The National Plant Biosecurity
Status Report

2020

Plant Health AUSTRALIA

21 years

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Font cover: *Purple cabbage kale growing in the field with water dews stock photo*

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Message from the Hon David Littleproud, Minister for Agriculture and Northern Australia, Member for Maranoa, Queensland

I congratulate our plant industries for their incredible resilience through this time of challenge and uncertainty – as shown in this year's National Plant Biosecurity Status Report.

The Australian Government is a strong supporter of Australia's plant industries and is committed to protecting our world-class biosecurity system. With ever-increasing trade and changes in the regional prevalence of pests and disease, we need to be continually vigilant about biosecurity risks.

We are setting the foundations to give Australia's agriculture industry what it needs for success and to reach the industry's goal of $100 billion in production by 2030.

A key piece is to build on our biosecurity measures at and beyond the border and being prepared if we do have an incursion. We are continuing our investment in innovation and biosecurity research is vital to the sustainability of Australian agriculture and the environment.

Last year we re-signed the Plant Biosecurity Research Initiative ensuring the continued coordination for research and development efforts for plant biosecurity. Under the initiative, 10 collaborative projects have been funded with a total value of $50 million to support plant biosecurity research.

These projects are improving our understanding of Xylella, brown marmorated stink bug and fall armyworm, all of which are high priority threats for Australian plant industries and the environment.

Commonwealth Biosecurity 2030 is an important pillar in delivering biosecurity outcomes and the government's Ag2030 plan. It is our roadmap for biosecurity, setting how we will address growing risks by making sure we have the best controls, tools, processes and networks in place. We will work with our biosecurity partners – industry, governments, research and tertiary institutions and the community – to develop a national biosecurity strategy.

Our commitments outlined in Commonwealth Biosecurity 2030 are supported by our Budget biosecurity investment of over $400 million, which comes on top of our record spending on biosecurity and export services in 2020–21.

I am confident our continued strong government–industry partnership and collective commitment to biosecurity will ensure Australia's plant resources and the industries and communities that are reliant on them are kept safe.

Hon David Littleproud
Minister for Agriculture and Northern Australia, Member for Maranoa, Queensland

Message from Steve McCutcheon, Chair Plant Health Australia

From droughts and bushfires continuing from late 2019 to a global pandemic, the past year has brought many challenges for agricultural industries in Australia. Showing grit and determination, Australian agriculture has been resilient and continued to be a pillar of the Australian economy. Overall, the agriculture industry is in a strong position, especially as expanding our export markets is being supported by the Australian Government.

The Covid-19 pandemic brought unwelcome changes, including the biggest economic downturn in activity on record for the global economy during the first half of 2020, forcing companies around the world to examine their supply networks and make changes to reduce vulnerabilities. However, the overall impact on agriculture from the pandemic appears to have not been a negative one and the future of the industry is looking secure.

In Australia, adaptation was required at our international borders, as commodities and goods were sourced from different parts of the world, altering the risk profile for exotic pest and disease arrivals on our shores. Plant Health Australia (PHA) has continued to create partnerships between government and industry to meet these challenges, and look for opportunities to formulate strategies with respect to the national biosecurity system. These strategies are designed to meet changing trading patterns and supply chains, shifts in geopolitics, merging of pest and disease regions, greater challenges at the border and post-border, and climate and land use change leading to ever-more expansive established pest ranges. And with every change in import and export, adjustments and allocation of biosecurity resources is needed at the international border and in negotiating market access arrangements.

Australia devotes considerable resources to plant biosecurity and we have a highly effective biosecurity system. PHA coordinates efforts and shared responsibility across a wide variety of stakeholders to help deliver a first-class biosecurity system capable of supporting sustainable plant production and environmental plant health while maintaining and enhancing market access.

First published in 2008, the annual National Plant Biosecurity Status Report provides a comprehensive overview of Australia's plant biosecurity system and the pre-border, border and post-border activities undertaken in 2020. It is also the only published source of biosecurity research, development and extension projects aimed at enhancing capability within the system.

Compiling the 2020 National Plant Biosecurity Status Report relies on input from more than 100 organisations, and without these contributors this report would not be possible. Thank you for your contribution. Together we can continue to build a strong and resilient national biosecurity system.

Steve McCutcheon
Chair
Plant Health Australia

Introduction

Australia's plant resources

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

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

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 with 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. As at June 2020, around 377 million hectares was farmed by 87,800 crop and livestock businesses.[1]

In 2019–20, plant industries represented a gross value of $30 billion[2] (including forest products, honey and beeswax, see Figure 2) and plant exports were worth more than $25 billion, mainly grains (such as wheat, barley and canola), sugar, wine, forestry, cotton and horticultural products.

Produce destined for overseas markets 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.

Australia has 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.[3]

Figure 1. Australia's varied climatic zones

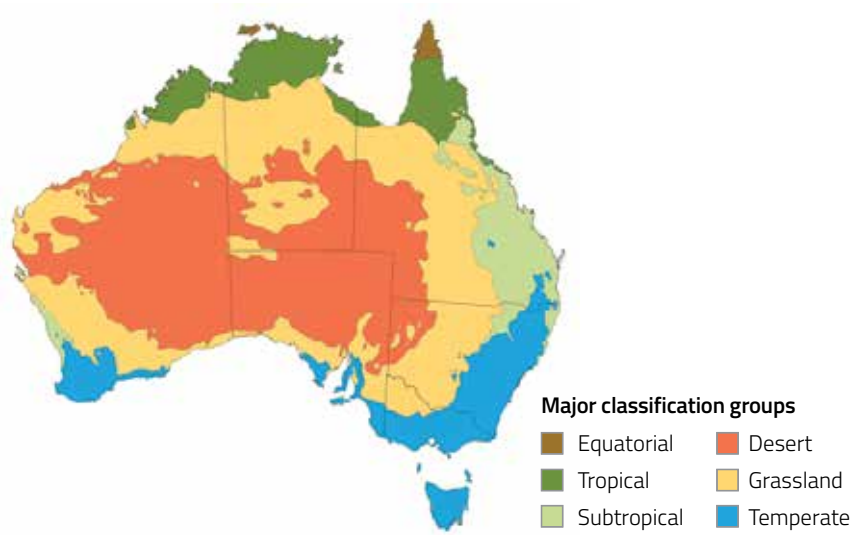


Image courtesy of the Bureau of Meteorology

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 social amenities such as parklands and other public amenities.[4]

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.

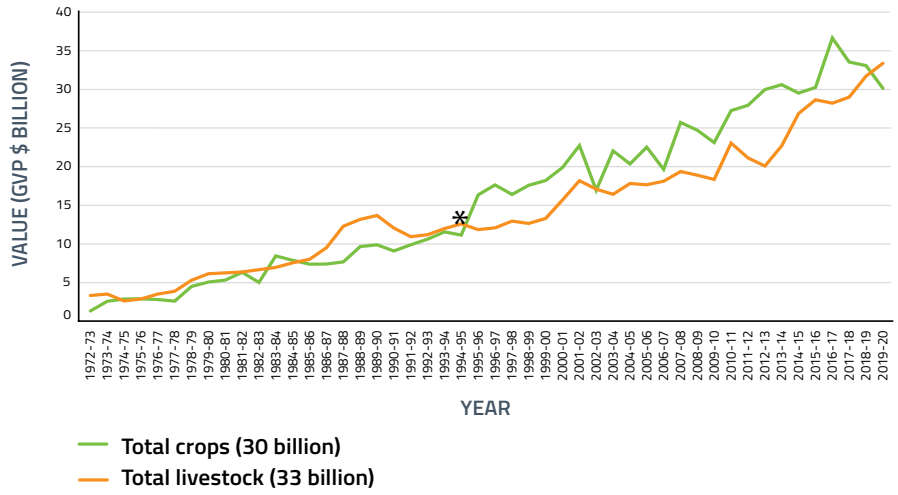
1 Australian Bureau of Statistics. Value of Agricultural Commodities Produced, Australia. Accessed online 26 May 2021 https://www.abs.gov.au/statistics/industry/agriculture/value-agricultural-commodities-produced-australia/latest-release

2 Australian Bureau of Agricultural and Research Economics and Sciences. Agricultural Commodities and trade data. Accessed online 26 May 2021 https://www.agriculture.gov.au/abares/research-topics/agricultural-outlook/data#agricultural-commodities

3 Commonwealth of Australia. Conserving Australia: Australia's National parks, conservation reserves and marine protected areas. Accessed online 3 May 2021 www.aph.gov.au/Parliamentary_BusinessCommittees/Senate/Environment_and_Communications/Completed_inquiries/2004-07/nationalparks/report/index

4 Australian Bureau of Statistics. Australian environmental–economics accounts, 2017, Cat. No. 4655.0. Accessed online 3 May 2021 https://www.abs.gov.au/ausstats/abs@.nsf/mf/4655.0

Figure 2. Gross value of plant and animal production industries in Australia, 1972-2020*



*Includes forestry from 1995–96

Features of 2020

2020 was a very challenging year for plants in Australia, whether grown by plant industries, in natural environments or in urban settings.

The year commenced with much of Australia affected by severe drought, with extreme heat and widespread bushfires in eastern Australia. Starting as early as September 2019, the Black Summer Bushfires had a devastating impact on coastal bushland areas and some agricultural enterprises, continuing into the early part of 2020.

Heatwaves returned in November, affecting large parts of south-eastern and eastern Australia. 2020 was Australia's fourth-warmest year on record, with the annual national mean temperature 1.15°C above average, as shown in Figure 3, immediately following Australia's warmest year on record, 2019 (1.52°C above average).[5]

While the national rainfall average was four per cent above average for the year at 483.4 mm, some parts of Australia experienced rainfall that was highest on record and others lowest on record, as shown in Figure 4. Flooding affected eastern Australia during February and March, particularly through Queensland (QLD), but rainfall was below average in the west of Western Australia (WA), south-east QLD and western Tasmania (TAS). Notably, La Niña was officially declared in September, reaching moderate strength by the end of the year.

No sooner had most of the fires been brought under control and the air cleared of smoke, when a human biosecurity emergency emerged. Covid-19 caused 'biosecurity' to appear in news headlines like never before, with the threat felt by all Australians. A positive outcome of the Covid-19 pandemic has been an increased awareness of biosecurity related preventative measures – like hygiene, contact tracing and quarantine measures – much of which can be translated to plant biosecurity.

Against this backdrop of extreme events, the gross value of agricultural production for 2020–21 was forecast to reach a record $66 billion, boosted by Australia's second-biggest winter crop on record.[6] Significantly larger harvests in every Australian state were forecast to result in a 59 per cent increase in the gross value of grains, oilseeds and pulses compared with the 2019–20 season. The value of crop exports was forecast to increase sharply in line with record production, up 12 per cent to $24 billion.

Figure 3. 2020 annual mean temperatures compared to historical temperature observations

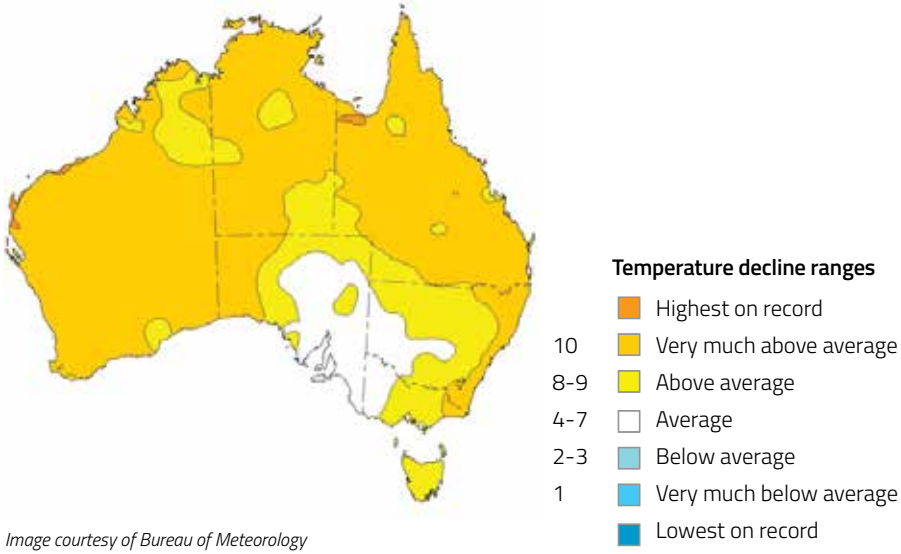


Image courtesy of Bureau of Meteorology

Figure 4. 2020 annual rainfall compared to historical rainfall observations

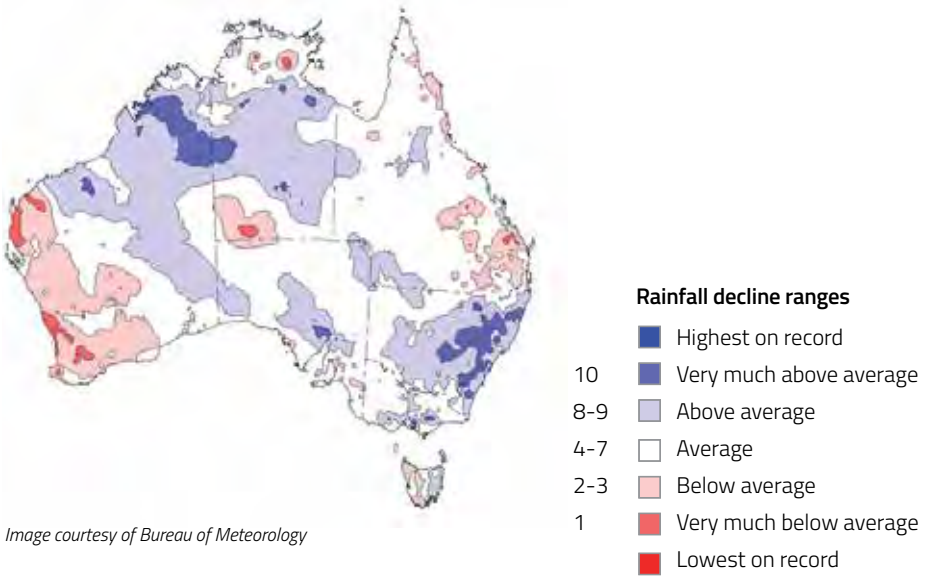


Image courtesy of Bureau of Meteorology

5 Australian Government Bureau of Meteorology. Annual climate statement 2020. Accessed online 30 April 2021 http://www.bom.gov.au/climate/current/annual/aus

6 Australian Bureau of Agricultural and Resource Economics and Sciences. Agricultural overview: March quarter 2021. Accessed online 30 April 2021 https://www.agriculture.gov.au/abares/research-topics/agricultural-outlook

Growing threats to plant health

Factors such as globalisation, international and interstate movement, climate change, geopolitics, tourism and the increasing volume of goods transported around the globe all contribute to increasing biosecurity risks in Australia.[7]

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.

To maintain Australia's favourable biosecurity status in this age of increased global trade and travel, a high priority is placed by all stakeholders on plant biosecurity. In general, the growth in trade and international movement of people presents biosecurity challenges for Australia. However, in 2020, Covid-19 caused dramatic shifts in the biosecurity risks from the movement of freight, passengers and mail items.

Pre-Covid-19, annually there was nearly 100 million tonnes of freight arriving by sea.[8] In 2020, 0.9 million tonnes of freight arrived by air, down from 1.1 million tonnes in 2019.[9]

International air passenger traffic for 2020 was 9.3 million, a 78 per cent decrease over the nearly 42.5 million airline passengers in 2019. In response to the changed risk due to Covid-19 and less international flights, dogs were redeployed to primarily screen arriving mail items. In 2020, detector dogs intercepted approximately 13,500 risk items and screened 15,706,488 mail items.[10]

Some 408 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.

7 Commonwealth of Australia. Priorities for Australia's Biosecurity System: Response from Australian agriculture ministers (November 2018). Accessed online 3 May 2021 https://www.agriculture.gov.au/sites/default/files/sitecollectiondocuments/igab-review-response.pdf

8 Department of Infrastructure, Transport, Cities and Regional Development. Australian Sea Freight 2016–17. Accessed online 3 May 2021 https://www.bitre.gov.au/publications/2019/australian-sea-freight-2016-17

9 Department of Infrastructure, Transport, Regional Development and Communication. Aviation: International airline activity December 2020. Accessed online 3 May 2021 https://www.bitre.gov.au/sites/default/files/documents/international_airline_activity_1220.pdf

10 Media release, the Hon David Littleproud. Super sleuth Ulf shows why he's top dog. Accessed online 3 May 2020 https://minister.awe.gov.au/littleproud/media-releases/super-sleuth-ulf

International Year of Plant Health 2020

The United Nations declared 2020 the International Year of Plant Health (IYPH) 'Protecting plants, protecting life'.

In Australia, the year was launched in February at Parliament House, with representatives from local and international governments, plant health industries and authorities, and the private sector.

Due to Covid-19, many of the face-to-face events were moved online. NSW Department of Primary Industries partnered with the Royal Botanic Gardens Sydney and the Australian Museum to develop an interactive Biosecurity Warrior webpage to explore how to keep plants healthy and identify pests.

Online profiles of 38 Plant Health Heroes were published detailing their work experience in plant health, exploring what motivates them, what their typical workday looks like and advice for newcomers.

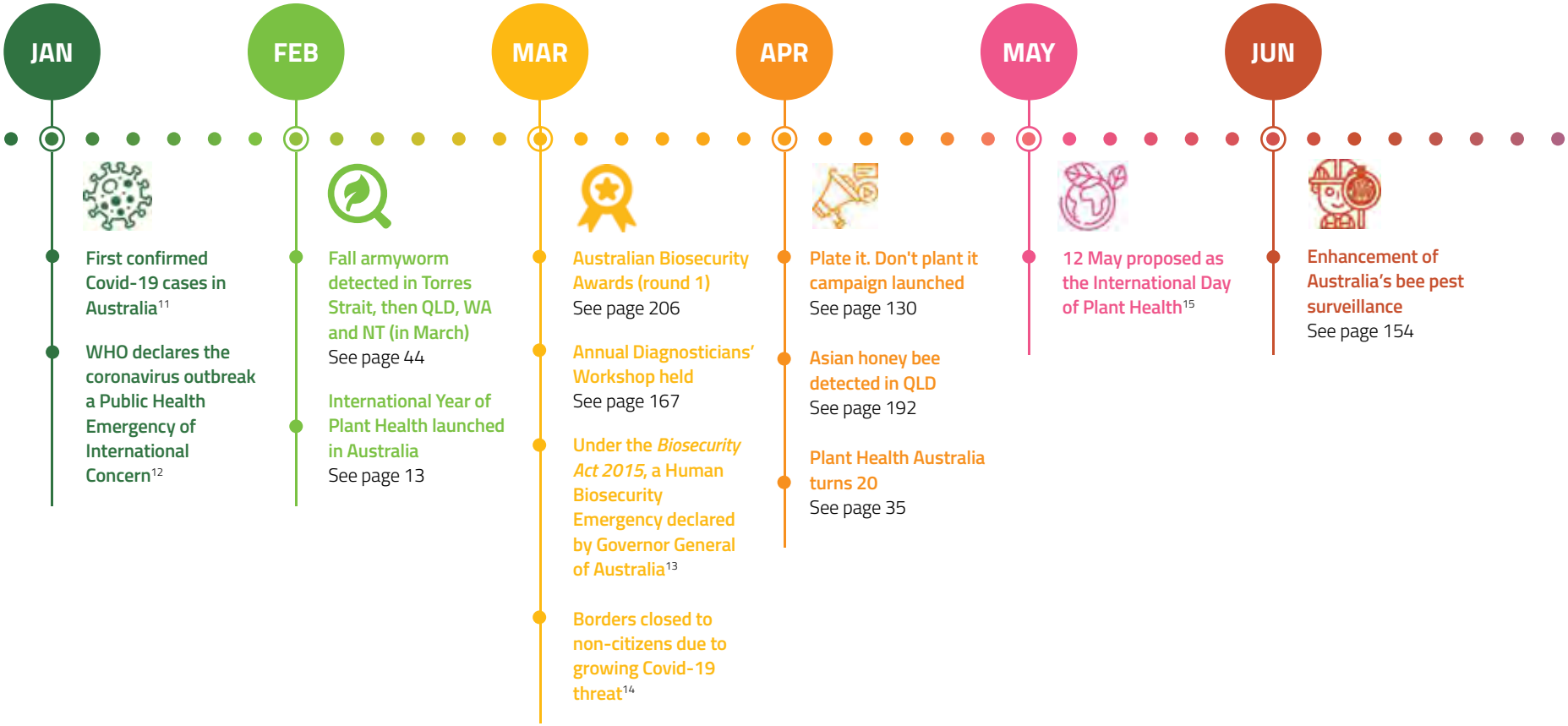
A partnership with the Plant Biosecurity Research Initiative and the Youth Community Greening team from the Royal Botanic Garden & Domain Trust in Sydney saw the IYPH team working with the students from bushfire affected Cobargo Public School in south-east NSW to design, plant and care for a bush tucker garden.

Due to the ongoing international impacts of Covid-19, IYPH was extended into 2021, with the closing ceremony scheduled for July in Helsinki, Finland.

Cobargo Public School students learning about setting up a bush tucker garden. Image courtesy of Michelle Portelli, IYPH Coordinator

Plant biosecurity highlights in 2020

Below is a timeline of some key biosecurity related events during 2020 that involved a broad range of stakeholders across Australia working to protect our plant resources. These events are referenced throughout the report.



11 Parliament of Australia. COVID-19: a chronology of state and territory government announcements (up until 30 June 2020). Accessed online 9 June 2021 https://www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/pubs/rp/rp2021/Chronologies/COVID-19StateTerritoryGovernmentAnnouncements#_Toc52275790

12 World Health Organisation. Timeline: WHO's COVID-19 response. Accessed online 9 June 2021 https://www.who.int/emergencies/diseases/novel-coronavirus-2019/interactive-timeline

13 Australian Government Federal Register of Legislation. Biosecurity (Human Biosecurity Emergency) (Human Coronavirus with Pandemic Potential) Declaration 2020. Accessed online 9 June 2021 https://www.legislation.gov.au/Details/F2020L00266

14 Parliament of Australia. COVID-19 Legislative response—Human Biosecurity Emergency Declaration Explainer. Accessed online 9 June 2021 https://www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/FlagPost/2020/March/COVID-19_Biosecurity_Emergency_Declaration

15 Food and Agriculture Organization of the United Nations. The FAO Council endorses the establishment of an International Day of Plant Health. Accessed online 9 June 2021 https://www.ippc.int/en/news/the-fao-council-endorses-the-establishment-of-an-international-day-of-plant-health/

JUL

First Environmental Biosecurity Webinar
See page 62

Plant Biosecurity in Australia BOLT course launched
See page 190

AUG

Biosecurity Bite video series launched
See page 135

Russian wheat aphid detected in WA
See page 33

Unsolicited packets of seeds arriving in the mail
See page 224

New user-focused guide for establishing or changing levies[16]

National Fruit Fly Council webinar

National Fall Armyworm Forum convened
See page 44

SEP

Reinforced seasonal measures against brown marmorated stink bug commenced[17]

National Fruit Fly Council webinar

OCT

National Fruit Fly Council webinar

First Farm Biosecurity Nuffield Scholar announced[18]

Fall armyworm podcasts published
See page 44

NOV

National Priority List of Exotic Environmental Pests, Weeds and Diseases released
See page 43

Australian Biosecurity 2030 Workshop
See page 205

Australian Biosecurity Awards (round 2)
See page 155 and 206

Australia's Biosecurity Future released by CSIRO
See page 218

2020–25 National Fruit Fly Strategy released
See page 200

New Export Plan between Australia and New Zealand signed
See page 137

DEC

Annual Surveillance Workshop
See page 153

National Fruit Fly Council webinar

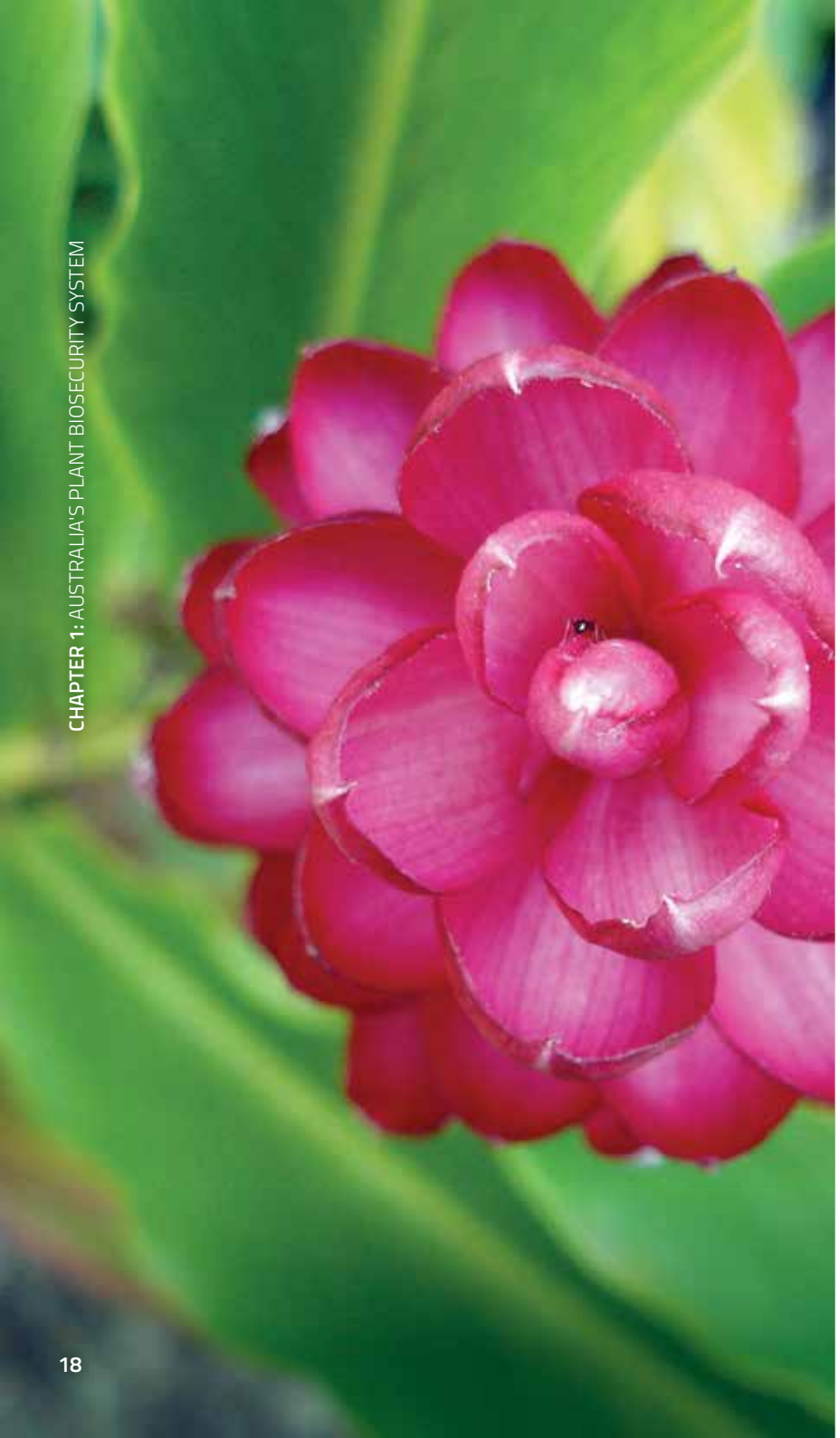
16 Australian Government Department of Agriculture, Water and the Environment. Media release: New user-focused guide for establishing or changing levies. Accessed online 9 June 2021 https://www.awe.gov.au/news/media-releases/new-user-focused-guide-levies

17 Australian Government Department of Agriculture, Water and the Environment. Media release: Biosecurity measures reinforced for brown marmorated stink bug season 2020-21. Accessed online 9 June 2021 https://www.awe.gov.au/news/media-releases/bio-measures-reinforced-bmsb-season-2020-21

18 https://www.farmbiosecurity.com.au/farm-biosecurity-nuffield-scholar-announced/

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 coordinated activities.

Australia works across the three layers of the plant biosecurity continuum – pre-border, at the border and post-border – with activities to help prevent the introduction, establishment and spread of pests. These three layers of protection and the whole of system assets are expanded upon throughout this report (see Figure 5).

Surveillance and monitoring of risk areas are critical to the integrity of the plant biosecurity system, along with border control activities which focus on assessing and managing potential biosecurity threats at Australia's airports, seaports and international mail centres at the national level, and between states and territories at the domestic level.

As global trade increases, biosecurity risks change, and pests have more opportunities to enter the country in more complex unpredictable pathways. The objective of the plant 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) and between states and territories. 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. State and territory governments, importers, agricultural industries and 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 and territory governments, 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.

This stakeholder effort is referred to as the plant biosecurity partnership. The principle of biosecurity partnerships was established in recognition that, in addition to plant producers and governments, the wider Australian community contribute to, and benefit from the biosecurity system. Benefits include improved productivity, product quality and cost, market access, trade, tourism, profitability, sustainability, and preservation of our unique natural environment and way of life.

Figure 5. Key components of Australia's plant biosecurity system, protecting agriculture and the environment

PRE-BORDER

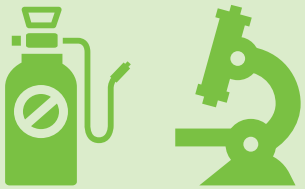
- Analysing pest risks associated with proposed imports
- Inspecting, verifying and auditing overseas exporters
- Undertaking pest surveillance overseas
- Developing international standards
- Building capacity overseas
- Anticipating pest threats by gathering global pest intelligence
- Negotiating export 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
- Conducting surveillance for early warning of incursions of exotic pests
- 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 underpinning Australia's effective plant biosecurity system is supported by a suite of strategies, agreements, review reports, policies and legislation, developed over many years. These provide an overview of structure and a vision for 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 enhance national collaboration among Australian governments in order to:

- strengthen Australia's biosecurity system
- 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 commenced in 2012. The current agreement was developed following a review of the IGAB 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.

NATIONAL PLANT BIOSECURITY STRATEGY

The National Plant Biosecurity Strategy (NPBS) aligns with the IGAB and sets the strategic direction for Australia's plant biosecurity system to 2020.

Since being developed by Plant Health Australia (PHA) in 2010, the NPBS has driven the way governments, plant industries and the community work closely together to strengthen the national plant biosecurity system.

The NPBS sets out ten strategies to respond to the challenges facing the system (see Table 1). Each strategy is supported by a series of recommendations and actions that focus on key areas of improvement.

Implementation of the NPBS is supported by the National Plant Biosecurity Diagnostic Strategy (2012) and the National Plant Biosecurity Surveillance Strategy (2013) and ensures that the plant biosecurity system continues to:

- protect Australia and Australians from the negative impacts of plant pests
- assist plant production industries to gain and maintain market access
- sustain Australia's high quality food supply
- support long-term sustainable production practices.

PHA has commenced development of a revised ten-year NPBS to build on the achievements of the 2010–20 NPBS and provide continued benefits for the national plant biosecurity system. Work on the revised 2021–31 NPBS is being informed by development of a new preparedness strategy and updated diagnostic and surveillance strategies. It is planned that the revised NPBS will be completed by the end of 2021.

Table 1. Key strategies that form the basis of the NPBS (2010–20)

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 plant 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, 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 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' Meeting (AMM) in achieving its objectives.

National Biosecurity Committee

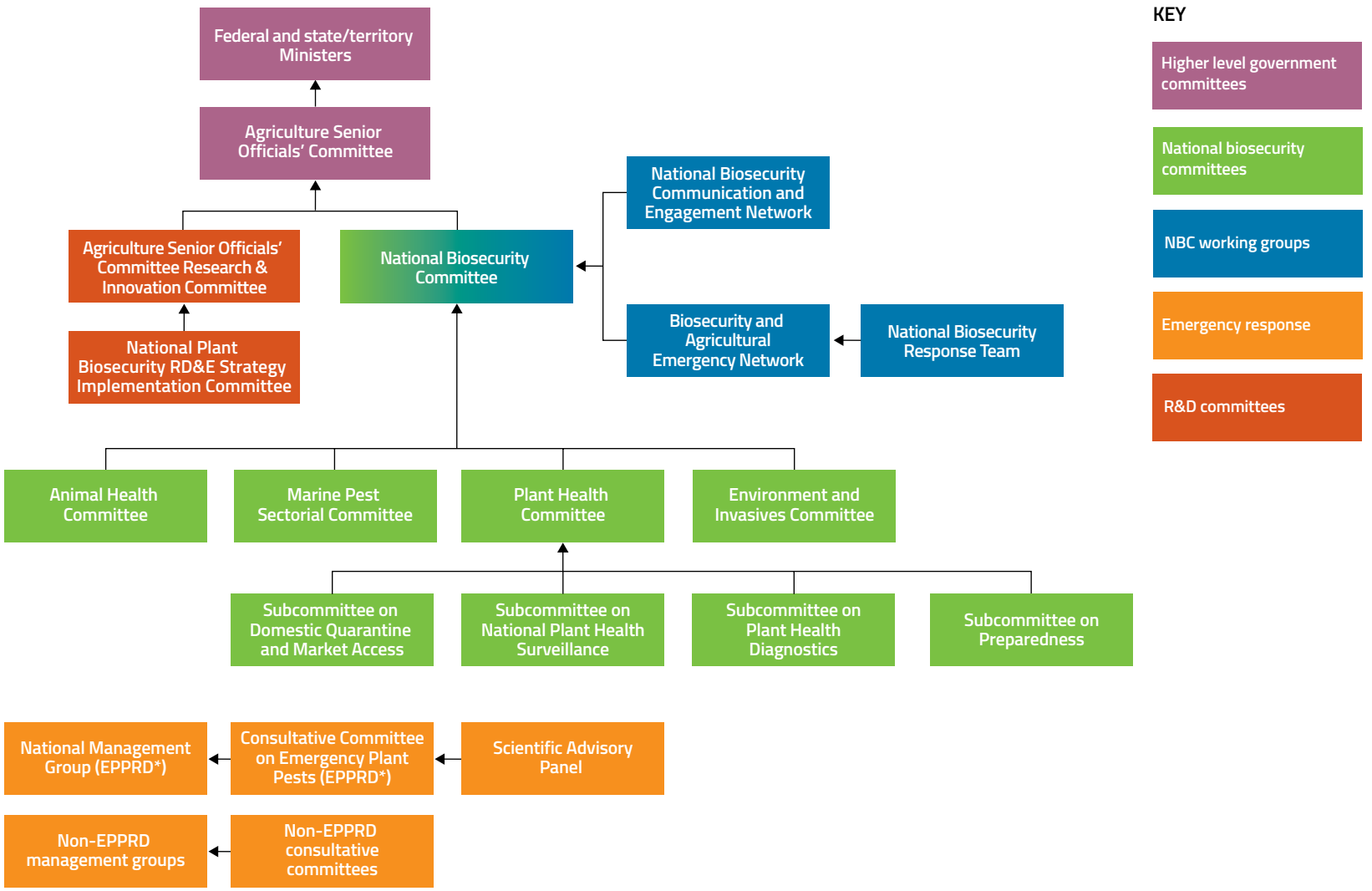
The National Biosecurity Committee (NBC) is responsible for managing a national, strategic approach to biosecurity issues and threats relating to plant and animal pests and diseases, marine and aquatic pests, and the impact of these on agriculture production, the environment, community wellbeing and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

A core objective of the NBC is to promote cooperation, coordination, consistency and synergies 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 NBC was established through the IGAB and is chaired by the Secretary of the Australian Government Department of Agriculture, Water and the Environment (DAWE), or their delegate. Membership of the NBC comprises senior officials from the Australian, state and territory primary industry and/or environment departments, as well as the New Zealand Government. PHA, Animal Health Australia (AHA), and the Australian Local Government Association are observers.

The NBC is supported by four sectoral subcommittees, comprising officers from the Australian, state and territory governments: the Animal Health Committee, Plant Health Committee, Environment and Invasives Committee, and Marine Pest Sectoral Committee.

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



*Emergency Plant Pest Response Deed (EPPRD)

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. PHCs 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 NPBS and the IGAB with respect to plant health.

Andrew Bishop, Chief Plant Protection Officer (TAS), was chair of PHC until November 2020, when Dr Rosa Crnov, Chief Plant Health Manager (VIC), commenced a two-year term as chair.

During 2020, PHC continued the implementation of the NPBS, using the document as one of the main guiding principles when determining work area priorities. PHC also continued to progress various lines of work to support and maintain trade and market access, both domestically and internationally.

In 2020, the PHC Plant Biosecurity Preparedness Working Group was formed. This working group aims to improve priority plant pest and system preparedness through national coordination of government preparedness activities.

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. The EIC provides a national forum for identifying and resolving national priorities for freshwater aquatic and terrestrial invasive species as well as other species where there is an environmental or community biosecurity impact, that are not within the scope of another NBC subcommittee.

Membership of the EIC comprises representatives from the DAWE and state and territory primary industry and environment departments. Jurisdictions may have up to two representatives and the EIC chair rotates every two years. Dr John Tracey, the Deputy Director General of the Department of Primary Industries (NSW), is the chair for 2020–22.

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, and the Centre for Invasive Species Solutions are observers on the committee.

The EIC is also advised by a community sector Environmental Biosecurity Advisory Group, which includes the Invasive Species Council, the Centre of Excellence for Biosecurity Risk Analysis, WWF Australia, Bush Heritage Australia, Natural Resource Management Regions Australia, Landcare, EcoTourism Australia, Ecological Society of Australia, Council of Australasian Weed Societies, the Indigenous Advisory Committee, NAILSMA 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 and the National Fruit Fly Council amongst others, such as biosecurity reference groups for each industry.

Table 2. Plant, honey bee and environmental biosecurity legislation across Australia

Jurisdiction	Administering authority	Legislation
Commonwealth	Department of Agriculture, Water and the Environment	▪ *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 (Exposed Conveyances – Exceptions from Biosecurity Control) Determination 2016* ▪ Biosecurity Regulation 2016 ▪ Biosecurity (Prohibited and Conditionally Non-prohibited Goods) Determination 2016 ▪ *Environment Protection and Biodiversity Conservation Act 1999*** ▪ Environment Protection and Biodiversity Conservation Regulations 2000
Australian Capital Territory	Environment Planning and Sustainable Development Directorate	▪ *Animal Diseases Act 2005* ▪ *Plant Disease Act 2002* ▪ *Pest Plants and Animals Act 2005*
New South Wales	Department of Primary Industries	▪ *Biosecurity Act 2015* ▪ Biosecurity Regulation 2017 ▪ Biosecurity Order (Permitted Activities) 2019 and other supporting legislation such as Control Orders
Northern Territory	Department of Industry, Tourism and Trade	▪ *Livestock Act 2008* ▪ Livestock Regulations 2009 ▪ *Plant Health Act 2008* ▪ Plant Health Regulations 2011
Queensland	Department of Agriculture and Fisheries	▪ *Biosecurity Act 2014* ▪ Biosecurity Regulations 2016
South Australia	Department of Primary Industries and Regions	▪ *Livestock Act 2007* ▪ Livestock Regulations 2013 ▪ *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	▪ *Livestock Act 2007* ▪ Livestock Regulations 2013 ▪ *Plant Health Act 2009* ▪ Plant Health Regulations 2009
Western Australia	Department of Primary Industries and Regional Development	▪ *Biosecurity and Agricultural Management Act 2007* ▪ Biosecurity and Agriculture Management Regulations 2013 ▪ Biosecurity and Agriculture (Identification and Movement of Stock and Apiaries) Regulations 2013 ▪ Biosecurity and Agriculture Management (Quality Assurance and Accreditation) Regulations 2013 ▪ Biosecurity and Agriculture Management (Agriculture Standards) Regulations 2013 ▪ Agriculture and Related Resources Protection (European House Borer) Regulations 2006 ▪ *Exotic Diseases of Animals Act 1993*

*This legislation impacts any kind of goods that enter Australia on an exposed conveyance, and is in itself, not specific to bee or plant biosecurity, but rather goes towards when a conveyance becomes subject to biosecurity control.

**The *EPBC Act 1999* aims to protect the environment and conserve biodivesity. Biosecurity contributes to achieving these.

BIOSECURITY LEGISLATION

Australia's biosecurity system operates under Commonwealth, state and territory legislation administered by the respective government agencies. Plant, honey bee and environmental (where applicable) biosecurity legislation, as at 31 December 2020, is listed in Table 2.

The DAWE administers a range of Commonwealth legislation to manage Australia's biosecurity system, manage imports and regulate export certification of agriculture, fish and forest products. The department also carries the responsibility for monitoring compliance with import and export legislation.

There is also legislation covering the collection of primary industry levies to cover the costs of biosecurity activities, reporting of suspicious pests and biosecurity incident responses.

The *Biosecurity Act 2019* (Tasmania) received Royal Assent on 26 August 2019, aligning with the *Biosecurity Act 2014* (Queensland), and the *Biosecurity Act 2015* (New South Wales), 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. Some of the other state and territory governments have indicated that they will also formalise this responsibility in legislation in the future.

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 38 plant industry peak bodies (as at 31 December 2020). PHA is the custodian of the EPPRD which came into effect in October 2005. More information about the EPPRD and emergency responses can be found in Chapter 6.

National Environmental Biosecurity Response Agreement

The National Environmental Biosecurity Response Agreement (NEBRA) establishes national emergency response arrangements for responding to newly detected pests and diseases that primarily impact the environment or social amenity. The agreement was signed by the Australian, state and territory governments in January 2012. The DAWE is the custodian of the NEBRA. A requirement of the NEBRA is that the agreement is reviewed within five years of commencement. Public consultation on a draft revised NEBRA closed in July 2019, however a final approved version was not available as of 31 December 2020.

PLANT BIOSECURITY STATUTORY LEVIES

The DAWE collects, administers and disburses agricultural levies and charges on behalf of Australia's primary industries.[19]

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.

Levy and charge revenue can be directed to biosecurity preparedness and emergency plant pest and animal disease responses, residue testing, marketing and research and development. It is the decision of a primary industry to determine the proportion of how a levy or charge is directed to each of these activities.[20]

Plant biosecurity levies, imposed under the *Plant Health Australia* (*Plant Industries*) *Funding Act 2002,* include the PHA levy and the Emergency Plant Pest Response (EPPR) levy which can be used 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) (as defined by the EPPRD). This includes meeting their financial obligations for 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.

19 Australian Government Department of Agriculture, Water and the Environment. Levies and charges. Accessed online 17 February 2021 https://www.agriculture.gov.au/ag-farm-food/levies

20 Australian Government Department of Agriculture, Water and the Environment. Levies and charges. Accessed online 17 February 2021 https://www.agriculture.gov.au/ag-farm-food/levies

Government roles

THE AUSTRALIAN GOVERNMENT

Protecting Australia's world-class biosecurity system and our enviable status as a pest and disease-free nation continues to be a major priority for the government. The Australian Government has committed around $873 million for biosecurity and export programs in 2020–21, an increase of $243 million since 2014–15.

Under national legislation, the Australian Government has responsibility for the bulk of biosecurity activities pre-border and at the border, such as 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. These activities benefit not only our plant industries, but also our unique environment and way of life.

As well as regulating imports, the Australian Government's biosecurity activities play a key role in supporting 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 plays a leading role in developing and implementing international standards that aim to prevent the spread of plant pests. Under the Agricultural Competitiveness White Paper, Stronger Farmers, Stronger Economy,[21] 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.

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

Department of Agriculture, Water and the Environment

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, Water and the Environment (DAWE) was formed in 2020 and 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.

DAWE 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 and implementation 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. DAWE's overseas officers play a key role in facilitating this process. The outcome of a 2020 review of the overseas network is available on the DAWE website.[22]

Within the department, Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) provides current scientific and economic advice to decision makers to support the plant biosecurity system. DAWE also contributes to the development of national policies on invasive pests, weeds and diseases that cause harm to the environment.

22 Department of Agriculture, Water and the Environment. Our agriculture counsellors. Accessed online 15 July 2021 www.agriculture.gov.au/market-access-trade/overseas-network

The *Biosecurity Act 2015* (Commonwealth) establishes that a biosecurity risk includes diseases or pests that can cause harm to the environment, including invasive pests. Complementing this, the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) is used to establish the list of live animal specimens considered suitable for live import into Australia, known as the Live Import List. While imports of live plants are managed separately by the DAWE, live animal imports can also impact on plant health and the natural environment. The import of live plants and animals should not be inconsistent with the *Biosecurity Act 2015* (Cwlth).

DAWE is responsible for ensuring that Australia complies with its obligations under the Convention on Biological Diversity and its Aichi Targets and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), manages permits for the import of CITES listed species (plants or animals), and works with the Australian Border Force to implement the conventions.

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, 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 brokers partnerships with public and private research institutions to improve the productivity and sustainability of agricultural systems and the resilience of food systems in the Indo-Pacific region.

Department of Home Affairs and the Australian Border Force

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, DAWE and the Department of Defence to facilitate the movement of goods and people across the Australian border. When the Australian Border Force detects unlawful importation of wildlife and exportation of Australian wildlife, it refers them to DAWE for investigation.

The Inspector-General of Biosecurity

igb.gov.au

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 (IGB) position was established to enhance the integrity of Australia's biosecurity systems through independent evaluation of the performance of these programs pre-border and at the border.

The position is independent of DAWE and its Minister. However, the Inspector-General may:

- consider requests for review(s)
- review the performance of functions and the exercise of powers by the Director of Biosecurity (who is also the Secretary of DAWE)
- make recommendations for improvement to the overall system.

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

On 25 July 2019, the Minister appointed Mr Rob Delane as the IGB to independently evaluate and verify the performance of DAWE's biosecurity risk management measures and systems.

A review program – set annually in consultation with the Minister for Agriculture and the Director of Biosecurity – is published on the website. In 2019–20, the Inspectors-General completed and progressed the following reviews:

1. Adequacy of preventative border measures to mitigate the risk of African swine fever (23 March 2020).
2. Biosecurity risk management of international express airfreight pathway for non-commercial consignments (3 July 2020).
3. Confidence testing for at border delivery of critical biosecurity functions (in progress).
4. Adequacy of the department's operational model to effectively mitigate biosecurity risks pre-border and at the border in evolving risk and business environments (in progress).

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.

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 biosecurity operations and the relevant legislation within their borders.

Each state and territory has a different approach to their 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 (see page 198).

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 and national freedom from the pest or disease can be re-established.

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 Emergency Plant Pest Response Deed (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, combined with regular plant surveillance activities to check for exotic pests (like fruit flies, gypsy moths and bee pests) around the airport will help address the increased biosecurity risks presented by international flights to Canberra Airport.

There have been several major plant health incidents in the ACT in 2020. The ACT in collaboration with DAWE, NSW Department of Primary Industries and other jurisdictions will be undertaking ongoing surveillance as part of national response plans. Earlier in the year a suspected potato wart report was found to be root knot nematode. The ACT also participated in initial investigations within the ACT where the serpentine leaf miner was suspected as part of the outbreak in NSW.

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 have been 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: Department of Industry, Tourism and Trade (DITT)
industry.nt.gov.au

Plant biosecurity in the Northern Territory (NT) is managed by the Plant Biosecurity Branch, within NT DITT's Biosecurity and Animal Welfare Branch. 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 half of this value ($278 million in 2018), with a significant proportion of that being derived from production of iconic NT produce such as mangoes and melons. Other markets offer growth opportunities. To protect this, the environment and social amenity, the Plant Biosecurity Unit 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.

In 2018, citrus canker was detected in the NT. The NT Government is in the process of eradicating this pest under the National Citrus Canker Eradication Program and working towards declaring proof of freedom from citrus canker at the end of 2020.

Fall armyworm were detected in agricultural areas around the NT in March 2020. The NT government continues to work closely with other jurisdictions, industry groups and communities to manage this pest.

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. A major review of the Plant Health Regulations 2011 was undertaken during 2020. The review effectively contemporised the regulations, and sought to clarify a number of regulations to remove potential ambiguities in their interpretation.

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 QLD's plant industries, environment and communities; facilitating market access for QLD'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 QLD. 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.

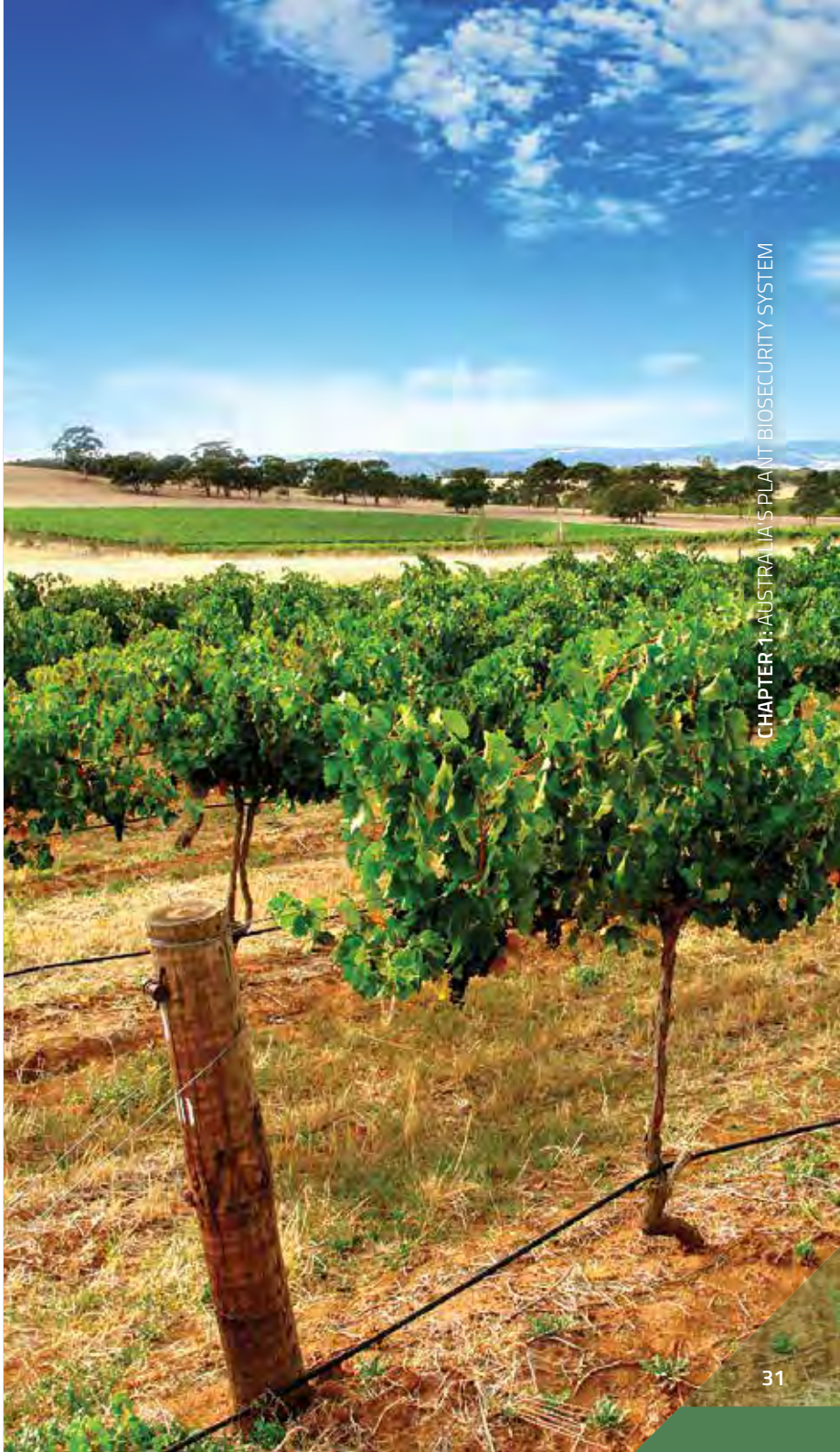
Currently the National Sterile Insect Technology Facility in Port Augusta produces 20 million sterile Queensland fruit flies per week for supply to Lindsay Island and Cobram in VIC, and Hillston in NSW, as well for eradication responses as required nationally, such as is in Perth.

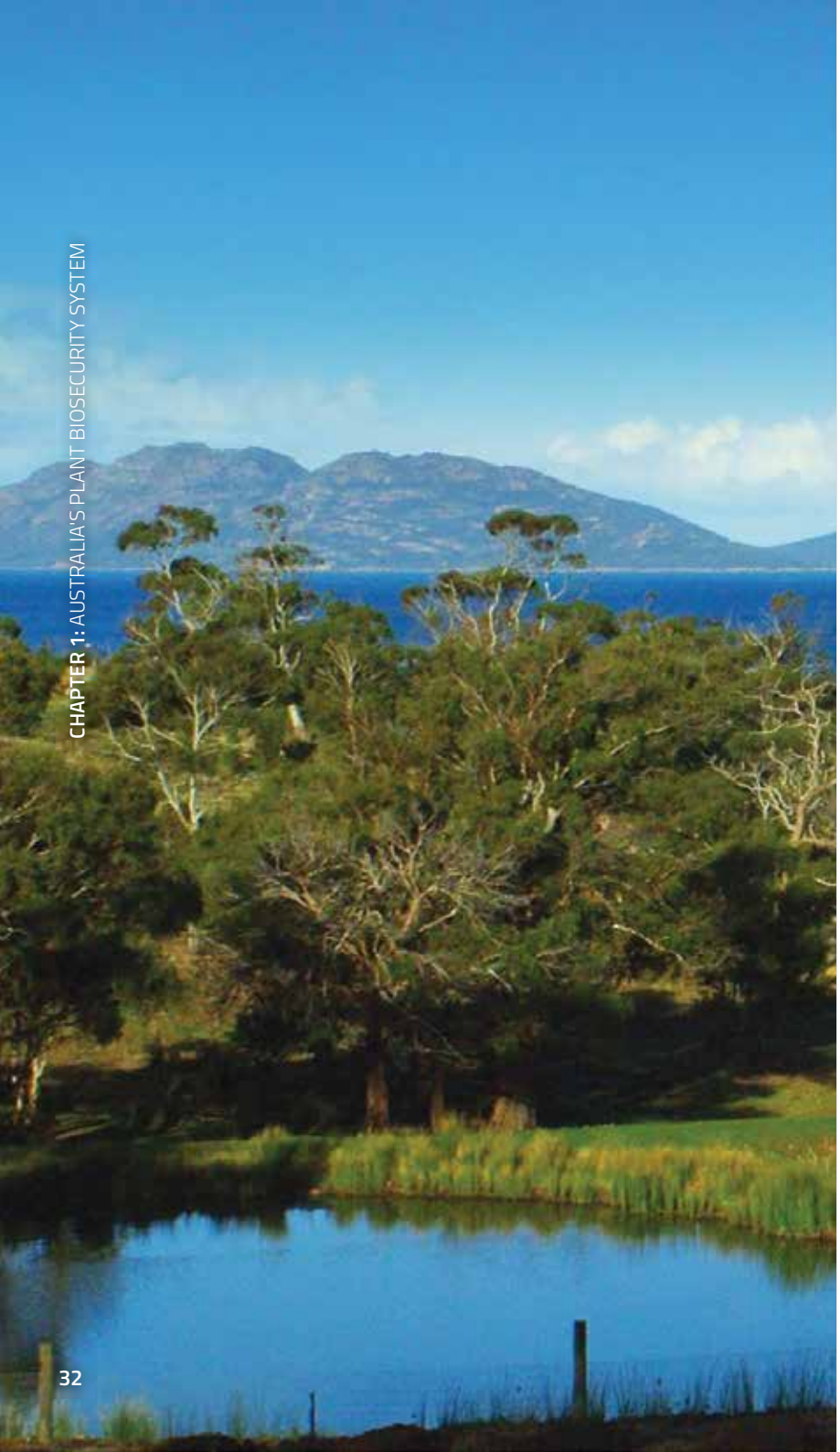
The South Australian Research and Development Institute (SARDI) is the principal research institute and provides Biosecurity SA with plant diagnostic, pathology and entomology capacity and advice.

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 for South Australia 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 the TAS biosecurity system in the development of plant biosecurity policy and the delivery of plant health diagnostic, market access, surveillance, and associated 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 TAS'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 Tasmanian Import Risk Analysis Framework.

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

TAS'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: 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 2020, WA responded to several biosecurity incidents and increased surveillance and preparedness activities to strengthen readiness for future incursions.

- Fall armyworm (FAW) was detected in the state in February 2020. A network of pheromone traps were initially established in the Kimberley, Pilbara and Gascoyne district. When FAW was detected in the northern grain belt outside of Geraldton, the surveillance network was expanded to include the wider grain belt of the south-west of the state.
- Russian wheat aphid was detected in August 2020 on properties along the south coast of the state. Delimiting surveillance activity was undertaken and, while it was not widespread, it was not eradicable.
- Queensland fruit fly was detected in Dalkeith through DPIRD's permanent grid of approximately 2,000 surveillance lure traps located across the Perth metropolitan area, triggering an incident on 26 March 2020. The response expanded to cover an area of 2,049 hectares and more than 13,500 premises, with over 300 personnel working on the incident at the height of the response. An additional 600 surveillance lure traps, 1,250 biolure traps and 13,000 bait and kill traps were deployed, which supplemented bait spraying, the primary eradication tool. Sterile Queensland fruit fly were released from December 2019 to January 2020.
- The Carnarvon Area Wide Freedom surveillance program of trapping at 100 sites concluded in June 2020. There were no detections of targeted pests, including tomato potato psyllid, glassy winged sharpshooter, exotic fruit flies, Asian citrus psyllid, brown marmorated stink bug, invasive ants, and vectors of plant diseases such as thrips, leaf hoppers and plant hoppers.
- The annual WA Biosecurity Blitz event was conducted from 19 October to 16 November 2020 and promoted the International Year of Plant Health 2020. The blitz is a citizen science project, aimed at improving community engagement in science and building an understanding that biosecurity is a shared responsibility.

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 58, as at 31 December 2020. Table 3 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 collaborate 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.

Table 3. 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	Horticulture Innovation Australia	Victorian Farmers' Federation
Cotton Research and Development Corporation	Northern Territory Farmers' Association	Vinehealth Australia
CSIRO	Protected Cropping Australia	Wine Australia
Grains Research and Development Corporation	Sugar Research Australia	

**Formerly Nursery and Garden Industry Australia*

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 2 and 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.

20 years of improving national biosecurity

Established in 2000, with a long-term goal of developing and maintaining an internationally outstanding plant health management system, Plant Health Australia (PHA) is the national plant biosecurity coordinator of the government–industry partnership bringing together plant industry stakeholders to share biosecurity responsibility.

Under the first Chair, Andrew Inglis, PHA identified national priorities in plant health management, reviewed existing systems, structures and programs, consulted members and established operating procedures.

2001 brought:

- consolidation of past work
- projects to resolve gaps and improve coordination and consistency of the national system
- a new website
- the launch of the Australian Plant Pest Database (APPD) with 46,000 pest records.

The introduction of the *Plant Health Australia (Plant Industries) Funding Act 2002* gave plant industry members the choice of using a levy mechanism to meet their yearly membership subscriptions.

In the following three years, PHA progressed the ratification of the world-first Emergency Plant Pest Response Deed (EPPRD), a more effective and transparent means to manage and reduce the cost of Emergency Plant Pests, and a crucial component of a world-class plant health system based on partnerships. EPPRD ratification was achieved in 2005 with the Australian Government, four state governments and 12 plant industry members as signatories. Another milestone was the production of PLANTPLAN, the first nationally consistent emergency response plan for Emergency Plant Pests.

The first decade of the millennium was characterised by tough conditions for producers, with the first application of the EPPRD in the first nationally funded response and successful plant pest eradication of Khapra beetle in WA.

In the 2010s, PHA focused on mitigating risks of post-border biosecurity and reducing pest impacts through improved national response capability.

The next decade saw increased EPPRD activity and the launch of the National Plant Biosecurity Strategy – the first national blueprint for building a better, coordinated national plant biosecurity system capable of rising to the expected challenges in the next 10 years.

PHA entered 2020 with 59 members, 48 EPPRD signatories, 35 staff and new CEO, Sarah Corcoran. Under her leadership PHA is developing a new five-year strategic plan, with a mission to deliver on priorities for plant health, manage change and provide the foundation for long-term agricultural, economic and biosecurity outcomes for 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 3).

Industry bodies consider biosecurity to be important because 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 (38 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
- 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 DAWE. 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

Tomato potato psyllid (Bactericera cockerelli) nymph. Image courtesy of Pia Scanlon, WA DPIRD

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.[23]

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 as 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 help increase the chance of detecting, 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.

23 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 list of National Priority Plant Pests[24] developed by the Department of Agriculture, Water and the Environment (DAWE) includes Australia's most serious exotic plant pest threats. The National Priority Plant Pests shown in Table 4 were reviewed by the Plant Health Committee and endorsed in August 2019, with the top ten shown in Table 5.

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 Pests enable 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 incursions of priority pests.

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.

24 Plant pests and diseases, Department of Agriculture, Water and the Environment (2019). Accessed online 10 March 2021 www.agriculture.gov.au/pests-diseases-weeds/plant

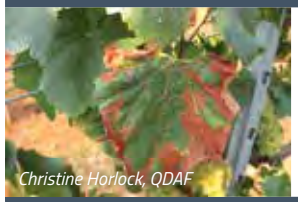
Table 4. Australia's National Priority Plant Pests

National priority plant pests (2019)			
1	*Xylella fastidiosa* and exotic vectors	22	Panama disease 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. (sudden oak death)	35	Grape phylloxera
15	Ug99 wheat stem rust	36	Exotic stem borers of sugarcane and cereals (*Chilo* spp.)
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 5. 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, containers or machinery.

3. Spotted wing drosophila


John Davis

Spotted wing drosophila (SWD, *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 than 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 DAWE is developing national action plans for the National Priority Plant Pests. The plans identify what's needed 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 DAWE website.

To date, two plans have been finalised:

The National Invasive Ant Biosecurity Plan 2018–28[25] 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[26] 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.

NATIONAL PRIORITY LIST OF EXOTIC ENVIRONMENTAL PESTS, WEEDS AND DISEASES

In November 2020, DAWE released the National Priority List of Exotic Environmental Pests, Weeds and Diseases (EEPL)[27] after it was endorsed by the National Biosecurity Committee.

The EEPL identifies exotic pests, weeds and diseases that pose the highest risk to our environment, public spaces, heritage and way of life. The list will be used to prioritise and enable activities that help prevent their entry, establishment and spread.

Development of the list was led by the Australian Bureau of Agricultural and Resource Economics and Sciences through an extensive national multi-stage expert elucidation and public consultation process.

The EEPL identifies 168 exotic pests, weeds and diseases spread across eight thematic groups: aquatic animal diseases, freshwater invertebrates, marine pests, native animal diseases, plant pathogens, terrestrial invertebrates, vertebrates, and weeds and freshwater algae. A subset of 42 species that pose the greatest risk to Australia's environmental biosecurity includes five or six high-risk species from each of the eight thematic groups.

There are a number of species that are also found on the list of National Priority Plant Pests, such as gypsy moths, invasive ants and Xylella. Many of the species found on both lists have common pathways (e.g. hitch-hiker pests), controls, or similar host species, including where the natural environment may provide a reservoir of production pests, or vice versa.
(Continued page 44)

25 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

26 Plant Health Committee (2019). National Xylella Action Plan 2019–29. Accessed online 12 February 2020 www.agriculture.gov.au/sites/default/files/documents/National-Thursday-Action-Plan-2019-2029.pdf

27 Department of Agriculture, Water and the Environment. The National Priority List of Exotic Environmental Pests, Weeds and Diseases. Accessed online 11 June 2021 https://www.agriculture.gov.au/biosecurity/environmental/priority-list

Improving preparedness for spotted wing drosophila

Spotted wing drosophila (SWD, *Drosophila suzukii*) is an exotic pest whose geographical distribution and economic impact overseas has increased significantly in recent years.

In Australia, SWD has a wide potential host range and is listed as a National Priority Plant Pest and a High Priority Pest of pome fruit, berries, blueberries, cherries, dried fruit, summerfruit, table grapes and wine grapes. Unlike most Drosophila species, the females can infest ripening fruit before harvest, impacting fruit quality, production and market access.

To prepare for a possible incursion in Australia, a review of potential entry pathways, establishment potential, impact, surveillance techniques and control measures was done. Funded by Hort Innovation and conducted by PHA, Cesar Australia and Plant and Food Research New Zealand, the review looked at management practices and impacts overseas, to help prepare management plans and assess whether emergency permits for chemicals can be put in place. The assessment of pathways and establishment potential indicated that regions across southern Australia, much of eastern Australia and southern WA have climates that would support populations and enable their rapid spread.

Another part of the same project was the development and implementation of a cross commodity contingency plan, including a communication and awareness program for affected industries. A preparedness guide and a preparedness plan to help determine how to initially respond to a detection in Australia, along with a collection of educational and outreach resources, were also developed and are available in a downloadable SWD extension pack. The resources are available from **horticulture.com.au/growers/help-your-business-grow/research-reports-publications-fact-sheets-and-more/mt17005**

Spotted wing drosophila female (left) and male (right). Image courtesy of Dr Elia Pirtle, Cesar Australia

Defending against a new pest, fall armyworm

Since it was first detected in northern parts of QLD, NT and WA in February 2020, fall armyworm (*Spodoptera frugiperda*) has established in these locations and moved into parts of southern Australia.

As a new pest, little was known about fall armyworm, with a heavy reliance on information and experience available from overseas. In unmanaged situations overseas, fall armyworm has been known to decimate crops, specifically maize, sweetcorn and sorghum, and has been observed on 350 different plant species with crops from 11 local industries potentially at risk.

This threat prompted concerted efforts to research its likely effects in Australia and develop resources to guide management of the pest. Throughout 2020, PHA sourced and collated international knowledge of the pest to produce a new fall armyworm continuity guide and record a series of podcasts to help industry manage the invasive moth species.

The podcast series, funded by Plant Biosecurity Research Initiative (PBRI) members and PHA, features growers, agronomists and leading Australian researchers sharing their experiences and delves into the biology and behaviour of the pest. The podcasts are available on **pbri.com.au**

To bolster local information, identify gaps in our understanding of how fall armyworm will behave in Australia and how best to manage it, a National Fall Armyworm Forum was convened. Led by PHA, and supported by the Australian Government, the forum comprising representatives from government, industry and research sectors, assisted with the development of a national management plan.

The Fall Armyworm Continuity Plan for the Australian Grains Industry – a Grains Research and Development Corporation (GRDC) investment initiative led by Cesar Australia with project partners PHA, Centre for Agriculture and Bioscience International, and the Queensland Department of Agriculture and Fisheries – is a reference guide on the pest and provides a basis for designing area wide management plans, crop specific management manuals and strategies to avoid chemical resistance. The guide is available from **planthealthaustralia.com.au/fall-armyworm**

(Continued from page 43)

The EEPL should not be considered as an exhaustive list of exotic environmental pests, weeds or diseases. This is due in part to there being some gaps in information and data on the potential risks or impacts of a species, both in their native environment and their estimated impact in Australia. Information gaps are compounded when estimating impacts in Australia due to the uniqueness of our native flora and fauna.

The Chief Environmental Biosecurity Officer is the custodian of the EEPL, and will administer its use and manage reviews, with oversight provided by the Environment and Invasives Committee. Reviews and amendments to the list will involve consultation with Plant Health Committee as required.

An implementation plan for the EEPL is currently being developed in consultation with government, community and industry stakeholders and is expected to be endorsed in the first half of 2021. More information on the EEPL implementation plan is on page 63.

Head lateral view of fall armyworm (Spodoptera frugiperda). Image courtesy of Pia Scanlon, WA DPIRD

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 a specific 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 industry members has developed a biosecurity plan in partnership with governments, and they are listed in Table 6. 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 the likelihood of entry, establishment and spread of each pest, as well as the economic impact if it established in Australia.

Table 6. Current biosecurity plans covering Australia's plant industries

Biosecurity plans		
Apple and Pear BP (Version 3.0)	Honey bee IBP (Version 1.1)	Rice IBP (Version 3.0)
Avocado BP (Version 3.0)	Lychee IBP (Version 1.0)	Sugarcane IBP (Version 3.0)
Banana BP (Version 3.2)	Mango BP (Version 3.1)	Summerfruit BP (Version 2.2)
Berry BP (Version 1.0)	Melon IBP (Version 2.0)	Sweetpotato BP (Version 1.1)
Blueberry BP (Version 1.0)	Nursery IBP (Version 3.0)	Tea Tree BP (Version 1.2)
Cherry BP (Version 3.1)	Olive BP (Version 2.0)	Tomato BP (Version 1.0)
Citrus BP (Version 3.0)	Onion BP (Version 3.1)	Tree nut BP (Version 3.0)
Coffee BP (Version 1.0)	Papaya IBP (Version 1.0)	Truffle BP (Version 1.0)
Cotton BP (Version 3.2)	Passionfruit IBP (Version 1.0)	Vegetable BP (Version 3.1)
Cut flower BP (Version 1.0)	Pineapple BP (Version 2.0)	Viticulture BP (Version 3.1)
Ginger BP (Version 2.2)	Plantation forest IBP (Version 2.0)	
Grains IBP (Version 3.0)	Potato BP (Version 3.1)	

The exotic pests that pose the greatest risk with the largest potential economic impact are deemed to be High Priority Pests. Table 7 lists all of the High Priority Pests identified in the 35 industry specific biosecurity plans developed by PHA. The same pests are also listed in the plant industry profiles throughout Chapter 3.

Unlike the National Priority Plant Pests (page 41), which are determined by the Australian Government and consider risks posed by a pest across multiple industries at a national level, High Priority Pests are industry specific pests. More information about risk assessment to determine High Priority Pests is available from **planthealthaustralia.com.au/biosecurity/risk-mitigation/risk-assessment**

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 RDC(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 2020, a new biosecurity plan was produced for the berry sector (rubus and strawberries), and revised biosecurity plans produced for the avocado, ginger and melon 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.

Image courtesy of Raspberries and Blackberries Australia

Table 7. High Priority Pest threats

Scientific name	Common name	High priority pest of
Abaca bunchy top virus (Babuvirus)	Abaca bunchy top	Banana
Acanthocoris scabrator	Squash bug	Mango
Acarapis woodi	Tracheal mite	Honey bee
Achatina achatina	Giant African snail, giant Ghana snail	Sweetpotato, Vegetable
Acute bee paralysis virus (Cripavirus)	Acute bee paralysis virus, ABPV	Honey bee
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	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	Nut, Truffle
Anthonomus grandis	Boll weevil	Cotton
Anthonomus grandis	Black bean aphid	Potato, Vegetable
Aphis gossypii (exotic strains)	Cotton aphid	Cotton, Potato and Production Nursery
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
Argyrotaenia citrana	Orange tortrix	Viticulture
Aristobia testudo	Lychee longicorn beetle	Lychee
Arthuriomyces peckianus	Orange rust (long-cycled)	Rubus
Ascochyta rabiei (MAT1-1)	Ascochyta blight	Grains
Aspidiella hartii	Yam scale	Ginger
Aulacophora foveicollis	Red pumpkin beetle	Vegetable

Table 7. High Priority Pest threats (continued)

Scientific name	Common name	High priority pest of
Austropuccinia psidii sensu lato (exotic variants) (syn. *Puccinia psidii*)	Myrtle rust, guava rust, eucalyptus rust	Cutflower, Plantation forest, Production nursery, Tea tree
*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
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, 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 melanotus	Fruit fly	Avocado, Mango, Passionfruit
Bactrocera occipitalis	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	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, Production nursery, 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 (Asian strain)	Citrus, Production nursery
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

Dorsal view of female banana lace-wing bug (Stephanitis typica). Image courtesy of Pia Scanlon, WA DPIRD

Table 7. High Priority Pest threats (continued)

Scientific name	Common name	High priority pest of
Cephus cinctus	Wheat stem sawfly	Grains
Cephus pygmeus	European wheat stem sawfly	Grains
Ceratitis rosa	Natal fruit fly	Viticulture
Ceratocystis fimbriata sensu lato	Mango sudden decline syndrome, ceratocystis blight	Coffee, Mango
Ceratocystis manginecans	Mango sudden decline syndrome	Mango
Ceratovacuna lanigera	Sugarcane woolly aphid	Sugarcane
Cercosporella rubi	Rosette	Rubus
Ceutorhynchus assimilis	Cabbage seedpod weevil	Grains
Ceutorhynchus napi	Rape stem weevil	Grains
Ceutorhynchus pallidactylus	Cabbage stem weevil	Grains
Cherry leaf roll virus (Nepovirus) (exotic strains)	Blackline	Rubus
Chickpea chlorotic dwarf virus (Mastrevirus) (syn. *Chickpea chlorotic dwarf virus* (Geminivirus)	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, C. halaris, Acrosternum hilare, A. hilaris, Nezara hilaris, Pentatoma hilaris*)	Green stink bug	Nut
Chlumetia transversa	Mango shoot borer	Mango
Chromatomyia horticola	Pea leafminer	Cutflower
Chrysoporthe austroafricana	Eucalyptus canker disease	Plantation forest
Citripestis sagittiferella	Citrus fruit borer	Citrus
Citrus leprosis virus (Cilevirus)	Citrus leprosis disease	Citrus
Citrus tristeza virus (Closterovirus) (mandarin stem-pitting strain)	Mandarin stem pitting	Citrus
Cladosporium allii (syn. *Heterosporium allii, Cladosporium allii-cepae, Mycosphaerella allii*)	Leaf spot	Onion
Colletotrichum higginsianum	Anthracnose	Vegetable
Colletotrichum kahawae subsp. *kahawai* (*Colletotrichum 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	Nut
Cryptosporella umbrina	Brown rose canker	Cutflower
Ctenopseustis herana	Brown headed leafroller	Avocado
Ctenopseustis obliquana	Brown headed leafroller	Avocado
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 amaramanjarae	Mango gall midge	Mango
Dasineura mali	Apple leaf curling midge	Apple and Pear
Deanolis sublimbalis (syn. *Noorda albizonalis*)	Red banded mango caterpillar	Mango
Deformed wing virus (Iflavirus)	Deformed wing virus	Honey bee

Table 7. High Priority Pest threats (continued)

Scientific name	Common name	High priority pest of
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, Production nursery
Diaporthe helianthi (syn. *Phomopsis 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. (onion infecting exotic pathovars) (syn. *Erwinia chrysanthemi*)	Bacterial soft rot	Onion
Dickeya spp. (pineapple infecting strains) (syn. *Erwinia chrysanthemi*)	Bacterial fruit collapse, bacterial heart rot	Pineapple
Ditylenchus destructor	Potato tuber nematode	Sweetpotato
*Diuraphis noxia**	Russian wheat aphid	Grains
Drosophila suzukii	Spotted wing drosophila	Apple and Pear, Blueberry, Cherry, Rubus, Summerfruit, Viticulture
Dryocosmus kuriphilus	Oriental chestnut gall wasp	Nut
Dysaphis plantaginea	Rosy apple aphid	Apple and Pear
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	Production nursery
Elasmopalpus lignosellus	Lesser corn stalk borer	Sweetpotato
Eldana saccharina	African sugarcane stalkborer	Sugarcane
Elsinoë perseae (syn. *Sphaceloma perseae*)	Avocado scab	Avocado
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 pv. *gypsophilae*	Bacterial gall	Cutflower
Erwinia papayae	Bacterial crown rot	Papaya
Erwinia spp.	Mushy canker	Papaya
Erwinia tracheiphila	Cucurbit bacterial wilt	Melon
Eumerus strigatus	Lesser bulb fly	Vegetable
Eumetopina flavipes	Sugarcane leafhopper (vector of Ramu stunt disease)	Sugarcane
Eurygaster integriceps	Sunn pest	Grains
Euscepes postfasciatus (syn. *Euscepes batatae*)	West Indian sweetpotato weevil	Sweetpotato
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

Table 7. High Priority Pest threats (continued)

Scientific name	Common name	High priority pest of
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. *lagenariae*	Fusarium root and stem rot of melons	Melon
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
Fusarium virguliforme	Sudden death syndrome	Grains
Fusarium xylarioides f. sp. *Abyssiniae, F. xylarioides* f. sp. *canephorae*	Coffee wilt	Coffee
F*usicladium effusum* (syn. *Cladosproium caryigenum*)	Pecan scab	Nut
Globodera pallida	Pale potato cyst nematode	Potato
Globodera rostochiensis (*pathotypes* RO2, RO3, RO4 and RO5)	Golden potato cyst nematode	Potato
Grapevine red blotch-associated virus (Geminivirus) (with vector)	Grapevine red blotch associated virus, GRBaV	Viticulture
Grassy shoot phytoplasma	Grassy shoot	Sugarcane
Groundnut bud necrosis virus (Tospovirus)	Bud necrosis disease	Grains, Melon, 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, Nut, Rubus, Summerfruit, Truffle, Vegetable, Viticulture
Haplothrips chinensis	Chinese thrips	Cutflower
Harpophora maydis (syn. *Acremonium maydis, Cephalosporium maydis*)	Late wilt	Grains, Vegetable
Heilipus lauri	Large seed weevil, avocado seed weevil	Avocado
Helicoverpa armigera (carrying Bt resistance alleles)	Cotton bollworm	Cotton
Hemileia vastatrix	Coffee leaf rust	Coffee
Heterocrossa rubophaga (syn. *Carposina rubophaga, C. adreptella*)	Raspberry bud moth	Rubus
Heterodera carotae	Carrot cyst nematode	Vegetable
Heterodera ciceri	Chickpea cyst nematode	Grains, Vegetable
Heterodera filipjevi	Cereal cyst nematode	Grains
Heterodera glycines	Soybean cyst nematode	Grains
Heterodera latipons	Mediterranean cereal cyst nematode	Grains
Heterodera sorghi	Sorghum cyst nematode	Grains
Homalodisca vitripennis (syn. *Homalodisca coagulata*)	Glassy winged sharpshooter	Citrus, Production nursery, Viticulture
Homalodisca vitripennis (with *Xylella fastidiosa*)	Glassy winged sharpshooter	Blueberry, Cherry, Summerfruit, Viticulture
Homoeosoma electellum	Sunflower moth	Grains
Hoplostoma fuligineus	Large hive beetle	Honey bee
Hylesia nigricans	Burning moth	Plantation forest
Hypocryphalus dilutus	Ambrosia beetle	Mango
Hypothenemus hampei	Coffee berry borer	Coffee
Hypothenemus obscurus	Tropical nut borer	Nut
Idioscopus nagpurensis	Mango leafhopper	Mango
Ips typographus	Spruce bark beetle	Plantation forest

Table 7. High Priority Pest threats (continued)

Scientific name	Common name	High priority pest of
Kyuri green mottle mosaic virus (Tobamovirus)	Tobamovirus group, KGMMV	Melon
Leptinotarsa decemlineata	Colorado potato beetle	Potato
Leptoglossus clypealis	Leaf footed bug	Nut
Leptoglossus occidentalis	Western conifer seed bug	Nut
Leptoglossus zonatus	Western leaf footed bug	Nut
Lettuce infectious yellows virus (Crinivirus) and other exotic whitefly transmitted viruses	Lettuce infectious yellows virus	Production nursery
Liriomyza bryoniae	Tomato leaf miner	Melon, Tomato, Vegetable
Liriomyza congesta	Pea leaf miner	Cutflower
Liriomyza huidobrensis	Serpentine leaf miner	Cutflower, Production nursery, Potato, Tomato, Vegetable
Liriomyza sativae	Vegetable leaf miner, American leaf miner	Melon, Onion, Potato, Tomato, Vegetable
Liriomyza trifolii	American serpentine leaf miner	Cutflower, Potato, Tomato, Vegetable
Lissachatina fulica (syn. *Achatina fulica*)	Giant African snail	Banana, Production nursery, Sweetpotato, Tomato, Vegetable
Lissorhoptrus oryzophilus	Rice water weevil	Rice
Lobesia botrana	European grapevine moth	Viticulture
Lycorma delicatula	Spotted lanternfly	Viticulture
Lygus hesperus	Western plant bug	Cotton, Strawberry, Vegetable
Lygus lineolaris	Tarnished plant bug	Cotton, Production nursery, Strawberry
Lymantria dispar	Asian gypsy moth	Apple and Pear, Nut, Plantation forest, Production nursery, Summerfruit
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. *Meloidogyne mayaguensis*)	Root knot nematode	Ginger, Onion, Potato, Sweetpotato, Vegetable
Meloidogyne naasi	Barley root knot nematode	Vegetable
Melon severe mosaic virus (Tospovirus)	Tospovirus, melon severe mosaic	Melon
Melon yellow spot virus (Tospovirus)	Tospovirus group	Melon
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
Monilinia vaccinii-corymbosi	Mummy berry, cotton ball disease	Blueberry
Monochamus spp. including *M. alternatus, M. galloprovinicialis, M. scutellatus, M. titillator*	Longhorn beetles	Plantation forest
Monosporascus cannonballus	Monosporascus root rot	Melon
Mungbean yellow mosaic virus, mungbean yellow mosaic India virus, dolichos yellow mosaic virus, horsegram yellow mosaic virus (Begomovirus)	Mungbean yellow mosaic virus	Grains
Mycosphaerella eumusae	Eumusae leaf spot	Banana
Nemorimyza maculosa	Chrysanthemum leaf miner	Cutflower
Neonectria ditissima (syn. *Nectria galligena* and *Neonectria galligena*)	European canker	Apple and Pear, Cherry
Nysius huttoni	Wheat bug	Grains
Oligonychus ilicis	Southern red mite	Coffee, Production nursery
Oligonychus perseae	Persea mite	Avocado
Orgyia thyellina	White spotted tussock moth	Plantation forest
Pantoea stewartii	Stewart's wilt of maize	Grains
Paracoccus marginatus	Papaya mealybug	Avocado, Coffee, Papaya

Table 7. High Priority Pest threats (continued)

Scientific name	Common name	High priority pest of
Paradasynus longirostris	Hong Kong stink bug	Lychee
Parasa lepida	Blue striped nettle grub	Mango
Passiflora chlorosis virus (Potyvirus)	Passiflora chlorosis virus	Passionfruit
Passionfruit crinkle virus (Potyvirus)	Passionfruit crinkle virus	Passionfruit
Passionfruit ringspot virus (Potyvirus)	Passionfruit ringspot virus	Passionfruit
Passionfruit severe leaf distortion virus (Begomovirus)	Passionfruit severe leaf distortion virus	Passionfruit
Passionfruit Sri Lankan mottle virus (Potyvirus)	Passionfruit Sri Lankan mottle potyvirus	Passionfruit
Passionfruit vein clearing virus (Rhabdovirus)	Passionfruit vein clearing rhabdovirus	Passionfruit
Passionfruit yellow mosaic virus (Tymovirus)	Passionfruit yellow mosaic virus	Passionfruit
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
Philaenus spumarius (with *Xylella fastidiosa*)	Meadow froghopper, meadow spittle bug	Summerfruit
Phomopsis cucurbitae (syn. *Diaporthe melonis*)	Melon black rot, phomopsis fruit rot	Melon
Phyllosticta spp. (including *P. cavendishii* and *P. sydowiana*)	Banana freckle	Banana
Phytomyza gymnostoma	Allium leaf miner	Vegetable
Phytophthora fragariae var. *fragariae*	Red steele root rot	Strawberry
Phytophthora infestans (A2 mating type and exotic strains of A1 mating type)	Late blight	Potato, Vegetable
Phytophthora mengei	Bark canker	Avocado
Phytophthora pinifolia	Dano foliar del pino	Plantation forest
Phytophthora ramorum	Sudden oak death	Avocado, Blueberry, Cutflower, Nut, Plantation forest, Production nursery, Tea tree, 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	Production nursery, 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	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 comstocki	Comstock's mealybug	Viticulture
Pseudococcus cryptus (syn. *Pseudococcus citriculus*)	Citrus mealybug, citriculus mealybug, cryptic mealybug	Coffee

Table 7. High Priority Pest threats (continued)

Scientific name	Common name	High priority pest of
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	Production nursery
Pseudomonas syringae pv. *syringae, Pantoea agglomerans, Xanthomonas campestris*	Bacterial canker complex, avocado blast complex	Avocado
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 e.g. Ug99)	Stem rust of wheat	Grains
Puccinia mixta	Rust of chives	Onion
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	Avocado
Ralstonia solanacearum phylotype IIB (banana infecting strains)	Moko	Banana
Ralstonia syzygii subsp. *celebesensis* (syn. *Ralstonia solanacearum* race 2, biovar 1)	Blood disease	Banana
Ralstonia syzygii subsp. *indonesiensis* (syn. *Ralstonia solanacearum* race 4, *Pseudomonas solanacearum)*	Bacterial wilt	Potato
Raspberry ringspot virus (Nepovirus)	Raspberry ringspot virus	Rubus, Strawberry
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. *sasakii* (AG1) (teleomorph *Corticium sasakii* (syn. *Thanatephorus cucumeris*))	Banded leaf, 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 (Waikavirus)	Waikavirus, rice tungro spherical virus	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
Spiroplasma citri	Stubborn	Citrus
Spodoptera eridania	Southern armyworm	Cutflower
*Spodoptera frugiperda**	Fall armyworm	Cotton, Cutflower, Melon, Vegetable
Spodoptera littoralis	Cotton leafworm	Cutflower
Stagonospora sacchari	Leaf scorch	Sugarcane
Stenoma catenifer	Seenomid (avocado) moth, avocado fruit borer, 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

Table 7. High Priority Pest threats (continued)

Scientific name	Common name	High priority pest of
Sweet potato chlorotic stunt virus (Crinivirus)	Sweet potato chlorotic stunt virus, SPCSV	Sweetpotato
Sweet potato mild mottle virus (Ipomovirus)**	Mild mottle of sweet potato, SPMMV	Sweetpotato
Sweet potato mild speckling virus (Potyvirus)**	Sweet potato mild speckling virus, SPMSV	Sweetpotato
Teratosphaeria gauchensis	Coniothyrium eucalyptus canker	Plantation forest
Teratosphaeria zuluensis	Coniothyrium eucalyptus canker	Plantation forest
Tetranychus pacificus	Pacific spider mite	Viticulture
Tetranychus piercei	Spider mite	Banana
Thaumatotibia leucotreta (syn. *Cryptophlebia leucotreta*)	False codling moth	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, backberry mosaic virus, red currant mosaic virus	Rubus, Strawberry
Tomicus piniperda	Pine shoot beetle	Plantation forest
Toxotrypana curvicauda	Papaya fly	Mango, Papaya
Trichoplusia ni	Cabbage looper	Vegetable
Trioza erytreae	African citrus psyllid	Citrus
Trogoderma granarium	Khapra beetle	Grains, Nut, Rice, Viticulture
Tropilaelaps clareae	Tropilaelaps mite	Honey bee
Tropilaelaps mercedesae	Tropilaelaps mite	Honey bee
Tuta absoluta	South American tomato moth, tomato leaf miner	Tomato, Vegetable
Unknown	Ramu stunt disease	Sugarcane
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	Honey bee
Varroa jacobsoni	Varroa mite	Honey bee
Veronicella cubensis	Cuban slug	Sweetpotato
Verticillium dahliae (defoliating strain)	Verticillium wilt	Cotton, Nut, Olive
Vespa spp. (exotic species including *V. orientalis, V. velutina, V. crabro*)	Hornets	Honey bee
Watermelon bud necrosis virus (Tospovirus)	Watermelon bud necrosis	Melon, Vegetable
Watermelon green mottle mosaic virus (Tobamovrus)	Tobamovrus	Melon
Watermelon silver melon virus (Tobamovrus)	Tobamovrus	Melon
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 citri subsp. *citri* (syn. *Xanthomonas axonopodis* pv. *citri*)	Citrus canker	Citrus
Xanthomonas citri subsp. *malvacearum* (syn. *X. axonopodis* pv. *malvacearum*)	Bacterial blight, angular leaf spot	Cotton
Xanthomonas fragariae	Strawberry angular leaf spot	Strawberry
Xylella fastidiosa (subspecies not specified)	Pierce's disease, blueberry leaf scorch, olive leaf scorch, olive quick decline, phony peach, plum leaf scald	Blueberry, Cherry, Production nursery, Summerfruit, Viticulture

Table 7. High Priority Pest threats (continued)

Scientific name	Common name	High priority pest of
Xylella fastidiosa subsp. *fastidiosa*	Pierce's disease, blueberry leaf scorch, olive leaf scorch	Coffee, Nut
Xylella fastidiosa subsp. *multiplex*		Nut, Olive
Xylella fastidiosa subsp. *pauca*	Pierce's disease, blueberry leaf scorch, olive quick decline	Citrus, Coffee, Olive
Xylella fastidiosa subsp. *piercei*		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, Vegetable
Zuccchini green mottle mosaic virus (Tobamovirus)	Tobamovirus group, ZGMMV	Melon

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

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 8 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. These contingency plans are located on PHA's website in the Pest Information Document Database at **planthealthaustralia.com.au/pidd**

Table 8. 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 8. 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 8. 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 8. Contingency plans (continued)

Scientific name	Common name	Year	Location of document	Scope
Puccinia psidii	Myrtle rust	2015 (Updated 2020)	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

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

Image courtesy of Madeleine Quirk, AUSVEG

Environmental Biosecurity Webinars: Building connections for better biosecurity

The Environmental Biosecurity Office of DAWE hosted a series of eight webinars between July and December 2020 with over 1,000 participants joining the 90-minute sessions. Each webinar featured presentations by biosecurity experts followed by 30 minutes of facilitated discussion.

Three webinars were dedicated to invasive plant pathogens Phytophthora and myrtle rust, pathogens that have created significant issues for plants growing in man-made and natural environments.

A number of constructive insights, lessons, messages and outcomes emerged from the discussions:

- stories and shared experiences are highly motivating and bring us together
- publicly and freely sharing research results and data is empowering
- there is a need to better understand and draw on Indigenous knowledge and past lessons
- early action and intervention is better and more cost-effective than waiting for the perfect plan
- everyone has an important role in protecting our environment, and those who want to be involved need more support.

Given its success, the Environmental Biosecurity Webinar Series will return in the first half of 2021. For more information, contact the Environmental Biosecurity Office at **acebo@awe.gov.au**

Environmental biosecurity preparedness

Environmental biosecurity supports our long-term mental and physical health, economic prosperity, national identity and underpins our existence on Earth. Caring for ecosystems, land, seas and aquatic environments benefits us all.

Environmental biosecurity often appears to be distinct from agricultural biosecurity, which focuses on pests that could have an economic impact on Australia's agricultural productivity. However, there is a significant overlap in pests, pathways, controls, and host species that affect plants grown for agricultural purposes and those found in the natural environment or that have social amenity in urban, rural and regional spaces. Our unique natural environment and wildlife also support a multi-billion dollar domestic and (pre-Covid-19, international) tourism sector.

Environmental biosecurity can make use of and build on many aspects of the system established for agricultural biosecurity. Environmental biosecurity risk mitigation objectives frequently overlap with other biosecurity risk mitigation programs, which will provide collaboration and efficiency opportunities.

In particular, the EEPL will be used to guide actions and programs that seek to reduce the chance of these organisms becoming established in Australian ecosystems and increase our ability to detect, contain and eradicate them from the Australian environment if they occur.

The Chief Environmental Biosecurity Officer is responsible for developing and delivering an EEPL implementation plan that takes into account recommendations made in the 2017 Intergovernmental Agreement on Biosecurity Review that cover a broad set of risk mitigation approaches, including:

- undertaking detailed risk assessments where required
- identifying risk management measures
- developing surveillance measures pre-border, at the border and post-border
- improving and creating diagnostic capabilities
- building response capacity
- supporting research and development
- undertaking communication activities.

The EEPL contains a diverse set of species that possess diverse traits affecting the likelihood of incursion and environmental impact. Some traits allow EEPL species to be targeted as a group for risk reduction measures.

A number of principles have guided development of the EEPL implementation plan. The most fundamental principle is to seek the greatest reduction to environmental risk for the investment. This will be achieved by using a set of guiding rationales to reveal where the greatest risk mitigation improvement may be made for the cost required to achieve the expected outcome.

Mitigation and preparedness activities are not limited to the species in the EEPL or its implementation plan. In 2019 and 2020, PHA was engaged by the Chief Environmental Biosecurity Officer to develop Environmental Risk Mitigation Plans for Acacia, mangroves and associated communities, and native Australian bees. The plans are the first of their kind, consider all environmental stakeholders and provide a template for similar work in the future.

National Plant Biosecurity Preparedness Strategy

To reflect a stronger focus on prevention, a new ten-year National Plant Biosecurity Preparedness Strategy (NPBPS) is being developed. Once completed, the NPBPS will underpin the National Plant Biosecurity Strategy and complement the national diagnostic and surveillance strategies.

The NPBPS will be underpinned by an implementation plan that identifies and prioritises investments and activities required to undertake a coordinated approach to addressing national plant biosecurity preparedness. Work on these documents is expected be completed by mid-2021.

Chapter 3

Plant industry profiles

Plant industry profiles

The following pages provide information on the economic value and the major growing regions for plant industries that are members of Plant Health Australia (PHA).

Graphs show trends over recent years in local value of production (LVP), which is the value of agricultural commodities at the farm gate. 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 2018–19.[28]

Each profile also provides details of the industry's key exotic pest threats and the biosecurity initiatives that they have undertaken in 2020. All of these industries are signatories to the Emergency Plant Pest Response Deed, apart from the Australian Blueberry Growers' Association.

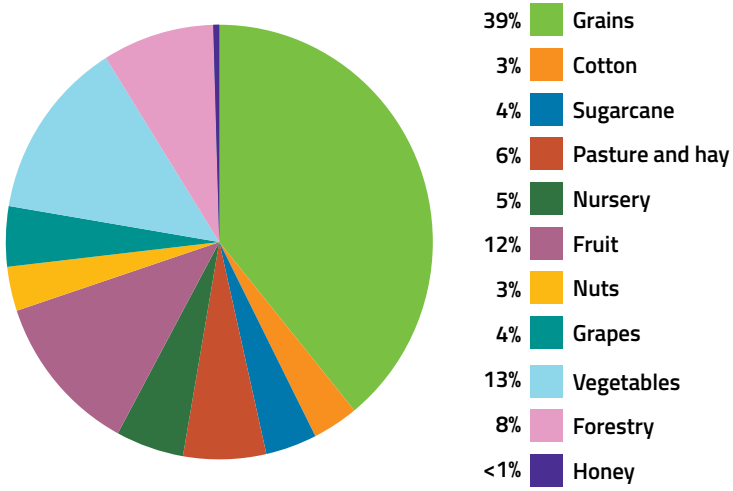
Figure 7 shows the contribution of each of the main plant production industries (including honey and beeswax) to total plant gross value of production in 2018–19, the latest year for which this breakdown is available.[29,30]

28 Hort Innovation (2021). Australian Horticulture Statistics Handbook 2019–20, Accessed online 28 March 2021. horticulture.com.au/growers/help-your-business-grow/research-reports-publications-fact-sheets-and-more/grower-resources/ha18002-assets/australian-horticulture-statistics-handbook/

29 Australian Bureau of Agricultural and Resource Economics and Sciences. Agricultural commodities: March quarter 2021. Accessed 20 March 2021. agriculture.gov.au/abares/research-topics/agricultural-outlook/data#agricultural-commodities

30 Australian Bureau of Statistics 7503.0 - Value of Agricultural Commodities Produced, Australia, 2018-19. Accessed online 20 March 2021. abs.gov.au/statistics/industry/agriculture/value-agricultural-commodities-produced-australia/latest-release#data-download

Figure 7. Comparative value of Australia's plant production industries, based on gross value of production, 2017-20



Source: ABS 7503 series and ABARES

ALMONDS

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

In 2018–19, almond production was valued at $720 million (LVP), with exports valued at $675 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 one of the major destinations for Australian almonds.

The industry has been expanding rapidly since 2016 with additional hectares bringing the total industry orchard area to just over 53,000 hectares. .

The 2020 production was 111,100 tonnes, however as recent plantings reach full maturity the industry's productive capacity will be approximately 170,000 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 230,000 hives required during the pollination season. The almond blossoms provide one of the first natural sources of food for bees each spring.

Table 9. 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

Figure 8. Annual value of almond production, 2007–19

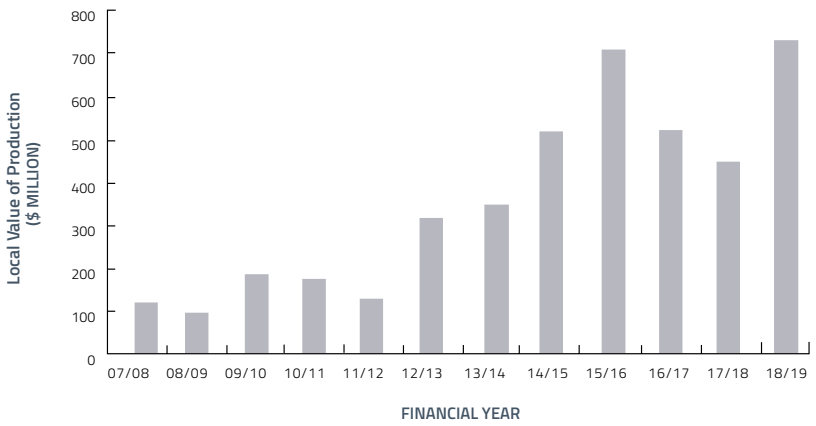
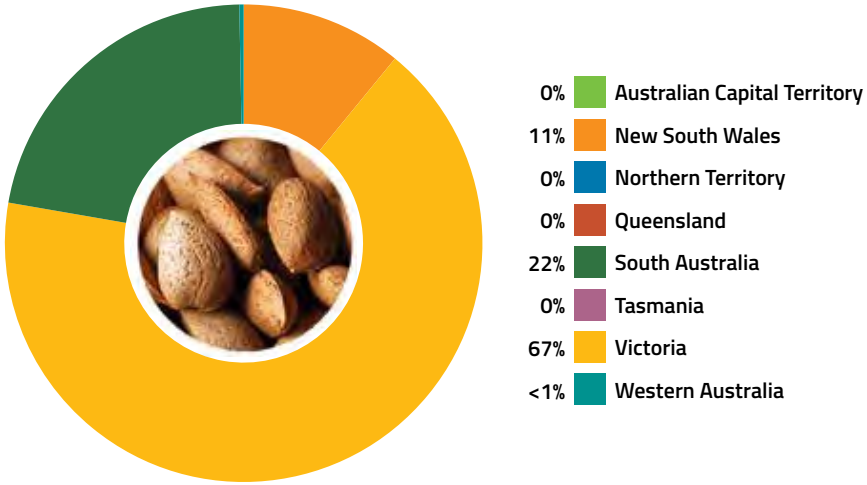


Figure 9. Distribution of almond production by state and territory, 2018–19 (based on LVP)



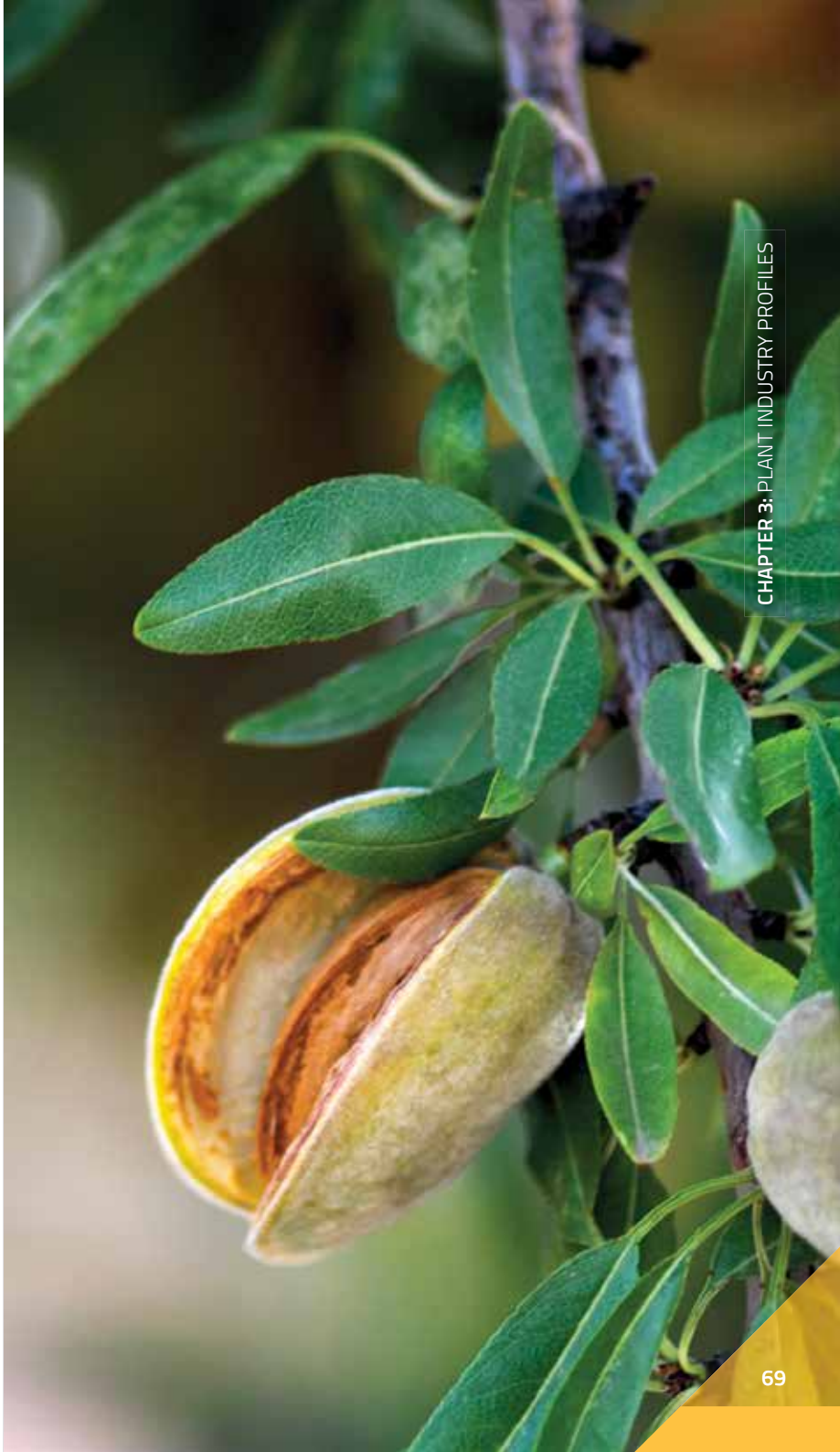


Image courtesy of Apple and Pear Australia Limited

APPLES AND PEARS

Represented by Apple and Pear Australia
apal.org.au

In 2018–19, apple and pear production was valued at $503 million (LVP) with fresh exports valued at $27 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. VIC 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 apple and pear industries produced 420,337 tonnes of fruit for the year ending 30 June 2020.

The major production areas include the Goulburn Valley, Gippsland, Yarra Valley and the Mornington Peninsula in VIC; Stanthorpe in QLD; Batlow and Orange in NSW; the Huon Valley and Tamar Valley in TAS; 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.

Image courtesy of Apple and Pear Australia Limited

Table 10. 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. *Nectria galligena* and *Neonectria 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, 2007–19

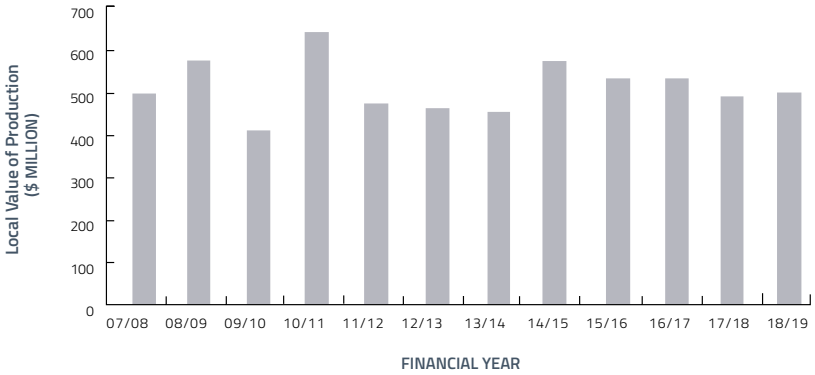
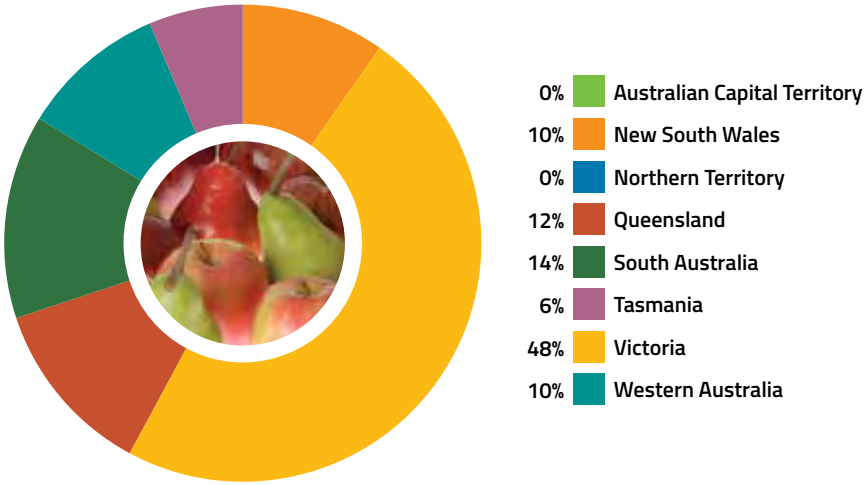


Figure 11. Distribution of apple and pear production by state and territory, 2018–19 (based on LVP)



AVOCADOS

Represented by Avocados Australia
avocado.org.au

In 2018–19, avocado production was valued at $296 million (LVP), with exports valued at $19.7 million, which were mainly shipped to Malaysia, Singapore, and Hong Kong.

Australians' love of avocados has grown steadily each year since the 1990s. Consumption in 2018–19 reached 3.8 kilograms per person, and 3.88 kilograms person in 2019–20, up from 1.2 kilograms in 1997–98.

QLD continues to dominate Australia's avocado production followed by WA, NSW, SA and VIC, with a small amount of production in TAS and one known orchard in the NT. Orchard areas are expanding in almost every growing region. This geographic diversity in growing regions ensures consumers have access to Australian avocados year-round. Fruit imported from New Zealand and, as of late 2020, Chile, 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.

Avocados Australia is active in the Consultative Committee on Emergency Plant Pests (CCEPP) and the National Management Groups (NMG) responding to the annual incursion of three fruit fly species in the Torres Strait, and to the detections of *Varroa jacobsoni* in QLD, also under active eradication (see page 191–2).

Avocados Australia has also recently participated in updating the industry's biosecurity plan (version 3.0 was released in February 2020), and signed a Memorandum of Understanding with PHA in June 2020 to improve the industry's capability to prepare for and respond to biosecurity risks, at the industry level.

Table 11. High Priority Pests of the avocado 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
Bactrocera passiflorae	Fijian fruit fly
Bactrocera xanthodes	Pacific fruit fly
Conotrachelus aguacatae	Small avocado seed weevil
Conotrachelus perseae	Small seed weevil
Ctenopseustis herana	Brown headed leafroller
Ctenopseustis obliquana	Brown headed leafroller
Elsinoë perseae (syn. *Sphaceloma perseae*)	Avocado scab
Heilipus lauri	Large seed weevil, avocado seed weevil
Oligonychus perseae	Persea mite
Paracoccus marginatus	Papaya mealybug
Phytophthora mengei	Bark canker
Phytophthora ramorum	Sudden oak death
Pseudomonas syringae pv. *syringae, Pantoea agglomerans, Xanthomonas campestris*	Bacterial canker complex, avocado blast complex
Raffaelea lauricola	Laurel wilt
Scirtothrips perseae	Avocado thrips
Stenoma catenifer	Seenomid (avocado) moth, avocado fruit borer, avocado seed moth
Zeugodacus curcubitae (syn. *Bactrocera cucurbitae*)	Melon fruit fly

Figure 12. Annual value of avocado production, 2007–19

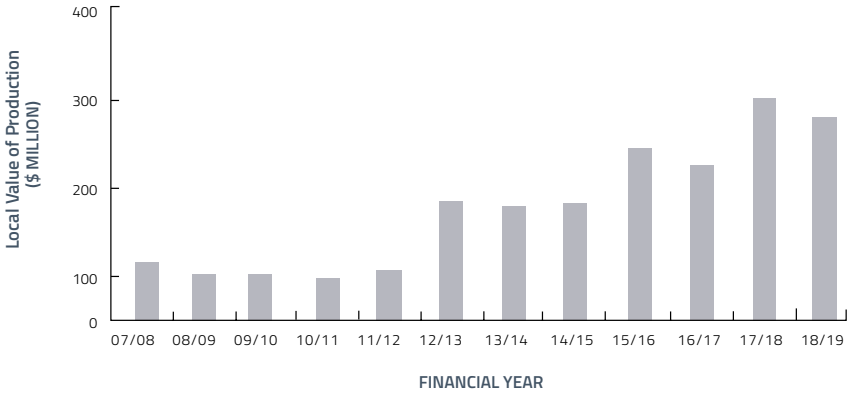
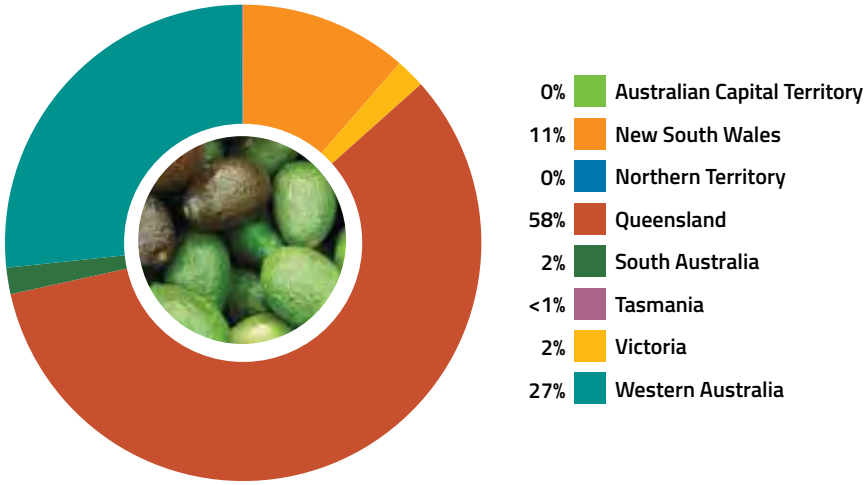


Figure 13. Distribution of avocado production by state and territory, 2018–19 (based on LVP)



BANANAS

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

In 2018–19, banana production was valued at $437 million (LVP). Most 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 QLD, NSW, WA and the NT. There are currently about 13,000 hectares of bananas grown in Australia; 94 per cent of which are located in four north QLD 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 2020 there continues to be two major biosecurity threats challenging the banana industry:

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

Panama TR4

Panama TR4 was first detected on a north QLD 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 2020 the disease was contained to five farms in the Tully Valley. While the plants on the original infected property were destroyed and all farming operations ceased, all other quarantined farms continue to produce and pack fruit under strict biosecurity conditions. Biosecurity Queensland conduct surveillance on all commercial banana farms in north QLD with the frequency of surveillance linked to the level of risk of Panama TR4 being detected. The ABGC and QDAF are working collaboratively to transition the leadership of the Panama TR4 Program from government to industry. It is expected that the transition will conclude by June 2023.

As a result of the second detection, Biosecurity Queensland, industry, local government stakeholders and the Queensland Department of Environment and Science came together to develop of a feral pig management plan that complements the activities of the Panama TR4 Program. Feral pigs in Tully have been identified as a major risk vector in the spread of the disease.

ABGC engaged a highly skilled vertebrate pest management contractor who coordinates, supports and mentors banana farmers to improve pest management practices on their land. This includes increasing skills and building long-term capacity in pest animal management, and raising awareness of responsibilities and obligations under legislation.

Banana bunchy top virus

A control program for banana bunchy top virus has been operating in NSW and south-east QLD 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 is working with growers to increase their capacity to manage bunchy top disease on their farms.

Yellow Sigatoka and biosecurity awareness, coordination and strategy

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 QLD 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 12. High Priority Pests of the banana industry

Scientific name	Common name
Abaca bunchy top virus (Babuvirus)	Abaca bunchy top
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
Erionota 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* and *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. *Ralstonia solanacearum* race 2, biovar 1)	Blood disease
Rastrococcus invadens	Mango mealybug
Rastrococcus spinosus	Mango mealybug
Tetranychus piercei	Spider mite

Figure 14. Annual value of banana production, 2007–19

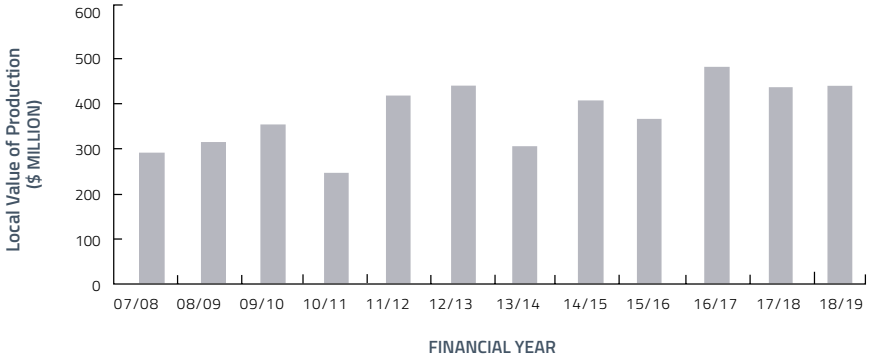
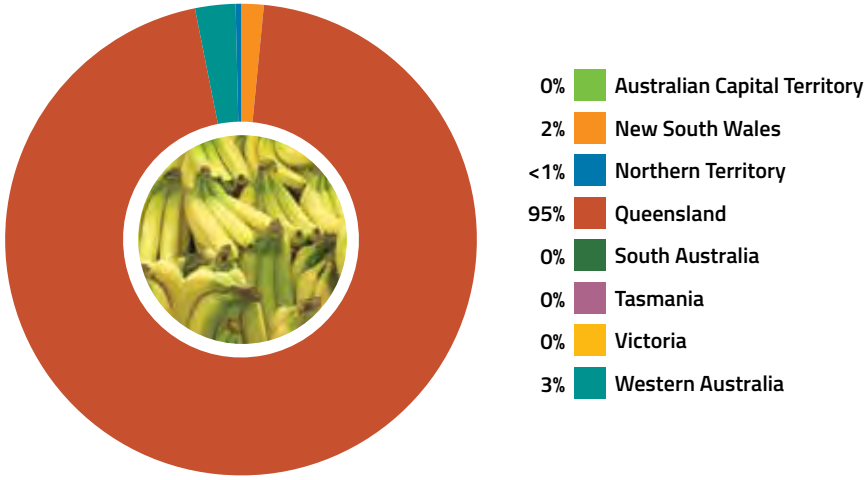
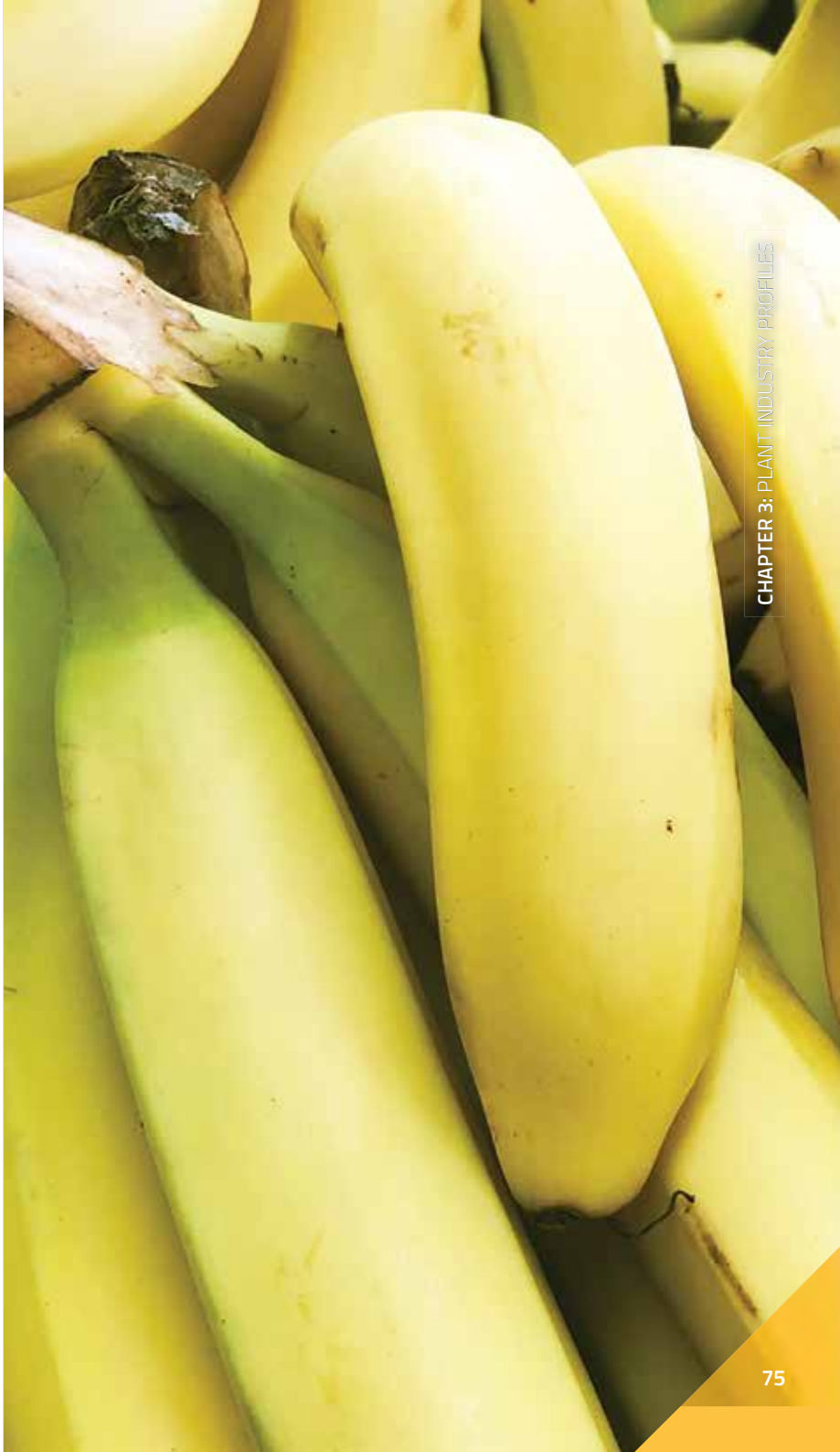


Figure 15. Distribution of banana production by state and territory, 2018–19 (based on LVP)





BLUEBERRIES

Represented by the Australian Blueberry Growers' Association
berries.net.au/home/about/blueberries/abga

In 2018–19, blueberry production was valued at approximately $271 million (LVP), with fresh exports valued at $4.8 million.

The industry is expanding, with an average 19,008 tonnes of blueberries being produced per annum. Most 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 85 per cent of the Australian crop in 2019. 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 QLD; the Tamar Valley, Meander Valley, Bernie, Devonport and the Huon Valley in TAS; the Grampians, Silvan and Strathbogie in VIC; 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 VIC, TAS and the southern highlands of NSW, whereas southern highbush and rabbiteye varieties are grown in NSW and QLD.

Figure 16. Annual value of blueberry production, 2011–19

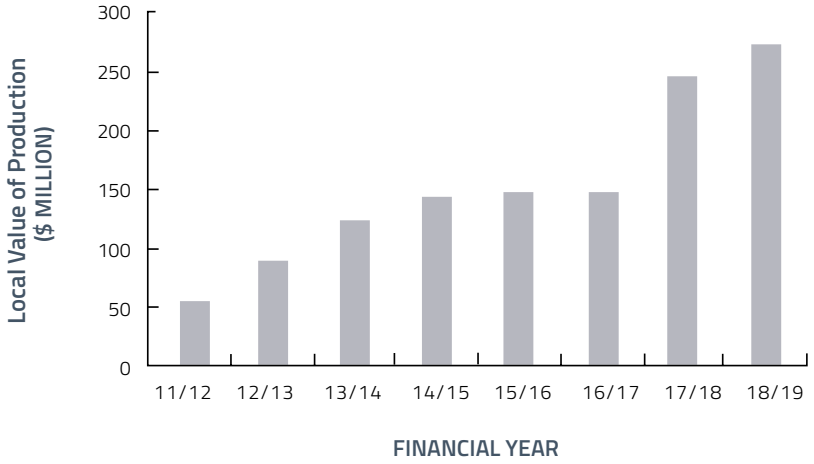


Figure 17. Distribution of blueberry production by state and territory, 2018–19 (based on LVP)

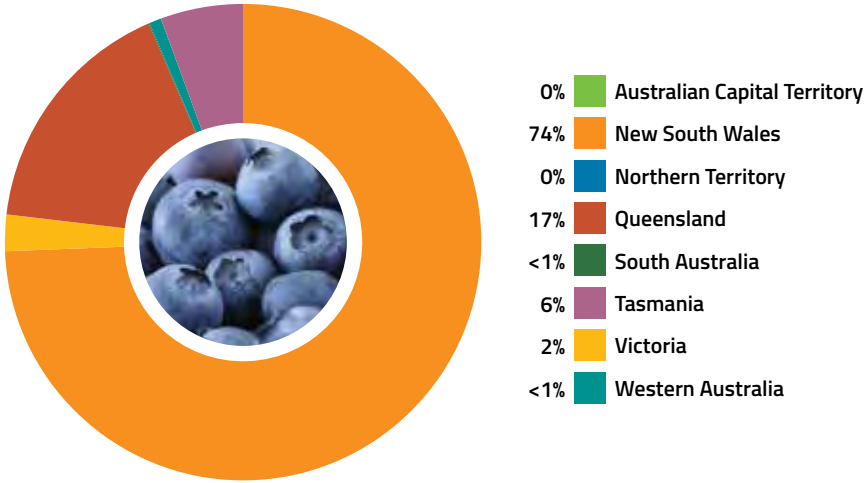


Table 13. High Priority Pests of the blueberry industry

Scientific name	Common name
Croesia curvalana	Blueberry leaftier
Drosophila suzukii	Spotted wing drosophila
Ericaphis fimbriata (with blueberry scorch carlavirus)	Blueberry aphid
Homalodisca vitripennis (with *Xylella fastidiosa*)	Glassy winged sharpshooter
Monilinia fructigena	Brown rot
Monilinia vaccinii-corymbosi	Mummy berry, cotton ball disease
Phytophthora ramorum	Sudden oak death
Xylella fastidiosa (subspecies not specified)	Pierce's disease, blueberry leaf scorch, olive leaf scorch, olive quick decline, phony peach, plum leaf scald

CANNED FRUITS

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

In 2018–19 production of canned fruit was valued at $14.7 million (LVP) with exports valued at $9.2 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 30,000 to 35,000 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 VIC, processing Australian apples, apricots, peaches, pears and plums at Shepparton.

Biosecurity plans and manuals have been developed with PHA and state governments for the pome fruit (apple and pear) and stone fruit (summerfruit) industries: however, the canned fruit industry does not have a specific biosecurity plan or manual.

Figure 18. Annual value of canned fruit production, 2007–19

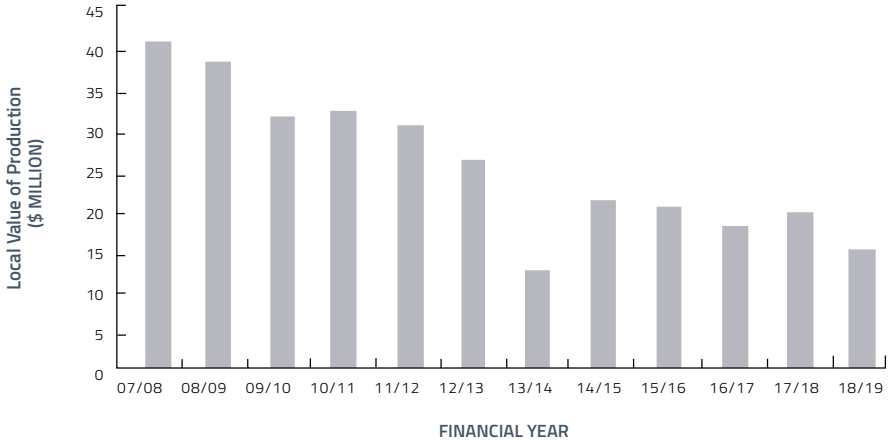
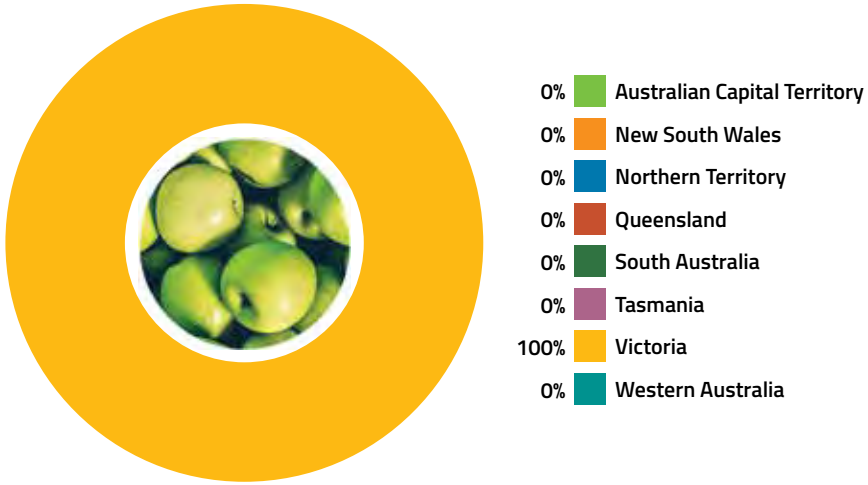


Figure 19. Distribution of canned fruit production by state and territory, 2018–19 (based on LVP)



CHERRIES

Represented by Cherry Growers Australia
cherrygrowers.org.au

In 2018–19, cherry production was valued at $157 million (LVP), with exports valued at $79.5 million.

Cherries are produced in six states, with NSW, VIC and TAS being the three largest producers, followed by SA. These four states have a strong export focus. WA and QLD are relatively small producers, focusing primarily 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.

Cherry production is increasing and moving into new areas largely due to increased export opportunities. Recent access to key Free Trade Agreement markets such as China, Korea and Vietnam have given mainland growers an unprecedented opportunity which until now has been the exclusive domain of TAS with its fruit fly free status.

Total production is approximately 20,000 tonnes annually of which 25 per cent was exported to 37 countries.

Figure 20. Annual value of cherry production, 2007–19

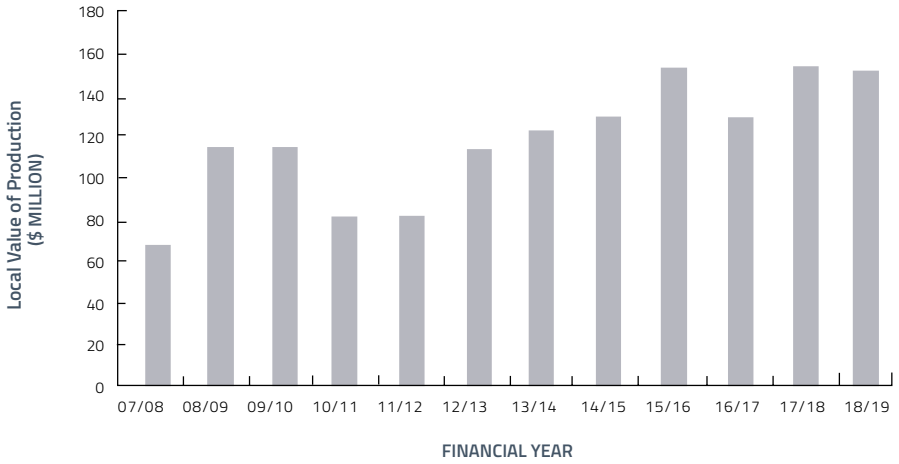
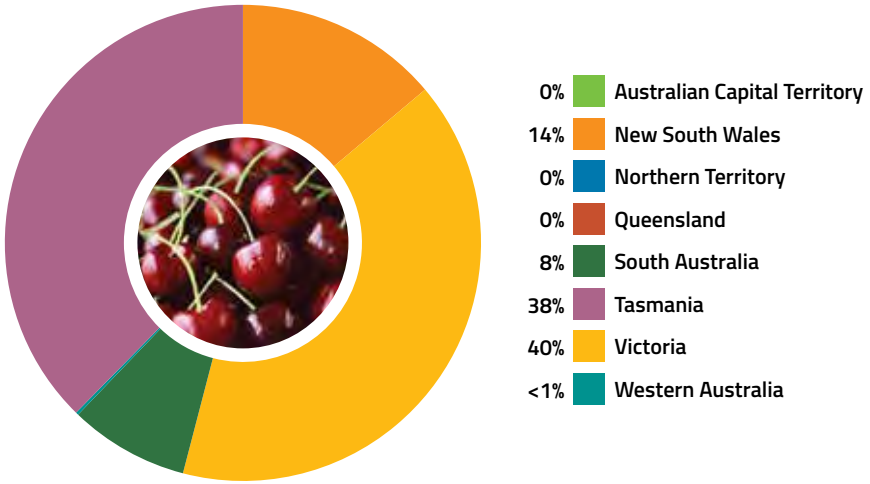


Table 14. High Priority Pests of the cherry industry

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 (with *Xylella fastidiosa*)	Glassy winged sharpshooter
Monilinia fructigena	Brown rot
Neonectria ditissima (syn. *Nectria galligena* and *Neonectria galligena*)	European canker
Planotortrix octo	Green headed leaf roller
Plum pox virus (Potyvirus)	Plum pox virus, sharka
Xylella fastidiosa (subspecies not specified)	Pierce's disease, blueberry leaf scorch, olive leaf scorch, olive quick decline, phony peach, plum leaf scald

Figure 21. Distribution of cherry production by state and territory, 2018–19 (based upon LVP)



CHESTNUTS

Represented by Chestnuts Australia
chestnutsaustralia.com.au

In 2018–19 chestnut production was valued at $7.8 million (LVP), with exports valued at less than $0.1 million.

Around 1,480 hectares are planted with 275,000 chestnut trees. In 2020, approximately 1,250 tonnes of chestnuts were produced. It is estimated that with more trees being planted in NSW, production will increase to approximately 1,500 tonnes with a value of $12 million by 2022. 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 VIC and NSW.

Throughout 2020, Chestnuts Australia participated in the Transition to Management program for chestnut blight, which began in December 2019. This included sitting on the chestnut blight decision-making committees, the CCEPP and the NMG and working specifically with Agriculture Victoria.

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 Strategic Blueprint 2030 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 15. High Priority Pests of the chestnut industry

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

Figure 22. Annual value of chestnut production, 2009–19

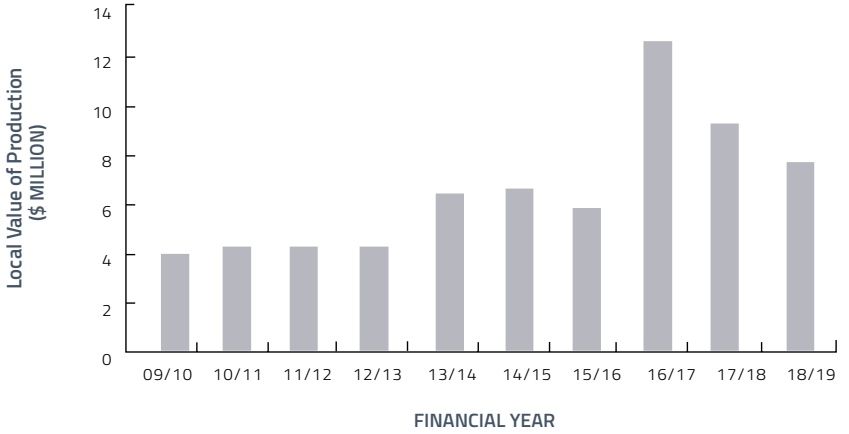
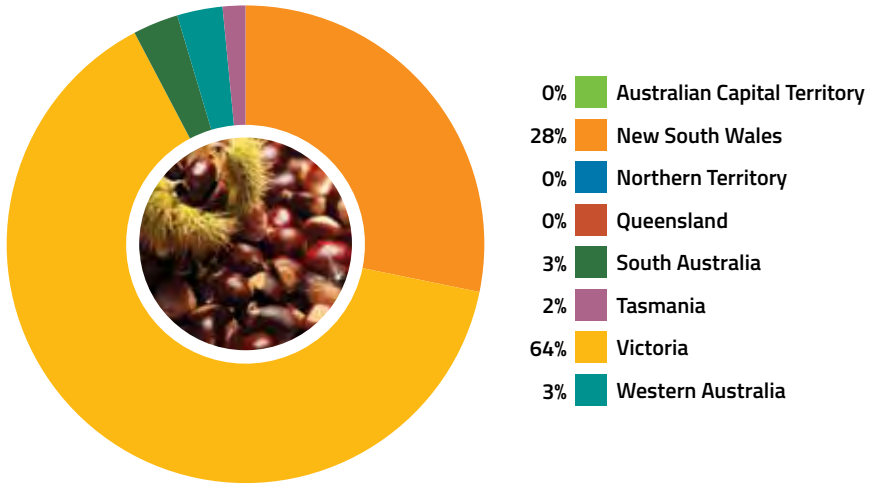
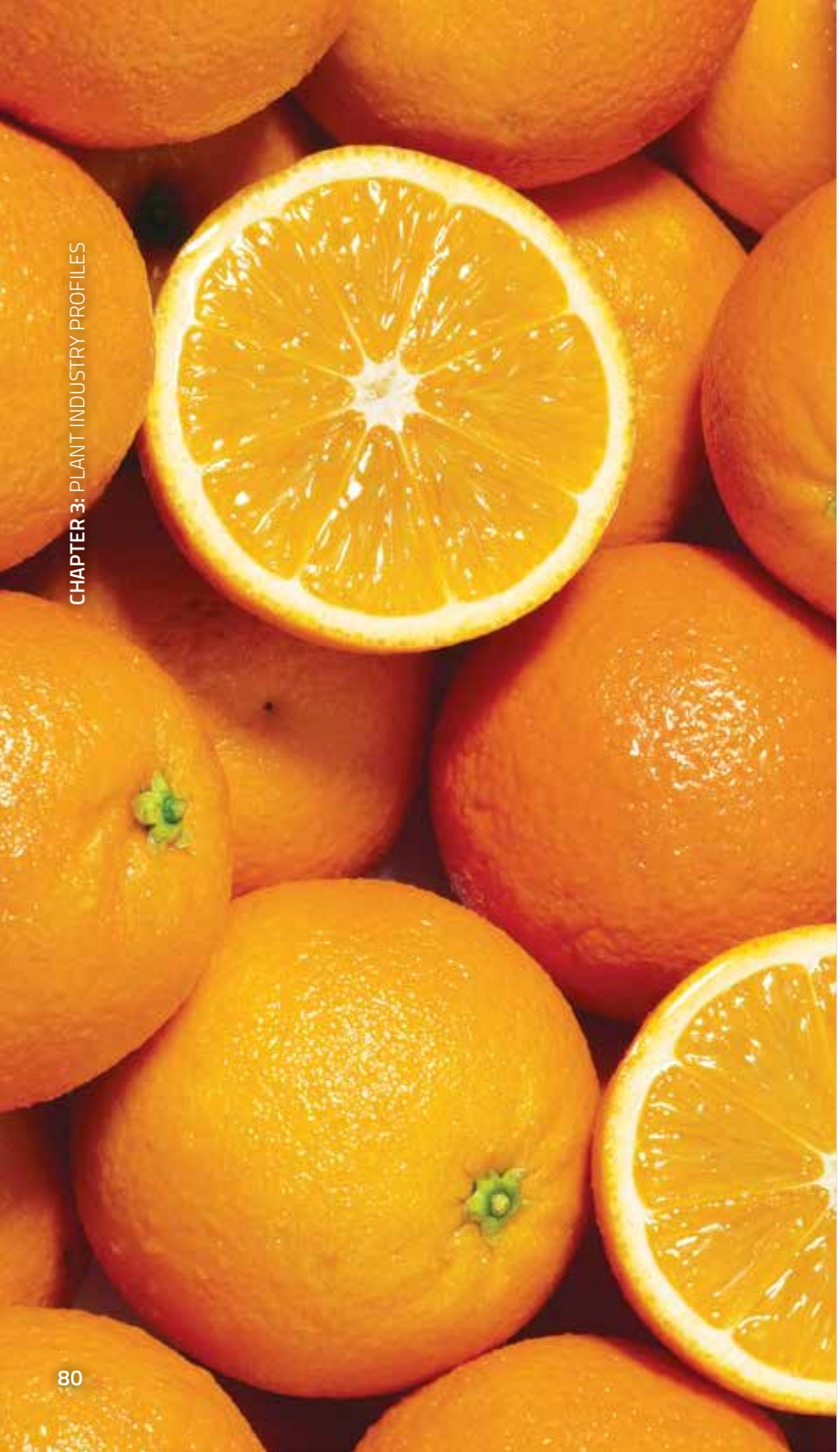


Figure 23. Distribution of chestnut production by state and territory, 2018–19 (based on LVP)





CITRUS

Represented by Citrus Australia
citrusaustralia.com.au

In 2018–19 production of oranges, mandarins, lemons, limes and grapefruit was valued at $783 million (LVP), with exports valued at $457 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 750,000 tonnes per annum, produced from approximately 27,000 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 QLD; Riverland in SA; the Murray Valley in VIC–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. Additional funding was 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 and the National Citrus Biosecurity Surveillance Strategy 2018–28.
See page 206 for information about the National Citrus Biosecurity Program.

Table 16. High Priority Pests of the citrus industry

Scientific name	Common name
Anastrepha ludens	Mexican fruit fly
Bactrocera carambolae	Carambola fruit fly
Bactrocera dorsalis (syn. *B. invadens, B. papayae, B. philippinensis*)	Oriental fruit fly
Bactrocera kandiensis	Fruit fly
Bactrocera occipitalis	Fruit fly
Bactrocera trivialis	New Guinea fruit fly
Caliothrips fasciatus	Bean thrips
Candidatus Liberibacter africanus	Huanglongbing (African strain)
Candidatus Liberibacter americanus	Huanglongbing (American strain)
Candidatus Liberibacter asiaticus	Huanglongbing (Asian strain)
Citripestis sagittiferella	Citrus fruit borer
Citrus leprosis virus (Cilevirus)	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. *Homalodisca coagulata*)	Glassy winged sharpshooter
Spiroplasma citri	Stubborn
Trioza erytreae	African citrus psyllid
Xanthomonas citri subsp. *citri* (syn. *Xanthomonas 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, 2007–19

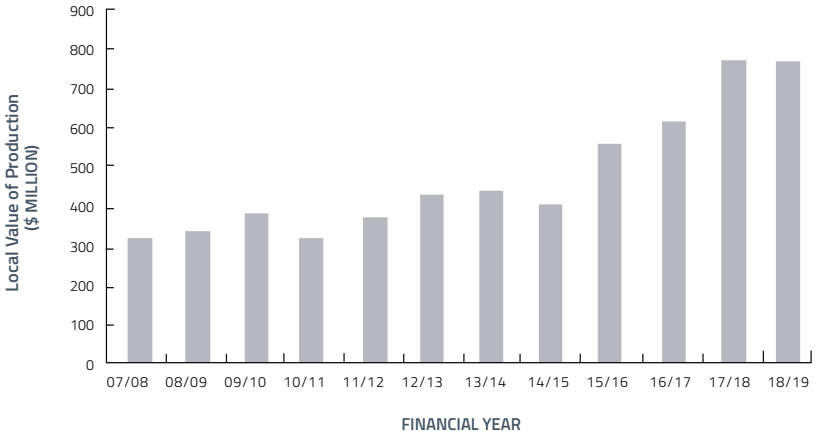
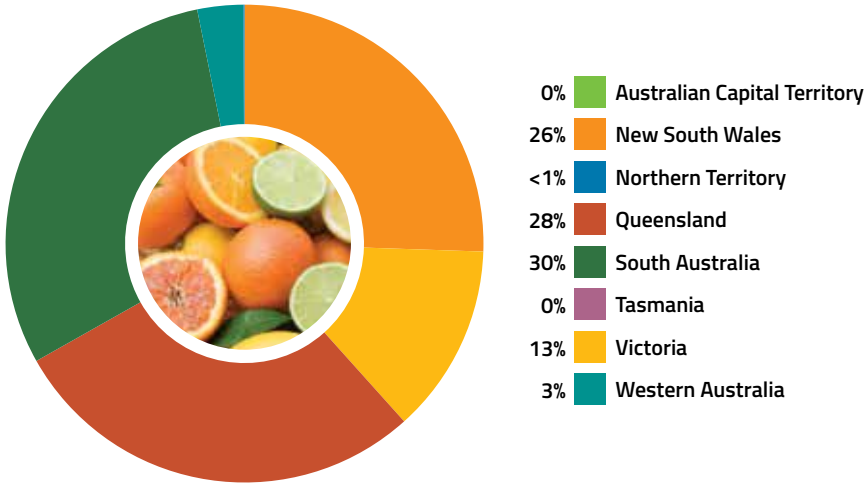


Figure 25. Distribution of citrus production by state and territory, 2018–19 (based on LVP)



COTTON

Represented by Cotton Australia
cottonaustralia.com.au

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. In 2018–19, cotton production was significantly reduced due to drought, valued at $1.1 billion (LVP).

Approximately 60 per cent of the national crop is grown in NSW, with the remainder grown in QLD and a small number of fields in VIC. 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.[31]

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, 2007–19

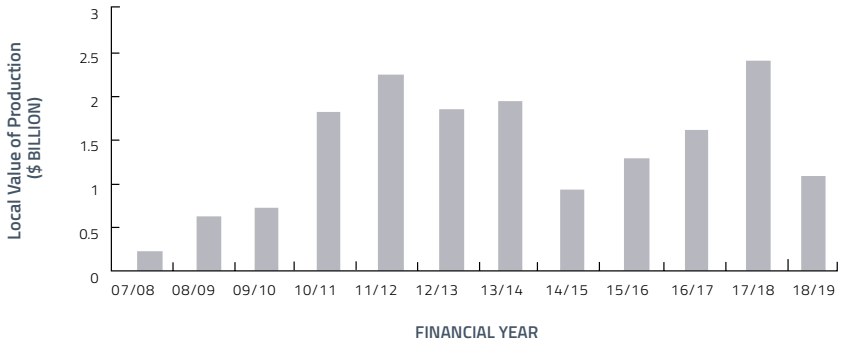
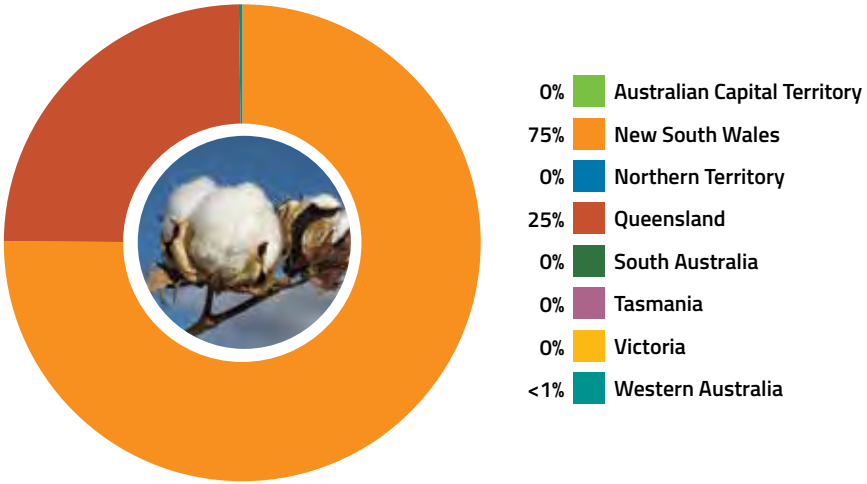


Table 17. High Priority Pests of the cotton industry

Scientific name	Common name
Anthonomus grandis	Boll weevil
Aphis gossypii (exotic strains)	Cotton aphid
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

**established in Australia*

Figure 27. Distribution of cotton production by state and territory, 2018–19 (based on LVP)



31 Cotton Australia (2018). Australian Cotton Industry Statistics

DRIED FRUITS (GRAPES)

Represented by Dried Fruits Australia
driedfruitsaustralia.org.au

In 2018–19, dried grape production (sultana types, currants and raisins) had an estimated value of $30 million (LVP), with exports valued at $25.1 million. The 2021 crop is estimated to be 15,000 tonnes. Export markets for dried vine fruits include Europe and Asia. Total exports are expected to increase to over 5,000 tonnes over the next several years.

In Australia, grapes for the dried fruit industry are predominantly grown in the Sunraysia region which spans north western VIC and south-west 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 dried fruit growers through the major industry processors. The industry also undertakes EPPRD training in order to understand roles and responsibilities in a pest incursion.

A biosecurity levy will be in place from 1 January 2021 to enable the dried vine fruits industry value chain to be a contributing participant in national biosecurity related activities and project such as surveillance and emergency scenarios.

Table 18. High Priority Pests of the dried fruit industry

Scientific name	Common name
Candidatus Phytoplasma solani	Bois noir
Drosophila suzukii	Spotted wing drosophila
Grapevine red blotch-associated virus (Geminivirus) (with vector)	Grapevine red blotch associated virus, GRBaV
Guignardia bidwellii	Black rot
Halyomorpha halys	Brown marmorated stink bug
Lycorma delicatula	Spotted lanternfly
Trogoderma granarium	Khapra beetle
Xylella fastidiosa (subspecies 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, 2007–19

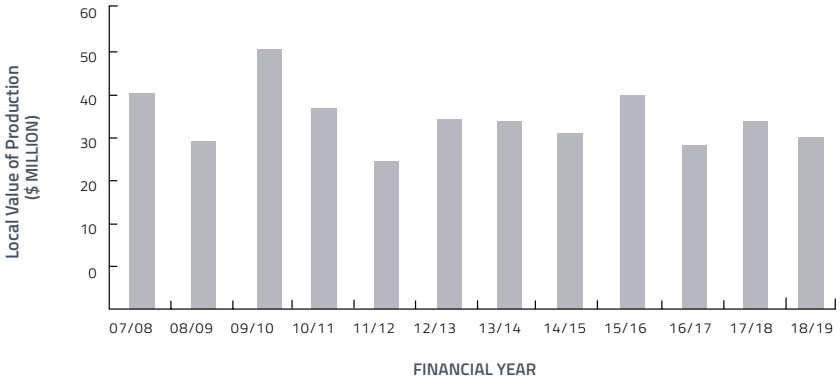
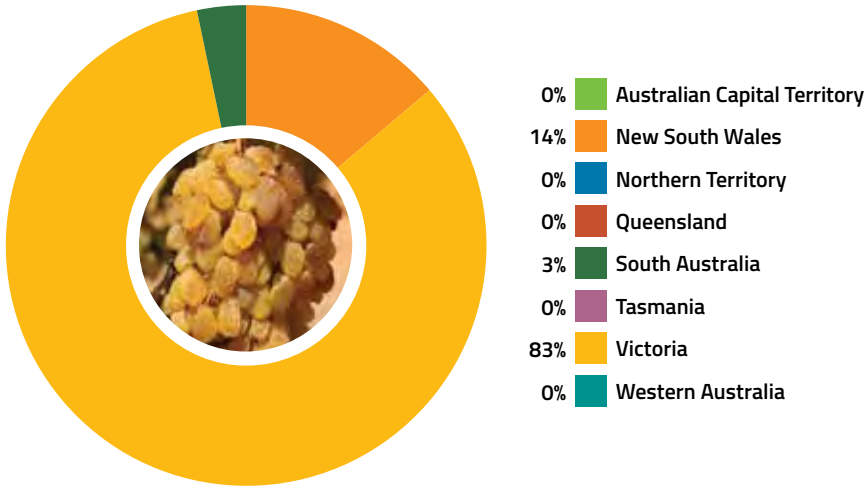


Figure 29. Distribution of dried fruit production by state and territory, 2018–19 (based on LVP)



GINGER

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

In 2018–19, ginger production was valued approximately $41 million (LVP). Land under cultivation was about 270 hectares that produced 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 QLD. Key growing districts are Gatton, Glasshouse Mountains, Beerwah, Yandina, Mary Valley, Maryborough and Bundaberg. Growers can also be found in northern NSW and far north QLD.

There are two varieties grown commercially: Jumbo (also known as Canton) and QLD, with 25 per cent sold to the processing sector and 75 per cent sold to the fresh market. No ginger is currently exported, and the industry is yet to develop a concrete plan for export.

Biosecurity is included in the AgriFutures 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, and information from PHA is shared regularly with members via meetings, newsletters and email up-dates.

Figure 30. Annual value of ginger production, 2010–19

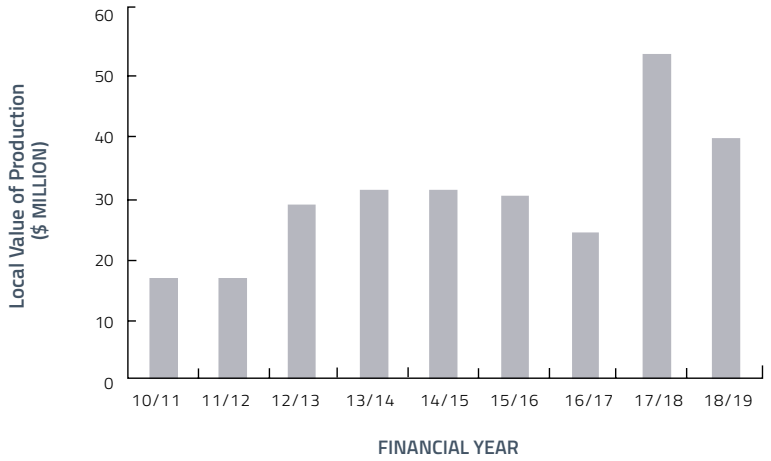
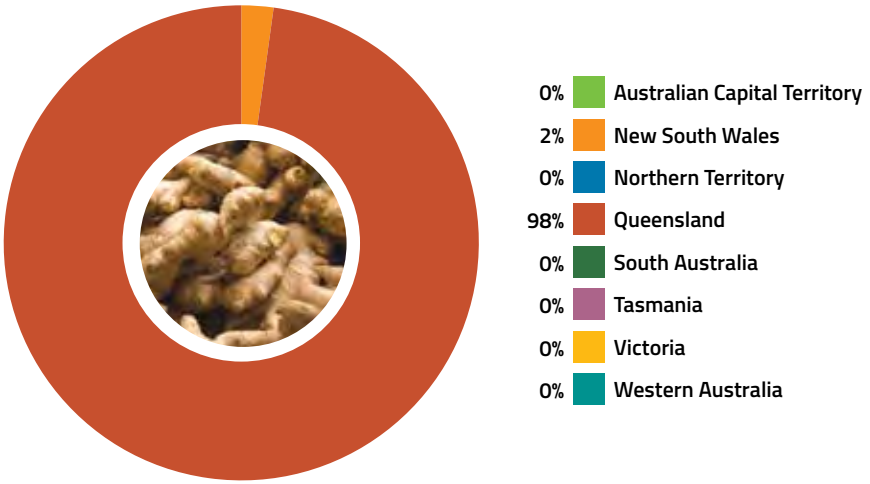


Table 19. High Priority Pests of the ginger industry

Scientific name	Common name
Aspidiella hartii	Yam scale
Meloidogyne enterolobii (syn. *Meloidogyne mayaguensis*)	Root knot nematode
Radopholus similis (exotic strains)	Burrowing nematode

Figure 31. Distribution of ginger production by state and territory, 2018–19 (based on LVP)



GRAINS

Represented by Grain Producers Australia
grainproducers.com.au

In 2018–19, grain production was valued approximately $11.8 billion (LVP) with exports valued at $7.8 billion. The grains industry accounts for 21 per cent of Australian agriculture's gross value of production and 16 per cent of agriculture's export income, making it Australia's largest plant industry.[32]

In an average year around 34 million tonnes of grain is produced from approximately 20 million hectares.[33] In the 2019–20 season, due to the second year of drought conditions for many of the grain producing regions of Australia, the winter cropping area was reduced to around 18 million hectares which produced a little over 27 million tonnes of grain. Due to feed shortages a large proportion of the grain was used domestically for stock feed during 2019–20.

It is estimated only 8–9 million tonnes were exported compared to an average of 11–12 million tonnes.

Most of Australia's grain is produced across the region known as the wheat belt, which stretches from central QLD through NSW, VIC, TAS, 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 205.

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. Implementation commenced in 2020 however, due to the impact of Covid-19, there were some delays in full implementation.

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.

Figure 32. Annual value of grain production, 2007–19

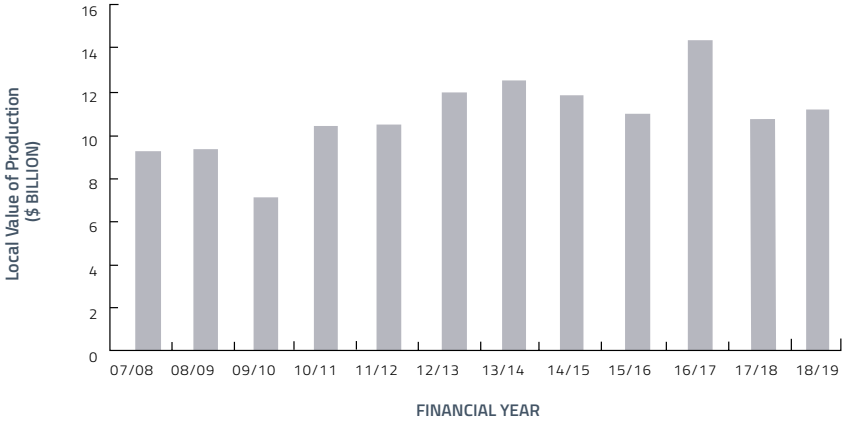
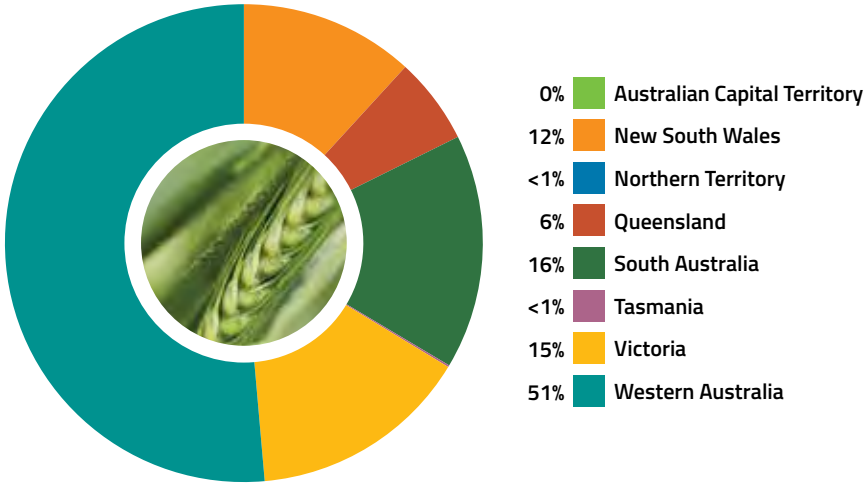


Figure 33. Distribution of grain production by state and territory, 2018–19 (based on LVP)



32 Australian Bureau of Agricultural and Resource Economics and Sciences. Agricultural commodities: March quarter 2021. Accessed 20 March 2021. agriculture.gov.au/abares/research-topics/agricultural-outlook/data#agricultural-commodities

33 Grains Research and Development Corporation. Our industry. Accessed online 12 March 2021 https://grdc.com.au/about/our-industry

Table 20. High Priority Pests of the grain industry

Scientific name	Common name
Ascochyta rabiei (MAT1-1)	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	Cabbage seedpod weevil
Ceutorhynchus napi	Rape stem weevil
Ceutorhynchus pallidactylus	Cabbage stem weevil
Chickpea chlorotic dwarf virus (Mastrevirus) (syn. *Chickpea chlorotic dwarf virus* (Geminivirus)	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 strain)	Lentil anthracnose
Cylindrocopturus adspersus	Sunflower stem weevil
Diabrotica barberi	Northern corn root worm
Diabrotica undecimpunctata	Southern corn root worm
Diabrotica virgifera	Western corn root worm
Diaporthe helianthi (syn. *Phomopsis 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 (syn. *Acremonium maydis*, *Cephalosporium 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, mungbean yellow mosaic India virus, dolichos yellow mosaic virus, horsegram 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 e.g. Ug99)	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, 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
hazelnutgrowersaustralia.org.au

In 2018–19, hazelnut production was valued at $3.0 million (LVP), with exports valued at $0.1 million.

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 2020. The industry estimates that by 2022 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, Narrandera, and north-east VIC around Myrtleford. They are also grown in central and eastern VIC and increasingly in northern TAS.

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 2020, Hazelnut Growers of Australia was involved in a number of responses to pest incursions affecting the hazelnut industry.

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 Hazelnut Industry Australia – Premium Australian Hazelnuts – Strategic Blueprint 2030, 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 34. Annual value of hazelnut production, 2010–19

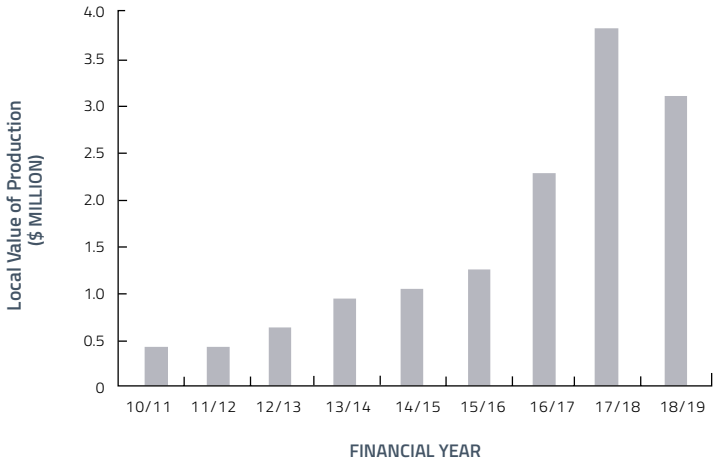
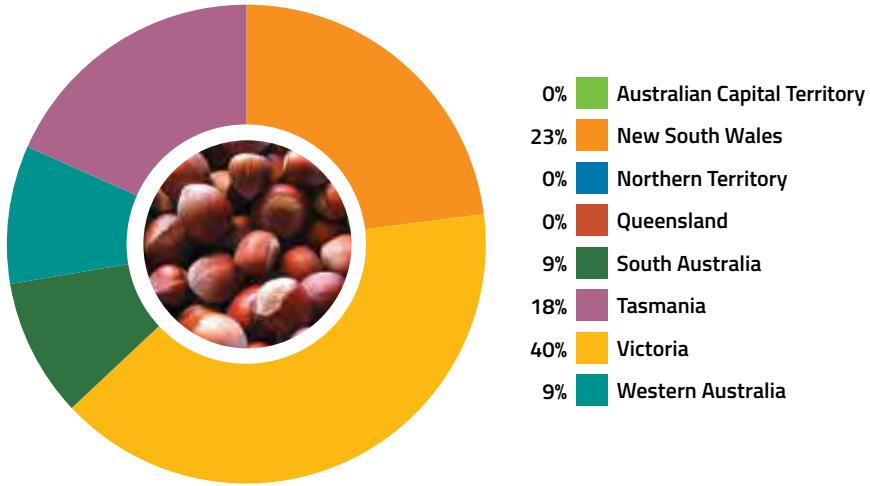


Figure 35. Distribution of hazelnut production by state and territory, 2018–19 (based on LVP)



HONEY BEES

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

In 2018–19, honey and beeswax production was valued at $162 million (LVP), and the unrecognised value of pollination is believed to be in the order of $14.2 billion.[34] There are approximately 25,000 registered beekeepers in Australia operating around 672,216 hives. Over 531,786 hives are operated by commercial beekeepers (those who have more than 50 hives).

The industry also exports live bees, and Australian beeswax commands a premium price overseas. Trade relies on the healthy status of Australia's bees, with high values attributed to the lack of residue from miticides that are 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.[35]

AHBIC works in partnership with other industries and governments to protect the health of bees with several biosecurity initiatives including the National Bee Pest Surveillance Program and the development of the Australian Honey Bee Industry Biosecurity Code of Practice.

The National Bee Pest Surveillance Program operates at ports around Australia to provide an early detection mechanism for exotic bees and pests of bees. More about this program is on page 154. This program is due to end on 12 December 2021, and its continuation is currently being considered.

The Australian Honey Bee Industry Biosecurity Code of Practice was endorsed nationally by the honey bee industry in 2016. The aim of the Code is to improve the management of established pests and diseases, and increase preparedness and surveillance for exotic pest threats. Parts of the Code have now been incorporated into beekeeping legislation by NSW, SA and VIC.

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 implement biosecurity measures and ensure they are complying with the Code of Practice and relevant legislation (see page 24).

Following the detection of Varroa mites (*Varroa jacobsoni*) on Asian honey bees (AHB) in Townsville in June 2016, DAWE established the National Varroa Mite Eradication Program (NVMEP), of which AHBIC has been a part. No AHB or Varroa mites associated with this incident have been found since November 2016 and proof of freedom has been completed.

Suspect Varroa mites (*V. jacobsoni*) were again detected on AHB 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. In April 2020, a further nest of AHB was detected at the Port of Townsville and *V. jacobsoni* were also detected from the nest. These were found to be genetically different from the 2016 and 2019 incursions. The NVMEP has been extended to include this incursion and proof of freedom is expected to be achieved in April 2021.

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

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

Figure 36. Annual value of honey bee and beeswax production, 2007–19

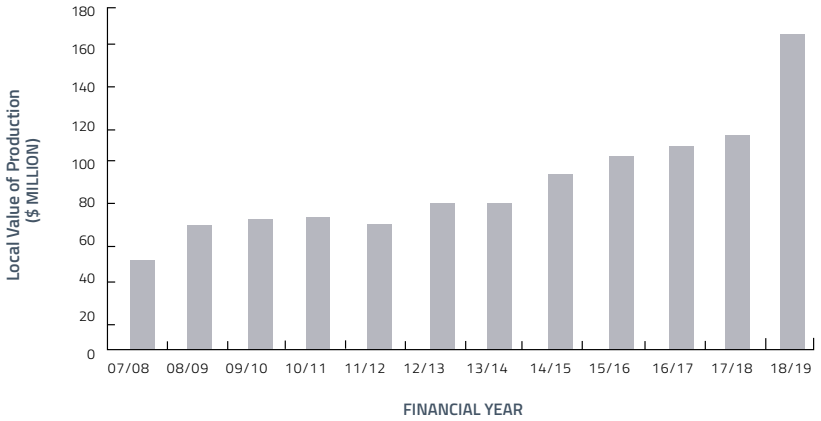


Figure 37. Distribution of honey and beeswax production by state and territory, 2018–19 (based on LVP)

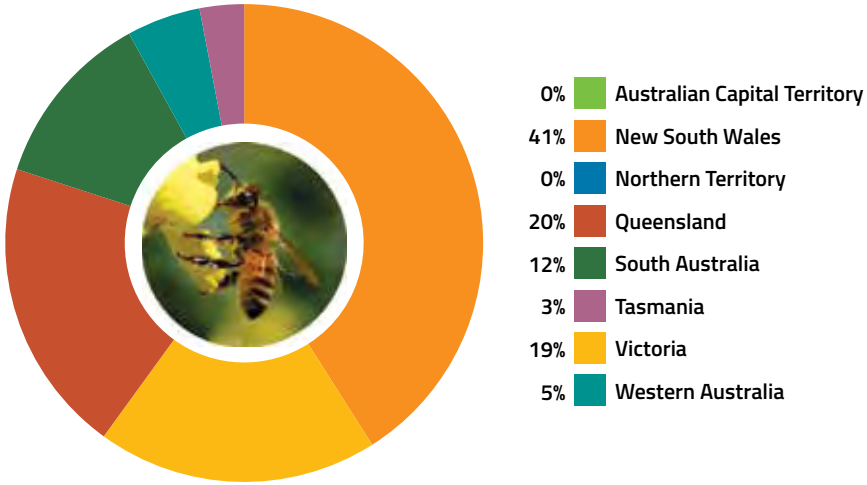


Table 22. High Priority Pests of the honey bee industry

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

LYCHEES

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

In 2018–19, lychee production was valued approximately $34 million (LVP), with exports valued at $7.4 million. Currently, the industry's annual production ranges between 2,500–3,000 tonnes. Lychees are grown in QLD and NSW. The harvest season begins in October in far north QLD and moves down through to NSW until early April.

Lychees were introduced into Australia more than 100 years ago and over this time the industry has developed from a 'small exotic fruit' industry into a progressive and robust industry. The demand for Australian lychees is on the increase domestically and overseas. Australian lychee exports to the United States continue to increase, with 24 tonnes exported in the 2019–20 season. These increases are expected to continue each year as more growers register for this export market.

Annual production is currently meeting the domestic demand and consumption with 20–25 per cent of production for export markets. New plantings will steadily increase the annual production as trees reach maturity and anticipated yield. It is anticipated that annual production will increase by up to 75 per cent, 5,000–5,500 tonnes within the next 10 years. A balance needs to be retained between domestic and export supply to ensure the industry continues to grow while maintaining its viability and sustainability for all lychee growers.

The Kwai Mai Pink lychee is the most widely grown variety in Australia. It is well regarded by Australian consumers for appearance, shelf life, taste and price. Kwai Mai Pink has become the main export variety especially to Hong Kong, USA, New Zealand and Canada. The late-cropping Wai Chee is also gaining export recognition with the small seeded Salathiel popular with buyers in Singapore. Other well-known varieties include: Tai So, Fay Zee Siu, Souey Tung, Sah Keng and Kaimana. Over the past 10 years, newer varieties have been developed and are now becoming popular with the Australian growers and consumers. These include: Chompogo, Baitaying, Erdon Lee, Linsansue, Red Ball, Sansuelin and Shuang Balia. Due to poor fruit set and irregular flowering, growers are now planting more of the newer varieties and phasing out the older varieties, Tai So, Fay Zee Siu and Souey Tung.

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 38. Annual value of lychee production 2009–19

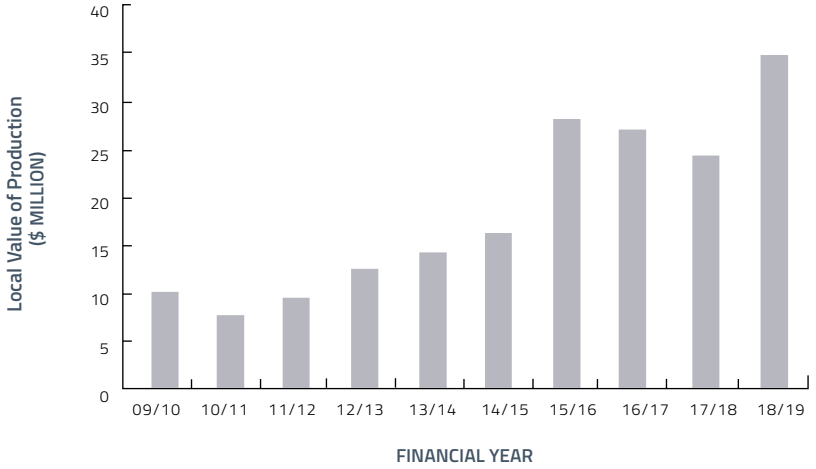
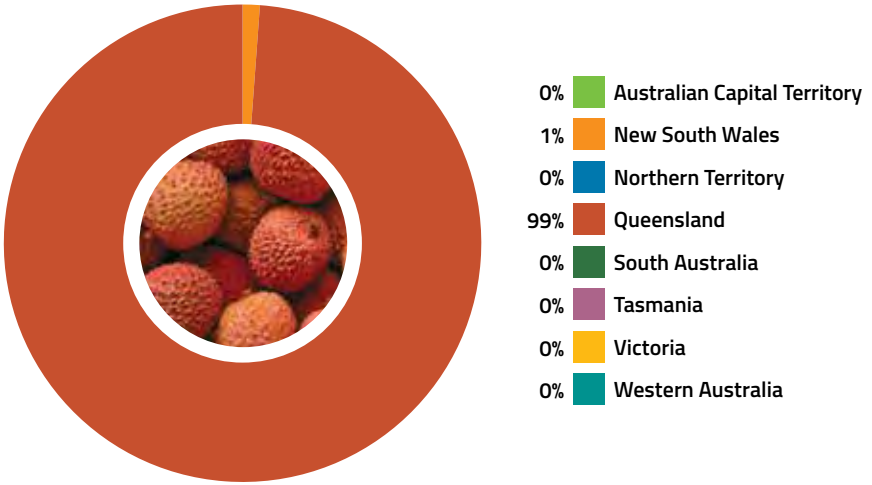


Figure 39. Distribution of lychee production by state and territory, 2018–19 (based on LVP)



MACADAMIAS

Represented by the Australian Macadamia Society
australian-macadamias.org

In 2018–19, macadamia production was valued at $245 million (LVP) with exports valued at $257 million. Annual macadamia production has more than tripled in the last 10 years. The export value of the Australian industry grew by 9.3 per cent in the 12 months to June 2019.

Approximately 75 per cent of the crop is exported, principally to Europe, the United States, Japan, South Korea, Taiwan 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, United States, the rest of Africa and South America are also significant producers. There are now approximately 800 macadamia growers with 33,000 hectares of crop under planting 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 QLD, from Port Macquarie in the south through to the Atherton Tablelands in the north. Collectively Bundaberg and the Northern Rivers region produce more than 80 per cent of the Australian crop. Production is growing fastest in Bundaberg in QLD and the Clarence Valley in NSW. New plantings are also being developed in Mackay and Maryborough in QLD 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 40. Annual value of macadamia production 2007–19

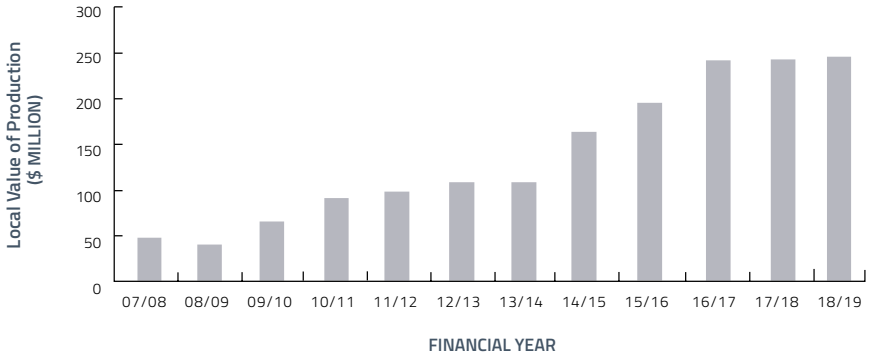
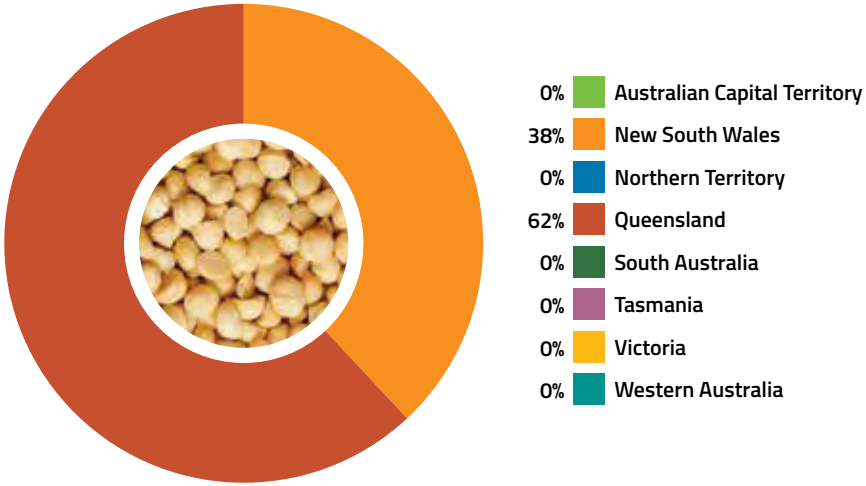


Figure 41. Distribution of macadamia production by state and territory, 2018–19 (based on LVP)



MANGOES

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

In 2018–19, mango production was valued at $110 million (LVP), with exports valued at $30.7 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 41 per cent of Australian production.

Other varieties include B74 (Calypso), Honey Gold, and R2E2, green eating varieties such as Keow Savoey, Falan 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 QLD 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. This and other associated documents were reviewed in 2020.

Figure 42. Annual value of mango production, 2007–19

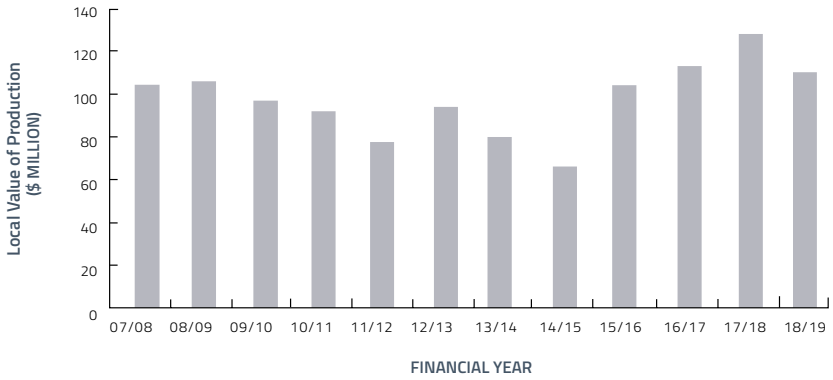


Figure 43. Distribution of mango production by state and territory, 2018–19 (based on LVP)

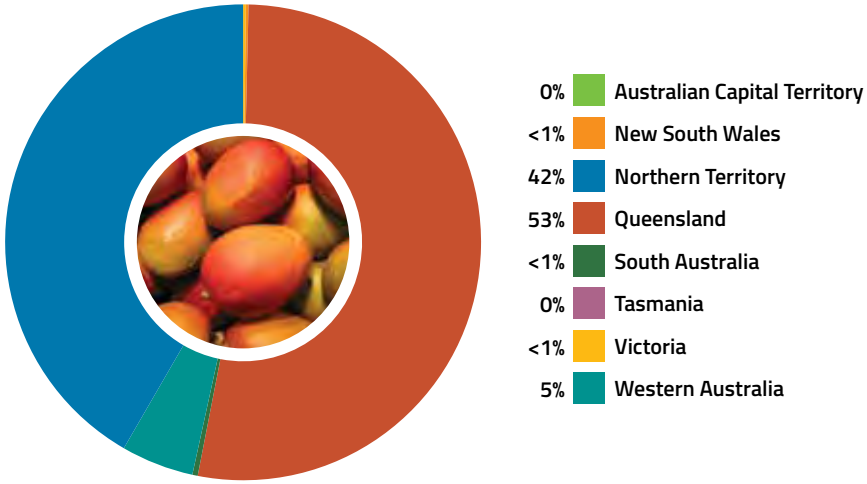


Table 25. High Priority Pests of the mango industry

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
Bactrocera occipitalis	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
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	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	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 2018–19 melon production was valued at $151 million (LPV), with exports valued at $37 million.

The Australian melon industry consists of approximately 250 growers producing, on average around 230,000 tonnes of melons annually across 8,500 hectares. Melons are produced in every mainland Australian state with the majority of production in QLD, NSW, NT and WA. 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 main destinations for melon exports are New Zealand, United Arab Emirates, Japan, Malaysia, Hong Kong and Singapore.

The Australian melon industry has a research and development levy, a PHA levy and an Emergency Plant Pest Response levy, currently set at zero. The industry contributes 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 biosecurity issues. In 2020, the melon industry updated their biosecurity plan and an on-farm biosecurity planner has been developed with NSW Department of Primary Industries.

Figure 44. Annual value of melon production, 2010–19

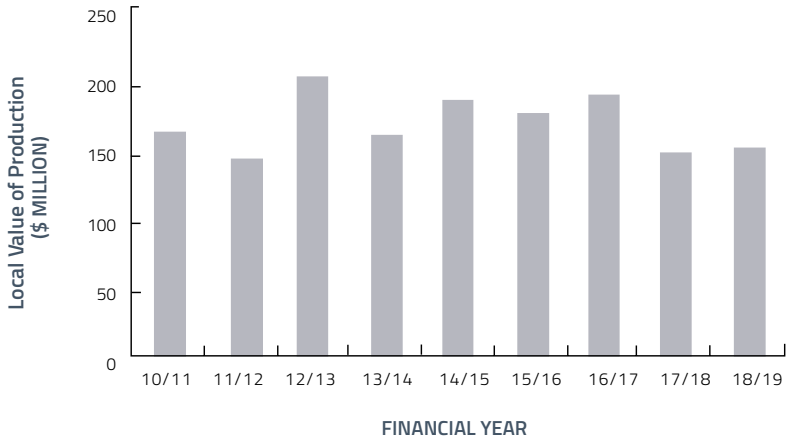
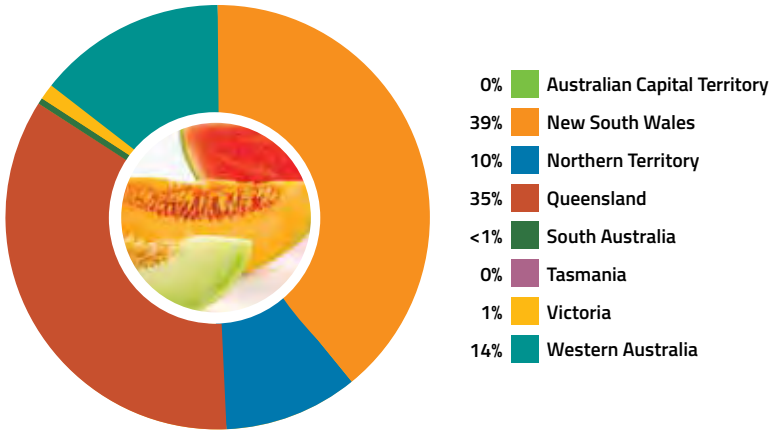


Table 26. High Priority Pests of the melon industry

Scientific name	Common name
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. *lagenariae*	Fusarium root and stem rot of melons
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
Groundnut bud necrosis virus (Tospovirus)	Bud necrosis disease
Kyuri green mottle mosaic virus (Tobamovirus)	Tobamovirus group, KGMMV
Liriomyza bryoniae	Tomato leaf miner
Liriomyza sativae	Vegetable leaf miner, American leaf miner
Melon severe mosaic virus (Tospovirus)	Tospovirus, melon severe mosaic
Melon yellow spot virus (Tospovirus)	Tospovirus group
Monosporascus cannonballus	Monosporascus root rot
Phomopsis cucurbitae (syn. *Diaporthe melonis*)	Melon black rot, phomopsis fruit rot
*Spodoptera frugiperda**	Fall armyworm
Watermelon bud necrosis virus (Tospovirus)	Watermelon bud necrosis
Watermelon green mottle mosaic virus (Tobamovrus)	Tobamovrus
Watermelon silver melon virus (Tobamovrus)	Tobamovrus
Zeugodacus curcubitae (syn. *Bactrocera cucurbitae*)	Melon fruit fly
Zuccchini green mottle mosaic virus (Tobamovirus)	Tobamovirus group, ZGMMV

**established in Australia*

Figure 45. Distribution of melon production by state and territory, 2018–19 (based on LVP)



OLIVES

Represented by the Australian Olive Association
australianolives.com.au

In 2018–19 Australian olive production was valued at $112 million (LVP), with only 49,750 tonne of fresh olives produced, significantly down from the 125,000 tonnes in the previous year. Ten million trees are grown on 450 commercial groves covering 20,568 hectares, with 70 per cent of olive trees concentrated across 20 groves.

In 2019-20 production of olive oil was 9,750 tonne (down from 20,000 tonne in the previous year), or 10 million litres, 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 then new growers have purchased olive groves 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.

Figure 46. Annual value of olive production, 2007–19

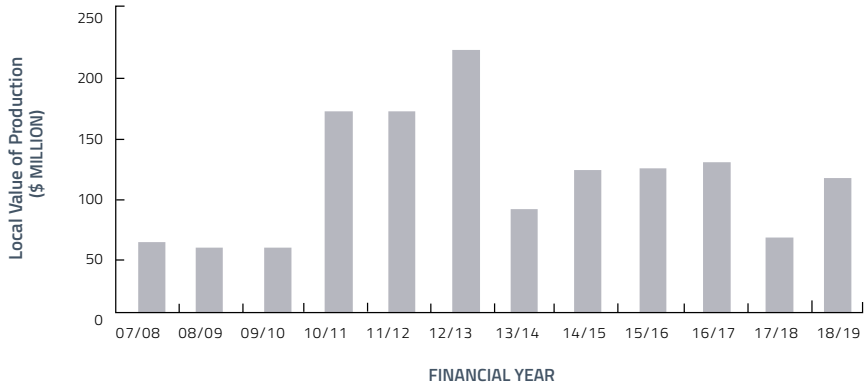
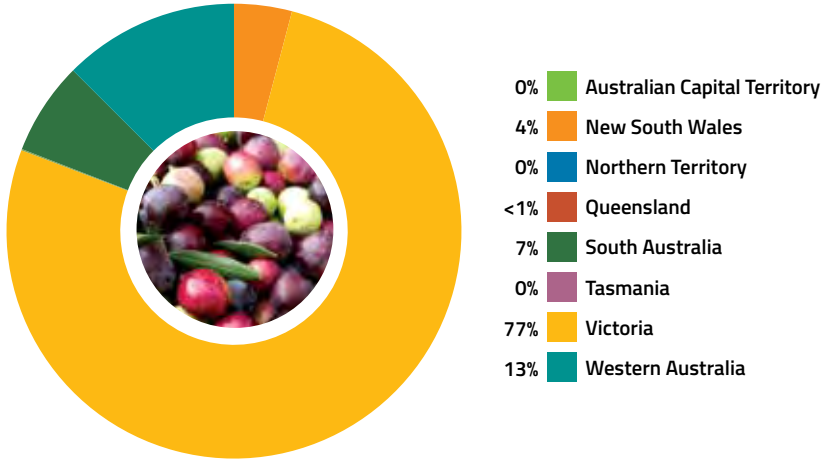


Table 27. High Priority Pests of the olive industry

Scientific name	Common name
Bactrocera oleae	Olive fly
Prays oleae	Olive moth
Verticillium dahliae (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 47. Distribution of olive production by state and territory, 2018–19 (based on LVP)



ONIONS

Represented by Onions Australia
onionsaustralia.org.au

In 2018–19, onion production was valued at $215 million (LVP) with fresh exports valued at $39.2 million.

Onions are grown in most states, but SA and TAS together produce 66 per cent of the Australian crop. Key onion production locations are the Lockyer Valley in QLD, north-eastern regions and the Adelaide Plains of SA and the Devonport–Launceston region of TAS. 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. *Heterosporium allii, Cladosporium allii-cepae, 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. *Meloidogyne 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 48. Annual value of onion production, 2007–19

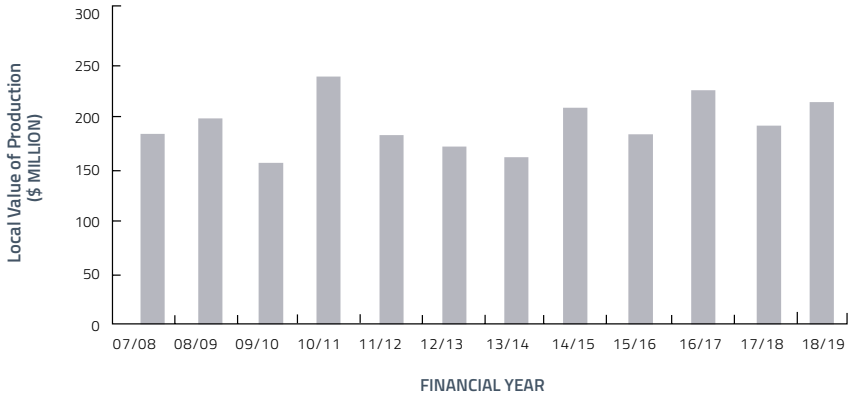
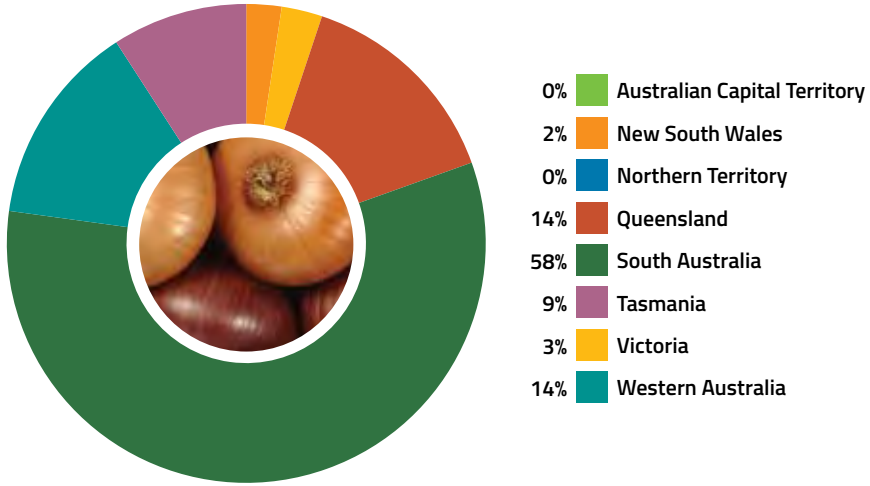


Figure 49. Distribution of onion production by state and territory, 2018–19 (based on LVP)



PASSIONFRUIT

Represented by Passionfruit Australia
passionfruitaustralia.org.au

In 2018–19, passionfruit production of 4,469 tonnes of fruit was valued at $19 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 QLD, and around one third in NSW. The industry is starting to expand in WA, and there are new plantings in the NT and VIC.

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
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 rhabdovirus
Passionfruit yellow mosaic virus (Tymovirus)	Passionfruit yellow mosaic virus
Xanthomonas axonopodis pv. *passiflorae*	Bacterial blight
Zeugodacus curcubitae (syn. *Bactrocera cucurbitae*)	Melon fruit fly

Figure 50. Annual value of passionfruit production, 2007–19

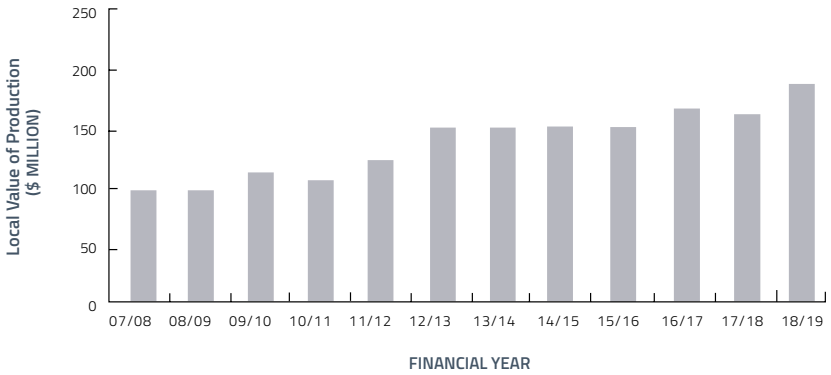
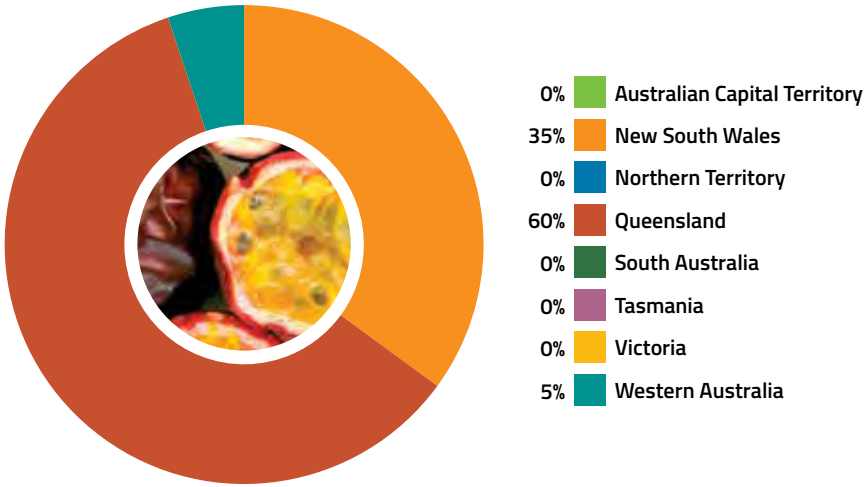


Figure 51. Distribution of passionfruit production by state and territory, 2018–19 (based on LVP)



PINEAPPLES

Represented by GROWCOM
growcom.com.au

In 2018–19 production was valued at $47 million (LVP). The industry estimates that in 2020 around 49,577 tonnes of fresh fruit and 21,056 tonnes of process fruit were marketed. The farm gate value for fresh fruit is $1,140 per tonne and the average price for processed fruit is $366 per tonne.

There are approximately 75 commercial pineapple enterprises, with all but one based in QLD. Key growing districts are in Wamuran, Elimba, 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, Kraft Heinz – Golden Circle Ltd, produces canned pineapple and juice accounting for 91 per cent of the processed fruit.

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

Figure 52. Annual value of pineapple production, 2007–19

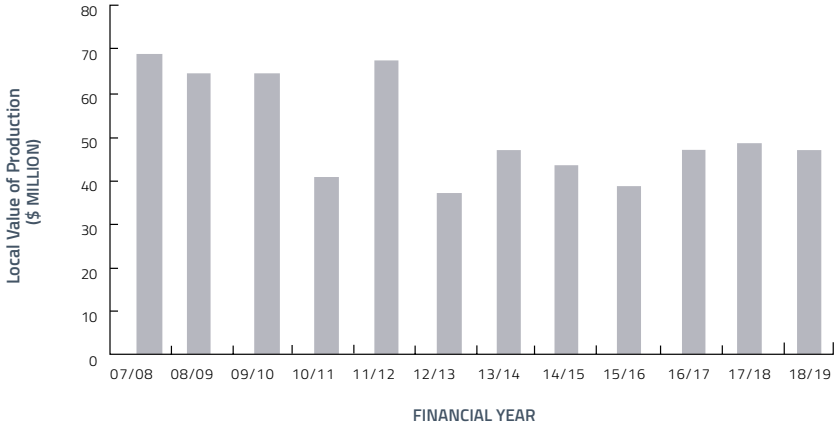


Figure 53. Distribution of pineapple production by state and territory, 2018–19 (based on LVP)

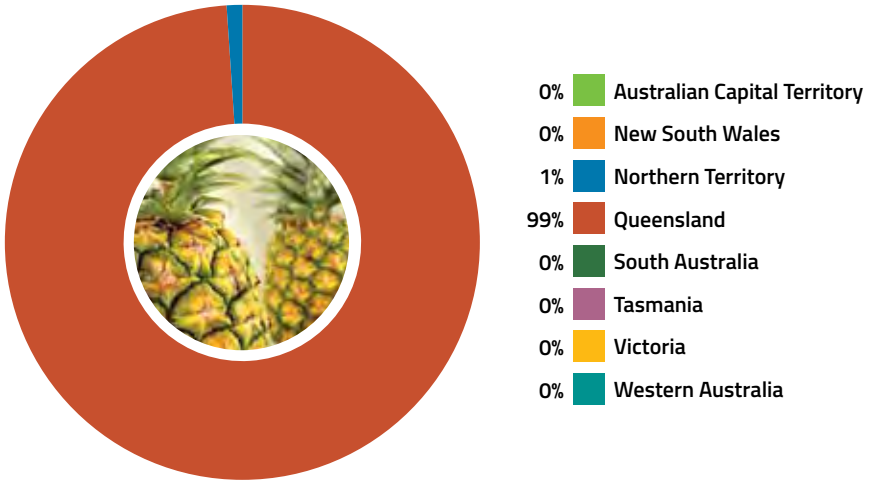


Table 30. High Priority Pests of the pineapple industry

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 Inc
pgai.com.au

In 2018–19, pistachio production was valued at $27 million (LVP), with exports valued at $16.6 million. In 2020, there were approximately 2,000 hectares (bearing and non-bearing) under cultivation with 2,900 tonnes of pistachio nuts produced from the productive orchards.

Major production areas are along the Murray River Valley between Swan Hill in VIC and Waikerie in SA. Further plantings are in central-west VIC and Pinnaroo, SA, with small plantings in WA. 180 hectares of new orchards were planted in 2018, 200 in 2019 and 220 in 2020 representing a total of 1,165 new hectares since 2014. None of this new orchard is currently in production. There are five large pistachio orchards and another five orchards of 10 to 15 hectares, which is the acknowledged size required to make a living solely from pistachio nut production. Around 20 mixed fruit growers each produce less than five tonnes of pistachios (dry) per annum from one to five hectares.

Australian pistachio production currently meets only 50 per cent of domestic consumption, with the remainder imported from other major producers including Iran and the United States. The domestic production of pistachio is expected to increase to 4,000 tonnes (rolling average of two seasons) by 2022 and to 12,000 tonnes by 2030.

Australia is free from major pests and diseases that affect pistachios overseas. Biosecurity is a priority for the industry, with aspects of biosecurity embedded in the Pistachio Industry Australia – the Premium Healthy Nut – Strategic Blueprint 2030, and in two completed Hort Innovation research projects (PS16000 and 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 54. Annual value of pistachio production 2008–19

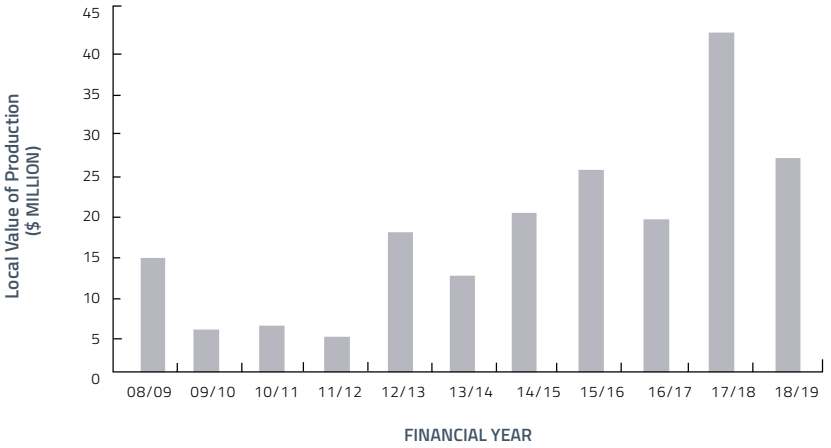
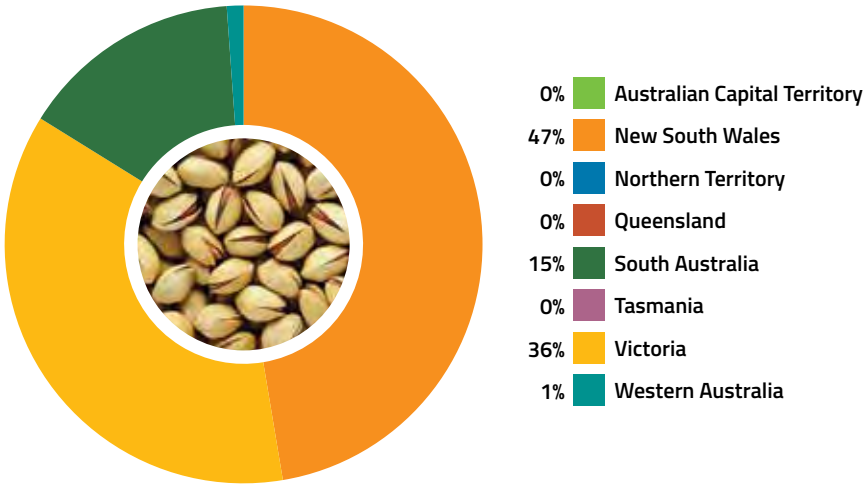


Figure 55. Distribution of pistachios by state and territory, 2018–19 (based on LVP)



PLANTATION FORESTS

Represented by the Australian Forest Products Association (AFPA)
ausfpa.com.au

In 2018–19, plantation forestry production was valued at $2.4 billion (LVP),[36] with wood product exports valued at $3.9 billion.[37] 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 132 million hectares of native forest on public and private land and two million hectares of plantation forestry. Of this native forest, only 78,000 hectares is harvested for timber production 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.

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, QLD, VIC, WA and TAS and are defined as crown land managed for a range of values including wood harvesting, water supply, conservation, recreation and environmental protection.

Plantation species are split 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. Most softwood grown in Australia is *Pinus radiata*, which is the dominant species in SA, WA, NSW, VIC and TAS. *P. elliottii* and *P. caribaea* are also grown in QLD 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 QLD 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. Dominant species planted include *Eucalyptus globulus*, *E. nitens* and *E. regnans*. There are also some plantings of *Acacia mangium*, African mahogany, grown in the NT. In 2015–16, there were 32,000 hectares of sandalwood plantations in the NT, QLD and WA. This estate comprised approximately 17,900 hectares (56%) of *Santalum spicatum* and 14,100 hectares (44%) of Indian sandalwood (*S. album*).[38]

In 2015, Forest and Wood Products Australia funded the development of the Biosecurity Manual for the Plantation Timber Industry and is currently supporting the development of the Plantation Forests Biosecurity Plan 2021–26. In 2017–18, the DAWE with support from the AFPA, funded the development of a National Forest Biosecurity Surveillance Strategy 2018–23.

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

37 Australian Bureau of Agricultural and Resource Economics and Sciences. Agricultural commodities: March quarter 2021. Accessed 20 March 2021. agriculture.gov.au/abares/research-topics/agricultural-outlook/data#agricultural-commodities

38 Australian Bureau of Agricultural and Resource Economics and Sciences. Australia's State of the Forests Report 2018. Accessed online 15 July 2021. agriculture.gov.au/sites/default/files/abares/forestsaustralia/documents/sofr_2018/web%20accessible%20pdfs/SOFR_2018_web.pdf

Since April 2020, AFPA has funded the position of National Forests Biosecurity Coordinator at PHA. The coordinator is working with Australian, state and territory governments and the plantation sector, to establish partnership arrangements that will support a post-border National Forest Pest Surveillance Program 2021–26. The program aims to improve early detection of exotic forest pests and improve the chances of successful eradication before they significantly impact native forests, plantation forests and urban street trees.

Table 32. 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. scutellatus, M. titillator*	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 56. Annual value of plantation forestry production, 2007–19

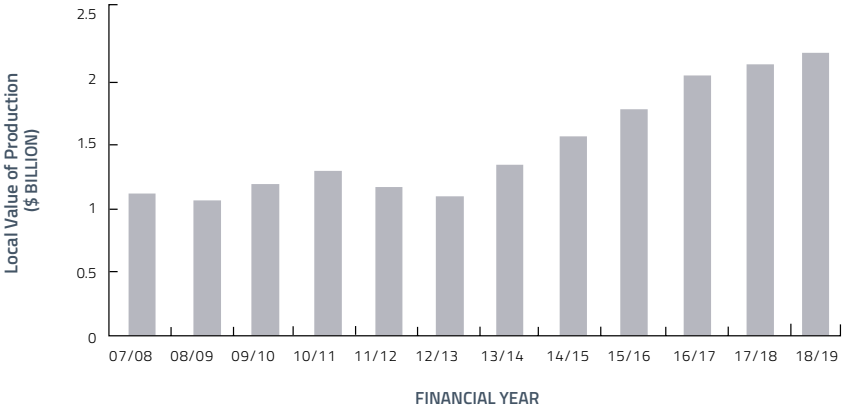
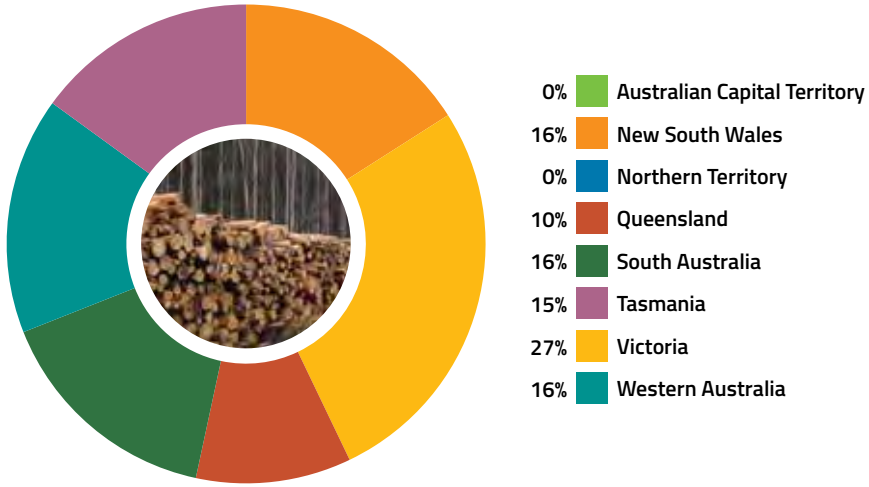


Figure 57. Distribution of plantation forestry production by state and territory, 2018–19 (based on LVP)



PROCESSING TOMATOES

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

In 2018–19, Australian processing tomato production was valued at approximately $23 million (LVP). A total of 210,477 tonnes of tomatoes were delivered to three processors, a slight decline from the previous year. Around 97 per cent of the 2,073 planted hectares were harvested, and the average yield of 105.1 tonnes per hectare was near the industry record despite wet weather during the harvest period.

Heinz varieties made up the bulk of crops grown in Australia. Most crops (86%) were transplanted, and 100 per cent of the production area was irrigated using sub-surface drip lines.

Australians consumed around 575,000 tonnes of processed tomatoes in 2019, 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, 2007–19

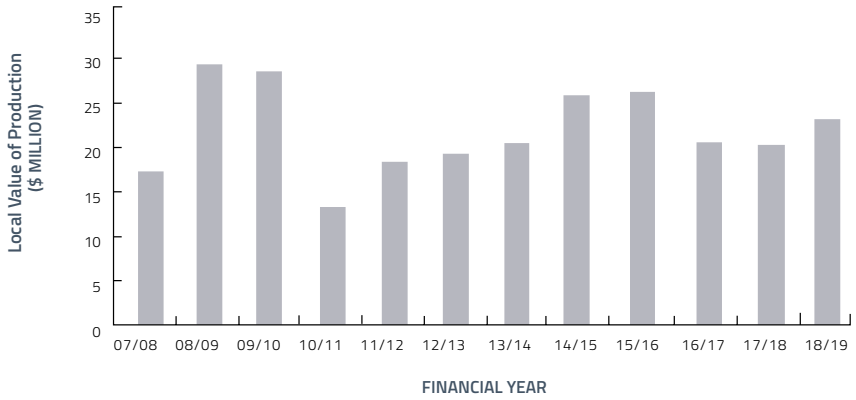


Table 33. High Priority Pests of the processing tomato industry

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, 2018–19 (based on LVP)

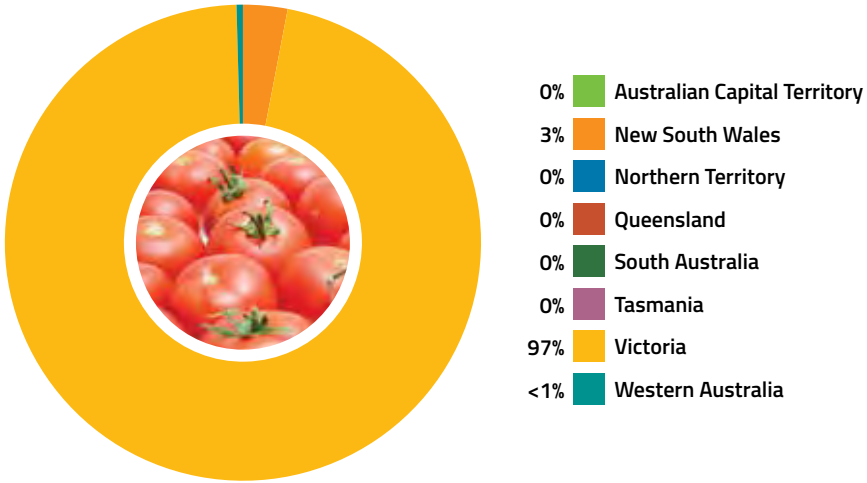


Image courtesy of the Australian Processing Tomato Research Council

PRODUCTION NURSERIES

Represented by Greenlife Industry Australia (GIA)
greenlifeindustry.com.au

The nursery industry operates in all states and territories of Australia, being one of the largest and most diverse plant industries in the country. The industry estimates an annual gross production value of approximately $0.9 billion (production nurseries only) will occur in 2021 across the entire supply chain. Greenlife production nurseries supply to ornamental retail, landscape, revegetation, rehabilitation and production horticulture sectors including tree crops (e.g. fruit, berries, 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. The industry has consistently guided RD&E levy investment towards plant protection and biosecurity resources both at a strategic national level as well as at a grower level.

In early 2018, Greenlife Industry Australia achieved certification and recognition of BioSecure HACCP as an Approved Biosecurity Scheme under the *Biosecurity Act 2014* (Queensland), the first such recognition of a third party certification program in Australia. This was followed by NSW providing equivalent certification under the *Biosecurity Act 2015* (NSW) 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 QLD, NSW, VIC, TAS, 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, 2007–19

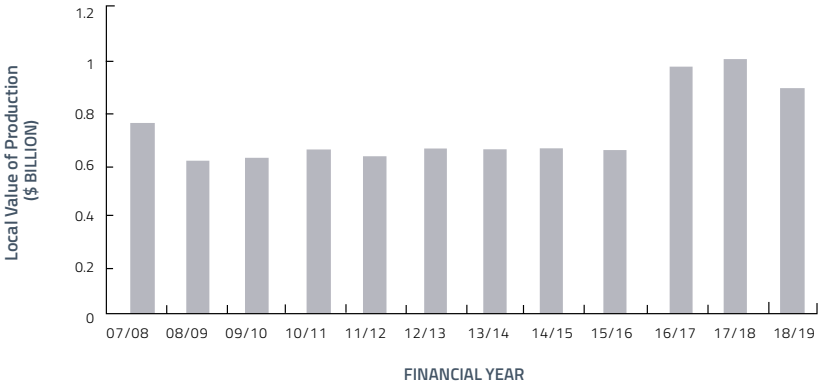


Figure 61. Distribution of production nurseries by state and territory, 2018–19 (based on LVP)

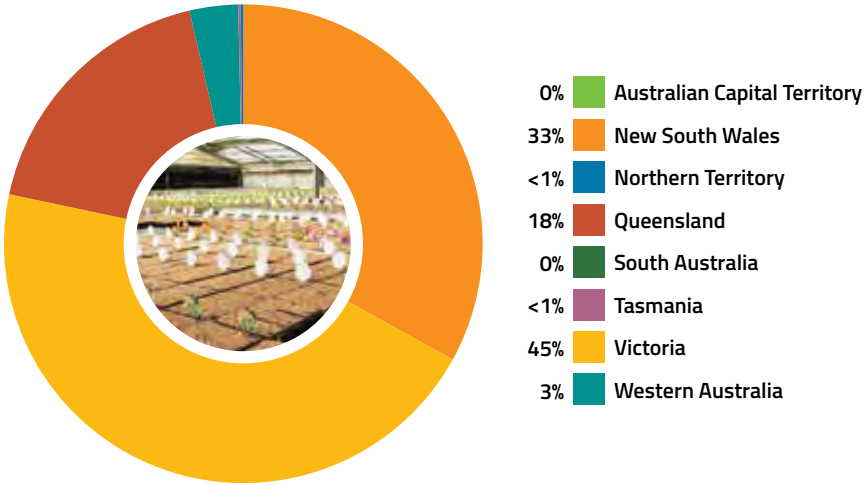


Table 34. High Priority Pests of the production nursery industry

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. *Homalodisca coagulata*)	Glassy winged sharpshooter
Lettuce infectious yellows virus (Crinivirus) and other exotic whitefly transmitted viruses	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 (subspecies not specified)	Pierce's disease, blueberry leaf scorch, olive leaf scorch, olive quick decline, phony peach, plum leaf scald

RICE

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

In 2018–19, rice production was valued at $31 million (LVP) with exports valued at $299 million.[39]

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 QLD and NT. In the 2019 season in NSW, 96 farms produced a total of 54,000 paddy tonnes of rice and in the 2020 season, 99 farms produced 45,000 paddy tonnes, the latter being the second lowest crop in 70 years.

Rice production in Australia is highly variable, reflecting water availability and the prices of alternative crops. Rice is sown from October to December and harvested in March to May in southern NSW.

Most of the rice produced in Australia is medium grain rice, the majority of which is exported. Ninety one percent of the 2019 harvest in southern NSW was medium or short grain varieties.[40]

The rice industry continues to conduct research into suitable varieties and management techniques to maximise water efficiency and allow production in north QLD.
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.

Table 35. High Priority Pests of the rice industry

Scientific name	Common name
Lissorhoptrus oryzophilus	Rice water weevil
Magnaporthe grisea	Rice blast
Pomacea cancliculata	Golden apple snail
Rice grassy stunt virus (Tenuivirus)	Rice grassy stunt virus
Rice ragged stunt virus (Oryzavirus)	Ragged stunt virus
Rice tungro bacilliform virus (unassigned)	Rice tungro bacilliform virus
Rice tungro spherical virus (Waikavirus)	Waikavirus, rice tungro spherical virus
Trogoderma granarium	Khapra beetle

Figure 62. Annual value of rice production, 2007–19

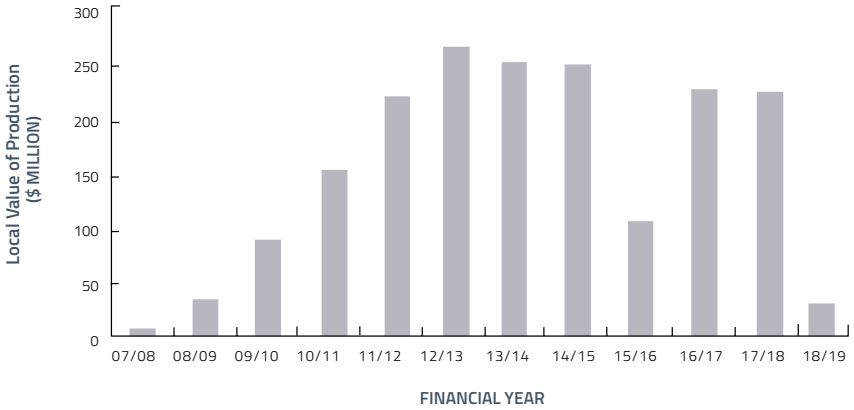
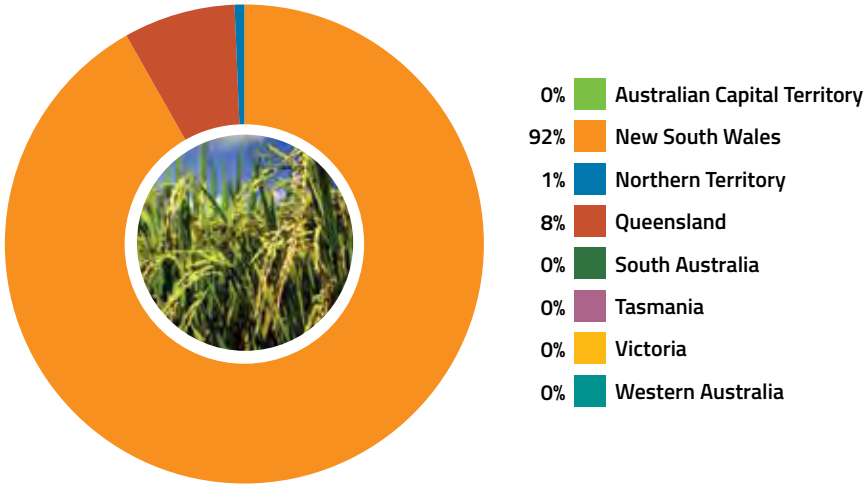


Figure 63. Distribution of rice production by state and territory, 2018–19 (based on LVP)



39 Australian Bureau of Agricultural and Resource Economics and Sciences. Agricultural commodities: March quarter 2021. Accessed 20 March 2021. agriculture.gov.au/abares/research-topics/agricultural-outlook/data#agricultural-commodities

40 Sunrice Annual Report 2019. Accessed online 20 March 2021. https://investors.sunrice.com.au/FormBuilder/_Resource/_module/2weQNICYSUy13FE_jxQXvg/file/annual-reports/Annual_Report_2019.pdf

RUBUS

Represented by Raspberries and Blackberries Australia (RABA)
berries.net.au/home/about/rubus/raba/

In 2018–19, the rubus industry was valued at $187 million (LVP), corresponding to production of 9,478 tonnes.

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, with approximately one per cent of production exported to Singapore, Hong Kong, India, Indonesia and Pacific Island countries. Fresh exports were valued at less than $100,000.

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.

Traditionally rubus is a cool temperate crop with peak production in early summer to autumn. However, year-round supply is possible from subtropical NSW and south-east QLD 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 36. 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 (syn. *Carposina rubophaga, C. adreptella*)	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, backberry mosaic virus, red currant mosaic virus

Figure 64. Annual value of rubus production, 2009–19

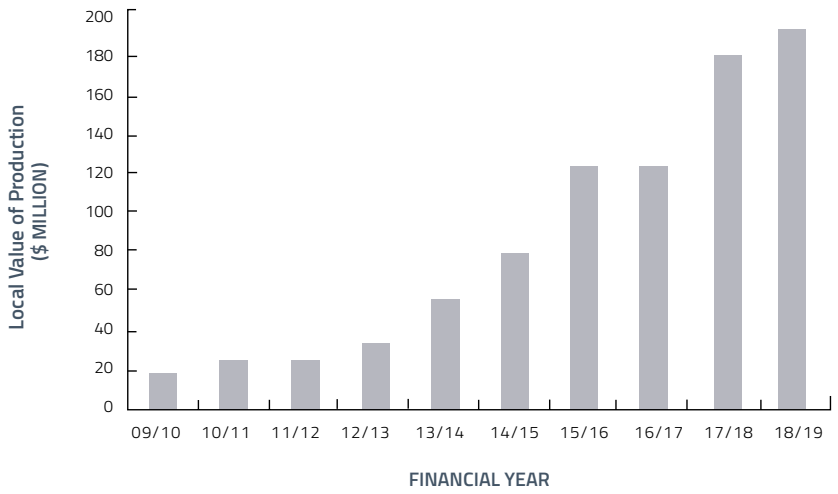
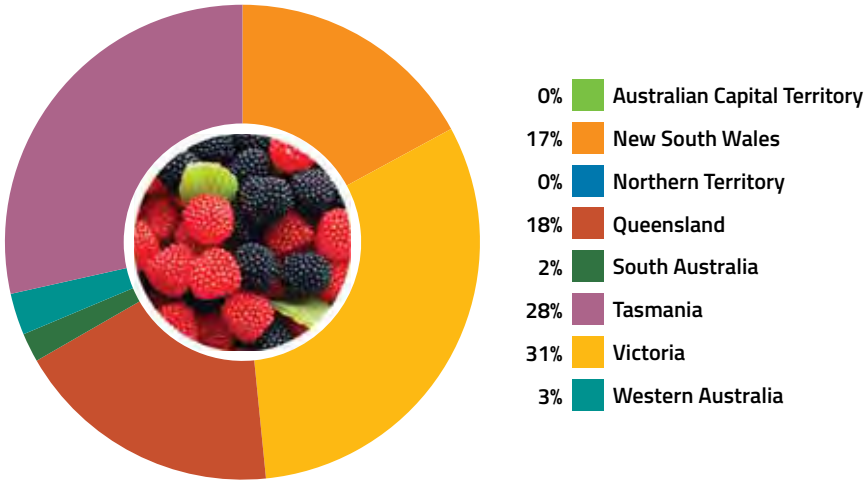


Figure 65. Distribution of rubus production by state and territory, 2018–19 (based on LVP)



STONE FRUIT

Represented by Summerfruit Australia
summerfruit.com.au

In 2018–19, stone fruit production (fresh apricots, nectarines, peaches and plums) was valued at $240 million (LVP), with exports valued at $89 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. VIC produces around 75 per cent of Australia's stone fruit (138,000 tonnes nationally) with the remaining production spread between NSW, QLD, SA, WA and TAS.

Increased stone fruit exports have been driven by demand from China. Market access to mainland China allowed an expansion of exports. During the 2018–19 export season, a record 23,013 tonnes were exported (an increase of 30%). While slightly down in 2019–20, Australia exported 21,300 tonnes of stone fruit worth $89.11 million, with 11,400 tonnes going to China and Hong Kong. Other major markets were United Arab Emirates, Saudi Arabia, Singapore and Malaysia.

In 2020, Summerfruit Australia was involved in several responses to pest incursions affecting the industry, including detections of brown marmorated stink bug, Varroa mite and exotic fruit fly. The industry had representation at PHA meetings and the relevant Australian Government Biosecurity Roundtables.

The Biosecurity Plan for the Summerfruit Industry (which also applies to the canned fruit industry) has been adopted, and components of the plan have been acted upon through 2020.

Table 37. 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 (with *Xylella fastidiosa*)	Glassy winged sharpshooter
Lymantria dispar	Asian gypsy moth
Philaenus spumarius (with *Xylella fastidiosa*)	Meadow froghopper, meadow spittle bug
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, 2007–19

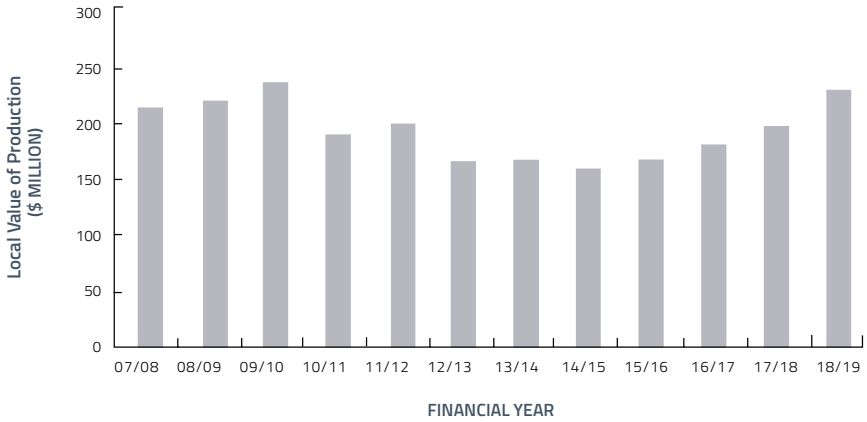
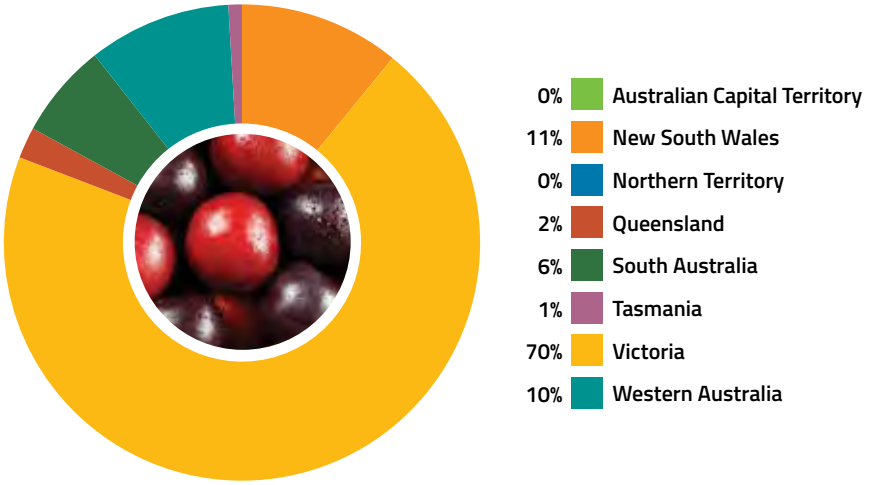


Figure 67. Distribution of stone fruit production by state and territory, 2018–19 (based upon LVP)



STRAWBERRIES

Represented by Strawberries Australia
berries.net.au/home/about/strawberries/sai

In 2018–19, strawberry production was valued at $323 million (LVP) with fresh exports valued at $24.4 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 2018–19 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 QLD, and the Yarra Valley and the Mornington Peninsula in VIC, with other production areas in Wannaroo, Bullsbrook and Albany in WA, the Adelaide Hills in SA, and TAS.

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 plantings of Australian-bred varieties are increasing, particularly in QLD.

Figure 68. Annual value of strawberry production, 2007–19

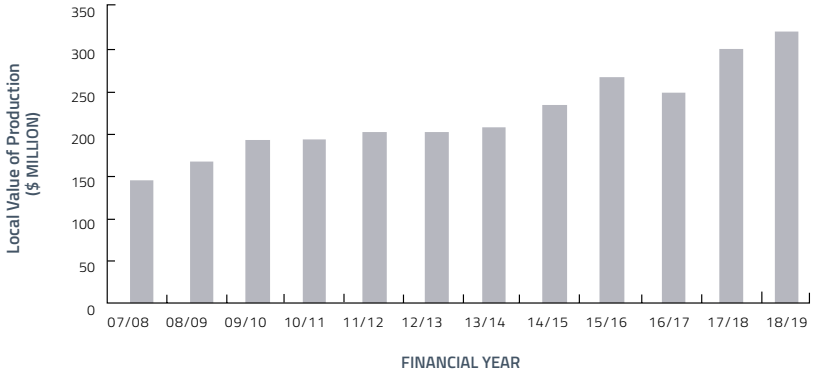


Figure 69. Distribution of strawberry production by state and territory, 2018–19 (based upon LVP)

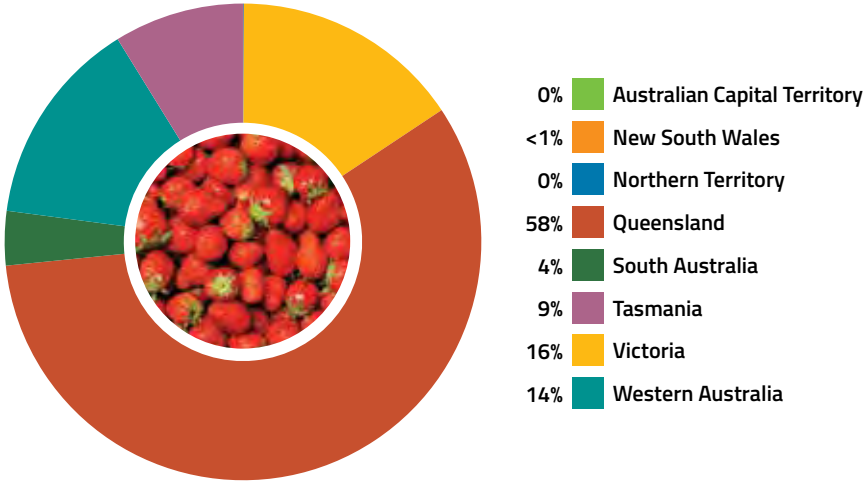


Table 38. High Priority Pests of the strawberry industry

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

SUGARCANE

Represented by CANEGROWERS
canegrowers.com.au

In 2018–19, sugarcane production was valued at $1.2 billion (LVP) with sugar exports valued at $1.53 billion.[41] In 2019, 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 QLD and Grafton in NSW. QLD 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.

41 Australian Bureau of Agricultural and Resource Economics and Sciences. Agricultural commodities: March quarter 2021. Accessed 20 March 2021. agriculture.gov.au/abares/research-topics/agricultural-outlook/data#agricultural-commodities

Figure 70. Annual value of sugarcane production, 2007–19

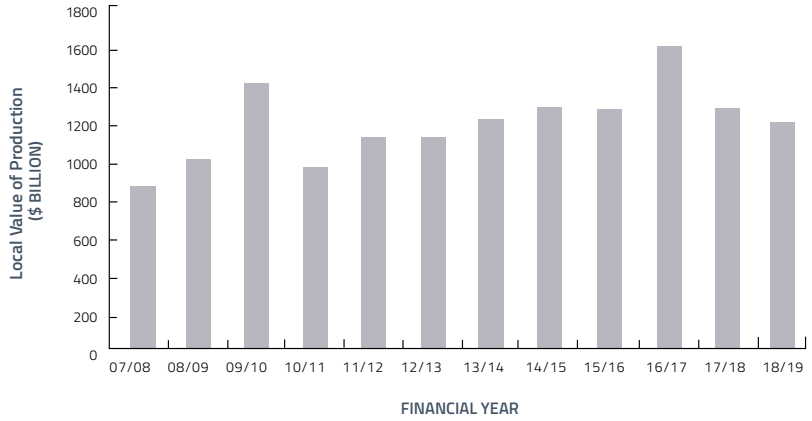


Figure 71. Distribution of sugarcane production by state and territory, 2018–19 (based upon LVP)

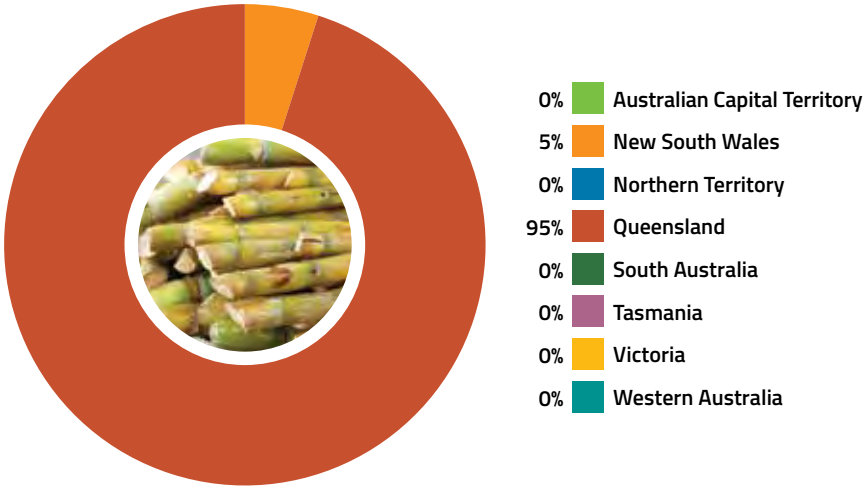


Table 39. High Priority Pests of the sugarcane industry

Scientific name	Common name
Aleurolobus barodensis	Sugarcane whitefly
Ceratovacuna lanigera	Sugarcane woolly aphid
Chilo auricilius	Sugarcane internode borer
Chilo infuscatellus	Yellow top borer of sugarcane
Chilo sacchariphagus	Sugarcane internode borer
Chilo terrenellus	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)
aspg.com.au

In 2018–19, sweetpotato production was valued at $83 million (LVP), with exports valued at $2.4 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 100,000 tonnes. There are around 80 commercial producers with farm sizes ranging from 10 to 200 hectares, with most being 15 to 80 hectares. QLD 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 QLD; 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 2020, the sweetpotato industry updated and progressed its biosecurity plan with PHA. Key efforts included biosecurity training for members of the ASPG executive, and initial development of the Owner Reimbursement Costs Framework, for application during an incursion.

Figure 72. Annual value of sweetpotato production, 2011–19

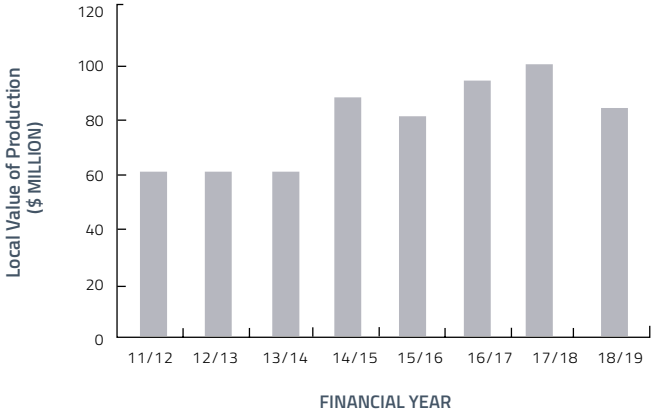


Table 40. High Priority Pests of the sweetpotato industry

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. *Euscepes 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, SPCSV
Sweet potato mild mottle virus (Ipomovirus)*	Mild mottle of sweet potato, SPCSV
Sweet potato mild speckling virus (Potyvirus)*	Sweet potato mild speckling virus, SPCSV
Veronicella cubensis	Cuban slug

**with sweet potato feathery mottle virus and sweet potato chlorotic stunt virus*

Figure 73. Distribution of sweetpotato production by state and territory, 2018–19 (based upon LVP)

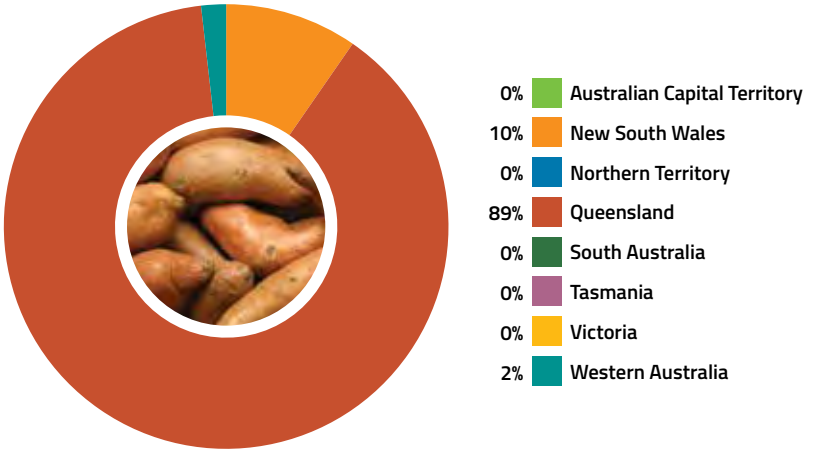


TABLE GRAPES

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

In 2018–19 table grape production was valued at $445 million (LVP), with 220,000 tonnes produced. Exports of 152,200 tonnes predominantly to China, Indonesia, Japan, Hong Kong and the Philippines were valued at $555 million.

In 2019–20, the table grape industry exported 152,200 tonnes, valued at $623 million, which was 12.2 per cent higher than the previous year. Green, red and blue-black varieties of table grapes are produced by approximately 900 growers in the major growing regions of Sunraysia and the Murray Valley in VIC; the Riverland in SA; Swan Valley, Carnarvon and Bunbury regions of WA; central QLD in Emerald, St George, Munduberra and Mareeba; and Ti Tree in the NT.

In the past three years there has been a significant expansion in the table grape sector, with 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 2020–21 season is forecast to see approximately 240,000 tonnes produced, with a 35:65 split between the domestic and export markets.

Figure 75. Distribution of table grape production by state and territory, 2018–19 (based upon LVP)

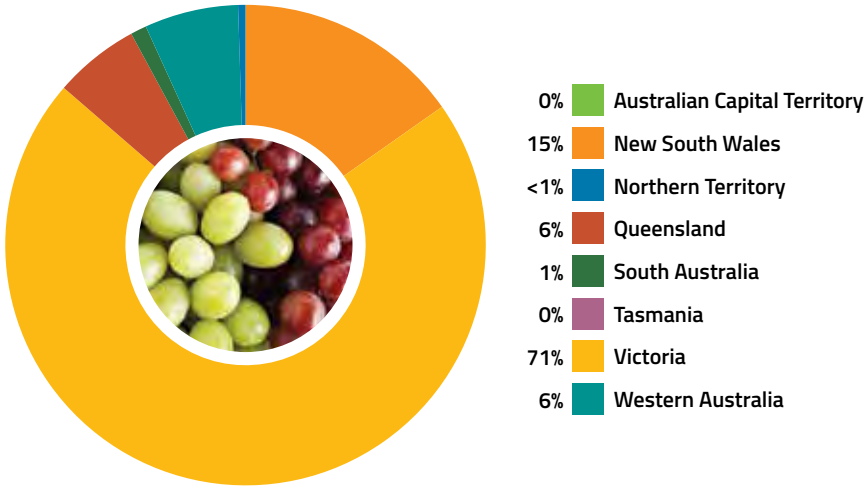
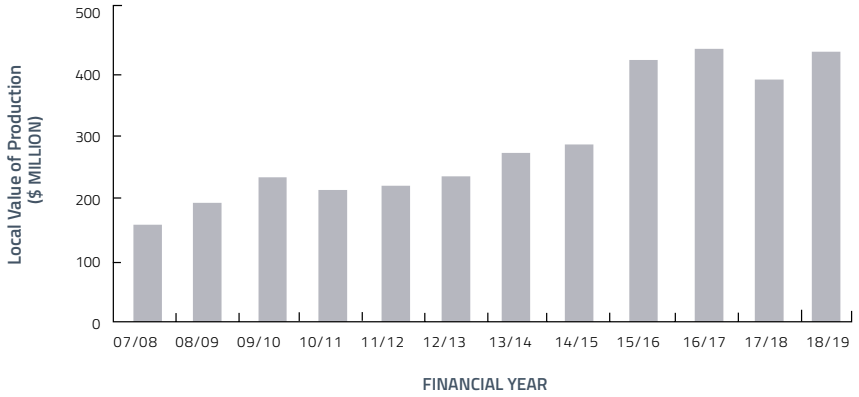


Table 41. High Priority Pests of the table grape industry

Scientific name	Common name
Argyrotaenia citrana	Orange tortrix
Bactrocera carambolae	Carambola fruit fly
Bactrocera dorsalis	Oriental fruit fly
Candidatus Phytoplasma solani	Bois noir
Ceratitis rosa	Natal fruit fly
Drosophila suzukii	Spotted wing drosophila
Grapevine red blotch-associated virus (Geminivirus) (with vector)	Grapevine red blotch associated virus, GRBaV
Guignardia bidwellii	Black rot
Halyomorpha halys	Brown marmorated stink bug
Homalodisca vitripennis (syn. *H. coagulata*)	Glassy winged sharpshooter
Homalodisca vitripennis (with *Xylella fastidiosa*)	Glassy winged sharpshooter
Lobesia botrana	European grapevine moth
Lycorma delicatula	Spotted lanternfly
Planococcus ficus	Vine mealybug
Polychrosis viteana	American berry moth
Pseudococcus comstocki	Comstock's mealybug
Pseudococcus maritimus	Grape mealybug
Tetranychus pacificus	Pacific spider mite
Xylella fastidiosa (subspecies not specified)	Pierce's disease

Figure 74. Annual value of table grape production, 2007–19



TEA TREE

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

In 2018–19, tea tree production was valued at $45 million (LVP), with the vast majority exported. This represents a significant (25%) drop in production due to frost, drought and fire events.

In 2020, there were about 140 tea tree growers in Australia and about 4,800 hectares under plantation production. Industry growth has stabilised, with an average annual production of 1,100 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 QLD.

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%) 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.

Figure 76. Annual value of tea tree production, 2013–19

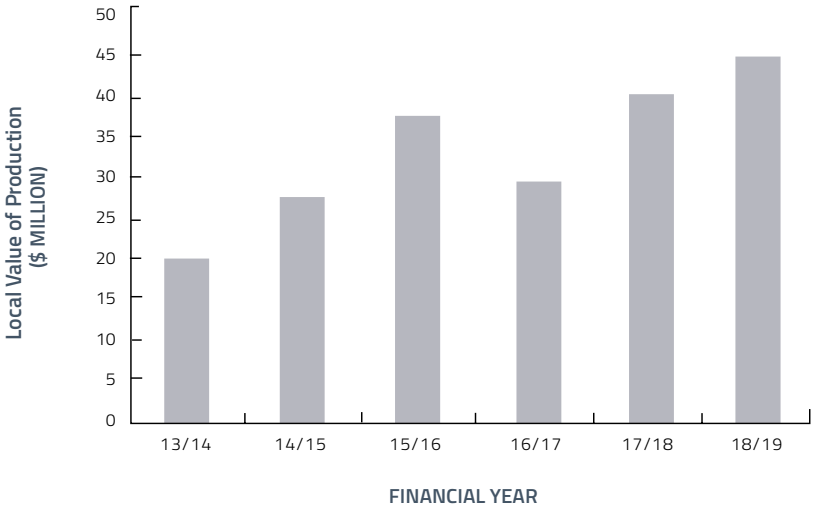


Figure 77. Distribution of tea tree production by state and territory, 2018–19 (based upon LVP)

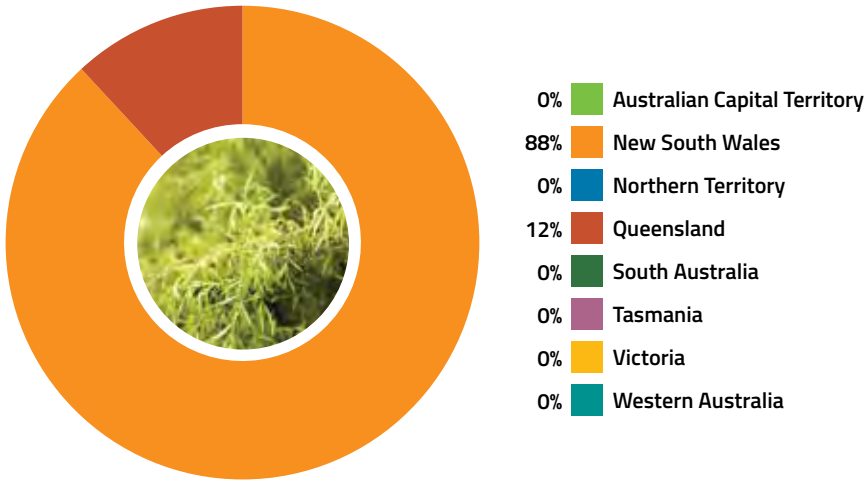


Table 42. High Priority Pests of the tea tree industry

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

TRUFFLES

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

In 2018–19, Australian truffle production was valued at $7 million (LVP), representing a significant reduction on the previous season.

Australian truffles are marketed in more than 40 different countries, with most of the harvest exported to Europe, the United States and Asia.

There is an estimated 450 to 500 truffle orchards, or truffières, around the country, 30 to 40 per cent of which 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 is the Manjimup region of WA, which accounts for around 75 per cent of the harvest. There is increasing production in TAS, ACT, NSW and VIC. A small number of newer farms in SA and southern QLD 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.*

The Australian truffle industry had a difficult 2020 season. The market supplying truffles for use in the home was buoyant, showing a significant increase on previous years, and there may be a flow-on effect next season. With many restaurants closed or only able to provide take home meals due to Covid-19, sales were down. However, in many locations there were reasonable sales made to this sector. The greatest impact was felt by the largest growers and exporters, as overseas markets were unpredictable, hard to access, and hard to get product to, due to transport limitations out of Australia.

Table 43. 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

Figure 78. Annual value of truffle production, 2012–19

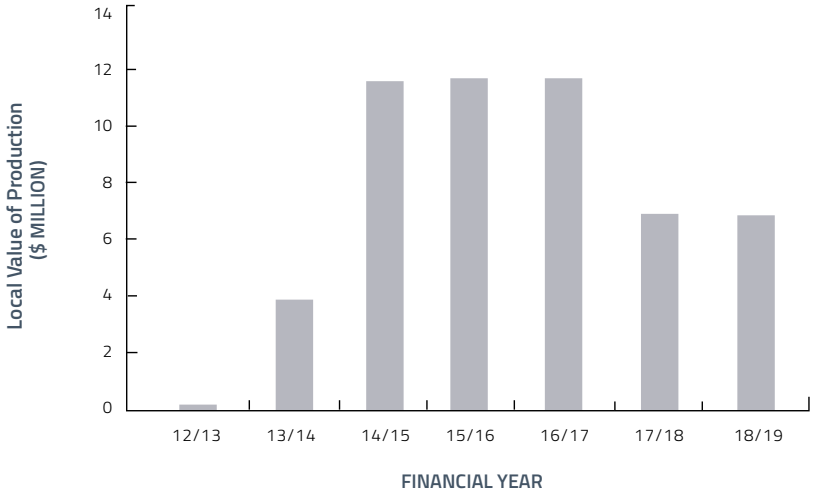
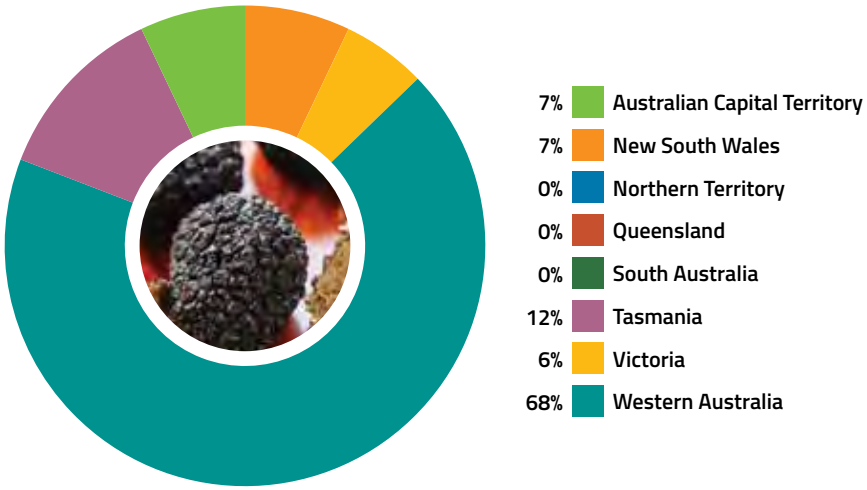


Figure 79. Distribution of truffle production by state and territory, 2018–19 (based on LVP)



VEGETABLES (INCLUDING POTATOES)

Represented by AUSVEG
ausveg.com.au

In 2018–19, vegetable and potato production was valued at $2.6 billion (LVP). Major crops include potatoes, carrots and lettuce. Potato production alone was valued at $659 million (LVP). Exports of vegetables, including potatoes, were valued at $292 million.

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

The Australian vegetable industry is committed to building its capacity to respond to potential biosecurity threats. The employment of two full-time biosecurity officers, a tomato potato psyllid national coordinator and a potato pest surveillance officer allows the industry to participate in a range of biosecurity related initiatives.

In 2020, the biosecurity officers visited numerous growing regions in Australia including Bundaberg in QLD, Katherine and Darwin in NT, Southern Tablelands in NSW, and the Lockyer Valley in QLD. They held a series of regional biosecurity awareness seminars in these regions and visited 18 individual farms. Due to Covid-19, further farm visits were not possible after mid-March. Instead, the officers conducted extensive grower consultation and interview sessions by telephone and Zoom. They also ran more than 10 biosecurity webinars and developed several videos and podcasts. Recordings of these are available at **ausveg.com.au**

The biosecurity officers also participated in technical committee, consultation and project development meetings with the DAWE, and engaged with state government departments, other industry bodies and PHA. They also facilitated a Melbourne-based pilot program that focused on exotic plant pest awareness in urban environments. Officers engaged with community gardeners and urban farmers, raising awareness of exotic plant pests and reporting protocols.

In 2020, the National Potato Biosecurity Surveillance Strategy was finalised, which involved significant engagement with potato growers, processors, seed suppliers and certifiers, industry bodies, the Australian Government and governments in WA, NSW, SA, TAS, VIC and QLD.

Figure 80. Annual value of vegetable production (excluding potatoes), 2007–19

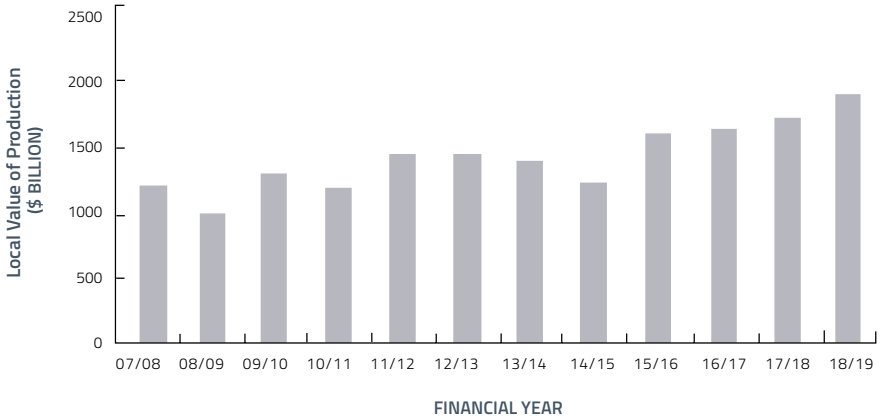


Figure 81. Distribution of vegetable production (excluding potatoes) by state and territory, 2018–19 (based upon LVP)

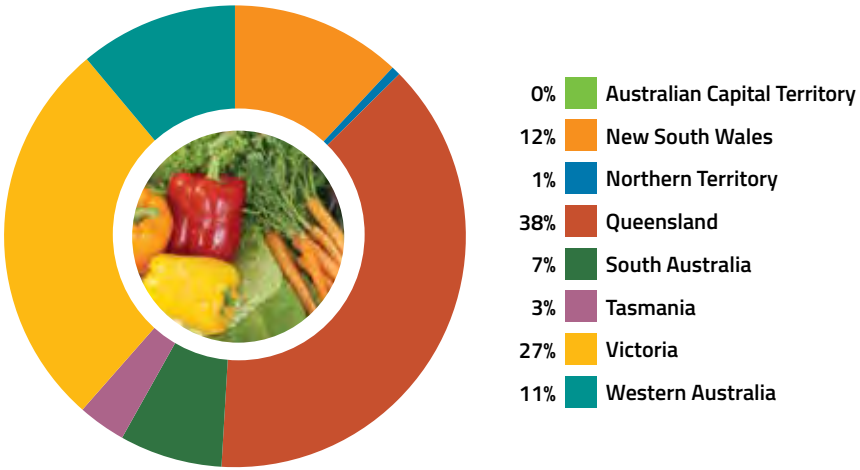


Table 44. High Priority Pests of the vegetable industry (excluding potatoes)

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 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 (syn. *Acremonium maydis, Cephalosporium 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. *M. 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, 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

**established in Australia*

Figure 82. Annual value of potato production, 2007–19

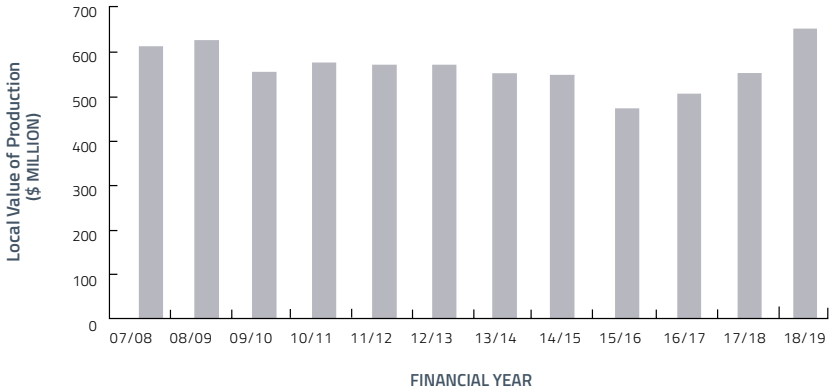


Figure 83. Distribution of potato production by state and territory, 2018–19 (based on LVP)

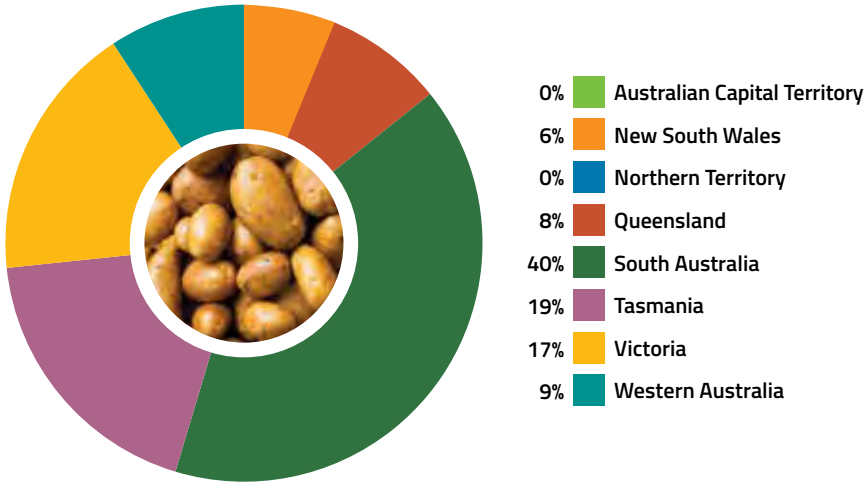


Table 45. High Priority Pests of the potato industry

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. *Ralstonia solanacearum* race 4, *Pseudomonas solanacearum*)	Bacterial wilt

WALNUTS

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

In 2018–19, the walnut industry was valued at $44 million (LVP), with exports valued at $17.9 million. In-shell production of 12,800 tonnes was produced from over 4,000 hectares or 1.2 million trees.

About 45 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 TAS; the Goulburn Valley near Shepparton; the Murray Irrigation Area near Kerang and Swan Hill in VIC; 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 Strategic Blueprint 2030 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 2020, the Australian Walnut Industry Association participated in responses to pest incursions, and funded projects to establish an Emergency Plant Pest Response (EPPR) levy and an Owner Reimbursement Cost Framework for the walnut industry, available on the association and PHA websites. Consultation was undertaken on the EPPR levy and the industry is working through the requirements, with the aim of the levy being legislated in 2021.

Table 46. 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, 2007–19

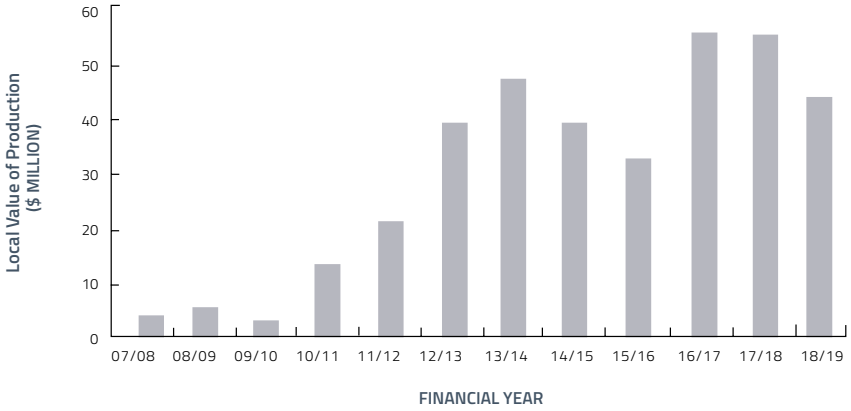
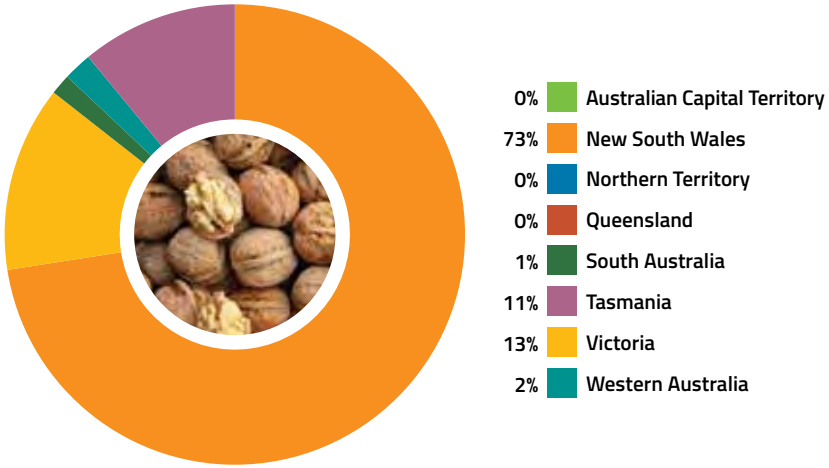


Figure 85. Distribution of walnut production by state and territory, 2018–19 (based on LVP)



WINE GRAPES

Represented by Australian Grape and Wine (AGW)
agw.org.au

In 2018–19, the Australian wine grape industry was valued at $961 million (LVP). The value of Australian wine exports was $2.95 billion.

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.

AGW promotes biosecurity within the sector and the viticulture industry more broadly. Its Wine Biosecurity Committee provides a mechanism to coordinate and prioritise biosecurity work across the wine sector and to promote leadership. AGW has worked to improve the sector's capacity to respond to a pest or disease incursion through emergency response planning and training for industry personnel Australia-wide.

In 2019 Hort Innovation and Wine Australia jointly funded the national Xylella preparedness initiative, funding a coordinator to manage cross-sectoral preparedness, act in a liaison role for potentially affected sectors, and ensure there is national awareness and coordination of high-priority RD&E to develop diagnostic tools, technologies, and protocols to screen plant material entering the country and to support active surveillance programs.

Figure 86. Annual value of wine grape production, 2007–19

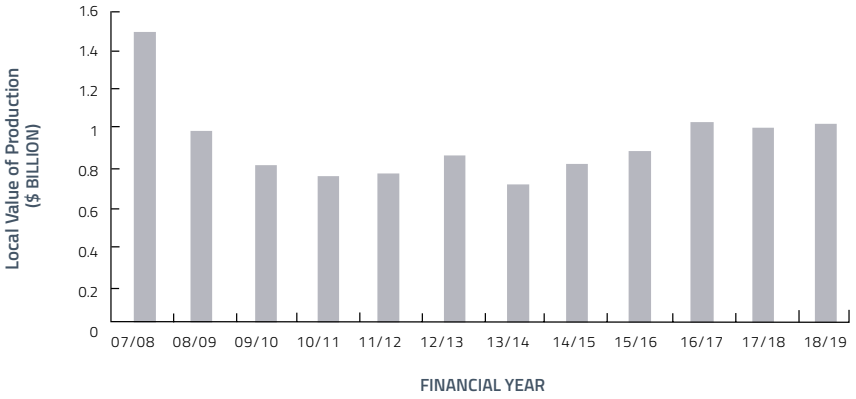
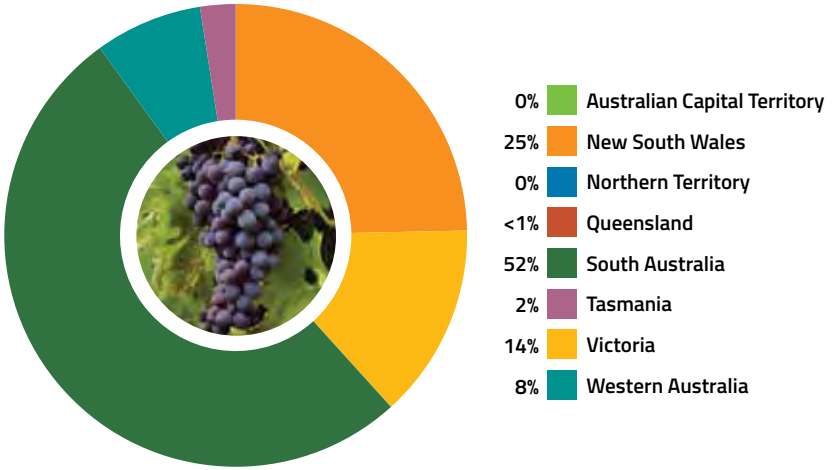


Table 47. High Priority Pests of the wine grape industry

Scientific name	Common name
Argyrotaenia citrana	Orange tortrix
Candidatus Phytoplasma solani	Bois noir
Daktulosphaira vitifoliae (exotic strains)	Grapevine phylloxera
Drosophila suzukii	Spotted wing drosophila
Grapevine red blotch-associated virus (Geminivirus) (with vector)	Grapevine red blotch associated virus, GRBaV
Guignardia bidwellii	Black rot
Homalodisca vitripennis	Glassy winged sharpshooter
Lobesia botrana	European grapevine moth
Lycorma delicatula	Spotted lanternfly
Planococcus ficus	Vine mealybug
Polychrosis viteana	American berry moth
Pseudococcus comstocki	Comstock's mealybug
Pseudococcus maritimus	Grape mealybug
Tetranychus pacificus	Pacific spider mite
Xylella fastidiosa (subspecies 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, 2018–19 (based on LVP)



Chapter 4

Biosecurity supporting market access and trade

Biosecurity supporting market access and trade

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, which 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, border and post-border to safeguard our biosecurity status and maintain trade.

The Department of Agriculture, Water and the Environment (DAWE) has primary responsibility for pre-border and border biosecurity activities. These activities focus on minimising the likelihood of exotic pests and diseases reaching our border or arriving through the movement of people and goods into the country. Australia depends on imports of plant propagative material from overseas, for example, importing large quantities of vegetable seeds annually.

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 such as the horticulture industry gradually increasing exports. The Australian Government's efforts to support exports is also 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 its 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 as a barrier to trade.

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 undertake science-based risk assessments to determine the level of risk, and if the risk does not achieve the ALOP for Australia, to determine the measures that need to be applied to reduce risk to achieve ALOP.

Australia has a number of bilateral free trade agreements with other countries, each of which deals with biosecurity issues and are consistent with the SPS Agreement as 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 help harmonise phytosanitary (plant health) measures.

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 plant pests, diseases and invasive species by international trade. 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 has over 180 contracting parties and is recognised in the SPS Agreement as the body responsible for the establishment of phytosanitary standards relating to pests associated with plants and plant products in international trade, as well as to anything that can act as a vector for plant pests and diseases.

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 DAWE, coordinates and provides input into four international 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 (SC) and associated working groups responsible for the development of ISPMs
- IPPC Implementation and Capacity Development Committee (IC) responsible for facilitating implementation of the convention and its standards and recommendations.

Australia contributes through membership of the SC (one of three members from the FAO's South West Pacific region) and IC, with one expert member. Australia also supports the development of Phytosanitary Treatments and Diagnostic Protocols through membership on the Technical Panel for Phytosanitary Treatments and the Technical Panel on Diagnostic Protocols. In addition to these longer-term roles, Australia strongly contributes to the development and use of ISPMs by providing nominees to the Expert Working Groups to develop new and revised standards and implementation materials.

Australia also continues to contribute a number of technical resources and expertise to support other contracting parties better manage biosecurity 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 contracting parties, is available on the International Phytosanitary Portal at **ippc.int**

Australia's membership of these IPPC bodies provides an important avenue for DAWE to raise and address plant health matters related to international trade. The department consults with peak industry groups and state and territory governments on documents released for global consultation to determine Australia's position on items for the IPPC agenda.

Canberra Agreement

The Pacific Plant Protection Organisation (PPPO), a Regional Plant Protection Organisation (RPPO) recognised under the IPPC, 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 and territories of the United States and France as well as Australia and New Zealand.

In 2020, the annual PPPO Executive Committee meeting was held face-to-face, with Australian participation. Australia also presented training seminars, alongside New Zealand and the PPPO Secretariat, to PPPO Executive Committee members and Biosecurity Authority of Fiji staff. Due to Covid-19 restrictions later in the year, the annual PPPO IPPC regional workshop to consider draft ISPMs and other materials was held virtually.

The Plant Protection Agreement for the Asia and Pacific region

Australia is also a member of a second RPPO, the Asia and Pacific Plant Protection Commission (APPPC). The Plant Protection Agreement is an intergovernmental treaty administered by the APPPC. 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 (RSPMs) that deal with specific regional issues, support the region's trade and may form the basis of an international standard. Australia is an active participant in the APPPC assisting with the development of standards and their implementation in the region. In late 2019, the RSPM for the movement of fresh mango fruit was adopted by the APPPC Session forum. This commodity standard was a first for the region and helped to inform development of the draft concept ISPM on commodity standards, at the international level. Australia holds the Chair – currently Mr Bertie Hennecke, Assistant Secretary at DAWE – and is a member of the APPPC Standards Committee. 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.

Due to Covid-19, the annual APPPC IPPC regional workshop was held virtually, and a number of other activities planned for the region are being augmented to be delivered virtually or have been delayed. This includes workshops four and five of the surveillance workshop series (2016–22) on surveillance management, methodologies and analysis, the workshop on risk categorisation, and that proposed on the topic of risk categorisation and mitigation for semi-processed products under ISPM 32.

PRE-BORDER ACTIVITIES TO MITIGATE THE RISKS FROM IMPORTS

The DAWE 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.

Pre-border activities include:

- conducting risk assessments and risk analyses to consider the level of biosecurity risk that may be associated with imports and imposing relevant risk management measures
- regulating imports to manage risks
- conducting pre-border verifications, inspections and audits on imports
- monitoring imports to ensure they meet all import conditions and managing non-compliance through engagement with importers and exporting country NPPOs as appropriate
- revise import conditions to manage emerging risk and/or changes in pest status, where necessary
- 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
- establishing pre-border risk management schemes in partnership with industry and National Plant Protection Organisations (NPPOs)
- education and awareness activities.

Plate it. Don't plant it.

The biosecurity risks posed by planting fruits, vegetables or seeds from plant food products intended for eating are explained in the 'Plate it. Don't plant it.' campaign.

With an increased focus on sustainable practices, home gardeners have been encouraged to be practical and plant seeds and planting material from food items like fruit and vegetables, and seed from herbs and spices. While this may seem to be a cost effective and resourceful option, there is a risk that people could unwittingly introduce exotic pests and diseases into their garden, which could then spread further, threatening Australia's agricultural industries, unique natural environment and biodiversity.

Instead, 'Plate it. Don't plant it' encourages gardening enthusiasts to visit reputable suppliers such as nurseries to source plants and seeds either certified as free of pests and diseases or grown from healthy propagation material.

Unlike the conditions imposed on imported goods (based on end-use and the potential high risk of introducing plant pests and diseases with seed imported for growing), eating goods have a lower risk of introducing pests and diseases and therefore have less strict import conditions on them. This creates a problem if people plant things meant to be eaten.

Locally, planting fruit and vegetable scraps and seeds saved from Australian-grown food may also unintentionally help spread pests and diseases that are found only in certain parts of the country. An example is bacterial wilt of potato, which could spread further within Australia by planting old potatoes.

More information is on the 'Plant it. Don't Plate it.' webpage **agriculture.gov.au/pests-diseases-weeds/protect-animal-plant/dont-plant-it**

The food you buy is for eating, not planting

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 commodities and intended uses. DAWE 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 permitted entry without a permit subject to meeting alternative conditions that are outlined 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 posed by pests 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, policy reviews and technical advice. 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 BIRA under the *Biosecurity Act 2015* may be conducted where relevant risk management measures have not been established, or where they exist for a similar product and pest or disease combination, but the likelihood or consequences of entry, establishment or spread of pests or diseases could differ significantly from those previously assessed. Otherwise, other forms of risk assessments can be used.

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.

Table 48 details policy advice finalised by December 2020, 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.

DAWE 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 policy can be undertaken 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.

Information about the assessment of plant imports for weed potential is in Chapter 7.

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 could 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 48. Australian Government import policy advice, final and in progress*

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 WA)	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

Table 48. Australian Government import policy advice, final and in progress (continued)

Year	Commodity	Country (from)
Finalised policy advice (continued)		
2006	Grapes (table, revisions)	USA
2006	Grains	Various
2006	Limes (Tahitian)	New Caledonia
2006	Mangoes	Taiwan
2006	Permitted seeds	All countries
2006	Stone fruit (into WA)	New Zealand
2006	Wood packaging	Generic
2007	Apples	New Zealand
2007	Avocado (revision)	New Zealand
2007	Grains	Various
2007	Lettuce (re-instatement)	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. for the biological control of the weed *Parkinsonia aculeata*	Source country
2014	Grapes (table)	Japan
2014	Salacca	Indonesia

Table 48. Australian Government import policy advice, final and in progress (continued)

Year	Commodity	Country (from)
Finalised policy advice (continued)		
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
2016	Grapes (table)	India
2016	Grapes (table)	Sonora, Mexico
2016	Grapes (table, into WA)	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
2020	Chinese jujubes	China
2020	Cucurbitaceous crop seeds (review of import conditions)	All countries
2020	*Listronotus appendiculatus* for the biological control of *Sagittaria platyphylla* and *Sagittaria calycina*	Source country
2020	Pomegranate	India
2020	*Puccinia spegazzinii* for the biological control of *Mikania micrantha*	Source country
2020	Strawberries	Japan
2020	*Venturia paralias* for the biological control of *Euphorbia paralias*	Source country

Table 48. Australian Government import policy advice, final and in progress (continued)

Year	Commodity	Country (from)
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
2018	*Capsicum* spp.	Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga, Vanuatu
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	*Xylella* bacterial pathogens	All countries
2020	Oriental melons and rockmelons	Korea

* Australian Government Department of Agriculture, Water and the Environment. Plant risk analyses. agriculture.gov.au/biosecurity/risk-analysis/plant

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 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.

DAWE 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 49. 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.

The *Export Control Act 1982* will be replaced with the *Export Control Act 2020* on 28 March 2021. Australia's agricultural export legislation continues to underpin our reputation as a supplier of safe and reliable food and other products, and the assurances to our trading partners that Australian exports meet their requirements. However, the new legislation will consolidate and streamline existing export-related requirements and ensure the legislation is more relevant, responsive and efficient for exporters, farmers and other primary producers.

Biosecurity Bite video series

In August 2020, DAWE released the Biosecurity Bite series. The seven animated videos in the series are aimed at the general public and explain key biosecurity principles and show how plant pest and disease risks are managed pre-border, at the border and post-border in Australia.

The videos cover a range of topics, from the key role biosecurity plays in ensuring safe trade, to explaining the import risk analysis process, and highlighting how biosecurity is everyone's responsibility. Although focused on plant biosecurity, the key messages apply to biosecurity in general and offer a great behind the scenes look at Australia's biosecurity system.

The full video series is available online **agriculture.gov.au/biosecurity/australia/biosecurity-bite**

Table 49. Australia's export legislation, administered by the Department of Agriculture, Water and the Environment

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
Horticulture Marketing and Research and Development Services Act 2000
Horticulture Marketing and Research and Development Services (Export Efficiency) Regulations 2002

* Will be repealed when the *Export Control Act 2020* commences on 28 March 2021

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.

The Plant Export Management System (PEMS) is an IT system that is used by the department to capture and store information relating to the export of plants and plant products from Australia, including plant export Authorised Officer (AO) inspection and calibration results for product and transport units.

The availability of PEMS for industry aims to streamline the plant export inspection documentation process for clients and external AOs, by eliminating the need for manual submission of inspection and calibration documentation.

With funding from the Busting Congestion for Agricultural Exporters budget announcement, DAWE is looking to further enhance PEMS and develop alternative methods of providing assurance that plant export entities are meeting their obligated requirements.

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

Table 50 (see page 138) details market access achievements since 2000, including access to new markets, improving opportunities in existing markets, and preserving existing market access.

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 of concern for market access. Outcomes are collated to provide evidence of absence of a pest from the country, state or region. Better surveillance information gives confidence of claims of pest absence and area freedom.

The Australian Government invested in improving biosecurity surveillance and analysis through the Agricultural Competitiveness White Paper which concluded in June 2019, strengthening surveillance arrangements in Australian industry groups and governments.

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 of the National Biosecurity Committee. Within the NMDS, each record has its own unique identifier code, with data captured on the location and type of surveillance activity, as well as the name and jurisdiction of the organisation capturing 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.

A new Export Plan for fresh produce to New Zealand

November 2020, saw Australia's DAWE and New Zealand's (NZ) Ministry for Primary Industries (MPI) meet virtually for the annual Australia–New Zealand Biosecurity Cooperation meeting.

At the meeting, the parties signed a new Export Plan replacing the 30-year-old Bilateral Quarantine Arrangement to come into effect in February 2021. The agreement removes the need for NZ specific requirements, often duplicated within Australia's system, provides a template for future market access negotiations and improvements and streamlines export requirements for those sending produce to multiple overseas markets.

Australia exports $170 million of horticultural produce to NZ each year. The new Export Plan is expected to reduce red tape and ease regulatory burden. The key changes that will save money and time in the horticultural export supply chain include:

- easier compliance with clearer requirements
- easier market entry for new entities
- removal of nominated inspectors, packhouse or growers each year, and being able to use whoever is approved by NZ
- no need for packhouses to be Registered Establishments if they are not undertaking treatments or Authorised Officer inspections, a cost saving of over $6,000 a year in registration fees and audits
- perpetual treatment provider registration, removing the need for annual re-applications
- reduced audit costs due to the move to a compliance-based assurance model with less audits on compliant entities
- only one inspection of a consignment, provided it has been completed by an Authorised Officer on a grower basis.

Relieving agricultural export congestion is part of the Australian Government's Ag2030 plan to reach $100 billion in farmgate value by 2030 and is welcomed by exporters.

Table 50. Market access achievements for pollinator and plant product exports from Australia since 2000

Year achieved	Commodity	Country
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 TAS)	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 VIC 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 TAS)	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	Philippines
2013	Cherries – access after initiating a protocol and meeting Chinese requirements	China
2013	Citrus	Philippines
2013	Creeping signal grass, sowing	Malaysia
2013	Pome fruit	Philippines

Table 50. Market access achievements for pollinator and plant product exports from Australia since 2000 (continued)

Year achieved	Commodity	Country
	Market access gained and restored (continued)	
2013	Macadamia nuts – access gained for macadamia nuts in-shell for consumption	Ecuador
2013	Teak seed, sowing	Peru
2013	Soybeans	Indonesia
2013	Summerfruit	Philippines
2013	Table grapes	Philippines
2014	Cherries	Thailand
2014	Eucalyptus seed	Paraguay
2014	Forage legume seed, sowing	Chile
2014	Grape seed	China
2014	Lupins	India
2014	Mahogany logs	India
2014	Maize grain	Mexico
2014	Sandalwood	India
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 and other apiculture products	French Polynesia
2016	Honey bees (live queens)	Fiji
2016	Melon (*Cucumus melo*)	Japan
2016	Nectarines	China
2016	Split broad beans	Iran
2016	Watermelons	Japan
2016	Wheat seed, sowing	Bolivia
2017	Apricots	China
2017	Cherries	Vietnam
2017	Lentils	Iran
2017	Logs without bark and sawn timber	Iran
2017	Plants and plant products	Myanmar
2017	Honey	Saudi Arabia
2017	*Medicago sativa* seed	Iran
2017	Peaches	China
2017	Plant-based horse feed	China
2017	Plums	China
2017	Queen bees	Solomon Islands
2017	Vegetable seeds, sowing	Chile
2017	Willow clefts	India
2018	All melons	Kuwait
2018	Dried, shelled almonds	Chile
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	Carrots – restored	Taiwan
2019	Carrot seeds	Ecuador
2019	Radish seeds	Mexico
2018	Raw cotton bales	Iran
2019	Walnuts	India
2020	Bean seeds (black beans, faba beans and mung beans), sowing	Argentina

Table 50. Market access achievements for pollinator and plant product exports from Australia since 2000 (continued)

Year achieved	Commodity	Country
Market access gained and restored (continued)		
2020	Brussel sprout seeds, sowing	Mexico
2020	Cherries (mainland Australia)	Korea
2020	Citrus – restored	European Union
2020	Grains	Iran
2020	Industrial or medicinal plants	Iran
2020	Oilseeds and oleaginous fruits	Iran
2020	Seeds and fruit	Iran
2020	Seeds, sowing	Argentina
2020	Straw and fodder	Iran
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 TAS) – 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 TAS) – 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

Year achieved	Commodity	Country
Improvements in market access (continued)		
2009	Citrus – revised protocol	China
2009	Mangoes – revised protocol	China
2010	Apples (from TAS) – improved conditions	China
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

Table 50. Market access achievements for pollinator and plant product exports from Australia since 2000 (continued)

Year achieved	Commodity	Country
Improvements in market access (continued)		
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	Cherries	China
2017	Chickpeas	Iran
2017	Chickpeas	Pakistan
2017	Citrus	China
2017	Lentils	Bangladesh
2017	Table grapes	China
2017	Wheat	Iran
2018	De-hulled kiln dried oats	India
2018	Persimmons	Thailand
2018	Rolled oats and oat flakes	Iran
2018	Seed potatoes	Indonesia
2018	Citrus	Vietnam
2018	Table grapes	Vietnam
2019	Seeds, sowing	Malaysia
2019	Table grapes	New Zealand
2019	Timber and logs	Malaysia
2020	Malting barley	India
2020	Pome fruit	India
2020	Summerfruit	India
2020	Table grapes	India
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

Table 50. Market access achievements for pollinator and plant product exports from Australia since 2000 (continued)

Year achieved	Commodity	Country
Maintained in market access (continued)		
2012	Barley (malting), processing	South Korea
2012	Multiple products	Indonesia
2012	Multiple products	Vietnam
2012	Pome fruit	India
2012	Summerfruit (plums)	Taiwan
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 – re-instated 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

Border biosecurity

Live animals and plants, packaging, plant material, animal products and certain food from overseas have the potential to introduce some of the world's most damaging pests into Australia. Pests, weeds and diseases can also hitchhike a ride on containers, machinery, vehicles, equipment and various non-plant and animal-based products. 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 DAWE 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, travellers and baggage, cargo, mail, animals, plants and plant products arriving in Australia
- managing the high biosecurity risks of live plants and animals through containment, observation, testing and/or treatment at post-entry 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.

The Australian border restrictions, implemented in March 2020 due to Covid-19, significantly reduced international arrivals. For much of the year, travellers were not arriving from the typical range of countries from which they would ordinarily arrive. Similarly, the numbers of biosecurity risk items intercepted at the airports were not typical of the numbers that would ordinarily occur. Between January and October 2020, 80,372 biosecurity risk items were intercepted at Australia's international airports: 18,364 at Melbourne, 11,888 at Perth and 27,097 at Sydney.

In 2020, around 79 million mail items moved through mail centres compared to 87 million in 2019. The most commonly intercepted items in both years were seeds, meat and other animal products, such as pet supplements.

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. All 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 import conditions for plant, animal, mineral and human commodities which must be met to be brought or imported into Australia. People wishing to bring in goods can check the conditions of entry at **agriculture.gov.au/import/online-services/bicon**

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.

Upon requests through import permit applications, goods may be allowed to be brought or imported into Australia under permit conditions that are different from import conditions specified on BICON. Where permit conditions are different from import conditions on BICON, the permit conditions must be met.

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 **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).

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, Water and the Environment

GOVERNMENT SCREENING AND INSPECTION

DAWE employs more than 7,000 staff,[42] some of whom contribute to the inspection of international vessels and travellers, 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 regulate 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 risk assessment and intelligence tools are used to assess biosecurity risk and respond appropriately.

Screening passengers

Passengers travelling to Australia are provided with an Incoming Passenger Card by the aircraft or cruise vessel crew. Similarly, the crew complete a Crew Declaration Form. The Incoming Passenger Card and Crew Declaration Form are legal documents and must be completed truthfully. Travellers must declare if they are carrying certain food, plant or animal products. Declared goods are assessed by a biosecurity officer and, if the import conditions are met, released to the traveller.

The department applies automated risk assessments to all international travellers to target high biosecurity risks. Biosecurity officers assess the risk and select travellers for screening based on both the declaration and the automated and physical risk assessment outcomes.

Baggage is screened for undeclared goods by x-rays, detector dogs or physical inspection. Based on risk assessments, biosecurity officers may inspect baggage regardless of whether travellers declare goods or do not declare any goods.

Depending on the item and its biosecurity risk, you may:

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

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.

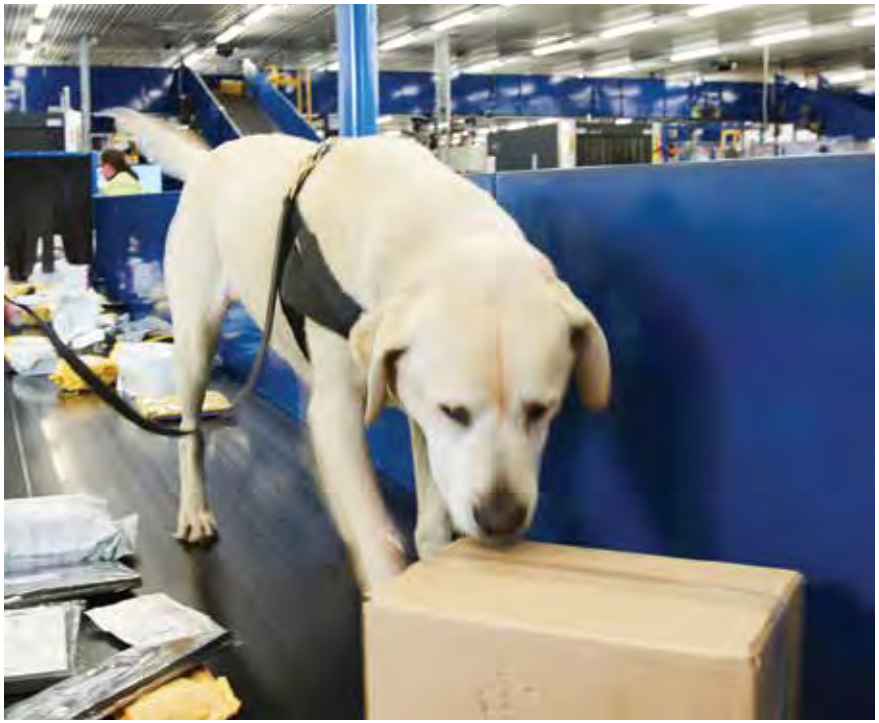
Alternatively, goods such as food, plant material or animal items that pose an unacceptable biosecurity risk can be voluntarily disposed of in bins located in the terminal. Goods that present an unacceptable level of biosecurity risk will be managed in accordance with the *Biosecurity Act 2015*. If arriving 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* may cause a visitor's visas to be cancelled for failing to declare food concealed in luggage, or knowingly providing false or misleading information.

Screening mail

When goods arrive at the Australian border, they are assessed for biosecurity risk and a decision is made on whether they can enter Australia.

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 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.



Detector dogs are trained to find items that could bring pests or diseases into Australia such as certain food, plant material and animal products. Image courtesy of the Department of Agriculture, Water and the Environment

42 Australian Government. Transparency Portal. Accessed online 31 March 2020 transparency.gov.au

Use of detector dogs

Detector dogs are used by DAWE 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, detector dogs intercept up to 9,000 biosecurity risks during their working life. In 2020 the detector dog fleet intercepted approximately 13,500 risk items and screened 15,706,488 million mail items nationally.[43] The three most common items the detector dogs find are seeds and nuts, fruit and meat. Some unusual finds included concealed seeds that were taped to the inside of a booklet, brown marmorated stink bugs on an imported forklift and cactus seeds declared as window decorations.

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.

Use of 3D x-ray technology

DAWE has established itself as the world leader in biosecurity innovation by being the first biosecurity agency in the world to deploy 3D x-ray capability in airport and mail environments. The department has also developed and deployed the world's first biosecurity algorithms to automatically detect biosecurity risk material. Algorithms to identify fruit, vegetable, plant material, meat and seafood are deployed on the 3D x-ray units enabling automatic detection of these risk items more accurately and faster than ever before.

The department has 3D x-ray units permanently installed in the Melbourne International Airport and Melbourne and Sydney International Mail Centres and has plans to further expand the use of 3D x-ray. Additional algorithm development projects are also underway as well as research and development of technologies to automatically identify seeds.

43 The Hon David Littleproud. Media release: Super sleuth Ulf shows why he's top dog. Accessed online 17 May 2021 https://minister.awe.gov.au/littleproud/media-releases/super-sleuth-ulf

NATIONAL BORDER SURVEILLANCE PROGRAM

The National Border Surveillance (NBS) Program commenced in late 2016 and operates under the policy direction of Border Controls Branch, Biosecurity Operations Division, within DAWE. NBS staff are located in the ports of Brisbane, Sydney, Melbourne, Adelaide, Perth and Darwin.

The teams' scope of work includes site assessments and plant health surveillance at all of Australia's biosecurity entry points. These include first points of entry (seaports and airports), and premises of businesses handling imported goods of biosecurity interest or biosecurity risk material (so-called Approved Arrangements[44]), plus associated or surrounding areas.

An assessment is made of the biosecurity risk a site poses based on a number of factors. These include the type, quantity and origin of the goods received, the presence of vegetation, dunnage or other rubbish piles, and the level of weed control and maintenance of surfaces.

NBS surveillance activities include general surveillance for any potential exotic pests in addition to targeted surveillance for a range of national high priority plant and environmental pests. The aim is to detect exotic pests that may have escaped from conveyances, containers, goods or passengers at the border and before they establish and to contribute to Australia's area freedom determinations.

NBS staff have a growing track record of detecting exotic plant pests with more than 60 detections since the program's establishment. They also maintain Australia's most extensive exotic ant surveillance program. When significant exotic plant pests are detected, NBS staff will delimit the extent of the infestation before conducting a response to complete its eradication. If the infestation is found to go beyond the biosecurity entry point, response activities are carried out together with state or territory counterparts.

When visiting sites, NBS staff engage with the industry participants and distribute information material to raise awareness of key exotic priority plant pests.

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

44 Approved Arrangements, previously Quarantine Approved Premises and Compliance Agreements, are voluntary arrangements entered into with the Department of Agriculture, Water and the Environment. 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 QLD to Broome in WA and including the Torres Strait – are managed by DAWE'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, Torres Strait operations or regulation, and community engagement.

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.

Figure 89. Biosecurity risk pathways regulated by NAQS

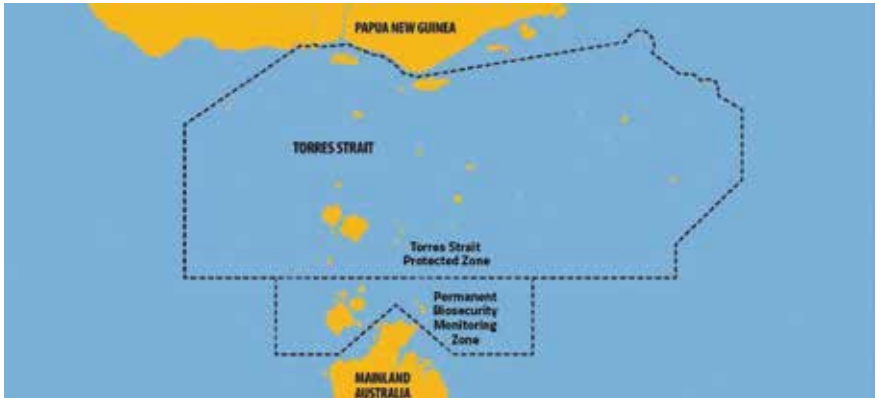


Image courtesy of the Department of Agriculture, Water and the Environment

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 being eradicated under the Exotic Fruit Fly in Torres Strait Response Plan 2018–21. 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 the 15 potentially affected industry Parties pay a share of the cost of keeping these pests out of Australia. See Chapter 6 for more on emergency responses.

Oriental fruit fly (left) and melon fly (right) are persistent biosecurity risks to Australia's horticultural industries. Images courtesy of Scott Bauer (left) and Florida Division of Plant Industry Archive, Florida Department of Agriculture and Consumer Services (right), Bugwood.org

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 specific import conditions. These include imported plant material spending time in post-entry quarantine facilities, allowing for growth and disease screening and testing to ensure only material free from pests and diseases of biosecurity concern to Australia can be released.

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 to enter 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 plant species that have not previously been imported and have no import conditions, will be subject to a weed risk assessment. A new plant genus will also require a disease risk assessment. Subject to the outcomes of the weed risk assessment and/or the disease risk assessment, the department may develop import conditions for the new species or genus which are added to BICON. High-risk nursery stock undergoes disease screening and testing at the government post-entry quarantine facility at Mickleham in VIC. Medium-risk nursery stock can undergo post-entry quarantine disease screening at a department's approved facility (see Table 51).

The amount of time the plants spend in a post-entry quarantine facility depends on the biosecurity risks they pose, and the specific screening and 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.

Some restricted seeds are also required to undergo post-entry quarantine disease screening. A subset of the department's approved facility listed in Table 51 that operate under a 'process management system' are permitted to undertake quarantine for restricted seeds, and some high-risk nursery stock. For restricted seeds, only the progeny seeds of the plants grown from imported seed that are free from diseases of biosecurity concern to Australia can be released.

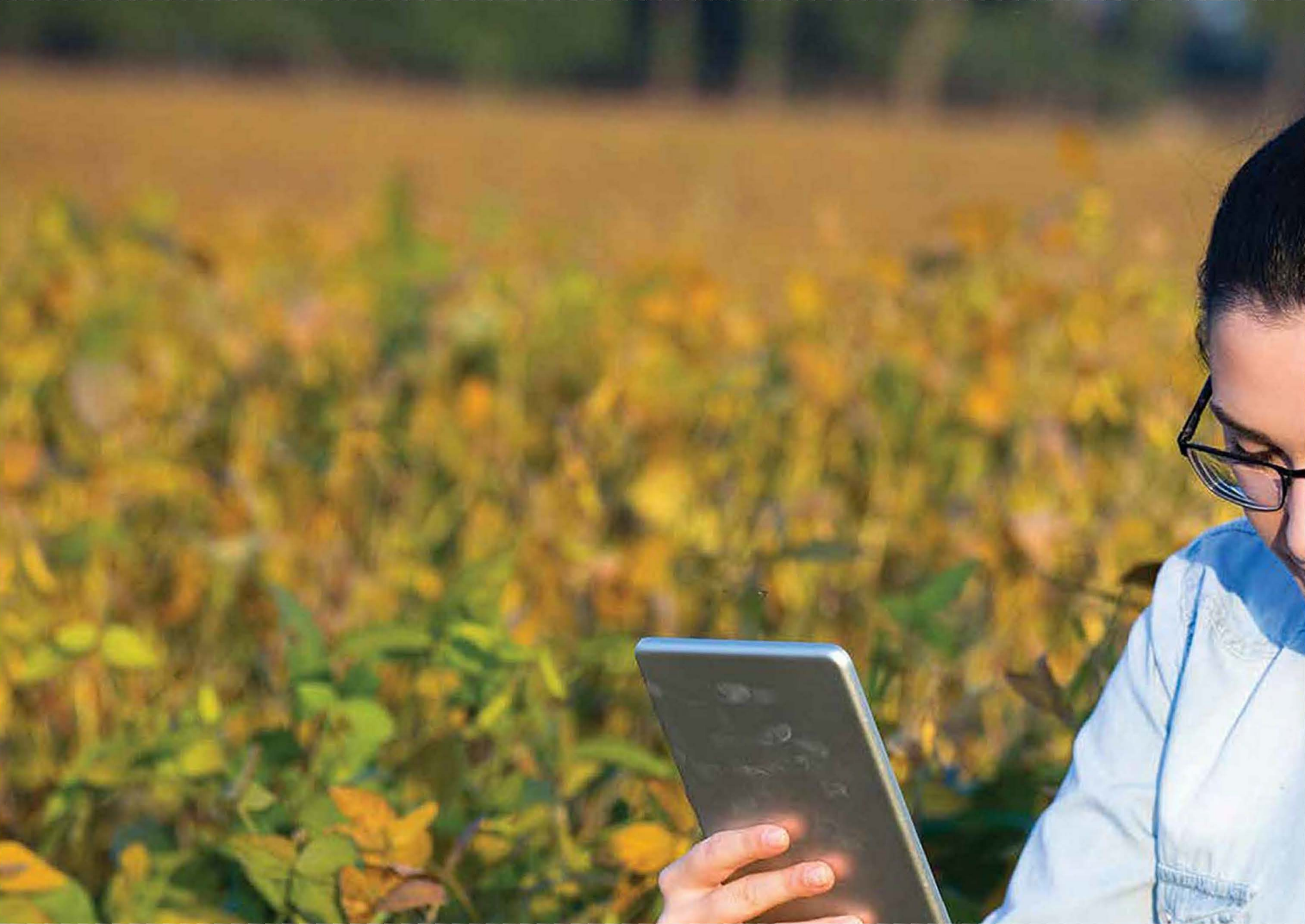
Table 51. Australia's post-entry plant quarantine facilities*

	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 21 Decmber 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.*



Chapter 5

Plant pest surveillance and diagnostics

Farmer and researchers. Image courtesy of CSIRO

Plant pest surveillance and diagnostics

Despite having excellent pre-border and border biosecurity systems in place there is always a chance that exotic pests can enter and become established in Australia. A unique and highly effective post-border biosecurity system exists to provide additional protection from exotic pests. Plant pest surveillance and diagnostics are critical components of this system.

Surveillance covers activities that detect and record the presence or absence of plant pests, while diagnostics is used to precisely identify a plant pest.

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:

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

Diagnostic services, are primarily provided by governments, universities and research organisations, and are coordinated via a national network to support the definitive identification of pest species, types and strains to:

- provide information to ensure appropriate response to an incursion is undertaken
- support pest management
- provide evidence of 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 provides critical information to support decisions for 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

The National Plant Biosecurity Surveillance Strategy (NPBSS) was developed in 2013 to guide national efforts to improve and reform surveillance arrangements. The NPBSS underpins the National Plant Biosecurity Strategy (see page 20) and complements the National Plant Biosecurity Diagnostic Strategy (see page 166).

Implementation of the 2013–20 NPBSS has played a key role guiding activities to support improvements to the national plant biosecurity surveillance system.

Some of the key achievements of the 2013–20 NPBSS include:

- implementation of the Plant Surveillance Network Australasia–Pacific (PSNAP)
- development of the national data aggregation system, AUSPest*Check*™, to connect and coordinate surveillance data systems across Australia
- creation of a suite of industry surveillance strategies to establish partnerships to improve national surveillance outcomes.

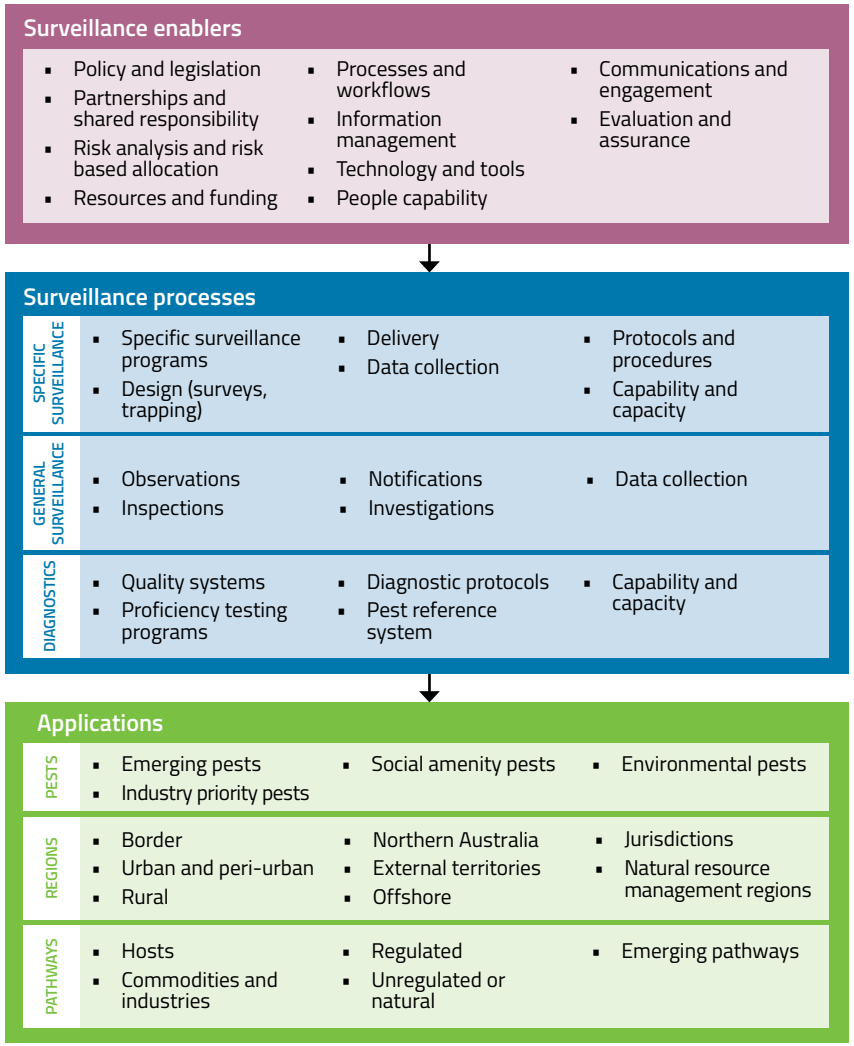
Work is underway to develop a revised ten-year NPBSS and implementation plan to provide continued benefits for the national plant health surveillance system. It is expected that this work will be completed during the first half of 2021.

National Plant Biosecurity Surveillance System framework

Under the National Plant Biosecurity Surveillance System framework developed in 2017 (see Figure 90), the Department of Agriculture, Water and the Environment (DAWE), peak industry bodies, state and territory governments, Plant Health Australia (PHA), community and environmental stakeholders work in partnership 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.

Figure 90. National Plant Biosecurity Surveillance System framework



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

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 Commonwealth Scientific and Industrial Research Organisation (CSIRO).

In 2020 the key roles of the subcommittee were:

- overseeing the development of National Surveillance Protocols, including the process for review
- supporting the PSNAP 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
- supporting review of the NPBSS
- enhancing the collaboration, coordination, efficiency and effectiveness of surveillance efforts nationally.

Plant Surveillance Network Australasia–Pacific

The PSNAP was established in 2017 and encourages membership from a range of stakeholders including, but not limited to, state and territory governments, the Australian Government, CSIRO, PHA, universities and plant industry experts.

Activities are coordinated via a network implementation working group and a network coordinator, operating out of PHA. The network provides a platform for communication about plant pest surveillance and acts as a coordination point for surveillance professionals and practitioners to strengthen surveillance capacity and capability.

The Annual Surveillance Workshop is delivered by PHA to share ideas and knowledge, and to provide professional development opportunities. The network is supported by a website **plantsurveillancenetwork.net.au** which contains resources, news and events on plant pest surveillance.

GOVERNMENT SURVEILLANCE PROGRAMS

Specific surveillance is where checks or surveys are made for particular pests, and records are captured. Most specific surveillance is done by governments, but plant industries also undertake specific surveillance for pests of concern.

The most extensive programs for specific 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 145), the Northern Australia Quarantine Strategy (see page 146) and surveillance programs for fruit flies (see page 146). 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 205).

These and other surveillance activities across Australia (as shown in Table 52 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 DAWE 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 (see page 41), 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 gypsy moths, 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 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 provides a critical source of the 'evidence of absence' data needed to support trade and market access for Australian producers.

Annual Surveillance Workshop 2020

Over 120 people working in pest surveillance attended the fourth Annual Surveillance Workshop in December 2020 with representatives from several plant industries, the Australian Government, state governments, research agencies, Fiji, New Zealand and Timor-Leste.

Delivered by PHA, the two-day virtual workshop built a better understanding of surveillance activities and initiatives in the wider plant pest surveillance system, connected stakeholders, facilitated capability building and grew the Plant Surveillance Network Australasia–Pacific.

The workshop theme aligned to the International Year of Plant Health was 'International, Regional, National and Local – where do you fit in the surveillance continuum?'. Program topics included international surveillance systems, post-border surveillance, cross-industry plant pest surveillance initiatives, urban surveillance and farm monitoring.

Input was also sought from participants on the future activities of the Plant Surveillance Network Australasia–Pacific and the structure and content of National Surveillance Protocols.

More information is available on the Plant Surveillance Network Australasia–Pacific website **plantsurveillancenetwork.net.au**

INDUSTRY SURVEILLANCE STRATEGIES AND PROGRAMS

Examples of industry surveillance programs (as shown in Table 52 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 and forest industries, for which specific national strategies were released in 2018, are being established.

National Bee Pest Surveillance Program in Derby, WA. Image courtesy of WA DPIRD

National Forest Biosecurity Program

Activities to initiate a National Forest Biosecurity Program continued in 2020 with the National Forest Biosecurity Coordinator (employed by PHA) progressing 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 high-risk site surveillance in QLD, NSW and VIC 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 and environmental groups. In 2020 the coordinator role was funded by the Australian Forest Products Association (see page 102).

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 detection system for a wide range of pests and diseases of honey bees.

The program uses a variety of surveillance activities for 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.

A total of 175 sentinel hives of European honey bees were located at 33 sea and airports in 2020. Sentinel hives contain active European honey bee colonies that are inspected for bee pests including Varroa mite, exotic bee viruses, tracheal mite, Tropilaelaps mites, large African hive beetle, small hive beetle and Braula fly. Apart from detections of established pests in known regions, no exotic bee pests were detected.

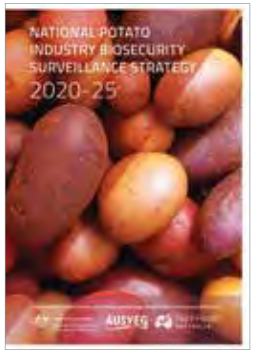
Floral sweep netting is also carried out near ports for the early detection of exotic pest bees including red dwarf honey bee, the giant honey bee, exotic and established strains of Asian honey bee and bumble bees. European honey bees collected by sweep netting may also be inspected for exotic pests.

Australia also had 200 empty hive boxes, termed catchboxes, positioned across 26 ports. Approximately 1,600 inspections took place for the presence of either European or Asian honey bees. European honey bee swarms were captured on eight occasions, and despite these catchboxes not being particularly suitable for Asian honey bees, this species was captured once. In addition, three European honey bee swarms, and two Asian honey bee swarms, were collected at or near Australian ports.

Development of surveillance strategies

The following surveillance strategies were funded by DAWE's Agricultural Competitiveness White Paper 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 Tropical Plant Industries Biosecurity Surveillance Strategy 2020–25 – Developed following extensive consultation with plant industries and governments, because 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 2020–25 – 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.

Inaugural winner of the Dr Kim Ritman Award for Science and Innovation

In November 2020, Professor Brendan Rodoni was announced as the inaugural winner of the Dr Kim Ritman Award for Science and Innovation. This category of the Australian Biosecurity Awards was created to honour the late Dr Kim Ritman's legacy that helped strengthen our biosecurity system to better manage the risk of exotic plant pests and diseases.

Brendan Rodoni, Research Director, Microbial Sciences, Pests and Diseases with Agriculture Victoria and a joint appointee with La Trobe University, was recognised for his outstanding scientific contributions and national leadership in improving Australia's capability in managing plant biosecurity risks.

Highly respected with a wealth of knowledge, Professor Rodoni's understanding of both the theoretical and practical perspectives of biosecurity have made him an influential and impactful scientist and educator, locally and internationally.

With a strong ethos of delivery of outcomes for stakeholders, a sense of public purpose and a passion for people and capability development, his efforts have contributed significantly to innovations in biosecurity.

More information about Professor Rodoni is on the ABA website **agriculture.gov.au/aba**

Brendan Rodoni, winner of the inaugural Dr Kim Ritman Award for Science and Innovation. Image courtesy of Agriculture Victoria

Building strong and integrated surveillance technology

The iMapPESTS: Sentinel Surveillance for Agriculture program is creating national cross-industry surveillance capability to help Australia's plant industries more effectively manage airborne pests and pathogens.

The program uses a mobile network of smart surveillance tools, with specialised trapping technology, deployed across Australia to monitor the presence of high priority pests and pathogens affecting major agricultural sectors, including grains, cotton, sugar, horticulture, wine, forestry, and also emerging industries.

The mobile 'sentinel' units incorporate airborne trapping equipment, a weather station, telemetry and power to capture samples for downstream laboratory analysis and reporting. Various techniques are used to determine which pests and pathogens are present, and in what quantities, based on defined lists of priority targets. Next generation sequencing technologies provide insect diversity data, including for beneficials and predators, to give a picture of insect population dynamics.

The resulting data are collated, visualised and shared with industry and government stakeholders to guide the direction and intensity of scouting efforts and pest control actions on-farm. The system can also facilitate a rapid, coordinated response during incursions, including use in delimiting surveys and proof-of-freedom claims.

More information is available at **www.imappests.com.au**

iMapPESTS is led by Hort Innovation and funded by DAWE as part of its Rural R&D for Profit Program, and the seven plant-based RDCs: Hort Innovation, GRDC, SRA, CRDC, Wine Australia, AgriFutures Australia and FWPA.

(from L to R) iMapPESTS Sentinels 2, 3 and 1 set up at SARDI's Waite Campus in Adelaide, SA. Image courtesy of asbCreative

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 undertake a wide range of routine crop monitoring activities 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 provide information that encourage the reporting of unusual pest or disease symptoms that may be detected during crop monitoring.

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

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

Queensland fruit fly surveillance in Nedlands and Dalkeith regions, WA. Image courtesy of WA DPIRD

International Plant Sentinel Network

The International Plant Sentinel Network (IPSN), coordinated by Botanic Gardens Conservation International, acts as an early warning system to recognise new and emerging pest and pathogen risks. Created in 2014, initially as a Euphresco project, the IPSN has established national and international partnerships between plant scientists, botanic gardens and arboreta.

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

By building connections with international networks, Australian plants in botanic gardens and arboreta overseas act as sentinels that may 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.

As of 2020, seven Australian botanic gardens – the Australian National Botanic Gardens (Canberra), National Arboretum Canberra, Royal Botanic Garden Sydney, Royal Botanic Gardens Victoria, Kings Park and Botanic Garden, Botanic Gardens of South Australia and Royal Tasmanian Botanical Gardens – were part of the network. More information is available from **plantsentinel.org**

The IPSN has been carrying out a pilot study in Australia and New Zealand to determine the feasibility of utilising botanic gardens collections for general surveillance of pests and disease issues on three plant species that are priorities in the United Kingdom (*Quercus robur*, *Pinus sylvestris* and *Rosa* spp.) This activity is funded by the Department for Environment, Food and Rural Affairs in the UK, from April 2020 to March 2021.

PHA is working with Australian botanic gardens and arboreta on a project entitled 'Establishing a program of plant pest surveillance', where a network of staff and volunteers in botanic gardens and arboreta has been formed to raise awareness of biosecurity and to undertake surveillance for key pests.

Boosting pest surveillance by gardeners

Agriculture Victoria's Urban Plant Health Network (UPHN) uses social media in combination with an extensionAUS™ website, **extensionaus.com.au/urbanplanthealthnetwork,** to boost general surveillance efforts by urban and community gardeners in Melbourne.

The online community of practice puts gardeners in touch with a team of scientists and industry experts who share information about exotic pests and diseases that might be found in the home garden. Gardeners are encouraged to look out for and report anything unusual using the MyPest*Guide*™ Reporter app. In 2020, the UPHN focused on six exotic pests:

- brown marmorated stink bug
- glassy winged sharpshooter
- Asian citrus psyllid
- spotted wing drosophila
- red imported fire ant
- Asian honey bee

To increase awareness about these pests and how to report them, UPHN posted content on social media, collaborated with PHA on a webinar series, and created the Top 6 Pests Activity Book and Pest Warrior Comic Book for kids.

In just 15 months, the UPHN grew from having 10 to 22 core members from 11 different industry and science-based organisations, and 1,160 followers on Facebook (@urbanplanthlth).

The Urban Plant Health Network put gardeners in touch with a team of scientists and industry experts to share information about exotic pests and diseases that might be found in the home garden

PLANT PEST SURVEILLANCE PROGRAMS IN 2020

The following figures show the same surveillance programs by target host (Figure 91) and target pest type (Figure 92).

During 2020, 117 plant pest surveillance programs were undertaken, which are detailed by jurisdiction in Table 52.

Figure 91. Surveillance programs by target host

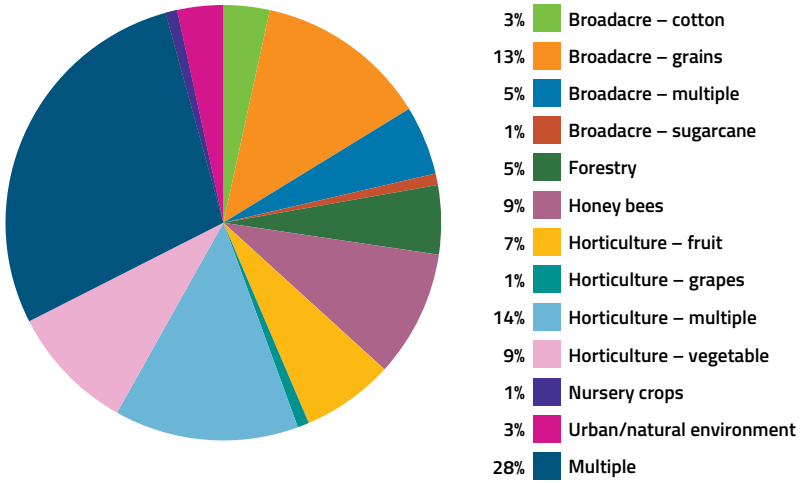


Figure 92. Surveillance programs by target pest type

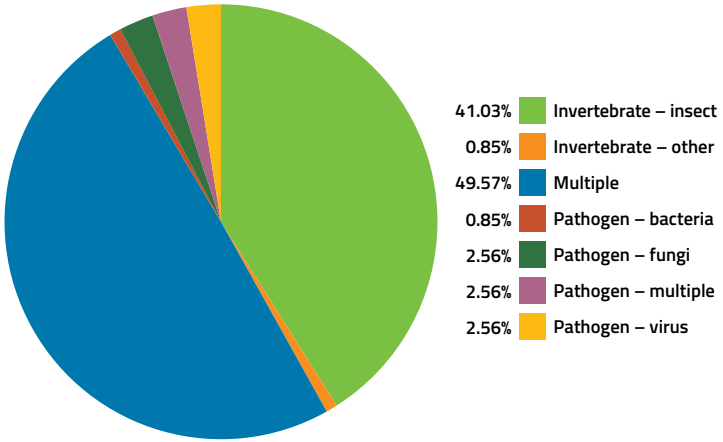


Table 52. Australia's plant biosecurity surveillance programs

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 specific
International Plant Health Surveillance Program	Tropical horticultural, environmental and agricultural species	High priority exotic pests	General and specific
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 and* new exotic swarms of *A. mellifera*	General (noting other stakeholders conduct the targeted surveillance required under this program)
National Border Surveillance Program	Plant families of high economic importance and known or potential key hosts of specific exotic pests, focusing on regulatory import pathway risks	Specific high priority exotic pests and any pest belonging to key taxonomic groups	General and specific
National Plant Health Surveillance Program (delivered through states and territories)	Various, based on the species surveyed	High priority exotic pests including exotic gypsy moth and fruit fly species	General and specific
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*	Specific
Northern Australia Quarantine Strategy – pest and disease surveys	Tropical horticultural, environmental and agricultural species	123 high priority exotic pests, diseases and weeds	General and specific

Table 52. 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	Specific
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	Specific
CGMMV Pest Free Place of Production	Cucurbits	Cucumber green mottle mosaic virus	Specific
Citrus budwood mother tree inspections	Multiple citrus hosts	Various graft transmissable diseases and other high priority pests	Specific
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*)	Specific
Exotic fruit flies – Riverina	Various horticultural crops (citrus, stone fruit)	Mediterranean fruit fly (*Ceratitis capitata*), other tri lure responsive exotic fruit flies	Specific
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*)	Specific
Fall armyworm	Maize, other summer grain crops	Fall armyworm (*Spodoptera frugiperda*)	Specific
Forestry Corporation of NSW Forest Health Surveillance	General forests	Various exotic and endemic high priority pests	Specific
Forest High-Risk Surveillance Program	Multiple	Various exotic and endemic high priority pests of *Pinus* spp.	Specific
Khapra beetle	Grain processing facility	*Trogoderma granarium*	Specific
National Bee Pest Surveillance Program	Ports and surrounding environment	*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*	Specific
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*)	Specific
National tomato potato psyllid and zebra chip surveillance	Solanaceous hosts	Tomato potato psyllid (*Bactericera cockerelli*)	Specific
Onion diseases – Riverina	Onions, garlic	White rot (*Sclerotium cepivorum*), onion smut (*Urocystis cepulae*), onion rust (*Puccinia allii*)	Specific

Table 52. Australia's plant biosecurity surveillance programs (continued)

Surveillance program name	Target hosts	Target pests	Type of surveillance*
Within New South Wales (continued)			
Serpentine leafminer	Multiple horticultural and ornamental hosts	Serpentine leafminer (*Liriomyza huidobrensis*)	Specific
Within the Northern Territory			
Area Freedom Surveillance Program	Horticultural crops	Queensland fruit fly (*Bactrocera tryoni*)	Specific
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	Ports and surrounding environment	*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,* and new exotic swarms of *A. mellifera*	Specific
National Plant Health Surveillance Program – multi pest surveillance	Multiple	Multiple including citrus canker (*Xanthomonas axonopodis* pv. *citri*), huanglongbing (*Candidatus* Liberibacter spp.), Asiatic 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.)	Specific

Surveillance program name	Target hosts	Target pests	Type of surveillance*
Within the Northern Territory (continued)			
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.)	Specific
Within Queensland			
Area freedom surveys	Multiple	Multiple pests	Specific
Area wide management of vegetable diseases	Multiple vegetable hosts	Multiple viruses and bacterial pests	Specific and general
Banana pest surveillance	Banana	A range of banana pests	General
Grain bulk handling companies	Stored grains	Endemic and exotic stored grain 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 of Verticillium wilt (*Verticillium dahliae*), exotic strains Fusarium wilt (*Fusarium oxysporum* f. sp. *vasinfectum*) and all other exotic viruses. Endemic cotton diseases, including *Fusarium* and *Verticillium* spp.	Specific
Endemic and exotic grains virus surveys	Grains and cotton	Various viruses, especially aphid transmitted Polerovirus complex	Specific
Exotic Fruit Fly in the Torres Strait Program	Multiple	Exotic fruit fly including *Bactrocera* and *Zeugodacus* spp.	Specific
Forest High-Risk Surveillance Program	Multiple	Various exotic and endemic high priority pests of *Pinus* spp.	Specific
General forest pest surveillance	Multiple	General forest pests	General

Table 52. Australia's plant biosecurity surveillance programs (continued)

Surveillance program name	Target hosts	Target pests	Type of surveillance*
Within Queensland (continued)			
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	Ports and surrounding environment	*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,* and new exotic swarms of *A. mellifera*	Specific
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*)	Specific
National Plant Health Surveillance Program	Multiple	Multiple, including exotic fruit flies, exotic gypsy moths, Pierce's disease (*Xylella fastidiosa*) and glassy winged sharpshooter (*Homalodisca vitripennis*)	Specific
Panama TR4 Program	Banana	Panama disease (*Fusarium oxysporum* f. sp. *cubense*)	Specific
Plant Pest Diagnostic Service – broadacre cropping	Broadacre field crops	All pathogens that can affect broadacre crops (cotton, grains, pastures)	General
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)	Specific
Sucking pest management in cotton	Cotton	Solenopsis mealybug (*Phenacoccus solenopsis*)	Specific
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 specific
Surveys and associated diagnostics of the incidence and severity of diseases of cereals and pulses within the northern region	Cereals and pulses	Various pests and diseases of cereals and pulses in the northern region	General and specific
National tomato potato psyllid and zebra chip surveillance	Solanaceae	Tomato potato psyllid (*Bactericera cockerelli*) and *Candidatus* Liberibacter solanacearum	Specific
West Indian drywood termite surveys	Timber structures	West Indian drywood termite (*Cryptotermes brevis*)	Specific
Fall Armyworm Response Project monitoring	Multiple	Fall armyworm (*Spodoptera frugiperda*)	General and specific
Serpentine leafminer monitoring	Multiple	Serpentine leafminer (*Liriomyza huidobrensis*)	General and specific
Bee pests and pest bees diagnostic service	European honey bee	Multiple pests	General and specific
Within South Australia			
Area freedom surveys	Multiple	Multiple pests	General and specific
Bee surveillance – endemic disease	European honey bees	American foulbrood (*Paenibacillus* spp.)	General and specific
Giant pine scale industry surveillance program	Pinaceae	Giant pine scale (*Marchalina hellenica*)	General and specific
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 specific
Grape phylloxera	*Vitus vinifera*	Grapevine phylloxera (*Daktulosphaira vitifoliae*)	General and specific

Table 52. Australia's plant biosecurity surveillance programs (continued)

Surveillance program name	Target hosts	Target pests	Type of surveillance*
Within South Australia (continued)			
Mediterranean fruit fly	Horticultural crops	Mediterranean fruit fly (*Ceratitus capitata*)	General and specific
National Bee Pest Surveillance Program	Ports and surrounding environment	*Varroa destructor, V. jacobsoni, Tropilaelaps clareae, T. mercedesae, Acarapis woodi, Oplostoma fuligineus, Braula coeca,* acute bee paralysis virus, deformed wing virus and slow paralysis virus, *Apis cerana, A. dorsata, A. florea, Bombus terrestris* and new exotic swarms of *A. mellifera*	General and specific
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*), glassy winged sharpshooters (*Homalodisca vitripennis* and *H. coagulata*), brown mamorated stink bug (*Halyomorpha halys*), *Xylella fastidiosa*	General and specific
Ports of Entry Trapping Program	*Eucalyptus* spp., ornamental trees	Exotic gypsy moths (*Lymantria* spp.)	General and specific
Ports of Entry Trapping Program	Various fruit fly hosts	Multiple – *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. tryoni, B. umbrosa, B. xanthodes, B. zonata, Ceratitis capitata, C. rosa, Zeugodacus cucurbitae, Z. tau*	General and specific
Mediterranean fruit fly	Horticultural crops	Mediterranean fruit fly (*Ceratitis capitata*)	General and specific
Queensland fruit fly	Horticultural crops	Queensland fruit fly (*Bactrocera tryoni*)	General and specific
Tomato potato psyllid program	Solanaceae	Tomato potato psyllid (*Bactericera cockerelli*)	General and specific
Tomato yellow curl leaf virus	Solanaceae	Tomato yellow curl leaf virus	General and specific
Trogoderma glabrum program	Multiple	*Trogoderma glabrum*	General and specific

Surveillance program name	Target hosts	Target pests	Type of surveillance*
Within Tasmania			
Bee surveillance – endemic disease and pests	European honey bees	American foulbrood (*Paenibacillus* spp.), European foulbrood (*Melissococcus pluton*), chalkbrood (*Ascophera apis*), sacbrood (*Nosema apis, N. ceranae*), sacbrood virus (*Morator aetatulas*), greater wax moth (*Galleria mellonella*), lesser wax moth (*G. achroia grisella*), European wasps (*Vespula germanica*), *Braula coeca*, bumble bee (*Bombus terestris*)	General and specific
Blueberry rust surveillance	Commercial blueberry crops and wholesale nurseries	Blueberry rust (*Thekopsora minima*)	Specific
Codling moth trapping surveillance	Apples, cherries	*Codling moth* (*Cydia pomonella*)	Specific
Fruit fly trapping surveillance	Host fruit trees, fruit and vegetables	*Bactrocera dorsalis, B. tryoni, Ceratitis capitata* and exotic fruit flies	Specific
National Bee Pest Surveillance Program	Ports and surrounding environment	*Varroa destructor, V. jacobsoni, Tropilaelaps clareae, T. mercedesae, Acarapis woodi, Oplostoma fuligineus, Aethina tumida,* acute bee paralysis virus, deformed wing virus and slow paralysis virus, *Apis cerana, A. dorsata, A. florea, Bombus terrestris* and new exotic swarms of *A. mellifera*	Specific
National Plant Health Surveillance Program – multi pest surveillance	Multiple	Brown marmorated stink bug (*Halyomorpha halys*), citrus canker (*Xanthomonas citri* subsp. *citri*), gypsy moths (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, Diaphorina citri, Trioza erytreae, B. trigonica, Trioza apicallis,* Pierce's disease (*Xylella fastidiosa*), glassy winged sharpshooter (*Homalodisca vitripennis*), *Bactrocera, Zeugodacus* and *Ceratitis* spp. (exotic fruit fly species)	Specific
Silverleaf whitefly surveillance	Nursery stock	Silver leaf whitefly (*Bemisia tabaci*)	Specific

Table 52. Australia's plant biosecurity surveillance programs (continued)

Surveillance program name	Target hosts	Target pests	Type of surveillance*
Within Tasmania (continued)			
Tomato potato psyllid	Commercial potato and tomato crops, community gardens, urban pathways	Tomato potato psyllid (*Bactericera cockerelli*)	Specific
Warehouse beetle and Khapra beetle trapping surveillance	Stored grains, grain processors and animal feed outlets	Warehouse beetle (*Trogoderma variable*), Khapra beetle (*Trogoderma granarium*)	Specific
Within Victoria			
Online public reporting	All hosts, general surveillance	All plant pests	General
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*), grapevine phylloxera, bacterial canker, cucumber green mottle mosaic virus, green snail, pyriform scale	Specific
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
Exotic fruit flies – Sunraysia	Various horticultural crops (citrus, stone fruit)	Mediterranean fruit fly (*Ceratitis capitata*)	Specific
Forest Health Surveillance Program	Multiple	Various exotic and endemic high priority pests of *Pinus* spp. Japanese sawyer beetle (*Monocamus alternatus*), wood wasp (*Urocerus fantoma*), black spruce longhorn beetle (*Tetropium castaneum*), brown spruce longhorn beetle (*Tetropium fuscum*), pine wilt nematode (*Bursaphelenchus* spp.) and dutch elm disease	Specific
Forest Health and Biosecurity Surveillance system	Multiple	Various exotic and endemic high priority pests	Specific
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*)	Specific
MyPestGuide e-surveillance	All hosts, general surveillance	All plant pests	General and specific
National Bee Pest Surveillance Program	Ports and surrounding environment	*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*	Specific
National Plant Health Surveillance Program – multi pest surveillance	Multiple	Multiple including citrus canker (*Xanthomonas axonopodis* pv. *citri*), exotic fruit flies (*Bactrocera* spp., *Ceratitis captitata*), Pierce's disease (*Xylella fastidiosa*), glassy winged sharpshooter (*Homalodisca vitripennis*), plum pox virus, Asian gypsy moth (*Lymantria dispar* and other *Lymantria* spp.), brown marmorated stink bug (*Halyomorpha halys*), Asian citrus psyllid (*Diaphorina citri*), African citrus psyllid (*Trioza erytreae*) and spotted wing drosophila (*Drosophila suzukii*)	Specific
National tomato potato psyllid and zebra chip surveillance	Solanaceous hosts	Tomato potato psyllid (*Bactericera cockerelli*)	Specific
Passive MedFly Program	Fruit trees in backyards	Mediteranean fruit fly (*Ceratitis capitata*)	General

Table 52.Australia's plant biosecurity surveillance programs (continued)

Surveillance program name	Target hosts	Target pests	Type of surveillance*
Within Victoria (continued)			
Urban Plant Health Network	Multiple plant hosts in periurban landscape, including community gardens	Various, including brown marmorated stink bug (*Halyomorpha halys*), Asian citrus psyllid (*Diaphorina citri*), African citrus psyllid (*Trioza erytreae*), Asian honeybee, red imported fire ant (*Solenopsis invicta*), spotted wing drosphila (*Drosophila suzukii*) and glassy winged sharpshooter (*Homalodisca vitripennis*)	General
Victorian funded containment program	Pasture and fruit trees	Green snail (*Cantareus apertus*)	Specific
Within Western Australia			
Agrisearch	Grain crops	Grain pests	General
AgWest grain testing laboratory	Grain crops	Grain pests	General
Ant Blitz	Urban areas	Browsing ant (*Lepisiota frauenfeldi*), red imported fire ant (*Solenopsis invicta*), Small black sugar ant (*Lepisiota capensis*)	General
Biosecurity Blitz	General surveillance, all hosts	All plant pests	General
Brown marmorated stink bug	General surveillance, all hosts, urban areas	Brown marmorated stink bug (*Halyomorpha halys*)	Specific
Candidatus Liberibacter solanacearum	Tomato, potato, capsicum, chilli and eggplant crops	Tomato potato psyllid (*Bactericera cockerelli*)	General
Codling moth surveillance	Pome fruit	Codling moth (*Cydia pomonella*)	Specific
European wasp surveillance	Urban areas and horticultural crops	European wasp (*Vespula germanica*)	General and specific
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 specific
Medfly Area Freedom (Ord River Irrigation Area)	Many horticultural hosts	Mediterranean fruit fly (*Ceratitis capitata*)	Specific
MyCrop e-surveillance	Broadacre crops, general surveillance	All plant pests	General and specific
MyPestGuide e-surveillance	All hosts, general surveillance	All plant pests	General and specific
National Bee Pest Surveillance Program	Ports and surrounding environment	*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*	Specific
National grain insect resistance monitoring program	Grain crops	Grain pests	Specific
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 fastidiosa*, brown marmorated stink bug (*Halyomorpha halys*)	Specific
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

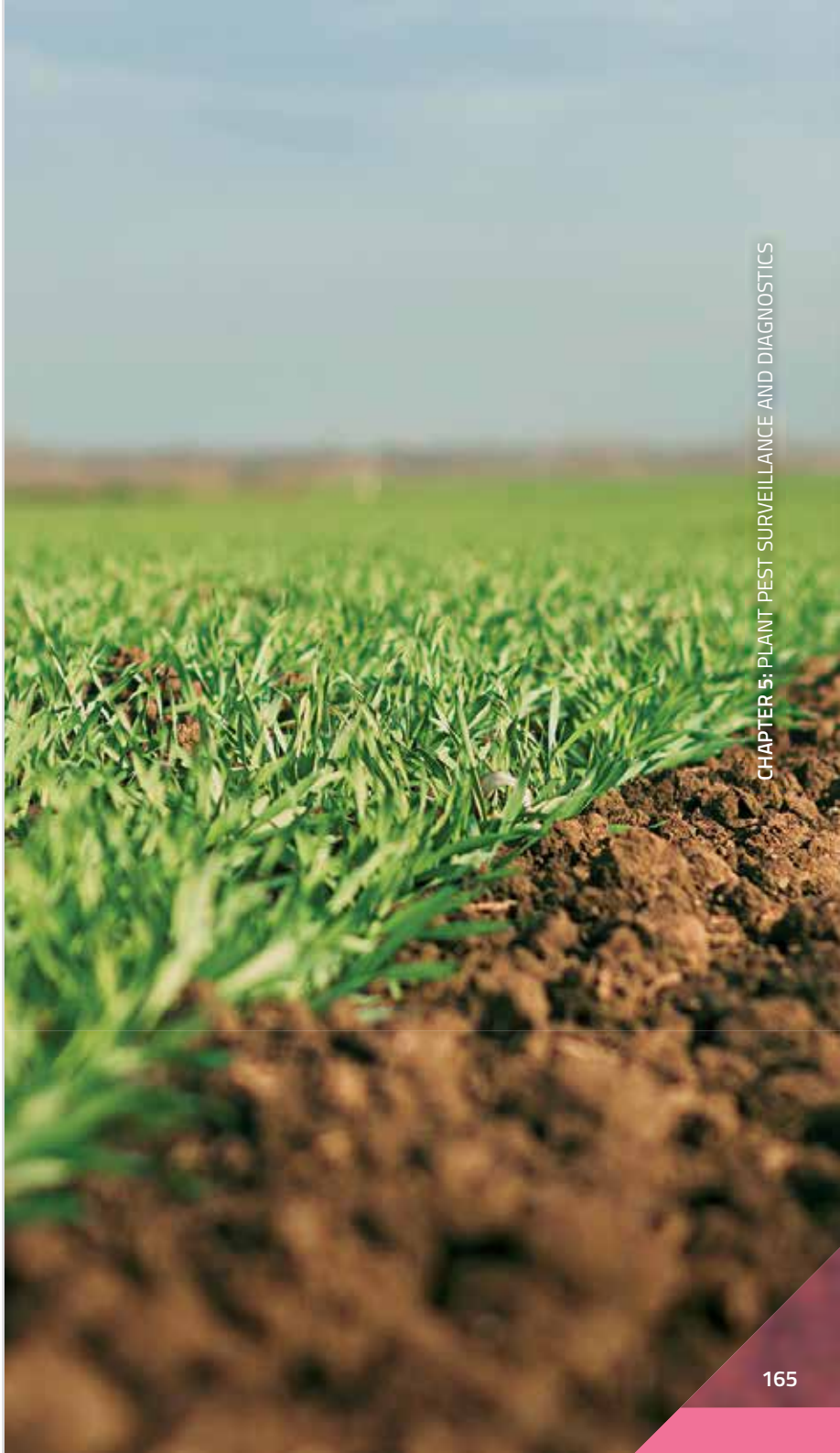
Table 52.Australia's plant biosecurity surveillance programs (continued)

Surveillance program name	Target hosts	Target pests	Type of surveillance*
Within Western Australia (continued)			
Port of Entry – Asian gypsy moth trapping	More than 600 forest, orchard, ornamental and native species	Asian gypsy moth (*Lymantria dispar*)	Specific
Port of Entry – fruit fly trapping	Horticultural hosts	Various *Bactrocera* and *Ceratitis* spp.	Specific
Queensland fruit fly surveillance	Many horticultural hosts	Queensland fruit fly (*Bactrocera tryoni*)	Specific
Sentinel stored products merchants	Stored grain products	Khapra beetle (*Trogoderma granarium*)	General and specific
Seed potato schemes	Seed potatoes	Tomato spotted wilt virus, potato leafroll virus, potato virus S, X and Y, potato spindle tuber viroid, potato cyst nematode	General and specific
Tramp ant surveillance	Environmental, urban areas, ports of entry, other high-risk sites	Browsing ant (*Lepisiota frauenfeldi*), red imported fire ant (*Solenopsis invicta*), small black sugar ant (*Lepisiota capensis*)	General

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.*



Diagnostics – identifying plant pests and diseases

Accurate diagnosis of plant pests and diseases underpins all aspects of the plant biosecurity system. The cause of poor plant health can sometimes 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.

It is essential that diagnostic services can quickly and accurately identify if a plant health issue is caused by a pest or disease and, if so, whether it is an established or exotic pest 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.

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.

DPIRD expert taxonomist for pest insects. Image courtesy of WA Agriculture Authority

OVERSIGHT OF NATIONAL PLANT BIOSECURITY DIAGNOSTICS

National Plant Biosecurity Diagnostic Strategy

The National Plant Biosecurity Diagnostic Strategy (NPBDS) has guided activities to support the strengthening of the diagnostic sector since its completion in 2012. The NPBDS underpins the National Plant Biosecurity Strategy (see page 20) and complements the National Plant Biosecurity Surveillance Strategy (see page 151) and the draft National Plant Biosecurity Preparedness Strategy, the development of which was progressed in 2020.

The 2012 NPBDS sets out the recommendations and actions necessary to ensure Australia has the people, infrastructure, diagnostic standards and tools to provide delivery of plant biosecurity diagnostic services.

Some of the key achievements include:

- implementation of the National Plant Biosecurity Diagnostic Network
- improved and enhanced output of National Diagnostic Protocols
- development of laboratory standards with accreditation and proficiency testing.

A revised NPBDS and implementation plan are being developed to guide activities over the next decade to ensure Australia's diagnostic system remains robust and effective. This work is expected to be completed during the first half of 2021.

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.

Implementation of the NPBDS 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
- building national capability 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.

The network comprises experts across the diagnostic system, from entomologists and plant pathologists, through to response program managers and policy makers. Members 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 network coordinator, operating out of PHA. 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 PHA-hosted 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 2020

The ninth Annual Diagnosticians' Workshop held in Brisbane in March 2020 attracted more than 80 participants involved in plant health diagnostics, who were keen to build their network, share their experiences and strengthen capability of the National Plant Biosecurity Diagnostic Network.

The attendees represented 19 organisations including all jurisdictions, the New Zealand Ministry for Primary Industries, Scion Research, CSIRO, Sugar Research Australia, multiple universities and PHA.

The theme for the workshop was 'Over the horizon – pests and tests' and included a number of presentations on different technologies including:

- next generation sequencing for viruses
- MALDI-TOF mass spectrometry for bacterial pathogens
- diagnostics for particular pests including African citrus greening
- *Dickeya fangzhongdai* and honey bee mites.

Four researchers who received residential placements offered by the National Plant Biosecurity Diagnostic Network also delivered presentations on their work.

Participants at the Annual Diagnosticians' Workshop, Brisbane, March 2020

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 methods and identification. New protocols include diagnostic information relevant to surveillance activities and the high throughput of samples.

The protocols are used in:

- emergency responses to exotic plant pests
- 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.

SPHD is responsible for endorsing the protocols, setting them as the agreed procedures for definitive identification of pests in the event of an incursion. The use of endorsed NDPs provides confidence in diagnostic outcomes and consistency across the laboratories of the NPBDN. Table 53 lists the published NDPs available on the NPBDN website **plantbiosecuritydiagnostics.net.au**

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 5.2)
- 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 is used in preference to an NDP, 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

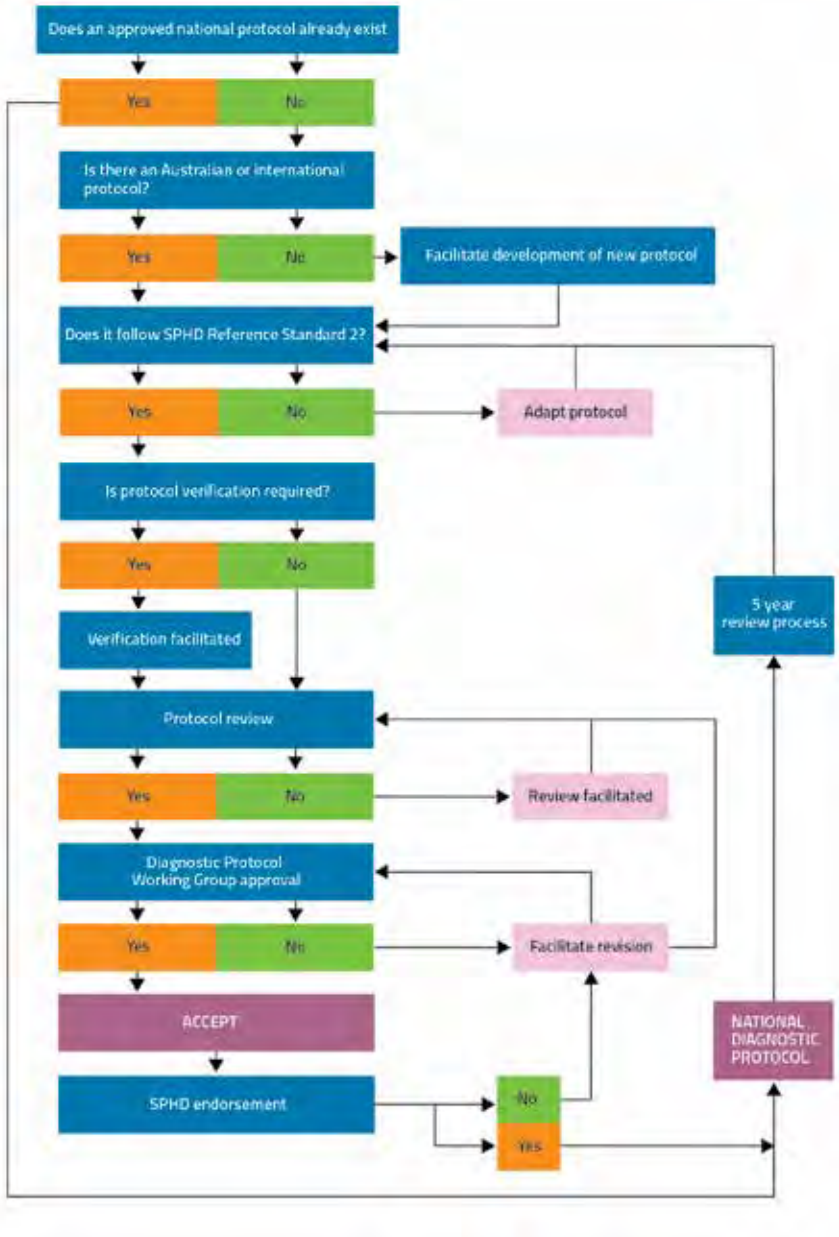


Table 53. National Diagnostic Protocols

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
Homalodisca vitripennis	Glassy winged sharpshooter	23
Leptinotarsa decemlineata	Colorado potato beetle	22
Liriomyza trifolii	American serpentine leafminer	27
Lymantria dispar	Asian gypsy moth, gypsy moth complex	42
Mayetiola destructor	Hessian fly	41
Monilinia fructigena	Apple brown rot	1
Neonectria ditissima	European canker	21
Ophiostoma ulmi	Dutch elm disease	37
Phakopsora euvitis	Grapevine leaf rust	29
Phyllosticta ampelicida (syn. *Guignardia bidwellii*)	Black rot	13
Phytophthora ramorum	Sudden oak death	5
Phytoptus avellanae	Hazelnut big bud mite	39
Endorsed protocols(continued)		
Plenodomus tracheiphilus (syn. *Phoma tracheiphila*)	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 (syn. *Magnaporthe grisea*)	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	
Austropuccinia psidii	Guava (eucalyptus) rust	
Banana bract mosaic virus (Potyvirus)	Banana bract mosaic virus	
Begamovirus group	Begamovirus group	
Burkholderia glumae	Panicle bight	
Bursaphelenchus cocophilus	Red ring nematode	
Bursaphelenchus xylophilus	Pine wilt nematode	
Bymovirus group	Bymovirus group	
Candidatus Phytoplasma solani	Bois noir	
Ceratocystis spp. *including C. maginecans, C. eucalypticola, C. fimbriata*	No common name	

** National Diagnostic Protocol reference number*

Table 53. National Diagnostic Protocols (continued)

Scientific name	Common name
Draft protocols (continued)	
Ceratovacuna lanigera	Sugarcane woolly aphid
Chilo spp. *including C. auricilius, C. infuscatellus, C. partellus, C. polychrysus, C. sacchariphagus, C. terrenellus*	Gold fringed rice borer, top borer, spotted stem borer, dark headed stripe borer, spotted borer and stem borer
Cicidula mbila	South African maize leafhopper
Citripestis sagittiferella	Citrus fruit borer
Colletotrichum lentis	Lentil anthracnose
Coptotermes spp. including *C. formosanus, C. gestroi*	Subterranean termite
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
Cryptotermes spp. including *C. brevis, C. dudleyi, Incisitermes minor*	Drywood termite
Daktulosphaira vitifoli	Grape phylloxera
Deanolis sublimbalis	Red banded mango caterpillar
Dendroctonus spp.	Southern and mountain pine beetles
Diaphorina citri	Asian citrus psyllid
Drosophila suzukii	Spotted wing drosophila
Dysaphis plantaginea	Rosy apple aphid
Erionata thrax	Banana skipper butterfly
Erwinia amylovera	Fire blight
Fusarium circinatum	Pine pitch canker
Fusarium oxysporum f. sp. *cubense*	Panama disease
Fuvovirus group	Wheat soil-borne virus group
Giberella fujikuroi	Bakanae
Globodera pallida, G. rostochiensis	Potato cyst nematode
Grapevine flavescence doree phytoplasma	Flavescence doree
Grapevine red blotch virus (Grablovirus)	Grapevine red blotch virus
Heterodera spp.	Cyst nematodes

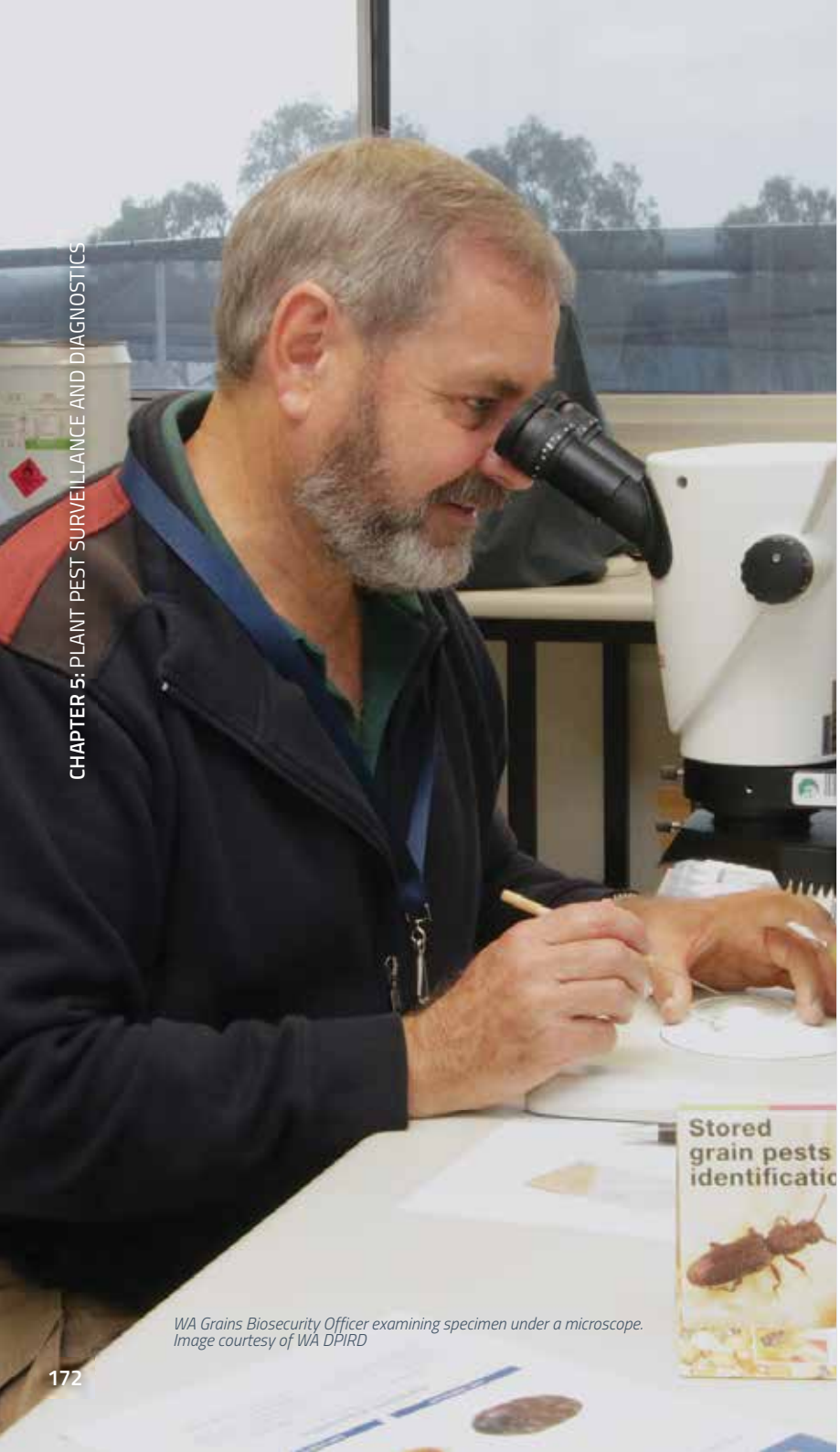
Scientific name	Common name
Draft protocols (continued)	
Honey bee viruses	Deformed wing virus strains, slow bee paralysis virus strains and acute bee paralysis virus
Hordieivirus group	Hordieivirus group
Hyalesthes obsoletus	Cixiidae plant hopper
Lepisiota frauenfeldi, L. incisa	Browsing ant
Liriomyza huidobrensis	Pea leafminer
Lissorhoptrus oryzophilus	Rice water weevil
Lobesia botrana	European grapevine moth
Maize dwarf mosaic virus (Potyvirus)	Maize dwarf mosaic virus
Orthaga euadrusalis	Mango web weaver
Pantoea stewartii	Stewart's wilt of maize
Pecluvirus group	Pectovirus group
Pernoscleospora spp.	Sugarcane downy mildew
Phyllosticta spp. including *P. cavendishii, P. maculata, P. musarum*	Banana freckle
Phymatotrichum omnivorum	Texas root rot
Phytophthora infestans A2	Late blight
Planococcus ficus	Vine mealybug
Pomacea canaliculata	Golden apple snail
Pseudocercospora fijiensis, Mycosphaerella eumusae	Black Sigatoka, eumusae leaf spot
Pseudococcus maritimus	Grape mealybug
Pseudomonas syringae pv. *papulans*	Blister spot of apple
Pseudopezicula tetraspora	Angular leaf scorch grape
Raffaelea lauricola	Laurel wilt and vector beetle
Ralstonia spp. including *R. solanacearum, R. syzygii* subsp. *celebesensis*	Moko, bugtok and banana blood disease
Ramu stunt (Tenuivirus)	Ramu stunt
Red clover vein mosaic virus (Carlavirus)	Red clover vein mosaic virus
Scirpophaga excerptalis	Top shoot borer

Table 53. National Diagnostic Protocols (continued)

Scientific name	Common name
Draft protocols (continued)	
Scirpophaga nivella	White rice borer
Scirtothrips aurantii	South African citrus thrips
Scolytines	Bark beetles
Sitobian avenae	English grain aphid
Stagonospora sacchari	Leaf scorch of sugar
Sternochetus frigidus	Mango pulp weevil
Sugarcane white leaf phytoplasma	Sugarcane white leaf phytoplasma
Tilletia barclayana (syn. *T. horrida*)	Kernel smut of rice
Trioza erytreae	African citrus psyllid
Trogoderma granarium	Khapra beetle
Tropilaelaps spp.	Tropilaelaps mites
Verticillium dahliae (defoliating strain)	Verticillium wilt
Wheat spindle streak mosaic virus (Bymovirus)	Wheat spindle streak mosaic virus
Xanthomonas axonpopodis pv. *allii*	Xanthomonas leaf blight (onion)
Xanthomonas citri subsp. *malvacearum*	Hyper virulent bacterial blight of cotton
Xanthomonas fragariae	Angular leaf scorch of strawberry
Xanthomonas vasicola pv. *musacearum*	Banana bacterial wilt
Xylella exotic leafhopper vectors (*Acrogonia terminalis, Cicadella viridis, Dilobopterus costalimai, Draeculacephala minerva, Graphocephala atropunctata, Oncometopia fascialis, Xyphon fulgidum*)	Xylella exotic leafhopper vectors
Xylella exotic vectors (*Philaenus spumarius*)	Meadow spittlebug
Xylophilus ampelinus	Bacterial blight of grapevine

Legend
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
syn. – synonym

Farmer and researchers. Image courtesy of CSIRO



WA Grains Biosecurity Officer examining specimen under a microscope. Image courtesy of WA DPIRD

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 54.

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.

Table 54. 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); DAWE Approved Arrangement 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	DAWE	Pest and disease identification, collection and rearing of immature stages of arthropods. Pathology investigation to determine causal agent	DAWE 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 54. 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 Department of Industry, Tourism and Trade	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	Department of Agriculture, Water and the Environment	Tropical plant pests. Plant pathology including microscopy, serology and molecular assays (conventional and real time PCR), NGS sequencing (minION), for selected organisms. Entomology and botany including microscopy and molecular capacity		Plant pathology: herbarium specimens, desiccated virus and virus-like disease collections in tissue and nucleic acids from Australia and northern neighbouring countries. Entomology: Northern Territory Quarantine Insect Collection which comprises pinned, wet and slide-mounted insect pests primarily from WA, NT and Timor Leste; includes the National Arbovirus Monitoring Program collection of Culicoides biting midges
Plant Pathology Laboratory, Berrimah		Plant pathology, virology, bacteriology, PCR, mycology and diagnostics	Registered for exchange of scientific specimens (Australian native non-CITES specimens) and the index herbarium	Northern Territory Plant Pathology Herbarium and plant pathogen nucleic acids collection
Queensland				
Biosecurity Queensland Control Centre, Berrinba	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

Table 54. Australia's diagnostic services, their capabilities, accreditations and collections (continued)

Laboratory and location	Organisation	Diagnostic capability	Accreditation	Collections
Queensland (continued)				
Ecosciences Precinct, Dutton Park	QDAF	Entomology, plant pathology, virology, bacteriology, mycology, nematology, molecular biology and exotic fruit fly screening	DAWE Approved Arrangement for Class 5.2 and 5.3. Biosecurity containment levels BC2 and BC3. NATA Accredited ISO/IEC 17025:2018	Plant pathology and entomology
Gatton Research Station, Gatton	QDAF	Vegetable pests and diseases		
Maroochy Research Station, Nambour	QDAF	Plant pathology		
Northern Australia Quarantine Strategy Regional Laboratory, Cairns	DAWE	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				
Australian Wine Research Institute, Urrbrae, Adelaide	Australian Wine Research Institute	Viticulture virology (molecular)		
Intertek, Adelaide	Intertek	Potato black leg (molecular)		
School of Earth and Environmental Sciences, Adelaide	University of Adelaide	Entomology		
South Australian Research & Development Institute (SARDI), Urrbrae, Adelaide	SARDI (PIRSA)	Molecular diagnostics and surveillance, plant pathology (cereals, pulse and horticulture), nematology, entomology	Molecular Diagnostics Laboratory is NATA accredited under Biologicals and for potato virus testing. DAWE accredited containment facilities for insects and plants (BC2)	Entomology collection, Adelaide University
South Australian Museum, Adelaide	SA Department of Premier and Cabinet	Entomology		

Table 54. Australia's diagnostic services, their capabilities, accreditations and collections (continued)

Laboratory and location	Organisation	Diagnostic capability	Accreditation	Collections
Tasmania				
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 DAWE containment approved, Virology section 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
Staphyt, Devonport	Staphyt, Australasia	Plant pathology		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, plant pathology, forest pathology and molecular testing	Laboratory DAWE containment approved	Insect reference collection
Victoria				
Agriculture Victoria, AgriBio, Bundoora	DJPR	Commercial diagnostic laboratory for general plant pathology, pathogen identification, entomology, mycology, virology, nematology, bacteriology, fungal and insect taxonomy, high throughput molecular diagnostics and weeds	DAWE accredited quarantine containment 5.2. Laboratory is NATA accredited under AgriBusiness. NATA accredited for potato virus testing, phytoplasma, nematology, 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
Agriculture Victoria, Horsham	DJPR	CropSafe Program: general plant pathology, entomology and virology (grains focus); Post-Entry Quarantine Facility (grains)	DAWE accredited quarantine containment 5.2/6.1	Fungal, bacterial and virus pathogen working collections pertaining to temperate grain crops; Australian Gene Bank (grain germplasm)
Operational Science Laboratory, Tullamarine Airport	DAWE	Entomology and plant pathology	DAWE accredited quarantine containment 5.2/7.2	Entomology collection

Table 54. Australia's diagnostic services, their capabilities, accreditations and collections (continued)

Laboratory and location	Organisation	Diagnostic capability	Accreditation	Collections
Victoria (continued)				
Plant Post-Entry Quarantine facility, Mickleham	DAWE	General plant pathology including mycology, bacteriology, botany, virology (traditional and modern) and nematology		
National Herbarium of Victoria	Royal Botanic Gardens Victoria	Mycology and weeds		Herbarium, including fungi and weeds
Melbourne Museum	Museums Victoria	Entomology		Entomology collection
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	DAWE	Identification of quarantine intercept samples, mostly exotic pests		Small reference collection, mostly exotic invertebrates
Operational Science, DA, Perth International Airport	DAWE	Identification of quarantine intercept samples, mostly exotic pests including arthropods, fungi, bacteria and viruses	DAWE 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		

Image courtesy of Agriculture Victoria

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 look-alikes 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[45] 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 2020, implementation of the strategy was undertaken to:

- confirm 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.

45 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.

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 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 **fruitflyidentification.org.au** is a companion to the handbook and 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.

Sterile Insect Technique (SIT) in Queensland fruitfly (Bactrocera tryoni) stained with pink dye. Image courtesy of Pia Scanlon, WA DPIRD

ONLINE SYSTEMS SUPPORTING PLANT BIOSECURITY

Digital resources are of increasing importance to plant biosecurity, providing fast access to and analysis of information. Many online systems are used by stakeholders in the biosecurity system.

AUSPest*Check*™

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 2020, AUSPest*Check*™ facilitated proof-of-concept trials for coordinating surveillance data online.

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

MyPest*Guide*™ Reporter

MyPest*Guide*™ Reporter is a free surveillance data capture and reporting app developed and operated by the WA Department of Primary Industries and Regional Development (DPIRD) primarily for use by the broader community and industry.

Using MyPest*Guide*™ Reporter, users send images of plant pests or symptoms directly to government diagnostic services for identification and receive a response back through the app.

To improve Australia's ability to collect general surveillance data and encourage reporting of new pests, requirements for national implementation of the MyPest*Guide*™ Reporter app are being investigated.

The Pest and Disease Image Library

The Pest and Disease Image Library (PaDIL) is a repository of high-quality images displaying the key diagnostic features of each pest and disease specimen and facilitates simple image comparison between features of similar species to assist with specimen triaging and taxonomic identification.

PaDIL contains detailed records of invertebrates, bacteria, fungi, viruses, viroids and phytoplasmas that threaten field crops, pasture, forestry, horticulture, marine, human health and animals. The resources within PaDIL assist government and industry to make decisions intended to protect Australia's economy, environment, human health and amenity from invasive threats. PaDIL is hosted and managed by PHA and jointly owned and governed by the DAWE, PHA, Museums Victoria and WA DPIRD.

The Australian Plant Pest Database

The Australian Plant Pest Database (APPD) is a key reference system for plant pests. The APPD contains information on validated specimen records of plant pests and diseases of significance to agriculture (including pastures), forestry or the environment.

Currently the APPD draws information from 18 databases throughout Australia. The database is interrogated during every plant pest incursion in Australia to assist with pest status information.

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 2020, there were 21 active Biosecurity Portal SharePoint sites, with another two new sites under construction.

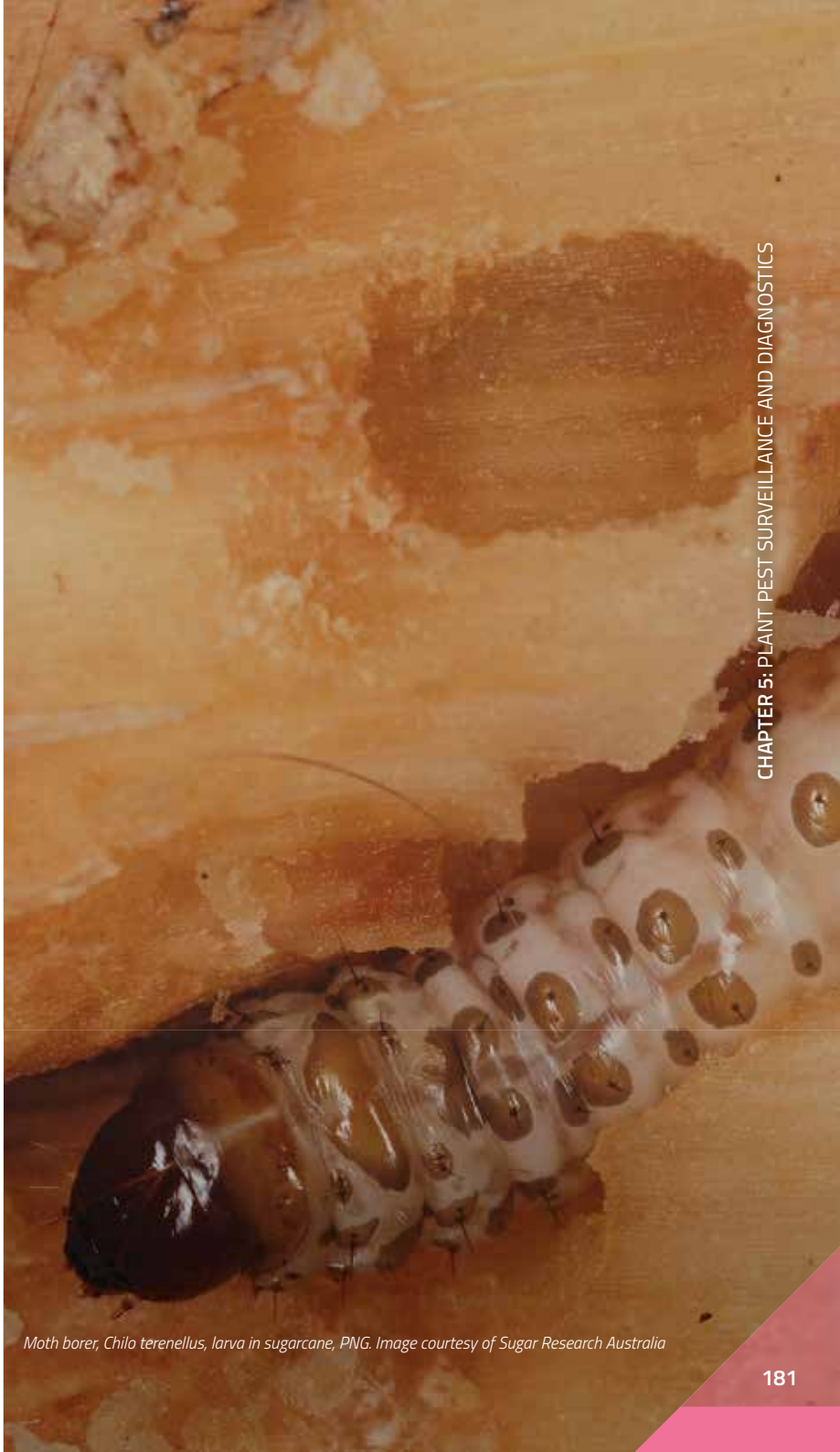
Sites on the Biosecurity Portal fall into four categories:

- 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
- awareness and information resources.

Other resources

Databases of agreed import policies (BICON) and export conditions (MICoR) are maintained by the DAWE, as described in Chapter 4.

PHA also 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.



Moth borer, Chilo terenellus, larva in sugarcane, PNG. Image courtesy of Sugar Research Australia

Image courtesy of Tamara Hepburn - Australian Macadamia Society

Chapter 6

Managing plant biosecurity emergencies

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 an 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 38 plant industry peak bodies (as at 31 December 2020). 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 majority of Australia's plant cropping sectors – extending across broadacre, horticulture, nursery production, forestry, edible fungi and honey bees – are represented by a peak industry body under the EPPRD.

During 2020 one new cropping sector signed up to the EPPRD, with Passionfruit Australia joining on behalf of the national passionfruit industry.

Emergency Plant Pests

For a plant pest to be covered by the EPPRD, it must be an 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

During 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.

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 187). 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. All supporting documents are available at **planthealthaustralia.com.au/plantplan**

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, an annual review of PLANTPLAN, individual incident debriefs (for completed or current responses), and findings arising from training activities.

In October 2020, the third formal review of the EPPRD was initiated, coinciding with a key milestone marking 15 years since ratification of the agreement. A holistic review of PLANTPLAN also commenced during 2020, providing an opportunity to reflect on its structure and format to ensure it continues to meet the needs of end users.

PHA manages the continual improvement to the EPPRD and PLANTPLAN on behalf of the signatories. With review processes in progress, no significant amendments to the EPPRD or changes to PLANTPLAN were made during 2020.

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 2020 the governments continued with their review of the agreement, and a new version is expected to be available in 2021.

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.

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.

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, Water and the Environment, 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.

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.

Industry liaison training

During 2020, PHA worked with state and territory governments to train plant industry representatives on the role of industry liaison functions in a biosecurity emergency response.

The training in QLD, WA and SA focused on how the industry liaison functions deliver the vital link between the Incident Management Team and the affected industry. Although differing in the level at which they work (local, operational or state coordination level), the liaison officer and the liaison co-ordinator both:

- contribute to decision making by providing the position of the affected industry on aspects of the response
- inform the response strategy and actions by providing advice on the industry sector and potential impacts of response actions
- support industry communication and engagement activities.

Attendees said that, apart from learning about their role in a response, the training was an excellent opportunity to network with other industry and government biosecurity representatives to establish links and relationships across sectors in advance of an incursion.

The training will continue to be rolled out nationally during 2021 with the remaining jurisdictions each having an opportunity to host.

More information about industry liaison functions is available from **planthealthaustralia.com.au/plantplan**

Representatives from ten plant industries participated in the liaison training in March 2020 in Brisbane

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).

A full list of VET training providers can be found on **myskills.gov.au**

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. This year, additional industry liaison training was implemented to provide additional training on the role of industry representatives in a response (see page 188). 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. Due to Covid-19, no simulation exercises were conducted in 2020.

Online training in plant biosecurity

PHA offers online training through the e-learning platform BOLT (Biosecurity Online Training). Courses available during 2020 included:

Plant Biosecurity in Australia – This course provides an overview of plant biosecurity in Australia. It also explains how emergency responses to plant pests are managed under the EPPRD.

National EPP Response Management – This course 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.

Biosecurity for Beekeepers – This course provides best practice industry advice on keeping honey bees healthy and supports the Australian Honey Bee Industry Biosecurity Code of Practice. In 2020, it was refreshed and access was made free for all beekeepers in Australia.

Researchers – Pest Reporting and Responses – This course outlines a researcher's role in reporting and responses, reporting obligations, how to report and what may happen afterwards.

Growers – Pest Reporting and Responses – This course outlines a grower's role in reporting and responses, how to report and what may happen afterwards.

In 2020, nearly 3,000 users enrolled in individual BOLT courses.

Since its release in July 2020, the Plant Biosecurity in Australia course has had 271 enrolments, indicating good uptake of information that has been updated to ensure currency with the evolving nature of emergency responses. The Pest Reporting and Responses courses for growers and researches had a combined total of 362 course enrolments in 2020.

BOLT courses are open to all plant biosecurity stakeholders and are available from **planthealthaustralia.com.au/bolt**

Plant Biosecurity in Australia: Online training

PHA hosts an online learning platform, BOLT, that provides free courses on topics related to plant biosecurity. In 2020, a new online course on the fundamentals of plant biosecurity in Australia was launched.

The Plant Biosecurity in Australia course covers important information on the:

- structure and key participants in the biosecurity system
- work completed before a pest is detected, designed to protect Australia's plant resources, including:
  - the National Plant Biosecurity Strategy
  - biosecurity planning
  - surveillance programs
  - training
  - on-farm biosecurity
- key elements of biosecurity emergency response management
- fundamentals of Emergency Plant Pest responses in action.

The course is essential learning for anyone who will be representing their organisation in the event of an emergency response to a plant pest. It is also great background knowledge for anyone who is involved in biosecurity.

This and other courses are available at **planthealthaustralia.com.au/BOLT**

Plant biosecurity in Australia operates best when key participants work as partners

Notifications and responses in 2020

This section highlights the notifications of plant pest incidents and the nationally coordinated responses that were managed under the EPPRD during 2020.

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 2020, a new incursion of *Varroa jacobsoni* in QLD initiated a response under the EPPRD, implemented through an amended version of the existing response plan for the unrelated 2019 incursion. In June 2020, area freedom from the 2016 incursion of *V. jacobsoni* was recognised nationally.

A short summary of a selection of national response plans in place during 2020, together with a description of key activities undertaken during the year, is in Table 55 (page 191).

OTHER PLANT PEST NOTIFICATIONS

A number of plant pests were reported during 2020 that did not proceed to a response plan in 2020. Some were assessed as requiring no further action: others were still under investigation in 2020 and further actions may be taken in 2021. These pest detections are listed in Table 56 (page 193).

Table 55. Responses to plant pests under EPPRD arrangements*

Scientific name	Common name	Crops affected	Region	Past action	Situation as of 31 December 2020
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 2019 the NMG agreed annual incursions had been eradicated through successful implementation of a 3-year response plan from July 2015 to June 2018. A new response plan was endorsed by the NMG for July 2018 to June 2021.	Surveillance and eradication activities in the Torres Strait were ongoing in response to sporadic fruit fly detections.
Bactrocera trivialis	New Guinea fruit fly				
Zeugodacus cucurbitae	Melon fly				
Cryphonectria parasitica	Chestnut blight	Chestnuts	VIC	First detected in September 2010. Response plan endorsed by the NMG in November 2010 and eradication activities undertaken. Following extensive surveillance activities sporadic detections occurred in 2014, 2016 and 2017 and eradication activities continued through to 2019. 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.	Ongoing activities for transition to management delivered under the response plan.
Varroa jacobsoni (2016 incident)	Varroa mite	Honey and various pollination-reliant crops	QLD	Detected on Asian honey bee (*Apis cerana*) in QLD in June 2016. Response plan endorsed by the NMG in September 2016 and eradication activities undertaken. Proof of freedom surveillance activities ongoing in 2019.	In June 2020 the NMG agreed that the 2016 incident of *Varroa jacobsoni* (2016) had been eradicated following successful completion of the response plan.
Varroa jacobsoni (2019 incident)	Varroa mite	Honey and various pollination-reliant crops	QLD	Detected on Asian honey bee (*Apis cerana*) in QLD in May 2019. The detection was a new entry into Australia and confirmed via genetic testing to not be related to the 2016 incursion. Response plan endorsed by the NMG in July 2019. The Asian honey bee nest and mites were destroyed. Surveillance activities implemented in 2019 with no further detections of Asian honey bee or *V. jacobsoni* related to this incursion.	The response entered the proof of freedom phase with surveillance activities ongoing. In July 2020 the response plan was revised to incorporate activities for eradication of the unrelated 2020 incursion of *V. jacobsoni* (see below). Proof of feedom is expected to be achieved in April 2021.

Table 55. Responses to plant pests under EPPRD arrangements* (continued)

Scientific name	Common name	Crops affected	Region	Past action	Situation as of 31 December 2020
Varroa jacobsoni (2020 incident)	Varroa mite	Honey and various pollination-reliant crops	QLD	New incursion in 2020.	Detected on Asian honey bee (*Apis cerana*) in QLD in April 2020. The detection was a new entry into Australia and confirmed via genetics to not be related to the 2016 or 2019 incursions. In July 2020 the NMG endorsed a revised version of the existing response plan for the unrelated 2019 incident of *V. jacobsoni*, to include activities for eradication of the 2020 incident. Proof of freedom is expected to be achieved in April 2021.
Xanthomonas 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 was restricted to potted plants in the home and garden sector. No natural spread of the disease was observed and there were no detections in commerical citrus orchards. Response plan endorsed by the NMG in May 2018 and extensive eradication activities undertaken. In 2019 a revised response plan was endorsed by the NMG which included all activities requried to successfully achieve proof of freedom. WA completed response activities and the NMG agreed that citrus canker had been eradicated from WA.	The response entered the proof of freedom phase following the successful completion of emergency response activities. Evidence of absence surveillance ongoing, with country freedom expected to be achieved early 2021.

** This table may not reflect all Cost Shared responses in 2020*

Table 56. Plant Pest detections notified under the EPPRD in 2020 that did not proceed to a response plan*

Scientific name	Common name	State**
New detections		
Alternaria burnsii	Alternaria blight	QLD
Aphis lugentis	No common name	SA
Cytospora sorbicola	Dieback	WA
Dickeya fangzhongdai	No common name	QLD
Erwinia persicina	No common name	TAS
Liriomyza huidobrensis	Serpentine leafminer	NSW
Planchonia stentae	South African pit scale	QLD, WA
Spodoptera frugiperda	Fall armyworm	Torres Strait, QLD

* Some pests not listed in this table are still under investigation. If further action is implemented, these pests may be reported in future publications.

** Reflects detection location as at the time of notification. In some cases the Plant Pest was subsequently detected in additional states or territories.

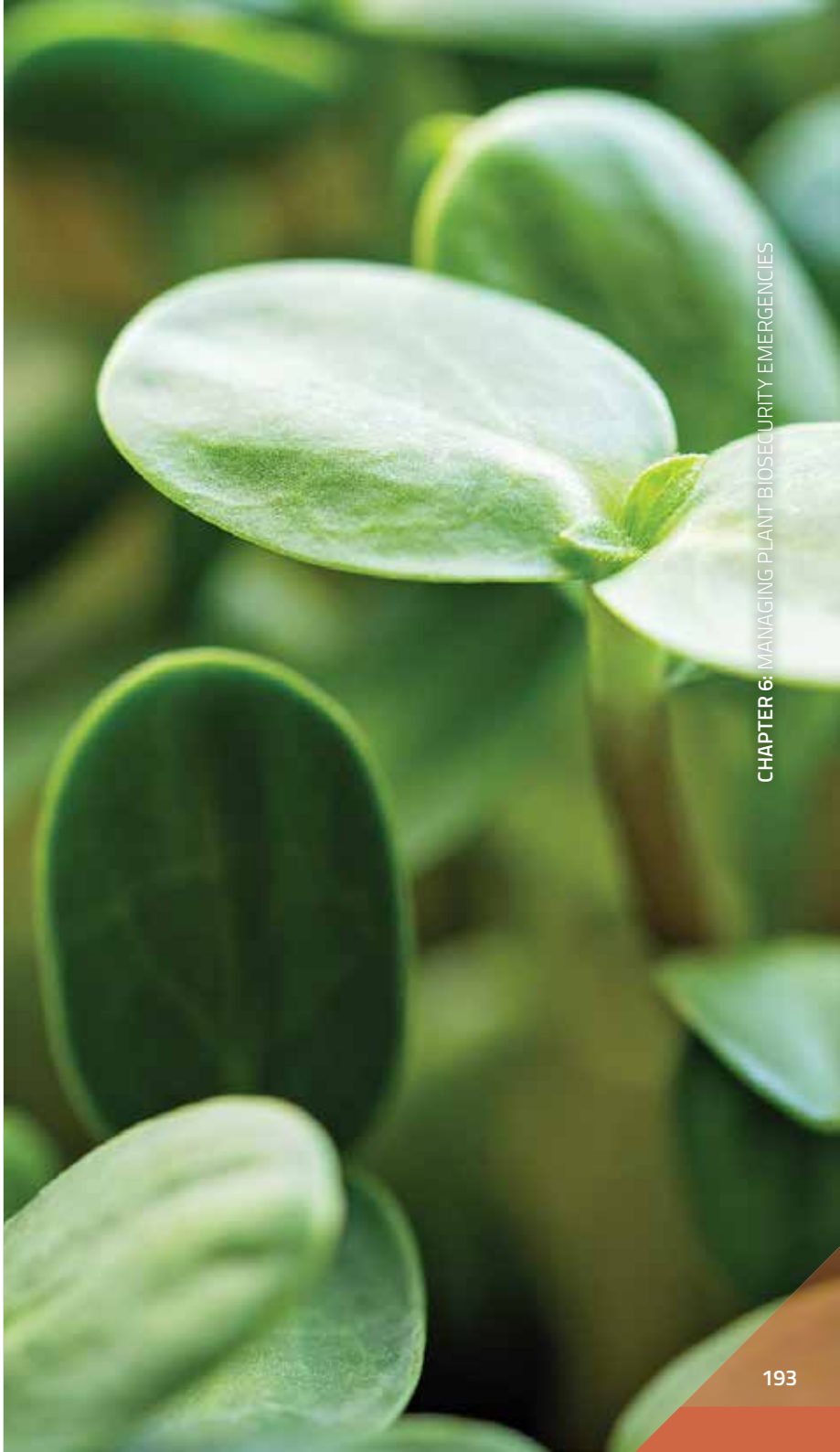


Image courtesy of Melinda Simpson

Chapter 7

Controlling plant pests and weeds

Image courtesy of AUSVEG

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 established pests and weeds found in certain parts of Australia that must be managed.

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 undertaken by Plant Health Australia (PHA), governments and industries to encourage on-farm biosecurity risk mitigation.

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, Water and the Environment (DAWE) 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.

SDQMA 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 **interstatequarantine.org.au** provides information on domestic quarantine restrictions for travellers and producers.
This information is also available in a downloadable booklet, Australian Interstate Quarantine: A Traveller's Guide.

There are 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.

Travellers must surrender fruit and vegetables in amnesty quarantine bins located at airports, seaports and checking stations.

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 – 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 – 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 – issued by a government officer when an area is known to be free of a particular pest.

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.

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

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

Legislation at the jurisdictional level supports the ability to contain pests. The legislation is supported by jurisdictional operations in cooperation with the other jurisdictions and relevant industries.

The regionalised pests listed in Table 57 (page 200) are those formally recognised and backed by legislation: it is not an exhaustive list of all pests found in Australia in 2020.

Resident receiving information about Queensland fruit fly during a response. Image courtesy of WA DPIRD

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 eradication 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 TAS, 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 (NFFC) 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 NFFC includes representatives from governments, horticulture industries and Hort Innovation. It has an independent chair and is supported by a manager and a secretariat from PHA. It focuses on four areas:

- maintaining Australia's freedom from exotic fruit fly
- minimising the incidence and spread of fruit fly
- ensuring national systems support market access
- adopting a cooperative approach to fruit fly management.

The NFFC oversees and monitors implementation of the National Fruit Fly Strategy.

In 2020, the NFFC worked with key stakeholders to review progress on the strategy and to update it to better reflect current and emerging national fruit fly management issues. The 2020–25 National Fruit Fly Strategy and associated 2020–21 Implementation Plan were launched in November 2020.

Regular meetings provide an important opportunity to identify priority areas for action and to promote coordination of activities between members. A particular focus in 2020 has been to improve engagement with stakeholders through an increased communication presence. This has brought the NFFC a better understanding of current fruit fly challenges across Australia and provided opportunities to increase the general awareness of fruit fly as important pests, how they can be managed, and promotion of 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.

2020–25 National Fruit Fly Strategy released

The 2020-25 National Fruit Fly Strategy was released in November 2020 at a meeting of the National Fruit Fly Council (NFFC). The strategy provides a framework for governments, industries and research funders to advance fruit fly management in Australia and prevent exotic species from establishing.

The strategy focuses on maintaining and improving access to domestic and international markets for affected industries, which make up about half of Australia's $13 billion horticulture sector.

The strategy builds on the 2008 version and is the result of a collaborative effort by Australia's horticultural industries, state governments, the Australian Government, Hort Innovation and various research institutions. It reflects their contributions and maps the actions required to meet the needs of affected parties.

These needs have been captured under eight interdependent priority areas: market access; management of established fruit fly; prevention, preparedness and response; research; surveillance; diagnostics; communication and engagement; and cooperation.

The NFFC is tasked with overseeing the implementation of the strategy under the 2020–21 Implementation Plan to identify and monitor key activities under the strategy.

More information is available from the Prevent Fruit Fly website **preventfruitfly.com.au**

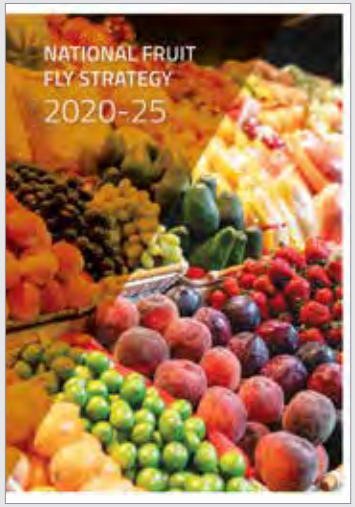


Table 57. Australia's regionalised pests

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
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
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
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
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
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
Cosmopolites sordidus	Banana weevil borer	Darwin rural area
Cucumber green mottle mosaic virus	CGMMV	Darwin, Darwin rural area, Katherine, Ti Tree
Fusarium oxysporum f.sp. *cubense* tropical race 4	Panama disease	Darwin, greater Darwin, Nhulunbuy
Thrips palmi	Melon thrips	Darwin rural area

Table 57. Australia's regionalised pests (continued)

Scientific name	Common name	Area of regionalisation
Queensland		
Anoplolepis gracilipes	Yellow crazy ant	Populations dotted in various locations from 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 close to Papua New Guinea (Saibai and Dauan)
Cucumber green mottle mosaic virus	Cucumber green mottle mosaic virus	Confined to three quarantined businesses; one in north QLD 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	Islands in the Torres Strait as well as Cape York Peninsula north of the Jardine River
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
Fusarium odoratissimum (syn: *Fusarium oxysporum* f. sp. *cubense*) (Panama disease tropical race 4)	Panama disease tropical race 4	Detected in 2015, 2017, 2018 and 2020 on five separate commercial banana growing properties in the Tully Valley. A containment program remains in place.
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 QLD, as far north as Bundaberg area
Planococcus lilacinus	Coffee mealybug	Boigu Island, Torres Strait islands
Procontarinia pustulata	Mango leaf gall midge	Torres Strait and northern tip of Cape York Peninsula
Pseudococcus jackbeardsleyi	Jack Beardsley mealybug	Torres Strait islands and the Cape York Peninsula

Table 57. Australia's regionalised pests (continued)

Scientific name	Common name	Area of regionalisation
Queensland (continued)		
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
Wasmannia auropunctata	Electric ant	Far north QLD, Cairns hinterland, Bingle Bay
South Australia		
Caracollina lenticula	Lens snail	Known to be present on four properties at Largs North
Cucumber green mottle mosaic virus	Cucumber green mottle mosaic virus	Known to be present on six properties on the Northern Adelaide Plains
Melissococcus pluton	European foulbrood	Endemic across most of SA but not known to occur on Kangaroo Island
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, under eradication following detection in honey sample from Kangaroo Island
Victoria		
Bemisia tabaci	Silverleaf whitefly	Murchison, Shepparton and Gillieston
Cantareus apertus	Green snail	Cobram
Daktulosphaira vitifoliae	Phylloxera	Six Phylloxera Infested Zones: Maroondah, Mooroopna, Nagambie, north-east VIC, Upton and Whitebridge
Globodera rostochiensis	Potato cyst nematode	Koo Wee Rup, Thorpdale, Gembrook, Wandin North and Mornington

Table 57. Australia's regionalised pests (continued)

Scientific name	Common name	Area of regionalisation
Western Australia		
Achroia grisella	Lesser wax moth	WA. Regulations or controls for movement and control in specified areas
Aethina tumida	Small hive beetle	Kimberley. Host material restricted from movement to rest of state
Bemisia tabaci (Gennadius, 1889) B biotype	Silverleaf whitefly	Perth and Carnarvon. Host material restricted from movement to Kununurra
Brontispa longissima	Palm leaf beetle	Broome. Host material restricted from movement to rest of state
Ceratitis capitata	Mediterranean fruit fly	WA. Regulations or controls for movement and control in specified areas
Chortoicetes terminifera	Australian plague locust	WA. Absent from east Kimberley region. Regulations or controls for movement and control in specified areas
Cornu apertus	Green snail	WA. Regulations for control in specified areas
Cosmopolites sordidus	Banana weevil borer	Kununurra. Host material restricted from movement to rest of state
Cryptolestes ferrugineus	Flat grain beetle	WA. Regulations or controls for movement and control in specified areas
Cryptolestes pusillus	Flat grain beetle	WA. Regulations or controls for movement and control in specified areas
Ephestia elutella	Tobacco moth	WA. Regulations or controls for insecticide resistant strains
Ephestia kuehniella	Mediterranean flour moth	WA. Regulations or controls for insecticide resistant strains
Galleria mellonella	Larger wax moth	WA. Regulations or controls for movement and control in specified areas
Hylotrupes bajulus	European house borer	WA. Regulations or controls for movement and control in specified areas
Oryzaephilus surinamensis	Sawtoothed grain beetle	WA. Regulations or controls for insecticide resistant strains

Table 57. Australia's regionalised pests (continued)

Scientific name	Common name	Area of regionalisation
Western Australia (continued)		
Pentalonia nigronervosa	Banana aphid	Carnarvon. Host material restricted from movement to rest of the state
Plodia interpunctella	Indian meal moth	WA. Regulations or controls for insecticide resistant strains
Rhyzopertha dominica	Lesser grain borer	WA. Regulations or controls for insecticide resistant strains
Sitophilus granarius	Granary weevil	WA. Regulations or controls for insecticide resistant strains
Sitophilus oryzae	Rice weevil	WA. Regulations or controls for insecticide resistant strains
Sitotroga cerealella	Angoumois grain moth, grain moth	WA. Regulations or controls for insecticide resistant strains
Thrips palmi	Melon thrips	Kimberley (area of low pest prevalence)
Tribolium castaneum	Rust-red flour beetle	WA. Regulations or controls for insecticide resistant strains
Tribolium confusum	Confused flour beetle	WA. Regulations or controls for insecticide resistant strains
Trogoderma variabile	Warehouse beetle	

*The regionalised pests listed are those formally recognised and backed by legislation in jurisdictions, and is not an exhaustive list of all pests found in Australia in 2020

Image courtesy of AUSVEG

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 QLD, NSW and TAS 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.

Australians are expected to abide by a general biosecurity duty or obligation and be aware of the risks posed by their activities, like bushwalking.

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 (page 208).

More and more 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.

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 national programs are often funded by grower levies and so tend to work with producers of particular crops.

Some state governments have additional outreach programs with officers who work with groups of producers and others along the supply chain to strengthen the state's biosecurity system. For example, the NSW Local Land Services brings together agricultural production advice including biosecurity, natural research management and emergency management for farmers, landholders and the community.

Grains Farm Biosecurity Program

The Grains Farm Biosecurity Program is funded by grain producers and managed by PHA and Grain Producers Australia, in partnership with the governments of five grain-producing states. Grains Biosecurity Officers are responsible for raising awareness of biosecurity management practices among grain growers and others along the supply chain. The officers engage growers at field days and conferences, giving presentations and demonstrations and running training sessions on biosecurity management practices that growers can use to protect their farms.

Since it began in 2007, thousands of in-crop and stored grain pest and disease surveys have been undertaken with industry, improving on-farm biosecurity as well as raising awareness in grain growing regions. Data from these surveys has and continues to be captured within 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 assist in any post-border incidents.

Australian Biosecurity 2030 Workshop: Building a mass movement

More than 250 biosecurity practitioners from across Australia and New Zealand convened in a virtual workshop in November 2020 to influence the future direction of Australia's biosecurity system through mobilising a 25-million strong biosecurity mass movement.

The workshop saw delegates from the 'biosecurity collective' from across the agriculture, human, weed, pest animal, wildlife, aquatic and environment sectors, build new partnerships and strengthen existing ones.

The workshop defined what the biosecurity system would look like in 2030 with discussions centred on creating and nurturing on-the-ground biosecurity and building the foundations of a mass movement. Guest speakers presented on successful Australian and New Zealand campaigns, followed by dialogues on strategies to mainstream biosecurity and motivating Australians to participate.

The consensus was to develop mechanisms to support biosecurity champions, expand the Biosecurity Warrior education program, share analysis and research on innovative and successful biosecurity initiatives, and encourage industry and community leaders to make a biosecurity commitment.

Outcomes from the workshop will feed into the 2021 Australian Biosecurity Symposium and will form the basis of the Biosecurity 2030 agenda.

Farm Biosecurity Producer of the Year Award winners

Each year, PHA and AHA through the Farm Biosecurity Program, partners with the Australian Government to recognise farmers who demonstrate exceptional, proactive biosecurity practices.

In 2020, two winners in the plant category were announced: Templeton Ginger at the ABARES Conference dinner in March and Kees Weel (KW) Orchards at the Australian Biosecurity Forum in November.

Having experienced cucumber green mottle mosaic virus in the NT in 2014, Kees became a strong advocate for proactive biosecurity measures. When establishing the KW Orchards citrus and wine grape property at Trentham Cliffs in NSW, Kees and the property's management team developed a farm biosecurity plan by combining previous management experience and advice from the Biosecurity Manual for Citrus Producers.

Templeton Ginger is Australia's largest ginger producer and, with its long history, the company has experienced how detrimental pest and disease outbreaks can be for small businesses. Current directors John, Shane and Kylie Templeton have a strong focus on implementing biosecurity practices to ensure the longevity, economic viability and integrity of their business and the industry as a whole.

Shane and Julie Templeton with Minister Littleproud at the ABARES Conference dinner. Image courtesy of Steve Keough Photography

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 2020, 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 2020, 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 DAWE, a National Citrus Biosecurity Program was initiated in 2017 to improve biosecurity planning, preparedness and awareness in the citrus industry.

During 2020, 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 in VIC.

Should an exotic pest enter Australia, early detection of incursions helps to limit their spread and aims to minimise the cost of eradication. Improved surveillance also helps to provide ongoing evidence to demonstrate area freedom from pests, to support market access.

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 biosecurity preparedness activities for 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 DAWE. The strategy is aligned with the National Plant Biosecurity Strategy and National Plant Biosecurity Surveillance Strategy, as described in Chapter 1.

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 provide information on exotic pests. Underpinning the program is the Australian Honey Bee Industry Biosecurity Code of Practice (the Code), which provides a framework for Australian beekeepers to engage in best-practice biosecurity.

Bee Biosecurity Officers (BBOs) are employed in all six states. The BBOs support beekeepers in understanding their biosecurity obligations under the Code and provide general advice on pest and disease management practices, while performing a variety of extension and education-based activities. These include attendance at industry field days, presentations at beekeeper club meetings, delivery of workshops and apiary visits.

To assist compliance with the Code and provide advice on keeping honey bees healthy, an online training course, Biosecurity for Beekeepers, was refreshed and made free to all beekeepers in Australia in 2020. The National Bee Biosecurity Program is funded by the honey bee industry through a component of the agricultural honey levy, with state governments contributing in-kind resources. The Victorian BBO position is co-funded through the Honey Bee Compensation and Industry Development Fund. The SA position is co-funded through the South Australian Apiary Industry Fund.

Farm biosecurity programs for plant 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 2020, PHA worked with melon, avocado, mango, grape and wine industry representatives to develop capability and deliver farm biosecurity information to producers.

The Farm Biosecurity Program

PHA and 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, templates for biosecurity gate signs, 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 DAWE to recognise the contribution of producers who demonstrate outstanding, proactive on-farm biosecurity practices (page 206).

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 58.

These documents are designed with growers and consultants in mind, explaining effective measures that can be incorporated in 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.

Table 58. 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	1.1

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)[46] of Australia's total value of crop production is attributable to the use of crop protection products. Table 59 illustrates the amount and type of agricultural chemicals used for controlling plant pests in Australia. This total expenditure on pesticides for plants represents over eight per cent of the gross value of production for all crops in Australia.[47, 48]

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.

46 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

47 Australian Pesticide and Veterinary Medicines Authority, Gazette No 5 March 2020. Accessed online 31 March 2020, apvma.gov.au/node/64531

48 Australian Bureau of Agricultural and Research Economics and Sciences. Agricultural commodities December quarter 2020. Accessed online 21 June 2021, abs.gov.au/statistics/industry/agriculture/value-agricultural-commodities-produced-australia/latest-release

Table 59. Sales of plant chemicals in Australia, 2016–20

		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**
2020	No. of products	3,772	1,589	1,133	149	133	57	16	**6,849**
	Value of product sales ($ million)	1,984	315	280	31	27	14	4	**2,655**

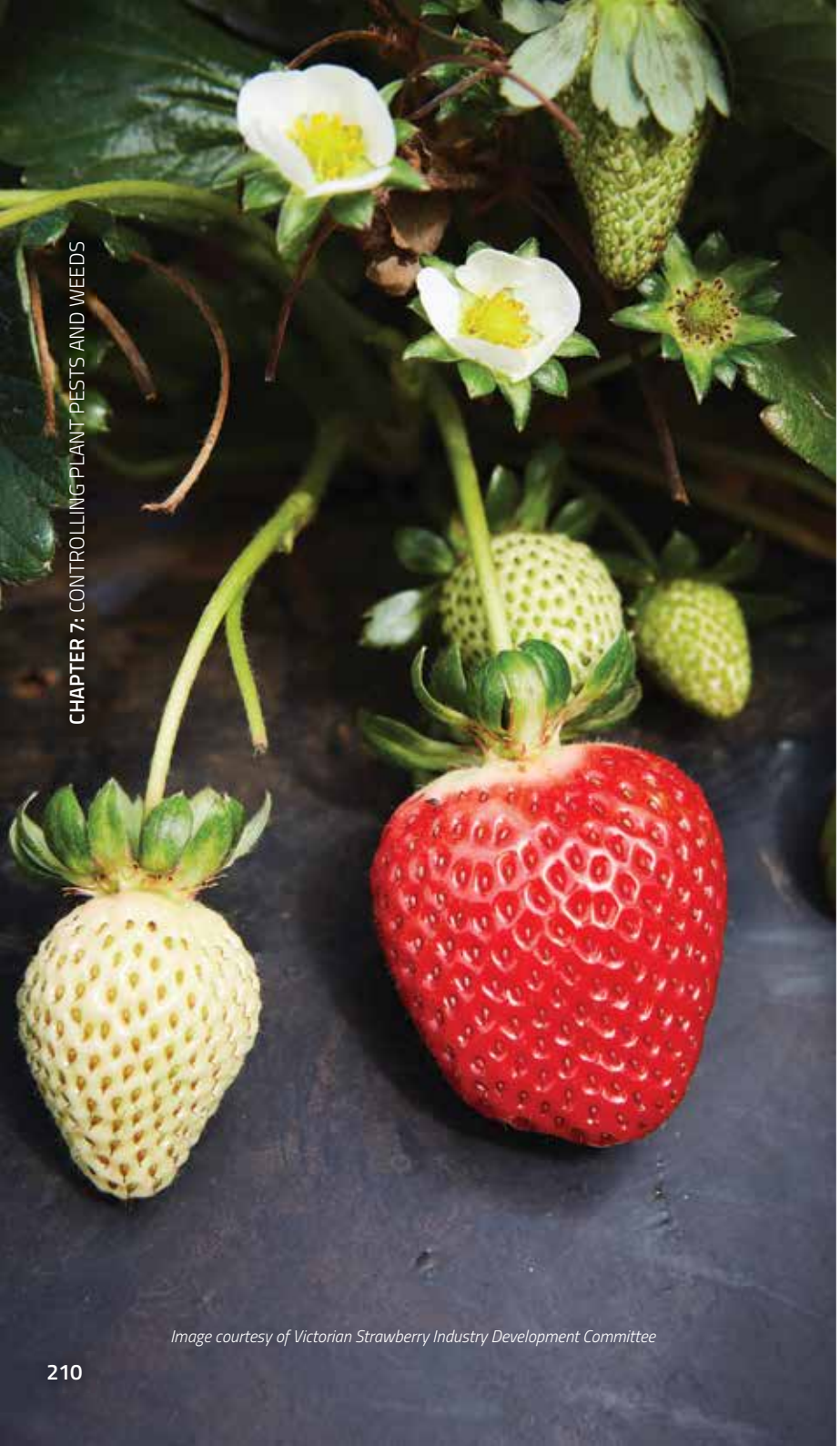


Image courtesy of Victorian Strawberry Industry Development Committee

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,[49] with a comparable cost likely to be incurred on the environmental sector.

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 new 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 governments, industries 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 take actions to prevent the entry of new weeds and manage established weeds on their properties. Plant industries play an integral part in the weed detection and reporting network.

49 McLeod R (2018) Annual Costs of Weeds in Australia. eSYS Development Pty Limited. Published by the Centre for Invasive Species Solutions, Canberra, Australia

NATIONAL APPROACH TO ADDRESSING WEED ISSUES

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 from **agriculture.gov.au/pests-diseases-weeds/pest-animals-and-weeds**

Ornamentals like agapanthus can easily escape garden beds and become a weed in the environment. If it was being imported today it would be subjected to a Weed Risk Assessment.

PREVENTING THE ENTRY OF NEW WEEDS INTO AUSTRALIA

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 DAWE 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 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). 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

State and local government weed officers conduct surveillance throughout Australia as part of routine inspections of properties for declared plants. Weeds are also targeted in the surveillance activities of the Northern Australia Quarantine Strategy (page 146).

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.

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 2020, targeting five weed species native to tropical America that have been detected in north QLD (and one also in northern NSW). The program is managed by the Queensland Government and is cost-shared by the Australian, QLD, NSW, NT and WA governments. The species are:

- limnocharis (*Limnocharis flava*), a wetland plant
- miconia (*Miconia calvescens, M. nervosa, M. racemosa*), a rainforest tree and shrubs
- mikania vine (*Mikania micrantha*).

The National Red Witchweed Eradication Program also continues. The response is led by the Queensland Government and has been funded by the Australian, QLD, NSW and NT governments, Meat and Livestock Australia, Grain Producers Australia and Canegrowers. After four years of treatment there has been a 99 per cent reduction in the number of red witchweed (*Striga asiatica*) detections and a demonstrated 85 per cent decline in the soil seedbank.

Hawkweeds, Hieracium species, are also the subject of eradication programs in NSW, VIC and TAS.

Weed containment programs occur at state, regional and local levels under each jurisdiction's legislation, aimed at preventing further spread of significant weeds that cannot be eradicated. One example is the ongoing detection and treatment of parthenium weed (*Parthenium hysterophorus*) incursions from established populations in QLD 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 (*Chromolaena odorata*).

Local or regional government organisations lead coordinated control programs for declared weeds across multiple properties within which control is generally the legal responsibility of each land owner.

Hawkweeds, Hieracium species, are the subject of eradication programs in NSW, VIC and TAS.

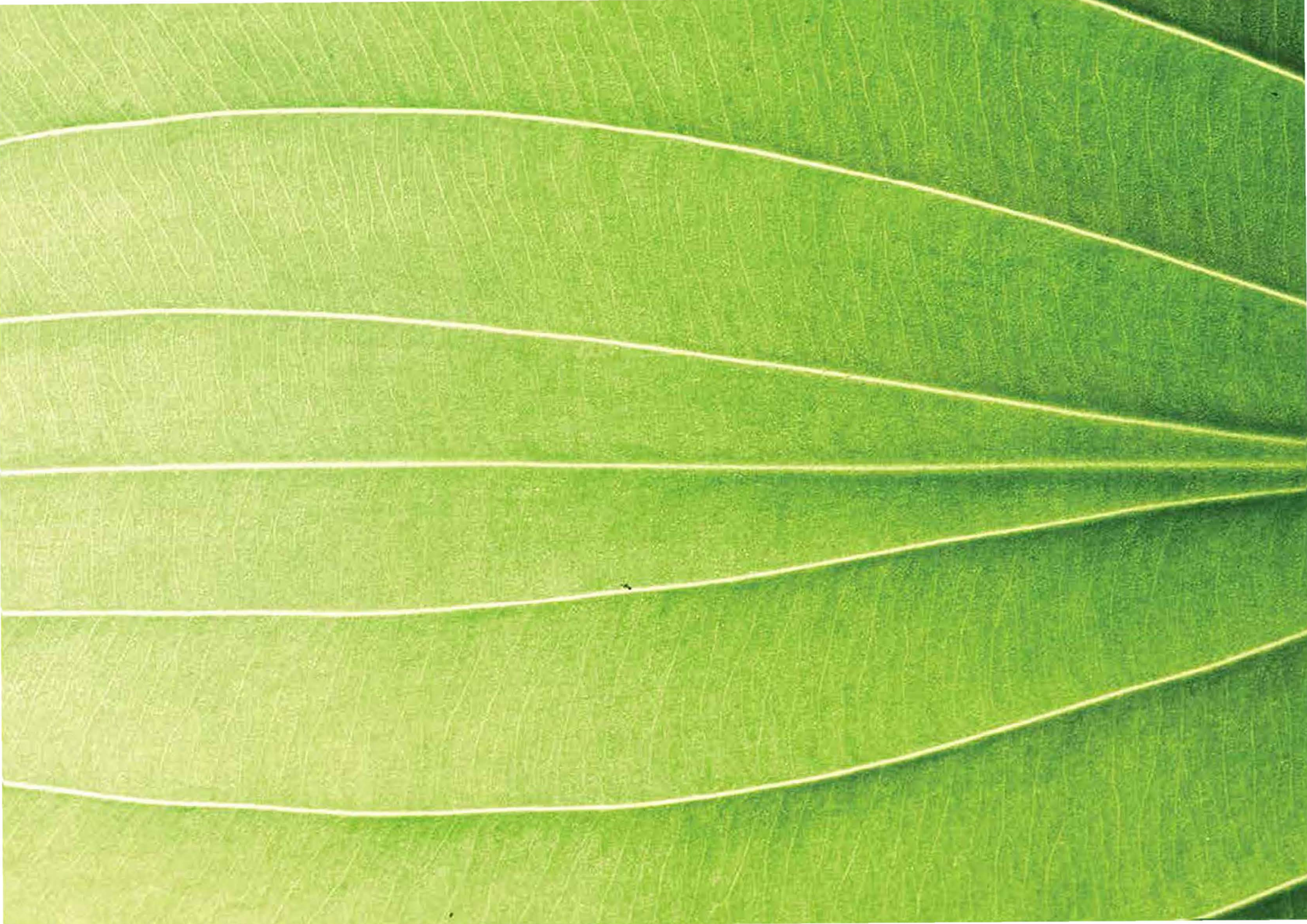
MANAGING ESTABLISHED WEEDS

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, including the National Landcare Program and the Established Pest Animals and Weeds Management Pipeline Program, 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.

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 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 and other difficult to control 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. See Table 60 (page 230) for examples of RD&E projects targeting weeds.

Weed management in natural ecosystems is undertaken by a range of groups including private and government land owners, pastoralists, rangers, volunteers and contractors. These groups undertake sensitive restoration activities to maintain local bushland and control weeds across the rangelands. 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, ranger groups also conduct surveillance for new incursions in collaboration with the states and territories and the Australian Government through the Northern Australian Quarantine Strategy.



Chapter 8

Plant biosecurity RD&E

Biosecurity Coordinator Callum Fletcher presenting on on-farm biosecurity and exotic pests, using tomato potato psyllid as a case study, at the 2020 NT Farmers workshop in Darwin, NT. Image courtesy of Madeleine Quirk, AUSVEG

Plant biosecurity research, development and extension

Understanding 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 it can be applied to minimise the 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 Australian Government, state and territory agencies as well as universities, plant industries, Plant Health Australia (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, crop protection, risk analysis, data management, surveillance, diagnostics, protecting the natural environment, and the basic biology of pests and crops. It also 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, as well as weeds, insects and other invertebrates, such as mites.

The 2020 data provides an overview of national plant, weed and pollinator biosecurity RD&E, with a summary of where it was carried out, the size, the topic, pest and crop types.[50] Surveillance programs that include some research or extension activities are also included, as are some training and awareness programs.

50 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 60 on page 230, 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 (GRDC), Wine Australia, CSIRO and the Plant Biosecurity Research Initiative.

The committee is funded by Hort Innovation (lead coordinator role across the Research and Development Corporations), the Victorian Department of Jobs, Precincts and Regions (on behalf of the state and territory governments), Cotton Research and Development Corporation, Dairy Australia, GRDC, 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, Water and the Environment (DAWE), 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

Through international agricultural research partnerships, the Australian Centre for International Agricultural Research (ACIAR) commissions research to achieve more productive and sustainable agricultural systems for the joint benefit of developing countries and Australia. By focusing on fields where Australia has special research competence, the research has positioned ACIAR as a trusted science partner and has resulted in enduring collaborations.

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

Building biosecurity science capacity in our neighbouring countries contributes to earlier knowledge of the spread of pests and diseases and contributes to Australia's preparedness for incursions and pre-border security. Research projects build capacity through Plant Health Clinics and expert mentoring, and the Pacific Plant Biosecurity Partnership offers online learning modules. ACIAR's initiation of a south-east Asian forest biosecurity network is reducing threats to species such as Acacia and Eucalyptus growing in Australia and across the region.

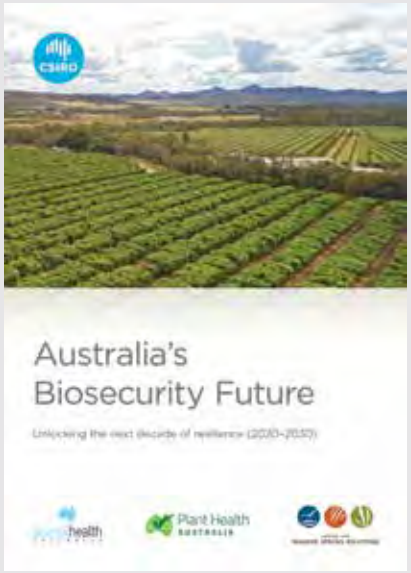
A memorandum of understanding signed in 2020 with the Plant Biosecurity Research Initiative will encourage further cross-sectoral activities.

Australia's Biosecurity Future: Unlocking the next decade of resilience

In November 2020, CSIRO released the report Australia's Biosecurity Future: Unlocking the Next Decade of Resilience. The report produced in partnership with Animal Health Australia, PHA and the Centre for Invasive Species Solutions is an update on the 2014 version.

The report was developed collaboratively through interviews and workshops with 26 organisations across the biosecurity system including the Australian Government, state governments, research, industry, and non-government organisations. It acknowledges the growing biosecurity risks with links to increasing trade and travel, outlines a transformational vision for a resilient biosecurity system in 2030 and provides recommendations under three key themes: system connectivity, shared responsibility, and science and technology.

The report is available from **csiro.au/en/Do-business/Futures/Reports/Health/Biosecurity-Futures**



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.

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 a multi-disciplinary national competition. 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.

Researchers in the lab of the Plant Innovation Centre at the Post-Entry Quarantine facility at Mickleham in VIC. Image courtesy of Mark Whattam, Plant Innovation Centre

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION

csiro.au/research

As Australia's national science agency, CSIRO solves the greatest challenges through innovative science and technology, in collaboration with industry, governments and communities. CSIRO feeds into the plant biosecurity system via the Health and Biosecurity and Agriculture and Food business units, and the national research collections.

The Health and Biosecurity 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 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 the biological knowledge that underpins a significant part of the country's taxonomic, genetic, agricultural and ecological research. Collections include the Australian Tree Seed Centre, Australian National Insect Collection and Australian National Herbarium, amongst others.

PLANT INNOVATION CENTRE

The Plant Innovation Centre was launched at the Mickleham Post-Entry Quarantine facility near Melbourne's Tullamarine Airport in November 2017. The purpose of the facility, known as PIC@PEQ, is to:

- develop in-house R&D capability to conduct applied trials that address operational issues with a focus on implementing into service delivery
- partner with scientific research communities and industry leaders
- 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 partner with external scientists and other biosecurity stakeholders to deliver on plant biosecurity related projects.

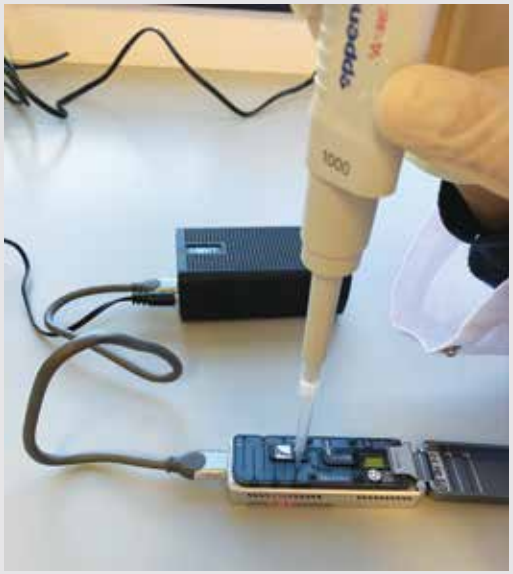
Improving border diagnostics and treatment options

The team from the Plant Innovation Centre at the Post-Entry Quarantine facility (PIC@PEQ), have partnered with key research and industry collaborators to further build diagnostic capability and assess emerging treatments to better manage biosecurity risks.

The team is working with the Queensland Department of Agriculture and Fisheries (QDAF) to assess the Oxford nanopore sequencing MinION technology which provides real-time DNA and RNA sequencing to improve identification of insects to species level at the border.

A related project is evaluating emerging technologies using CRISPR-Cas genetic manipulation for in-field detection of high priority pathogens. With QDAF's help, the Department of Agriculture, Water and the Environment is updating the use of conventional DNA amplification assays to more efficient quantitative or 'real-time' assays to target key pests and pathogens in imported high-risk plants.

In terms of assessing emerging treatments, the team is investigating alternative herbicides to replace glyphosate as a pre-border treatment to 'devitalise' imported cut flowers to prevent them from being propagated.



MinION e-DNA system is being used to identify species of insects. Image courtesy of CSIRO

Testing alternative treatments to devitalise imported cut flowers so they cannot be propogated. Image courtesy of Mark Whattam, Plant Innovation Centre (PIC@PEQ)

RESEARCH AND DEVELOPMENT CORPORATIONS

Research and development corporations (RDCs) bring together industry and researchers to establish the strategic directions for RD&E and to fund projects that provide industries with the innovation and productivity tools needed to compete in global markets.

There are fifteen rural RDCs covering most Australian agricultural industries, with seven focusing on plant production. RDCs provide funding and support to research providers including state governments, universities, CSIRO, industry associations and research organisations in the private sector. They invest around $800 million each year, with almost $300 million of this from Australian Government funding and around $500 million from industry levies.

In 2020, the DAWE released its National Agricultural Innovation Agenda, providing national leadership and driving improvements across the agricultural innovation system by targeting five pillars of reform:

1. strengthening **ecosystem leadership**, cohesion and culture through clear strategic direction and increased collaboration
2. improving the balance of **funding and investment** to deliver both incremental and transformational innovation, and growing private sector and international investment
3. embedding **world-class innovation practices** through greater transparency and entrepreneurship
4. **strengthening our regions** to achieve a greater uptake of innovation
5. creating the **next generation innovation platform** by improving the foundations of agricultural innovation, including data and regulatory setting.

In late 2020, 15 rural RDCs came together to form the Agricultultural Innovation Australia Ltd (AIA) to drive a new cross-industry research, leverage private sector investment and to target transformational innovation.

The National Agricultural Innovation Policy Statement is expected to be released in the first half of 2021, to deliver maximum benefits to industry and the broader economy.

The statement will:

- provide a narrative for Australia's agricultural innovation system, including the importance of supporting the uptake of innovation
- help new entrants navigate the system through its many players, organisations and structures
- outline new National Agricultural Innovation Priorities to drive collaboration and focus investment.

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 RDC, new and emerging industries, and the issues that affect the agricultural sector. 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 the cotton industry and the wider community. A key driving force behind the 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 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, with the exception of 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 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 partially 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' and an overarching core biosecurity framework are 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.

HORT INNOVATION

horticulture.com.au

Hort Innovation is a not-for-profit, grower-owned research and development corporation (RDC) for Australia's $14.4 billion horticulture industry.[51] Around $110 million is invested in research, development and marketing annually to provide benefit to industry and the wider community. Key functions are to:

- provide leadership to, and promote the development of, the Australian horticulture sector
- increase the productivity, farm gate profitability and global competitiveness of horticultural industries by investing grower levies and government funds in RD&E, marketing, programs and services
- provide information, services and products related to program outcomes
- promote the interests of Australian horticultural industries overseas, including the export of horticultural products.

Hort Innovation is accountable for the efficient, effective and economically and ethically sound investment of industry and public funds, and supports capacity building by maintaining a diverse range of RD&E and marketing service providers.

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. A 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

Collaboration and coordinated investment in biosecurity RD&E continued to be a focus for the Plant Biosecurity Research Initiative (PBRI) throughout 2020.

Since 2017, there have been 15 collaborative RD&E projects coordinated and contracted though PBRI members. The total value of the cross-sectoral portfolio over the three-year period, including cash and in-kind, is approximately $50 million.

In May 2020, an independent review found the PBRI had coordinated investment in projects of national significance, which have the potential to create a real difference to plant biosecurity.

In July 2020, the PBRI program was refunded for a further three years, and the PBRI Strategy was subsequently renewed to provide a current framework for co-investment. An investment plan will be developed to implement this strategy, using the PBRI's six key focus areas to ensure that RD&E priorities reflect current national biosecurity issues.

Strategic international partnerships with Better Border Biosecurity (B3) New Zealand (NZ) and Euphresco, extend the role of PBRI's collaboration and co-investment on common global biosecurity issues. In November 2020, a further partnership was formalised with ACIAR to work with its country partners on biosecurity research and capacity building with mutual benefits.

In the later part of 2020, the PBRI supported the national efforts of the UN-declared International Year of Plant Health, providing a strong focal point for collaboration between industry and government.

51 Hort Innovation (2020). *Australian Horticulture Statistics Handbook 2018-19*

Regulating biosecurity risks from seed in the mail

Imported seeds and invasive weeds pose a significant biosecurity risk as they can carry exotic insects and diseases.

Regulations imposed on imported seeds depend on the species, the risks posed and end-uses. Some can be imported without restrictions, others require treatment at the border, and some need to be grown and tested for diseases in post-entry quarantine facilities.

Last year, more than 158 million mail articles were posted to Australia. The challenge of regulating mail was expounded by an international 'brushing' scheme which led to people receiving unsolicited seeds in their mail. Over 200 seed packets are found daily and, while detector dogs regularly find seeds, packaging and low odour makes it difficult.

To improve detection, DAWE partnered with Rapiscan Systems to trial low-energy, high-resolution x-rays with real-time video imaging and computer algorithms to automatically detect seeds in mail.

PIC@PEQ are also working with Steritech to assess the use of low dose eBeam and x-rays to treat undeclared seed in mail by 'shooting' a beam of electrons to break DNA molecules, to kill the seed or render it harmless.

Proof-of-concept trials have begun, with various substrates – like glass, electronics and plastics – to assess possible negative effects on other materials.

Seeds are most commonly intercepted biosecurity risk items. In 2020 they made up 75 per cent of the total interceptions in mail centres. Image courtesy of DAWE

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.

Field of legumes. Image courtesy of Madeleine Quirk, AUSVEG

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.

Centre for Crop Health – a partnership between University of Southern Queensland and Queensland Department of Agriculture and Fisheries.

A partnership also exists between the Northern Territory Department of Primary Industry, Tourism and Trade 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 to mid-2022.

There are 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.

In 2019, the centre grew to more than 75 researchers and professional support staff who, through laboratory-based research, field work and the development of integrated farm management strategies, worked to deliver real impact and in-field solutions for Australian growers.

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 with 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 supports research fellows and PhD students, who are distributed across and move freely between participating organisations. Research activities are supported by a $3.7m grant from the ARC's Industrial Transformation Training Centre program, with supplementary support from the 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 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's DAWE, 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. The Foundation aims to build on the legacy of the PBCRC, strengthening the collaborative networks between communities, governments, research and industry in Australia and overseas.

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 by focusing on honey bee hive sites, honey products, health and chain of custody. The CRC has 25 industry and community partners and is presently running 35 projects.

Bee Biosecurity Officers inspecting hives in an avocado orchard. Image courtesy of WA DPIRD

Kevin Powell (SRA) and ISRI team evaluating moth borer trails in sugarcaine, Indonesia. Image courtesy of Sugar Research Australia

Plant biosecurity RD&E projects in 2020

In 2020, 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 60, starting on page 230, lists 681 plant biosecurity related research projects undertaken during 2020. 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

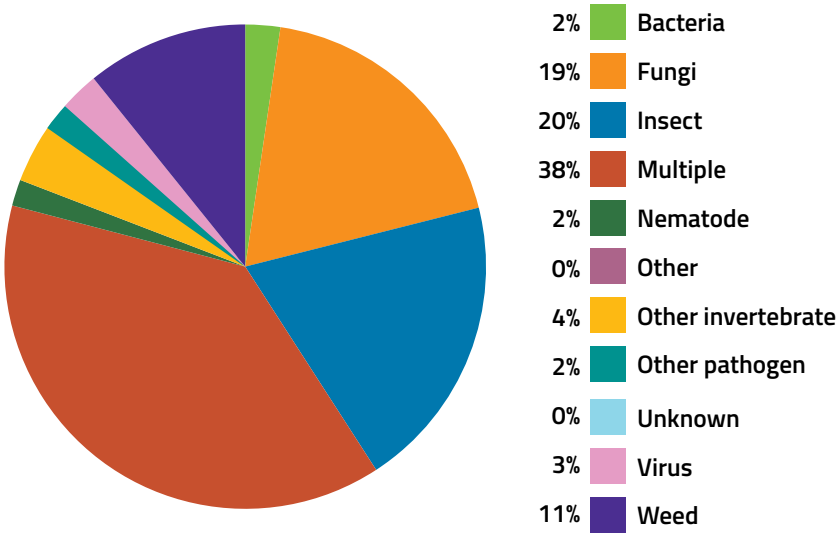


Figure 95. RD&E projects by research type or location

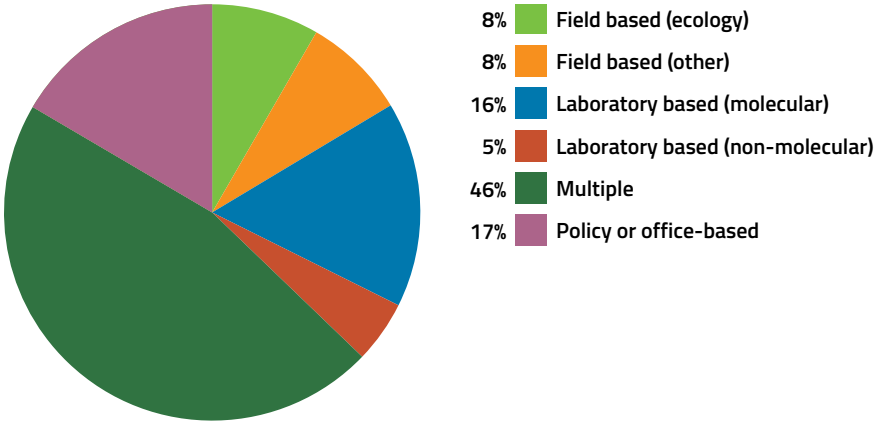


Figure 96. RD&E projects by project value

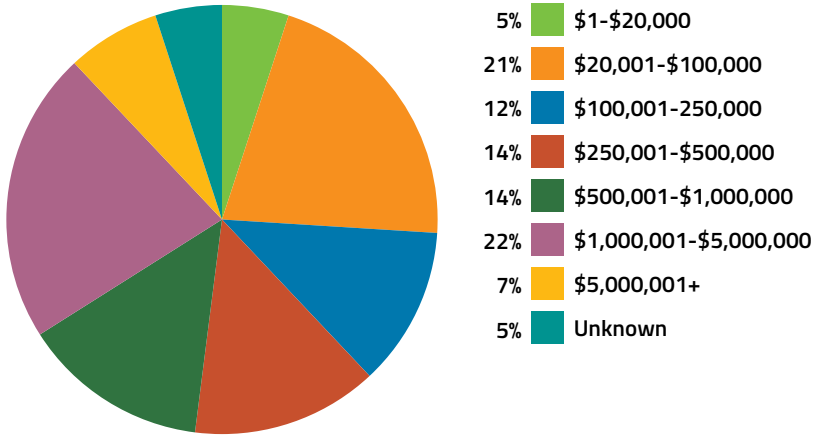


Figure 97. RD&E projects by biosecurity areas

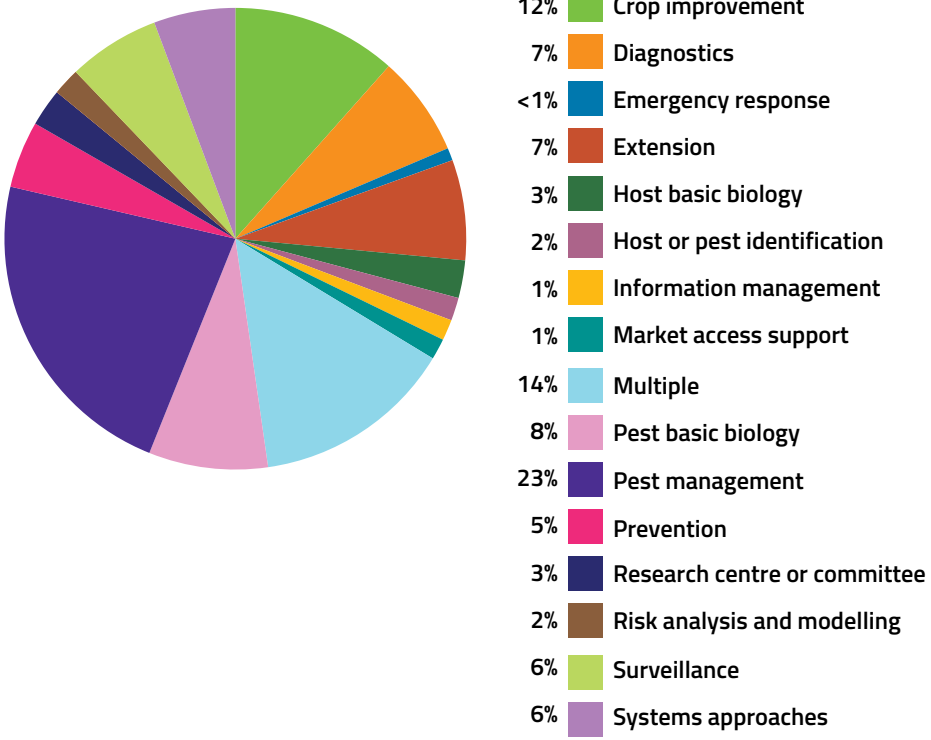
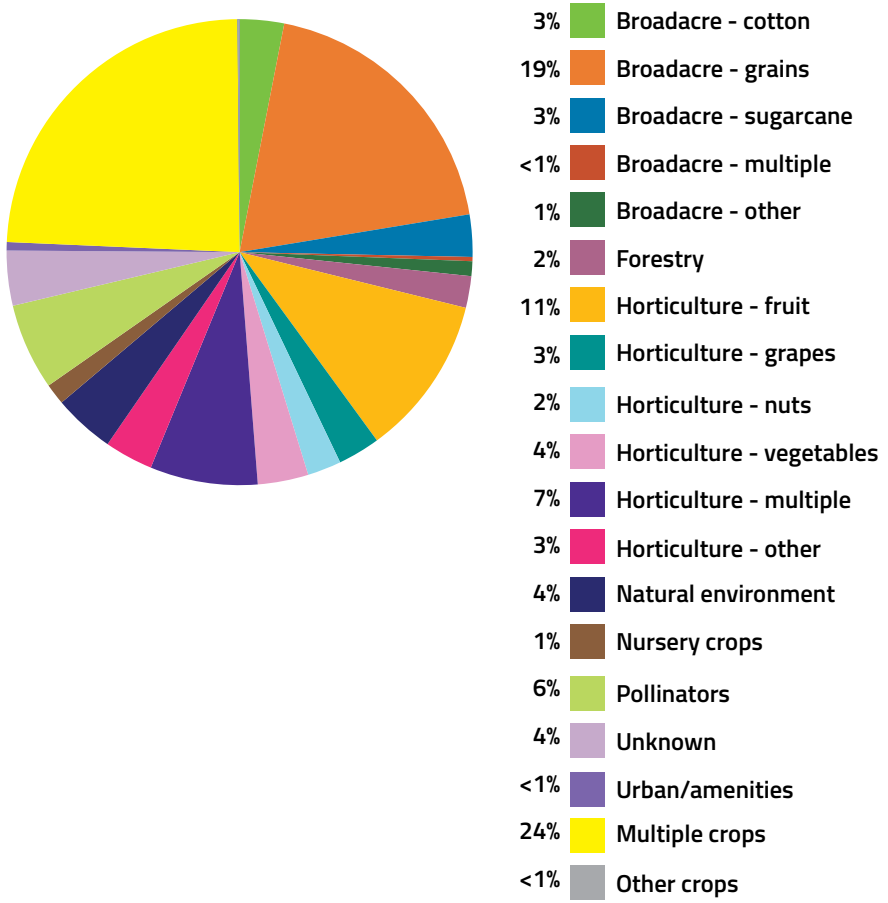


Figure 98. RD&E projects by crop type*



*The definition for 'crop type' are generally based on the Hort Innovation, AgriFutures Australia and GRDC crop groupings.

Table 60. 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)
Bioclay Verticillium for cotton	University of Queensland	ARC Hub
Biological based products for improved cotton production	Western Sydney University	CRDC, Converte Pty Ltd
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	DAWE
Evaluate efficacy of novel chemistries, biocontrol agents and management practices to control Alternaria and black root rot disease in cotton	NSW DPI	CRDC, NSW DPI
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
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
Managing Verticillium risk for cotton – Fullbright Scholarship support	NSW DPI, Lower Namoi CGA, Texas Tech	CRDC, Fullbright Scholarship, NSW DPI
Mirid and mealybug management best practice	QDAF	CRDC, QDAF
National biosecurity or disease extension and central QLD 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
Sustainable silverleaf whitefly resistance management through improved insect resistance monitoring	QDAF	CRDC, QDAF
Transformation of *Verticillium dahliae*, causal agent of Verticillium wilt of cotton with the GFP gene (Hon)	NSW DPI, University of Queensland	CRDC
Using DNA diagnostics to monitor disease suppressive cotton farming systems	Crown Analytical, University of Sydney	CRDC, Cotton Seed Distributors Ltd, CSIRO
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, WA Agricultural Authority	GRDC
A simple and innovative test for real-time detection of resistance in weeds	University of Western Australia	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

Table 60. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Broadacre – grains (continued)		
Ascochyta blight of field pea	Curtin University (CCDM)	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
Assess wheat cultivars for tolerance to root lesion nematode	University of Southern Queensland	LongReach Plant Breeders, Australian Grain Technologies
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), University of Southern Queensland, University of Melbourne	GRDC
Australian wheat and barley molecular marker program – genetic analysis	University of Adelaide	GRDC
Bioinformatics foundation project	Curtin University (CCDM)	GRDC
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
Chemical cues used by aphidophagous arthropods to locate aphids in canola fields (PhD)	Murdoch University	GRDC
Communicatons and engagement foundation project	Curtin University (CCDM)	GRDC
Conduct integrative taxonomic revision of Australian Trogoderma species	CSIRO	DAWE
Consultative review determine potential herbicides for managing WA blue lupin and other broadleaf weeds in narrow leaf and albus lupin crops	Independent Consultants Australia Network Pty Ltd	GRDC
Control of snails and slugs: New products for snail and slug control – biological control of slugs using ciliate protozoa	University of Melbourne	GRDC
Crown rot resistance	University of Southern Queensland	Intergrain
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
Determining the incidence of herbicide resistance in Australian grain cropping	Charles Sturt University	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

Table 60. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Broadacre – grains (continued)		
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
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
Do some chickpeas produce metabolites for and against ascochyta blight?	Department of Regional NSW	GRDC
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 genetic control of *Septoria tritici* blotch	NSW DPI	GRDC
Effective genetic control of *Stagonospora nodorum* blotch	WA DPIRD	GRDC
Effective use of diquat for late season weed set control of annual ryegrass (*Lolium rigidum*) in barley	Synergy Consulting	GRDC
Engineering rust resistance	CSIRO	Two Blades Foundation (USA)
Enhancing resistance to wheat stripe rust disease	Australian National University	ARC
Evaluation of CAIGE elite genotypes for *Pratylenchus thornei* resistance and tolerance	University of Sydney, University of Southern Queensland	GRDC
Extension and engagement	Curtin University (CCDM)	GRDC
Extracellular vesicles in the pathogenesis of fungal plant disease	La Trobe University	ARC
Fungicide resistance detection and underlying mechanisms	Curtin University (CCDM), University of Southern Queensland	GRDC
Future options for the control of red legged earth mite in Australian grain crops	Cesar Australia	GRDC
Genetic control of nematode species affecting major crops – germplasm enhancement for nematode control in cereals and pulses	University of Southern Queensland, GRDC	GRDC
Genetic solutions to crown rot in barley	CSIRO	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
Glasshouse trial for *Pratylenchus thornei* and *P. neglectus* with specific treatments	University of Southern Queensland	FMC Australasia
Grain weeds advisory committee	Rural Directions Pty Ltd	GRDC
Grains farm biosecurity program	PHA	GPA
Herbicide options for the management of emerging summer grass weeds in winter cereals	Northern Grower Alliance Incorporated	GRDC
Identification of novel sources of resistance to Septoria leaf blotch and understanding of evolution and virulence of the pathogen	University of Adelaide	GRDC

Table 60. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Broadacre – grains (continued)		
Identification, surveillance and advisory platform for management of grains pests	Cesar Australia	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 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 management of Phytophthora root rot of chickpea	Western Sydney University	NSW DPI
Improving monitoring and management of Etiella in lentils	SARDI	SA Grain Industry Trust
Improving weed control in pulses – delivery of herbicide tolerance traits	University of Adelaide	GRDC
Incidence and severity of disease in cereal and pulses	DJPR	GRDC, DJPR
Insecticide resistance in the green peach aphid – national surveillance, preparedness and implications for virus management	Cesar Australia	GRDC
Integrated disease management package for ascochyta blight in chickpeas	CSIRO	GRDC
Integrated disease management strategies for cereal and pulse growers	DJPR	GRDC, DJPR
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
Integrated weed management of herbicide resistant annual ryegrass at Lake Bolac	Southern Farming Systems	GRDC
International mungbean improvement network	Asian Vegetable Research and Development Centre, QDAF	ACIAR
Investigating snail rollers to clean small conical snails out of barley and canola	Stirlings to Coast Farmers	GRDC
Let's talk glyphosate resistant ryegrass workshop, south-east NSW	FarmLink Research Limited	GRDC
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 Australia	GRDC
Managing early season canola pests in NSW – establishment and co-ordination of grower and advisor groups	FarmLink Research Limited	GRDC
Mechanisms, evolution and inheritance of resistance	University of Adelaide	GRDC
Mechanisms of antifungal resistance in blackleg disease of canola	University of Melbourne	ARC
Minimising the impact of major barley foliar pathogens on yield and profit: development of international host differential sets	DJPR	GRDC
Minimising the impact of major barley foliar pathogens on yield and profit: screening of elite breeder material transitioning to a fee for service model	QDAF	GRDC
Minimising the impact of major barley foliar pathogens on yield and profit: surveillance and monitoring of pathogen populations	University of Adelaide, SARDI	GRDC

Table 60. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Broadacre – grains (continued)		
Mitigating disease constraints to improve productivity and sustainability of faba beans in Ethiopia	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 Brassica germplasm improvement program – phase II	NSW DPI	GRDC
National hay agronomy project	WAAA, DJPR	AgriFutures Australia
National mungbean improvement program	QDAF	GRDC, QDAF
National variety trials – pathology	University of Southern Queensland	GRDC
National variety trials – pathology of cultivar disease resistance ratings	DJPR	GRDC
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
Optimum management strategies to improve profitability of producing high quality Australian prime hard and durum grain in northern NSW including interactions with Fusarium crown rot	Department of Regional NSW	GRDC
Pathology support for the QLD mungbean improvement program	University of Queensland	QDAF
Pathways to registration – minor use	AKC Consulting Pty Ltd	GRDC
Phosphine resistance	Murdoch University	WA DPIRD
Protection of stored grains against insect pests	Davren Global Pty Ltd	ACIAR
PulseBio 4 – biosecure pulse seeds	DJPR	GRDC
Quantification of fungicide actives in plant tissue to guide sustainable use by growers	Department of Regional NSW	GRDC
Regional risk assessment and thresholds for Russian wheat aphid	SARDI, Cesar Australia	GRDC
Resistance to barley net blotches	Curtin University (CCDM)	GRDC
Screening of diverse barley germplasm for rapid discovery and utilisation of novel disease resistance in barley novel using R-HapSelect, a haplotype-based toolkit	University of Queensland	GRDC
Septoria nodorum blotch of wheat	Curtin University (CCDM)	GRDC
Snail biocontrol revisited – phase II	CSIRO	GRDC
Soil-borne disease 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
Stem nematode in oats	University of Adelaide	AgriFutures Australia
Surveillance of herbicide resistant weeds in Australian grain cropping	Charles Sturt University, University of Western Australia	GRDC

Table 60. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Broadacre – grains (continued)		
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 cereals and pulses in the northern region	QDAF	GRDC, QDAF
Surveys and associated diagnostics of the incidence and severity of diseases of cereals and pulses in the southern region (SA)	University of Adelaide	GRDC
The functional characterisation of a novel immune response in plants	Australian National University	ARC
The interaction between arbuscular mycorrhizal fungi, rhizobia and root lesion nematodes in mungbean	University of Southern Queensland	GRDC Scholarship
The roles of pathogen effectors in promoting rust diseases of plants	Australian National University	ARC
Towards effective genetic and sustainable management of ascochyta blight of chickpea: accurate, effective, cheaper and rapid high-throughput method for qualitative and quantitative evaluation for ascochyta blight genetic resistance	DJPR	GRDC
Towards effective genetic and sustainable management of scochyta blight of chickpea: ascochyta blight pathogen biology, population dynamics and epidemiology	Griffith University, University of Southern Queensland, DJPR, WA DPIRD	GRDC
Towards effective genetic and sustainable management of ascochyta blight of chickpea: identification and characterisation of novel sources of ascochyta blight resistance in elite cultivars and wild relatives of chickpea	University of Adelaide	GRDC

Moth borer Sesamia grisescens larva in sugarcane. Image courtesy of Sugar Research Australia

Table 60. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Broadacre – grains (continued)		
Towards effective genetic and sustainable management of ascochyta blight of chickpea: phenotyping of pathogen isolates and chickpea genotypes	International Centre for Agriculture Research in Dry Areas	GRDC
Towards understanding the molecular details of canola infection by Fusarium	University of Melbourne	ARC
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
Weed species for potential research investment	DJPR	GRDC
Weed surveillance	QDAF	GRDC
Broadacre – sugarcane		
Control of red witchweed by ethylene injection (PhD)	University of Queensland	QDAF
Development of an artificial diet for canegrubs	SRA	SRA
Development of commercial molecular biological assays for improved sugarcane soil health and productivity	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 QLD	SRA	SRA
General pest management – north QLD	SRA	SRA
General pest management – south QLD	SRA	SRA
Identification of potential arthropod vectors of sugarcane streak mosaic virus in Myanmar	SRA	ACIAR
Identifying new generation insecticides for canegrub control as contingency for loss of amenity with existing product	SRA	SRA, QDAF
International and domestic quarantine for sugarcane germplasm	SRA	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
Ratoon stunting disease detection at the sugar factory – disease detection blueprint	SRA, University of Queensland	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
Situation analysis and opportunities for pest, disease and weed RD&E (including biosecurity) in Australian sugarcane	SRA	SRA
Soil diagnostic assay laboratory – nematodes and Pachymetra root rot	SRA	SRA
Soldier fly management	SRA	SRA
Broadacre – multiple		
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		
Eco-friendly pesticides for crop protection	University of Queensland	ARC, NSW DPI, Innovate Ag Pty Ltd
Ensuring lucerne seed production in the absence of bees	University of Western Australia	AgriFutures Australia

Table 60. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Broadacre – other (continued)		
Fireweed biocontrol (weevil: *Gasteroclisus*)	CSIRO, DAWE	DAWE
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
Northern Rice Australia – developing rice growing packages for tropical north Australia	University of Southern Queensland	AgriFutures Australia
Quantitative DNA tests for lucerne seed wasp and associated parasitoid wasps	University of Adelaide	AgriFutures Australia
Rice – weed management in Australia	Agropraisals Pty Ltd	AgriFutures Australia
Horticulture – fruit		
Additional cold treatment schedule for Queensland fruit fly in blueberries for market access to China	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
Biosecurity plan for lychee, papaya and passionfruit industries	PHA	Hort Innovation
Breeding better bananas	University of Queensland	International Institiute for Tropical Agriculture, Bill & Melinda Gates Foundation
Cherry market access and trade development	Cherry Growers Australia	Hort Innovation
Citrus agrichemical and export maximum residue limit program	Citrus Australia	Hort Innovation

Table 60. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Horticulture – fruit (continued)		
Citrus canker research	NT DITT	National citrus canker eradication program
Citrus pest and disease prevention committee	Citrus Australia	Citrus Australia
Cold plasma treatment of post-harvest strawberry pathogens	Murdoch University	Agricultural Produce Commission (Strawberry Committee)
Conditional non-host systems protocol for fruit fly in mangoes	QDAF	Hort Innovation
Developing integrated pest management compatible controls for spotted wing drosophila (*Drosophila suzukii*)	IPM Technologies	Hort Innovation
Developing knowledge and management of strawberry red leaf disorder	QDAF, University of Queensland	Hort Innovation
Development of area-wide management approaches for fruit flies in mangoes for Indonesia, Philippines, Australia and the Asia-Pacific region	QDAF	ACIAR
Development of integrated pest management compatible methods for controlling *Drosophila suzukii* in berry crops	IPM Technologies, Cesar Australia	Hort Innovation
Development of molecular markers for Fusarium wilt resistance in banana	University of Queensland	Hort Innovation
Disinfestation of blueberries against Mediterranean fruit fly for market access to Japan	Murdoch University	Hort Innovation
Employment of a national citrus surveillance coordinator	Citrus Australia	PHA
Expanding crop protection options for control of blueberry rust	University of Tasmania (Tasmanian Institute of Agriculture), Staphyt Pty Ltd, NSW DPI	Tasmanian Government (Agricultural Innovation Fund)
Exploring integrated pest management compatible methods for spotted winged drosophila in berry crops	Cesar Australia	Hort Innovation
Facilitating the development of the Australian berry industries	Berries Australia	Hort Innovation
Farm survey 2020 – charcoal rot incidence in the VIC strawberry industry	Victoria Strawberry Industry Certification Authority	Victorian Strawberry Industry Development Committee
Fusarium wilt tropical race 4 research program 2	University of Queensland	Hort Innovation
Fusarium wilt tropical race 4 research program 3	QDAF (led), NT DITT, James Cook University	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
High health, pre-commercial propagation material for Australian strawberry growers	DJPR	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 DITT	Hort Innovation
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

Table 60. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Horticulture – fruit (continued)		
Industry led surveillance pilot	Citrus Australia	Citrus Australia
Integrated pest management of redberry mite (*Acalitus essigi*) on blackberries	University of Tasmania	Hort Innovation
Investigating technical feasibility of enhanced management of black Sigatoka, and disease suppression with a view to eradication in the Torres Strait	QDAF	DAWE
Investigation into citrus blossom bugs in avocados	QDAF, University of Queensland	Hort Innovation
Low-dose methyl bromide fumigation of plums	QDAF	Hort Innovation
Management of banana pests and diseases in north QLD	Australian Banana Growers' Council	Hort Innovation
Management of six spotted mite in WA avocado orchards – phase 2	WAAA	Hort Innovation
Melon industry biosecurity officer	Melons Australia	Hort Innovation
National banana bunchy top virus program (phase 4) – surveillance and education	Australian Banana Growers' Council	Hort Innovation
National master classes 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 1	Southern Cross University	Hort Innovation
National passionfruit breeding program 2	Southern Cross University	Hort Innovation
National strawberry varietal improvement program	QDAF	Hort Innovation
Odour detection dog and development of a volatile profile for citrus canker	NT DITT	DAWE
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	Hort Innovation (RRD4P)
Reversing the impact of banana blood disease in Indonesia	University of Queensland (QAAFI)	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 sector	PHA	Hort Innovation
Review of the national biosecurity plan for the banana industry	PHA	Hort Innovation
Review of the national biosecurity plan for the cherry industry and development of a biosecurity manual for cherry producers	PHA	Hort Innovation
Rubus industry minor use program	Hort Innovation	Hort Innovation
Strategic industry development, biosecurity and sustainability in the banana industry	Australian Banana Growers' Council	Hort Innovation
Strawberry industry minor use program	Hort Innovation	Hort Innovation
Strengthening the banana industry diagnostic capacity	University of Queensland	Hort Innovation
Topical application of BioClay-delivered dsRNA for management of pineapple and avocado diseases	University of Queensland	QDAF

Table 60. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Horticulture – fruit (continued)		
Understanding and managing the role of honey bees in cucumber green mottle mosaic virus epidemiology	NT DITT	Hort Innovation
Use of biofumigant crops for management of charcoal rot	Victorian 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		
Area wide integrated pest management support for Queensland fruit fly in table grapes	Australian Table Grape Association	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
Collecting and disseminating information of agrochemicals	Australian Wine Research Institute	Wine Australia
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
Field trials with new scion-rootstock combinations and evaluation of new technology for improved water efficiency and reduced costs	CSIRO	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
Managing fungicide resistance in Australian viticulture	SARDI	Wine Australia
Molecular epidemiology and physiology of Shiraz disease with an emphasis on grapevine virus A (PhD)	University of Adelaide, Australian Wine Research Institute	Wine Austraia, University of Adelaide, Australian Wine Research Institute
New technologies for dynamic canopy and disease management	CSIRO	Wine Australia
Novel autonomous robotic weed control to maximise agricultural productivity (Ag Kelpie)	Agent Oriented Software, University of New England	CRC Project Round 9, Australian Department of Industry, Science, Energy and Resources
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
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
Surveillance of SA for phylloxera	Vinehealth Australia	Vinehealth Australia
The molecular epidemiology and control of grapevine pinot gris virus in Australian agriculture (PhD)	La Trobe University, DJPR	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
Chestnut blight response coordinator	Chestnuts Australia	Chestnuts Australia
Chestnut industry biosecurity officer	Chestnuts Australia	Chestnuts Australia

Table 60. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Horticulture – nuts (continued)		
Chestnut industry communications program	Chestnuts Australia Inc.	Hort Innovation
Establishing the walnut Emergency Plant Pest Response levy	Australian Walnut Industry Association	Australian Walnut Industry Association
Hazelnut growth through the implementation of the 2030 strategic blueprint	Hazelnut Growers of Australia	AgriFutures 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
National almond breeding and evaluation program	University of Adelaide	Hort Innovation, Australian Almonds
National macadamia breeding and evaluation program	University of Queensland	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
Walnut owner reimbursement cost template	Australian Walnut Industry Association	Australian Walnut Industry Association
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
Area wide management of vegetable diseases – viruses and bacteria	QDAF (lead), University of Tasmania, NSW DPI, NT DITT, DJTR, WA DPIRD	Hort Innovation, QDAF, DJPR, WA DPIRD, University of Tasmania

Mark testing Abraxis kit for devitalisation test. Image courtesy of Mark Whattam, PIC@PEQ

Table 60. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Horticulture – vegetable (continued)		
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)
Elucidating the epidemiology of bacterial crown and fruit rot, an unusual Pseudomonas disease of zucchini	DJPR	DJPR
Germinate to exterminate	University of Tasmania	Simplot Pty Ltd
Integrated pest management of nematodes in sweetpotatoes	QDAF	Hort Innovation, QDAF, Australian Sweetpotato Growers, Central Queensland University, University of Southern Queensland
Investigation the soil pH and nutrition factors influencing pink rot in potato	University of Tasmania	Hort Innovation
Mechanisms and manipulation of resistance to powdery scab in potato roots	University of Tasmania	Hort Innovation
Microbial rhizosphere diversity in glasshouse hydroponic crops	University of New England	Future Food Systems Ltd
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
Peri-urban vegetable biosecurity pilot project	AUSVEG, PIRSA, DJPR, NSW DPI	DAWE
Polymerase chain reaction tests for seeds	DJPR	DAWE
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	DAWE, DJPR
Vegetable and potato biosecurity officer program	AUSVEG	AUSVEG
Horticulture – multiple crops		
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 Cooperative Research Program (Austria)
Biochemistry of ejaculate mediated sexual inhibition in Queensland fruit flies (PhD)	Macquarie University	Hort Innovation

Table 60. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Horticulture – multiple crops (continued)		
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 integrated pest management programs (PhD)	Macquarie University	Hort Innovation
Comparisons of new sexing strains of Queensland fruit fly	Macquarie University	International Atomic Energy Agency Cooperative Research Program (Austria)
Contribution RRD4P project – improving plant pest management	Hort Innovation	AgriFutures Australia
Crop hygiene – hort indexing	DJPR	Fee for Services
Cucumber green mottle mosaic virus and melon necrotic spot virus diagnostic project	DJPR	DAWE
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
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 VIC horticultural produce destined for Asian markets	DJPR	La Trobe University Scholarship

Macadamias. Image courtesy of Tamara Hepburn

Cauliflowers. Image courtesy of Madeleine Quirk, AUSVEG

Table 60. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Horticulture – multiple crops (continued)		
Generation of data for pesticide application in horticulture 1	Eurofins	DAWE
Generation of data for pesticide application in horticulture 2	Peracto Pty Ltd	DAWE
Genetics of fruit fly thermal tolerance and pupal colour	Macquarie University	Hort Innovation
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
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
Interactions of entomopathogens and Australian fruit fly	Western Sydney University	ARC
Investigate the use of smart traps in fruit fly surveillance	Hort Innovation	DAWE
Mating frequency of Queensland fruit fly – a potential constraint on SIT (PhD)	Macquarie University	Hort Innovation
Molecular basis of sexual performance in Queensland fruit fly (PhD)	Macquarie University	ARC

Table 60. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Horticulture – multiple crops (continued)		
Multi-scale monitoring tools for managing Australian tree crops – phase II	University of New England, Central Queensland University, NT DITT, QDAF	Horticulture Innovation, DAWE RRD4P, Ceres Imaging, University of New England, Tie up farming, Central Queensland University, NT DITT, American Medical Informatics Association, QDAF, NSW DPI
National biosecurity plan for the summerfruit industry	PHA	Hort Innovation
National centre for post-harvest disinfestation research on Mediterranean fruit fly (Australian Medfly R&D Centre)	Murdoch University	AgriFutures Australia, Hort Innovation, Kalang Consultancy Services Pty Ltd, QDAF, WA DPIRD
National diagnostic protocols – Xylella vectors	DJPR, WA DPIRD	PHA (SPHD)
National Fruit Fly Council – phase III	NFFC, PHA	Hort Innovation, state governments
National tomato potato psyllid and zebra chip surveillance	WA DPIRD (led), NT DITT, 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
Olfactory relationship between fruit flies and associated bacteria (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 1	Macquarie University	Hort Innovation
Post-factory pilot of SITPlus fly production 2	Macquarie University, DJPR, SARDI, NSW DPI, PFRA	Hort Innovation, Maquarie University, DJPR, SARDI, NSW DPI, PFRA
Potential of gene drives to eliminate incursions of *Drosophila suzukii*	University of Melbourne	ARC
Quality control procedures for Queensland fruit fly mass-rearing (PhD)	Macquarie University	Hort Innovation
Sampling for *Candidatus* Liberibacter solanacearum	SARDI	Hort Innovation
Sex determination of fruit fly pupa using near infrared spectroscopy	James Cook University	QDAF
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 – 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
Strategic Agrichemical Review Process	AGK Services	Hort Innovation
The evolution of generalism – why so many polyphagous fruit flies?	Queensland University of Technology	ARC
Wolbachia endosymbionts – novel strain dynamics in Australian Drosophila	University of Melbourne	ARC
Horticulture – other		
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	DAWE
Chemical minor use permit research	QDAF	AgriFutures Australia

Table 60. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Horticulture – other (continued)		
Developing tools to screen native pepper for resistance to dieback and tolerance to drought (PhD)	University of Tasmania	Diemen Pepper
Development of a biosecurity plan for Australian mushrooms	PHA	Hort Innovation
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)
Enhanced market agility for the Australian tea tree industry	Southern Cross University	CRC, Southern Cross University, Australian Tea Tree Industry Association
Ginger extension coordination project	Australian Ginger Industry Association	AgriFutures Australia
Ginger ninja – automating disease detection in seed ginger stock	Queensland University of Technology	AgriFutures Australia
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
Pest and disease management and research services for the mushroom industry	University of Tasmania	Hort Innovation
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 integrated pest management in tea tree oil plantations	QDAF	AgriFutures Australia
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
Tea tree breeding program 2	Southern Cross University	Agrifutures Australia, Australian Tea Tree Industry Association
The biosecurity risk and risk mitigation of imported fresh cut flowers and their role as a pathway for invasive insect species	Murdoch University	Murdoch University
Natural environment		
Application of remote sensing for surveillance of high risk invasive plants	DJPR	DJPR
Boneseed invasion management in WA	CSIRO, WAAA, South West Catchments Council	WA DPIRD
Colonisation by alien microbiota – identifying key ecological processes	Western Sydney University	ARC
Combating myrtle rust, a new disease threatening Australia's unique flora	University of Sydney	ARC, Australian Tea Tree Industry Association, Australian Flora Foundation, NZIPFR, NSW Office of Environment and Heritage
Control options for Mimosa bush (*Vachellia farnesiana*) in natural grasslands, threatened ecological communities	University of Queensland	North West Local Land Services
Developing an environmental risk mitigation plan for Australian Acacia species	PHA	DAWE

Table 60. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Natural environment (continued)		
Developing an environmental risk mitigation plan for mangroves and associated communities	PHA	DAWE
Egeria containment in irrigation channels	DJPR	Goulburn Murray Rural Water Corporation, 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
Environmental biosecurity – adding a cultural context	Butchulla Land and Sea Rangers	APBSF
Eradication of inkweed, a new priority weed incursion on King Island	King Island Natural Resource Management Group	National Landcare Program
Evolution of chemical warfare in plants	Monash University	ARC
Expanding environmental biosecurity capacity to protect our unique ecosystems on K'gari (Fraser Island)	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
Exploration of RNAi vaccines as a novel control for myrtle rust in critically endangered Australian taxa	University of Queensland	APBSF
Fire and rust – impact of myrtle rust on regeneration of fire damaged Myrtaceae and associated ecosystems	QDAF	APBSF
Impact of draw-down on Egeria in Lake Mulwala	DJPR	Goulburn Murray Rural Water Corporation, DJPR
Impact of myrtle rust (*Austropuccinia psidii*) infection on community composition and ecological function	University of Queensland, Queensland University of Technology	APBSF
Myrtle rust in WA – surveillance plan and testing preparedness	Murdoch University	APBSF
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
Plant epidemiology – host susceptibility to myrtle rust	Queensland University of Technology	APBSF
Plant invasions as a driver of tri-trophic community structures in dry forest ecosystems	Monash University	Ecological Society of Australia
Proactive pre-border vigilance against exotic strains of myrtle rust	QDAF	APBSF
Restoration of Phytophthora impacted jarrah forest (PhD)	Murdoch University	Shire of Mundaring
The role of drought stress and insect attack on rainforest plant health	James Cook University, Griffith University	ARC
Using metabolites as biomarkers for the identification of innate resistance to myrtle rust across the Myrtaceae	Western Sydney University	APBSF
WA bitou management – eradication program	CSIRO	Fremantle Port Authority

Table 60. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Nursery crops		
Building plant health surveillance capacity in Australia's nursery production industry project	GIA	DAWE
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
Improving surveillance strategies for tospoviruses and thrips to enhance the biosecurity of the nursery industry	Queensland Alliance for Agriculture and Food Innovation, QDAF, Agribio	Hort Innovation
Integrated disease management in pyrethrum	University of Tasmania	Hort Innovation
National nursery industry biosecurity program	GIA	Hort Innovation
Greenlife Industry Australia biosecurity engagement measures	GIA	DAWE
Production nursery industry biosecurity plan review and update	PHA	Hort Innovation
National biosecurity and sustainability plant production program	GIA	Hort Innovation
Resourcing, supporting and assessing biosecurity in nursery production	QDAF	Hort Innovation
Plantation forests		
A model system for the discovery and development of biocontrol agents against forest pests	University of the Sunshine Coast	FWPA, DAWE, University of the Sunshine Coast, NSW DPI, Forestry Tasmania
Biological Control of Eucalypt Pests (BiCEP) alliance	University of the Sunshine Coast	IPEF Brazil, Forestry South Africa, CELPA Portugal, University of the Sunshine Coast, QDAF
Biological invasions in forestry – drivers and mitigation for industry's biosecurity	University of the Sunshine Coast	Advance Qld (DITID), DAF, USC, FWPA, PHA, NSCC, HQP
Control of Teratosphaeria leaf disease	Forest Pest Management Research Consortium	FWPA, DAWE, University of the Sunshine Coast
Developing exotic forest and tree pest surveillance capacity in high-risk areas	PHA, WA DPIRD, PIRSA, University of South Australia, NT DPIR, DPJR, DPIPWE, NSW DPI, QDAF	FWPA, DAWE
Development of a portfolio of alternative weed control strategies for use in plantations	University of South Australia	FWPA, Grower Collaborative Fund, University of South Australia
Giant pine scale biology and ecology (PhD)	La Trobe University	FWPA, Australian Forest Products Association (16 companies)
Giant pine scale chemical control	HVPlantations	FWPA, Australian Forest 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
Mobile applications to support exotic forest pest surveillance	PHA, WA DPIRD, PIRSA, NT DPIR, DPJR, DPIPWE, NSW DPI, QDAF	FWPA, DAWE
National forestry biosecurity surveillance program	PHA	DAWE (Agricultural Competitiveness White Paper)
Plantation forests biosecurity plan review	University of the Sunshine Coast, PHA	FWPA
Scoping for a forest biosecurity network in south-east Asia	University of the Sunshine Coast, University of Tasmania	ACIAR, University of the Sunshine Coast
Sirex biocontrol – cryptic nematode field strain prompts urgent review of program	University of the Sunshine Coast, FABI	FWPA, National Sirex Coordination Committee, University of the Sunshine Coast
The industry plantation management group – applied research and extension	WA Plantation Resources	WA Plantation Resources
Pollinators		
A world without bees – simulating important agricultural insect pollinators	Monash University	ARC
Be(e) friendly venomous spiders – novel biopesticides from arachnid venoms	University of Queensland	ARC

Table 60. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Pollinators (continued)		
Bee pollination projects	Western Sydney University	Syngenta Australia
Chain of custody for honey bee products	University of Western Australia	CRC for Honey Bee Products
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
Development and implementation of a portal solution for the national bee pest surveillance program	Soda Strategic	PHA (DAWE)
Development and implementation of protocols to enable importation of improved honey bee genetics to Australia	CSIRO	Hort Innovation
Development of an environmental risk mitigation plan for Australian native bees	PHA	DAWE
Diagnostics for American foulbrood in honey bees	University of Western Australia	Agrifutures Australia (managed through CRC for Honey Bee Products)
Enhanced national bee pest surveillance program	PHA	Hort Innovation, AHBIC, Grain Producers Australia, DAWE
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 industry development grant	BQUAL	AgriFutures Australia
Honey bee nutrition – early detection of malnutrition and colony collapse	University of Western Australia	CRC for Honey Bee Products
Improving Asian honey bee surveillance	State and territory departments of agriculture, PHA	PHA (DAWE)
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
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
Multi-point honeybee monitoring in glasshouses and polytunnels	Monash University	AgriFutures Australia
National bee biosecurity program	PHA	AHBIC
National bee pest surveillance program enhancements	PHA	DAWE
Pollination harmony	University of Western Australia	CRC for Honey Bee Products
Portal website support and maintenance	MTP Services	Hort Innovation, AHBIC, Grain Producers Australia, DAWE
Probiotic development for bees – analysing gut bacteria in healthy bees	University of Canberra	AgriFutures Australia
Rapid evolution via genetic novelty in an invasive social insect	University of Sydney	ARC
Redevelopment of the PortBees website	MTP Services	PHA (DAWE)
Refinement, development and deployment of remote catchboxes as part of the overarching national bee pest surveillance program	University of Southern Queensland	PHA (DAWE)
Remote bee hive health communication using low-power, long-range communication technology	University of Western Australia	CRC for Honey Bee Products

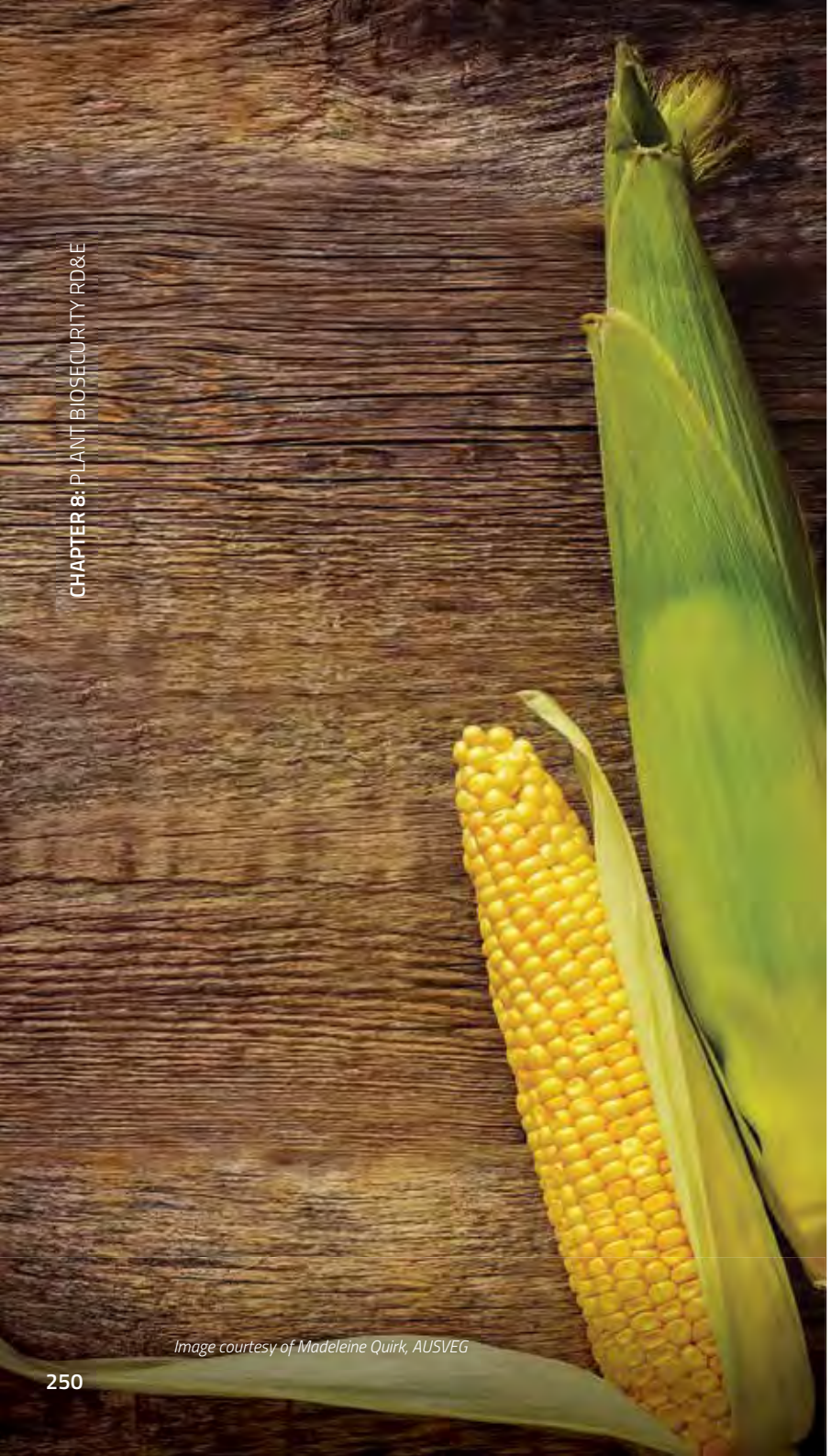


Image courtesy of Madeleine Quirk, AUSVEG

Table 60. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Pollinators (continued)		
Review and update standard operating procedures for bee surveillance	PHA	PHA (DAWE)
Review of the biosecurity plan for the honey bee industry	PHA	PHA honey bee levy
Review of the national bee pest surveillance program	Biosecurity Advisory Service	Hort Innovation, AHBIC, Grain Producers Australia, DAWE
Securing pollination for productive agriculture – guidelines for effective pollinator management and stakeholder adoption	AgriFutures Australia	Hort Innovation, University of Sydney, University of Adelaide, University of New England, Australian National University, WA 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	PFRNZ	Hort Innovation
The mechanisms underlying crop pollinator effectiveness in agro-ecosystems	University of New England	ARC

Table 60. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Pollinators (continued)		
Tropical crop pollination, productivity and response to a changing climate (PhD)	James Cook University	Mars Incorporated
Varroa mite host switch	Australian National University	ARC
Unknown crop		
2020 International Year of Plant Health	Hort Innovation	All plant RDCs, PBRI, PHA
2020 International Year of Plant Health event coordinator	Hort Innovation	CRDC, GRDC, Hort Innovation, AgriFutures Australia, Wine Australia
Advancing microbe assisted crop protection through plant immune-biosensors and omics-guided compound discovery	CSIRO	CSIRO
Application of DArT technology for invertebrate species identification	Murdoch University	Chevron (USA)
ARC Centre of Excellence for Innovations in Peptide and Protein Science	University of Queensland	ARC, Boston Children's Hospital, AB Sciex Australia Pty Ltd, Almac Group, AstraZeneca, Beta Therapeutics Pty Ltd, Bioplatforms Australia, CSIRO, Hexima Ltd, Innovate Ag Pty Ltd, Massachusetts Institute of Technology, Nexgen Plants Pty Ltd, Novo Nordisk, Questacon, University of Illinois at Urbana-Champaign, University of Oxford, University of Southampton, University of Tokyo, University of Washington, Vapourtec Ltd, Zealand Pharma
Biosecurity network coordination and enhancement	PHA	DAWE
Building in-house molecular capability to develop and validate new diagnostic tests	QDAF, DAWE	DAWE
Can natural gene drives be parts of sustainable agriculture?	CSIRO	CSIRO
Catalysing collective action for effective weed management	University of Wollongong	ARC
Developing host-delivered RNAi approaches for effective control of insect pests	CSIRO	CSIRO
Fungal ribosomally synthesised and post-translationally modified peptides	University of Western Australia	ARC
Harnessing past and new work to improve uptake and impact of best practice risk analysis approaches in MPI analysis	CEBRA, University of New England	NZMPI, CEBRA
Hermitage Research Facility – schools 'plant health' science competition 2020	QDAF	APBSF
How do different mycorrhizal fungal communities affect plant defences against below-ground herbivory?	University of Southern Queensland	Australian Academy of Science
Indonesia's decentralised and local responses to Covid-19 – implications for bilateral biosecurity engagement with Australia	Indonesian Biosecurity Foundation	APBSF
International Year of Plant Health – biosecurity surveillance scavenger hunt	NSW DPI	APBSF
Investigating novel pest treatments to improve management of biosecurity risks	Steritech, DAWE	DAWE
National plant biosecurity diagnostics and surveillance activities	PHA	DAWE
Profiling the profiler – a novel approach to boost crop immunity	CSIRO	CSIRO
Remote sensing	Hort Innovation	DAWE
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

Table 60. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Unknown crop (continued)		
The control of fungal pathogens by the use of a Trichoderma formulation	Western Sydney University	Neutrog Australia Pty Ltd, Department of Industry, Science, Energy and Resources
Trialling more accurate border diagnostic outcomes using MinION nanopore sequencing	QDAF, DAWE	DAWE
Understanding the mechanisms of peptide cyclisation	University of Queensland	ARC
Urban and amenity		
Establishing a program of plant pest surveillance in Australian botanic gardens and arboreta	PHA	DAWE
Remote sensing and machine learning applications for urban forest biosecurity surveillance	NSW DPI	APBSF
Strengthening the weakest link in peri-urban Mediterranean fruit fly suppression	University of Western Australia, WA DPIRD, Peel Harvey Biosecurity Group	APBSF
Urban plant biosecurity – using a foundational approach to understand emerging risks, support resilient cities and safeguard rural industry	Cesar Australia	APBSF
Multiple		
A national biocontrol program to manage pest fruit flies in Australia	DJPR	DAWE
Advancing splatter gun technology for control of rangeland weeds	QDAF, University of Queensland	DAWE
AgVet access grants 2018	AgAware Consulting Pty Ltd	AgriFutures Australia
AgVet minor use access grants – trial management	AgAware Consulting Pty Ltd	AgriFutures Australia
Applying new image recognition techniques for automatic detection and spraying of Harrisia cactus	Autoweed Pty Ltd, James Cook University, North West Local Land Services, Warrakirri Cropping	DAWE
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, Hort Innovation, QDAF, NSW DPI, Wine Australia, Australian Wine Research Institute, AUSVEG, Griffith University, Curtin University, La Trobe University, University of Tasmania, University of California (Riverside)
Area wide management for cropping systems weeds, investigating the weed management, social and economic opportunity	CSIRO, University of Adelaide, University of Queensland	GRDC (RRD4P), CRDC, AgriFutures Australia
Artificial intelligence methods for early disease detection using hyperspectral and thermal imagery	University of Melbourne	DAWE
AUSPest*Check*™ trial	PHA	DAWE
Australian herbicide resistance initiative – phase V	University of Western Australia	GRDC
Australian herbicide resistance initiative – phase VI	University of Western Australia	GRDC
Biocontrol research for weed management – stage 2	CSIRO	Environmental Trust

Table 60. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Multiple (continued)		
Biocontrol solutions for sustainable management of weed impacts to agriculture	Meridian Agriculture, CSIRO, NSW DPI, QDAF, DJPR, Hot Tin Roof Communications	AgriFutures Australia, GRDC, CSIRO, DJPR, NSW DPI, QDAF, PIRSA, Seqwater, Shire of Ravensthorpe, NSW Weed Biocontrol Taskforce, North West Local Land Services, NSW DPE, Bundaberg Regional Council, Gladstone Regional Council, HQPlantations, Goulburn–Murray Water Corporation, Murrumbidgee Irrigation Ltd, Coleambally Irrigation Cooperative, Goulburn Broken Catchment Management Authority, Murray Local Land Services, USDA Agricultural Research Service (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 blackberry	CSIRO, Meat and Livestock Australia, DJPR	DJPR
Biological control of crop pests using next-generation precision biopesticides for horticultural and broadacre agriculture	Murdoch University	WA Department of Jobs, Tourism, Science and Innovation
Biological control of giant pine scale in Australia	DJPR, CABI, Hellenic Agricultural Organization (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

Image courtesy of Madeleine Quirk, AUSVEG

Table 60. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Multiple (continued)		
Biological control of giant rats tail grass with leaf smut fungi	University of Queensland	QDAF
Biological control of silverleaf nightshade	DJPR	DAWE (RRD4P), AgriFutures Australia, PIRSA, GRDC
Boosting biosecurity awareness and action in the freight and logistics industry	NSW DPI	APBSF
Boosting diagnostic capacity for plant production industries	WA DPIRD, Department of Regional NSW, QDAF, DJPR, BioProtection Research NZ, Cesar Australia, CSIRO, DPIPWE, NT DITT, NZIPFR, PHA, SARDI, AUSVEG, SRA, Lincoln University	GRDC (RRD4P), CRDC, WA DPIRD, NSW DPI, QDAF, DJPR, BioProtection Lincoln, Cesar Australia, CSIRO, DPIPWE, NT DITT, NZIPFR, PHA, SARDI
Boosting diagnostics for plant production industries	Western Sydney University	GRDC
Boosting national interest R&D for Australia's ongoing management of *Spodoptera frugiperda* (fall armyworm)	PHA	DAWE
Clay nanoparticle-facilitated RNAi for non-transgenic modification of crops	University of Queensland	ARC
Collation and analysis of Mediterranean fruit fly data across Australia and comparison with overseas data to identify difference and key management areas	Aghort Solutions	DAWE
Compliance based inspection scheme – continuous sampling plan sensitivity analysis	CEBRA, University of New England	DAWE, CEBRA
Consultative review of past, current and future chemical and biological control options of Rutherglen bug	Independant Consultants Australia Network Pty Ltd	GRDC
Cotton bush weed management	CSIRO, WA Agriculture Authority, South West Catchments Council	WA DPIRD
Crop health and nutrient management of shallot-chilli-rice cropping systems in coastal Indonesia	University of Queensland	ACIAR
Curate and prepare WA Mediterranean fruit fly data	Murdoch University	DAWE
Delivering broad conservation benefits by controlling a threatening transformer weed (*Passiflora foetida*) in the Pilbara	CSIRO, Department of Parks and Wildlife	Department of Biodiversity, Conservation and Attractions
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
Determining the role of ground pearls in pasture dieback	University of Queensland	Meat and Livestock Australia
Developing a national systems approach for meeting AM17001 biosecurity requirements to access key Asian markets	CSIRO	Hort Innovation
Developing methods to infer the distribution, abundance and impact of established vertebrate pests and weeds using disparate data sources	CSIRO, ABARES, DAWE	ABARES, DAWR
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)	DAWE
Developing self-sustaining weed management tools using gene technologies	CSIRO	CSIRO
Developing strategies to mitigate and manage resistance to key herbicides	University of Adelaide	GRDC
Development of a national diagnostic protocol for termites in the genus *Coptotermes*	NT DITT	PHA (DAWE)
Development of a national diagnostic protocol for identification of *Ceratocystis fimbriata* and related taxa	University of Queensland	PHA (DAWE)
Development of an innovative trapping solution for detection of exotic invasive ant species	NT DITT	DAWE

Table 60. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Multiple (continued)		
Development of smart surveillance tools	DJPR	DJPR
Diagnostic surge capacity simulators for National Priority Plant Pests	SPHD (Surge Capacity Working Group)	PHA (DAWE)
Disease management strategies in broadacre grain crops for SA	University of Adelaide	GRDC
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
Efficacy data to support methyl bromide disinfestation treatments against fruit flies	QDAF	DAWE
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
Enhance the capability of use of AUSPest*Check*™ in collating surveillance data	PHA	DAWE
Estimating worldwide brown marmorated stink bug risk of establishment	University of Melbourne (CEBRA)	DAWE
Evaluation of insecticidal spider peptides	University of Queensland	UniQuest Pty Ltd
Fall armyworm insecticide sensitivities and genetic make-up	CSIRO	GRDC (lead), ACIAR, CRDC, FMC Australasia, Corteva Agriscience
Farm biosecurity program	PHA, AHA	PHA, AHA
Field surveillance capability	DJPR	DAWE
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	DAWE
Giant rats tail grass biological control using endemic pathogens	CSIRO, QDAF	QDAF
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, NZPFR, Rothamsted Research (UK), Burkard Manufacturing Company (UK), GIA, DAWE (RRD4P), WA DPIRD
Implementation of a multi-target surveillance system	Murdoch University	Chevron (USA)
Improved profiling of risks associated with seed interceptions in the international mail pathway	University of Melbourne (CEBRA)	DAWE
Improving access to new germplasm using next-generation sequencing	DJPR, Queensland University of Technology	Hort Innovation, DJPR, Queensland University of Technology
Improving implementation of biosecurity planning	PHA	DAWE
Improving diagnostics and biosecurity for graft-transmissible diseases in citrus	NSW DPI, University of Queensland (QAAFI), 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, DAWE
Improving plant industry access to new genetics through faster and more accurate diagnostics using high-throughput sequencing	Queensland University of Technology, DAWE, DJPR, NZMPI	Hort Innovation, DAWE
Improving the methodology for consequence assessment of amenity and environmental pests	University of Melbourne (CEBRA), University of New England	DAWE

Table 60. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Multiple (continued)		
Improving weed management in high break crop intensity farming systems	SARDI	GRDC
Industrial transformation training centre – Centre for Fruit Fly Biosecurity Innovation	CSIRO, Macquarie University	Macquarie University
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	DAWE
Insecticide resistance management in red legged earth mite and chemical sensitivities	University of Melbourne	GRDC
Integrated management and development of additional agents for Parkinsonia	CSIRO, Meat and Livestock Australia, DJPR	Meat and Livestock Australia
Integrated taxonomic revision of Australian leaf blotch miner moths	CSIRO	DAWE
Interstate trade reform – interstate certification assurance scheme	PHA	DAWE, state and territory governments
Investigating a rapid, accurate and field deployable test to detect *Xylella fastidiosa*	QDAF, DAWE	DAWE
Locally important weeds	WA DPIRD	GRDC
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
Melon biosecurity champions	Melons Australia	DAWE
Molecular basis for susceptibility and immunity to Fusarium wilt disease	Australian National University	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
National diagnostic protocols – entomology	DJPR	SARDI (SPHD)
National diagnostic protocols – microbiology	DJPR	SARDI (SPHD)
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, Aerial Application Association of Australia
New horizons with BioClay – protecting crops from aphids and whiteflies	University of Queensland	Queensland Department of Science Information Technology and Innovation
New South Wales Trust – stage 3 weed biocontrol, implementation plan 1	CSIRO, NSW Environmental Trust	NSW Environmental Trust

Table 60. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Multiple (continued)		
New South Wales Trust – stage 3 weed biocontrol, implementation plan 2	CSIRO, NSW Environmental Trust	NSW Environmental Trust
Next-generation sequencing – post entry quarantine plant virus and viroids	Queensland University of Technology	DAWE
Non-English speaking growers biosecurity engagement plan	NT Farmers' Association	DAWE
Novel technologies for control of crop diseases	CSIRO	CSIRO
Novel technologies to assist rapid and sensitive detection of brown marmorated stink bug	Cesar Australia, Victorian Farmers' Federation, EnviroDNA, PFRNZ	Hort Innovation, PFRNZ, Wine Australia
Novel tropical vegetable and cotton virus protection	University of Queensland	Hort Innovation
Online plant health surveillance training and awareness resources	PHA	DAWE
Ornamental and Asian vegetable plants as entry pathways for viruses	University of Queensland	APBSF
Paddock level herbicide resistance management for western growers and advisers	University of Western Australia	GRDC
Parasitoids for the management of fruit flies in Australia	DJPR	Hort Innovation
Peri-urban environmental biosecurity network – pilot community of practice for general surveillance	NSW DPI	DAWE
Pest and Disease Image Library	PHA	DAWE
Phenology, demography and distribution of Australia's fruit flies	QDAF (led), Queensland University of Technology, NSW DPI, VIC DJPR, WA DPIRD, NT DPIR, PIRSA	DAWE
Phylogenomic classification of rust fungi in Australia	University of Queensland	DAWE
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
Plant Biosecurity Research Initiative – phase II	Projects led by individual RDCs	Hort Innovation, FWPA, PHA, AgriFutures Australia, CRDC, Council of RRDC, DAWE, GRDC, HLA, SRA, Wine Australia
Plant breeding – Australian native flora	Kings Park and Botanic Garden	Various external funding sources
Plant health – a major challenge to achieving sustainable 'green' agriculture in Myanmar	CABI (Malaysia)	ACIAR
Podcasts for fall armyworm management in northern farming systems (*Spodoptera frugiperda*)	CRDC	GRDC
Portable, in-field pathogen detection	DJPR	DJPR
Post doctoral fellowship – maximising crops and minimising weeds with smart phase farming	University of Western Australia	GRDC

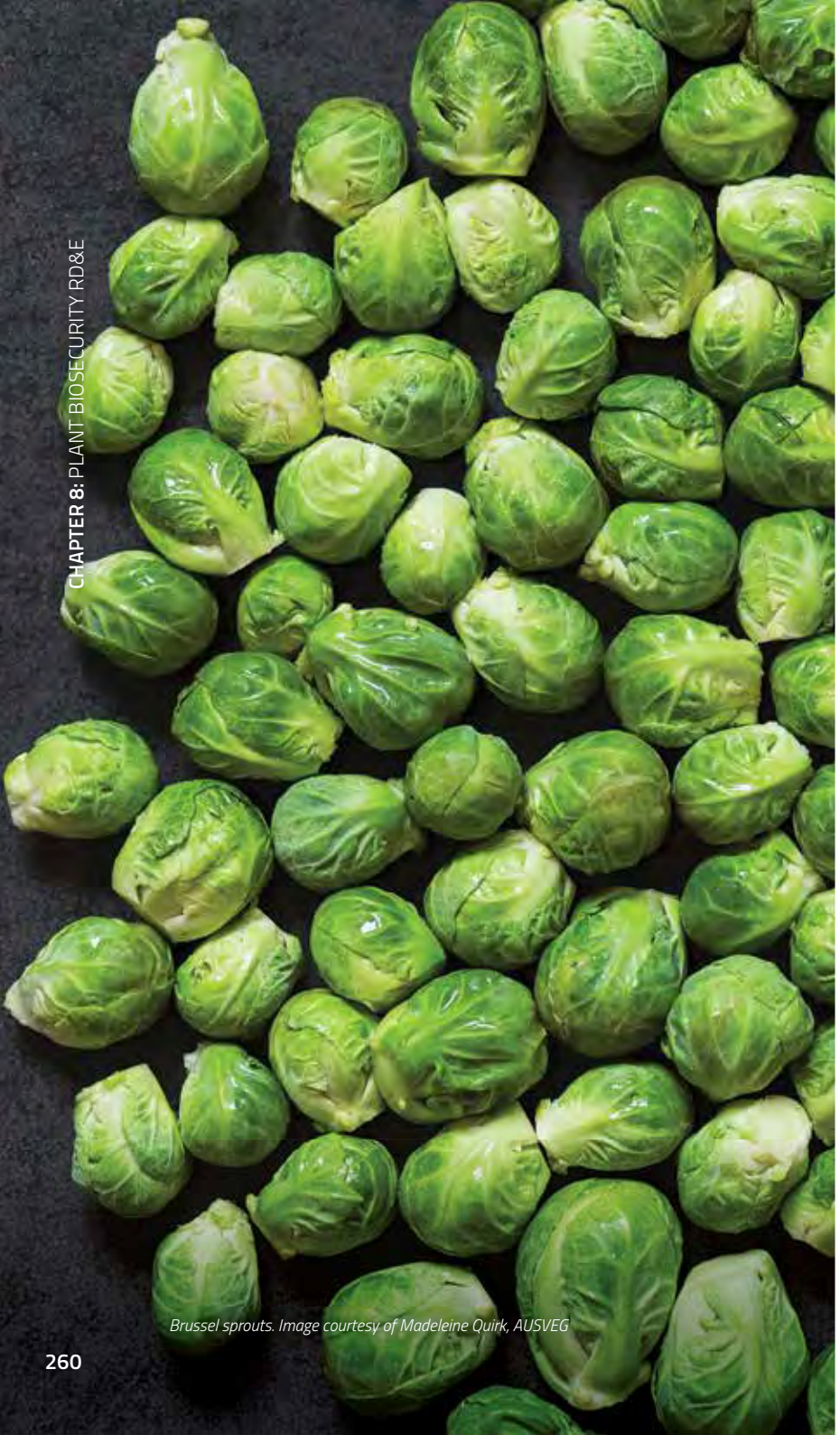
Table 60. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Multiple (continued)		
Prevention and control of West Indian drywood termite	QDAF	QDAF
Prevention and preparedness for fall armyworm (*Spodoptera frugiperda*) – output 1	Cesar Australia	GRDC
Prevention and preparedness for fall armyworm (*Spodoptera frugiperda*) – output 2	CSIRO	GRDC
Protecting Australia's food future – shared responsibility for biosecurity	University of Tasmania	ARC
Putting new herbicide targets on the table	University of Western Australia	ARC
Rapid diagnostics for major biosecurity threats	SARDI, Macquarie University	DAWE
RD&E program for control, eradication and preparedness for vegetable leafminer	AUSVEG, Cesar Australia, 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), University of New England	DAWE, CEBRA
Reference collections strategy implementation	DJPR	PHA
Regional master classes in plant biosecurity (Indonesia)	Lovett Associates	APBSF
Regulatory support and coordination (pesticides)	AKC Consulting	Hort Innovation
Resolution of disease epidemiology and detection of genetic and genotypic diversity in Australian populations of myrtle rust	University of Queensland (QAAFI)	APBSF
Responding to emerging pest and disease threats to horticulture in the Pacific Islands	University of Queensland	ACIAR
Response procedures for invasive ants	BSASP Pty Ltd	DAWE
Review and development of national strategies to support implementation of the National Plant Biosecurity Strategy	PHA	DAWE (Agricultural Competitiveness White Paper)
RNA vaccines for next generation crop protection against fungal pathogens	University of Queensland	Queensland Government Department of Innovation, Tourism Industry Development
RNAi technology for pest control	CSIRO	CSIRO
Scoping study for VirusCurateAU	DJPR	DAWE
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	DAWE (Agricultural Competitiveness White Paper)
Spotted lanternfly (*Lycorma delicatula*) biology, ecology and awareness in the Australian environment	Cesar Australia	PBRI, APBSF, DAWE
Streamlining plant pest contingency plans	DJPR	DAWE
Structure based investigations into new modes of action for herbicides	University of Western Australia	ARC
Summer weed survey of WA cropping districts	AGRONOMO	GRDC

Table 60. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Multiple (continued)		
Surge capacity simulation model	SPHD (Surge Capacity Working Group)	PHA (SPHD)
Systematics of the chalcid wasp genus Psyllaephagus (Hymenoptera: Encyrtidae), parasitoids of lerp insects	University of Adelaide	University of Adelaide, DAWE
Tackling pests using game theory to support cooperative management	University of Queensland	ARC
Taxonomic study of *Trissolcus mitsukurii* and its efficacy in control of *Halyomorpha halys*, the brown marmorated stink bug	CSIRO	DAWE
Technical support on pest and disease forecasts and early warning for the agromet program in Asia and the Pacific countries, with particular focus on Cambodia	University of Southern Queensland	FAO of the United Nations
Tools and knowledge to mitigate the potential spread of *Xylella fastidiosa* in Australia and New Zealand by understanding its potential vectors	DJPR, Wine Australia, DJPR, DPI NSW, PFRNZ	DAWE, Hort Innovation, Wine Australia
Towards herbicide cocktails with a new mode of action to avert resistance	La Trobe University	ARC
Tropical plant industries biosecurity surveillance strategy	PHA	DAWE
Uncovering how rust fungi cause devastating plant diseases	Australian National University	ARC
Underpinning agricultural productivity and biosecurity by weed biological control	CSIRO, AgriFutures Australia	GRDC, AgriFutures Australia
Understanding when biocontrol and enemy release affect plant populations	CSIRO, University of New South Wales	University of New South Wales
Upskilling TAS growers and advisors to manage annual ryegrass through exposure to external knowledge and peer-to-peer learning	Southern Farming Systems	GRDC

Hives in an almond orchard, to be inspected by a Bee Biosecurity Officer. Image courtesy of James Sheehan



Brussel sprouts. Image courtesy of Madeleine Quirk, AUSVEG

Table 60. Plant biosecurity RD&E projects (continued)

Project title	Organisation undertaking the research	Funding source or body
Multiple (continued)		
Urban plant health network – pilot community of practice for general surveillance	DJPR	DAWE
Using pest establishment likelihood maps to inform multi-pest early detection surveillance designs	University of Melbourne (CEBRA)	DAWE
Validation of procedures for confidence in exporting from Australia's fruit fly pest free areas	Janren Consulting Pty Ltd	DAWE
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
Weed biological control	University of Southern Queensland	QDAF
WeedSmart	University of Western Australia	GRDC
When are earwigs pests and when are they beneficial?	CSIRO	GRDC
When is hybridisation helpful or harmful to invaders?	Monash University	ARC
Wildfire impact on disease and pest populations and successional re-establishment in a grain crop fire scar	AgXtra Pty Ltd	GRDC
Xylella coordinator	Wine Australia	Wine Australia, Hort Innovation, PBRI
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	WA DPIRD

Greenhouse strawberries. Image courtesy of Tamara Hepburn

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, Water and the Environment	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

Organisation	Website	Phone
Australian Macadamia Society	australianmacadamias.org	+61 2 6622 4933
Australian Mango Industry Association	industry.mangoes.net.au	+61 7 3278 3755
Australian Melon Association	melonsaustralia.org.au	+61 413 101 646
Australian National University	anu.edu.au	+61 2 6125 5111
Australian Olive Association	australianolives.com.au	+61 478 606 145
Australian Plant Biosecurity Science Foundation	apbsf.org.au	+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 Trade, Industry and Tourism, Northern Territory	industry.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.

Macadamia. Image courtesy of Tamara Hepburn, Australian Macadamia Society

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
AFPA	Australian Forest Products Association
AHA	Animal Health Australia
AHB	Asian 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
DAF	Department of Agriculture and Fisheries, Queensland
DAWE	Australian Government Department of Agriculture, Water and the Environment
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 DITT	Department of Industry, Tourism and Trade, Northern Territory
ORC	Owner Reimbursement Costs
PBCRC	Plant Biosecurity Cooperative Research Centre
PBRI	Plant Biosecurity Research Initiative
PFRNZ	Plant and Food Research New Zealand
PHA	Plant Health Australia
PHC	Plant Health Committee
PIRSA	Department of Primary Industries and Regions, South Australia
PPPO	Pacific Plant Protection Organisation
QLD	Queensland
QDAF	Department of Agriculture and Fisheries, Queensland
RABA	Raspberries and Blackberries Australia

Acronym	Full name
R&D	research and development
RD&E	research, development and extension
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
TAS	Tasmania
TCCS	Transport Canberra and City Services
VIC	Victoria
WA	Western Australia

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Plant Health
AUSTRALIA
21
years


Plant Health
AUSTRALIA
21
years