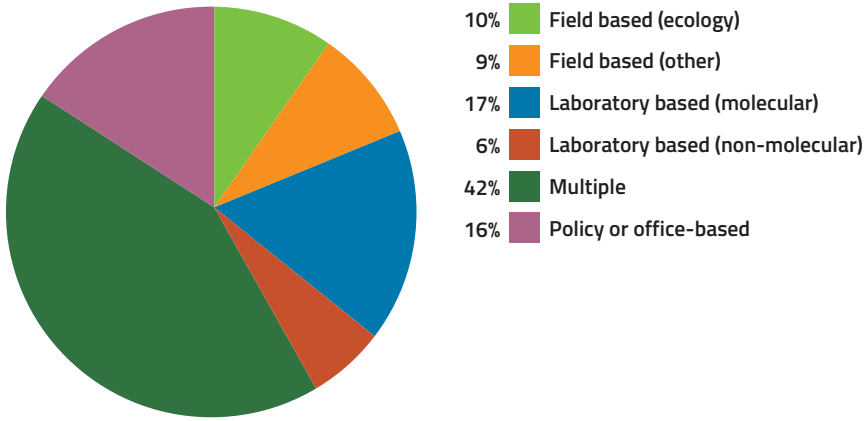


Figure 96. RD&E projects by project value

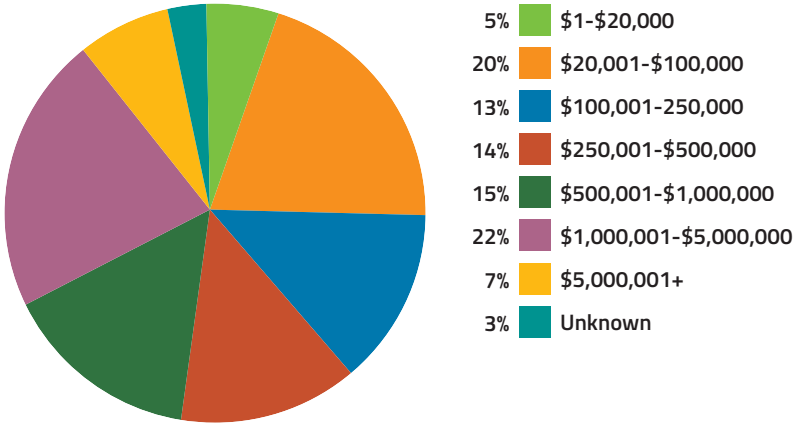
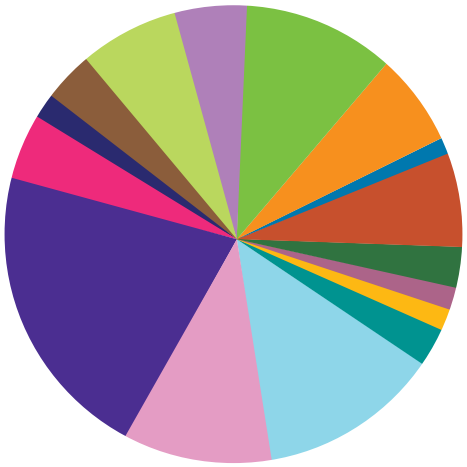
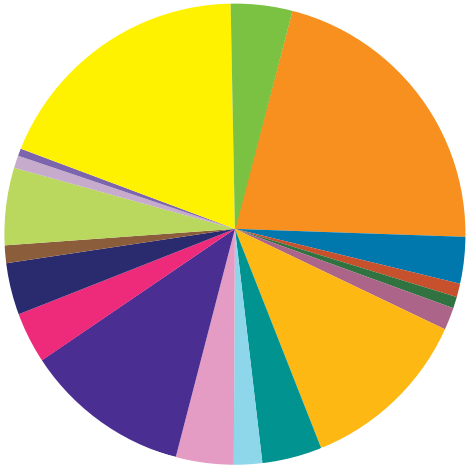


Figure 97. RD&E projects by biosecurity areas



11%	Crop improvement
7%	Diagnostics
<1%	Emergency response
7%	Extension
3%	Host basic biology
2%	Host or pest identification
<1%	Information management
3%	Market access support
14%	Multiple
10%	Pest basic biology
20%	Pest management
5%	Prevention
2%	Research centre or committee
2%	Risk analysis and modelling
7%	Surveillance
5%	Systems approaches

Figure 98. RD&E projects by crop type*



4%	Broadacre - cotton
21%	Broadacre - grains
3%	Broadacre - sugarcane
1%	Broadacre - multiple
1%	Broadacre - other
1%	Forestry
12%	Horticulture - fruit
4%	Horticulture - grapes
2%	Horticulture - nuts
4%	Horticulture - vegetables
11%	Horticulture - multiple
4%	Horticulture - other
4%	Natural environment
1%	Nursery crops
5%	Pollinators
<1%	Unknown
<1%	Urban/amenities
19%	Multiple crops
<1%	Other crops

*The definition for 'crop type' are generally based on the Hort Innovation, Agrifutures Australia and GRDC crop groupings.

Table 59. Plant biosecurity RD&E projects

Project title	Organisation undertaking the research	Funding source or body
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
Biological based products for improved cotton production	Western Sydney University	CRDC
Biology of *Amarathus hybridus, A. mitchellii* and *A. powelii* (PhD)	University of Queensland	CRDC
Characteristics of disease suppressive cotton farming systems and soils	QDAF, NSW DPI, CSIRO	CRDC, QDAF, NSW DPI, CSIRO
Detecting cotton pests and pathogens using environmental DNA from irrigation water	University of Queensland	DA
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 integrated pest management in cotton	Univeristy 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
Integrated pest management technical lead and pest management for high yield research	QDAF	CRDC, QDAF
Integrated pest management to support management of emerging cotton pests 1	NSW DPI	CRDC, NSW DPI
Integrated pest management to support management of emerging cotton pests 2	CSIRO	CRDC, CSIRO

Project title	Organisation undertaking the research	Funding source or body
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
National biosecurity or disease extension and central Queensland regional extension	QDAF	CRDC, QDAF
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
Sustainable silverleaf whitefly resistance management through improved insect resistance monitoring	QDAF	CRDC, QDAF
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

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Broadacre – grains		
A 'focus farms' study to optimise weed resistance management practices in WA	University of Western Australia	GRDC
A model for predicting chickpea Ascochyta blight risk	University of Southern Queensland, WAAA	GRDC
A simple and innovative test for real-time detection of resistance in weeds	University of Western Australia	GRDC
Accelerating the utilisation and deployment of durable adult plant resistance to leaf rust in barley	University of Sydney, University of Queensland	GRDC
Actinobacterial endophytes for increased chickpea yield	Flinders University	Flinders University
Actinobacterial endophytes for increased lentil yield	Flinders University	Flinders University
An integrative approach towards sustainable management of sorghum stalk rot in the GRDC northern region	University of Southern Queensland	GRDC
Aphid and insecticide resistance management in oil seed and pulse crops	cesar	GRDC
Ascochyta blight of field pea	Curtin University (CCDM)	GRDC
Ascochyta blight of pulses – integrating development of novel selection methods, mining germplasm for resistance and pathogen surveillance	Curtin University, Griffith University	GRDC
Ascochyta blight of pulses with a focus on chickpea	Curtin University (CCDM)	GRDC
Ascochyta blight of pulses with a focus on lentils	Curtin University (CCDM), SARDI	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 program – 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 1	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 2	University of Sydney	GRDC
Australian cereal rust control program – wheat and barley breeding support	University of Sydney	GRDC
Australian Fungicide Resistance Extension Network – fungicide resistance management targeted at regional level	Curtin University (CCDM)	GRDC
Australian wheat and barley molecular marker program – genetic analysis	University of Adelaide	GRDC
Bioinformatics foundation project	Curtin University (CCDM)	GRDC
Biology and management of snails and slugs in grain crops	SARDI	GRDC
Cell wall structure and dynamics in emerging fungal pathogens of crops	University of Adelaide	ARC
Centre for Crop Disease Management	Curtin University (CCDM)	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
Chaff lining in the Geraldton port zone – a new, cost effective harvest weed seed control tool	Planfarm Pty Ltd	GRDC
Characterising structural variation in the canola genome	University of Western Australia	ARC

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Broadacre – grains (continued)		
Communicatons and engagement foundation project	Curtin University (CCDM)	GRDC
Conduct integrative taxonomic revision of Australian Trogoderma species	CSIRO	DA
Control of snails and slugs – new products for snail and slug control – biological control of slugs using ciliate protozoa	University of Melbourne	GRDC
Cultivar crown rot tolerance trials	Crown Analytical Services Pty Ltd	GRDC
Cultural management for weed control and maintenance of crop yield	University of Western Australia	GRDC
Delivery of improved invertebrate pest management in the northern grains region	QDAF	GRDC
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
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, CSIRO	GRDC
Development of local strategies to enable the integrated and profitable management of annual ryegrass seed banks in high rainfall zone farming systems of the southern region	University of Adelaide	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 programs	DJPR	GRDC, DJPR
Disease epidemiology and management tools	DJPR, WAAA, NSW DPI, SARDI, University of Southern Queensland, University of Western Australia, Curtin University (CCDM)	GRDC, DJPR, WAAA, NSW DPI, SARDI, University of Southern Queensland, University of Western Australia, Curtin University (CCDM)
Disease epidemiology and management tools for Australian grain growers	WAAA, NSW DPI, SARDI, DJPR, University of Southern Queensland, University of Western Australia, Curtin University (CCDM)	GRDC
Disease screening service (fee for service)	DJPR	Fee for Service
Durable resistance to barley powdery mildew	Curtin University (CCDM)	GRDC
Durum crown rot benchmarking for improved grower access to durum varieties with greater crown rot resistance	University of Southern Queensland	GRDC
Effective control of barley yellow dwarf virus in wheat	University of Tasmania	GRDC
Effective genetic control of *Septoria tritici* blotch	NSW DPI	GRDC
Effective genetic control of *Stagonospora nodorum* blotch	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

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Broadacre – grains (continued)		
Establishing the international mungbean improvement network	Asian Vegetable Research and Development Centre, QDAF	ACIAR
Extension and engagement	Curtin University (CCDM)	GRDC
Fungicide resistance detection and underlying mechanisms	Curtin University (CCDM)	GRDC
Genetic control of nematode species affecting major crops – germplasm enhancement for nematode control in cereals and pulses	University of Southern Queensland, GRDC	GRDC
Genetically improving wheat's ability to out-compete weeds	CSIRO	GRDC
Genetics of wild germplasm, gene-pool expansion and integrated ASSD approach to enhance adaptive potential in chickpea	Curtin University (CCDM)	GRDC
Genetics solutions to Sclerotinia stem rot of canola and pulses	Curtin University (CCDM)	GRDC
Grain crop disease management in Victoria	DJPR	GRDC, DJPR
Grain weeds advisory committee	Rural Directions Pty Ltd	GRDC
Grains farm biosecurity program	PHA	GPA
GRDC Communities – field crop diseases	DJPR	GRDC
Herbicide options for the management of emerging summer grass weeds in winter cereals	Northern Grower Alliance Incorporated	GRDC
Identification and utilisation of novel sources of resistance to crown rot and the root lesion nematodes in adapted spring and durum wheat	International Maize and Wheat Improvement Center (CIMMYT; Mexico)	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
Identification, surveillance and advisory platform for management of grains pests	cesar	GRDC
Impacts of host resistance on disease-induced yield loss	DJPR	GRDC, WA DPIRD, NSW DPI, SARDI, QDAF, University of Western Australia, DJPR
Improved approaches for rapid *de novo* fungicide resistance and disease diagnostics	Curtin University (CCDM)	GRDC
Improved disease management in South Australian field crops through surveillance, diagnostics and epidemiology knowledge	SARDI	GRDC
Improved farming systems	Curtin University	GRDC
Improved genetic solutions for management of yellow spot in wheat	WA DPIRD, University of Southern Queensland, Curtin University (CCDM), WAAA, University of Adelaide, DJPR	GRDC
Improving disease management through improved agronomic practices	SARDI	GRDC
Improving grower surveillance management, epidemiology knowledge and tools to manage crop disease	University of Southern Queensland, GRDC	GRDC
Improving grower surveillance, management, epidemiology knowledge and tools to manage crop disease	WA DPIRD	GRDC
Improving grower surveillence, management, epidemiology knowledge and tools to manage crop disease – national chickpea pathology program	Griffith University, University of Melbourne, NSW DPI, 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
Incidence and severity of disease in cereal and pulses	DJPR	GRDC, DJPR
Insect tolerant chickpea for Bangladesh	CSIRO	ACIAR
Integrated disease management tools to manage summer crop diseases in the GRDC northern region	University of Southern Queensland (lead), QDAF	GRDC
Integrated genetic solutions to crown rot in wheat	University of Sydney, University of Southern Queensland, CSIRO, QDAF	GRDC

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Broadacre – grains (continued)		
Integrated weed management of herbicide resistant annual ryegrass at Lake Bolac	Southern Farming Systems	GRDC
Integrated disease management strategies for cereal and pulse growers	DJPR	GRDC, DJPR
Investigating snail rollers to clean small conical snails out of barley and canola	Stirlings to Coast Farmers	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
Management of barley diseases under threat of fungicide resistance	Curtin University (CCDM)	GRDC
Managing Botrytis diseases in intensive pulse cropping systems	SARDI	GRDC
Managing early season canola establishment pests in NSW – development of technical content	cesar	GRDC
Managing early season canola pests in NSW – establishment and co-ordination of grower and advisor groups	FarmLink Research Ltd	GRDC
Managing on-farm biosecurity risk in wheat through pre-emptive breeding	NSW DPI	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 disease constraints to improve productivity and sustainability	University of Western Australia	ACIAR
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
Modelling framework for optimising deployment of fungicides for management of resistance	Curtin University (CCDM)	GRDC
National barley foliar pathogen variety improvement program	QDAF, DJPR, Australian National University, SARDI, WAAA, NSW DPI, University of Adelaide, University of Southern Queensland, University of Tasmania	GRDC, QDAF, DJPR, Australian National University, SARDI, WAAA, NSW DPI, University of Adelaide, University of Southern Queensland, University of Tasmania
National barley foliar pathogen variety improvement program – extension	University of Queensland	QDAF
National barley foliar pathogen variety initiative program	QDAF, Australian National University, SARDI, DJPR, DAFWA, NSW DPI, University of Adelaide, University of Southern Queensland, University of Tasmania	GRDC
National Brassica germplasm improvement program – phase II	NSW DPI	GRDC
National canola pathology program	University of Melbourne, Marcroft Grains Pathology, NSW DPI, SARDI, WA DPIRD, CSIRO	GRDC
National crown rot epidemiology and management program	NSW DPI, DJPR, QDAF, University of Southern Queensland, SARDI, WAAA, DAFWA	GRDC, DAFWA, NSW DPI, SARDI, QDAF, University of Western Australia, DJTR
National hay agronomy project	WAAA, DJPR	AgriFutures Australia
National mungbean improvement program	QDAF	GRDC, QDAF
National nematode epidemiology and management program	DJPR, SARDI, NSW DPI, QDAF, WAAA	GRDC, DJPR, SARDI, NSW DPI, QDAF, WAAA
National variety trials – pathology	University of Southern Queensland	GRDC
National variety trials disease screening	DJPR	GRDC

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Broadacre – grains (continued)		
New capability to survey pulse and cereal crops for root pathogens	SARDI	GRDC, SA Grain Industry Trust
New knowledge to improve the timing of pest management decisions in grain crops	CSIRO	GRDC
New uses for existing chemistry	University of Queensland	GRDC
Novel suppression and resistance management of invertebrate grain pests	University of Melbourne	GRDC
NVT pathology of cultivar disease resistance ratings	DJPR	GRDC
Pathology support for the Queensland mungbean improvement program	University of Queensland	QDAF
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 with collaborators in Nigeria, Burkina Faso and Ghana	African Agricultural Technology Foundation
Protection of stored grains against insect pests	Davren Global Pty Ltd	ACIAR
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
PulseBio 4 – biosecure pulse seeds	DJPR	GRDC
Push notifications to enable proactive management of pests, weeds and diseases	DJPR	GRDC
Rapid detection and diagnosis of plant pathogens	Australian National University	Hermon Slade Foundation
Regional risk assessment and thresholds for Russian wheat aphid	SARDI, cesar	GRDC
Resistance to barley net blotches	Curtin University (CCDM)	GRDC
Sclerotinia stem rot of canola	Curtin University	GRDC
Septoria nodorum blotch of wheat	Curtin University (CCDM)	GRDC

Professor John Thompson and Roslyn Reen inspecting chickpea plants as part of the GRDC funded project assessing collections of wild chickpea relatives for resistance to root-lesion nematodes. Image courtesy of David Martinelli, University of Southern Queensland

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Broadacre – grains (continued)		
Snail biocontrol revisited – phase II	CSIRO	GRDC
Snails, slugs and slaters in WA – case studies of growers in WA's southern coastal region	Stirlings to Coast Farmers	GRDC
Soil-borne diseases interaction in Australian farming systems	DJPR, NSW DPI, CSIRO, SARDI, University of Southern Queensland, WA DPIRD, WAAA	GRDC, DJPR, NSW DPI, CSIRO, SARDI, University of Southern Queensland, WA DPIRD
Sorghum midge testing scheme	QDAF	GRDC
Statistics for the Australian grains industry western node	Curtin University	GRDC
Surveillance of herbicide resistant weeds in Australian grain cropping	Charles Sturt University, University of Western Australia	GRDC
Survey of the summer and autumn Brassica refuges for diamondback moth in the Western region to predict early season risk of infestation	WA DPIRD	GRDC
Survey of vertebrate and invertebrate pests and beneficials harbouring in harvest weed-seed control systems	WA DPIRD	GRDC
Surveys and associated diagnostics of the incidence and severity of diseases of cereal and pulses within the Northern Region	QDAF	GRDC, QDAF
The functional characterisation of a novel immune response in plants	Australian National University	ARC
Two new phytotoxins in *Septoria nodorum* blotch – biosynthesis and functions	University of Western Australia	ARC
Understanding or evaluating the effectiveness of fungicides to manage Septoria and leaf rust	Foundation for Arable Research	GRDC
Virus threats – new tools and germplasm for Australian pulse and oilseeds breeding programs to respond to changing virus threats	NSW DPI, QDAF, University of Queensland, DJPR, WA DPIRD	GRDC, NSW DPI
Virus threats for pulse and oil seeds breeding	NSW DPI, DJPR, University of Queensland, QDAF, WAAA	GRDC, NSW DPI, DJPR, University of Queensland, QDAF, WAAA
Weed surveillance	QDAF	GRDC
Yellow spot of wheat	Curtin University (CCDM)	GRDC
Yield loss response curves for host resistance to leaf, crown and root diseases in wheat and barley	WA DPIRD, QDAF, NSW DPI, DJPR	GRDC
Broadacre – sugarcane		
Bio-prospecting for beneficial endophytes of sugarcane	AgResearch Ltd	SRA
Delivering solutions for chlorotic streak disease	SRA	SRA
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
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
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, DA, Hort Innovation
Integrated disease management of sugarcane streak mosaic in Indonesia	SRA	ACIAR

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Broadacre – sugarcane (continued)		
Integrated solution for on-farm pathogen detection for sugarcane diseases	SRA, Griffith University	SRA
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	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
Soil diagnostic assay laboratory – nematodes and Pachymetra root rot	SRA	SRA
Using leaf sheath biopsy metagenomics for determining if novel bacterial strains are associated with yellow canopy syndrome	University of Queensland	SRA
Broadacre – multiple		
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
Sustainable insect management through improved insect resistance monitoring	NSW DPI	CRDC, NSW DPI, GRDC
Time to prime – using silicon to activate grass resistance under higher CO_2	Western Sydney University	ARC
Broadacre – other		
Ensuring lucerne seed production in the absence of bees	University of Western Australia	AgriFutures Australia
Impacts of the pasture legume phase on the seedbank, establishment, and growth of barnyard grass (*Echinochloa crus-galli*) in drill-sown rice	Charles Sturt University	AgriFutures Australia
Lucerne seed wasp management	NSW DPI	AgriFutures Australia
Northern Rice Australia – developing rice growing packages for tropical north Australia	University of Southern Queensland	AgriFutures Australia
Potential exotic virus threats to lucerne seed production in Australia	University of Queensland	AgriFutures Australia, University of Queensland
Rice – weed management in Australia	Agropraisals Pty Ltd	AgriFutures Australia
Rice pest and disease biosecurity II	NSW DPI	AgriFutures Australia, NSW DPI

Sharon Zuiddam learning sweep netting techniques for Cephus cinctus (wheat stem sawfly) in Montana grasslands, USA, June 2019. Image courtesy of Sharon Zuiddam, WA Department of Primary Industries and Regional Development

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Forestry		
A model system for the discovery and development of biocontrol agents against forest pests	University of the Sunshine Coast	FWPA, DA, University of the Sunshine Coast, NSW DPI, Forestry Tasmania
Biological control of galling insect pests of eucalypt plantations in the Mekong region	University of the Sunshine Coast	ACIAR
Forestry aerial spray review for coastal regions	University of Queensland	Hancock Queensland Plantations
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
Maximising productivity of Eucalyptus and Acacia plantations for growers in Indonesia and Vietnam	CSIRO	ACIAR
National forestry biosecurity surveillance program	PHA	DA (Agricultural Competitiveness White Paper)
Plantation forests biosecurity plan review	University of the Sunshine Coast, PHA	FWPA
The Industry Plantation Management Group – applied research and extension	WA Plantation Resources	WA Plantation Resources

Project title	Organisation undertaking the research	Funding source or body
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
An integrated management response to the spread of Fusarium wilt of banana in south-east Asia	QDAF	ACIAR
An integrated pest, disease and weed management program for the Australian apple and pear industry	DJPR, University of Tasmania	Hort Innovation, DJPR, WA DPIRD, University of Tasmania, NSW DPI, QDAF
Auscitrus horticultural project	NSW DPI	Collaborative Research
Australian lychee industry communication program	Australian Lychee Growers' Association	Hort Innovation
Australian mango industry biosecurity project	Australian Mango Industry Association	PHA
Avocado industry biosecurity capacity building	University of Queensland	Hort Innovation
Avocado sunblotch viroid survey	University of Queensland	Hort Innovation
Banana bunchy top virus mitigation – community management in Nigeria, and screening wild banana progenitors for resistance	University of Queensland	Bill & Melinda Gates Foundation
Banana industry R&D coordination	Australian Banana Growers' Council	Hort Innovation
Bee surveillance for avocado sunblotch viroid	CSIRO	University of Queensland
Cherry export readiness and market access	Cherry Growers Australia	Hort Innovation

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Horticulture – fruit (continued)		
Citrus agrichemical and export maximum residue limit program	Citrus Australia	Hort Innovation
Citrus canker research	NT DPIR	National citrus canker eradication program
Citrus pest and disease prevention committee	Citrus Australia	Citrus Australia
Clean seed program for the papaya industry	QDAF, Griffith University	Hort Innovation
Conditional non-host systems protocol for fruit fly in mangoes	QDAF	Hort Innovation
Developing diagnostic protocols for Ralstonia on bananas	University of Queensland	SARDI (SPHD)
Developing IPM-compatibe controls for spotted wing drosophila (*Drosophila suzukii*)	IPM Technologies	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 IPM compatible methods for controlling *Drosophila suzukii* in berry crops	IPM technologies	Hort Innovation
Development of molecular markers for Fusarium wilt resistance in banana	University of Queensland	Hort Innovation
Diagnosis and control of *Botrytis cinerea* on post-harvest blueberry fruit (PhD)	Murdoch University	Government of Iraq
Employment of a national citrus surveillance coordinator	Citrus Australia	PHA (DA)
Evaluation of *Beauveria bassiana* for rust thrips control in Australian bananas	James Cook University	Department of Industry, Innovaiton and Science
Exploring IPM-compatible methods for spotted wing drosophila in berry crops	cesar	Hort Innovation
Farm survey 2020 – charcoal rot incidence in the Victoria strawberry industry	Victoria Strawberry Industry Certification Authority	Victorian Strawberry Industry Development Committee
Field triage capability and capacity for citrus pests	PHA	DA
First detector network – USA huanglongbing and citrus canker	Citrus Australia	Hort Innovation
Fusarium wilt tropical race 4 research program 1	QDAF	Hort Innovation
Fusarium wilt tropical race 4 research program 2	University of Queensland	Hort Innovation
Fusarium wilt tropical race 4 research program 3	NT DPIR	Hort Innovation
Generation of data for pesticide applications in horticulture crops 1	Peracto Pty Ltd	Hort Innovation
Generation of data for pesticide applications in horticulture crops 2	Peracto Pty Ltd	Hort Innovation
Huanglongbing tolerant rootstock evaluation	NSW DPI	NSW DPI
Implementation of recommendations from the avocado industry nursery voluntary accreditation scheme review	GIA	Hort Innovation
Implementing precision agriculture solutions in Australian avocado production systems	University of New England	Hort Innovation
Improved management of charcoal rot of strawberry	QDAF	Hort Innovation
Improved plant protection for the banana industry	QDAF, NT DPIR	Hort Innovation

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
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
Improving pest and disease surveillance in the Australian mango industry	PHA	DA
Industry led surveillance pilot	Citrus Australia	Citrus Australia
Integrated disease management strategies for the productive, profitable and sustainable production of high quality papaya fruit in the southern Philippines and Australia	QDAF	ACIAR
Integrated management of Fusarium wilt of bananas in the Philippines and Australia	QDAF	ACIAR
Integrated management of yellow Sigatoka	Australian Banana Growers' Council	Hort Innovation
Integrated pest management of redberry mite (*Acalitus essigi*) on blackberries	University of Tasmania	Hort Innovation
International industry analysis for diphenylamine decontamination, alternative treatments and review of current best practice	University of Melbourne	Hort Innovation
Investigation into citrus blossom bug in avocados	QDAF	Hort Innovation
Investigation into citrus blossom bugs in avocados	QDAF, University of Queensland	Hort Innovation
Low-dose methyl bromide fumigation of plums	QDAF	Hort Innovation
Lychee pest and disease field guide	Australian Lychee Growers' Association	Hort Innovation
Management of banana pests and diseases in north Queensland	Australian Banana Growers' Council	Hort Innovation
Melon industry biosecurity	Dianne Fullelove & Associates Pty Ltd	Melon PHA levy
Mite and insect disinfestation of lychee fruit using high pressure water sprays	Australian Lychee Growers' Association, QDAF	Hort Innovation, DA
Monitoring mangoes through the supply chain to the US	NT DPIR	Hort Innovation
National banana bunchy top virus program – phase III	Australian Banana Growers' Council	Hort Innovation
National banana bunchy top virus program – phase IV	Australian Banana Growers' Council	Hort Innovation
National citrus biosecurity surveillance program	PHA, Citrus Australia	DA (Agricultural Competitiveness White Paper)
National masterclasses to improve biosecurity for control of soil-borne diseases on strawberry farms	Victorian Strawberry Industry Development Committee	APBSF
National papaya breeding program, including PRSV-P resistance breeding	Griffith University	Hort Innovation
National passionfruit breeding program	Southern Cross University	Hort Innovation
Odour detection dog and development of a volatile profile for citrus canker	NT DPIR	DA
Opportunities and strategies to improve biosecurity, market access and trade for selected mango markets	Griffith University	ACIAR

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Horticulture – fruit (continued)		
Pilot sterile codling moth releases for the apple industry	University of Tasmania (Tasmanian Institute of Agriculture)	Hort Innovation, Fruit Growers Tasmania
Pineapple integrated crop protection program	QDAF, Growcom, Agri Supply Global	Hort Innovation
Protecting Australia's citrus genetic material	NSW DPI, Australian Citrus Propagation Association Incorporation	Auscitrus, Hort Innovation, NSW DPI
Remote sensing for biosecurity surveillance in urban and peri-urban environments	University of New England	Horticulture Innovation (Rural Research and Development for Profit)
Reversing the impact of banana blood disease in Indonesia	University of Queensland	APBSF
Review and extension of avocado arthropod pests and their management	IPM Technologies	Hort Innovation
Review of national biosecurity plans for avocados and mangoes	PHA	Hort Innovation
Review of the biosecurity plan for the berry industry	PHA	Hort Innovation
Review of the existing lychee industry biosecurity plan	Australian Lychee Growers' Association	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 strategic research to safeguard the banana industry in China, Philippines, Laos, Indonesia and Australia	Australian Banana Growers' Council	ACIAR
Strengthening the banana industry diagnostic capacity	University of Queensland	Hort Innovation

Dr Simon Lawson in a Lao Eucalyptus plantation, part of an ACIAR project on the biological control of galling insect pests of eucalypt plantations in the Mekong region. Image courtesy of ACIAR

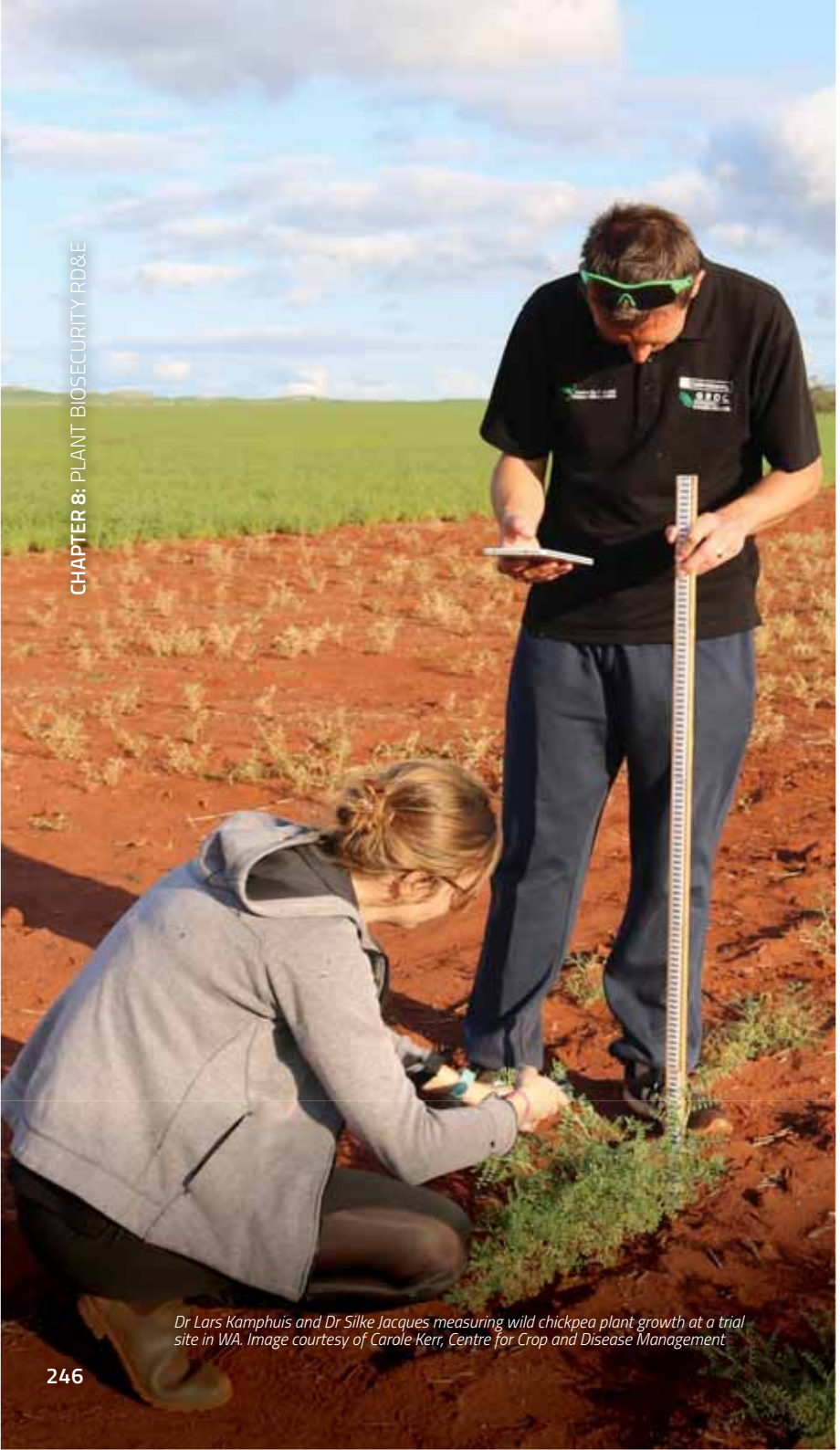
Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Horticulture – fruit (continued)		
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
Topical application of BioClay-delivered dsRNS for management of pineapple and avocado diseases	University of Queensland	QDAF
Understanding and managing the role of honey bees in cucumber green mottle mosaic virus epidemiology	NT DPIR	Hort Innovation
Use of biofumigants for management of charcoal rot and weeds: step by step video	Victoria Strawberry Industry Certification Authority	Victorian Strawberry Industry Development Committee
Variety evaluation and tree certification devices for the apple and pear industry	Apple and Pear Australia Limited	Hort Innovation
Horticulture – grapes		
A comprehensive review of grapevine pinot gris virus	Vinehealth Australia	Wine Australia
Area wide integrated pest management support for Queensland fruit fly in table grapes	Australian Table Grape Association	Hort Innovation
Building capacity in area wide integrated pest management 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
Determining thresholds for bunch rot tolerance in wine and detection of unwanted fungal aromas	Charles Sturt University	Wine Australia
Do viral infection(s) 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
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
Fungicide resistance monitoring in viticulture	Curtin University	Wine Australia
Grapevine pinot gris virus information extension program	Vinehealth Australia	Wine Australia
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
Phylloxera LAMP	DJPR	DJPR
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

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
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 Institute	Wine Australia
Strategic policy approach for phylloxera management in Australia	PHA	DJPR
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 Institute	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 New South Wales	Australian Macadamia Society, Hort Innovation
Chestnut industry communications program	Chestnuts Australia	Hort Innovation
Communication and adoption program for the Australian chestnut industry	Chestnuts Australia	Hort Innovation, Chestnuts Australia
Integrated pest management in macadamia	NSW DPI	Hort Innovation
Investigating the infection process of *Rhizopus stolonifer* and symptom development in the almond disease, hull rot	DJPR	DJPR
Macadamia integrated disease management	University of Queensland	Hort Innovation

Dr Nicole Thompson is based at SRA's Woodford research station, which plays a vital role in biosecurity research activity for the Australian sugarcane industry. Image courtesy of Sugar Research Australia



Dr Lars Kamphuis and Dr Silke Jacques measuring wild chickpea plant growth at a trial site in WA. Image courtesy of Carole Kerr, Centre for Crop and Disease Management

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Horticulture – nuts (continued)		
Mid-term review of macadamia integrated pest mangement program	DJPR	Hort Innovation
New technologies for improved insect management for the almond industry	DJPR	DJPR
Pathogens and other factors contributing to dark staining on pistachio shells	AgXtra Pty Ltd	Hort Innovation
Understanding and managing insect pests of pistachios	Ag Dynamics Pty Ltd	Hort Innovation
Horticulture – vegetable		
A genomic approach to understanding the diversity and biology of phytoplasmas threatening vegetable production in Australia	DJPR	DJPR
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	QDAF (lead), University of Tasmania, NSW DPI, NT DPIR, DJTR, WA DPIRD	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, University of Southern Queensland, Charles Sturt University, PNG-Unitech, Central Queensland University, Fresh Produce Development Agency (PNG), National Agricultural Research Institute (PNG)

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Horticulture – vegetable (continued)		
Developing the national potato biosecurity surveillance strategy	PHA	DA
Elucidating the epidemiology of bacterial crown and fruit rot, an unusual Pseudomonas disease of zucchini	DJPR	DJPR
Exploring Spongospora suppressive soils in potato production	NZ PFR	Hort Innovation
Extension of the PreDicta Pt potato diagnostic service	SARDI	Hort Innovation
Fungus resistant crop development	Australian National University	ARC
Improved management of pumpkin brown etch	Applied Horticultural Research Pty Ltd	Hort Innovation
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, University of Queensland, Secretariat of the Pacific Community, PNG-NARI, the governments of Fiji, Solomon Islands, Tonga and Samoa
Integrated pest management of nematodes in sweetpotatoes	QDAF	Hort Innovation, QDAF, Australian Sweetpotato Growers, Central Queensland University, University of Southern Queensland
Mechanisms and manipulation of resistance to powdery scab in potato roots	University of Tasmania	Hort Innovation
Minor use permits for the onion industry	Hort Innovation	Onions Australia
National diagnostic protocols – nematology	DJPR	SARDI (SPHD)
Novel approaches for root knot nematode control	Central Queensland University, QDAF, Henderson RDE, Australian Sweetpotato Growers	QDAF, Australian Sweetpotato Growers
Potato virus resistance to support potato production in Indonesia	DJPR	La Trobe University Scholarship
Program approach for pest and disease potato industry investments	RMCG Consultancy	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
Review of the national biosecurity plan for the potato industry and development of a biosecurity manual for potato producers	PHA	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
Testing of carrot seed for *Candidatus* Liberibacter solanacearum	DJPR	DA, DJPR
Vegetable and potato biosecurity officer program	AUSVEG	AUSVEG
Horticulture – multiple crops		
Area wide fruit fly management in Sunraysia	Alison Macgregor	Hort Innovation
Assessment of alternative approaches to establishing measures for assurance about regulatory compliance of consignments of seeds imported for purposes of sowing	CEBRA	DA

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Horticulture – multiple crops (continued)		
Benefits and risks of raspberry ketone supplements for Queensland fruit fly, and selection lines as an alternative approach to reduced cuelure responsiveness	Macquarie University	International Atomic Energy Agency Co-operative Research Program (Austria)
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) (Honours)	Queensland University of Technology	DEE
Biotic mortality factors of Australian fruit fly across different regions (PhD)	Western Sydney University	ARC
Chemical relationships between Queensland fruit flies and their natural enemies (PhD)	Macquarie University	ARC
Combining SIT in Queensland fruit fly IPM 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)
Contribution RnD4P project – improving plant pest management	Hort Innovation	AgriFutures Australia
Crop hygiene – hort indexing	DJPR	Fee for Services
Detection and prediction of herbicide residues for the protection of crop plantations	Monash University	Yitpi Foundation
Develop new molecular methods for comprehensive and rapid fruit fly diagnosis	SARDI	DA
Dynamics of the Queensland fruit fly microbiome under mass-rearing (PhD)	Macquarie University	Hort Innovation
Entomology – use of genomic tools to improve molecular diagnostics and surveillance of Queensland fruit fly	DJPR	DJPR
Essential market access data packages	QDAF	Hort Innovation
Evaulation of fumigation and cold treatment for fruit fly on post-harvest citrus	Murdoch University	Korean Quarantine Department
Factors influencing efficacy of *Trichoderma harzianum* and its interaction with *Botrytis cinerea* to improve biological control in horticultural crops	University of Tasmania	BioAust, Hort Innovation
Fruit fly lures from microbial odours (PhD)	Macquarie University	ARC
Fungal taxonomy – use of genomic tools to differentiate important fungal pathogens of Victorian horticultural produce destined for Asian markets	DJPR	La Trobe Univerrsity Scholarship
Gamma irradiation of garlic, ginger and vegetable seed	DA	DA
Generation of data for pesticide application in horticulture 1	Eurofins	DA
Generation of data for pesticide application in horticulture 2	Peracto Pty Ltd	DA
Genetic consequences of domestication in the Queensland fruit fly (PhD)	Macquarie University	Hort Innovation

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Horticulture – multiple crops (continued)		
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 (PhD)	DJPR, La Trobe University	DJPR
Gut bacteria-mediated physiology in Queensland fruit fly (PhD)	Macquarie University	Hort Innovation
Heritability of stress tolerance in Queensland fruit fly (PhD)	Macquarie University	Hort Innovation
Implementation of RapidAIM – real-time monitoring for the presence and location of fruit fly	CSIRO	Hort Innovation
Implementing brown sugar flotation for assuring freedom in fruit fly	Applied Horticultural Research Pty Ltd	Hort Innovation
Improving preparedness of the Australian horticultural sector to the threat potentially posed by *Xylella fastidiosa* (a severe biosecurity risk)	NSW DPI, DJPR, WA DPIRD, QDAF, NZ MPI	Hort Innovation
Improving the biosecurity preparedness of Australian horticulture for the exotic spotted wing drosophila (*Drosophila suzukii*)	PHA	Hort Innovation
Industrial transformation training centre – Centre for Fruit Fly Biosecurity Innovation	Macquarie University, Western Sydney University, Queensland University of Technology	ARC
Integrated pest and disease management – PIPs II	DJPR	Hort Innovation, DJPR
Interactions of entomopathogens and Australian fruit fly	Western Sydney University	ARC
Investigate the use of smart traps in fruit fly surveillance	Hort Innovation	DA
LAMP post harvest fruit fly detection in floatation trials	DJPR	DJPR
Mating frequency of Queensland fruit fly – a potential constraint on SIT (PhD)	Macquarie University	Hort Innovation
Methoprene and dietary yeast as pre-release supplements for Queensland fruit fly SIT (PhD)	Macquarie University	Hort Innovation
Methyl bromide disinfection of Queensland fruit fly	NSW DPI	Hort Innovation
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 sexual performance in Queensland fruit fly (PhD)	Macquarie University	ARC
Multi-scale monitoring tools for managing Australian tree crops – phase II	University of New England, Central Queensland University, many others	Horticulture Innovation, Rural R&D for profit
National biosecurity plan for the summerfruit industry	PHA	Hort Innovation
National centre for post-harvest disinfestation research on Mediterranean fruit fly	Murdoch University (Australian Mediterranean Fruit Fly R&D Centre)	AgriFutures Australia, Hort Innovation, Kalang Consultancy Services Pty Ltd, QDAF, WA DPIRD
National diagnostic protocols – Xylella vectors	DJPR, WA DPIRD	SARDI (SPHD)
National tomato potato psyllid and zebra chip surveillance	WA DPIRD, DJPR, SARDI	Hort Innovation, DJPR, SARDI
National tomato potato psyllid program coordinator	AUSVEG	Hort Innovation
New integrated pest management tools for insect pests of biosecurity significance	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
Pheromones as potential fruit fly lures (PhD)	Macquarie University	ARC
Plant pest surveillance project	DJPR, University of Queensland	Hort Innovation
Planthoppers in Cixiidae	NSW DPI	DEE
Post factory pilot of SITplus fly production	Macquarie University	Hort Innovation

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Horticulture – multiple crops (continued)		
Post-factory pilot of SITPlus fly production	Macquarie University, DJPR, SARDI, NSW DPI, PFRA	Hort Innovation, Maquarie University, DJPR, SARDI, NSW DPI, PFRA
Potential impacts of climate change on habitat suitability for the Queensland fruit fly (PhD)	Macquarie University	Hort Innovation
Potential of gene drives to eliminate incursions of *Drosophila suzukii*	University of Melbourne	ARC
Predator-prey interactions in Queensland fruit flies (PhD)	Macquarie University	Hort Innovation
Psyllid microflora – implications for Liberibacter disease surveillance and pest control	DJPR	La Trobe Univerrsity Scholarship
Quality control procedures for Queensland fruit fly mass-rearing (PhD)	Macquarie University	Hort Innovation
Queensland fruit fly behaviour (PhD)	Macquarie University	Hort Innovation
Sampling for *Candidatus* Liberibacter solanacearum	SARDI	Hort Innovation
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, Queensland fruit fly strain	SARDI	Hort Innovation
SITplus – dietary sterilisation of male Queensland fruit fly	CSIRO	Hort Innovation
SITplus – Port Augusta Queensland fruit fly sterile insect technique factory pilot operation 1	PIRSA	Hort Innovation
SITplus – Port Augusta Queensland fruit fly sterile insect technique factory pilot operation 2	PIRSA, Western Sydney University	Hort Innovation, Western Sydney University
SITplus – raising Queensland fruit fly SIT to world standard	Macquarie University	Hort Innovation
SITplus production facility – proof of concept	Western Sydney University	Hort Innovation
Synthesis and analysis of zingerone analogues as fruit fly attractants (PhD)	Macquarie University	Hort Innovation
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
Wolbachia endosymbionts – novel strain dynamics in Australian Drosophila	University of Melbourne	ARC
Horticulture – other		
Alternative herbicide treatments to devitalise cut flowers	DA	DA
An integrated pest and disease management extension program for the olive industry	Western Sydney University	Hort Innovation
Australian tea tree industry leadership structural development initiative	PHA	DA
Basic research on the cocoa pod borer in Papua New Guinea to permit effective pest management	NSW DPI	ACIAR
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
Developing tools to screen native pepper for resistance to dieback and tolerance to drought (PhD)	University of Tasmania	Diemen Pepper

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Horticulture – other (continued)		
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, DPIPWE, Poppy Growers Tasmania, SunPharm Aus, Tasmanian Alkaloids, USDA
Disease diagnostics for small cocoa farmers in west Africa	University of Queensland	University of Queensland (Office of the Deputy Vice-Chancellor)
Entomopathogens for management of key pests of tea tree	NSW DPI	AgriFutures Australia, NSW DPI
Fusarium oxysporum on ginger	University of Queensland	AgriFutures Australia, QDAF
Ginger ninja – automating disease detection in seed ginger stock	Queensland University of Technology	AgriFutures Australia
Identification and management of nematodes in coffee (PhD)	University of Sydney	DFAT (Australia Awards)
Improved capacity for integrated disease management of couch smut (*Ustilago cynodontis*) in turf	University of Queensland	Hort Innovation
Improving ginger to future proof the industry against pests and diseases	University of the Sunshine Coast	AgriFutures Australia
Integrated pest management of phytophagous mites on turfgrass	IPM Technologies	Hort Innovation
Minor use permit renewals	Peracto Pty Ltd	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.
Protecting the coffee industry from coffee berry borer in Papua New Guinea and Australia	QDAF	ACIAR
Review of the biosecurity plan for the ginger industry	PHA	AgriFutures Australia
Safeguarding and deploying coconut diversity for improving livelihoods in the Pacific Islands	Pacific Community (SPC)	ACIAR
Scoping study of sustainable weed management in tea tree oil plantations	University of New England	AgriFutures Australia
Site-specific weed control for ginger cropping systems	University of Sydney	AgriFutures Australia
Natural environment		
Application of remote sensing for surveillance of high risk invasive plants	DJPR	DJPR
Aquatic weed ecology (PhD)	Macquarie University	Macquarie University, Sydney Water
Colonisation by alien microbiota – identifying key ecological processes	Western Sydney University	ARC
Developing an environmental risk mitigation plan for mangroves and associated communities	PHA	DA
Developing an environmental risk mitigation plan for Australian Acacia species	PHA	DA
Egeria containment in irrigation channels	DJPR	Goulburn Murray Rural Water Corportation, DJPR
Enhancing community capacity to assess the impacts of myrtle rust on rainforest Myrtaceae in ecologically and culturally significant lowland subtropical rainforests associated with World Heritage Gondwana Rainforest ecosystems	NSW DPI	APBSF

Image courtesy of Jane Richter, Vines with a View.

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Natural environment (continued)		
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
Expanding environmental biosecurity capacity to protect our unique ecosystems	QDAF	APBSF
Expanding indigenous communities biosecurity surveillance and monitoring capacity to care for country and to protect country from pests and diseases	Charles Darwin University	APBSF
Impact of draw-down on Egeria in Lake Mulwala	DJPR	Goulburn Murray Rural Water Corportation, DJPR
Information gap theory as a tool to assist in biosecurity decision making (PhD)	Murdoch University	Murdoch University, Chevron (USA)
Mixed models to analyse pre-border and border surveillance to assist with decision making (PhD)	Murdoch University	Murdoch University, Chevron (USA)
Optimising plant populations for ecological restoration and resilience	University of New South Wales	ARC
Phosphonate bark painting of Wollemi pine	Royal Botanic Gardens Domain Trust, NSW Office of Environment and Heritage	NSW Department of Planning and Environment, Royal Botanic Garden Sydney
Plant ecophysiology – prospecting for weed control using a native parasitic plant, from laboratory to field implementation	University of Adelaide	ARC, SA Water, Forestry SA, DEWNR SA, PIRSA, Nature Foundation SA, Lirabenda Endowment Fund, Adelaide and Mount Lofty Ranges, South Australian Murray Darling Basin Natural Resources Management Boards

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Natural environment (continued)		
Plant epidemiology – host susceptibility to myrtle rust	Queensland University of Technology	APBSF
Plant invasions as a driver tri-trophic community structures in dry forest ecosystems	Monash University	Ecological Society of Australia
Research and access potential pests and pathogens that could significantly impact biodiversity in NSW	Macquarie University, University of Melbourne	Macquarie University, NSW Office of Environment and Heritage
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
WeedFutures	Macquarie University	Macquarie University, NSW Office of Environment and Heritage
Nursery crops		
Building plant health surveillance capacity in Australia's nursery production industry project	GIA	DA
Building the resilience and on-farm biosecurity capacity of the Australian production nursery industry	QDAF	Hort Innovation
Improving pest management for the nursery industry	GIA	Hort Innovation
Integrated disease management in pyrethrum	University of Tasmania	Hort Innovation
National nursery industry biosecurity program	GIA	Hort Innovation
Northern Australia biosecurity training program	GIA	NT DPIR
Greenlife Industry Australia biosecurity engagement measures	GIA	DA
Nursery production visual training resources	EHR Consultants	PHA

Project title	Organisation undertaking the research	Funding source or body
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
Be(e) friendly venomous spiders – novel biopesticides from arachnid venoms	University of Queensland	ARC
Bee pollination projects	Western Sydney University	Syngenta Australia Ltd
Context dependent flower choice in honey bees	University of Sydney	ARC
Development and establishment of a honey bee virus diagnostic surveillance network within the national bee pest surveillance program	CSIRO	PHA (DA)
Development and implementation of a portal solution for the national bee surveillance program	Soda Strategic	PHA (DA)
Development and implementation of protocols to enable importation of improved honey bee genetics to Australia	CSIRO	Hort Innovation
Development of target plant lists and floral maps for specific high-risk ports in the national bee pest surveillance program	State and territory departments of agriculture as part of the National Bee Pest Surveillance Program contracts	PHA (DA)
Enhancing and safeguarding pollination services for almond production in Australia	Western Sydney University	Olam International Pty Ltd
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 biosecurity resources and better understanding bee health in Australia	PHA	AgriFutures Australia
Improving the health of hives used in pollination	University of Adelaide	AgriFutures Australia

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Pollinators (continued)		
Increasing participation of honey bee industries in the Pacific	CSIRO	Southern Cross University
Investigating factors that influence chalkbrood outbreaks in Australia	CSIRO	AgriFutures Australia
Managing flies for crop pollination	WAAA, Western Sydney University, University of New England	Hort Innovation
Molecular marker identification for disease resistance and implementation into a bee breeding program	University of Western Australia	CRC for Honey Bee Products
National bee biosecurity program	PHA	AHBIC
National bee pest surveillance program	PHA	Hort Innovation, AHBIC, Grain Producers Australia, DA
National bee pest surveillance program enhancements	PHA	DA
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
Probiotic development for bees – analysing gut bacteria in healthy bees	University of Canberra	AgriFutures Australia
Progressing implementation of genetic selection in Australian honey bees	University of New England	AgriFutures Australia
Quantifying the role of wild insect pollinator biodiversity in the provision of pollination ecosystem services	University of New England	Ian Potter Foundation
Rapid evolution via genetic novelty in an invasive social insect	University of Sydney	ARC
Refinement, development and deployment of remote catchboxes as part of the overarching national bee pest surveillance program	University of Southern Queensland	PHA (DA)
Remote bee hive health communication using low power, long range communication technology	University of Western Australia	CRC for Honey Bee Products
Securing pollination for productive agriculture: guidelines for effective pollinator management and stakeholder adoption	AgriFutures Australia	DA (Rural R&D for Profit), 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
Stingless bees as effective managed pollinators for Australian horticulture	Western Sydney University	Hort Innovation
Strengthening and enabling effective pollination for Australia	NZ PFR	Hort Innovation
Systematics and host associations of the Australian gasteruption wasps	Flinders University	DEE

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
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
Hermitage Research Facility – Pest Invaders competition and workshops 2019	QDAF	APBSF
Hermitage Research Facility – schools 'plant health' science competition 2020	QDAF	APBSF
Sexual conflict and evolutionary dynamics of insecticide resistance genes	University of Melbourne	ARC
Systematics of Australian microgastrine wasps (Hymenoptera: Braconidae) – a key group of caterpillar parasitoids (PhD)	University of Adelaide	University of Adelaide
Taxonomy, phylogeny and host associations in Labeninae parasitoids from south-east Australia (Hymenoptera: Ichneumonidae) (Honours)	University of Adelaide	DEE
Urban and amenity		
Establishing a program of plant pest surveillance in Australian botanic gardens and arboreta	PHA	DA
Strengthening the weakest link in peri-urban Mediterranean fruit fly suppression	University of Western Australia, WA DPIRD, Peel Harvey Biosecurity Group	APBSF

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Multiple		
2020 International Year of Plant Health	Hort Innovation	All plant RDCs, PBRI, PHA
AgVet access grants 2018	AgAware Consulting Pty Ltd	AgriFutures Australia
AgVet minor use access grants – trial management	Agaware Consulting Pty Ltd	AgriFutures Australia
ARC research hub for driving farming productivity and disease prevention	Monash University	ARC
ARC research hub for sustainable crop protection	University of Queensland	ARC, Nufarm Limited, CRDC, GRDC, HI, QDAF, NSW DPI, Wine Australia, Australian Wine Research Institute, AUSVEG, Griffith University, Curtin University, La Trobe University, University of Tasmania, University of California, Riverside
AUSPest*Check*™ trial	PHA	DA
Australian herbicide resistance initiative – phase V	University of Western Australia	GRDC
Australian psyllids – implications for conservation and biosecurity	University of Adelaide	DEE
Best practice glyphosate use for Esperance port zone growers	AGRONOMO	GRDC
Biocontrol solutions for sustainable management of weed impacts to agriculture	Meridian Agriculture, CSIRO, NSW DPI, QDAF, DJPR, Hot Tin Roof Communications (extention)	DA (Rural R&D for Profit), AgriFutures Australia, 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
Biological control of giant pine scale in Australia	DJPR, CABI, Hellenic Agriculture Org. Demeter	FWPA, DJPR, ADK Softwoods, The Trust Company ANZOF Sub 1, Hancock Vic Plantations Pty Ltd, Forestry SA, Norske Skog, Forestry Corporation of NSW, ACT Parks Conservation and Lands, Green Triangle Forest Operating Sub Trust, HQ Plantations Pty Ltd, OneFortyOne Plantations, Hume Forests, Green Triangle Forest Products, Forest Products Commission

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Multiple (continued)		
Biological control of silverleaf nightshade	DJPR	DA (Rural Research and Development for Profit), AgriFutures Australia, PIRSA, GRDC
Biosecurity planning workshop – Australia and Indonesia	Lovett Associates	APBSF
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
Boosting biosecurity awareness and action in the freight and logistics industry	NSW DPI	APBSF
Boosting diagnostic capacity for plant production industries	WA DPIRD, NSW DPI, QDAF, DJPR, BioProtection Research NZ, cesar, CSIRO, DPIPWE, DPIR NT, NZ PFR, PHA, SARDI, AUSVEG, SRA	GRDC (Rural R&D for Profit), CRDC, WA DPIRD, NSW DPI, QDAF, DJPR, BioProtection Lincoln, cesar, CSIRO, DPIPWE, NT DPIR, NZ PFR, PHA, SARDI
Brown marmorated stink bug trapping and surveillance	DJPR	DJPR
Clay nanoparticle-facilitated RNAi for non-transgenic modification of crops	University of Queensland	ARC
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	DA
Demonstrating and validating the implementation of integrated weed management strategies to control barley grass in the low rainfall zone farming systems	University of Adelaide	GRDC
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	University of Melbourne (CEBRA)	DA
Developing molecular fingerprinting of myrtle rust disease to facilitate strategies in monitoring and control	Western Sydney University	APBSF
Developing scientifically robust risk maps for priority plant pests	University of Melbourne (CEBRA)	DA
Development of biodegradable controlled release pesticides	University of Queensland	UniQuest Pty Ltd
Development of effective insect surveillance plans utilising economic portfolio theory (PhD)	Murdoch University	Murdoch University, Chevron (USA)
Development of proof of freedom guidelines	CEBRA	DA
Development of smart surveillance tools	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
Driving food safety culture and integrity across value chains	DJPR	DJPR
Early and effective summer weed control – a workshop series for the WA grainbelt	AGRONOMO	GRDC
Ecological impacts of myrtle rust (PhD)	Macquarie University	CRC (Plant Biosecurity), NSW DPI

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Multiple (continued)		
Efficacy of a biocontrol agent against plant pathogenic fungi	Monash University	Nutrifield Pty Ltd
Elucidating trifluralin resistance in Australian major weed *Lolium rigidum*	University of Western Australia	ARC, NuFarm Australia
Engineering better sprays for leaf coating – from drop impact to retention	University of New South Wales	ARC
Enhancing NSW biosecurity food safety risk management system	University of Melbourne	NSW DPI
Estimating worldwide brown marmorated stink bug risk of establishment	University of Melbourne (CEBRA)	DA
Evaluation of insecticidal spider peptides	University of Queensland	UniQuest Pty Ltd
Farm biosecurity project	PHA, AHA	PHA, AHA
Field surveillance capability	DJPR	DA
Forging an effective fight against Phytophthora in NSW	Royal Botanic Gardens Domain Trust, NSW Office of Environment and Heritage	Royal Botanic Gardens Domain Trust, NSW Office of Environment and Heritage
General surveillance	CSIRO	DA
Harvest weed seed control for the southern region	Southern Farming Systems	GRDC
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	Eight service providers (one for each subproject) – PHA, AUSVEG, SRA, University of Queensland (via CRDC), SARDI (Burkard Scientific Limited [UK], Rothamsted Research Limited [UK]), DJPR, CSIRO, WA DPIRD	Hort Innovation, PHA, SRA, GRDC, AgriFutures Australia, Wine Australia, FWPA, CRDC, SARDI, DJPR, CSIRO, NZ PFR, Rothamsted Research (UK), Burkard Manufacturing Company (UK), GIA, DA (Rural Research and Development for Profit), WA DPIRD
Implementation of a multi-target surveillance system	Murdoch University	Chevron (USA)
Improve biosecurity capabilities for demonstrating pest area freedom	PHA	DA
Improved management options for cucumber green mottle mosaic virus	NT DPIR	Hort Innovation
Improving access to new germplasm using next generation sequencing	DJPR, Queensland University of Technology	Hort Innovation, DJPR, Queensland University of Technology
Improving AusPest*Check*™ data quality and transfer	PHA	DA
Improving biosecurity implementation of biosecurity planning	PHA	DA
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 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, DA
Improving weed management in high break crop intensity farming systems	SARDI	GRDC
Innovative BioClay platform for fire ant eradication	University of Queensland	QDAF
Innovative crop weed control for northern region cropping systems	University of Sydney	GRDC
Innovative plant pathogen surveillance using metabarcoding and next generation sequencing on spore trap contents	DJPR	La Trobe University Scholarship
Innovative technologies project – remote sensing for presence or absence	CSIRO	DA

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Multiple (continued)		
Insecticide resistance management in red-legged earth mite and chemical sensitivities	University of Melbourne	GRDC
Interstate trade reform – Interstate Certification Assurance scheme	PHA	DA, state and territory governments
Invasion pathway analysis for Australia – insects	Monash University	Invasive Species Council
Invasive grass LAMP platform	NSW DPI	DA
Locally important weeds	WA DPIRD	GRDC
Lucid identification keys for Australian endemic and exotic genera	DJPR	DA, DJPR
Making Green Guard® greener – enhancing the efficacy of a biopesticide	University of Sydney, University of Adelaide	ARC
Managing weeds in the GRDC northern grains region – coordination of workshop material and establishment and monitoring of regional focus paddocks	Local Land Services	GRDC
Manipulating plant root exudation for soil-borne disease control	University of Tasmania	ARC
Molecular characterisation of specimens in the Victorian plant pathogen herbarium to support market access into Asian markets - powdery mildews (PhD)	DJPR, La Trobe University	DJPR
Molecular Diagnostic Centre – national disease surveillance	SARDI	GRDC
Monitoring diamondback moth for forecasting and adaptive management of outbreak and insecticide resistance risk	SARDI	GRDC
Myrtle rust masterclass – community awareness	Box Hill Institute (TAFE)	APBSF
National Diagnostic Protocols – entomology	DJPR	SARDI (SPHD)
National Diagnostic Protocols – microbiology	DJPR	SARDI (SPHD)
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	DA
National tree genomics program – genotype prediction toolbox	Western Sydney University	Hort Innovation
National working party on pesticide applications	PHA	CropLife Australia, GRDC, Wine Australia, CRDC, SRA, AAAA
New Gene Sequencing – PEQ plant virus and viroids	Queensland University of Technology	DA
New horizons with BioClay – protecting crops from aphids and whiteflies	University of Queensland	Queensland Department of Science Information Technology and Innovation
Novel tropical vegetable and cotton virus protection	University of Queensland	Hort Innovation
Online plant health surveillance training and awareness resources	PHA	DA
Ornamental and Asian vegetable plants as entry pathways for viruses	University of Queensland	APBSF
Pest and Disease Image Library	PHA	DA
Phylogenomic classification of rust fungi in Australia	University of Queensland	Australian Government Department of Sustainability, Environment, Water, Population and Communities
Pilot workshops – why weeds grow where they do and how to control them	Planfarm Pty Ltd	GRDC
Plant Biosecurity Research Initiative	Projects led by individual RDCs	Hort Innovation, CRDC, GRDC, Wine Australia, SRA, AgriFutures Australia, FWPA

Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Multiple (continued)		
Plant health – a major challenge to achieving sustainable 'green' agriculture in Myanmar	CABI (Malaysia)	ACIAR
Plant industry liaison officer for northern Australia	PHA	DA
Portable, in-field pathogen detection	DJPR	DJPR
Post doctoral fellowship – maximising crops and minimising weeds with smart phase farming	University of Western Australia	GRDC
Prevention and control of West Indian drywood termite	QDAF	QDAF
Protecting Australia's food future – shared responsibility for biosecurity	University of Tasmania	ARC
Provision of a revised economic allocation theory model – Barrow Island biosecurity	University of Melbourne	Murdoch University, Chevron (USA)
Pursuing sensitive limits of biochemical geographic discrimination as generic tool for high-risk plant pests	Queensland University of Technology	APBSF
Putting new herbicide targets on the table	University of Western Australia	ARC
Rapid diagnostics for major biosecurity threats	SARDI, Macquarie University	DA
RD&E program for control, eradication and preparedness for vegetable leafminer	AUSVEG, cesar, NAQS, University of Melbourne, PHA	Hort Innovation
Real-time phylogenetics for food-borne outbreak surveillance	University of Technology Sydney	ARC
Re-evaluating management of established pests including the European wasp, *Vespula germanica*, using biocontrol agents	University of Melbourne (CEBRA)	DA
Reference collections strategy implementation	Agriculture Victoria	PHA (DA)
Regional master classes in plant biosecurity (Indonesia)	Lovett Associates	APBSF
Research to inform yellow crazy ant management in the wet tropics	James Cook University	Wet Tropics Management Authority
Resolution of disease epidemiology and detection of genetic and genotypic diversity in Australian populations of myrtle rust	University of Queensland (Queensland Alliance for Agriculture and Food Innovation)	APBSF
Resolve the taxonomy of native Australian longhorn beetles	CSIRO	DA
Responding to emerging pest and disease threats to horticulture in the Pacific Islands	University of Queensland	ACIAR
Review and development of national strategies to support implementation of the National Plant Biosecurity Strategy	PHA	DA (Agricultural Competitiveness White Paper)
Revision of bristle fly genus Rutilia	CSIRO	DEE
RNA vaccines for next generation crop protection against fungal pathogens	University of Queensland	Queensland Government Department of Innovation, Tourism Industry Development
Seed bank biology of emerging weeds	University of Adelaide	GRDC
Single model irregular region retrieval for rapid plant disease detection	Griffith University	ARC
Smart surveillance tools	DJPR	DA (Agricultural Competitiveness White Paper)
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
Multiple (continued)		
Summer weed survey of WA cropping districts	AGRONOMO	GRDC
Surge capacity simulation model	SPHD (Surge Capacity Working Group)	PHA (SPHD)
Sustainable productivity improvements in Allium and solanaceous vegetable crops in Indonesia and sub-tropical Australia	QDAF	ACIAR
Systematics of the chalcid wasp genus Psyllaephagus (Hymenoptera: Encyrtidae), parasitoids of lerp insects	University of Adelaide	University of Adelaide
Systematics, biodiversity and host associations of Australian psyllids – implications for conservation and biosecurity	University of Adelaide	University of Adelaide
Tackling pests using game theory to support cooperative management	University of Queensland	ARC
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	DA
The role of reproductive parasites in the biology of invasive pest thrips (PhD)	Western Sydney University	Western Sydney University
Towards herbicide cocktails with a new mode of action to avert resistance	La Trobe University	ARC
Uncovering how rust fungi cause devastating plant diseases	Australian National University	ARC

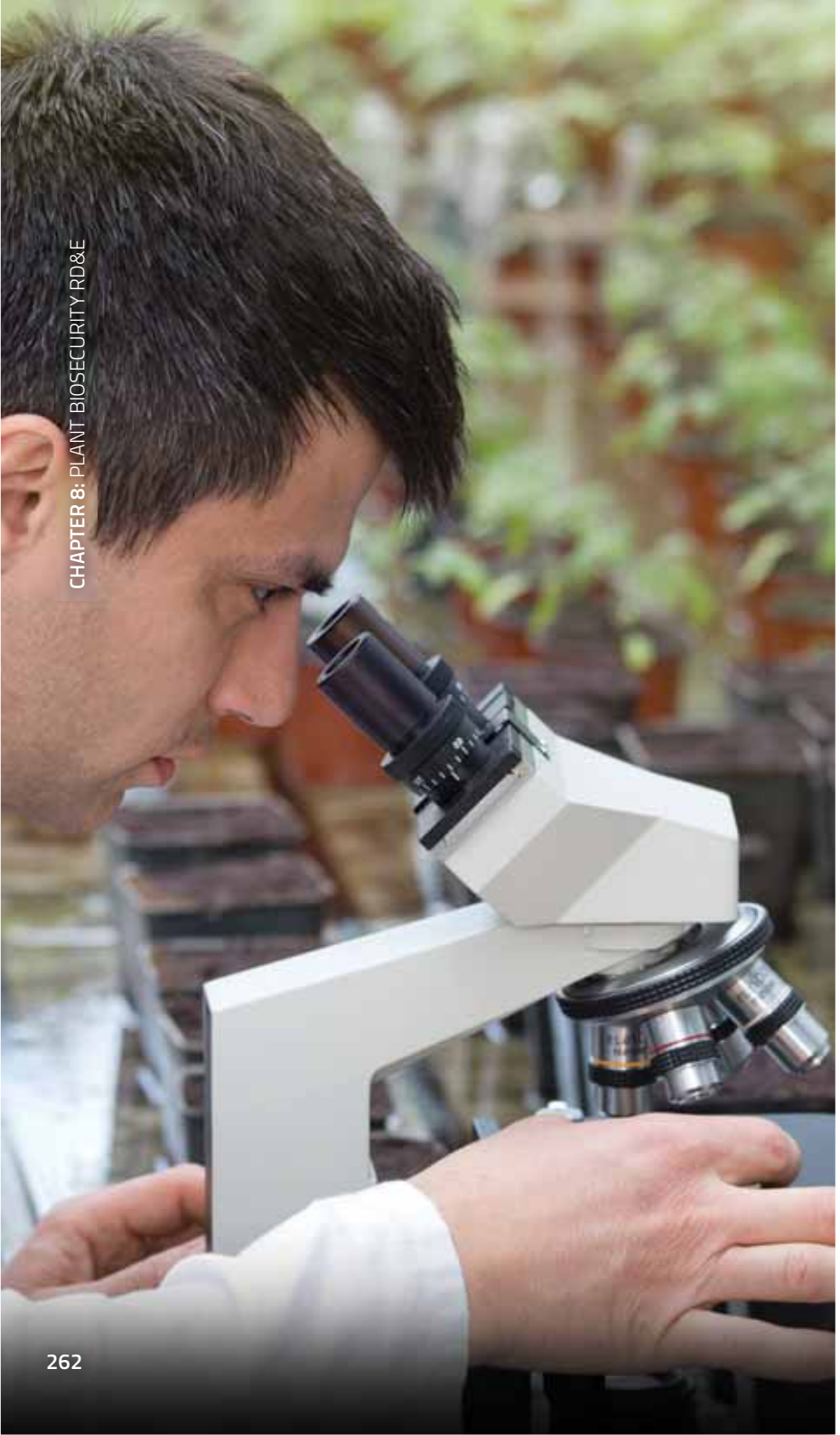


Table 59. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Multiple (continued)		
Upskilling Tasmanian growers and advisors to manage annual ryegrass through exposure to external knowledge and peer-to-peer learning	Southern Farming Systems	GRDC
Using mobile apps to identify pests and diseases	DA	DA
Virtual fencing for better crop integrated weed management	CSIRO	GRDC
Weed biocontrol	DJPR	Goulburn Murray Water, Murrumbidgee Irrigation, Coleambally Irrigation, Goulburn Broken CMA, Wyong Shire, NSW Office of Environment and Heritage, Central Murray Council, NQ Dry Tropics, Murray Local Land Services, Murrumbidgee Landcare, PIRSA, GRDC
When are earwigs pests and when are they beneficial?	CSIRO	GRDC
When is hybridisation helpful or harmful to invaders?	Monash University	ARC
Xylella coordinator	Wine Australia	Wine Australia, Hort Innovation, Plant Biosecurity Research Initiative
Other crops		
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

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 6770 2300
Australian Government – Australian Research Council	arc.gov.au	+61 2 6287 6600
Australian Government – Department of Agriculture	agriculture.gov.au	+61 1800 900 090
Australian Government – Department of Agriculture, Australian Bureau of Agricultural and Resource Economics and Sciences	agriculture.gov.au/abares	+61 1800 900 090
Australian Government – Department of Agriculture, Northern Australia Quarantine Strategy	agriculture.gov.au/biosecurity/australia/naqs	+61 1800 900 090
Australian Government – Department of Agriculture, 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 of 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
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	+61 419 992 914
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	
Central Queensland University	cqu.edu.au	+61 13 27 86
Centre for Crop and Disease Management	ccdm.com.au	+61 8 9266 4818
Centre for Fruit Fly Biosecurity Innovation	fruitflyittc.edu.au	
Centre of Excellence for Biosecurity Risk Analysis	cebra.unimelb.edu.au	+61 3 8344 4405
Charles Darwin University	cdu.edu.au	+61 8 8946 6666
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	+61 3 5751 1466
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	+64 7 838 5275
CRC for Honey Bee Products	crchoneybeeproducts.com	+61 8 6488 8525
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 1800 084 881
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
Greenlife Industry Australia	greenlifeindustry.com.au	+61 2 8861 5100
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
Hort Innovation	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

Organisation	Website	Phone
Monash University	monash.edu	+61 3 9902 6000
Murdoch University	murdoch.edu.au	+61 8 9360 6000
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 Research Initiative	pbri.com.au	
Plant Breeding Institute, University of Sydney	sydney.edu.au/agriculture/our-research/research-facilities.html	+61 2 9351 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
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 on 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.

Acronyms

Acronym	Full name
ABARES	Australian Bureau of Agricultural 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
AGMIN	Agriculture Ministers' Forum
AGSOC	Agriculture Senior Officials' Committee
AHA	Animal Health Australia
AHB	Australian Honey Bee
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
ASEAN	Association of Southeast Asian Nations
BAS	Biosecurity and Agriculture Services
BBO	Bee Biosecurity Officers
BICON	Biosecurity Import Conditions
BIMS	Biosecurity Incident Management System
BIPIM	Biosecurity Incident Public Information Manual
BIRA	Biosecurity Import Risk Analysis
BMSB	brown marmorated stink bug
BOLT	Biosecurity Online Training
CCDM	Centre for Crop and Disease Management
CCEPP	Consultative Committee on Emergency Plant Pests
CEBRA	Centre of Excellence for Biosecurity Risk Analysis
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CPDPC	Citrus Pest and Disease Prevention Committee

Acronym	Full name
CRC	Cooperative Research Centre
CRDC	Cotton Research and Development Corporation
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DA	Australian Government Department of Agriculture
DAF	Department of Agriculture and Fisheries, Queensland
DPIRD	Department of Primary Industries and Regional Development, Western Australia
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
EHB	European honey bee
EIC	Environment and Invasives Committee
ELISA	enzyme-linked immunosorbent assay
EPP	Emergency Plant Pest
EPPR	Emergency Plant Pest Response
EPPRD	Emergency Plant Pest Response Deed
EPSDD	Environment Planning and Sustainable Development Directorate, Australian Capital Territory
ERA	Excellence in Research for Australia
EXDOC	Export Documentation System
FAO	Food and Agriculture Organization
FPoE	First Point of Entry
FWPA	Forest and Wood Products Australia
GIA	Greenlife Industry Australia
GPA	Grain Producers Australia
GRDC	Grains Research and Development Corporation
HACCP	Hazard Analysis Critical Control Point
Hort Innovation	Horticulture Innovation Australia
ICA	Interstate Certification Assurance
IGAB	Intergovernmental Agreement on Biosecurity

Acronym	Full name
IPPC	International Plant Protection Convention
IRA	Import Risk Analysis
ISPM	International Standards for Phytosanitary Measures
LAMP	loop mediated isothermal amplification
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
NEBRA	National Environmental Biosecurity Response Agreement
NMDS	National Minimum Dataset Specifications
NPBDN	National Plant Biosecurity Diagnostic Network
NPPO	National Plant Protection Organisations
NPPP	National Priority Plant Pests
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
ORC	Owner Reimbursement Costs
PBCRC	Plant Biosecurity Cooperative Research Centre
PBRI	Plant Biosecurity Research Initiative
PHA	Plant Health Australia
PHC	Plant Health Committee
PIRSA	Department of Primary Industries and Regions, South Australia
PPPO	Pacific Plant Protection Organisation
QDAF	Department of Agriculture and Fisheries, Queensland
RABA	Raspberries and Blackberries Australia
R&D	research and development
RD&E	research, development and extension

Acronym	Full name
RDC	research and development corporation
SA	South Australia
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
SRA	Sugar Research Australia
TCCS	Transport Canberra and City Services
WA	Western Australia

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