



TROPICAL PLANT INDUSTRIES BIOSECURITY SURVEILLANCE STRATEGY 2020–25

BACKGROUND INFORMATION, INDUSTRY STATISTICS AND SURVEILLANCE ACTIVITIES

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Details of plant industries in Northern Australia

Sugar

Canegrowers is recognised as the peak industry body representing sugar cane growers. Another association, Australian Cane Farmers Association also represents the industry. Sugar cane millers are represented by the Australian Sugar Milling Council.

Sugar is produced from the sugar cane plant (*Saccharum officinarum*). In 2018, 380,000 hectares was harvested, producing 4,275 million tonnes of sugar, valued at \$1.75 billion. Eighty percent of Australian sugar production is in north Queensland. There are over 4,000 sugar producing farms in Australia and the industry contributes in excess of \$4 billion directly and indirectly to Australia's economy.¹

The industry invests in research, development and extension with much of these activities being managed by Sugar Research Australia. Biosecurity is an important focus for the industry. A focus on breeding for disease resistance and working closely with federal and state governments in prevention and preparedness is an industry priority. The industry is also very active in developing and maintaining professional networks with sugar industries around the world to maintain awareness of the status of pest and diseases in other sugar producing countries.

Cotton

Cotton Australia represents Australian cotton growers. Research and development activities are managed by the Cotton Research and Development Corporation (CRDC).

The 5-year average production (2013–14 to 2017–18) was 3.48 million bales, grown on 359,832 hectares.² Cotton is grown primarily for the production of lint with an additional product of cottonseed, which is of value as a cattle feed supplement. The majority of lint produced in Australia is exported.

Cotton is grown by approximately 1500 growers in Australia. Until the late 1990s it was principally grown in central western regions from Emerald in Queensland, south to the Macquarie Valley in New South Wales (NSW). Its production has now expanded south in southern NSW and northern Victoria.

1. Australian Sugar Milling Council, 2019

2. Cotton Australia, 2018

Recently large-scale trials have been planted in north Queensland (near Georgetown), the Northern Territory (NT; Tipperary Station and Katherine) and the Ord River Irrigation Area in northern Western Australia (WA). Cotton is an annual crop and, while some is grown as a dryland crop, the majority is grown as an irrigated crop. Because of its dependence on irrigation, the size of the crop fluctuates with water availability and the world cotton price.

CRDC invests heavily in biosecurity issues and the emerging production in northern Australia has important risk pathway issues associated with it.

Grains

The biosecurity aspect of the grains industry is represented by Grain Producers Australia. Research and development activities are managed by the Grains Research and Development Corporation (GRDC). Grain production of 34 million tonnes, worth \$9 billion (as annual farm gate value) represents Australia's largest plant industry.³ The majority of product is exported and represents 24 per cent of total agricultural exports.

Most of Australia's grain is produced in the wheat belt, which stretches from central Queensland through NSW, Victoria, Tasmania, South Australia (SA) and southern WA. However, due to the wide-ranging soil and climatic variability across Australia, a range of crop species and varieties are grown. There is limited grain production in north Queensland and the Ord River Irrigation Area of WA, predominantly sorghum and maize. This production is increasing, particularly in the Ord River Irrigation Area, and is an important biosecurity risk for major production areas further south.

Through GRDC, the industry invests heavily in managing biosecurity threats and issues. The grains industry has several levies in place (see Table 2, page 11, for details).

Rice

The industry has the capacity to produce 1 million tonnes and in 2016–17 rice production was valued at \$230 million, with the export value estimated at \$149 million. The area under production varies depending upon water availability and other factors. In recent years, the area under production has ranged from 27,000 hectares to 113,000 hectares.⁴ Most of Australia's rice is exported to Asia, the Middle East, and nations in the Pacific.

3. *Grains Research and Development Corporation, 2019*

4. *Ricegrowers' Association of Australia; Department of Agriculture, Water and the Environment, 2018*

5. *Hort Innovation, 2019*

6. *Hort Innovation, 2019*

Australian rice is grown in the Murrumbidgee and Murray Valleys of south-western NSW, with small areas of rice grown in adjacent areas of northern Victoria. The major varieties grown are temperate Japonica varieties planted in October to November and harvested from March to May of the following year. Historically rice was grown in north Queensland, the NT and the Ord River Irrigation Area of northern WA. Small quantities are still grown in northern Australia and further research is being conducted to investigate increasing production in the north.

The rice industry is conducting research into suitable varieties and management techniques to maximise water efficiency and allow production in north Queensland. Strict biosecurity measures have been put in place to ensure that any pests endemic in northern Australia are not spread south to the major rice growing area in NSW.

Avocados

Avocados Australia is the peak industry body representing Australia's avocado growers.

The 2017–18 crop was 77,032 tonnes, valued at \$655 million, and the majority was consumed domestically.⁵ Important export markets for the industry include Malaysia, Singapore and Hong Kong (non-protocol markets). Avocados can also be exported to Japan from areas free from Queensland fruit fly. Although exports currently represent less than five per cent of seasonal production, the industry is increasing its focus on export markets.

The industry supports a significant research program and has several projects focusing on high priority exotic pests.

Bananas

Australian Banana Grower's Council is the peak industry body representing Australia's banana growers.

Bananas are produced in tropical and sub-tropical regions of Australia, with the majority of production occurring in the Tully–Innisfail, Atherton Tablelands and Lakelands regions of north Queensland, with smaller production occurring in Bundaberg (south-east Queensland), Coffs Harbour (northern NSW), Darwin (NT), and Carnarvon and Kununurra in WA.

The Australian banana crop is marketed predominantly towards domestic markets with only small volume exports into south-east Asian countries. In 2017–18 the industry produced 388,265 tonnes, valued at \$587 million.⁶ The banana industry is very focused on biosecurity and surveillance and in collaboration with the Department of Agriculture and Fisheries, Queensland invests significantly in biosecurity.

Citrus

Citrus Australia is the peak industry body representing Australian citrus growers.

The Australian citrus industry produces oranges, mandarins, lemons, limes and grapefruit. In 2018 it produced 746,297 tonnes, valued at \$798 million, and exported 258,196 tonnes of fruit valued at \$428 million.⁷ The key export markets include China, Japan, Hong Kong, Malaysia, Indonesia, United Arab Emirates, USA and Thailand.

Citrus fruits are grown commercially throughout the Australian mainland excluding the Australian Capital Territory (ACT). Major growing areas include the Riverina in NSW; central Burnett, Central Highlands and Far North in Queensland; Riverland in SA; the Murray Valley in Victoria and NSW, and the midlands, the Ord River Irrigation Area and south-west of WA. There is a small number of commercial orchards in Darwin and the Katherine regions of the NT.

Citrus Australia has six regional advisory committees which act to identify and communicate industry issues, including biosecurity, to Citrus Australia. The recent establishment of the Citrus FNQ Regional Advisory Committee and its focus on biosecurity issues is an important development for biosecurity planning in northern Australia.

Custard apples

Custard apple growers are represented by Custard Apples Australia.

Custard apple production in 2017–18 was 1,693 tonnes and valued at \$6.5 million.⁸ It is grown along the sub-tropical and tropical coast of the eastern seaboard from the Atherton Tablelands in north Queensland to Lismore in northern NSW. The largest production area is the Sunshine Coast in south-east Queensland.

Lychees

The Australian Lychee Grower Association, is the peak industry body representing Australia's lychee growers.

Lychees are grown principally in Queensland (Atherton Tablelands, Rockhampton, Bundaberg and the Sunshine Coast) with limited production in northern NSW.

7. Hort Innovation, 2019

8. Hort Innovation, 2019

9. Hort Innovation, 2019

The Australian lychee crop is predominantly marketed domestically, with approximately 20 per cent of production exported to non-protocol markets including Hong Kong and the United Arab Emirates. 2017–18 production was 2,633 tonnes and valued at \$24 million.⁹ The industry recently gained access to the United States and is exporting small volumes to this protocol market. Growers are also required to conduct orchard crop monitoring for the United States market.

Mangoes

The Australian Mango Industry Association (AMIA) is the peak industry body representing mango growers.

Mango production is predominantly in Queensland (Atherton Tablelands, Burdekin, Bowen and Bundaberg), and the NT (Darwin, Katherine and Mataranka). Production also occurs in Kununurra, Carnarvon and Gingin in WA, northern NSW and small plantings in the Sunraysia and Riverland regions of Victoria and SA. Total production in 2017–18 was 83,315 tonnes and valued at \$210 million.¹⁰

While much of the crop is marketed domestically, the industry is focused on increasing exports. In 2017–18 the industry exported 7,694 tonnes valued at \$28.7 million. Significant markets include Hong Kong, Singapore, New Zealand and the United Arab Emirates.¹¹ Protocol markets include New Zealand, Japan, China, Korea, United States and Middle Eastern countries. Export markets requiring orchard crop monitoring include China and Korea.

AMIA has a focus on biosecurity and surveillance and has two industry development officers who undertake orchard and packing shed surveillance during the season.

Melons

There are approximately 200 melon growers in Australia and the Australian Melon Association is the peak industry body representing them.

2017–18 production was 215,519 tonnes valued at \$124 million.¹² Melons are grown throughout Australia, with principal production regions including Darwin, Katherine and Mataranka in the NT; Bowen and Bundaberg in Queensland; Cowra and the Riverina in NSW; the Sunraysia area in Victoria; the Riverland in SA; and the Ord River Irrigation Area, Carnarvon, and South Perth in WA. While the domestic market consumes much production, export markets include New Zealand, the United Arab Emirates, Malaysia, Hong Kong and Singapore.

10. Hort Innovation, 2019

11. Hort Innovation, 2019

12. Hort Innovation, 2019

Production nurseries

Production nurseries are represented by Greenlife Industry Australia.

The nursery industry, worth \$2.3 billion,¹³ produces for the landscape industry, revegetation, and plants for the ornamental and retail supply chains. It is also the supplier for commercial fruit, vegetable and forestry sectors. Nursery businesses represent a critical biosecurity linkage between plant industry production areas and urban and peri-urban areas. Their supply chain role into these areas is an important focal point for biosecurity activity.

Papaya

Papaya Australia is the peak industry body representing papaya growers.

In 2017–18 the industry produced 16,196 tonnes valued at \$31 million. Only minimal volumes are exported to countries such as New Zealand and Oman.¹⁴ Papaya are grown predominantly in north Queensland, with small volumes grown for the local market in the Darwin region of the NT and Kununurra in WA.

Papaya Australia is not a signatory to the EPPRD nor a member of PHA. The industry has been addressing a recently detected disease, papaya sticky disease caused by a meleira virus.

Passionfruit

Passionfruit Australia represents passionfruit growers.

In 2017–18, 4,790 tonnes of passionfruit were produced from 300 hectares and valued at \$16.8 million.¹⁵ The majority of production comes from regions extending from far north Queensland south to northern NSW. Small volumes of production also occur in other states and the NT. About two thirds of the Australian passionfruit crop is grown in Queensland and around one third in NSW. The majority of production is consumed by the domestic market.

13. Hort Innovation, 2019

14. Hort Innovation, 2019

15. Hort Innovation, 2019



Pineapples

Growcom represents Australian pineapple growers.

The pineapple industry is predominantly Queensland based, with some production in the NT. In Queensland, production occurs on the Atherton Tablelands, central Queensland, the Wide Bay region and in south-east Queensland. In 2018 the industry produced 76,002 tonnes with a value of \$53.4 million. The industry markets fresh pineapple with 38 per cent of production destined for processing.¹⁶

Sweet potatoes

Australian Sweetpotato Growers Inc represents sweetpotato growers.

In 2018 approximately 100,000 tonnes were grown with a value of \$80 million.¹⁷ The majority of production is consumed domestically with under one per cent exported. Queensland growers produce 70 per cent of production, with most production occurring around the Bundaberg region and smaller areas of production on the Atherton Tablelands and Rockhampton. In northern NSW, production occurs in the Cudgen and Murwillumbah areas. Small areas of production occur in the Perth, Carnarvon and Kununurra regions of WA. There are approximately 85 commercial growers.

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

Despite the limited commercial production in northern Australia, it is widely cultivated in the tropics and forms an important food role for communities in neighbouring countries. Consequently, biosecurity risk pathways specific to northern Australia are important for the industry.

16. Hort Innovation, 2018

17. Australian Sweetpotato Growers, 2019

18. Hort Innovation, 2019

Exotic tropical fruits

The tropical fruits industry includes a diverse range of crops with six of the fruit crops produced in commercial quantities with a further 60 species grown in small volumes by commercial growers and tropical fruit enthusiasts. These species may be commercialised in the future. Many are produced in small volumes and sold locally, although several species such as rambutans, durian, jackfruit and dragon fruit are produced in larger volumes and sold into major domestic markets.

These crops do not have industry specific representative bodies or any levies in place. They have had research projects funded through Agrifutures Australia in the past.

Most of these crops are exotic in origin and the extensive suite of pests and diseases associated with them overlaps with threats in other plant industries. For this reason, they represent an important component for biosecurity surveillance planning in northern Australia.

Vegetables

AUSVEG is the peak industry body representing Australia's vegetable growers.

In 2017–18, Australian growers produced 3.7 million tonnes of vegetables, valued at \$4.4 billion. Export volumes as 205,665 tonnes valued at \$255 million. Major crops include potatoes, carrots and lettuce.¹⁸

Australia's diverse climate and soils accommodate vegetable cultivation in all states and territories, ensuring a constant supply of fresh vegetables. Australian vegetable growers provide the majority of fresh vegetables consumed in Australia and an increasing amount of fresh vegetables consumed overseas. In northern Australia the principal vegetables grown include Asian vegetables (snake bean, okra, bok choy, okra, bitter melon and long melon), principally in the Darwin region of the NT as well as pumpkin grown in the Katherine region. In north Queensland, principal vegetables grown include tomatoes, capsicum, beans and sweet corn (Bowen region), and potatoes on the Atherton Tablelands. Combined value of vegetable production in northern Australia is estimated at over \$500 million.

The Australian vegetable industry is committed to building its capacity to respond to potential biosecurity threats. The industry has access to two full-time biosecurity officers and a potato pest surveillance project officer who facilitate the industries' participation in a range of biosecurity initiatives.



Table 1. Current levy rates for horticulture industries¹⁹

Commodity		Emergency Plant Pest Response	Marketing	National Residue Testing	Plant Health Australia	Research and Development	Total
Avocados	Fresh domestic and export	\$0.00	4.5 c/kg	-	0.1 c/kg	2.9 c/kg	7.5 c/kg
	Processing	\$0.00	-	-	-	1 c/kg	1 c/kg
Bananas		\$0.00	1.15 c/kg	-	0.5 c/kg	0.54 c/kg	2.19 c/kg
Citrus	Oranges in bulk	\$1.05/t	75 c/t	-	30 c/t	\$3.20/t	\$5.30/t
	Oranges not in bulk	\$2.1c/box	1.5 c/box	-	0.6 c/box	6.4 c/box	10.6 c/box
	Other citrus in bulk	\$1.05/t	-	-	30 c/t	\$3.20/t	\$4.55/t
	Other citrus not in bulk	\$2.1c/box	-	-	0.6 c/box	6.4 c/box	9.1 c/box
Custard apples	Package	-	13 c/tray	-	-	27 c/tray	40 c/tray
	Bulk	-	\$16.00/t	-	-	\$34.00/t	\$50.00/t
Lychees	Domestic and export	-	2.5 c/kg	-	-	5.5 c/kg	8 c/kg
	Processing	-	-	-	-	1 c/kg	1 c/kg
Mangoes		0.114 c/kg	1 c/kg	-	0.029 c/kg	0.75 c/kg	1.893 c/kg
Melons		\$0.00	-	-	0.1 c/kg	0.3 c/kg	0.4 c/kg
Nursery products		0%	2% of the sale price	-	0.25% of the sale price	2.75% of the sale price	5% of the sale price
Papaya	Fresh domestic and export	-	1 c/kg	-	-	1 c/kg	2 c/kg
	Processing	-	-	-	-	0.25 c/kg	0.25 c/kg
Passionfruit	Packed in cartons	-	20 c/carton	-	-	20 c/carton	40 c/carton
	Not packed in cartons	-	20 c/8 kg	-	-	20 c/8 kg	40 c/8 kg
	Processing	-	1.5 c/kg	-	-	1.5 c/kg	3 c/kg
Pineapples	Domestic and export	\$0.00	\$2.00/t	-	10 c/t	\$2.90/t	\$5.00/t
	Processing	\$0.00	-	-	10 c/t	\$1.90/t	\$2.00/t
Sweet potatoes		\$0.00	1% of the sale price	-	0.015% of the sale price	0.485% of the sale price	1.5% of the sale price
Vegetables	Unprocessed	0.010% of the sale price	-	-	0.015% the sale price	0.485% of the sale price	0.51% of the sale price
	Processed	0.010% of the value of the vegetable if it were first sold as an unprocessed vegetable	-	-	0.015% of the value of the vegetable if it were first sold as an unprocessed vegetable	0.48% of the value of the vegetable if it were first sold as an unprocessed vegetable	0.51% of the value of the vegetable if it were first sold as an unprocessed vegetable

19. Levy and charge rates, Australian Government Department of Agriculture, Water and the Environment. Accessed online 25 September 2020 www.agriculture.gov.au/ag-farm-food/levies/rates#horticulture

Table 2. Current levy rates for selected field crops²⁰

Commodity	Emergency Plant Pest Response	National Residue Testing	Plant Health Australia	Research and Development	Total
Chickpeas	0.005% of the sale value	0.015% of the sale value	0.01% of the sale value	0.99% of the sale value	1.020% of the sale value
Cotton	\$0.00	-	\$0.04/ 227 kg bale	\$2.21/ 227 kg bale	\$2.25/ 227 kg bale
Maize	0.005% of the sale value	0.015% of the sale value	0.007% of the sale value	0.693% of the sale value	0.720% of the sale value
Mung beans	0.005% of the sale value	0.015% of the sale value	0.01% of the sale value	0.99% of the sale value	1.020% of the sale value
Rice	\$0.00	-	\$0.06/t	\$2.94/t	\$3.00/t
Seed Cotton	\$0.00	-	7 c/t	\$3.99 /t	\$4.06/t
Sorghum	0.005% of the sale value	0.015% of the sale value	0.01% of the sale value	0.99% of the sale value	1.020% of the sale value
Soybeans	0.005% of the sale value	0.015% of the sale value	0.01% of the sale value	0.99% of the sale value	1.020% of the sale value
Sugar cane	\$0.00	-	-	70 c/t	70 c/t



20. Levy and charge rates, Australian Government Department of Agriculture, Water and the Environment. Accessed online 25 September 2020 www.agriculture.gov.au/ag-farm-food/levies/rates#horticulture



Current surveillance in Northern Australia

Plant industries

Most plant industries are members of Plant Health Australia (PHA) and signatories to the Emergency Plant Pest Response Deed (EPPRD). The EPPRD is a legally binding document that provides a framework that allows shared decision making between the Australian Government, state and territory governments, plant industries and PHA to determine the most appropriate response to detections of new pests. Most plant industries also have biosecurity plans which describe the biosecurity system and contain implementation plans that are beginning to outline specific surveillance goals. The following summaries for each industry contain brief descriptions of significant activities associated with biosecurity surveillance.

Sugar, cotton, grains and rice

Sugar, cotton and grains industries coordinate much of their biosecurity preparedness activities through their respective research organisations: Sugar Research Australia (SRA), Cotton Research and Development Corporation (CRDC) and Grains Research and Development Corporation (GRDC). These large plant industries have significant levy generated resources that can be directed towards biosecurity preparedness and, where appropriate, pest and disease surveillance.

Sugar

The Australian sugar industry has a long history of proactive surveillance and biosecurity research investment in northern Australia (Queensland) and in neighbouring Pacific and Asian countries. In many cases it has been conducted in partnership with governments or counterpart organisations overseas. Most sugar industry biosecurity threats are managed through a combination of overseas collaboration, plant breeding research, and restrictions on movement of machinery and plant material between Australian growing regions. As there is a suite of specific plant biosecurity threats that may arrive through the Torres Strait in Queensland, the industry works closely with the Northern Australia Quarantine Strategy (NAQS) to ensure appropriate surveillance occurs. SRA delivers training to industry staff for awareness of endemic and exotic pests and diseases which forms part of the industries general surveillance strategy. Particular pest and disease surveillance activities are also conducted as needed and usually done in partnership with the Queensland Government.

Cotton

In the cotton industry, structured pest and disease surveillance occurs within established cotton production regions in NSW and Queensland. Pest surveillance is typically delivered by agronomists with bi-weekly frequency during the growing season. Disease surveys are conducted in each region twice per season by pathologist and regional cotton extension officers. These activities are sustained in partnerships between the industry and two state governments. Similar capacity for structured surveillance is not yet established for emerging cotton crops in Kununurra in NT or north Queensland. Industry funded research has examined the distribution of cotton viruses in northern Australia and neighbouring countries and included structured surveillance of cotton and important hosts related to cotton.

Grains

While there is limited grain production in northern Australia and little requirement for structured surveillance, with the recent emergence of commercial maize crops in Kununurra, and specific counter-seasonal production of grain for seed for southern Australia, there is a need to consider future specific surveillance requirements. General surveillance is supported by industry research projects through the Cooperative Research Centre for Developing Northern Australia (CRCNA) and the Northern Australia Crop Research Alliance.

Rice

There is no significant commercial rice production in northern Australia, however, two native species of rice are widespread. Pest and disease surveillance of wild rice has been conducted by NAQS during the past decade. A suite of native pests and diseases exist on wild rice and, being poorly understood, may be threats to future northern rice production. The abundant presence of wild rice also represents significant susceptibility to the establishment of exotic threats. Current CRCNA and the Department of Agriculture, Water and the Environment investments include assessment of rice industry potential in northern Australia.

Horticultural industries

The horticultural tropical plant industries, except the smaller tropical fruit industries who do not have representative organisations or pay levies, rely on Hort Innovation for most of their biosecurity preparedness investment. Hort Innovation constructs strategic investment plans for all levy paying horticultural industries and these include biosecurity goals appropriate to each. Some have strong biosecurity focus and investments, and a few include surveillance activities.

Many of these industries have not conducted targeted biosecurity surveillance until recently and, within northern Australia, structured surveillance often only occurs when a research project specifically includes a surveillance component. Further detail is provided in the following sections.

Avocados

The avocado industry invests in structured surveillance for avocado sunblotch viroid with surveys in Sunraysia, south-east Queensland, and the Atherton Tableland. The industry also partners with University of Queensland in the development of contemporary diagnostic capability for a range of other biosecurity threats. Some avocado nurseries are accredited under the Avocado Nursery Voluntary Accreditation Scheme, managed by Avocados Australia. The scheme involves sourcing clean planting material, regular nursery surveillance and testing new planting material for diseases such as phytophthora. Area freedom from Queensland fruit fly is important for growers in WA and this status is maintained through fruit fly trapping surveillance conducted by the Department of Primary Industries and Regional Development (DPIRD). The industry has also invested in preparedness for laurel wilt, a devastating fungal disease affecting avocados in other parts of the world. This is a threat that is heavily linked to urban pathways, and effort has focused on surveillance trapping design and diagnostic capability for the fungus. Avocados Australia provides biosecurity information to growers, including pest and disease awareness, through its Best Practice Resource, providing support for general surveillance and reporting.

Bananas

Structured surveillance occurs for three biosecurity diseases within the banana industry. Banana bunchy top is the most devastating viral disease affecting bananas globally but has been contained to south-east Queensland and northern NSW through an ongoing surveillance and management program. Yellow Sigatoka is an established disease and a significant production constraint especially in the wet tropics where most of the industry is located. A surveillance and management program operates in north Queensland to assist growers manage the disease and keep disease incidence below recommended levels. Panama disease tropical race 4 is currently under containment in north Queensland and a program of surveillance for early detection and destruction is underway to slow its spread and buy time for the industry to find long-term solutions. The Panama TR4 Program, initially delivered by the Department of Agriculture and Fisheries, Queensland is now being transitioned across to a sustainable model in partnership with the banana industry. Collection of data associated with the three programs is coordinated by specifically designed software

applications and used by the peak body, Australian Banana Growers Council. The banana industry has a strong focus on biosecurity and its activities include improving biosecurity assurance within the nursery supply chain, grower pest and disease awareness and best management practice extension, investment in improved molecular diagnostics, and disease resistance plant breeding programs. The industry is aware of biosecurity risks associated with urban pathways and the Bunchy Top Program, yellow Sigatoka surveillance program and management of nursery supply chain involve significant urban components.

Citrus

The citrus industry has a strong focus on biosecurity and business objectives centre on surveillance for a number of key threats. The industry body, Citrus Australia, employs a National Citrus Surveillance Coordinator and is currently investing in structured surveillance programs. Businesses exporting to Korea, China and Thailand deliver specific surveillance as a market access requirement and the industry also incorporates other exotic plant pests within that surveillance program. The Korea, China and Thailand protocol surveillance, which covers about 50 per cent of the national citrus crop, is delivered by certified crop scouts and audited by participating exporters. In northern Australia, the industry has partnered with NAQS and the three governments to deliver a series of intensive production property surveys over recent years. These surveys were delivered by surveillance scientists and focused on demonstrating absence of key industry threats in Kununurra, Darwin and the Atherton Tableland growing regions. The industry also invests in professional linkages with overseas citrus industries and recently conducted a study tour in the United States. Objectives included improved understanding of the threats posed by citrus canker and HLB (huanglongbing, citrus greening disease), how the California and Florida industries are responding, and to ensure Australian industry and agencies are prepared for an incursion. Citrus Australia provides pest and disease awareness to its grower members which supports general surveillance and reporting. The industry invests in a range of research and some of this aids future surveillance capability. Two of three separate projects utilising remote sensing have direct surveillance benefits and these include capability to detect urban host trees and ability to map production areas. Investments also include collaboration with PHA and Agriculture Victoria in a pilot phase of an urban community garden surveillance project, and an Australian Centre for International Agricultural Research project working in Indonesia and China on HLB and its vector the Asian citrus psyllid (ACP) with the objectives to evaluate the performance of HLB tolerant germplasm, develop

novel ACP management techniques, understand the factors that influence ACP/HLB distribution, and improve the capacity of farmers to manage HLB/ACP on farm.

Mangoes

The Australian Mango Industry Association (AMIA) recently initiated structured surveillance within selected packing sheds and orchards across production regions in northern Australia. The program was initially funded through the Department of Agriculture, Water and the Environment and is being transitioned towards a sustainable industry funding model. It is delivered by industry development officers and targets a range of key industry threats including both established and exotic pests and diseases. Some businesses within the industry are also conducting structured surveillance for export market access and for access into restricted domestic markets (e.g. mango cutting to demonstrate freedom from mango seed weevil (*Sternochetus mangiferae*) for access to WA).

Melons

The Australian Melon Association (AMA) is currently undertaking a two-year project to review its biosecurity threats and capability and a coordinated approach to future industry surveillance is expected to come from this process. Melon growers and the AMA have recently invested in assurance mechanisms and improved product traceability after a biosecurity response to cucumber green mottle mosaic virus (CGMMV) and a serious food safety response. There is not currently structured pest and disease surveillance for exotics being conducted, however, extensive surveillance has been conducted with state governments to delimit CGMMV and prove freedom in particular growing regions. While one sixth of national production is exported, New Zealand is the only export market where surveillance data are required. New Zealand exports are occurring from Queensland and southern growing regions only and grower led surveillance is focused on demonstrating absence of CGMMV. NSW Department of Primary Industries provides surveillance training and a laboratory diagnostic service to support this activity. The AMA supports general surveillance outcomes through digital biosecurity content that includes pest and disease information. This is provided directly to growers through USB data sticks.

Production nurseries

There is no structured surveillance by production nurseries occurring within the nursery industry in northern Australia aside from a varying level of crop pest monitoring and on occasions, targeted surveillance by NAQS. The industry

body, Greenlife Industry Australia (GIA), developed surveillance components within the procedures of the BioSecure HACCP plant protection/biosecurity program which builds upon the best management practice elements under the Nursery Industry Accreditation Scheme Australia (NIASA). GIA has been partnering with other horticulture sectors to build specific criteria into NIASA to improve nursery stock production of avocados, bananas, macadamias and strawberries with future opportunities in citrus and grapevine production nurseries. BioSecure HACCP is the only non-government market access program legally approved for the issuing of BioSecure HACCP Biosecurity Certificates for the cross-border trade in nursery stock. The system allows growers to self-certify their nursery stock consignments in compliance with interstate plant entry conditions. The entire scheme is managed via a web-based platform, Audit Management System (AMS), which requires growers to upload plant protection/biosecurity records (e.g. crop monitoring, site surveillance) through digitised record templates that provide databased information that can be interrogated. This platform could support general surveillance reporting outcomes with GIA undertaking a current project to allow for a digitised grower template, for field use (tablets, smartphones), to connect to the national surveillance database AUSPestCheck™. Production nurseries in other parts of Australia have begun to utilise the BioSecure HACCP system and GIA is currently working with the industry in the NT, Queensland and WA to achieve adoption within northern businesses. GIA also provides pest and disease awareness material to industry members, including a pest, disease and weed identification platform (pestid.com.au) which is a 'live' web-based resource constantly being updated with information, including EPPs, and can be immediately updated with information on any new incursion. GIA and its members have the highest level and frequency of involvement in emergency response activities and the associated surveillance, including ongoing market access protocols that offer an ad hoc form of surveillance. Unlike most plant industries that have infrequent emergency pest detections, production nurseries are involved in the supply chain for most plant cropping systems hence their involvement in the bulk of the pest and disease detections and responses across all jurisdictions. This pivotal role in the system requires improvement in surveillance capability and efficiencies to affect a more resilient national biosecurity system.

Vegetables

The vegetable industry is currently investing heavily through the Hort Innovation funded VG16086 'Area wide management of vegetable diseases: viruses and bacteria project'. It is a national program and includes surveillance delivery from most state and territory governments (excluding SA and the ACT). The industry is also investing



through Hort innovation to support jurisdictional delivery of surveillance for tomato potato psyllid and its vectored bacteria that causes the disease zebra chip. Industry growers in Darwin and Carnarvon are working with NT Farmers Association (NT Farmers), NT Department of Primary Industry and NAQS to conduct surveillance for a range of pests and diseases. The industry body, AUSVEG, is also active in promoting grower awareness of important pests and diseases. This includes exotic threats as well as those spreading within the country.

Other horticultural industries and crops

Other plant industries do not currently invest in structured surveillance programs: however, many invest in general surveillance and encourage reporting by promoting awareness of key pest and disease threats through industry communication material. Similarly, awareness for some of those threats is increased through PHA and government communications. Increased awareness within industries and the broader community increases the likelihood of early detection and is an important component of general surveillance and an effective biosecurity system.

Governments

The four government jurisdictions, associated with biosecurity in northern Australia, include the Australian Government Department of Agriculture, Water and Environment (DAWE), the NT Department of Primary and Resources (DPIR), the WA Department of Primary Industries and Regional Development (DPIRD) and the Department of Primary Industries and Fisheries Queensland (DAFQ), all employ specific surveillance staff who conduct surveillance and or diagnostics. The role of surveillance practitioners differs slightly between governments and is largely driven by their broader departmental responsibilities. Australian Government staff are mostly focused on surveillance for exotics, while state and territory staff focus on a broader range of threats, including emergency response delimitation surveillance and proving area freedom. The following paragraphs summarise some of the surveillance activities within each government. Each jurisdiction has specific surveillance needs and the DAWE works across the whole northern region, particularly NAQS. The way in which Australian Government activity integrates with state and territory activity is very important. Achieving appropriate coordination is one of the key drivers for developing this strategy and a collaborative approach. In addition to structured surveillance, all governments are supporting general surveillance and encouraging reporting through a range of communication channels.

Western Australia

The DPIRD in WA conducts proactive structured surveillance for early detection of a range of pests and diseases. These efforts include surveillance for key national priority pests which is funded by the DAWE. Most effort is focused on southern WA; however, some surveillance is conducted in the Kimberly region, particularly Broome and Kununurra. Fruit flies are the primary surveillance target in these areas. In addition to structured early detection surveillance, DPIRD conducts surveillance to support emergency response activities. In recent years these have included CGMMV, tomato potato psyllid and citrus canker. In Kununurra, surveillance for citrus canker was comprehensive and resulted in confirmation of host locations in both production and urban areas. DPIRD staff work collaboratively with NAQS staff to deliver bi-annual pest and disease surveys on commercial production properties in Kununurra. These surveys generally focus on early detection of exotic pests, and pests affecting interstate trade at the time.

DPIRD has also invested heavily in supporting general surveillance data collection through development of a mobile device application. The MyPestGuide™ app has been particularly successful in generating surveillance data within urban environments in and around Perth, and it has important future utility in northern Australia.

Northern Territory

The NT Government delivers early detection surveillance for a similar suite of national priority pests to that in WA. It also conducts surveillance to support emergency response activities. In addition to those mentioned above for WA, banana freckle was a significant recent eradication program in the NT. The NT Department of Primary Industry and Resources is working closely with NT Farmers to build trusted partnerships with growers. A current focus is building relationships and providing extension support to non-English speaking vegetable growers in the Darwin region. Both organisations are partnering with NAQS to deliver farm surveillance activities supporting vegetable growers.

Queensland

Department of Agriculture and Fisheries, Queensland (DAFQ), through Biosecurity Queensland (BQ), delivers structured pest surveillance in response to similar drivers as for the other jurisdictions. Surveys are conducted in agricultural, urban and peri-urban areas based on proximity to high-risk pathways of pest entry and establishment, volume of host plants/commodities produced, the biology of the pest being targeted, and interstate and international market access requirements. Standardised methodologies are used by trained plant health inspectors to undertake the surveys.

Most surveillance is undertaken in eastern Queensland near major production areas including in north Queensland. BQ and NAQS work in partnership under the nationally cost-shared Exotic Fruit Flies in Torres Strait Eradication Program, to manage the seasonally active fruit fly pathway into Torres Strait. Surveillance for this program is delivered predominantly by NAQS, while management of the program and delivery of key response components are delivered by BQ. BQ also maintains a comprehensive fruit fly trapping network with many sites in north Queensland. Many DAFQ research and extension scientists deliver surveillance within particular industries, however, the data is not always captured within the BQ system.

Australian Government

The Australian Government delivers a number of surveillance programs and funds components of surveillance programs by state and territory jurisdictions in northern Australia. Some of these programs have been mentioned above. Australian Government delivered surveillance programs include:

- Early warning surveillance in neighbouring countries through the International Plant Health Surveillance Program aims to confirm the pest status in neighbouring countries for key industry threats.
- Early detection surveillance in northern Australia through NAQS aims to detect exotic pests that have entered northern Australia via movement in Torres Strait and wind pathways.
- Early detection surveillance at international borders through the National Border Surveillance Program aims to detect exotic pests that have recently established in association with approved import premises in the major ports and cities.

At a national level, DAWE is working with a range of partners to explore and implement mechanisms and programs to achieve improved surveillance in urban areas. These environments have diverse, and often abundant, hosts which act as receptive reservoirs for the establishment of the many pests that could enter urban areas through international passengers, mail and cargo.

Other surveillance components

Plant Health Australia

PHA, assisted by funding from DAWE, is developing a network of surveillance sites at botanic gardens and a coordinated surveillance program. It focuses on key exotic pests and major threats already in the country, such as myrtle rust. Sentinel surveillance concepts like this are important features of developing surveillance capability in urban areas.

Grower associations and organisations

Important coordination roles are played by grower associations and this often includes working with growers to facilitate surveillance across production regions. In northern Australia there are several key groups including Ord River District Co-operative Ltd (ORDCO), NT Farmers, Far North Queensland Growers, Bowen Gumlu Growers Association, Nursery and Garden Industry Queensland and Nursery and Garden Industry WA.

Research programs

The iMAPpests research project is a significant investment by plant industry R&D corporations and governments. It is currently in progress and aims to develop mobile capability for trapping wind-borne insects and pathogens. It has potential to improve the ability to detect biosecurity risks prior to their establishment and to support long-term intelligence regarding the transient local prevalence of pests established or endemic in Australia.



Progress to improve surveillance in Northern Australia

There has been considerable reform achieved within the Australian biosecurity system in recent years. This has been driven within the government through the National Biosecurity Committee and, for plant surveillance, the Plant Health Committee. Within industry, individual PIBs have invested in biosecurity research to improve preparedness and in surveillance capability through staff and on-farm activity. These investments are increasing the resilience of industries to the impacts of pests. In addition to these ongoing improvements, significant investment occurred through the Australian Government's Agricultural Competitiveness White Paper and the White Paper on Developing Northern Australia. The following information summarises some of these improvements that collectively have taken us closer to the surveillance capability required to effectively protect plant industries in northern Australia.

Industry investments

Larger plant industries have significant investment in biosecurity and relevant surveillance. They also conduct regular workshops where surveillance planning occurs. The melon industry recently ran a biosecurity planning workshop that included surveillance components. Many smaller industries are also now employing staff, directly or indirectly through research funding, to provide surveillance capability within their biosecurity investments. For example, Citrus Australia has employed a national citrus surveillance coordinator and is investing in a number of programs. Similarly, the Australian Mango Industry Association (AMIA) recently employed two industry development officers who deliver a surveillance program for key industry threats. The nursery industry has consistently invested in biosecurity focused staff (currently six staff across Australia) and has recently worked towards increasing the uptake of biosecurity surveillance principles into businesses.

A number of plant industries within Australia have begun to organise property level surveillance data for the purpose of export certification. The original industry to do so was the table grape industry through the Australian Table Grape Association (ATGA). DAWE assisted ATGA to develop software that managed various data associated with export requirements. While the data is not currently analysed by ATGA or DAWE for the purpose of determining particular regional pest status, it has significant potential

for this purpose. Other plant industries who have export components to their profile are considering the power of such export data and its utility for biosecurity surveillance.

A number of PIBs have been running workshops for growers that include pest information and surveillance skills. Recent examples include a series of workshops run by AUSVEG, seven workshops run by Greenlife Industry Australia (GIA), and a large workshop facilitated by Citrus Australia.

State and territory investments

DAFQ have made significant investment in the Cape York Biosecurity Centre located at Coen in southern Cape York. This centre is strategically located on the primary arterial road on Cape York Peninsula and on the southern border of the Far Northern Biosecurity Zone where it serves to both educate travellers and regulate southward movement of regulated plant pest carriers. It is critical for impeding the movement of plant pests from the Northern Peninsula Area and the Torres Strait to mainland production areas.

DAFQ, DAWE and local government in the Torres Strait and Northern Peninsula Area of Cape York have developed a regional biosecurity strategy based on a collaborative approach of inclusive management for addressing future biosecurity issues, surveillance and emergency responses.

DAFQ have provided funding for 2019–22 to improve biosecurity surveillance and response capability and capacity in the Torres Strait and Northern Peninsula Area. DAFQ now has a Director, Far Northern Biosecurity, to concentrate on rolling out the Far Northern Biosecurity Initiative, and a senior officer is now based on Thursday Island. Funding will be provided to each local government to employ a biosecurity 'trainee' to deliver a range of surveillance activities, including plant health. DAFQ have also commenced close collaboration with Torres Strait Regional Authority rangers to proactively block exotic fruit fly in the outer islands. Lastly, DAFQ will be investing in communication products and techniques in this region to enhance passive surveillance and community pest reporting.

NTDPIR has made several significant investments to improve surveillance. A systematic review of risk pathways and threats to the plant industries operating in the NT has been conducted and surveillance business will be aligned against risk. The department is supporting growers and industry bodies through a range of projects including a large capital works program, with assistance from DAWE, to construct enhanced diagnostic laboratories in Darwin.

In WA, DPIRD has invested in development of a Regional Biosecurity Plan for the Ord River Irrigation Area. This will involve all regional stakeholders and its many components will include surveillance activities. DPIRD has also invested in the region through appointment of an agricultural entomologist to be based in Kununurra.

Australian Government investments

The Australian Government, through the Subcommittee for National Plant Health Surveillance, has invested in the development of a website to facilitate dissemination of surveillance information, manuals, guides and protocols. The website, Plant Surveillance Network Australasia-Pacific (PSNAP, plantsurveillancenetwork.net.au) represents a platform to improve communication and access to information across the entire surveillance community.

Through the Agricultural Competitiveness White Paper, DAWE has invested in a number of projects to strengthen implementation of a reform agenda for the national plant biosecurity surveillance system policy framework. These include development of prioritisation and design policies, processes and associated documents to better guide surveillance programs to align with highest risks, decision tools to assist in determining which threats warrant surveillance and mechanisms to measure the associated benefits of surveillance activities, and review of the National Priority Plant Pests. These initiatives will improve the surveillance evidence used by stakeholders to manage biosecurity, including in relation to preparedness, business productivity and market access.

GIA and NTDPIR are collaborating in a project designed to assist several key production nurseries across northern Australia adopt improved biosecurity systems. The nursery industry's BioSecure HACCP program is a best practice business system designed to integrate pest management and pest surveillance (amongst other objectives) into business operating models. Improving the ability to detect and manage plant industry biosecurity threats within the nursery supply chain crossover between urban and production areas is a critical capability for the future.

A pilot study examined the utility of small drones for remote sensing of host trees in urban areas. Whilst the study demonstrated it was not a viable solution for determining presence of hosts, the concept was the basis for a larger investment that has now been funded and initiated through Hort Innovation. This work is in progress and will generate algorithms and software capability to find host citrus trees within urban environments.

The resolution of this surveillance is expected to be at the single tree level. This exciting project has potential to significantly change urban surveillance planning and analysis and could also be scaled across to other key plant hosts.

A project run by AMIA developed the capability for pest surveillance by inspecting fruit in mango packing sheds. The surveillance targets included established and exotic pests. In the second year of the project surveillance activity was extended to include orchard observations. AMIA has also developed a mobile device application allowing data capture in the field and ensuring appropriate data standards are met. The surveillance is delivered by AMIA staff and a sustainable funding model is being pursued.

A partnership project, led by NT Farmers and including NTDPIR and NAQS, focuses on working with non-English speaking vegetable producers in the NT. A close-knit community of Vietnamese and Cambodian vegetable producers operate within the peri-urban environment bordering Darwin. As a result of language barriers, this group is relatively unaware of biosecurity issues, threats and practices to manage them. NT Farmers and NTDPIR worked very closely with these growers in responding to the detection of CGMMV. These interactions and support activities were successful in raising awareness, building trust, and containing the spread of the disease.

PHA, with assistance from DAFQ, NTDPIR and NT Farmers, is leading a project to profile tropical fruit industries. The diverse array of tropical fruits produced in northern Australia is not well understood or documented. No representative organisations exist, and limited support investment occurs. The markets in which produce is sold, the communication networks between growers, the scale and geographic identity of this industry is poorly understood. There is also a diverse array of pests associated with these crops, many of which threaten other plant industries. Understanding this industry, and supporting biosecurity practice, is important for future outcomes.

Through a collective of the three northern governments, the Australian Government, PHA and Animal Health Australia, an agreement was made to invest in common branding that embodied the concept of a collective approach to biosecurity in northern Australia. The shared artistic logo has no organisational identity and can be used freely by any party to communicate the principles of a shared approach to biosecurity.

Terms and abbreviations

TERM or ABBREVIATION	DEFINITION
Biosecurity community	A description of the people who are involved in biosecurity, either directly or indirectly. This community comprises a wide cross section of the general community including owners and staff of plant production businesses (e.g. farms, nurseries, logistics partners, markets, retail), industry representatives, department of agriculture or primary industry staff, researchers, environment managers and community members who grow plants in urban and peri-urban environments.
BQ	Biosecurity Queensland, part of DAFQ responsible for biosecurity.
DAFQ	Department of Agriculture and Fisheries, Queensland.
DAWE	Department of Agriculture, Water and Environment.
EPP(s)	<p>Emergency Plant Pest(s) are defined within the EPPRD as those that meet one or more of the following criteria:</p> <ul style="list-style-type: none"> ▪ known exotic plant pest, the economic consequences of an incident of which would be economically or otherwise harmful for Australia, and for which it is considered to be in the regional or national interest to be free of the plant pest ▪ variant form of an established plant pest which can be distinguished by appropriate investigative and diagnostic methods, and which if established in Australia, would have a regional or national impact ▪ serious plant pest of unknown or uncertain origin which may, on the evidence available at the time, be an entirely new plant pest, and which if established in Australia would have an adverse economic impact regionally and or nationally ▪ plant pest already found in Australia that: <ol style="list-style-type: none"> i. is restricted to a defined area through the use of regulatory measures intended to prevent further spread of the pest out of the defined area or into an endangered area; and ii. has been detected outside the defined area; and iii. is not a native of Australia; and iv. is not the subject of any instrument for management which is agreed to be effective risk mitigation and management at a national level; and v. is considered likely to have an adverse economic impact such that an emergency response is required to prevent an incident of regional and national importance.
EPPRD	Emergency Plant Pest Response Deed. A formal legally binding agreement between PHA, the Australian Government, all state and territory governments and national plant industry body signatories. It covers the management and funding of responses to Emergency Plant Pest incidents.
Endemic pest	A pest which is native to Australia.
Established pest	A pest that is perpetuated for the foreseeable future, within any area and where it is not feasible (whether in terms of technical feasibility or a benefit–cost analysis) to eradicate.
Exotic pest	A plant pest which is not normally found in Australia.
First reporter	The first person/business to report a pest, which is subsequently identified as an exotic pest which may require a management/eradication response.
General surveillance	A process whereby information on particular pests of concern in an area is gathered from many sources.
High Priority Pest (HPP)	A plant pest that has been identified to have one of the highest potential impacts to a particular plant industry and is listed in a biosecurity plan or in Schedule 13 of the EPPRD. An outcome of a prioritisation process.
NAQS	Northern Australia Quarantine Strategy.

TERM or ABBREVIATION	DEFINITION
National Surveillance Protocol	A document recognised nationally which contains the key information about how to conduct surveillance for a pest in different situations.
NMDS	National Minimum Dataset Specification.
Northern Australia	For the purposes of the TPIBSSIP, northern Australia is defined as the part of Australia north of the Tropic of Capricorn in WA and Queensland, and all of the NT.
NTDITT	Northern Territory Department of Industry, Tourism and Trade.
Plant Health Australia (PHA)	The national coordinator of the government–industry partnership for plant biosecurity in Australia.
Plant industries	Industries that produce agriculture, horticulture, forestry and amenity plants and plant products.
Peak industry body (PIB)	Peak industry bodies are recognised by the Australian Government as being the representative body for a specific industry. Most are signatories to the EPPRD.
Pest	The term pest includes insects, mites, snails, nematodes, or pathogens (diseases) that have the potential to adversely affect food, fibre, ornamental crops, bees, and stored products, as well as environmental flora and fauna.
Surveillance strategy principles	<p>The TPIBSS is principle-based, which includes:</p> <ul style="list-style-type: none"> ▪ surveillance undertaken with a collaborative approach to data sharing and analysis ▪ surveillance undertaken to agreed national standards ▪ data sharing in accordance to pre-agreed parameters ▪ confidentiality of data maintained within pre-agreed guidelines between all parties ▪ agreed collaborative arrangements ▪ agreed conflict resolution processes.
R&D	Research and development.
Regulated pathway	A pathway which or from which plants, plant products and other regulated articles are subjected to phytosanitary measures.
SPHD	Subcommittee on Plant Health Diagnostics. It aims to sustain and improve the quality and reliability of plant pest diagnostics in Australia.
SNPHS	Subcommittee on National Plant Health Surveillance. The principal focus is to maintain and improve Australia’s plant health surveillance capacity and capability in support of the economy, environment and community.
Specific surveillance	A surveillance activity conducted over a defined period of time that records the detection of, or confirms the absence of, specific pests.
Surveillance	Processes which collect and record data on pest occurrence or absence by survey, monitoring or other procedures.
TPIBSS	Tropical Plant Industries Biosecurity Surveillance Strategy.
Tropical plant industries	Tropical plant industries include those with substantial production in northern Australia, such as avocados, bananas, citrus, lychees, mangoes, melons, papaya, passionfruit and sugarcane.
WA DPIRD	WA Department of Primary Industries and Regional Development.



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