Chapter 7

Post-border biosecurity – controlling pests and weeds

Post-border biosecurity – controlling plant pests and weeds

While many resources are invested in keeping new pests out of Australia and responding to pest detections, existing pests and weeds require biosecurity measures to prevent further spread.

This chapter describes biosecurity measures that apply to pests found in certain parts of Australia, pests that are established and must be managed, and weeds.

There is a national system that coordinates domestic quarantine restrictions to prevent pest spread within Australia, but post-border control of pests and weeds is one part of the biosecurity system where agricultural industries and the Australian community have a major role to play.

Farmers are aware that they have responsibility for controlling pests and weeds on their property and the use of on-farm biosecurity practices is on the rise. However, there is more that producers can do to prevent biosecurity incursions on their properties. This chapter details the communication initiatives to encourage on-farm biosecurity risk mitigation undertaken by Plant Health Australia (PHA), government and industries.

The chapter finishes with an overview of Australia's weed biosecurity system.

Domestic quarantine

Plant pests can be spread easily from one part of Australia to another through the movement of plants, plant products, people, soil and equipment. The main concerns are newly established and regionalised pests.

To address this risk, domestic quarantine restrictions imposed on the movement of high-risk items apply in each state and territory. Restrictions operate under state and territory legislation to complement and support the national quarantine legislation that governs the import and export of goods to and from Australia.

SUBCOMMITTEE ON DOMESTIC QUARANTINE AND MARKET ACCESS

The coordination of domestic quarantine between the state and territory governments is assisted by the Subcommittee on Domestic Quarantine and Market Access (SDQMA). This committee consists of senior plant health regulators from state and territory governments, representatives from the Australian Government Department of Agriculture, and an independent chair from PHA.

The objective of the committee is to develop, review and maintain domestic quarantine standards and conditions that allow movement of produce around the country while avoiding the spread of regionalised plant pests. For example, produce from fruit fly affected regions can be moved to non-affected regions for sale, once it has met certain conditions such as in-field and post-harvest treatments.

The SDQMA is tasked with ensuring that conditions are:

- technically justified and least trade restrictive, to minimise regulatory burdens on industry
- coordinated and harmonised across the country and regions to the extent possible
- consistent with Australia's international obligations under the World Trade Organization's Agreement of the Application of Sanitary and Phytosanitary Measures.

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

RESTRICTIONS ON INTERSTATE TRAVELLERS CARRYING PRODUCE

Anyone travelling within Australia, moving house across regional or state borders, or moving produce around the country is bound by restrictions on what they can and cannot carry set by state and territory legislation. Rules apply to high-risk material including plants and plant products, fruit and vegetables, honey and beekeeping equipment, soil, agricultural machinery and recreational equipment.

The Australian Interstate Quarantine website found at **interstatequarantine.org.au** provides information on domestic quarantine restrictions for travellers and producers. This information is also in a booklet – Australian Interstate Quarantine: A Traveller's Guide – the electronic version of which was updated in August 2019.

There are interstate quarantine bins at some high-risk domestic airports, ferry terminals, and state or quarantine zone borders. Travellers must dispose of any restricted products at those points. Rules change as new pest incursions occur, so travellers are advised to check on the Australian Interstate Quarantine website for the latest information.

SA has enforced on-the-spot fines for travellers entering the state if caught with restricted fresh fruit and fruiting vegetables at the Yamba Quarantine Station or roadblocks. Commercial operators cannot carry fresh fruit and fruiting vegetables into SA without a Plant Health Certificate or Plant Health Assurance Certificate.

Nursery industry biosecurity program pays off

In September 2019 the National Biosecurity Committee recognised the achievements of the first national third-party accreditation system for biosecurity, the Australian nursery industry's BioSecure HACCP program.

The on-farm plant protection and biosecurity program was developed by Nursery & Garden Industry Australia (now Greenlife Industry Australia) with funding from Hort Innovation and continues to be supported by the industry levy through the Hort Innovation Nursery Fund.

The system allows certified production nurseries to self-certify consignments of nursery stock for interstate market access and issue BioSecure HACCP Biosecurity Certificates. The system allows businesses to generate these certificates electronically, adding to business efficiencies and securing market access records.

Lockyer Valley production nursery, Pohlmans Nursery, is one business that is benefitting from adopting the BioSecure HACCP program. The business produces more than 1,200 different types of plants on 150 acres in the fertile Lockyer Valley in Queensland, employing more than 200 staff.

The plant protection and biosecurity program helps them to better manage endemic and exotic pests, disease and weed risks. It has enabled the business to establish an internal plant protection and quarantine process for imported and exported plant material, underpinned by reliable plant data to support decision-making.

Staff now use smartphones and tablets to monitor and survey plants on a routine basis. This has led to greater staff engagement and a team that is likely to communicate and act as soon as an issue is detected.

By adopting the BioSecure HACCP risk management approach, Pohlmans Nursery has halved pesticide use and reduced stock losses by more than two per cent, whilst maintaining a system that supports the safe trade of plants.

Greenlife Industry Australia

Restrictions on interstate movement of commercial consignments

Commercial trade in products being moved around Australia is managed by the states and territories, who regulate the provision of certificates attesting that the goods meet the receiving state or territory's entry conditions. Consignments of produce that originate from a controlled region can be shipped into a region that does not have the pest of concern, if the produce is certified to have been treated in such a way that it no longer poses a biosecurity risk. It might be growing or packing produce in a particular way, such as under cover, or being treated after harvest.

Four types of certificates are issued by the exporting state or territory to certify that produce for interstate trade meets the receiver's requirements:

- **Plant Health Certificate** – issued by a government officer from the state or territory of origin.
- **Plant Health Assurance Certificate** – is supplied by an approved business under an Interstate Certification Assurance (ICA) scheme. To issue these certificates a business must meet specific requirements and undergo regular audits by the state or territory government accreditation authority.
- **BioSecure HACCP Biosecurity Certificate** – is issued through a third party. In 2018, Nursery and Garden Industry Australia (now Greenlife Industry Australia) received approval to issue the first certificates of this type.
- **Area Freedom Certificate** – is issued by a government officer when an area is known to be free of a particular pest.

In 2019, states and territories updated several ICAs for a variety of produce to mitigate the risk of spreading Queensland and Mediterranean fruit fly, and blueberry rust. The Australian Interstate Quarantine website lists all ICAs by state or territory and holds the Schedule of National Interstate Certification Assurance Documents, a complete list of ICAs. The site also refers users to BioSecure HACCP Biosecurity Certificates, where they exist.

Mangosteens at a market in Cairns. Image courtesy of Sue Pederick, Primary Industries and Regions SA

OFFICIAL CONTROL OF QUARANTINE PLANT PESTS TO PROTECT OVERSEAS TRADE

Since 2017, the Plant Quarantine Pest and Official Control National Policy – implemented by the Chief Plant Health Managers across Australia – has helped to contain and control new plant pests and diseases, while allowing the Australian Government to continue to regulate imports to prevent pest entry at the international border. The policy also facilitates exports, so growers can continue sending their products to overseas markets.

On occasions, an exotic plant pest or disease may enter Australia that cannot be eradicated. In these circumstances, responsibility for managing the pest or disease rests with industry and the government of the state or territory in which it occurs.

When 'official control' is applied, the state or territory government has put in place measures that aim to contain and control the pest or disease. These mandatory activities include:

- containment or suppression activities (mostly involving destruction, disposal and decontamination)
- surveillance in the area where the pest or disease could establish
- movement restrictions so the pest or disease does not spread to an area that is not affected.

Official control can be applied at a regional or national level. If it is applied nationally, it must be consistent across all states and territories.

When an exotic pest or disease enters and is officially confirmed to be in Australia, the Department of Agriculture has an obligation to notify the International Plant Protection Convention. When other countries become aware of the presence of the pest or disease in Australia, it can trigger trade bans or restrictions on our exports, as well as requests for Australia to review its current import conditions.

If Australia can provide trading partners with evidence that the pest or disease is under official control, the department can continue to justify regulating international imports to prevent exotic pest entry.

Official control may also underpin negotiations for export with concerned trading partners to accept plants or products that have been produced in areas of Australia that are not affected by the pest or disease, or are treated to importing country standards to manage the biosecurity risk. If an established pest is not under official control, the department cannot justify continuing to prevent the pest's entry by regulating imported goods and conveyances for that pest.

While there are numerous benefits in implementing official control, there are also costs associated with containment, surveillance and movement restrictions. State and territory governments, in consultation with peak industry bodies, must determine whether official control is cost-beneficial or whether other management options are more appropriate for the plant pest.

AUSTRALIA'S REGIONALISED PESTS

When pests that have the potential to damage the environment or agriculture are detected, eradication is the ideal goal. In some cases, however, a pest cannot be eradicated. Depending on the circumstances, domestic quarantine measures may be implemented to contain the pest, minimising negative impacts.

Regionalised pests can be contained at a local, regional or state level, depending on current distribution and the ability to implement cost-beneficial measures for containment.

In addition to introduced pests, some regionalised pests are native to parts of Australia, notably the Queensland fruit fly which is found on the mainland states on the east coast, but not in SA, Tasmania or WA.

Table 56 lists the 96 regionalised pests recognised by state and territory governments and their current area of distribution within Australia.

Table 56. Australia's regionalised pests

Scientific name	Common name	Area of regionalisation
New South Wales		
Bactrocera tryoni	Queensland fruit fly	Endemic within all of NSW excluding the Queensland Fruit Fly Control Zone on the Victorian border as defined in *Biosecurity (Queensland Fruit Fly) Control Order 2017* under the *Biosecurity Act 2015*
Banana bunchy top virus (Babuvirus)	Banana bunchy top virus	Present within the Banana Bunchy Top Virus Control Zone on the far north coast as defined in the *Biosecurity (Banana Bunchy Top Virus) Control Order 2017* under the *Biosecurity Act 2015*
Daktulosphaira vitifoliae	Grapevine phylloxera	Present within the Grapevine Phylloxera Infested Areas, comprising the Sydney and the Albury-Corowa regions as defined in the *Biosecurity Regulation 2017* under the *Biosecurity Act 2015*
Panonychus citri	Citrus red mite	Present within the Citrus Red Mite Biosecurity Zone, comprising the Cumberland and Northumberland counties as defined in the *Biosecurity Regulation 2017* under the *Biosecurity Act 2015*
Ralstonia solanacearum	Bacterial wilt of potatoes	Present in NSW excluding the Seed Protected Area, comprising specific areas within the Central Tablelands and Northern Tablelands as defined in the *Biosecurity Regulation 2017* under the *Biosecurity Act 2015*
Spongospora subterranea	Powdery scab of potatoes	Present in NSW excluding the Seed Protected Area, comprising specific areas within the Central Tablelands and Northern Tablelands as defined in the *Biosecurity Regulation 2017* under the *Biosecurity Act 2015*

Table 56. Australia's regionalised pests (continued)

Scientific name	Common name	Area of regionalisation
Northern Territory		
Aleuroidicus dispersus	Spiraling whitefly	Darwin, Palmerston, Darwin rural area, Katherine
Bactrocera tryoni	Queensland fruit fly	Darwin, Palmerston, Darwin rural area, Katherine, Tennant Creek, Alice Springs
Bemisia tabaci	Silver leaf whitefly	Darwin, Palmerston, Darwin rural area, Katherine, Alice Springs
Brontispa longissima	Palm leaf beetle	Darwin, Palmerston, Darwin rural area
Citripestis eutrapera	Mango fruit borer	Darwin, Darwin rural area, Katherine
Cosmopolites sordidus	Banana weevil borer	Darwin rural area
Cryptosporiopsis citri	Cryptosporiopsis leaf spot	Darwin, Darwin rural area, Batchelor, Daly River, Litchfield region
Cucumber green mottle mosaic virus (Tobamovirus)	Cucumber green mottle mosaic virus	Darwin rural area, Katherine, Alice Springs (Ti Tree)
Fusarium oxysporum f. sp. *cubense* (tropical race 4)	Panama disease	Darwin, Darwin rural area
Fusarium oxysporum f. sp. *niveum*	Fusarium wilt of watermelon	Darwin, Darwin rural area, Katherine
Idioscopus clypealis	Mango leaf hopper	Tiwi Islands, Darwin rural area
Idioscopus nitidulus	Mango leaf hopper	Darwin, Palmerston, Darwin rural area, Adelaide River, Pine Creek, Katherine
Monomorium dichroum	Monomorium dichroum	Darwin
Parlatoria blanchardi	Date palm scale	Alice Springs
Phakopsora cherimoliae	Phakopsora rust	Darwin rural area
Pineapple mealy bug wilt associated virus (Ampelovirus PMWaV-1, PMWaV-3)	Pineapple mealy bug wilt associated virus	One property only (Darwin Correctional Facility Shoal Bay)
Pseudocercospora purpurea	Cercospora spot	Darwin rural area
Selenothrips rubrocinctus	Red banded thrips	Darwin, Palmerston, Darwin rural area, Adelaide River, Pine Creek, Katherine

Table 56. Australia's regionalised pests (continued)

Scientific name	Common name	Area of regionalisation
Northern Territory (continued)		
Sternochetus mangiferae	Mango seed weevil	Darwin, Palmerston, Darwin rural area, Batchelor, Adelaide River
Tetranycus gloveri	Glovers' mite	Darwin rural area
Thrips palmi	Melon thrips	Darwin rural area
Uredo morifolia	Mulberry rust	Dundee Downs, Palmerston, Noonamah, Darwin rural area
Queensland		
Aleurodicus dispersus	Spiraling whitefly	Torres Strait Islands, Cape York Peninsula, Mareeba, Charters Towers, coastal towns south to Bundaberg
Anoplolepis gracilipes	Yellow crazy ant	Populations dotted in various locations spanning Cairns to the Gold Coast
Apis cerana, Java genotype	Asian honey bee	Surrounding Cairns region, north to Twyford (near Mossman), west of Dimbula and south to Feluga. A genetically distinct population of AHB is the focus of a *Varroa jacobsoni* (Varroa mite) eradication in Townsville
Banana bunchy top virus (Babuvirus)	Bunchy top	Noosa, south to the NSW border
Chilo terrenellus (Pagenstecher)	Sugarcane stem borer	Detected on a number of occasions in sugarcane on two of the three Torres Strait islands closest to Papua New Guinea (Saibai and Dauan)
Cucumber green mottle mosaic virus (Tobamovirus)	Cucumber green mottle mosaic virus	Confined to three quarantined businesses; one in north Queensland and two in the Wide Bay region
Cryptotermes brevis	West Indian drywood termite	Greater Brisbane, Wide Bay–Burnett, Rockhampton, Bowen, Townsville
Deanolis sublimbalis	Red banded mango caterpillar	Far northern Cape York Peninsula
Eumetopina flavipes (Muir)	Island sugarcane planthopper	Torres Strait island archipelago and the northern peninsula area of Cape York
Fiji disease virus	Fiji disease virus	Sugarcane biosecurity zones 4, 5 and 6

Table 56. Australia's regionalised pests (continued)

Scientific name	Common name	Area of regionalisation
Queensland (continued)		
Fusarium oxysporum f. sp. *cubense* (race 1, race 2, subtropical race 4 and tropical race 4)	Panama disease	Race 1 endemic throughout banana growing regions; race 2 south Johnstone and Cairns; race 4 (subtropical) south-east Queensland as far north as Rosedale (north of Bundaberg); races 1, 2 and subtropical race 4 are no longer in regulation, although the General Biosecurity Obligation applies. Race 4 (tropical) detected in 2015, 2017 and 2018 on three separate properties (a containment program remains in place)
Idioscopus clypealis	Mango leaf hopper	Cape York Peninsula and Mareeba area, south to Atherton, and along the coast from Wangetti to Gordonvale. Managed under the General Biosecurity Obligation
Idioscopus nitidulus	Mango leaf hopper	Cape York Peninsula. Managed under the General Biosecurity Obligation
Liriomyza sativae	Vegetable leafminer	Some islands in Torres Strait and at Seisia in the northern peninsula area of Cape York
Mycosphaerella fijiensis	Black Sigatoka	Some northern and eastern Torres Strait islands
Papaya ringspot virus (Potyvirus)	Papaya ringspot virus	South-east Queensland as far north as Bundaberg area
Planoccoccus lilacinus	Coffee mealybug	Boigu Island, Torres Strait islands
Procontarinia spp.	Mango leaf gall midge	Torres Strait and northern tip of Cape York Peninsula
Pseudococcus cryptus	Cryptic mealybug	Islands in the Torres Strait and isolated places in north Queensland, including Cairns (not widely distributed)
Pseudococcus jackbeardsleyi	Jack Beardsley mealybug	Torres Strait islands and the Cape York Peninsula
Pseudocercospora purpurea	Cercospora leaf spot	Mareeba Shire Council and Tablelands Regional Council
Sugarcane mosaic virus (strain A) (Potyvirus)	Sugarcane mosaic virus	Sugarcane biosecurity zones 4, 5 and 6
Sugarcane striate mosaic associated virus (Carlavirus)	Sugarcane striate mosaic virus	Sugarcane biosecurity zone 2 and 6
Tetranychus piercei	Spider mite	Weipa, Cape York Peninsula
Thrips palmi	Melon thrips	South-east Queensland as far north as Bundaberg area. North Queensland coastal areas from Ayr to Mossman and Atherton Tablelands
Wasmannia auropunctata	Electric ant	Far north Queensland, Cairns hinterland and Bingle Bay
South Australia		
Achroia grisella	Lesser wax moth	Endemic across all of SA
Aethina tumida	Small hive beetle	Limited known distribution within all of SA, but not known to occur on Kangaroo Island
Ascosphaera apis	Chalkbrood	Endemic across all of SA
Chortoicetes terminifera	Australian plague locust	Endemic within all of SA
Cucumber green mottle mosaic virus (Tobamovirus)	Cucumber green mottle mosaic virus	Known to be present on at least five properties on the Northern Adelaide Plains
Diuraphis noxia	Russian wheat aphid	Endemic within SA cereal growing regions
Galleria mellonella	Greater wax moth	Endemic across all of SA
Grapevine pinot gris virus	Grapevine pinot gris virus	Established in SA
Melissococcus pluten	European foulbrood	Endemic across most of SA, but not known to occur on Kangaroo Island
Nosema apis	Nosema	Endemic across all of SA
Nosema ceranae	Nosema	Endemic across most of SA, but not known to occur on Kangaroo Island
Paenibacillus larvae	American foulbrood	Endemic across most of SA, but not known to occur on Kangaroo Island

Table 56. Australia's regionalised pests (continued)

Scientific name	Common name	Area of regionalisation
Victoria		
Cornu apertus (syn. *Cantareus apertus*)	Green snail	Management of green snail linked and infested lands (refer to specific gazetted orders)
Daktulosphaira vitifoliae	Grapevine phylloxera	Phylloxera Infested Zone and Phylloxera Free Zone (refer to specific gazetted orders)
Globodera rostochiensis	Potato cyst nematode	Management of potato cyst nematode linked and infested lands, and Plant Protection District (refer to specific gazetted orders)
Western Australia		
Achroia grisella	Lesser wax moth	Regulations or controls for movement and control in specified areas
Aethina tumida	Small hive beetle	Kimberley Region. Host material restricted from movement to rest of state
Bemisia tabaci (B biotype)	Silverleaf whitefly	Carnarvon. Host material restricted from movement to Kununurra
Brontispa longissima	Palm leaf beetle	Broome. Host material restricted from movement to rest of state
Cornu apertus (syn. *Cantareus apertus*)	Green snail	Regulations or controls for movement and control in specified areas
Ceratitis capitata	Mediterranean fruit fly	Absent from east Kimberley region (Ord River Irrigation Area). Regulations or controls for movement and control in specified areas
Chortoicetes terminifera	Australian plague locust	Regulations for control in specified areas
Cosmopolites sordidus	Banana weevil borer	Kununurra and Carnarvon. Host material restricted from movement to rest of state
Cryptolestes ferrugineus	Flat grain beetle	Regulations or controls for movement and control in specified areas
Cryptolestes pusillus	Flat grain beetle	Regulations or controls for movement and control in specified areas
Ephestia elutella	Tobacco moth	Regulations or controls for insecticide resistant strains
Ephestia kuehniella	Mediterranean flour moth	Regulations or controls for insecticide resistant strains
Fusarium oxysporum f. sp. *cubense* (race 1)	Panama disease	Carnarvon. Host material restricted from movement to rest of the state
Western Australia (continued)		
Galleria mellonella	Larger wax moth	Regulations or controls for movement and control in specified areas
Hylotrupes bajulus	European house borer	Regulations or controls for movement and control in specified areas
Oryzaephilus surinamensis	Sawtooth grain beetle	Regulations or controls for insecticide resistant strains
Pentalonia nigronervosa	Banana aphid	Carnarvon. Host material restricted from movement to rest of the state
Plodia interpunctella	Indian meal moth	Regulations or controls for insecticide resistant strains
Potato spindle tuber viroid (Pospiviroidae)	Potato spindle tuber viroid (PSTVd)	Carnarvon
Rhyzopertha dominica	Lesser grain borer	Regulations or controls for insecticide resistant strains
Sitophilus granarius	Granary weevil	Regulations or controls for insecticide resistant strains
Sitophilus oryzae	Rice weevil	Regulations or controls for insecticide resistant strains
Sitotroga cerealella	Angoumois grain moth	Regulations or controls for insecticide resistant strains
Thrips palmi	Melon thrips	Kimberley (low pest prevalence area)
Tribolium castaneum	Rust red flour	Regulations or controls for insecticide resistant strains
Tribolium confusum	Confused flour beetle	Regulations or controls for insecticide resistant strains
Trogoderma variabile	Warehouse beetle	Regulations or controls for movement and control in specified areas

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

PREVENTING THE SPREAD OF FRUIT FLIES

Australia is fortunate to be free of some of the most damaging fruit fly species that occur overseas. Some of these – like the Oriental fruit fly, Natal fruit fly, melon fly and peach fruit fly – would cause considerable damage to crop production in Australia should they establish here. To ensure we remain free of these devastating pests, Australia has an extensive system of surveillance and an ongoing response in the Torres Strait.

Two fruit fly species in Australia are significant pests economically – Queensland fruit fly and the Mediterranean fruit fly. They are the focus of pest management programs and quarantine restrictions to prevent Queensland fruit fly from spreading into Tasmania, WA and SA, and Mediterranean fruit fly spreading from WA.

Given the widespread ramifications of fruit flies, it's in everyone's interest to prevent exotic fruit flies from reaching or becoming established in Australia and to tackle fruit fly management collectively.

The National Fruit Fly Council helps drive the delivery of a national system that prevents fruit flies being a constraint to sustainable production or a barrier to trade and market access. The Council includes representatives from governments, plant industries and Hort Innovation. It has an independent chair and is supported by a manager and a secretariat from PHA.

The Council focuses on four areas:

- systems for the prevention, detection, eradication and management of fruit flies
- maximising market access, including activities that assist in securing entry conditions for horticultural produce into markets
- legislation and regulation that supports fruit fly management, is harmonised across Australia and is consistent with international standards
- research and development to ensure that innovative solutions and technically justifiable approaches are available to meet the requirements of the three areas above.

The Council oversees and monitors implementation of the National Fruit Fly Strategy. In 2019 work began to review progress on the strategy and to update it to better reflect current and emerging national fruit fly management issues.

Regular meetings of the Council provide an important opportunity to identify priority areas for action and to promote coordination of activities between members. It is also working to improve the general awareness of fruit fly as important pests, of how they can be managed, and of the Council's role in a nationally coordinated system.

The website **preventfruitfly.com.au** provides information for backyard growers and commercial producers. It is supported by an e-newsletter and Twitter to keep stakeholders informed.

Mediterranean fruit fly is established in parts of WA. Other states and territories require fruit and fruiting vegetables to be treated before they are allowed to enter their jurisdictions.

Community involvement in domestic quarantine

THE BIOSECURITY OBLIGATIONS OF ALL AUSTRALIANS

Abiding by international and domestic border restrictions is one role that all Australians must play in maintaining Australia's biosecurity status. In addition, everyone has an obligation to avoid spreading plant pests and weeds, including keeping a lookout for anything unusual and reporting unfamiliar pests.

The introduction of a general biosecurity obligation or duty makes explicit the role that all Australians have to play in the biosecurity system. A biosecurity risk exists when dealing with any pest, disease or contaminant. This includes moving an animal, plant, turf, soil, machinery or equipment that could carry a pest, disease or contaminant.

People in Queensland, NSW and Tasmania are now required by law to take all reasonable and practical steps to prevent or minimise the risk of causing a biosecurity 'event' and limit the consequences of such an event. A biosecurity event is caused by a pest, disease or contaminant that is, or is likely to become, a significant problem for human health, social amenity, the economy or the environment.

Australians are not expected to know about all biosecurity risks but are expected to know about those associated with their day-to-day work and hobbies. For example:

- Those who live or work in a biosecurity zone (for example a builder or developer in a fire ant biosecurity zone) are expected to know what can and cannot move in to and out of the zone, and any other precautions required.
- Residential gardeners are expected to know the basics about reducing the risks of spreading a pest or disease, and the problem pests in their local area. They are not expected to know about all of the biosecurity risks to plants.
- Farmers are expected to stay informed about and appropriately manage the pests and diseases that could affect or be carried by their crops and livestock, as well as weeds and pest animals that could be on their property.
- Land owners are expected to stay informed about and appropriately manage the weeds and pest animals (such as wild dogs) that could be on their property.
- Transporters of agricultural produce are expected to check whether the transportation of goods could spread diseases or pests and, if so, to manage the risks appropriately.

THE ROLE OF LOCAL GOVERNMENT

As the community's closest tier of government, local government is a key stakeholder in biosecurity management. Local government's involvement in biosecurity varies from state to state and even from region to region, but generally includes:

- managing pest species on land owned by local governments
- on-going support for local community groups in the area of natural resource management including the management of post-border invasive species
- developing and enforcing pest management local laws under the *Local Government Act 1995*
- providing tools, management plans, staff support and training on post-border biosecurity issues
- delivering environmental education programs and other information relating to biosecurity in the community
- regional collaboration between local governments to deal with regional biosecurity issues
- providing field trial sites for biological control of certain weeds.

The general biosecurity duty or obligation means that Australians are expected to know about the biosecurity risks related to their day-to-day work and hobbies, like gardening.

On-farm biosecurity

On-farm biosecurity is a set of measures producers can use to protect a property from the entry and spread of pests, diseases and weeds. Measures used on farm establish another layer of protection, allowing producers to minimise pest problems as well as boosting biosecurity for their region, their industry and supporting market access for produce.

On-farm biosecurity measures are most effective when integrated into everyday activities. Often measures are procedural, such as changing vehicles between zones on a property, providing footwear for visits to production areas, disinfecting pruning shears and ensuring that farm inputs are clean and disease free. These measures and information about the pests of their crop are included in biosecurity manuals (see page 209).

Increasingly, growers are appreciating the benefits of on-farm biosecurity. The rate of uptake of on-farm biosecurity varies between and within industries. Increasing this uptake is the remit of several programs, described in the following sections.

The Goulburn Murray Valley Regional Fruit Fly Project won two Victorian Regional Achievement and Community Awards. From left to right: Merran Socha, Adrian Conti, Ross Abberfield (holding the award), Russell Fox,. Cr Libro Mustica, Cr Dinny Adem and Michael Carrafa. Image courtesy of Dannika Bonser

Regional fruit fly initiative recognised

A regional fruit fly project in Victoria's Goulburn Murray Valley was recognised with two Victorian Regional Achievement and Community Awards in October 2019.

Control of Queensland fruit flies is a high priority in Victoria where they pose a significant threat to the state's horticulture industry, affecting production and disrupting trade, and impacting produce grown in community and home gardens.

The Goulburn Murray Valley Regional Fruit Fly Project is an initiative bringing together members of the local horticulture industry associations, agronomists, Agriculture Victoria, government agencies, industry, growers and the community. The project uses the 'No Flies On Us' message to strengthen management of Queensland fruit fly in its region.

There are similar groups in Greater Sunraysia and the Yarra Valley who have developed comprehensive regional plans. They align with an overarching action plan for managing fruit fly in Victoria.

The Managing Fruit Fly in Victoria Action Plan 2015–20 takes a collaborative and coordinated approach to managing fruit fly across the state, focusing on the large fruit growing regions and emphasising that everyone has a role to play in the management of fruit fly.

Agriculture Victoria's $7.8 million Regional Grants Program funds the implementation of regional plans and the appointment of three regional coordinators.

Some of the highlights include:

- working with landholders to manage fruit fly 'hotspots', including an urban trapping program in Sunraysia and host tree removal on public land and private urban land
- advertising, community signage, school programs, community and industry workshops, field days and one-on-one discussions, that have all contributed to raising awareness of fruit fly impacts and management options
- providing smaller community grants of up to $5,000 to allow groups to tackle Queensland fruit fly in individual towns or localities in innovative ways
- building capability within industry and community to take ownership of fruit fly management, resulting in collaboration and outcomes which would be hard to replicate using a purely government-based approach to management.

BIOSECURITY EXTENSION AND ENGAGEMENT PROGRAMS

Through the leadership of their peak bodies, plant industries are becoming increasingly involved in biosecurity communication and engagement. Biosecurity extension and engagement programs are funded by industries to improve the management of, and preparedness for, biosecurity risks at the farm level. Biosecurity officers associated with some of these programs are often funded by grower levies and so tend to work with producers of particular crops.

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

NSW Grains Biosecurity Officer, Bill Gordon, at AgQuip in August 2019. Image courtesy of Pip Cotter (former NSW DPI Plant Biosecurity Officer)

Grains Farm Biosecurity Program

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

Since it began in 2007, thousands of in-crop and stored grain pest and disease surveys have been undertaken with industry, improving on-farm biosecurity as well as raising awareness in grain growing regions. Data from these surveys has and continues to be captured within PHA for inclusion in the national reporting tool AUSPest*Check*™. Media, newsletter and Ground Cover articles are distributed year-round to raise awareness of seasonal biosecurity risks for grain growers. Biosecurity officers also undertake surveillance for exotic pests of grains and have assisted in various recent post-border incidents such as Russian wheat aphid and lupin anthracnose.

Vegetable and Potato Farm Biosecurity Program

The Vegetable and Potato Farm Biosecurity Program is an extension and engagement program funded by vegetable growers and managed by PHA and AUSVEG to enhance the biosecurity management practices of producers and others along the supply chain in that industry.

It focuses on increasing the awareness and adoption of farm biosecurity among vegetable and potato growers and is increasingly being used as a platform for driving strategically important biosecurity initiatives.

Two dedicated biosecurity officers develop extension and training material, write articles on biosecurity themes for industry magazines, engage with producers at field days, and liaise with growers during pest incursions. In 2019, the officers completed a pilot urban biosecurity program after many of the recent exotic pest incursions were located at seaports, airports and other urban hotspots across Australian cities.

Throughout 2019, the officers took part in a variety of forums, biosecurity meetings and working groups. Their involvement also precipitated a number of initiatives with industry and researchers to extend surveillance capabilities and improve general surveillance reporting outcomes.

National Citrus Biosecurity Program

As part of a partnership program funded by Hort Innovation and the Department of Agriculture (through the Agricultural Competitiveness White Paper), a National Citrus Biosecurity Program was initiated in 2017 to improve biosecurity planning, preparedness and awareness in the citrus industry.

During 2019, the National Citrus Biosecurity Coordinator worked with government and industry to improve surveillance for exotic pests and raise awareness of pest threats among citrus growers and others along the supply chain.

The program re-established the First Detectors Network, a group of growers and crop scouts who monitor their crops regularly for any sign of exotic pests. The coordinator has also worked with the Urban Plant Health Network to improve awareness and surveillance in peri-urban and urban communities.

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

The National Citrus Biosecurity Coordinator is a member of the Citrus Pest and Disease Prevention Committee (CPDPC), an industry initiative established in 2018 to identify and coordinate research and extension needed to manage High Priority Pests for the citrus industry. The CPDPC and the National Citrus Biosecurity Program are working to establish a network of traps for Asian citrus psyllid, the vector of huanglongbing.

The program is guided by the framework provided by the National Citrus Biosecurity Surveillance Strategy 2018–28, developed by PHA in consultation with Citrus Australia and the Department of Agriculture. The strategy is aligned with the National Plant Biosecurity Strategy and National Plant Biosecurity Surveillance Strategy, as described in Chapter 1. Read more about pest and disease surveillance in the citrus industry on page 153.

National Bee Biosecurity Program

The National Bee Biosecurity Program is managed and administered by PHA on behalf of the Australian Honey Bee Industry Council. The program aims to help beekeepers manage pests and diseases that are already in Australia, and to prepare for incursions by exotic pests. Underpinning the program is the Australian Honey Bee Industry Biosecurity Code of Practice which provides a framework for Australian beekeepers to engage in best-practice biosecurity.

Bee Biosecurity Officers (BBOs) are employed in all six states. The officers help beekeepers to understand their biosecurity obligations under the Code of Practice, and provide advice on pest and disease management practices. Extension and education-based activities include attending industry field days, presentations at beekeeper club meetings, delivery of workshops and visits to apiaries. The program is funded by industry via the honey levy, with state governments also contributing extensive in-kind resources.

Farm biosecurity programs for horticultural industries

Each year the number of industries establishing farm biosecurity programs continues to grow. Many industries now recognise the importance of tailoring information to raise awareness of on-farm biosecurity and improve management decisions to mitigate the biosecurity risks to their crop(s).

In 2019 PHA worked with melon, avocado, mango, grape and wine industry representatives to develop capability and deliver farm biosecurity information to producers.

National Citrus Biosecurity Coordinator Jeff Milne speaks with growers in Mundubbera, Queensland. Image courtesy of Citrus Australia

Strawberry grower awarded for on-farm biosecurity

The plant category of the 2019 Farm Biosecurity Producer of the Year Award went to Victoria's Yarra Valley strawberry grower Luciano Corallo.

The award is supported by Plant Health Australia and Animal Health Australia, and is part of the annual Australian Biosecurity Awards run by the Department of Agriculture.

Luciano Corallo was nominated because he has demonstrated a commitment to ensuring his farm is a leader in industry best practice, quality assurance and biosecurity.

He takes a preventative approach to disease and pest management, actively participating in surveillance and hosting biosecurity workshops on-farm to share his knowledge with the industry.

Luciano takes part in the Queensland fruit fly awareness program in the Yarra Valley, with the farm hosting remotely accessed camera- based fruit fly traps as part of a sentinel detection network for the region.

Left: Victorian strawberry producers Heather and Luciano Corallo, winners of the 2019 Farm Biosecurity Producer of the Year Award. Right: (L to R) Karen Thomas of the Port Phillip and Westernport Catchment Management Authority, who nominated the Corallos for the award, Luciano and Heather Corallo

The Farm Biosecurity Program

Plant Health Australia (PHA) and Animal Health Australia (AHA) work together in a joint communication and awareness program, Farm Biosecurity, to provide biosecurity advice for both crop and livestock producers.

The program aims to help producers identify and reduce the risks to their enterprises posed by diseases, pests and weeds. The program website **farmbiosecurity.com.au** provides an array of information and tools, including biosecurity manuals, templates for record keeping, farm biosecurity gate signs to download or purchase, industry specific information, videos outlining best practice, a personal profile builder, a biosecurity planner and a planning app.

Resources produced by Farm Biosecurity are structured around the six biosecurity essentials:

- farm inputs
- people, vehicles and equipment
- production practices
- feral animals and weeds
- farm outputs
- train, plan and record.

By considering how these principles apply to their properties, producers can go a long way towards protecting their farms and their future from the impact of new or established diseases, pests and weeds.

The Farm Biosecurity Producer of the Year Award was established by PHA, AHA and the Department of Agriculture to recognise the contribution of producers who demonstrate outstanding, proactive on-farm biosecurity practices.

BIOSECURITY MANUALS FOR PRODUCERS

To help improve farm biosecurity, PHA in partnership with plant industries and governments, has released 21 crop-specific biosecurity manuals, listed in Table 57. In 2019 a biosecurity manual for cherry producers was developed.

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

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

New Cherry Growers' Biosecurity Manual

A revised version of the Cherry Growers' Biosecurity Manual released in May 2019 provides an up-to-date guide for growers and their consultants and advisors to improve biosecurity on farm.

The manual was produced by PHA in collaboration with Cherry Growers Australia and government representatives from state departments of primary industries and agriculture.

The manual includes fact sheets on high priority exotic pests and diseases of cherries that were identified during an update to the Biosecurity Plan for the Cherry Industry.

This project was funded by Hort Innovation, using the cherry research and development levy and contributions from the Australian Government.

Table 57. Biosecurity manuals for producers

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

MANAGING PESTS ON FARM

Australian farmers manage pests with a variety of methods tailored to the type of pest, the crop and agroecological conditions. Most growers use an integrated pest management approach, which means that they combine chemical, cultural, mechanical and biological controls in a flexible way that can change over time.

Chemical control

For the management of many plant pests, pesticides are the fastest and easiest option for control and most growers use at least one type of chemical to maintain productive agriculture. Pesticide availability in Australia is regulated by the Australian Pesticides and Veterinary Medicines Authority (APVMA), an independent statutory authority. As the national regulator of agricultural and veterinary chemicals, the APVMA regulates pesticides in line with responsibilities described in the *Agricultural and Veterinary Chemicals (Administration) Act 1992* and the *Agricultural and Veterinary Chemicals Code Act 1994*.

The APVMA exists to ensure that Australia has access to safe and effective agricultural and veterinary chemicals to control pests and diseases of animals and plants. It also monitors and enforces compliance with the Agricultural and Veterinary Chemicals Code and other legislation. Records are kept of approved agricultural and veterinary constituents, registered products and approved labels. More information is available from **apvma.gov.au**

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

It is estimated that up to 73 per cent ($20.6 billion) [36] of Australia's total value of crop production is attributable to the use of crop protection products. Table 58 illustrates the amount and type of agricultural chemicals used for controlling plant pests in Australia. This total expenditure on pesticides for plants represents over six per cent of the gross value of production for all crops in Australia. [37] [38]

Cultural and mechanical control

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

Biological control

Biological control is a method of controlling pests using natural enemies. Natural enemies of pests are known as biological control agents and include predators, parasitoids and pathogens. Biological control has been highly successful in many instances, with a number of pest problems permanently solved by importation and successful establishment of biological control agents. Successes tend to be confined to particular ecosystems or pest situations, and when they are effective, can provide long-term and even permanent results.

Table 58. Sales of plant chemicals in Australia, 2016-19 [39]

		Herbicide	Insecticide	Fungicide	Mixed function pesticide	Miticide	Molluscicide	Nematicide	Total
2016	No. of products	3,301	1,445	939	149	131	54	18	**6,037**
	Value of product sales ($ million)	1,717	337	254	32	19	12	4	**2,375**
2017	No. of products	3,363	1,482	967	148	131	54	15	**6,160**
	Value of product sales ($ million)	1,683	484	343	39	36	16	2	**2,603**
2018	No. of products	3,517	1,515	1,021	145	131	52	16	**6,397**
	Value of product sales ($ million)	1,714	413	269	37	20	14	2	**2,469**
2019	No. of products	3,643	1,570	1,088	145	134	51	17	**6,648**
	Value of product sales ($ million)	1,507	358	242	32	25	13	3	**2,180**

Australia's weed biosecurity system

The scope of Australia's plant biosecurity system covers more than just invertebrates and pathogens, with a range of prevention, surveillance, eradication and ongoing management activities in place to address the threats posed by weeds. It has been estimated that the annual cost to the Australian economy from the agricultural impacts of weeds is almost $5 billion. [40]

A weed is a plant that requires some form of action to reduce its negative effects on the economy, the environment, human health or amenity. Weeds reduce the establishment, growth and yields of field crops, pastures and forestry, and can invade natural environments, outcompeting native plants and disrupting ecosystem processes.

Around 20 naturalisations of garden plants are recorded each year, albeit a small number from the large pool of over 30,000 plant species that have been imported for cultivation in Australia.

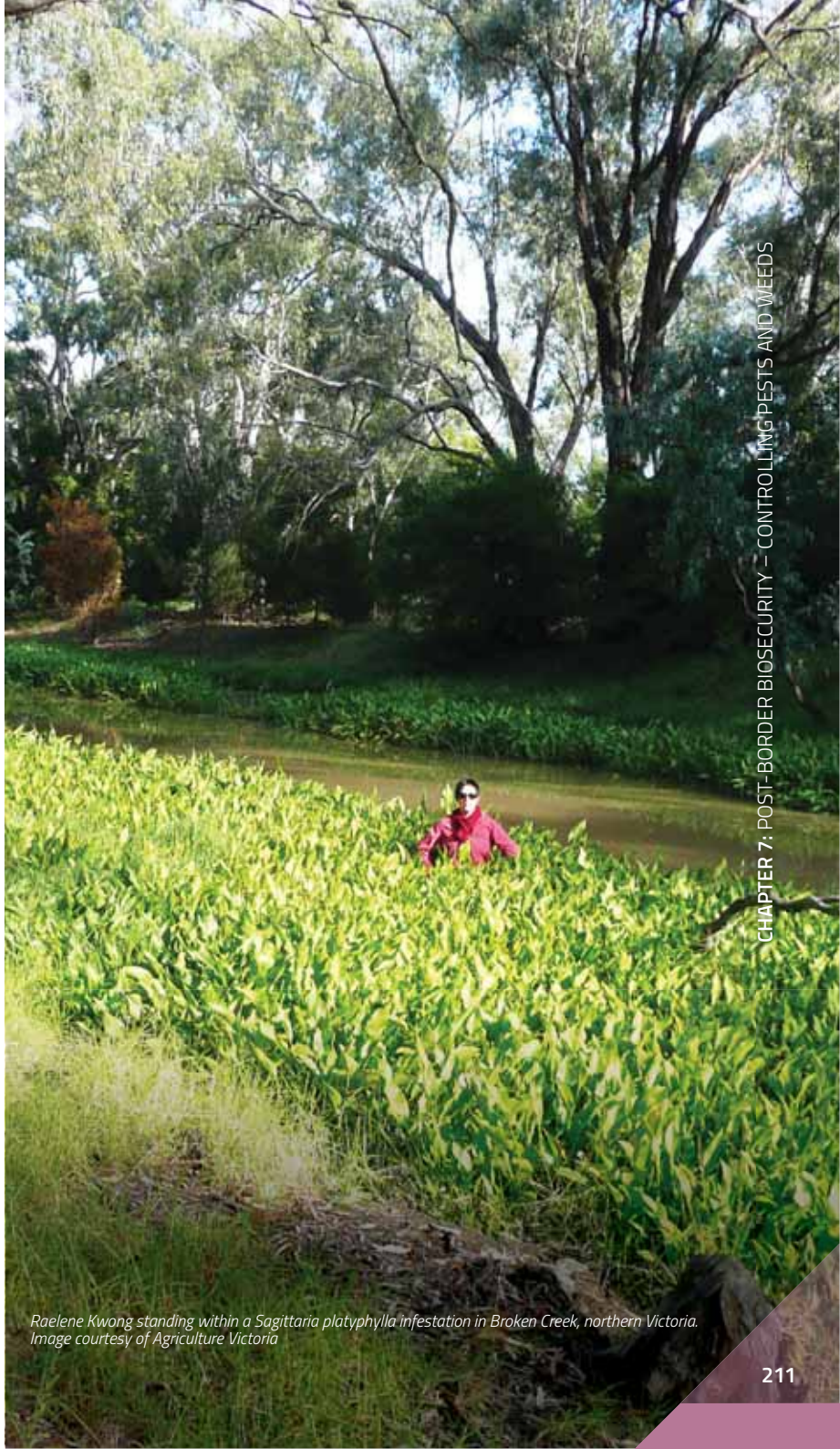
Australia's weed biosecurity system aims to:

- prevent entry of high weed risk species
- detect and eradicate or contain significant weeds in the early stages of invasion
- mitigate the impacts of established weeds.

Responsibility for weed biosecurity is shared between government, industry and the community. Legislation sets out the various roles of governments in managing weeds across Australia. State and territory government departments of primary industries and environment, along with local governments or natural resource management authorities, have responsibility for weed biosecurity policy and management.

Weed management is also a component of on-farm biosecurity. Producers of both crops and livestock manage weeds on individual properties to reduce their impacts and play an integral part in the weed detection and reporting network.

36. CropLife Australia, 2018. Economic activity attributable to crop protection products. Deloitte Access Economics Pty Ltd. agriculture.gov.au/SiteCollectionDocuments/abares/data/agricultural-commodities-statistics.xlsx
37. Australian Pesticide and Veterinary Medicines Authority, Gazette No 5 March 2020. Accessed online 31 March 2020, apvma.gov.au/node/64531
38. Australian Bureau of Agricultural and Research Economics and Sciences. Agricultural commoditiesDecember quarter 2019. Accessed online 16 March 2020, agriculture.gov.au/abares/researchtopics/agricultural-commodities/australian-crop-report
39. Australian Pesticide and Veterinary Medicines Authority, Gazette No 5 March 2020. Accessed online 31 March 2020, apvma.gov.au/node/64531
40. McLeod R (2018) Annual Costs of Weeds in Australia. eSYS Development Pty Limited. Published by the Centre for Invasive Species Solutions, Canberra, Australia



Raelene Kwong standing within a Sagittaria platyphylla infestation in Broken Creek, northern Victoria. Image courtesy of Agriculture Victoria

Two weevil species under consideration for the biological control of Sagittaria platyphylla are the fruit-feeding weevil (left) and crown-boring weevil (right). Image courtesy of Agriculture Victoria

COORDINATION OF WEED MANAGEMENT

The Environment and Invasives Committee (EIC) provides an intergovernmental mechanism for identifying and resolving weed issues at a national level. It comprises members from the Australian Government, all state and territory governments, and observers from the CSIRO, PHA, the Centre for Invasive Species Solutions, Wildlife Health Australia, AHA, and ABARES.

EIC oversees the administration of the Australian Weeds Strategy 2017–27, which is the overarching policy for weed management in Australia. It outlines goals and actions required to keep Australia's economic, environmental and social assets secure from the impacts of weeds. The strategy is reviewed every 10 years to ensure it remains relevant to Australia's needs.

The strategy provides information on where improvements can be made at the national level that will result in benefits across Australia. It draws attention to areas that require national collaboration and will drive the development of consistent and coordinated national approaches by clarifying priorities, roles and responsibilities.

The strategy is available at **agriculture.gov.au/pests-diseases-weeds/pest-animals-and-weeds/review-aus-pest-animal-weed-strategy/aus-weeds-strategy**

PREVENTING THE ENTRY OF NEW WEEDS

Around 65 per cent of current weed species were originally imported for use as garden ornamentals, with introductions for potential pasture species being another key source. However, most of these species were imported decades ago and modern improvements to biosecurity arrangements have significantly reduced this risk.

The Department of Agriculture develops and implements biosecurity policies for plant imports (seeds, tissue culture or any other material for propagation) into Australia. Since 1997, new plant species have been subject to a Weed Risk Assessment process that determines the weed potential of any proposed new plant imports.

If a plant species is not listed in the department's Biosecurity Import Conditions database (BICON) as being permitted to enter Australia, it will require a weed risk assessment to determine its potential weed risk. Australia's Weed Risk Assessment system was developed following extensive consultation and collaboration of weed experts and has been adapted for use in other parts around the world.

All propagative material entering the country must meet standard biosecurity import conditions, including verification of the botanical name (species). In order to prevent the entry of weeds that may be present as a contaminant, consignments must also be inspected by a biosecurity officer before permission is given for it to enter.

Generally, larger seed lots (more than 10 kilograms) undergo purity analysis under a strict regime of statistical sampling and analysis at a laboratory accredited by the International Seed Testing Association. If any weed species are detected either by visual inspection or purity analysis, the seed lot may be denied entry until the weed seeds have been removed.

Seed consignments imported for other uses, such as for human consumption, may also be directed for mandatory treatment if weed seeds are found. Treatments devitalise the seeds to ensure they are unable to grow and spread, should they be inadvertently released in the environment.

WEED SURVEILLANCE

Weeds are also an integral part of the Northern Australia Quarantine Strategy (see page 146), which involves surveillance activities in Australia's north and neighbouring countries. Elsewhere, state and local government weed officers conduct surveillance as part of routine inspections of properties for declared plants.

Community-based weed spotter programs are active in many states and local areas. Volunteers in these groups report new weed detections in their areas and are generally supported in their activities by government agencies through state herbaria. An example is the Weeds at the Early Stage of Invasion program run by the Victorian Government.

Surveillance also extends to online trade, with governments sharing information between jurisdictions when declared plants are found to be advertised for sale.

Host specificity testing of candidate biological control agents being undertaken by biocontrol scientists Nathan Harms (left) and Jackie Steel (right) within Agriculture Victoria's quarantine insectary. Image courtesy of Agriculture Victoria

Increased support for weed biocontrol

Biocontrol is considered the only cost-effective approach to manage abundant and widespread weeds across different land uses, with benefits outweighing R&D costs by over 23:1. It is a sustainable approach that requires little further investment once biocontrol agents are widely established, have built-up their populations and had a negative impact on the weed.

Investment in research on weed biocontrol has increased in recent years. An example is the Australian Government's Rural Research and Development for Profit that includes significant co-investments from other governments and industries.

Three projects on biocontrol of priority weeds have been funded from 2015 to 2022. The projects have brought together biocontrol expertise from four Australian and multiple international research agencies to support the development and deployment of new agents or fast-tracking of agent releases on 19 priority weed targets for primary industry and agricultural water assets: African boxthorn, African lovegrass, cabomba, clidemia, cylindropuntia, European blackberry, fleabane, giant rat's tail grass, gorse, Hudson pear, mother of millions, navua sedge, ox-eye daisy, parkinsonia, parthenium, prickly acacia, sagittaria, silverleaf nightshade and sowthistle.

Activities have spanned three stages:

- identification of potential biocontrol agents
- risk and efficacy assessment of agents
- mass-rearing and field release of approved agents in Australia.

This approach is ensuring that Australia has a sustained pipeline of weed biocontrol agents for the future.

The weed purple Viper's bugloss (Echium vulgare) is similar to Paterson's curse (Echium plantagineum)

ERADICATION AND CONTAINMENT OF WEEDS

Eradication of weeds is only possible if incursions are detected early, and a response is mounted before they have a chance to spread too far.

The National Tropical Weeds Eradication Program continued in 2019, targeting six weed species native to tropical America that have been detected in north Queensland (and one also in northern NSW). The program is managed by Biosecurity Queensland and is cost-shared by the Australian, Queensland, NSW, NT and WA governments. The species are:

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

The National Red Witchweed (*Striga asiatica*) Eradication Program also continues. The response is led by the Queensland Government and is being funded by the Australian, Queensland, NSW and NT governments, Meat and Livestock Australia, Grain Producers Australia and Canegrowers. Since July 2013 there has an 85 per cent reduction in the soil seedbank and a 99.99 per cent decline in plant detections, indicating good progress towards eradication.

Hawkweeds, *Hieracium* species, are also the subject of eradication programs in NSW, Victoria and Tasmania.

Weed containment programs occur at state, regional and local levels under a jurisdictions' legislation, aimed at preventing further spread of significant weeds that cannot be eradicated. A state-level example is the ongoing detection and treatment of parthenium weed (*Parthenium hysterophorus*) incursions from established populations in Queensland into NSW. Similarly, the NT has on-going responses to detect and treat new cross-border incursions of parthenium, rubber vine (*Cryptostegia grandiflora*) and Siam weed (*Chromalaena odorata*).

Local or regional government organisations lead coordinated control programs for declared weeds across multiple properties, where control is generally the legal responsibility of each land owner.

MANAGING ESTABLISHED WEEDS

The management of established weeds is a shared responsibility between landholders, community, industry and government. At the national level, the Australian Government administers a number of programs to assist with the management of established weeds for the benefit of the environment, agricultural productivity and local communities. Through these programs, the Australian Government invests in RD&E activities, national coordination and the development and implementation of policy and associated programs.

The National Landcare Program provides a range of measures to support natural resource management and sustainable agriculture, and to protect Australia's biodiversity. Now in the second phase of the program, the Australian Government aims to work in partnership with governments, industry, communities and individuals to manage established weeds for the protection and improvement of soil, water, vegetation and biodiversity on-farm, as well as reduce off-farm impacts on natural resources.

Combating weeds is an integral part of most farming systems. Problem weeds and their management differ greatly among industries and regions, but most production systems take an integrated approach of chemical and non-chemical control methods. Weeds are commonly managed using a combination of competition with other plants, herbicide applications, soil tillage, slashing, grazing, weed seed capture and/or burning. No-till production systems, which use herbicides to control weeds, are now common in Australia.

Plant industry research funding bodies, such as the Grains Research and Development Corporation, invest considerably in RD&E to improve weed management systems, particularly for herbicide resistant weeds. Co-investment by industries and governments is often used for the biological control of high priority weeds, which is particularly important in rangeland grazing systems and natural ecosystems where intensive weed control measures are cost-prohibitive.

Weed management in natural ecosystems is undertaken by volunteers, groups, contractors and private and government owners of conservation parks and reserves, undertaking sensitive restoration activities to maintain local bushland. For example, in Indigenous Protected Areas and other areas under management by traditional owners in the NT, indigenous ranger groups are employed to reduce the impact of established weeds across extensive areas of country. On the northern coastline, these ranger groups also conduct surveillance for new incursions in collaboration with the states and territories and the Northern Australian Quarantine Strategy.

Cocker spaniel Sally diligently sniffs the landscape for hawkweed at the protected Blue Lake Ramsar site in Kosciuszko National Park. Image courtesy of NSW National Parks and Wildlife Service

Multi-prong attack on hawkweed yields results

Eradicating a weed from an invaded range is a deceptively difficult task: the infestation must be delimited (all plants found), reproduction halted, above ground biomass controlled, and the seedbank exhausted.

The NSW Hawkweed Eradication Program – the largest weed eradication program in NSW – aims to eradicate mouse-ear and orange hawkweed from Kosciuszko National Park and surrounds. The program integrates cutting-edge airborne surveillance technology with traditional on-the-ground weed detection methods.

From the air, drones able to detect the unique orange hawkweed flowers capture high resolution images of the landscape. Helicopters transport equipment and eradication teams into and out of remote and hard to access areas. Working together on the ground, humans visually scan the terrain for hawkweed and detector dogs sniff out and locate plants.

Over an increasing large search area, the number of new hawkweed detections is decreasing. In 2018–19, the area of orange hawkweed discovered decreased by 60 per cent compared to the previous season and has dropped by nearly 97 per cent since 2010–11. Less than one square metre, or 160 plants, of mouse-ear hawkweed was found in 2018–19, indicating eradication of this species is on target.

Research to further enhance the program covers:

- behavioural change to improve weed hygiene practices of park users
- modelling wind data to determine hawkweed seed dispersal patterns
- multispectral imagery to improve detection of hawkweed
- hawkweed ecology and seed longevity
- time to eradication modelling.

The program is being delivered by the NSW Environmental Trust, Department of Primary Industries, South East Local Land Services and a range of other partners, along with a large group of technical experts and volunteers.