Biosecurity Plan
for the Papaya Industry

A shared responsibility between government and industry

Version 2.4 November 2024

Plant Health AUSTRALIA

Hort Innovation
Strategic levy investment

PAPAYA FUND

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Revision history

VERSION NUMBER	DATE	DETAILS
2.0	October 2021	Biosecurity Plan for the Papaya Industry
2.1	July 2022	Biosecurity Plan for the Papaya Industry (updated following BRP meeting #1)
2.2	June 2023	Biosecurity Plan for the Papaya Industry (updated following BRP meeting #2)
2.3	May 2024	Biosecurity Plan for the Papaya Industry (updated following BRP meeting #3)
2.4	November 2024	Biosecurity Plan for the Papaya Industry (updated following BRP meeting #4)

Acknowledgements

The *Biosecurity Plan for the Papaya Industry* project was coordinated by Plant Health Australia and developed through a partnership approach with government and industry.

The following organisations and agencies were involved in the development and finalisation of the plan.

Endorsement

The *Biosecurity Plan for the Papaya Industry (Version 2.0)* was formally endorsed by the Papaya industry (through the Papaya Australia in October 2021, and all state and territory governments (through the Plant Health Committee) in November 2021.

The Australian Government endorses the document without prejudice for the purposes of industry's planning needs and meeting the Department's obligations under Clause 13 of the EPPRD. In providing this endorsement the Department notes page 31 of the Plan which states: "This Document considers all potential pathways by which a pest might enter Australia, including natural and assisted spread (including smuggling). This is a broader view of potential risk than the Biosecurity Import Risk Assessment (BIRA) conducted by the Department of Agriculture, Forestry and Fisheries which focus only on specific regulated import pathways."

Reporting suspect pests

Any unusual plant pest should be reported immediately to the relevant state/territory agriculture department through the Exotic Plant Pest Hotline (1800 084 881). Early reporting enhances the chance of effective control and eradication.

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LIST OF ACRONYMS

ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
ACIAR	Australian Centre for International Agricultural Research
ACPPO	Australian Chief Plant Protection Officer
AgVic	Agriculture Victoria
ALGA	Australian Lychee Growers Association
APC	AUSPest*Check*®
APVMA	Australian Pesticides and Veterinary Medicines Authority
AS/NZS	Australian Standard/New Zealand Standard
BICON	Australian Biosecurity Import Conditions Database
BIRA	Biosecurity Import Risk Analysis
BISOP	Biosecurity Incident Standard Operating Procedure
BRP	Biosecurity Reference Panel
BMP	Best Management Practise
BOLT	Biosecurity On-Line Training
BP	Biosecurity Plan
CABI	Centre for Agriculture and Bioscience International
CCEPP	Consultative Committee on Emergency Plant Pests
CPHM	Chief Plant Health Manager
DAF NT	Department of Agriculture and Fisheries, Northern Territory
DAF Qld	Department of Agriculture and Fisheries, Queensland
DAFF	Department of Agriculture, Fisheries and Forestry
DAWE	Department of Agriculture, Water and the Environment (now DAFF)
DEECA	Department of Energy, Environment and Climate Action, Victoria
DITT NT	Department of Industry, Tourism and Trade, Northern Territory (now DAF NT)
DPI NSW	Department of Primary Industries, New South Wales
DPIRD	Department of Primary Industries and Regional Development, WA
EPP	Emergency Plant Pest
EPPO	European and Mediterranean Plant Protection Organization
EPPRD	Emergency Plant Pest Response Deed
FAO	Food and Agriculture Organization of the United Nations
HACCP	Hazard Analysis Critical Control Point
HPP	High Priority Pest
ICA	Interstate Certification Assurance
IGAB	Intergovernmental Agreement on Biosecurity
ILO	Industry Liaison Officer
IPM	Integrated Pest Management
IPPC	International Plant Protection Convention
ISPM	International Standards for Phytosanitary Measures
LLC	Local Control Centres
MICoR	Manual of Importing Country Requirements
NAQS	Northern Australian Quarantine Strategy

NDP	National Diagnostic Protocol
NMG	National Management Group
NPBDN	National Plant Biosecurity Diagnostic Network
NPBS	National Plant Biosecurity Strategy
NPPP	National Priority Plant Pest
NSP	National Surveillance Protocol
NSW	New South Wales
NRE Tas	Department of Natural Resources and Environment, Tasmania
NT	Northern Territory
ORC	Owner Reimbursement Costs
PA	Papaya Australia
PAI	Passionfruit Australia Inc
PaDIL	Pest and Disease Image Library
PBRI	Plant Biosecurity Research Initiative
PHA	Plant Health Australia
PHC	Plant Health Committee
PIC	Property Identification Code
PIRSA	Primary Industries and Regions South Australia
PPIM	Plant Property Identification Model
QA	Quality Assurance
R&D	Research and Development
RDC	Research and Development Corporation
RD&E	Research, Development and Extension
SA	South Australia
SARDI	South Australian Research and Development Institute
SCC	State Coordination Centres
SDQMA	Subcommittee for Domestic Quarantine and Market Access (now SMART)
SMART	Subcommittee on Market Access, Risk and Trade
SNPHS	Subcommittee for Plant Health Surveillance
SPHD	Subcommittee on Plant Health Diagnostics
SPS	Sanitary and Phytosanitary
T2M	Transition to Management
TBA	To be announced
TRP	Technical Review Panel
TST	Threat Summary Table
WA	Western Australia
WTO	World Trade Organization

DEFINITIONS

The definition of a plant pest used in this document includes insects, mites, snails, or diseases (pathogens, including nematodes) that have the potential to adversely affect food, fibre, ornamental crops, bees and stored products, as well as environmental flora and fauna. Exotic pests are those not currently present in Australia. Endemic pests are those that are not native but established within Australia.

Emergency Plant Pest (EPP) – for a pest to be classified as an emergency plant pest (EPP), it must either be listed in Schedule 13 of the EPPRD[1], or be determined by the Categorisation Group or National Management Group (NMG) to be of potential national significance and meet at least one of the criteria below:

- a known exotic pest
- a variant form of an established plant pest
- a previously unknown pest
- a confined or contained pest.

High Priority Pest (HPP) – an exotic plant pest identified as one of the greatest pest threats to one or more plant production industries. A HPP must have a High or Extreme overall rating through the Biosecurity Planning process. For more information on risk ratings please refer to page 30.

[1] https://www.planthealthaustralia.com.au/response-arrangements/emergency-plant-pest-response-deed-epprd/

EXECUTIVE SUMMARY

To ensure their future viability and sustainability, it is important that the Australian Papaya Industry, represented by the Papaya Australia as the peak industry body, minimise the risks posed by exotic pests and respond effectively to plant pest threats. This biosecurity plan is a framework to coordinate biosecurity activities and investment for the Australian Papaya Industry. It provides a mechanism for industry, Australian Commonwealth, State and Territory governments, and relevant stakeholders (referred to as key stakeholders throughout the remainder of this biosecurity plan) to better prepare for and respond to, incursions of pests that could have significant impacts on these industries. It identifies and prioritises exotic plant pests (not currently present in Australia) and other pests of biosecurity concern and focuses on future biosecurity challenges.

The Biosecurity Plan for the Papaya Industry (this biosecurity plan) was developed in concert with the development of biosecurity plans for the Australian Lychee and Australian Passionfruit Industries. Facilitated by Plant Health Australia (PHA) and involving the collaboration of plant health and biosecurity experts from relevant Commonwealth, State and Territory agriculture agencies, and representatives from the Australian Lychee Growers Association (ALGA), Papaya Australia and Passionfruit Australia. These parties will be referred to as key stakeholders in the remainder of this document.

Key stakeholders were represented in the Technical Expert Group (TEG) and Biosecurity Implementation Group (BIG) and these groups provided advice in the development of the three Biosecurity Plans (Lychee Biosecurity Plan, Papaya Biosecurity Plan, Passionfruit Biosecurity Plan).

A key part of the biosecurity planning process was the development of combined Threat Summary Tables (TST) for all three industries (Table *1*). Containing over 120 exotic plant pests, these tables demonstrate the potential biosecurity threats faced by these industries. Each pest on the list was given an overall risk rating based on four criteria; entry potential, establishment potential, spread potential, and potential for economic impact. In this biosecurity plan, other pests of biosecurity significance for the papaya industry were also identified as good biosecurity practices benefit the ongoing management of and surveillance for these pests.

The Biosecurity Plan also details current mitigation and surveillance activities being undertaken and identifies contingency plans, fact sheets and diagnostic protocols that have been developed for pests relevant to the papaya industry. This enables identification of gaps and prioritisation of specific actions, as listed in the Biosecurity Implementation Table (Table 3; Table 4). The development of this table will increase the industry's biosecurity preparedness and response capability by outlining specific areas of action which could be undertaken through a government and industry partnership.

The Biosecurity Plan is principally designed for use by decision makers. It provides industry and government with a mechanism to identify exotic plant pests as well as to address the specific strengths and weaknesses of the Australian Papaya Industry's current biosecurity position. It is envisaged that annual reviews of this biosecurity plan will be undertaken to assess progress against agreed activities, with another formal review conducted after five years.

The Biosecurity Plan is a document outlining the commitment to the partnership between the key stakeholders to improve biosecurity.

SIGNIFICANT BIOSECURITY THREATS

Document overview

The Biosecurity Plan for the Australian Papaya Industry focuses on the following five key areas over the years 2021-2026 (i.e. the life of this Biosecurity Plan).

High priority exotic pests and other pests of biosecurity significance

A key outcome of this biosecurity plan is the identification of the exotic high priority pests, and other pests of biosecurity significance for the Australian Papaya industry. This section includes:

- the High Priority Pests (HPP), which are the most significant exotic threats affecting the Australian Papaya industry as identified through a prioritisation process; and
- the other pests of biosecurity significance, identified in consultation with the Australian Papaya industry.

The exotic HPP list and other pests of biosecurity significance will allow industry and government to better prioritise preparedness activities and will assist in the implementation of effective grower and community awareness campaigns, targeted biosecurity education and training programs for growers, development of surveillance programs, diagnostic protocols as well as development of pest-specific mitigation activity.

Implementing biosecurity for the Australian Papaya Industry 2021-2026

This section includes the biosecurity implementation plan and a gap analysis of the current level of preparedness for HPP of the Australian Papaya Industry. The Biosecurity Implementation Group (BIG), comprised of both industry and government representatives, developed the implementation plan that sets out shared biosecurity goals and objectives over the next five years. It is intended that the biosecurity implementation plan is revisited by the Biosecurity Reference Panel (BRP) regularly over the next five years to maintain its relevance. The TEG, the BIG and the BRP all contained representatives of the three industries as well as technical experts from Australian commonwealth, state and territory governments.

Threat identification and pest risk assessments

Guidelines are provided for the identification and ranking of biosecurity threats through a process of qualitative risk assessment. The primary goal is to coordinate identification of exotic pest threats that could impact productivity, or marketability. This plan strengthens risk assessment work already being done both interstate and overseas. All exotic biosecurity threats considered in this biosecurity plan are detailed in Threat Summary Tables (APPENDIX 2: THREAT SUMMARY TABLES). From the prioritisation process undertaken in the TST, pests with an overall rating of high were determined to be HPP (Table 1).

Risk mitigation and preparedness

This section provides a summary of activities to mitigate the impact of pest threats on the Australian Papaya industry, along with a set of guidelines for managing risk at all operational levels. Many pre-emptive practices can be adopted by plant industries and government agencies to reduce risks. The major themes covered include:

- Barrier quarantine
- Surveillance
- Training
- Awareness
- Farm biosecurity
- Reporting of suspect exotic pests

A summary of pest-specific information and preparedness documents, such as fact sheets, contingency plans and diagnostic protocols are also described to outline activities industry has undertaken to prepare for an exotic pest incursion. Information for industry on how to align preparedness activities with RD&E, such as researching integrated pest management (IPM) strategies, and chemical control are also provided.

Response management

This section provides a summary of the processes in place to respond to emergency plant pest (EPP)[2] incursions that would affect the Australian Papaya Industry. Areas covered in this section include the Emergency Plant Pest Response Deed (EPPRD), PLANTPLAN (outlines the generic approach in response management under the EPPRD), categorisation of pests under the EPPRD and industry specific response procedures and industry communication. Please note that Papaya Australia are not signatories to the EPPRD and therefore Papaya Australia my not have a 'formal' role in a response as outlined in the EPPRD and PLANTPLAN.

PESTS OF BIOSECURITY SIGNIFICANCE OVERVIEW

A key component of this biosecurity plan is to identify the exotic and other pests of biosecurity significance to the Australian Papaya Industry. This section provides information on the High Priority Pest (HPP) list, and the other pests of biosecurity significance for the Australian Papaya industry. These pest lists, provide the Australian Papaya Industry, commonwealth, state and territory governments, and other relevant stakeholders with the information needed to prioritise resources for biosecurity risk management.

The exotic HPP list and other pests of biosecurity significance will allow industry and government to better prioritise preparedness activities and will assist in the implementation of effective grower and community awareness campaigns, targeted biosecurity education and training programs for growers, development of surveillance programs, diagnostic protocols as well as development of pest-specific mitigation activities.

Established weeds of biosecurity significance were considered during the development of this plan. No weeds of biosecurity significance were identified for the Australian Papaya industry through consultation with government and industry.

[2] Refer to the PHA website for details http://www.planthealthaustralia.com.au/biosecurity/emergency-plant-pests/

Papaya industry high priority exotic pests

Table 1 provides an overview of the top ranked biosecurity pest threats (invertebrates, pathogens and nematodes) for the Australian Papaya Industry. Further details on each pest along with the basis for the likelihood ratings are provided on page 32. Assessments may change given more detailed research, and the priority list will be formally reviewed along with the Biosecurity Plan on an annual basis through the Biosecurity Reference Panel.

Table 1. Papaya industry High Priority Pest list.

Common name	Scientific name	Host(s)	Affected plant part	Movement and dispersal	Geographic distribution[3]	Entry potential	Est.[4] potential	Spread potential	Economic impact	Overall risk
Invertebrates										
Diptera (flies and midges)										
Carambola fruit fly	*Bactrocera carambolae*	Highly polyphagous (75 hosts from 26 families) including grapefruit, orange, lemon, lime, mandarin, cashew, breadfruit, jackfruit, carambola, capsicum, mango, guava, banana, avocado, tomato, mangrove, passionfruit	Fruit	Infested plant material (fruit). Adults capable of flight. Pupae are soilborne.	Asia (Brunei, India, Indonesia, Malaysia, Singapore, Thailand) South America (Brazil, French Guiana, Guyana, Suriname)	HIGH	HIGH	HIGH	HIGH	HIGH
Guava fruit fly	*Bactrocera correcta*	Polyphagous, including: cashew, carambola, Citrus spp., longan, mango, melon	Fruit		Asia (Bhutan, China, India, Japan, Myanmar, Nepal, Pakistan, Sri Lanka, Taiwan, Thailand) North America (United States)	HIGH	HIGH	HIGH	HIGH	HIGH
Oriental fruit fly	*Bactrocera dorsalis (Bactrocera invadens; Bactrocera papayae; Bactrocera philippinensis)*	Polyphagous, with wide host range including: cashew, soursop, breadfruit, jackfruit, bell pepper, chilli, citrus, watermelon, coffee, melon, cucumber, longan, persimmon, mangosteen, dragon fruit, mango, apple, banana, avocado, lychee, passionfruit	Fruit	Infested plant material (including fruit), soil and hitchhiking. Adults capable of flight. Pupation occurs in the soil	Asia, Africa, North America, Europe, Oceania.[5]	HIGH	HIGH	HIGH	HIGH	HIGH

[3] (CABI, 2023).

[4] Establishment potential.

[5] Asia (Bangladesh, Bhutan, Brunei Darussalam, Cambodia, China, Christmas Island (Indian Ocean), India, Indonesia, Laos, Malaysia, Myanmar, Nepal, Oman, Pakistan, Philippines, Singapore, Sri Lanka, Taiwan, Thailand, United Arab Emirates, Vietnam). Africa, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, Democratic Republic of Congo, Cote d'Ivoire, Equatorial Guinea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea Bissau, Kenya, Liberia, Madagascar, Mali, Mauritania, Mayotte, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, Sudan, Swaziland, Tanzania, Togo, Uganda, Zambia, Zimbabwe). North America (USA). Europe (Italy). Oceania (Federated states of Micronesia, French Polynesia, Northern Mariana Islands, Palau, Papua New Guinea)

Common name	Scientific name	Host(s)	Affected plant part	Movement and dispersal	Geographic distribution[3]	Entry potential	Est.[4] potential	Spread potential	Economic impact	Overall risk
Tongan fruit fly, Tropical fruit fly	*Bactrocera facialis*	*Citrus spp*., mango, avocado, peach, guava, cashew, capsicum, tomato, breadfruit, longan	Fruit	Infested plant material (including fruit), soil and hitchhiking. Adults capable of flight. Pupation occurs in the soil.	Oceania (Tonga)	HIGH	HIGH	HIGH	HIGH	HIGH
Fijian fruit fly	*Bactrocera passiflorae*	Polyphagous (49 hosts in 28 families) including cashew, breadfruit, lime, mandarin, mango, avocado, guava, eggplant, cocoa, passionfruit	Fruit	Infested plant material (fruit). Adults capable of flight. Pupae are soilborne.	Oceania (Fiji, Niue, Tonga, Tuvalu, Wallis & Futuna)	HIGH	HIGH	HIGH	HIGH	HIGH
	Bactrocera tuberculata	Mango, *Syzygium* spp., peach, sapodilla	Fruit	Infested plant material (fruit). Adults capable of flight. Pupae are soilborne.	Asia (Bangladesh, Bhutan, China, Myanmar, Thailand, Vietnam)	MEDIUM	HIGH	HIGH	HIGH	HIGH
Melon fruit fly	*Zeugodacus cucurbitae*	Watermelon, rockmelon, cucumber, pumpkin, tomato	Fruit	Infested plant material (fruit). Adults capable of flight. Pupae are soilborne.		HIGH	HIGH	HIGH	HIGH	HIGH
Hemiptera (stink bugs, aphids, mealybugs, scale, whiteflies and hoppers)										
Coconut bug	*Amblypelta cocophaga*	Navel orange, coconut, melon, mango, cassava, peach, sugarcane, cocoa, kapok, *Eucalyptus deglupta*, *E. terecornis*, *E. urophylla*	Stems, growing points, fruit	Infested plant material and machinery. Adult females capable of flight. Nymphs are active crawlers.	Asia (Singapore) Oceania (Fiji, Papua New Guinea, Solomon Islands)	HIGH	HIGH	HIGH	HIGH	HIGH
Mealybug	*Dysmicoccus nesophilus*	Polyphagous including sweet orange, grapefruit, lemon, mango, avocado, pines, taro, ginger, tamarillo, figs, coffee	Leaves, flowers, fruit	Infested plant material. Adult males capable of flight over short distances.	Oceania (Cook Islands, Fiji, Kiribati, Papua New Guinea, Tonga, Tuvalu, Western Samoa)	HIGH	HIGH	HIGH	HIGH	HIGH
Coconut mealybug	*Nipaecoccus nipae*	Polyphagous including breadfruit, pigeon pea, citrus,	Fruit, leaves, stems,	Infested plant material and	Africa, Asia, North America, Oceania. [6]	HIGH	HIGH	HIGH	HIGH	HIGH

[6] Africa, Zimbabwe). Asia (Bangladesh, China, Georgia, India, Indonesia, Pakistan, Philippines, South Korea, Thailand, Turkey, Vietnam). Europe (Austria, Belgium, Czechoslovakia, France, Hungary, Italy, Poland, Portugal, , Russia, Spain, United Kingdom). North America (Antigua and Barbuda, Bahamas, Barbados, Belize, Bermuda, British Virgin Islands, Cayman Islands, Costa Rica, Cuba, Dominica, Dominican Republic, El Salvador, Grenada, Guadeloupe, Guatemala, Jamaica, Mexico, Nicaragua, Panama, Puerto Rico, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago, U.S. Virgin Islands, United States). Oceania (Federated States of Micronesia, Fiji, Guam, Samoa, Solomon Islands). South America (Argentina, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname, Venezuela).

Common name	Scientific name	Host(s)	Affected plant part	Movement and dispersal	Geographic distribution[3]	Entry potential	Est.[4] potential	Spread potential	Economic impact	Overall risk
		coconut, fig, breadfruit, pigeon pea, sweet potato, mango, cassava, banana, olive, orchids, avocado, guava, potato, cocoa, grape, ginger	growing point	machinery, adult males capable of flight.						
Fruit tree mealybug	*Rastrococcus invadens*	Breadfruit, citrus, figs, mango, banana, guava	Fruit, inflorescence, leaves, stems		Africa (Benin, Burkina Faso, Congo, Democratic Republic of the, Congo, Republic of the, Côte d'Ivoire, Gabon, Ghana, Nigeria, Senegal, Sierra Leone, Togo), Asia (Bangladesh, Bhutan, China, Hong Kong, India, Indonesia, Malaysia, Pakistan, Philippines, Singapore, Sri Lanka, Thailand, Vietnam), South America (French Guiana)	HIGH	HIGH	HIGH	HIGH	HIGH
Pathogens										
Bacteria										
Bacterial crown rot **Papaya bacterial canker**	*Erwinia mallotivora*[7]	Known to survive on the leaves of cowpea, tomato and rockmelon for at least 14 days.	Leaves, fruit, stems		DAFF lists as: Anguilla; Antigua and Barbuda; Barbados; Dominica; Grenada; Guadeloupe; Indonesia; Japan; Malaysia; Martinique; Montserrat; Northern Mariana Islands; Philippines; Saint Kitts and Nevis; Saint Lucia; Saint Vincent and the Grenadines; Tonga; Trinidad and Tobago; Venezuela, Bolivarian Republic of; and Virgin Islands, United States of America.	MEDIUM	HIGH	HIGH	HIGH	HIGH
Viruses and viroids										
Cotton leaf curl Alabad virus	*Cotton leafcurl virus complex* (*Begomovirus*)	Cotton. Additional hosts include hibiscus, okra, tobacco, radish, tomato, French bean, chilli and many weeds	Leaves symptomatic, whole plant affected		Asia (Oman)	MEDIUM	HIGH	HIGH	HIGH	HIGH

[7] In the Biosecurity Reference Panel meeting #4 the scientific name of Bacterial crown rot was updated from *Erwinia papaya*.

Other pests of biosecurity significance

Pollination pests

Although there are a variety of mechanisms for pollination, the European honey bee (*Apis mellifera*) is the most important insect pollinator of cultivated agricultural and horticultural crops in Australia. Pollination services of the European honey bee are provided by beekeepers to growers of pollinator-reliant crops.

As European honey bees forage for nectar and pollen their activities naturally pollinate plants, resulting in increased seed or fruit set, improved fruit shape and more even maturation of some crops.

Established and exotic pests of European honey bees as well as exotic pest bees can have a major impact on crop pollination services. Honey bee pests and pest bees can also impact unmanaged colonies which also provide pollination.

Papaya rely on a range of native and established insect species for pollination, including European honey bees. A list of the high priority bee pests and pest bees which could impact the papaya industry can be located on the PHA website planthealthaustralia.com.au/industries/honey-bees/ and the BeeAware website beeaware.org.au/pests/

Introduction

This section identifies other pests of biosecurity significance for the Australian papaya industry. By identifying pests which are either currently under quarantine arrangements or which papaya producers already manage, mechanisms can be put in place to better align industry and government resources and provide a stronger base for biosecurity risk management for the industry.

Identification of other pests of biosecurity significance will also assist in the implementation of effective grower and community awareness campaigns, targeted biosecurity education and training programs for growers, surveillance coordinators, diagnosticians and development of pest-specific mitigation activities.

Threat identification

In order to be considered as a pest of biosecurity significance, the pests included should be economically important to the papaya industry and at least one of the following:

- currently under quarantine arrangements or restricted to regions within Australia,
- notifiable by law,
- have market access implications,
- able to be prevented from entering a farm through good biosecurity practices.

These pests were considered in an effort to prioritise investment but did not undergo a formal pest risk assessment.

Table 2. Other pests of biosecurity significance.

Common name (Scientific name)	Hosts	Affected plant part	Distribution in Australia	State movement controls or market impact by pests	Factsheets	Comments
Invertebrates						
Acari (mites and ticks)						
Varroa mite *Varroa destructor*	*Apis cerana, A. mellifera*.	Brood and adults (honey bee life stage)	NSW and Vic[8].	Movement restrictions of hives and other equipment apply for Qld[9], SA[10], NT[11], WA[12], Vic[13], ACT[14], Tas[15]	PHA[16], BeeAware[17], NSWDPI[18]	A 2-year transition to management (T2M) plan was approved in February 2024.[19]
Diptera (flies and midges)						
Queensland fruit fly *Bactrocera tryoni*	Polyphagous including papaya	Fruit	NSW, NT, Qld, Vic	Movement restrictions in the Greater Sunraysia Pest Free Area	NSW DPI[20], PHA[21], QDAF[22], AgVic[23]	https://www.fruitflyidentification.org.au/species/bactrocera-tryoni/
Mediterranean fruit fly *Ceratitis capitata*	Polyphagous including papaya	Fruit	WA (except Ord River Irrigation Area - ORIA)	Movement controls of fruit	PHA[21], NSW DPI[24], DPIRD[25], AgVic[26] QDAF[27]	https://www.fruitflyidentification.org.au/species/ceratitis-capitata/
Hemiptera (stink bugs, aphids, mealybugs, scale, whiteflies and hoppers)						
Papaya mealybug	Polyphagous	Fruit, growing point, inflorescence, leaves,	NT (Darwin, Palmerston and	Queensland has movement controls on soil, plant movement and related	Yes –NT[30], QLD[31]	

[8] https://www.dpi.nsw.gov.au/emergencies/biosecurity/current-situation/varroa-mite-emergency-response
[9] https://www.business.qld.gov.au/industries/farms-fishing-forestry/agriculture/animal/industries/bees/move
[10] https://pir.sa.gov.au/biosecurity/animal_health/animal_species/bees/moving_bees_and_bee_products
[11] https://nt.gov.au/industry/agriculture/livestock-and-animals/honey-bees-and-beekeeping
[12] https://www.agric.wa.gov.au/livestock-animals/livestock-species/bees
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[14] https://www.environment.act.gov.au/parks-conservation/plants-and-animals/biosecurity/biosecurity-alerts/varroa-destructor-mite
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[24] https://www.dpi.nsw.gov.au/biosecurity/insect-pests/medfly
[25] https://www.agric.wa.gov.au/medfly/mediterranean-fruit-fly-life-cycle-biology
[26] https://agriculture.vic.gov.au/biosecurity/pest-insects-and-mites/priority-pest-insects-and-mites/mediterranean-fruit-fly
[27] https://www.business.qld.gov.au/industries/farms-fishing-forestry/agriculture/biosecurity/plants/priority-pest-disease/mediterranean-fruit-fly
[30] https://nt.gov.au/industry/agriculture/food-crops-plants-and-quarantine/papaya-mealybug
[31] https://www.business.qld.gov.au/industries/farms-fishing-forestry/agriculture/biosecurity/plants/priority-pest-disease/papaya-mealybug

Paracoccus marginatus	including papaya[28]	stems, whole plant	Howard Springs), Qld (South east Qld and Townsville).	equipment[29].		
Pathogens						
Viruses						
Papaya ringspot disease Papaya ringspot virus type P (PRSV-P) *(Potyvirus)*	Papaya, cucurbits	Fruit, leaves, stems, and trunk	Southeast Queensland	Two biosecurity zones in southeast Queensland[32]	QLD[33]	
Papaya sticky disease Combined infection with *Papaya meleira virus* (PMeV) and *Papaya meleira virus 2* (PMeV2) (Unassigned, Totiviridae)	Papaya	Fruit, leaves	Qld, NT.		DPIRD[34]	An article published on DPIRD's website in 2022 reported that the disease has been detected in the NT.[35]

[28] Polyphagous (over 55 plants from 25 genera) including Citrus spp., papaya, avocado, mango, cherry, pineapple, pomegranate, hibiscus, cotton, tomato, eggplant, capsicum, bean, pea, sweet potato, coffee, acacia, cassava, guava, cocoa.

[29] https://www.business.qld.gov.au/industries/farms-fishing-forestry/agriculture/biosecurity/plants/priority-pest-disease/papaya-mealybug

[32] https://www.daf.qld.gov.au/__data/assets/pdf_file/0011/377606/Papaya-Ringspot-Biosecurity-Zones-1-And-2.pdf

[33] https://www.business.qld.gov.au/industries/farms-fishing-forestry/agriculture/land-management/health-pests-weeds-diseases/weeds-diseases/surveillance/papaya-ringspot

[34] https://www.agric.wa.gov.au/sites/gateway/files/PF025-22%20Papaya%20sticky%20disease%20factsheet%20PRINT.pdf

[35] https://www.agric.wa.gov.au/plant-biosecurity/papaya-sticky-disease-declared-pest

Implementing biosecurity for the Australian Papaya Industry 2021-2026

This section includes the biosecurity implementation plan and a gap analysis of the current level of preparedness for HPP of the Australian Papaya Industry. The Biosecurity Implementation Group (BIG), comprising of representatives of key stakeholders and other relevant experts, developed the implementation plan that sets out the Biosecurity Plans shared goals and objectives. It is intended that the implementation plan is revisited by the BRP regularly over the next five years to maintain its relevance. The TEG, the BIG and the BRP contain representatives of the three industries as well as scientific and technical experts from Australian commonwealth, state and territory governments, and other relevant organisations.

Biosecurity Implementation Table

The Biosecurity Implementation Table aims to build upon the themes outlined in the Intergovernmental Agreement on Biosecurity (IGAB)[36] and the National Plant Biosecurity Strategy (NPBS)[37] by providing a clear line of sight between the development of this Biosecurity Plan and broader plant health policy and legislation.

This table also aims to provide focus and strategic direction for plant biosecurity activities relating to the Australian Papaya Industry over the next five years (i.e. the life of this Biosecurity Plan). The Biosecurity Implementation Table provides specific recommendations for potential biosecurity activities identified by key stakeholders to improve biosecurity preparedness for pest threats.

Biosecurity is a shared responsibility between the key stakeholders and other stakeholders. The Biosecurity Implementation Table has been produced to help coordinate actions and resources in the Australian biosecurity system. Activities may require additional funding to be sourced prior to commencement. Implementing the specific actions listed in the Biosecurity Implementation Table, will not only strengthen Australian Papaya Industry biosecurity systems, but also the broader Australian plant biosecurity systems. Future versions of this table will also track progress on the activities described.

The Biosecurity Implementation Table previously outlined eight strategy areas where industry and government should align their biosecurity efforts. The eight strategy areas were:

- Capacity and Capability
- Education and Awareness
- Preparedness and Response
- Surveillance
- Diagnostics
- Established Pests of Biosecurity Concern
- Research, Development & Extension
- Legislation and Regulatory Issues of Importance

During the life of the Biosecurity Plan, changes have been made to the structure of the Implementation Table to better align with the structure of the IGAB and the NPBS. The Implementation Table has been updated to reflect this new structure below.

[36] For more information visit agriculture.gov.au/animal-plant-health/pihc/intergovernmental-agreement-on-biosecurity
[37] For more information visit planthealthaustralia.com.au/national-programs/national-plant-biosecurity-strategy/

Table 3. The Biosecurity Implementation Plan for the Australian Papaya industry 2021 - 2026.

Biosecurity Plan Strategy	Action	Output	Outcome	Potential Partners	Current Activities	Timeframe
1. Preparedness and Response	1.1 Describe and evaluate current biosecurity risk pathways into Australia and determine appropriate mitigation measures.	Papaya biosecurity pathway risk analysis.	Greater understanding of the biosecurity risks associated with pathways will provide the opportunity to develop pre-emptive mitigation measures.	Papaya Australia, Department of Agriculture, Fisheries and Forestry (DAFF), State and Territory Governments (where appropriate).		
	1.2 Understand current surveillance programs undertaken by industry and government.	Surveillance analysis and a Papaya industry surveillance program.	Early detection of key exotic pests and an improved knowledge of geographic spread of established pests.	Papaya Australia, Commonwealth, State and Territory Governments, Subcommittee on National Plant Health Surveillance (SNPHS), PHA.		Ongoing
	1.3 Participate in future simulation exercises that test the preparedness and response of the biosecurity system to exotic pest and/or pathogen incursions.	Simulation exercises.	Participating industries and governments are better prepared to respond to a pest incursion.	Papaya Australia, Commonwealth, State and Territory Governments, Hort Innovation, PHA.		Ongoing
	1.4 Review the availability of crop protection products available to manage exotic pests and pathogens and identify gaps in control options.	A list of important pests and control options are available with gaps identified.	Industry will have a list of identified gaps in control options for important pests and pathogens.	Papaya Australia, State and Territory Governments (where appropriate), Australian Pesticides and Veterinary Medicines Authority (APVMA), collaborating industries.		
	1.5 Prioritise identified gaps in pest control options and develop options to address gaps.	A plan to address crop protection gaps.	A prioritised list of pests and control options with strategies developed to gain access.	Papaya Australia, APVMA, collaborating industries, crop protection companies.		
	1.6 Review availability of diagnostics for the high priority pests and assess the capability to perform diagnostics (normal capacity and surge capacity).	Diagnostic tools and methods that provide accurate and timely identification of pests and pathogens.	Increased accuracy and rapid diagnosis of pests/pathogens will provide greater opportunity for eradication and/ or management.	Papaya Australia, State and Territory Governments (where appropriate), collaborating industries, Subcommittee on Plant Health Diagnostics (SPHD).		Ongoing
	1.7 Maintain an understanding of relevant biosecurity legislation and regulations in all states/territories.	Regular legislation and regulation update.	Any specific state/ territory or discordant requirements identified. Increase industry awareness of legislation and regulations impacting their businesses.	Papaya Australia.		Ongoing

2. Capacity & Capability	2.1 In collaboration with industry and governments, gain an understanding of diagnostic capacity within both government and private providers and assess methods to address capacity and capability gaps.	Diagnostic capacity analysis.	Increased diagnostic capacity or a greater understanding of gaps and methods to address these gaps.	Papaya Australia, Hort Innovation, collaborating industries, State and Territory Governments.		
	2.2 Build and maintain international networks of production and biosecurity specialists who can contribute to growth of knowledge and skills within the Australian Papaya industry.	International Biosecurity Network.	Improved preparedness to manage both established and exotic pests.	Papaya Australia, Hort Innovation.		Ongoing
	2.3 Development and implementation of a biosecurity training framework for the Papaya industry.	Biosecurity training framework.	Papaya framework with training modules will assist develop a skilled biosecurity focussed workforce.	Papaya Australia, Hort Innovation, PHA.		
3. Communication and Engagement	3.1 Papaya Australia maintains an industry database which holds current contact information for Papaya growers and key industry stakeholders.	Industry database.	Critical information on biosecurity can be delivered rapidly to the industry.	Papaya Australia, other authorised buyers.		Ongoing
	3.2 Papaya Australia delivers an effective industry communications program with multiple delivery methods which has the capacity to deliver relevant biosecurity information, including Beeaware and the National Fruit Fly Council (NFFC).	Papaya communications program.	The Papaya industry is well informed on the range of issues impacting on industry and business.	Papaya Australia.		Ongoing
	3.3 Promote, disseminate, and demonstrate benefits of biosecurity to industry within and across each component of the supply chain.	BOLT courses.	Improved knowledge of biosecurity and process and systems supporting biosecurity.	Papaya Australia, State and Territory Governments, PHA.		Ongoing
	3.4 Prepare articles (including fact sheets) on biosecurity and key pests (exotic and established) for publication in industry journals and website.	Articles, fact sheets, other information.	Industry stakeholders are informed on pests, current management practices and research activities.	Papaya Australia, State and Territory Governments, PHA.		2021-2022
4. Innovation, Research, Development and Extension	4.1 Review and prioritise Papaya biosecurity Research, Development and Extension (RD&E) annually and identify opportunities for collaboration and cross-sectoral investment.	Papaya biosecurity RD&E plan.	A Papaya innovation and RD&E program that addresses key issues challenging the Papaya industry.	Papaya Australia, Biosecurity Reference Panel (BRP), State and Territory Governments (where appropriate), PHA.		Ongoing
	4.2 Keep informed of activities with SPHD through the national Diagnostic and Surveillance Network Coordinator.	Rapid field diagnostic tools.	More rapid diagnosis of pathogens will asset growers implement the most suitable eradication or management program.	Papaya Australia, State and Territory Governments.		Ongoing
5. Collaboration and partnerships	5.1 Build strong networks among both researchers and regulators in Commonwealth and State/Territory governments.	A robust and collaborative research and regulatory network.	Greater input into future decisions making that may impact on the industry.	Papaya Australia, State and Territory Governments, Universities.		

	5.2 Maintain collaborative arrangements with universities and other research and education providers so opportunities for Papaya research and development activities can be addressed.	Collaborative biosecurity programs.	The Papaya industry maintains access to innovative solutions and products.	Papaya Australia, State and Territory Governments (where appropriate), Universities.		
	5.3 Support addressing gaps in biosecurity preparedness by collaborating with other industries, governments, and other stakeholders.	Collaborative biosecurity programs.	Improved biosecurity preparedness by industry and government.	Papaya Australia, other industries, State and Territory Governments.		
	5.4 Facilitate and maintain an international network of Papaya technical specialists who can contribute to growth of knowledge and skills within the Australian Papaya industry.	Papaya pest and disease network.	Improved capability and capacity to manage both established and exotic pests.	Papaya Australia.		Ongoing
	5.5. Engage in initiatives to improve preparedness and response to cross sectoral pests and or diseases.	Improved preparedness for pests and diseases.	Shared investment into RD&E.	Papaya Australia, Plant Biosecurity Research Initiative (PBRI), PHA.		Ongoing

Australian Papaya industry - biosecurity preparedness

The following table documents the current preparedness documents and activities relating to the Australian Papaya Industry HPP. The aim of this table is to document the current preparedness documents and activities which are available and are currently being undertaken. This will allow industry, governments and RD&E agencies to better prepare for these high priority pests and align future activities as listed in the Biosecurity Implementation Table (Table 3).

Table 4. Documents and activities currently available for High Priority Pests of the Papaya industry.

Common name (Scientific name)	National Diagnostic Protocol[38]	Surveillance programs[39]	Fact sheets	Contingency plan	EPPRD category[40]	National Priority Plant Pest[41]	Potential Collaborators[42]
Invertebrates							
Diptera (flies and midges)							
Carambola fruit fly *Bactrocera carambolae*	For diagnostic information on fruit flies, refer to the Australian Handbook for the Identification of Fruit Flies.[43]	Australian Government & all states (excl. ACT), NAQS[44]	Not developed	Not developed	Not categorised	No. 4	Avocado, Citrus, Mango, Tomato, Vegetable
Guava fruit fly *Bactrocera correcta*	For diagnostic information on fruit flies, refer to the Australian Handbook for the Identification of Fruit Flies.[43]	Australian Government & all states (excl. ACT), NAQS[44]	Not developed	Not developed	Not categorised	No. 4	Mango
Oriental fruit fly *Bactrocera dorsalis*	For diagnostic information on fruit flies, refer to the Australian Handbook for the Identification of Fruit Flies.[43]	Australian Government & all states (excl. ACT), NAQS[44]	PHA[45], QDAF[46], NSW DPI[47], NFFC[48]	Not developed	2	No. 4	Avocado, Mango, Summerfruit, Apple and Pear, Citrus, Viticulture, Banana, Coffee, Cherry, Tomato, Vegetable

[38] https://www.plantbiosecuritydiagnostics.net.au/resources/?category=national-diagnostic-protocols

[39] Information presented has been taken from National Plant Biosecurity Status Report 2020, National Plant Health Surveillance Program and the Northern Australian Quarantine Strategy and confirmed through the Plant Health Committee.

[40] https://www.planthealthaustralia.com.au/response-arrangements/emergency-plant-pest-response-deed-epprd/

[41] https://www.agriculture.gov.au/biosecurity-trade/pests-diseases-weeds/plant/national-priority-plant-pests-2019

[42] Industries listed in this column identify these pests within their biosecurity plans. Pests listed as a High Priority Pest are indicated by HPP.

[43] https://www.fruitflyidentification.org.au/wp-content/uploads/2018/10/The-Australian-Handbook-for-the-Identification-of-Fruit-Flies-v3.1.pdf

[44] Australian Gov.: Northern Australian Quarantine Survey exotic fruit fly trapping, NSW: Exotic Fruit Flies-Ports & Riverina (protocol based on pheromone traps), Tas.: Fruit Fly Trapping program (area freedom & export protocol), VIC: National Plant Health Surveillance Project (protocol developed), SA: Ports of Entry Trapping Program (protocol developed), WA: Port of Entry Fruit Fly Trapping (Fruit fly Codes of Practice protocol), QLD: Exotic fruit fly trapping (protocol developed), NT: Fruit Fly monitoring and surveillance

[45] https://www.planthealthaustralia.com.au/wp-content/uploads/2024/02/Exotic-fruit-flies-FS.pdf

[46] https://www.business.qld.gov.au/industries/farms-fishing-forestry/agriculture/crop-growing/priority-pest-disease/oriental-fruit-fly

[47] https://www.dpi.nsw.gov.au/biosecurity/plant/insect-pests-and-plant-diseases/orientalff

[48] https://www.preventfruitfly.com.au/about-the-oriental-fruit-fly/

Common name (Scientific name)	National Diagnostic Protocol[38]	Surveillance programs[39]	Fact sheets	Contingency plan	EPPRD category[40]	National Priority Plant Pest[41]	Potential Collaborators[42]
Tongan fruit fly, Tropical fruit fly *Bactrocera facialis*	For diagnostic information on fruit flies, refer to the Australian Handbook for the Identification of Fruit Flies.[43]	Australian Government & all states (excl. ACT), NAQS[44]	Not developed	Not developed	Not categorised	Not listed	Mango, Avocado, Tomato
Fijian fruit fly *Bactrocera passiflorae*	For diagnostic information on fruit flies, refer to the Australian Handbook for the Identification of Fruit Flies.[43]	Australian Government & all states (excl. ACT), NAQS[44]	PHA[49]	Not developed	Not categorised	Not listed	Mango, Avocado, Vegetable
Bactrocera tuberculata	For diagnostic information on fruit flies, refer to the Australian Handbook for the Identification of Fruit Flies.[43]	Australian Government & all states (excl. ACT), NAQS[44]	Not developed	Not developed	Not categorised	Not listed	Mango
Melon fruit fly *Zeugodacus cucurbitae*	For diagnostic information on fruit flies, refer to the Australian Handbook for the Identification of Fruit Flies.[43]	Australian Government & all states (excl. ACT), NAQS[44]	PHA[50], QDAF[51], NPBDN/Cesar[52]	Not developed	Not categorised	No. 4	Tomato, Melon, Mango
Hemiptera (Stink bugs, aphids, mealybugs, scale, whiteflies and hoppers)							
Coconut bug *Amblypelta cocophaga*	Not developed	Not covered by a pest specific surveillance program	PHA[53]	Not developed	Not categorised	Not listed	
Mealybug *Dysmicoccus grassii* (Syn. *Pseudococcus grassi*)	Not developed	Not covered by a pest specific surveillance program	Not developed	Not developed	Not categorised	Not listed	
Mealybug *Dysmicoccus nesophilus*	Not developed	Not covered by a pest specific surveillance program	Not developed	Not developed	Not categorised	Not listed	
Coconut mealybug *Nipaecoccus nipae*	Not developed	Not covered by a pest specific surveillance program	Not developed	Not developed	Not categorised	Not listed	
Fruit tree mealybug *Rastrococcus invadens*	Not developed	Not covered by a pest specific surveillance program	Not developed	Not developed	Not categorised	Not listed	Mango

[49] https://www.planthealthaustralia.com.au/wp-content/uploads/2024/02/Fijian-fruit-fly-FS.pdf
[50] https://www.planthealthaustralia.com.au/wp-content/uploads/2024/01/Melon-fruit-fly-FS.pdf
[51] https://www.business.qld.gov.au/industries/farms-fishing-forestry/agriculture/biosecurity/plants/priority-pest-disease/melon-fly
[52] https://www.plantbiosecuritydiagnostics.net.au/resources/melon-fruit-fly-fact-sheet/
[53] https://www.planthealthaustralia.com.au/wp-content/uploads/2024/01/Coconut-bug-FS.pdf

Common name (Scientific name)	National Diagnostic Protocol[38]	Surveillance programs[39]	Fact sheets	Contingency plan	EPPRD category[40]	National Priority Plant Pest[41]	Potential Collaborators[42]
Pathogens							
Bacteria							
Bacterial crown rot, Papaya bacterial canker *Erwinia mallotivora*[54]	Not developed	Not covered by a pest specific surveillance program	PHA[55]	Developed 2011[56]	Not categorised	Not listed	
Viruses and viroids							
Cotton leaf curl Alabad virus *Cotton leaf curl virus (Begomovirus)*	Draft under review (for cotton)	Not covered by a pest specific surveillance program	PHA[57]	Draft submitted for assessment	3 (for cotton)	Not listed	Cotton

[54] In the Biosecurity Reference Panel meeting #4 the scientific name of Bacterial crown rot was updated from *Erwinia papaya*.
[55] https://www.planthealthaustralia.com.au/wp-content/uploads/2024/01/Bacterial-crown-rot-FS.pdf
[56] https://www.planthealthaustralia.com.au/wp-content/uploads/2024/01/Bacterial-crown-rot-CP.pdf
[57] https://www.planthealthaustralia.com.au/wp-content/uploads/2024/01/Apple-maggot-Cotton-leaf-curl-disease-FS.pdf , https://www.planthealthaustralia.com.au/wp-content/uploads/2024/01/Tarnished-plant-bug-Cotton-leaf-curl-disease-Technical-FS.pdf

NATIONAL BIOSECURITY SYSTEM

What is biosecurity and why is it important?

Plant biosecurity is a set of measures which protect the economy, environment and community from the negative impacts of exotic plant pests. A fully functional and effective biosecurity system is a vital part of the future profitability, productivity and sustainability of Australia's plant production industries and is necessary to preserve the Australian environment and our way of life.

Plant pests include (but are not limited to) insects, mites, snails or diseases (pathogens, including nematodes) that have the potential to adversely affect fresh food, fibre, ornamental crops, honey bees and stored products, as well as environmental flora and fauna. For agricultural systems, if exotic plant pests enter Australia, they can reduce crop yields, affect trade and market access, significantly increase costs to production and in the worst-case scenario, bring about the complete failure of a production system. Historical examples present us with an important reminder of the serious impact that exotic plant pests can have on agricultural production.

Australia's geographic isolation and lack of shared land borders have, in the past, provided a degree of natural protection from exotic plant pest threats. Australia's national quarantine system also helps to prevent the introduction of harmful exotic threats to plant industries. However, there will always be some risk of an exotic pest entering Australia, whether through natural dispersal (such as wind) or assisted dispersal as a result of increases in international tourism, imports and exports, mail and changes to transport procedures (e.g., refrigeration and containerisation of produce).

The plant biosecurity system in Australia

Australia has a unique and internationally recognised biosecurity system to protect our plant production industries and the natural environment against new plant pests. The system is underpinned by a cooperative partnership between plant industries and all levels of government.

The framework for managing the cooperative partnership for delivering an effective plant biosecurity system is built on a range of strategies, policies and legislation, such as the Intergovernmental Agreement on Biosecurity (IGAB) and the National Plant Biosecurity Strategy (NPBS). These not only provide details about the current structure but provide a vision of how the future plant biosecurity system should operate.

Australia's biosecurity system has been subject to several reviews in recent times, with the recommendations recognising that a future-focused approach is vital for maintaining a strong and resilient biosecurity system that will protect Australia from new challenges. As a result, there is a focus on continuous improvement from industry and governments to keep Australia's plant biosecurity system effective, with the key themes including:

- Targeting what matters most, including risk-based decision making and managing biosecurity risks across the biosecurity continuum (pre-border, border and post-border).
- Good regulation, including reducing regulatory burden and having effective legislation in place.
- Better processes, including service delivery modernisation with electronic, streamlined systems.
- Sharing the responsibility, including maintaining productive relationships with all levels of government, primary industries and the wider Australian public.
- Maintaining a capable workforce.

Papaya peak industry body

Papaya Australia is the peak industry body for the papaya industry. Currently Papaya Australia is not a signatory to the EPPRD.

Plant Health Australia

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

PHA is a not-for-profit, subscription-funded public company. The main activities of PHA are funded from annual subscriptions paid by members. The Australian Government, state and territory governments and 38 plant industry organisations are all members of PHA and each meet one third of the total annual membership subscription. This tripartisan funding model ensures the independence of PHA.

Plant Health Australia was formed to address priority plant health issues, and to work with all its members to develop an internationally outstanding plant health management system that enhances Australia's plant health status and the sustainability and profitability of Australia's plant industries. Through PHA, current and future needs of the plant biosecurity system can be mutually agreed, issues identified, and solutions to problems found. The independence and impartiality of PHA, allows the organisation to put the interests of the plant biosecurity system first and support a longer-term perspective.

For more information about PHA visit planthealthaustralia.com.au .

The Biosecurity Plan

The Biosecurity Plan for the Australian Papaya Industry was developed in consultation with the Technical Expert Group and Biosecurity Implementation Group. These groups were comprised of plant health and biosecurity experts and industry representatives from key stakeholders.

The biosecurity plan not only details exotic plant pest threats to the Australian Papaya Industry but also contains information on the current mitigation and surveillance activities being undertaken against these threats, and identifies contingency plans, fact sheets and diagnostic protocols that have been developed for these pests.

This plan is a framework to coordinate biosecurity activities and investment for Australia's Papaya Industry, and to build on strengths and address weaknesses in the industry's current biosecurity position. It provides a mechanism for key stakeholders to better prepare for and respond to, incursions of plant pests that could have significant impacts on the Australian Papaya Industry.

Biosecurity planning

Biosecurity planning provides a mechanism for the Australian Papaya Industry and other key stakeholders to actively determine plant pests of highest priority, analyse the risks they pose and put in place practices and procedures that would rapidly detect and minimise the impact of a pest incursion and/or reduce the chance of pests becoming established. Effective industry biosecurity planning relies on effort and engagement from all stakeholders, including government agencies, industry, and the public (Figure 1).

Ensuring the Papaya industry has the capacity to minimise the risks posed by pests, and to respond effectively to any pest threats is a vital step for the future sustainability and viability of the industry. Through this pre-emptive planning process, the industry will be better placed to maintain domestic and international trade and reduce the economic and social costs of pest incursions on both growers and the wider community. The information gathered during these processes provides additional assurance that the Australian Papaya industry is free from specific pests and has systems in place to control and manage biosecurity risks, which assists the negotiation of access to new overseas markets.

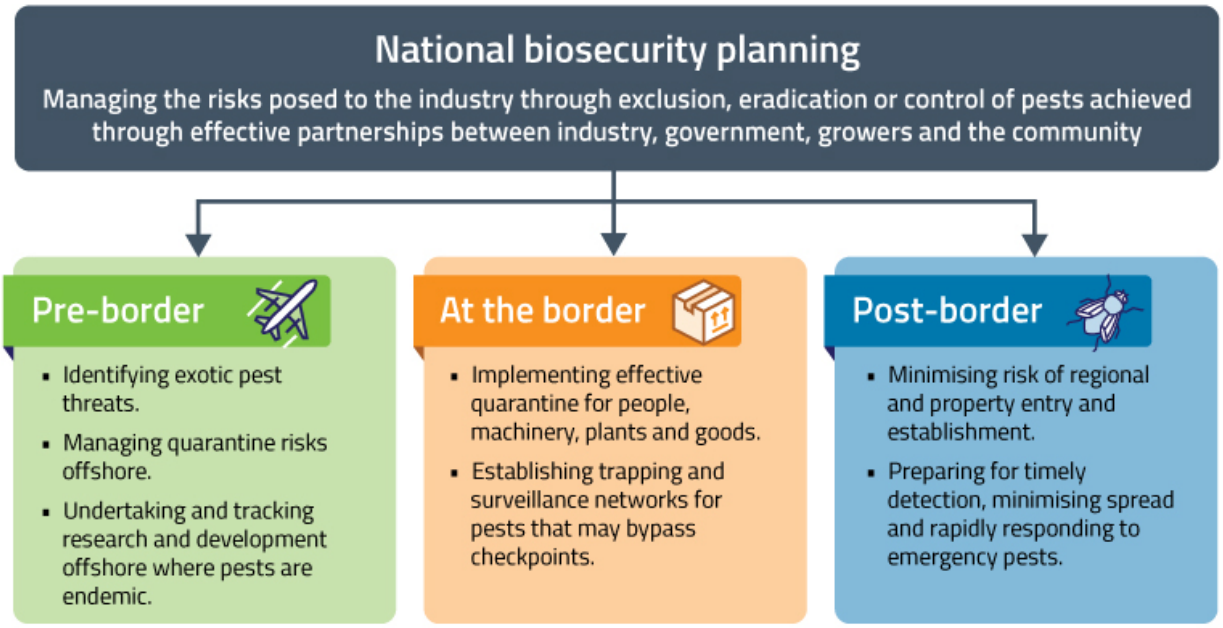

Figure 1. Industry biosecurity: a shared responsibility.

Biosecurity Plan development

With the assistance of Passionfruit Australia, Australian Lychee Growers Association and Papaya Australia, a Tropical Fruits Technical Expert Group (TEG) and a Tropical Fruits Biosecurity Implementation Group (BIG) were formed to work on the review of the Biosecurity Plan for the Papaya industry. These groups were coordinated by Plant Health Australia (PHA) and included representatives from the three industries, relevant Commonwealth, state, and territory agriculture agencies.

Key roles of the Technical Expert Group for the BP included:

- identifying and documenting key threats to the Passionfruit industry
- confirming an agreed high priority pest (HPP) list.

Key roles of the Biosecurity Implementation Group for the BP included:

- documenting pest-specific fact sheets, contingency plans, diagnostic protocols and surveillance programs for HPPs
- documenting the roles and responsibilities of stakeholder groups
- developing a biosecurity implementation table for future biosecurity related work to be conducted over the life of this biosecurity plan.

Table 5. Members of the Tropical Fruit Technical Expert Group (TEG) and/or the Tropical Fruit Biosecurity Implementation Group (BIG).

NAME	ORGANISATION	AREA OF EXPERTISE	MEMBER OF TEG	MEMBER OF BIG
Jill Houser	ALGA	Industry	✓	✓
Gerard Kath	Papaya Australia	Industry	✓	✓
Joe Zappala	Papaya Australia	Industry		✓
Dennis Chant	Passionfruit Australia	Industry	✓	✓
Jane Richter	Passionfruit Australia	Industry	✓	

Greg Chandler	Hort Innovation	Biosecurity, Research & Development	✓	
Matt Adkins	NSW DPI	Research & Development	✓	
Ruth Huwer	NSW DPI	Entomology	✓	✓
Fucheng Shan	WADPIRD	Research	✓	✓
Touhidur Rahman	WADPIRD	Entomology	✓	
Alison Mackie	WA DPIRD	Pathology, Research		✓
Ceri Pearce	DAF QLD	Pathology	✓	✓
Fiona Giblin	DAF QLD	Pathology	✓	✓
Lindy Coates	DAF QLD	Pathology	✓	
Christine Horlock	DAF QLD	Pathology	✓	
Ian Newton	DAF QLD	Entomology	✓	✓
Jose Liberato	NTDITT	Pathology	✓	✓
Stuart Kearns	PHA	Biosecurity	✓	
Victoria Ludowici	PHA	Biosecurity	✓	
Bosibori Bett	PHA	Biosecurity	✓	
Trevor Dunmall	PHA	Biosecurity	✓	✓
Stephen Quarrell	PHA	Biosecurity		✓
Rebecca Powderly	PHA	Biosecurity		✓

Table 6. Scientists and others who contributed information for the review of the biosecurity plan. [58]

NAME	ORGANISATION	AREA OF EXPERTISE
Cherie Gambley	DAF QLD	Virology
Danuta Knihinicki	DPI NSW	Entomology
Denis Persley	DAF QLD	Virology
Jennifer Cobon	DAF QLD	Nematology
Marc Poole	WA DPIRD	Entomology
Nanditha Panthania	DAF QLD	Pathology
Peter Gillespie	DPI NSW	Entomology
Tony Pattison	DAF QLD	Pathology
Sharl Mintoff	NT DITT	Pathology
Merran Neilsen	NT DITT	Pathology
Brian Thistleton	NT DITT	Entomology

[58] These people did not attend the technical expert group or biosecurity implementation group meetings but were approached for assistance during the biosecurity plan review process.

Review processes

With the support of the relevant industry bodies and PHA this plan should be reviewed on a 5-year basis. The review process will ensure:

- Threat Summary Tables are updated to reflect current knowledge,
- pest risk assessments are current,
- changes to biosecurity processes and legislation are documented, and
- contact details and references to available resources are accurate.

In addition to the formal review process above, the document should be revisited annually by a Biosecurity Reference Panel comprised of representatives of relevant industry, government and other stakeholder groups as well as PHA, to ensure currency and relevance of information and to monitor progress with implementation. As an example, the industry biosecurity priorities identified within the biosecurity plan could feed directly into industry RD&E priority setting activities on an annual basis.

Opportunities to make out-of-session changes to the biosecurity plan, including the addition/subtraction of HPP or changes to legislation are currently being investigated. Such changes would need to include consultation with and agreement of relevant industry groups and governments. This flexibility enhances the plan's currency and relevance.

THREAT IDENTIFICATION AND PEST RISK ASSESSMENTS

Introduction

This section identifies high-risk exotic plant pest threats to the Australian Papaya Industry, and presents a framework for assessing the potential economic, social and environmental impacts associated with each threat. This part of the biosecurity plan uses a nationally consistent and coordinated approach to threat identification and risk assessment to provide a strong base for future risk management in the Australian Papaya Industry.

By identifying key threats, a pre-emptive approach may be taken to risk management. Under this approach, mechanisms can be put into place to increase our response effectiveness when pest incursions occur. One such mechanism is the EPPRD that has been negotiated between PHA government and industry members. The EPPRD ensures reliable and agreed funding arrangements are in place in advance of EPP incursions and can assist in responses to EPP incursions, particularly for those EPP identified as key threats.

Identification of high-risk exotic plant pests will also assist in the implementation of effective grower and community awareness campaigns, targeted biosecurity education and training programs for growers and diagnosticians, and development of pest-specific incursion response plans.

Other pests of biosecurity significance are also considered in this biosecurity plan. It has been demonstrated that good biosecurity practice is beneficial for the ongoing management of other pests, as well as for surveillance and early detection of exotic plant pests. Other plant pests cause ongoing hardships for growers and these plant pests have been listed with the support of industry and government in recognition that they need a strategic, consistent, scientific and risk-based approach to better manage these plant pests for the benefit of the Australian Papaya industry.

Exotic plant pests of the Papaya industry

Threat identification

Information on exotic plant pest threats to the Australian Papaya Industry described in this document came from a combination of:

- past records,
- industry practice and experience,
- relevant published literature,
- local industry and overseas research, and
- specialist and expert judgment.

At this time, only invertebrate pests (insects, mites, and molluscs) and diseases (pathogens, including nematodes) of plants have been identified for risk assessment in this biosecurity plan, as these organisms dealt with under the nationally agreed EPPRD. At this time, pest plants (weeds) are dealt with under the National Environmental Biosecurity Response Agreement (NEBRA). If exotic pest plants (weeds) of commercial crops were included in the EPPRD in the future, then the inclusion of pest plants (weeds) of papaya crops would be considered at that time.

Pest risk assessments

The assessment process used in this biosecurity plan was developed in accordance with the International Standards for Phytosanitary Measures (ISPM) No. 2[59] and 11 [Food and Agriculture Organization of the United Nations.[60] A summary of the pest risk analysis protocol followed in this biosecurity plan is shown in Table *7*.

While there are similarities in the ranking system used in this document and the Biosecurity Import Risk Analysis (BIRA)[61] process followed by the Department of Agriculture, Fisheries and Forestry (DAFF), there are differences in the underlying methodology and scope of consideration that may result in different outcomes between the two assessment systems. This includes different guidance to assignment of qualitative probabilities.

Modifications of the DAWR[62] (Department of Agriculture and Water Resources, 2016) protocol have been made to suit the analysis required in the biosecurity plan development process, including, but not limited to:

- Entry potential: The determination of entry potential in this biosecurity plan considers multiple possible pathways for the legal importation of plant material as well as illegal pathways, contamination and the possibility of introduction through natural means such as wind. Therefore, the scope is wider than that used in the BIRA process, which only considers legal importation of plants or plant commodities.
- Potential economic impact of pest establishment in this document only considers the impacts on the Australian papaya industry. The BIRA process has a wider scope, including the impacts on all of Australia's plant industries, trade, the environment, social amenity and public health.
- Risk potential and impacts: The categories used in this biosecurity plan for describing the entry, establishment, spread, and potential economic impacts (see page 32) differs in comparison to that used in the BIRA process.

Table 7. Summary of pest risk assessment process used in BPs.

Step 1	Clearly identify the pest	• Generally, pest defined to species level • Alternatively, a group (e.g. family, genus level) can be used • Sub-species level (e.g. race, pathovar, etc.) may be required
Step 2	Assess entry establishment and spread likelihoods	• Assessment based on current system and factors • Negligible, low, medium, high or unknown ratings
Step 3	Assess the likely consequences	• Primarily based on likely economic impact to industry based on current factors • Negligible, low, medium, high, extreme or unknown ratings
Step 4	Derive overall risks	• Entry, establishment and spread likelihoods are combined to generate a likelihood score • Likelihood score combined with the likely economic impact to generate an overall risk score
Step 5	Review the risks	• Risk ratings should be reviewed with the BP

[59] FAO (2007).
[60] FAO (2004).
[61] https://www.agriculture.gov.au/sites/default/files/sitecollectiondocuments/bira-guidelines-2016.pdf
[62] Now the Department of Agriculture, Fisheries and Forestry (DAFF).

The objective of risk assessment is to clearly identify and classify biosecurity risks and to provide data to assist in the evaluation and mitigation of these risks. Risk assessment involves consideration of the sources of risk, their consequences, and the likelihood that those consequences may occur. Factors that affect the consequences and likelihood may be identified and addressed via risk mitigation strategies.

Risk assessment may be undertaken to various degrees of refinement, depending on the risk information and data available. Assessment may be qualitative, semi-quantitative, quantitative, or a combination of these. The complexity and cost of assessment increase with the production of more quantitative data. It is often more practical to first obtain a general indication of the level of risk through qualitative risk assessment, and if necessary, undertake more specific quantitative assessment later [Australian Standard/New Zealand Standard (AS/NZS) ISO 31000, 2009].

Ranking pest threats

Key questions required for ranking the importance of pests include the following:

- What are the probabilities of entry into Australia, establishment and spread, for each pest?
- What are the likely impacts of the pest on cost of production, overall productivity and market access?
- How difficult is each pest to identify and control and/or eradicate?

The Threat Summary Tables (page 61) present a list of potential plant pest threats to the Australian Papaya industry and provide summarised information on entry, establishment and spread potential, the economic consequences of establishment and eradication potential (where available). The most serious threats from the TST were identified through a process of qualitative risk assessment and are listed in the HPP list (Table 1).

> This document considers all potential pathways by which a pest might enter Australia, including natural and human-assisted spread (including illegal means such as smuggling). This is a broader view of potential risk than the BIRA process conducted by Department of Agriculture, Fisheries and Forestry which focuses only on specific, regulated import pathways.

When a pest that threatens multiple industries is assessed, the entry, establishment and spread potentials take into account all known factors across all host industries. This accurately reflects the ability of a pest to enter, establish and spread across Australia and ultimately results in different industries, and their biosecurity plans, sharing similar pest ratings. However, the economic impact of a pest is considered at an industry specific level (i.e., only for the Australian Papaya Industry in this biosecurity plan), and therefore this rating may differ between biosecurity plans.

Description of terms used in pest risk tables

The descriptions below relate to terms used in Table 1 and provides an overview of the top ranked biosecurity pest threats (invertebrates, pathogens and nematodes) for the Australian Papaya Industry. Further details on each pest along with the basis for the likelihood ratings are provided in the TST. Assessments may change given more detailed research, and the priority list will be formally reviewed along with the Biosecurity Plan on an annual basis through the Biosecurity Reference Panel.

Entry potential

Negligible	The probability of entry is extremely low given the combination of all known factors including the geographic distribution of the pest, quarantine practices applied, probability of pest survival in transit and pathways for pest entry and distribution to a suitable host.
Low	The probability of entry is low, but clearly possible given the expected combination of factors described above.
Medium	Pest entry is likely given the combination of factors described above.
High	Pest entry is very likely and potentially frequent given the combination of factors described above.
Unknown	The pest entry potential is unknown or very little of value is known.

Establishment potential

Negligible	The probability of entry is extremely low given the combination of all known factors including the geographic distribution of the pest, quarantine practices applied, probability of pest survival in transit and pathways for pest entry and distribution to a suitable host.
Low	The probability of entry is low, but clearly possible given the expected combination of factors described above.
Medium	Pest entry is likely given the combination of factors described above.
High	Pest entry is very likely and potentially frequent given the combination of factors described above.
Unknown	The pest entry potential is unknown or very little of value is known.

Spread potential

Negligible	The pest has very limited potential for spread in Australia given the combination of dispersal mechanisms, availability of hosts, vector presence, industry practices and geographic and climatic barriers.
Low	The pest has the potential for natural or assisted spread to susceptible hosts within Australia yet is hindered by a number of the above factors
Medium	The pest has an increased likelihood of spread due to the above factors
High	The natural spread of the pest to most production areas is largely unhindered and assisted spread within Australia is also difficult to manage
Unknown	The spread potential is unknown or very little of value is known.

Economic impact

Negligible	There are very minor, often undetectable, impacts on production with insignificant changes to host longevity, crop quality, production costs or storage ability. There are no restrictions to market access.
Very low	There are minor, yet measurable, impacts on production including either host longevity, crop quality, production costs or storage ability. There are no restrictions to market access.
Low	There are measurable impacts to production including either host mortality, reduction in yield, production costs, crop quality, storage losses, and/or minimal impacts on market access.
Medium	There are significant impacts on production with either host mortality, reduction in yield, production costs, crop quality, storage losses, and/or moderate impacts on market access.
High	There are severe impacts on production including host mortality and significant impacts on either crop quality or storage losses, and/or severe impacts on market access.
Extreme	There is extreme impact on standing crop at all stages of maturity, with high host mortality or unmanageable impacts to crop production and quality, and /or extreme, long term, impacts on market access.
Unknown	The economic potential of the pest is unknown or very little of value is known.

References

AS/NZS ISO 31000:2009 Risk management - Principles and guidelines. Standards Australia, Sydney, and Standards New Zealand, Wellington.

Australian Government Department of Agriculture and Water Resources 2017, *Final group pest risk analysis for thrips and orthotospoviruses on fresh fruit, vegetable, cut-flower and foliage imports*, Department of Agriculture and Water Resources, Canberra, available at http://www.agriculture.gov.au/biosecurity/risk-analysis/group-pest-risk-analyses/group-pra-thrips-orthotospoviruses/final-report

DAFF (2011) Import Risk Analysis Handbook 2011. Australian Government Department of Agriculture, Fisheries and Forestry, Canberra.

Department of Agriculture and Water Resources 2019a, *Draft report for the review of biosecurity import requirements for fresh avocados from Chile*, Department of Agriculture and Water Resources, Canberra, Australia, available at http://www.agriculture.gov.au/SiteCollectionDocuments/biosecurity/risk-analysis/plant-reviews/draft-report-Avocados-chile.pdf.

Department of Agriculture and Water Resources 2019b, *Final group pest risk analysis for mealybugs and the viruses they transmit on fresh fruit, vegetable, cut-flower and foliage imports*, Department of Agriculture and Water Resources, Canberra, available at http://www.agriculture.gov.au/biosecurity/risk-analysis/group-pest-risk-analyses/mealybugs/final-report

FAO (2004) Pest risk analysis for quarantine pests including analysis of environmental risks and living modified organisms. International Standards for Phytosanitary Measures No. 11. Secretariat of the International Plant Protection Convention, Food and Agriculture Organization of the United Nations, Rome.

FAO (2007) Framework for pest risk analysis. International Standards for Phytosanitary Measures No. 2. Secretariat of the International Plant Protection Convention, Food and Agriculture Organization of the United Nations, Rome.

RISK MITIGATION AND PREPAREDNESS

Introduction

There are a number of strategies that can be adopted to help protect and minimise the risks of Emergency Plant Pests under International Plant Protection Convention (IPPC) standards[63] and Commonwealth and state/territory legislation.

Many pre-emptive practices can be adopted to reduce the risk of exotic pest movement for the Australian Papaya Industry (Figure 2). Such risk mitigation and preparedness practices are the joint responsibility of governments, industry and the community.

A number of key risk mitigation areas are outlined in this guide, along with summaries of the roles and responsibilities of the Australian commonwealth, state and territory governments, and Australian Papaya Industry members. This section is to be used as a guide outlining possible activities that may be adopted by industry and growers to mitigate the risk and prepare for an incursion response. Each grower will need to evaluate the efficacy of each activity for their individual situation.

Figure 2. Examples of biosecurity risk mitigation activities.

[63] https://www.ippc.int/en/core-activities/standards-setting/ispms/

Barrier quarantine

Barrier quarantine refers to the biosecurity measures implemented at all levels of the Australian Papaya industry including national, state, regional and farm levels.

National level – importation restrictions

The Department of Agriculture, Fisheries and Forestry (DAFF) is the Australian Government department responsible for maintaining and improving international trade and market access opportunities for agriculture, fisheries, forestry, and food industries. DAFF achieves this through:

- Establishment of scientifically based quarantine policies,
- provision of effective technical advice and export certification services,
- negotiations with key trading partners,
- participation in multilateral forums and international sanitary and phytosanitary (SPS) standard-setting organisations,
- collaboration with portfolio industries and exporters.

DAFF is responsible for developing biosecurity (i.e. SPS) risk management policy and reviewing existing quarantine measures for the importation of live animals and plants, and animal and plant products. In particular, DAFF undertakes import risk analyses to determine which products may enter Australia, and under what quarantine conditions. DAFF also consults with industry and the community, conducting research and developing policy and procedures to protect Australia's animal and plant health status and natural environment. In addition, DAFF assists Australia's export market program by negotiating other countries' import requirements for Australian animals and plants. Further information can be found at agriculture.gov.au.

The administrative authority for national quarantine is vested in DAFF under the Australian Government *Biosecurity Act 2015*. Quarantine policies are developed through the Biosecurity Import Risk Analysis (BIRA) process. This process is outlined in the BIRA Guidelines 2016 (Department of Agriculture and Water Resources, 2016). DAFF maintains barrier quarantine services at all Australian international sea and airports, and in the Torres Strait region. The management of quarantine policy, as it relates to the introduction into Australia of fruit, seed, or other plant material, is the responsibility of DAFF.

The Australian Biosecurity Import Conditions Database (BICON) contains the current Australian import conditions for more than 20,000 foreign plants, animal, mineral, and human products and is the first point of access to information about Australian import requirements for a range of commodities. It can be used to determine if a commodity intended for import to Australia requires a quarantine import permit and/or treatment or if there are any other quarantine prerequisites. BICON can be accessed at agriculture.gov.au/import/bicon. For export conditions see the Manual of Importing Country Requirements (MICoR) database at https://micor.agriculture.gov.au/Pages/default.aspx.

The Australian Government is responsible for the inspection of machinery and equipment being imported into Australia. Any machinery or equipment being imported into Australia must meet quarantine requirements. If there is any uncertainty, contact DAFF on 1800 900 090, or visit the website at awe.gov.au/biosecurity-trade/import/online-services/bicon.

The World Trade Organization (WTO) SPS Agreement facilitates international trade while providing a framework to protect the human, animal, and plant health of WTO members. SPS measures put in place must minimise negative effects on trade while meeting an importing country's appropriate level of protection. For plant products, these measures are delivered through the IPPC standard setting organisations and collaboration with portfolio industries and exporters. For more information on the IPPC visit ippc.int.

State and regional level – movement restrictions

The ability to control movement of materials that can carry and spread papaya pests is of high importance. Each state/territory may have quarantine legislation in place to control the importation of papaya fruit and or papaya pest carriers interstate and intrastate, and to manage agreed pests if an incursion occurs (contact details in Table 8). Further regulations have been put in place in response to specific pest threats and these are regularly reviewed and updated by state/territory authorities and the Subcommittee on Market Access, Risk and Trade (SMART; previously the Subcommittee for Domestic Quarantine and Market Access (SDQMA)).

Moving plant material between states/territories generally requires permits from the appropriate authority, depending on the plant species and which territory/state the material is being transferred to/from. Moving plant material intrastate may also require a permit from the appropriate authority. Information on pre-importation inspection, certification and treatments and/or certification requirements for movement of papaya can be obtained by contacting your local state or territory agriculture department directly (contact details in Table 8), or through the SMART website[64] which lists relevant contacts in each state/territory as well as Interstate Certification Assurance (ICA) documents relating to each state/territory.

The movement of farm vehicles and equipment between states is also restricted because of the high risk of inadvertently spreading pests and weed seed. Each state/territory has quarantine legislation in place governing the movement of machinery, equipment, and other potential sources of pest contamination. Further information can be obtained by contacting your local state/territory agriculture department (contact details in Table 8).

[64] https://interstatequarantine.org.au/

Table 8. Interstate and interregional movement of plant products – legislation, quarantine manuals and contact numbers.

STATE	ADMINISTERING AUTHORITY	LEGISLATION	LINKS TO QUARANTINE MANUAL	PHONE
ACT	Environment ACT environment.act.gov.au	*Plant Disease Act 2002* *Pest Plants and Animals Act 2005*	https://www.environment.act.gov.au/__data/assets/pdf_file/0007/902293/act-biosecurity-strategy-2016-2026.pdf	13 22 81
NSW	Department of Primary Industries dpi.nsw.gov.au	*Biosecurity Act 2015* *Biosecurity Regulation 2017* *Biosecurity Order (Permitted Activities) 2017* and other supporting legislation such as Control Orders	https://www.dpi.nsw.gov.au/biosecurity/managing-biosecurity/legislation	(02) 6391 3384
NT	Department of Agriculture and Fisheries, Northern Territory https://daf.nt.gov.au/biosecurity	*Plant Health Act 2008* *Plant Health Regulations 2011*	https://industry.nt.gov.au/__data/assets/pdf_file/0011/396587/Plant-Quarantine-Manual.pdf	(08) 8999 2118
QLD	Biosecurity Queensland, a part of the Department of Agriculture and Fisheries, Queensland daf.qld.gov.au/biosecurity	*Biosecurity Act 2014* *Biosecurity Regulation 2016*	https://www.daf.qld.gov.au/__data/assets/pdf_file/0004/379138/qld-biosecurity-manual.pdf	132 523
SA	Primary Industries and Regions SA pir.sa.gov.au	Plant Health Act 2009 Plant Health Regulations 2022	pir.sa.gov.au/biosecurity/plant_health/importing_commercial_plants_and_plant_products_into_south_australia	(08) 8207 7820
TAS	Biosecurity Tasmania, a part of the Department of Natural Resources and the Environment Tasmania https://nre.tas.gov.au/biosecurity-tasmania	Biosecurity Act 2019 Plant Quarantine Act 1997 Weed Management Act 1999	https://nre.tas.gov.au/documents/Plant%20Biosecurity%20Manual%20Tasmania.pdf	1300 368 550
VIC	Agriculture Victoria, a part of the Department of Energy, Environment and Climate Action https://agriculture.vic.gov.au/	Plant Biosecurity Act 2010 Plant Biosecurity Regulations 2016	agriculture.vic.gov.au/psb	136 186
WA	Department of Primary Industries and Regional Development agric.wa.gov.au/	Biosecurity and Agriculture Management Act 2007	https://www.agric.wa.gov.au/qtine/default.asp	(08) 9368 3333

New South Wales

Information on pre-importation inspection, certification and treatment requirements may be obtained from NSW DPI Regulatory Services by phone 02 6391 3384 or by visiting the NSW Department of Primary Industries website dpi.nsw.gov.au/aboutus/about/legislation-acts/plant-diseases.

Northern Territory

Administrative authority for regional quarantine in the Northern Territory (NT) is vested in the Department of Primary Industry and Resources (DPIR) under the Plant Health Act 2008 and Plant Health Regulations 2011. The Act enables notifiable pests to be gazetted, quarantine areas to be declared and inspectors appointed to carry out wide ranging control and/or eradication measures. Plant import requirements for particular pests, plants or plant related materials are identified in the Regulations. Further information on NT import requirements and treatments can be obtained by contacting NT Quarantine on (08) 8999 5511 or email quarantine@nt.gov.au.

For more information refer to the NT DPIR website dpir.nt.gov.au/.

Queensland

Information on specific pre-importation inspection, treatments and/or certification requirements for movement of any fruit or plant material into Queensland, as well as maps of pest quarantine areas, may be obtained from the Biosecurity Queensland part of the DAF QLD website (Restrictions on moving plant material, soil and related equipment into Queensland | Business Queensland).

Further details can be obtained from the DAF Queensland Customer Service Centre by phoning 13 25 23 or by fax 07 3404 6900.

South Australia

Information on pre-importation inspection, certification and treatments and/or certification requirements for movement of fruit or plant material in South Australia (SA) may be obtained from Biosecurity SA - Plant Health by phone (08) 8207 7820 or fax (08) 8207 7844. Further information can be found at pir.sa.gov.au/biosecurity/plant_health.

Primary Industries and Regions South Australia (PIRSA) have strict regulations and requirements regarding the entry of plant material (fruit, vegetables, flowers, plants, soil and seeds) into the State.

For further information on import conditions consult the Plant Quarantine Standard (pir.sa.gov.au/biosecurity/plant_health/importing_commercial_plants_and_plant_products_into_south_australia).

Tasmania

Information on specific pre-importation inspection, treatments and/or certification requirements for movement of any fruit or plant material into Tasmania may be obtained from the Department of Primary Industries, Parks, Water and Environment (DPIPWE) Biosecurity website (www.dpipwe.tas.gov.au/biosecurity) or by phoning 1300 368 550.

General and specific import conditions apply to the importation of plant material into Tasmania to prevent the introduction of pests and diseases into the State. Plants and plant products must not be imported into Tasmania unless State import requirements are met and a Notice of Intention to import has been provided to a Biosecurity Tasmania inspector not less than 24 hours prior to the importation.

For further information on import conditions consult the Plant Quarantine Manual (dpipwe.tas.gov.au/biosecurity-tasmania/plant-biosecurity/plant-biosecurity-manualhttp://dpipwe.tas.gov.au/biosecurity/plant-biosecurity/plant-biosecurity-manual).

Victoria

The movement into Victoria of plants and plant products may be subject to a prohibition, or to one or more conditions which may include chemical treatments. These prohibitions and conditions are described on the Department of Jobs, Precincts and Regions (DJPR) website (see link in Table 8). Some items may need to be presented to a DJPR inspector or an accredited business, for checking of details such as correct certification, labelling or treatment.

Further information on pre-importation inspection, certification and treatments and/or certification

requirements for movement of fruit or plant material into or within Victoria may be obtained from DJPR on the web at agriculture.vic.gov.au/psb or by phone 136 186.

Western Australia

The lead agency for agricultural biosecurity in Western Australia is the Department of Primary Industries and Regional Development (DPIRD). Western Australia is naturally free from a large number of pests and diseases that are present in many other parts of the world. WA's geographical isolation in conjunction with a robust plant biosecurity system including border and intrastate regulations, industry and public awareness campaigns and surveillance programs maintains this status.

There are general and specific legislative requirements which underpin Western Australian plant biosecurity. Amongst other things the legislation regulates movement of potential carriers (such as plant material, honey, machinery, seeds etc.) into and within the state.

General conditions include (but are not limited to the following):

- The requirement for all potential carriers to be presented to an inspector for inspection upon arrival in WA
- Soil is prohibited entry and imported goods, including containers, must be free from soil
- Freedom from pests and diseases of quarantine concern to WA

In addition to the general requirements, specific requirements are also in place for movement into and within the state.

For further information on requirements contact Quarantine WA on (08) 9368 3333.

Farm level – exclusion activities

A significant risk of spreading pests onto farms arises when propagation material, people, machinery and equipment move from property to property and from region to region. It is the responsibility of the industry and the owner/manager of each property to ensure these risks are minimised.

It is in the interests of industry to encourage and monitor the management of risk at the farm level, as this will reduce the probability of pest entry and increase the probability of early detection. This should in turn reduce the likelihood of a costly incident response, thereby reducing costs to industry, government and the community.

One major way this can be achieved is through management of industry biosecurity at the farm level using exclusion practices. Further detail on potential strategies is included in the Farm Biosecurity section (page). The Australian Papaya Industry is already a strong supporter of farm biosecurity; but should continue to further extend this message of promoting good farm hygiene in a wide range of ways.

Surveillance

Surveys enhance prospects for early detection, minimises costs associated with eradication and are necessary to meet the treaty obligations of the WTO SPS Agreement with respect to the area freedom status of Australia, Australian states and territories and intra state/territory regions.

The SPS Agreement gives WTO members the right to impose SPS measures to protect human, animal and plant life health provided such measures do not serve as technical barriers to trade. In other words, for countries (such as Australia) that have signed the SPS Agreement, imports of food, including fresh fruit and cherries, can only be restricted on proper, science-based quarantine grounds. Where quarantine conditions are imposed, these will be the least trade restrictive measures available that meet Australia's appropriate level of quarantine protection. The SPS Agreement also stipulates that claims of area freedom must be supported by appropriate information, including evidence from surveillance and monitoring activities. This is termed "evidence of absence" data and is used to provide support that we have actively looked-for pests and not found them.

ISPM No. 6 (ippc.int/sites/default/files/documents/20140528/spec_61_revispm6_2014-05-28_201405281352--150.18%20KB.pdf) provides international guidelines for structured pest surveys. Structured pest survey planning and implementation depends on the risk involved, the resources available, and the requirements of trading partners (particularly when Australia wishes to access overseas markets). The intensity and timing of surveys also depend on the spread characteristics of the pest, detection techniques available and the potential impact of the pest.

Early detection of an exotic pest incursion can significantly increase the likelihood of a successful eradication campaign and reduce the associated costs. Effective surveillance plays a critical role in working toward this goal. Surveillance can be either targeted toward specific pests, or general in nature. General non-targeted surveillance is based on recognising normal versus suspect plant material. Targeted surveillance is important to determine the presence or absence in each area (state/territory or region.

Industry personnel can provide very effective early detection of new or unusual symptoms through their normal management practices (i.e. 'passive surveillance'), provided individuals are aware of what to look for and of reporting procedures. Consultants and crop scouts can provide valuable information as they are regularly in the field, and hence can observe any unusual pest activity or symptoms on plants.

National surveillance programs

The Department of Agriculture, Fisheries and Forestry (DAFF) maintains barrier quarantine services at all international ports and in the Torres Strait region. DAFF also surveys the northern coast of Australia, offshore islands and neighbouring countries for exotic pests that may have reached the country through other channels (e.g., illegal vessel landings in remote areas, bird migrations, wind currents) as part of the Northern Australia Quarantine Strategy (NAQS).[65] NAQS surveillance programs relevant to the Australian Papaya Industry are listed in Table *9*.

State surveillance programs

State level surveillance depends on the participation of all stakeholder groups, particularly state/territory agriculture departments, industry representative groups, agri-businesses and growers.

The state/territory agriculture department can provide:

- planning and auditing of surveillance systems,
- coordination of surveillance activities between industry and interstate groups,
- diagnostic services,
- field diagnosticians for special field surveillance,
- surveillance on non-commercial sites,
- liaison services with industry members,

[65] https://www.agriculture.gov.au/biosecurity-trade/policy/australia/naqs

- communication, training and extension strategies with industry,
- biosecurity training, and
- reporting services to all interested parties (DAFF, national bodies, trading partners and industry).

Various pest surveillance programs are managed by the DAFF and the state/territory agriculture departments. Many state/territory agriculture agencies run diagnostic programs whereby samples of pests suspected to be EPP or HPP can be forwarded to the local agency and diagnosed for the presence of exotic pests free of charge. Official surveillance programs that target pests of the Australian Papaya Industry (exotic or those under official control in a region or state/territory) are shown in Table *9*.

Table 9. Official surveillance programs that target pests of the Passionfruit industry (as of July 2020). [66]

SURVEILLANCE PROGRAM	TARGET PEST(S)	TARGET HOST(S)
Australian Government		
External Territories Surveillance Program	High priority exotic pests	Various environmental, production and ornamental plants
International Plant Health Surveillance Program	High priority exotic pests	Tropical horticultural, environmental and agricultural species
National Bee Pest Surveillance Program	*Varroa destructor, V. jacobsoni, Tropilaelaps clareae, T. mercedesae, Acarapis woodi, Oplostoma fuligineus, Braula coeca,* acute bee paralysis virus, deformed wing virus, slow paralysis virus, *Apis cerana, A. dorsata, A. florea, Bombus terrestris* and new exotic swarms of *A. mellifera*	Bee swarms at first points of entry
National Border Surveillance Program	Specific high priority exotic pests and any pest belonging to key taxonomic groups	Plant families of high economic importance and known or potential key hosts of specific exotic pests, focusing on regulatory import pathway risks
National Plant Health Surveillance Program (delivered through states and territories)	High priority exotic pests including exotic gypsy moth and fruit fly species	Various, based on the species surveyed
Northern Australia Quarantine Strategy – exotic fruit fly trapping	Exotic fruit flies including *Bactrocera dorsalis, B. latifrons, B. trivialis, B. umbrosa, Zeugodacus atrisetosa, Z. cucurbitae, Z. decipiens*	Various
Northern Australia Quarantine Strategy – pest and disease surveys	123 high priority exotic pests, diseases and weeds	Tropical horticultural, environmental and agricultural species
Within New South Wales		
Exotic fruit flies – Riverina	Mediterranean fruit fly (*Ceratitis capitata*), other tri lure responsive exotic fruit flies	Various horticultural crops (citrus, stone fruit)
Exotic longhorn beetle trapping	Asian longhorn beetle (*Anoplophora glabripennis*), Japanese pine sawyer beetle (*Monochamus alternatus*), brown mulberry longhorn beetle (*Apriona germari*)	Various hosts around ports
National Bee Pest Surveillance Program	*Varroa destructor, V. jacobsoni, Tropilaelaps clareae, T. mercedesae, Acarapis woodi, Oplostoma fuligineus, Braula coeca,* acute bee paralysis virus, deformed wing virus, slow paralysis virus, *Apis cerana, A. dorsata, A. florea, Bombus terrestris* and new exotic swarms of *A. mellifera*	Ports and surrounding environment

[66] Information presented has been taken from the National Plant Biosecurity Status Report 2020 and confirmed by the Sub-committee on National Plant Health Surveillance (sub-committee of the Plant Health Committee) and NAQS

National Plant Health Surveillance Program – multi pest surveillance	Multiple including *Bactrocera albistrigata, B. carambolae, B. caryae, B. correcta, B. curvipennis, B. dorsalis, B. facialis, B. kandiensis, B. kirki, B. melanotus, B. occipitalis, B. passiflorae, B. psidii, B. trilineola, B. trivialis, B. umbrosa, B. xanthodes, B. zonata, Ceratitis capitata, Zeugodacus cucurbitae, Z. tau,* gypsy moth (*Lymantria* spp.), glassy winged sharpshooter *(Homalodisca vitripennis), Xylella fastidiosa,* fire blight *(Erwinia amylovora),* brown marmorated stink bug *(Halyomorpha halys),* exotic mites *(including Brevipalpus* spp., *Aceria granati*), Asian citrus psyllid *(Diaphorina citri)*, African citrus psyllid *(Trioza erytreae)*, huanglongbing (*Candidatus* Liberibacter asiaticus), citrus canker *(Xanthomonas axonopodis* subsp. *citri)*, and invasive ants *(Solenopsis* spp., *Wasmannia auropunctata*, *Anoplolepis gracilipes*)	Multiple
Serpentine leafminer	Serpentine leafminer (*Liriomyza huidobrensis*)	Multiple horticultural and ornamental hosts
Within the Northern Territory		
Area Freedom Surveillance Program	Queensland fruit fly (*Bactrocera tryoni*)	Horticultural crops
National Bee Pest Surveillance Program	*Varroa destructor, V. jacobsoni, Tropilaelaps clareae, T. mercedesae, Acarapis woodi, Oplostoma fuligineus, Braula coeca, Aethina tumida,* acute bee paralysis virus, deformed wing virus and slow paralysis virus, *Apis cerana, A. dorsata, A. florea, Bombus terrestris,* and new exotic swarms of *A. mellifera*	Ports and surrounding environment
National Plant Health Surveillance Program – multi pest surveillance	Multiple including citrus canker (*Xanthomonas axonopodis* pv. *citri*), huanglongbing (*Candidatus* Liberibacter spp.), Asiatic citrus psyllid (*Diaphorina citri*), giant African snail (*Achatina fulica*), glassy winged sharpshooter (*Homalodisca vitripennis*), Pierce's disease (*Xylella fastidiosa*), banana black sigatoka (*Mycosphaerella fijiensis*), red imported fire ant (*Solenopsis invicta*), electric ant (*Wasmannia auropunctata*), yellow crazy ant (*Anoplolepis gracilipes*), *Bactericera cockerelli*, *Candidatus* Liberibacter solanacearum, potato leafminer, pea leafminer, serpentine leafminer (*Liriomyza huidobrensis*), American leafminer (*Liriomyza trifolii*), vegetable leafminer (*Liriomyza sativae*), exotic fruit flies (*Bactrocera* spp. and *Ceratitis* spp.)	Multiple
Plant Pest Diagnostic Service – horticulture	All pests and pathogens that can affect horticultural crops (mango, chilli, watermelon, Cucurbitaceae)	Horticultural crops
Regional Fruit Fly Monitoring and Surveillance	Exotic fruit flies (*Bactrocera* spp. and *Ceratitis* spp.)	Horticultural crops
Within Queensland		
Area freedom surveys	Multiple pests	Multiple
Exotic Fruit Fly in the Torres Strait Program	Exotic fruit fly including *Bactrocera* and *Zeugodacus* spp.	Multiple
Grow Help Australia diagnostic service project	All pests and pathogens that can affect horticultural crops, national parks, gardens, hobby growers and home gardeners. Commonly encountered pathogens include *Phytophthora* spp., *Fusarium* spp., *Colletotrichum* spp., *Alternaria* spp., *Rhizoctonia* spp., *Pythium* spp., *Ralstonia* spp., *Erwinia* spp. and viruses	Fruit, vegetable and ornamental hosts
National Bee Pest Surveillance Program	*Varroa destructor, V. jacobsoni, Tropilaelaps clareae, T. mercedesae, Acarapis woodi, Oplostoma fuligineus, Braula coeca, Aethina tumida,* acute bee paralysis virus, deformed wing virus and slow paralysis virus, *Apis cerana, A. dorsata, A. florea, Bombus terrestris,* and new exotic swarms of *A. mellifera*	Ports and surrounding environment
National Plant Health Surveillance Program	Multiple, including exotic fruit flies and Mediterranean fruit fly (*Ceratitis capitata*), exotic gypsy moths, Pierce's disease (*Xylella fastidiosa*) and	Multiple

– multi pest surveillance	glassy winged sharpshooter (*Homalodisca vitripennis*), and brown marmorated stink bug (*Halyomorpha halys*).	
Bee pest and pest bee diagnostic service	Multiple pests	European honey bee
Within South Australia		
Area freedom surveys	Multiple pests	Multiple
Bee surveillance – endemic disease	American foulbrood (*Paenibacillus* spp.)	European honey bees
Mediterranean fruit fly	Mediterranean fruit fly (*Ceratitus capitata*)	Horticultural crops
National Bee Pest Surveillance Program	*Varroa destructor, V. jacobsoni, Tropilaelaps clareae, T. mercedesae, Acarapis woodi, Oplostoma fuligineus, Braula coeca,* acute bee paralysis virus, deformed wing virus and slow paralysis virus, *Apis cerana, A. dorsata, A. florea, Bombus terrestris* and new exotic swarms of *A. mellifera*	Ports and surrounding environment
National Plant Health Surveillance Program – multi pest surveillance	Multiple, including exotic invasive ants (tramp ants), Asian and African citrus psyllids (*Diaphorina citri*, *Candidatus* Liberibacter africanus), huanglongbing (*Candidatus* Liberibacter asiaticus), citrus canker (*Xanthomonas axonopodis* pv. *citri*), glassy winged sharpshooters (*Homalodisca vitripennis* and *H. coagulata*), brown mamorated stink bug (*Halyomorpha halys*), xylella (*Xylella fastidiosa*)	Multiple
Ports of Entry Trapping Program	Multiple – *Bactrocera albistrigata, B. carambolae, B. caryae, B. correcta, B. curvipennis, B. dorsalis, B. facialis, B. kandiensis, B. kirki, B. melanotus, B. occipitalis, B. passiflorae, B. psidii, B. trilineola, B, trivialis, B. tryoni, B. umbrosa, B. xanthodes, B. zonata, Ceratitis capitata, C. rosa, Zeugodacus cucurbitae, Z. tau*	Various fruit fly hosts
Mediterranean fruit fly	Mediterranean fruit fly (*Ceratitis capitata*)	Horticultural crops
Queensland fruit fly	Queensland fruit fly (*Bactrocera tryoni*)	Horticultural crops
Within Tasmania		
Bee surveillance – endemic disease and pests	American foulbrood (*Paenibacillus* spp.), European foulbrood (*Melissococcus pluton*), chalkbrood (*Ascophera apis),* sacbrood (*Nosema apis, N. ceranae),* sacbrood virus (*Morator aetatulas*), greater wax moth *(Galleria mellonella)*, lesser wax moth (*G. achroia grisella)*, European wasps (*Vespula germanica*), *Braula coeca,* bumble bee *(Bombus terestris)*	European honey bees
Fruit fly trapping surveillance	*Bactrocera dorsalis, B. tryoni, Ceratitis capitata* and exotic fruit flies	Host fruit trees, fruit and vegetables
National Bee Pest Surveillance Program	*Varroa destructor, V. jacobsoni, Tropilaelaps clareae, T. mercedesae, Acarapis woodi, Oplostoma fuligineus, Aethina tumida*, acute bee paralysis virus, deformed wing virus and slow paralysis virus, *Apis cerana, A. dorsata, A. florea, Bombus terrestris* and new exotic swarms of *A. mellifera*	Ports and surrounding environment
National Plant Health Surveillance Program – multi pest surveillance	Brown marmorated stink bug (*Halyomorpha halys*), citrus canker (*Xanthomonas citri* subsp. *citri*), gypsy moths (including *Lymantria albescens, L. atameles, L. concolor, L. dispar asiatica, L. dispar dispar, L. dispar japonica, L. dissoluta, L. fumida, L. marginata, L. minomonis, L. monacha, L. postalba, L. pulverea, L. sinica, L. umbrosa, L. xylina*), huanglongbing (*Candidatus* Liberibacter asiaticus), *Bactericera cockerelli*, *Diaphorina citri*, *Trioza erytreae*, *B. trigonica*, *Trioza apicallis*, Pierce's disease (*Xylella fastidiosa*), glassy winged sharpshooter (*Homalodisca vitripennis*), *Bactrocera, Zeugodacus* and *Ceratitis spp.* (exotic fruit fly species)	Multiple

Within Victoria		
Alert contacts	All plant pests	All hosts, general surveillance
Exotic fruit flies – Sunraysia	Mediterranean fruit fly (*Ceratitis capitata*)	Various horticultural crops (citrus, stone fruit)
MyPestGuide e-surveillance	All plant pests	All hosts, general surveillance
National Bee Pest Surveillance Program	*Varroa destructor, V. jacobsoni, Tropilaelaps clareae, T. mercedesae, Acarapis woodi, Oplostoma fuligineus, Braula coeca,* acute bee paralysis virus, deformed wing virus, slow paralysis virus, *Apis cerana, A. dorsata, A. florea, Bombus terrestris* and new exotic swarms of *A. mellifera*	Ports and surrounding environment
National Plant Health Surveillance Program – multi pest surveillance	Multiple including citrus canker (*Xanthomonas axonopodis* pv. *citri*), exotic fruit flies (*Bactrocera* spp., *Ceratitis captitata*), Pierce's disease (*Xylella fastidiosa*), glassy winged sharpshooter (*Homalodisca vitripennis*), plum pox virus, Asian gypsy moth (*Lymantria dispar* and other *Lymantria* spp.), brown marmorated stink bug (*Halyomorpha halys*), Asian citrus psyllid (*Diaphorina citri*), African citrus psyllid (*Trioza erytreae*) and spotted wing drosophila (*drosophila suzukii*)	Multiple
Passive MedFly Program	Mediteranean fruit fly (*Ceratitis capitata*)	Fruit trees in backyards
Urban Plant Health Network	Various, including brown marmorated stink bug (*Halyomorpha halys*), Asian citrus psyllid (*Diaphorina citri*), African citrus psyllid (*Trioza erytreae*), Asian honeybee, red imported fire ant (*Solenopsis invicta*), spotted wing drosphila (drosophila suzukii) and glassy winged sharpshooter (*Homalodisca vitripennis*)	Multiple plant hosts in periurban landscape, including community gardens
Within Western Australia		
Ant Blitz	Browsing ant (*Lepisiota frauenfeldi*), Red Imported Fire Ant (*Solenopsis invicta*), Small black sugar ant (*Lepisiota capensis*)	Urban areas
Biosecurity Blitz	All plant pests	General surveillance, all hosts
Medfly Area Freedom (Ord River Irrigation Area)	Mediterranean fruit fly (*Ceratitis capitata*)	Many horticultural hosts
MyPestGuide e-surveillance	All plant pests	All hosts, general surveillance
National Bee Pest Surveillance Program	*Varroa destructor*, *V. jacobsoni*, *Tropilaelaps clareae*, *T. mercedesae*, *Acarapis woodi*, *Oplostoma fuligineus*, *Braula coeca*, acute bee paralysis virus, deformed wing virus, slow paralysis virus, *Apis cerana*, *A. dorsata*, *A. florea*, *Bombus terrestris* and new exotic swarms of *A. mellifera*	Ports and surrounding environment
National Plant Health Surveillance Program – multi pest surveillance	Multiple including Asian citrus psyllid (*Diaphorina citri*), citrus canker (*Xanthomonas axonopodis* pv. *citri*), citrus longicorn beetle (*Anoplophora chinensis*), glassy winged sharpshooter (*Homalodisca vitripennis*), xylella (*Xylella fastidiosa*), brown marmorated stink bug (*Halyomorpha halys*)	Pome and citrus crops
Port of Entry – Asian gypsy moth trapping	Asian gypsy moth (*Lymantria dispar*)	More than 600 forest, orchard, ornamental and native species
Port of Entry – fruit fly trapping	Various *Bactrocera* and *Ceratitis* spp.	Horticultural hosts
Queensland fruit fly surveillance	Queensland fruit fly (*Bactrocera tryoni*)	Many horticultural hosts

Farm level pest monitoring

Farm level monitoring involves the participation and interaction of growers, agribusinesses and industry representative groups. Examples of the surveillance activities that can be carried out by each of these groups are outlined in Figure 3. Conducting regular surveys of farms and nurseries provides the best chance of spotting new plant pests early and implementing eradication or management responses.

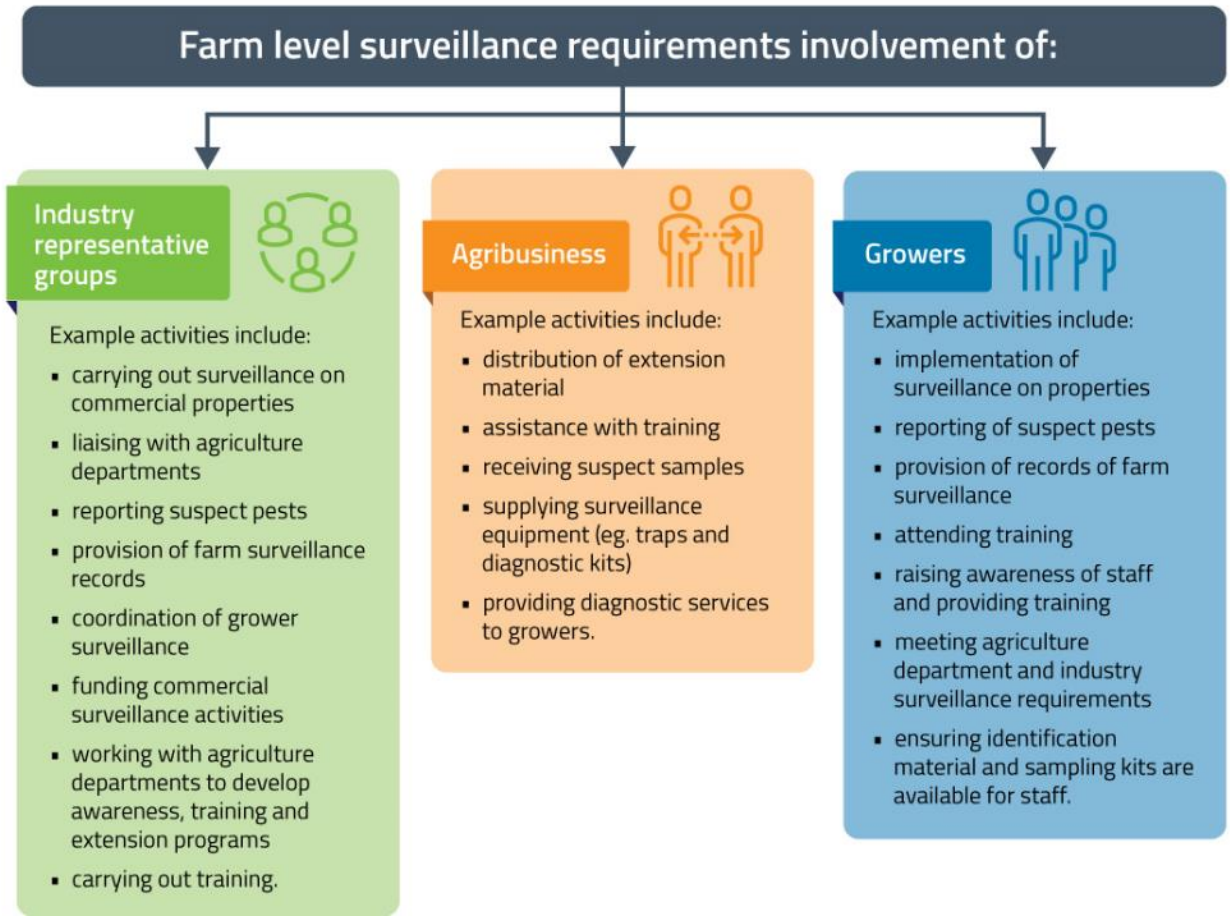

Figure 3. Examples of farm level surveillance activities.

Training

A key component of biosecurity preparedness is ensuring personnel engaged are effectively trained for their designated roles in a response. Biosecurity preparedness training is the responsibility of all governments and industries involved in the biosecurity system.

National EPP Training Program

PHA supports members in training personnel through the delivery of the National EPP Training Program. This program is focussed on ensuring personnel from relevant governments and peak industry bodies who will be involved in responding to exotic plant pest incursions have the skills and knowledge to effectively fulfil the roles and responsibilities of their parties, as signatories to the EPPRD. This covers a range of areas, from representatives on the national decision-making committees (i.e. the Consultative Committee on Emergency Plant Pests and the National Management Group) through to industry liaison personnel in the State Coordination or Local Control Centres.

In addition to face to face training delivered to members and the provision of simulation exercises, PHA also offers biosecurity training through the Biosecurity OnLine Training (BOLT) platform which houses a variety of eLearning courses relevant to plant biosecurity. Access to BOLT is free and open to any stakeholder interested in biosecurity and is available through planthealthaustralia.com.au/bolt.

For more information on the National EPP Training program, refer to planthealthaustralia.com.au/training.

Awareness

Early reporting enhances the chance of effective control and eradication. Awareness activities raise the profile of biosecurity and exotic pest threats to the Australian Papaya Industry, which increases the chance of early detection and reporting of suspect pests. Responsibility for awareness material lies with industry and government, with assistance from PHA as appropriate. Any unusual plant pest should be reported immediately to the relevant state/territory agriculture department through the Exotic Plant Pest Hotline (1800 084 881).

Pests contained in Table 1 have been identified as high priority plant pest threats to the Australian Papaya industry by members of the TEG. They have been assessed as having high entry, establishment and spread potentials and/or a high economic impact. This list should provide the basis for the development of awareness material for the industry.

Further information on high priority pests

The websites listed below contain information on pests across most plant industries, including the Papaya industry.

Table 10. Sources of information on high priority pest threats for the Papaya industry.

SOURCE	WEBSITE
CABI – Crop Protection Compendium	cabi.org/cpc/
DAF QLD Priority plant pests and diseases	https://www.business.qld.gov.au/industries/farms-fishing-forestry/agriculture/crop-growing/priority-pest-disease
Department of Agriculture, Water and the Environment	agriculture.gov.au
European and Mediterranean Plant Protection Organization (EPPO)	eppo.int/DATABASES/pqr/pqr.htm
Plant Health Australia (PHA)	planthealthaustralia.com.au/
Pest and Disease Image Library (PaDIL)	padil.gov.au/
University of California Statewide Integrated Pest Management (IPM) Program	ipm.ucdavis.edu/EXOTIC/exoticpestsmenu.html

Further information/relevant websites

A range of government and grower organisation details and websites for persons seeking further information on Papaya industry biosecurity (Table 11).

Table 11. Industry and government contact details.

AGENCY	WEBSITE/EMAIL	PHONE	ADDRESS
National			
Papaya Australia	australianpapaya.com.au/	0488 932 123	
Department of Agriculture	agriculture.gov.au	(02) 6272 3933 1800 020 504	GPO Box 858 Canberra, ACT 2601
Plant Health Australia	planthealthaustralia.com.au biosecurity@phau.com.au	(02) 6215 7700	Level 1, 1 Phipps Cl Deakin, ACT 2600
New South Wales			
Department of Primary Industries	dpi.nsw.gov.au/biosecurity/plant	(02) 6391 3535	Locked Bag 21 Orange, NSW 2800
Queensland			
Biosecurity Queensland, a part of the Department of Agriculture and Fisheries, Queensland	daf.qld.gov.au info@daf.qld.gov.au	13 25 23	41 George Street Brisbane, QLD 4000
Northern Territory			
Department of Industry, Tourism and Trade	industry.nt.gov.au/	(08) 8999 5511	Berrimah Farm, Science Precinct 29, Makagon Road Berrimah, NT 0828
South Australia			
Primary Industries and Regions SA	pir.sa.gov.au	(08) 8207 7820	GPO Box 1671 Adelaide, SA 5001
Biosecurity SA-Plant Health	pir.sa.gov.au/biosecuritysa/planthealth PIRSA.planthealth@sa.gov.au	(08) 8207 7820	33 Flemington Street Glenside, SA 5065
Biosecurity SA-Plant Health Market access and Interstate Certification Assurance	IRSA.planthealthmarketaccess@sa.gov.au	(08) 8207 7814	
Biosecurity SA-Plant Health Transport manifest lodgement	pirsa.planthealthmanifest@sa.gov.au	Fax: (08) 8124 1467	

South Australian Research and Development Institute	sardi@sa.gov.au	(08) 8303 9400	2b Hartley Grove Urrbrae, SA 5064
Tasmania			
Department of Primary Industries, Parks, Water and Environment	dpipwe.tas.gov.au BPI.Enquiries@dpipwe.tas.gov.au	1300 368 550	GPO Box 44, Hobart, TAS 7001
Victoria			
Department of Jobs, Precincts and Regions	economicdevelopment.vic.gov.au/	136 186	CPHO Group, Division of Market Access and Regulation, Biosecurity Branch Department of Jobs, Precincts and Regions 475 Mickleham Road, Attwood, Victoria 3047
Western Australia			
Department of Primary Industries and Regional Development	agric.wa.gov.au/	(08) 9368 3333	DPIRD, 1 Nash Street, Perth, WA 6000 DPIRD, Locked Bag 4, Bentley Delivery Centre, WA 6983

Farm biosecurity

Introduction

Plant pests can have a major impact on production if not managed effectively. This includes pests already present in Australia and a number of serious pests of papaya that are not currently known to be present in Australia.

Farm biosecurity measures can be used to minimise the impacts of both exotic and established plant pests The farm biosecurity and hygiene measures outlined in this section, can be considered as options for each farm's risk management. Many of these measures can be implemented in a range of different ways, so that the individual needs of any given farm can be addressed, and each farm can have an appropriate level of biosecurity.

Farm biosecurity measures, reporting procedures and hygiene strategies that reduce the impact of plant pest threats covered in this document are:

- selection and preparation of appropriate planting material,
- appropriate use of chemical and other plant pest control measures,
- control of vectors,
- control of alternative hosts,
- management of neglected farms and volunteer plants,
- post-harvest handling and produce transport procedures,
- use of warning and information signs,
- managing the movement of vehicles and farm equipment,
- managing the movement of people,
- how to safely visit other farms/orchards (including interstate and international trips) – what to watch out for when you return,
- including farm biosecurity in industry best management practice and quality assurance schemes, and
- an example farm biosecurity checklist.

Development of an specific farm biosecurity plan tailored to the needs of an individual business or farm is a good way to integrate best practice biosecurity into day-to-day operations (farmbiosecurity.com.au/planner/).

Further information on farm biosecurity can be found at farmbiosecurity.com.au.

Reporting suspect emergency plant pests

Rapid reporting of exotic plant pests is critical as early detection gives Australia the best chance to effectively control and eradicate pests. If you find something you believe could be an exotic plant pest, call the Exotic Plant Pest Hotline immediately to report it to your local state or territory government.

The one phone number – 1800 084 881 – will connect to an automated system that allows the caller to choose the state or territory that the report relates to. The caller will then be connected to the relevant authority for that jurisdiction. Most lines are only monitored during business hours. Messages can be left outside of those hours and calls will be returned as soon as an officer is available. A summary of the opening hours for each state and territory is provided in Table *12***.** Each jurisdiction also has an alternative contact to ensure no report is missed. It does not matter which of these methods is used to report a suspect exotic plant pest. The important thing is to report it.

Calls to the Exotic Plant Pest Hotline will be answered by an experienced person, who will ask some questions to help understand the situation, such as:

- What was seen (describe the pest or send a photo)
- Where it was found
- What it was found on
- How many pests are present/how infected is the crop
- How widely distributed it is
- When it was first noticed

It is important not to touch or move the suspect material as this may spread the exotic pest or render samples unsuitable for diagnostic purposes. A biosecurity officer may attend the location to inspect and collect a sample. In some cases, the biosecurity officer will explain how to send a sample for testing. In this circumstance they will explain how to do this without risk of spreading the pest and ensuring it arrives at the laboratory in a suitable condition for identification.

Every report will be taken seriously, will be followed up and treated with confidentiality.

Table 12. Exotic Plant Pest Hotline hours of operation and Alternate contact information for reporting per jurisdiction.

STATE/TERRITORY	HOTLINE HOURS	ALTERNATIVE CONTACT
NSW	Operates 08:30 – 16:30 Monday to Friday. After hours answering machine service with messages followed up the next business day.	biosecurity@dpi.nsw.gov.au
NT	Operates 08:00 – 16:30 Monday to Friday. After hours answering machine service with messages followed up the next business day.	quarantine.NT@nt.gov.au
QLD	Operates 08:00-17:00 Monday to Friday (09:00-17:00 Thursday). Calls outside these hours answered by a third party who will take the message and depending on the urgency of the report, organise a response from a biosecurity officer as soon as possible.	Biosecurity Queensland on 13 25 23 https://www.daf.qld.gov.au/contact/report-a-biosecurity-pest-or-disease
SA	Operates 24 hrs/ 7 days	Online plant pest report form
TAS	Operates 24 hrs/ 7 days	Biosecurity Tasmania on (03) 6165 3777
VIC	Operates 08:00 – 18:00 Monday to Friday. After hours answering machine service with messages followed up the next business day. Option also to forward to the 24 hr Emergency Animal Disease Watch Hotline.	plant.protection@ecodev.vic.gov.au
WA	Operates 08:30 – 16:30 Monday to Friday. After hours answering machine service with messages followed up the next business day.	info@agric.wa.gov.au

Recent changes to legislation in some states includes timeframes for reporting and have implications for those who do not report. It is important that individuals know the obligations for their state or territory.

Some papaya pests are notifiable under each state or territory's quarantine legislation. Each state or territory's list of notifiable pests are subject to change over time so contacting your local state/territory agricultural agency (Table *12*) will ensure information is up to date. Landowners and consultants have a legal obligation to notify the relevant agriculture agency of the presence of those pests within a defined timeframe.

Preparedness

Pest-specific preparedness and response information documents

To help prepare for an incursion response a list of pest-specific preparedness and response information documents are provided in Table 4**.** Over time, as more resources are produced for pests of the Australian Papaya Industry they will be included in this document and made available through the PHA website. Resources include the development of pest-specific information and emergency response documents, such as fact sheets, contingency plans, diagnostic protocols and a summary of surveillance programs currently in operation for these HPP (see www.planthealthaustralia.com.au/pidd). These documents and programs should be developed over time for all medium to high-risk pests listed in the TST.

Fact sheets

Fact sheets or information sheets are a key activity of biosecurity extension and education with growers. Fact sheets provide summary information about the pest, its biology, what it looks like and what symptoms it may cause. They also contain detailed images. Refer to Table 4 for a list of current fact sheets available for papaya producers.

Contingency Plans

Contingency Plans provide background information on the pest biology and available control measures to assist with preparedness for incursions of a specific pest into Australia. A contingency plan provides guidelines for steps to be undertaken and considered when developing a response plan for the eradication of that pest. Any response plan developed using information in whole or in part from a contingency plan must follow procedures as set out in PLANTPLAN and be endorsed by the National Management Group prior to implementation.

For a list of current contingency plans see planthealthaustralia.com.au/pidd.

National Diagnostic Protocols

Diagnostic protocols are documents that contain information about how to diagnose or identify a specific plant pest, or related group of pests. National Diagnostic Protocols (NDP) are nationally agreed diagnostic protocols for the unambiguous taxonomic identification of a pest in a manner consistent with ISPM No. 27 – Diagnostic Protocols for Regulated Pests. NDP include diagnostic procedures and data on the pest, its hosts, taxonomic information, and detection and identification.

Australia has a coherent and effective system for the development of NDP for plant pests managed by the Subcommittee on Plant Health Diagnostics (SPHD). NDP are peer reviewed and verified before being endorsed by Plant Health Committee (PHC).

Endorsed NDP are available on the National Plant Biosecurity Diagnostic Network (NPBDN) website (plantbiosecuritydiagnostics.net.au), together with additional information regarding their development and endorsement.

Diagnostic information for some papaya pests is available through the PHA website (planthealthaustralia.com.au/pidd). For diagnostic information on fruit flies, refer to the Australian Handbook for the Identification of Fruit Flies available from the PHA website. The Handbook is endorsed by the Subcommittee on Plant Health Diagnostics (SPHD).

Research, Development and Extension

Research, Development and Extension – Linking Biosecurity Outcomes to Priorities

Through the biosecurity planning process, gaps in knowledge or the extension of knowledge will have been identified and documented in the implementation table. Some of these gaps will require further research and development (e.g. understanding risk pathways, developing surveillance programs or diagnostic protocols, developing tools to facilitate preparedness and response, developing IPM or resistance breeding strategies), other gaps will require communication or extension of that knowledge to various target audiences

(developing awareness raising materials, undertaking training exercises, running workshops, consideration of broader target audiences).

It is important that the RD&E gaps identified through this plan feed directly into the normal annual RD&E priority setting and strategic planning activities that an industry undertakes. This is fundamental if an industry is to progress biosecurity preparedness and response goals throughout the life of the biosecurity plan.

Market access

As an active trading nation, Australia has entered into a number of multilateral and bilateral trade agreements that influence its plant biosecurity system. On a multilateral level, Australia's rights and obligations in relation to plant biosecurity are set out under World Trade Organization (WTO) agreements, particularly the Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement), although others may apply in certain circumstances.

The SPS Agreement provides WTO member countries with the right to use sanitary and phytosanitary measures to protect human, animal and plant life or health. Under this agreement countries are allowed to specify consistent, science-based conditions aimed at providing sanitary and phytosanitary protection but not unnecessarily restricting trade. The establishment of exotic pests in Australia may result in conditions on Australian exports that previously did not apply and in some cases, may result in the short or long-term loss of overseas markets, depending on the significance of the pest to the trading partner and the availability of options to reduce the risk to acceptable levels. These options could include measures such as pest free areas or place of production or treatments e.g. cold or fumigation. The time taken to regain access will depend on the availability and acceptance of measures to reduce risk and the receiving markets risk appetite.

Market access for the papaya industry

Export is currently not a major focus for the papaya industry. There is limited data to support evidence of substantial export volumes.

Implementation actions

To help maintain or facilitate domestic market access, in the event of an incursion, the papaya industry in partnership with the DAFF and the relevant state and territory governments should develop the following, for the HPP pests:

- Surveillance plan including a method for collecting and storing surveillance data
- Diagnostic protocols that have been assessed in the Australian environment
- Biosecurity treatment measures (e.g. irradiation or fumigation)

Implementation of these actions is recommended for pests with market access implications as this data will also be crucial for maintaining interstate trade should an incursion occur within Australia, resulting in a restricted distribution or quarantine zone. A single system will facilitate market access discussions for both domestic and international trade and will minimise the potential disruption to the industry.

References

Department of Agriculture, Fisheries and Forestry (2011) Import Risk Analysis Handbook 2011. Australian Government Department of Agriculture, Fisheries and Forestry, Canberra.

CABI (2019) CABI Crop Protection Compendium. Available at: cabi.org/cpc/

RESPONSE MANAGEMENT

Introduction

No matter how many preparedness activities are undertaken or how much surveillance is done at the border, a small number of plant pests will inevitably make their way into Australia. This section outlines the national agreements and processes in place to effectively respond to such incursions.

Gathering information, developing procedures, and defining roles and responsibilities during an incident response can be extremely difficult. To address this area, PHA coordinated the development of PLANTPLAN, a national set of incursion response guidelines for the plant sector, detailing the procedures required and the roles and responsibilities of all Emergency Plant Pest Response Deed (EPPRD) signatories affected by the detection of an Emergency Plant Pest (EPP) within Australia.

Currently Papaya Australia is not a member of PHA nor a EPPRD signatory. As such in the event of an incursion and response to an exotic pest, Papaya Australia may not have a formal role in the decision-making processes involved in the response. The following sections would be applicable in the event Papaya Australia becomes a PHA member and EPPRD signatory.

The following section includes key contact details and communication procedures that should be used in the event of an incursion. Additionally, a listing of pest-specific emergency response and information documents are provided that may support a response. Over time, as more of these documents are produced for pests of the Papaya industry they will be included in this document and made available through the PHA website.

The Emergency Plant Pest Response Deed

A fundamental component of the Australian plant biosecurity system is the EPPRD, which is an agreement between the Australian commonwealth, state and territory governments, 38 plant industries (including ALGA) and PHA (collectively known as the signatories), that facilitates the rapid and efficient responses EPP incursions. The EPPRD is a legally binding document that outlines the basic operating principles and guidelines for EPP eradication responses.

The EPPRD provides:

- A national response management structure that enables all governments and plant industry signatories affected by the EPP to contribute to the decisions made about the response.
- An agreed structure for the sharing of costs associated with eradication activities undertaken in response to the detection of EPP in Australia. Costs are divided between signatories affected by the EPP in an equitable manner based on the relative potential impact of the EPP.
- A mechanism to encourage reporting of suspected EPP detections and the implementation of risk mitigation activities.
- A mechanism to reimburse growers whose crops or property are directly damaged or destroyed as a result of implementing a Response Plan.
- Mechanisms to support early detection and response to EPP.
- Rapid responses to EPPs (excluding weeds).
- A framework to ensure that decisions to eradicate are based on appropriate criteria (e.g. eradication must be technically feasible and cost beneficial).
- An industry commitment to biosecurity and risk mitigation and a government commitment to best management practice.
- An Agreed Limit for Cost Sharing.
- An effective industry/government decision-making process.

For further information on the EPPRD, including copies of the EPPRD, fact sheets or Frequently Asked Questions, visit planthealthaustralia.com.au/epprd and planthealthaustralia.com.au/epprd-qa.

PLANTPLAN

PLANTPLAN outlines the generic approach to response management under the EPPRD and introduces the key roles and positions held by industry and government during a response. The document is supported by a number of operating guidelines, job cards and standard operating procedures that provide further detail on specific topics. PLANTPLAN underpins the EPPRD and is endorsed by all EPPRD signatories.

The current version of PLANTPLAN and supporting documents are available on the PHA website (planthealthaustralia.com.au/biosecurity/incursion-management/plantplan/).

For more information about PLANTPLAN and the supporting document visit planthealthaustralia.com.au/biosecurity/incursion-management/plantplan/

Funding a response under the EPPRD

The following section outlines how eradication responses are nationally cost shared between affected industries and governments.

A copy of the EPPRD can be downloaded from the PHA website planthealthaustralia.com.au/epprd.

Cost sharing a response

Affected industries and governments invest in the eradication of EPPs and share the costs of an agreed response plan, this is referred to as 'cost sharing'. Not all activities in a response are eligible to be cost shared, with some activities considered as normal commitments for signatories.

The cost shared costs of a response are divided between affected industries and governments in an equitable manner directly related to the benefit obtained from eradicating the EPP. These relative benefits are represented by the category of the pest, with the overall view that 'the higher the benefit, the greater the investment'.

There are four categories for EPPs (Table *13*). The category indicates how the funding will be split between government and industries; with the government funding the share of public benefit and industry funding the share of private benefit. It does not indicate its likelihood of eradication or its overall importance i.e. an EPP listed as Category 1 is not deemed to be any more or less important than an EPP listed as Category 4.

Table 13. Response funding allocation between Government and Industry for an EPP.

CATEGORISING OF EPP	GOVERNMENT FUNDING	INDUSTRY FUNDING
Category 1	100%	0%
Category 2	80%	20%
Category 3	50%	50%
Category 4	20%	80%

Pest categorisation

The list of categorised EPPs can be found in Schedule 13 of the EPPRD. In the event that a response plan is endorsed for an uncategorised EPP, cost sharing will commence using the default category (Category 3) and may be revised later.

Any signatory to the EPPRD can request for additional pests to be categorised and added to Schedule 13 of the EPPRD. Contact EPPRD@phau.com.au for more information and guidance on this process.

Once a substantiated request has been received by PHA a group of independent scientific technical experts (known as the categorisation group) will be convened to assess all known information about the EPP to identify the public and private benefits. Full details can be found in *Clauses 7 and 9 of the EPPRD*.

EPPs that are relevant to papaya categorised to date

EPPs relevant to the Papaya industry that are categorised and listed within Schedule 13 of the EPPRD.

Table 14. Formal categories for pests of the Papaya industry listed in Schedule 13 of the EPPRD (as of July 2021).

FORMAL CATEGORY	SCIENTIFIC NAME	COMMON NAME
2	*Bactrocera dorsalis* (syn. *B. invadens, B. papayae, B. philippiensis*)	Oriental fruit fly

How to respond to a suspect EPP

Following the detection of a suspect EPP, the relevant state agency will be notified either directly or through the Exotic Plant Pest Hotline. Within 24 hours of the state agency having a reasonable suspicion that they are dealing with an EPP, the Chief Plant Health Manager (CPHM) of the state or territory will inform the Australian Chief Plant Protection Officer (ACPPO). All signatories affected by the EPP (both government and industry) are then notified immediately, and a Consultative Committee on Emergency Plant Pests (CCEPP) meeting is convened (this process is outlined in Figure 4). Only the industry signatories affected by the EPP are engaged in the response process. These are determined based on the known hosts of the EPP. All positive detections of EPPs or suspect EPPs must undergo secondary identification from an independent laboratory. Confirmation of the identification should not delay the reporting of the EPP to the ACPPO or the CCEPP.

Figure 4. Reporting of suspect EPPs and notification process.

Once a pest incursion is confirmed to be an EPP, and the formal notification processes are complete, all signatories affected by the EPP participate in the national management of the EPP. Formal activities undertaken by signatories to respond to an EPP incursion are documented in a Response Plan. This is primarily through the two national decision-making committees:

- The Consultative Committee on Emergency Plant Pests (CCEPP) which provide scientific and technical expertise on the pest, mitigating measures and response activities, and
- The National Management Group (NMG) which acts on recommendations from the CCEPP and make the final decisions about EPP responses (such as approving formal response plans) and funding.

Technical and economic considerations are reviewed by the CCEPP, and a decision made on whether to eradicate using the cost sharing mechanisms under the EPP (i.e. develop a response plan) or take another course of action (potentially to contain, or to accept the presence of the pest and transition to long term management).

The relevant state/territory agriculture department is responsible for the on-ground activities stipulated by the Response Plan, and will adopt precautionary emergency containment measures if appropriate. Depending on the nature of the EPP, measures could include:

- restriction of operations in the area,
- disinfection and withdrawal of people, vehicles and machinery from the area,
- restricted access to the area, and
- control or containment measures.

Each response to an EPP is different due to the nature of the incursion, however, each follows the defined phases of a response as outlined at planthealthaustralia.com.au/biosecurity/incursion-management/phases-of-an-emergency-plant-pest-response/.

Owner reimbursement costs

Owner Reimbursement Costs (ORC) are included in the shared costs of a response and are available to eligible growers to alleviate the financial impacts of crops or property that are directed to be destroyed under an agreed Response Plan.

ORC were developed to encourage early reporting and increase the chance of successful eradication. ORC are paid to the owner and cover direct costs associated with implementing a Response Plan, including:

- Value of crops destroyed,
- Replacement of lost capital items, and
- Fallow periods.

ORC are only available when there is an approved Response Plan under the EPPRD, and only to industries that are signatories to the EPPRD.

The value of ORC is directed by the ORC Evidence Frameworks and is based on an agreed valuation approach developed for each industry.

Further information about ORCs is available from planthealthaustralia.com.au/biosecurity/incursion-management/owner-reimbursement-costs/

Industry specific response procedures

Industry communication

Papaya Australia is the peak industry body for the Papaya industry. Although not currently a member of PHA nor a signatory to the EPPRD, it is likely that Papaya Australia will be an industry contact point if a plant pest affecting the Papaya industry is detected.

Close cooperation is required between relevant government and industry bodies to ensure the effective development and implementation of a response to an emergency plant pest, and the management of media/communication and trade issues. Readers should refer to PLANTPLAN or undertake the relevant BOLT courses for further information.

Table 15. Contact details for Papaya Australia.

Website	australianpapaya.com.au
Email	admin@australianpapaya.com.au

References

PLANTPLAN (2018) PLANTPLAN Australian Emergency Plant Pest Response Plan. Version 3.2. (planthealthaustralia.com.au/plantplan).

APPENDIX 1: PROFILE OF THE AUSTRALIAN PAPAYA INDUSTRY

To develop any biosecurity plan it is critical to understand the profile and context of the industry.

Papaya Australia

Papaya Australia is the recognised body representing the Australian Papaya industry along with its growers, industry people, associated businesses and its members. It was formed in 2002 to represent the interests of Australian papaya/papaw growers and foster the growth of the industry.

All commercial Papaya growers in Australia pay statutory national levies which are used for research and development (R&D) and marketing. These levies are collected by the Australian Government. Papaya Australia works closely with Hort Innovation through the Papaya Strategic Industry Advisory Panel (SIAP) to ensure that the R&D and marketing levies are well directed to the needs of the industry The Papaya Strategic Investment Plan 2017-2021 provides guidance in the investment of Papaya marketing and R&D levies.

Papaya	Marketing	R&D	TOTAL
Fresh - domestic and export	1 cent per kilogram	1 cent per kilogram	**2 cents per kilogram**
Processing	-	0.25 cents per kilogram	**0.25 cents per kilogram**

Figure 5. Papaya levy and charge rates as of November 2024.[67]

[67] https://www.agriculture.gov.au/agriculture-land/farm-food-drought/levies/rates/papaya

Industry profile

The Australian papaya industry has growers across Northern Australia from Queensland to Western Australian with production of 21,760 tonnes in 2022/23 for a farm gate value of $39.0 million (Australian Horticulture Statistics Handbook 2022/23). Over 85% of production comes from Queensland with growers spread between Bundaberg (South east Queensland) and Lakeland (Far North Queensland). Product is either yellow, referred to as papaw, or red fleshed, known as papaya[68]. In northern Australia, papaya grows all year round and because of this the industry has the capacity to provide consistent supply of fruit to consumers and year-round income to growers. There are over 130 growers in Australia, but production is dominated by several large producers.

Growers produce different varieties that include hybrids of both yellow and red breeds. Understanding consumer taste provides the best basis for determining how varieties should be developed through additional research such as the papaya breeding program. Commercial lines and breeding lines will conduct taste trials to incorporate consumer preferences with the breeding project. Production occurs in tropical and sub-tropical areas and the crops are susceptible to a variety of pests and fungal disease. Some of these pests and diseases also affect other fruit varieties and there is opportunity for collaboration on research in these areas.

Specific research in papaya to address ongoing improvements in production and development of varieties that are resistant to some of the pests and diseases will provide benefits across the industry. Papaya is viewed as a fruit that has good opportunities to significantly expand within the domestic market but to do this the industry needs to develop a more consistent product, so the retailers and consumers have confidence in the ongoing quality and supply.

Red papaya and yellow papaws are predominately grown in the warmer tropical climate areas of Tully, Mareeba, and Innisfail to Mossman in Far North Queensland. There are also plantings in Lakeland, Far North Queensland as well as in Darwin, Northern Territory and Kununurra, Western Australia. Both are available all year round with increased supply during spring and autumn. Currently papaw and papaya varieties are based on a range of commercially available Australian-produced hybrid varieties[69], imported seed and grower-bred seed stock. Red-fleshed Hybrid RB1, Sunrise Solo, Linda Solo and Sunset Solo are the most popular papaya varieties grown in Far North Queensland.

Papaya grown in Queensland can be transported to all Australian states and territories except Western Australia. Queensland grown papaya is unable to be transported to Western Australia due to import requirements related to pests and diseases of biosecurity concern to Western Australia.

Fruit consigned to Tasmania, Victoria, South Australia and certain areas within New South Wales must be produced and treated under specific Interstate Certification Assurance (ICA) schemes (Papaya Industry Strategic Plan 2022-2026).

References

Hort Innovation (2024). *Australian Horticulture Statistics Handbook (AHSH) 2022/23*. Horticulture Innovation Australia Limited, Sydney NSW. Available online at: https://public.tableau.com/app/profile/flopenanalytics/viz/HortStatsOnlinev1_1FY23-HIADRAFTMain/MainPage

Papaya industry Strategic Plan 2022-2026. Horticulture Innovation Australia Limited, Sydney NSW. Available online at: https://www.australianpapaya.com.au/wp-content/uploads/bsk-pdf-manager/2024/04/PapayaSIP-2022-26.pdf

[68] The terms papaya and papaw are referred to differentiate the product in the papaya industry

[69] (papaw – 1B and 13, papaya – RB1, RB2, RB4),

APPENDIX 2: THREAT SUMMARY TABLES

The information provided in the threat summary tables is an overview of exotic plant pest threats to the Papaya Industry. More than 120 exotic plant pests were identified. Summarised information on entry, establishment and spread potentials and economic consequences of establishment are provided where available. Pests under official control[70] or eradication may be included in these tables where appropriate. However, pests that are established but regionalised within Australia are not covered by TSTs but may be assessed in state biosecurity plans. Assessments may change given more detailed research and will be reviewed with the biosecurity plan. Full descriptions of the risk rating terms can be found on page 32. Additional information on a number of the pests listed in the TSTs can be found in Table 4.

Invertebrates

Table 16. Papaya invertebrate threat summary table.

SCIENTIFIC NAME	COMMON NAME	PRIMARY HOSTS	AFFECTED PLANT PART	MOVEMENT & DISPERSAL	GEOGRAPHIC RANGE	ENTRY POTENTIAL	EST. POTENTIAL	SPREAD POTENTIAL	ECONOMIC IMPACT	OVERALL RISK
Amblypelta cocophaga[71]	Coconut bug	Papaya, navel orange, coconut, melon, mango, cassava, peach, sugarcane, cocoa, kapok, *Passiflora quadrangularis*, winged bean, *Eucalyptus deglupta*, *E. terecornis*, *E. urophylla*	Stems, growing points, fruit	Infested plant material and machinery. Adult females capable of flight. Nymphs are active crawlers.	Asia (Singapore) Oceania (Fiji, Papua New Guinea, Solomon Islands)	HIGH	HIGH	HIGH	HIGH	HIGH
Dysmicoccus nesophilus[72]	Mealybug	Polyphagous including sweet orange, grapefruit, lemon, papaya, mango, avocado, pines, taro, ginger, tamarillo, figs, coffee.	Leaves, flowers, fruit	Infested plant material. Adult males capable of flight over short distances.	Oceania (Cook Islands, Fiji, Kiribati, Papua New Guinea, Tonga, Tuvalu, Western Samoa)	HIGH	HIGH	HIGH	HIGH	HIGH
Helopeltis clavifer	Cocoa mirids	Passionfruit, tea, cocoa; cashew, sweet potato and other host plants reported from New Guinea include *Acalypha caturus, Annona* spp., *Bixa orellana, Camellia sinensis,* *Cassia fistula, Centrosema pubescens, Eucalyptus deglupta, Flemingia strobilifera, Glincidia sepium, Ixora* sp.,	Pods	Infested plant materials	Asia (Indonesia, Malaysia) Oceania (Papua New Guinea); New Britain and New Ireland	HIGH	HIGH	HIGH	HIGH	HIGH

[70] Official control defined in ISPM No. 5 as the active enforcement of mandatory phytosanitary regulations and the application of mandatory phytosanitary procedures with the objective of eradication or containment of quarantine pests or for the management of regulated non-quarantine pests.

[71] Numerous *Amblypelta* species are established in Australia making diagnostics difficult. This pest can fly but only over short distances making natural dispersal into new areas unlikely (CABI). Causes reduced fruit set and fruit damage. Eggs are not ususally laid on fruit making it unlikely that this pest would enter Australia through infested fruit. Long range dispersal is generally through infested planting material.

[72] http://scalenet.info/catalogue/Dysmicoccus%20nesophilus/

		Leucaena leucocephala, Mangifera indica, Mimosa invisa, Passiflora edulis, Persea americana, Polyscias sp., *Psidium guajava* and *Pueraria phaseoloides*.								
Nipaecoccus nipae[73]	Coconut mealybug, spiked mealybug, nipa mealybug, avocado mealybug, sugar apple mealybug, Kentia mealybug	Polyphagous including breadfruit, pigeon pea, papaya, citrus, coconut, fig, rubber plant, soursop, sugar apple, breadfruit, pigeon pea, sweet potato, mango, cassava, mulberry, banana, olive, orchids, avocado, guava, potato, cocoa, grape, ginger	Fruit, leaves, stems, growing point	Infested plant material and machinery, adult males capable of flight.	Africa (Algeria, Madagascar, Morocco, South Africa, Zimbabwe) Asia (Bangladesh, China, Georgia, India, Indonesia, Pakistan, Philippines, South Korea, Thailand, Turkey, Vietnam) Europe (Austria, Belgium, Czechoslovakia, France, Hungary, Italy, Poland, Portugal, , Russia, Spain, United Kingdom) North America (Antigua and Barbuda, Bahamas, Barbados, Belize, Bermuda, British Virgin Islands, Cayman Islands, Costa Rica, Cuba, Dominica, Dominican Republic, El Salvador, Grenada, Guadeloupe, Guatemala, Jamaica, Mexico, Nicaragua, Panama, Puerto Rico, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago, U.S. Virgin Islands, United States) Oceania (Federated States of Micronesia, Fiji, Guam, Samoa, Solomon Islands) South America (Argentina, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname, Venezuela)	HIGH	HIGH	HIGH	HIGH	HIGH
Rastrococcus invadens	Fruit tree mealybug	Breadfruit, papaya, Citrus, figs, mango, banana, passionflower, frangipani, guava	Fruit, inflorescence, leaves, stems		Africa (Benin, Burkina Faso, Congo, Democratic Republic of the, Congo, Republic of the, Côte d'Ivoire, Gabon, Ghana, Nigeria, Senegal, Sierra Leone, Togo) Asia (Bangladesh, Bhutan, China, Hong Kong, India, Indonesia, Malaysia, Pakistan, Philippines, Singapore, Sri Lanka, Thailand, Vietnam) South America (French Guiana)	HIGH	HIGH	HIGH	HIGH	HIGH

[73] http://www.cabi.org/cpc/datasheet/36334
http://entnemdept.ufl.edu/creatures/orn/mealybug/coconut_mealybug.htm
N. nipae is polyphagous and attacks 80 genera of plants belonging to 43 families.

Tetranychus piercei[74] (Syn. *T. manihotis*)	Pierce's spider mite; Red spider mite	Highly polyphagous including peanut, papaya, butterfly-pea, sweet potato, banana, bean, castor bean, *Ageratum spp*., cucurbits, maize, rose, banana, grapevine, cassava, eggplant, mulberry, passionfruit, peach, oil palm, lab lab, soybean, maize, turmeric, grape, capsicum, jasmine, rose, frangipani, taro, wild ginger, cowpea, mungbean	Above ground plant parts (Leaves, fruits)	Infested plant material and machinery, natural dispersal from PNG (wind dispersal for localised spread)	Asia (Bangladesh, China, Indonesia, Malaysia, Japan, Philippines, Taiwan, Thailand, South Korea, Vietnam) North America (Suriname) Oceania (Papua New Guinea)	MEDIUM Papaya	HIGH Papaya	HIGH Papaya	MEDIUM - HIGH Papaya	MEDIUM – HIGH Papaya
Anastrepha ludens	Mexican fruit fly	Cashew nut, cherimoya, hardshell custard-apple, soursop, sugar apple, papaya, *Citrus* spp., coffee, persimmon, apple, mango, passionfruit, avocado, peach, strawberry guava, guava, pomegranate, European pear, rose apple	Fruit	Infested plant material, machinery and soil. Adults are capable of flight over long distances [209]. Transmitted via infested plant material (fruit and puparia in soil or packaging with plants that have already fruited).	North America (Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, United States)	LOW Papaya Passionfruit,	HIGH Papaya LOW Passionfruit	HIGH Papaya LOW Passionfruit	HIGH Papaya MEDIUM Passionfruit	MEDIUM Papaya LOW Passionfruit
Anastrepha spp, *Inc.* *A. distincta* *A .fraterculus* *A. pseudoparallela* *A. serpentina*		Polyphagous, wide variety of hosts including Papaya, mango, citrus, guava, caimito, kiwifruit, cherimoya, soursop, sugar apple, carambola, coffee, quince, persimmon, loquat, common fig, round kumquat, walnut…	Fruit	Infested plant material (including fruit), soil and machinery. Adults capable of flight over long distances. Pupariation is in the soil	North, central and South America (Species have different geographical ranges	LOW Papaya Passionfruit	MEDIUM Papaya Passionfruit	MEDIUM Papaya Passionfruit	MEDIUM Papaya Passionfruit	LOW Papaya Passionfruit
Bactrocera carambolae	Carambola fruit fly	Highly polyphagous (75 hosts from 26 families) including grapefruit, orange, lemon, lime, mandarin, cashew, breadfruit, jackfruit, soursop, carambola, capsicum, mango, guava, passionfruit, papaya, banana, avocado, tomato, bell pepper, coco plum, navel orange, pomegranate, mangrove, common jujube	Fruit	Infested plant material (fruit). Adults capable of flight. Pupae are soilborne.	Asia (Brunei, India, Indonesia, Malaysia, Singapore, Thailand) South America (Brazil, French Guiana, Guyana, Suriname)	HIGH Papaya, Passionfruit	HIGH Papaya, Passionfruit	HIGH Papaya, Passionfruit	HIGH Papaya, Passionfruit	HIGH Papaya, Passionfruit

[74] Present in the Philippines. Modelling of potential distribution does not put Australia as an area the mite may expand to
After spraying to control banana weevil, mites become more abundant and are currently causing damage in the Australian banana industry. This mite species could cause significant issues if it becomes established in Australian banana growing regions. *T. piercei* is found in the Far northern biosecurity zone.

Bactrocera correcta	Guava fruit fly	Cashew nut, carambola, papaya, *Citrus* spp., melon, longan tree, mango, sapodilla, Spanish cherry, plantain, cherry, peach, guava, black plum, rose apple, Malay apple, water apple, Singapore almond, common jujube	Fruit		Asia (Bhutan, China, India, Japan, Myanmar, Nepal, Pakistan, Sri Lanka, Taiwan, Thailand) North America (United States)	HIGH Papaya	HIGH Papaya	HIGH Papaya	HIGH Papaya	HIGH Papaya
Bactrocera curvipennis (Syn. *Chaetodacus curvipennis; Dacus curvipennis; Strumeta curvipennis*)	Banana fruit fly	Polyphagous (41 hosts from 20 families) including *Citrus spp*., mango, papaya, grape, tomato, bell pepper, capsicum, nectarine, peach, plum, coffee, sweet pepper, strawberry	Fruit	Infested plant material (fruit), soil and hitchhiking. Adults capable of flight. Pupation occurs in the soil.	New Caledonia, Vanuatu, Fiji	UNKNOWN Papaya	UNKNOWN Papaya	UNKNOWN Papaya	UNKNOWN Papaya	UNKNOWN Papaya
Bactrocera diversa (Syn. Asiadacus diversus; Dacus diversus)	Fruit fly, three striped	*Citrus spp*., papaya, gourd, pumpkin, guava, jamun, marrow	Fruit		Asia (China, India)	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN
Bactrocera dorsalis (Syn. Bactrocera; Bactrocera invadens; Bactrocera papayae; Bactrocera philippinensis;	Oriental fruit fly, Philippine fruit fly, Invasive fruit fly, Asian Papaya fruit fly	Lychee, papaya, passionfruit, red fruit passion flower, giant granadilla, corkystem passionflower, red-bead tree, cashew nut, cherimoya, pond apple, soursop, bullock's heart, wild custard apple, sugar apple, black currant tree, coral berry, sugar palm, breadfruit, jackfruit, champedak, monkey jack, bilimbi, carambola, Akee apple, toddy palm, Alexandrian laurel, perfume tree, Indian caper, bell pepper, chilli, tummy wood, caranda, white sapote, evergreen chinkapin, Chittagong wood, Citrus, watermelon, scarlet-fruited ivy gourd, coffee, melon, cucumber, giant pumpkin, marrow, Burma simpoh, longan tree, persimmon, loquat, weeping fig, Indian laurel tree, cluster tree, sacred fig tree, sycamore fig, governor's plum, rukam, round kumquat, oval kumquat, mangosteen, dragon fruit, wild mango, bottle gourd, langsat, Indian laurel, acerola, apple, mango, sapodilla, Spanish cherry, bitter gourd, black mulberry, banana, plantain, avocado, common bean, cutleaf groundcherry, black pepper, fijian longan, Trifoliate orange, canistel, apricot, sweet cherry, sour cherry, plum, peach, Japanese plum, strawberry guava, guava, pomegranate, European	Fruit	Infested plant material (including fruit), soil and hitchhiking. Adults capable of flight. Pupation occurs in the soil[33]	Asia (Bangladesh, Bhutan, Brunei Darussalam, Cambodia, China, Christmas Island (Indian Ocean), India, Indonesia, Laos, Malaysia, Myanmar, Nepal, Oman, Pakistan, Philippines, Singapore, Sri Lanka, Taiwan, Thailand, United Arab Emirates, Vietnam) Africa, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, Democratic Republic of Congo, Cote d'Ivoire, Equatorial Guinea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea Bissau, Kenya, Liberia, Madagascar, Mali, Mauritania, Mayotte, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, Sudan, Swaziland, Tanzania, Togo, Uganda, Zambia, Zimbabwe) North America (USA) Europe (Italy) Oceania (Federated states of Micronesia, French Polynesia, Northern Mariana Islands, Palau, Papua New Guinea)	HIGH Lychee, Papaya, Passionfruit	HIGH Lychee, Papaya, Passionfruit	HIGH Lychee, Papaya, Passionfruit	HIGH Papaya, Passionfruit LOW Lychee	HIGH Papaya, Passionfruit, LOW Lychee

		pear, Oriental pear tree, mangrove, Downy rose-myrtle, marula, grey bitter-apple, tomato, aubergine, watery rose-apple, clove, black plum, sea apple, rose apple, Malay apple, water apple, Singapore almond, cocoa, limeberry, christmas palm, shea tree, common jujube, jujube, pomelo, tropical almond, star fruit, sour orange, calamondin orange								
Bactrocera facialis	Tongan fruit fly, tropical fruit fly	*Citrus spp*., mango, papaya, avocado, passionfruit, peach, guava, cashew nut, capsicum, tomato, breadfruit, longan tree	Fruit	Infested plant material (including fruit), soil and hitchhiking. Adults capable of flight. Pupation occurs in the soil.	Oceania (Tonga)	HIGH Papaya	HIGH Papaya	HIGH Papaya	HIGH Papaya	HIGH Papaya
Bactrocera kandiensis	Sri Lankan fruit fly	Cashew nut, jackfruit, carambola, papaya, pummelo, mango, avocado, guava, pomegranate, clove, rose apple, calamandarin	Fruit	Infested plant material (fruit). Adults capable of flight. Pupae are soilborne.	Asia (Sri Lanka)	UNKNOWN Papaya	UNKNOWN Papaya	UNKNOWN Papaya	UNKNOWN Papaya	UNKNOWN Papaya
Bactrocera melanotus	Asian papaya fruit fly, Cook Islands fruit fly	Papaya, *Citrus spp*., mango, longan, guava	Fruit	Infested plant material (fruit). Adults capable of flight. Pupae are soilborne.	Oceania (Cook Islands)	MEDIUM Papaya	MEDIUM Papaya	MEDIUM Papaya	HIGH Papaya	MEDIUM Papaya
Bactrocera passiflorae	Fijian fruit fly	Polyphagous (49 hosts in 28 families) including Cashew, breadfruit, papaya, lime, mandarin, mango, passionfruit, giant granadilla, avocado, guava, eggplant, cocoa	Fruit	Infested plant material (fruit). Adults capable of flight. Pupae are soilborne.	Oceania (Fiji, Niue, Tonga, Tuvalu, Wallis & Futuna)	HIGH Papaya, Passionfruit	HIGH Papaya, Passionfruit	HIGH Papaya, Passionfruit	HIGH Papaya, Passionfruit	HIGH Papaya, Passionfruit
Bactrocera psidii	South sea guava fruit fly	Candlenut tree, mango, pummelo, mango, fig, cashew, custard apple, granadilla, strawberry guava, guava, rose apple, papaya, carambola, peach, plum, grape	Fruit	Infested plant material (including fruit), soil and hitchhiking. Adults capable of flight. Pupation occurs in the soil.	Oceania (New Caledonia)	HIGH Papaya	HIGH Papaya	HIGH Papaya	UNKNOWN Papaya	Unknown Papaya
Bactrocera trilineola[75]	Vanuatu fruit fly	Papaya, *Citrus* spp., guava, Malay apple, Suriname cherry, tropical almond,	Fruit	Infested plant material (fruit).	Oceania (New Caledonia, Vanuatu)	MEDIUM Papaya	MEDIUM Papaya	HIGH Papaya	MEDIUM Papaya	LOW Papaya

[75] Leblanc, L., Vueti, E. T., & Allwood, A. J. (2013). Host plant records for fruit flies (Diptera: Tephritidae: Dacini) in the Pacific Islands: 2. Infestation statistics on economic hosts.

		Tahitian chestnut, carambola, avocado, mango, soursop, pineapple, cashew, breadfruit, plantain, guava, kumquat, Pacific lychee, *Syzygium* spp., Indian almond, *Musa* spp.		Adults capable of flight. Pupae are soilborne.						
Bactrocera tuberculata[76]	No common name	Mango, papaya, *Syzygium* spp., peach, sapodilla	Fruit	Infested plant material (fruit). Adults capable of flight. Pupae are soilborne.	Asia (Bangladesh, Bhutan, China, Myanmar, Thailand, Vietnam)	MEDIUM Papaya	HIGH Papaya	HIGH Papaya	HIGH Papaya	HIGH Papaya
Bactrocera xanthodes[77]	Pacific fruit fly	Papaya, passionfruit, breadfruit, mandarin, guava, tomato, soursop, mango, tropical almond, watermelon, avocado, Tahiti chestnut, jackfruit, round kumquat, tangerine, sweet orange, star apple, pomelo, capsicum	Fruit	Infested plant material (fruit). Adults capable of flight. Pupae are soilborne.	Oceania (American Samoa, Cook Islands, Fiji, Nauru, New Zealand, Niue, Samoa, Tonga, Tuvalu, Vanuatu, Wallis and Futuna)	LOW Papaya Passionfruit	LOW Papaya Passionfruit	LOW Papaya Passionfruit	LOW Papaya UNKNOWN Passionfruit	NEGLIGIBLE Papaya UNKNOWN Passionfruit
Bactrocera zonata	Peach fruit fly/ guava fruit fly	Papaya, golden apple, sugar apple, *Citrus* spp., Quince, fig, apple, mango, bitter gourd, date-palm, peach, guava, pomegranate, potato	Fruit	Infested plant material (fruit), soil and hitchhiking. Adults capable of flight. Pupae are soilborne.	Africa (Egypt, Libya, Mauritius, Réunion, Sudan) Asia (Bangladesh, Bhutan, India, Indonesia, Iran, Iraq, Israel, Laos, Myanmar, Nepal, Oman, Pakistan, Saudi Arabia, Sri Lanka, Thailand, United Arab Emirates, Vietnam, Yemen) North America (United States)	LOW Papaya	LOW Papaya	LOW Papaya	LOW Papaya	NEGLIGIBLE Papaya
Ceratitis rosa	Natal fruit fly	Polyphagous; Lychee, cashew, papaya, citrus, grape, soursop, sugar apple, carambola, chilli, coffee, pumpkin, longan tree, persimmon, loquat, mangosteen, apple, mango, blackberry, *Musa* spp., avocado, prickly pear, apricot, plum, peach, nectarine, guava, European pear, tomato, tobacco, cocoa, grapevine, common jujube	Fruit	Infested plant material, adults capable of flight. Larvae pupate in the soil	Africa (Ethiopia, Kenya, Lesotho, Malawi, Mozambique, South Africa, Swaziland, Tanzania, Zambia)	LOW Lychee, Papaya	HIGH Lychee, Papaya	MEDIUM Lychee, Papaya	MEDIUM Lychee, Papaya	LOW Lychee, Papaya
Lissachatina fulica *(Syn. Achatina fulica)*	Giant African land snail, Giant Ghana snail	Polyphagous: cassava, lettuce, papaya, sweet potato, orange, oil palm, pear, cereals, yam, onion, Oriental garlic, pineapple, cherimoya, soursop, Anthurium, peanut, breadfruit trees, breadfruit, jackfruit, carambola, Bougainvillea, *Brassica* spp., canola, cauliflower, cabbage, pigeon pea, tea, capsicum, chrysanthemum, watermelon,	Whole plant, above ground (Leaves, stems, roots, growing points and fruit)	Infested plant material, contaminated soil, tools and machinery and hitchhiking.	Africa (Central African Republic, Côte d'Ivoire, Ethiopia, Ghana, Kenya, Madagascar, Mauritius, Morocco, Nigeria, Réunion, Seychelles, South Africa, Tanzania, Togo) Asia (Bangladesh, Brunei, Cambodia, China, Hong Kong, India, Indonesia, Israel, Japan, Malaysia, Maldives, Myanmar, Nepal, Philippines,	HIGH Papaya	HIGH Papaya	HIGH Papaya	HIGH Papaya	HIGH Papaya

[76] https://fruitflyidentification.org.au/species/bactrocera-tuberculata/#host-range

[77] Leblanc, L., Vueti, E. T., & Allwood, A. J. (2013). Host plant records for fruit flies (Diptera: Tephritidae: Dacini) in the Pacific Islands: 2. Infestation statistics on economic hosts.

		Citrus spp., butterfly-pea, coffee, taro, melon, melo, cucumber, giant pumpkin, marrow, carrot, white yam, oil palm, eucalyptus, soyabean, short staple cotton, sunflower, hyacinth bean, bottle gourd, leucaena, ornamental species apple, cassava, bitter gourd, horse radish tree, banana, wild banana, oleander, tobacco, prickly pear, rice, yam bean, passionflower, beans, gooseberry, pea, radish, castor bean, roses, sage, sesame, tomato, eggplant, potato, sorghum, spinach, teak, cocoa, pointed gourd, vanilla, cowpea, grapevine, maize			Singapore, Sri Lanka, Taiwan, Thailand, Vietnam, Europe, Spain, North America, Anguilla, Antigua and Barbuda, Barbados, Cuba, Dominica, Guadeloupe, Martinique, Netherlands Antilles, Saint Lucia, Trinidad and Tobago, United States) Oceania (American Samoa, Christmas Island, Federated States of Micronesia, Fiji, French Polynesia, Guam, Kiribati, Marshall Islands, New Caledonia, New Zealand, Niue, Northern Mariana Islands, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu, U.S. Minor Outlying Islands, Vanuatu, Wallis and Futuna) South America (Argentina, Bolivia, Brazil, Colombia, Ecuador, Paraguay, Peru, Venezuela)					
Aleurocanthus woglumi	Citrus black fly	Polyphagous: Citrus, avocado, cashew nut, jackfruit, papaya, coconut, coffee, lychee, mango, sapodilla, banana, passionfruit, quince, guava, frangipani, pomegranate, pears, roses, grapevine, ginger	Leaves, stems	Infested plant material and machinery, adults capable of flight. Natural movement, infested soil and plant material and vectors	Asia (Bangladesh, Bhutan, Cambodia, China, Christmas Island (Indian Ocean), India, Iran, Laos, Malaysia, Maldives, Myanmar, Nepal, Oman, Pakistan, Philippines, Singapore, Sri Lanka, Taiwan, Thailand, United Arab Emirates, Vietnam, Yemen), Africa (Kenya, Seychelles, South Africa, Swaziland, Tanzania, Uganda, Zimbabwe), North America (Bermuda, Mexico, USA), Central America and Caribbean (Antigua and Barbuda, Bahamas, Barbados, Belize, British Virgin Islands, Cayman Islands, Costa Rica, Cuba, Dominica, Dominican Republic, El Salvador, Guadeloupe, Guatemala, Haiti, Jamaica, Netherlands Antilles, Nicaragua, Panama, Puerto Rico, Saint Kitts and Nevis, Saint Lucia, Trinidad and Tobago), South America (Brazil, Ecuador, French Guiana, Guyana, Suriname, Venezuela), Oceania (Papua New Guinea)	HIGH Papaya Passionfruit	HIGH Papaya Passionfruit	MEDIUM Papaya Passionfruit	LOW Papaya Passionfruit	LOW Papaya Passionfruit
Aonidomytilus albus	Tapioca scale	Papaya, mango, cassava, roses, sage, Solanum (nightshade)	Leaves, stems		Africa (Angola, Cabo Verde, Democratic Republic of the Congo,	MEDIUM	HIGH	HIGH	LOW	LOW

					Côte d'Ivoire, Gambia, Ghana, Guinea-Bissau, Kenya, Liberia, Madagascar, Malawi, Mauritius, Mozambique, Nigeria, Senegal, Somalia, Tanzania, Uganda, Zambia) Asia (Bahrain, China, Hong Kong, India, Indonesia, Malaysia, Sri Lanka, Taiwan, Thailand) North America (Antigua and Barbuda, Bahamas, Barbados, British Virgin Islands, Cuba, Dominica, Dominican Republic, Grenada, Guadeloupe, Haiti, Honduras, Jamaica, Martinique, Mexico, Montserrat, Puerto Rico, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago, U.S. Virgin Islands, United States) South America (Argentina, Brazil, Colombia, French Guiana, Guyana, Peru, Suriname)					
Aphis illinoisensis	Grapevine aphid[78]	Papaya, grapevine, mango	Shoots, leaves and fruit	Infested plant material	Africa (Algeria, Libya, Tunisia, Asia, Israel, Turkey, Europe, Albania, Cyprus, Greece, Italy, Malta, Montenegro, Spain) North America (Belize, Canada, Costa Rica, Cuba, Dominican Republic, El Salvador, Guadeloupe, Haiti, Honduras, Jamaica, Mexico, Panama, Puerto Rico, United States) South America (Argentina, Brazil, Chile, Colombia, Uruguay, Venezuela)	LOW	MEDIUM	MEDIUM	MEDIUM	LOW
Asterolecanium pustulans (Syn. *Asterolecanium sambuci; Russelaspis pustulans*)[79]	Oleander pit scale, akee fringed scale	Sugar apple (sweet sop), papaya, akee apple, pigeon pea, tea, coconut, coffee, silky oak, leucaena, mango, sapodilla, aubergine, cocoa, oleander, cabbage, broccoli, cauliflower, kale, Brussels sprouts, collard greens, savoy, Australian pine tree, Euphorbia, Acacia, *Bauhinia tomentosa*, pigeon pea, Leucaena, cotton, Hibiscus, fig tree, plantain, Eucalyptus, guava, Syzygium, Bougainvillea, jasmine, passionfruit, olive, Grevillea, Prunus, roses, citrus,	Stems, branches		Africa (Egypt, São Tomé and Príncipe, Mozambique, Tanzania, South Africa, Sierra Leone, Seychelles, Rodrigues Island, Madagascar, Malawi, Kenya, Comoros, Gabon) Asia (China, Cape Verde, India, Indonesia, Iran, Israel, Taiwan, Oman, Pakistan, Yemen, Sri Lanka, Saudi Arabia, Bonin Islands - Ogasawara Islands) Europe (Cyprus, Italy, Malta, United Kingdom)	LOW	MEDIUM	MEDIUM	MEDIUM	LOW

[79] http://scalenet.info/catalogue/Russellaspis%20pustulans/

		chilli pepper, Solanum (nightshade), tea, lantana, grapevine			North America (Agalega Islands, Anguilla, Antigua and Barbuda, Bahamas, Barbados, Bermuda, Costa Rica, Cuba, Curaçao, Dominica, Dominican Republic, El Salvador, Grenada, Guadeloupe, Haiti, Hawaiian Islands, Honduras, Jamaica, Martinique, Mexico, Montserrat, Nicaragua, Panama, Panama Canal Zone, Puerto Rico and Vieques Island, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Saint Martin and Saint Barthelemy, Saint Croix, Trinidad and Tobago, U.S. Virgin Islands, USA) Oceania (Fiji, French Polynesia, Guam, Papua New Guinea, Tuvalu, New Caledonia, Kiribati) South America (Brazil, Colombia, Ecuador, Guyana, Peru, Venezuela, Galapagos Islands)					
Brachylybas variegatus[80]	Brown coreid bug, passionvine bug	Polyphagous including giant passionfruit, papaya, taro, pumpkin, tomato, coconut, fig, sugarcane, Eucalyptus, cabbage, banana, ginger	Leaves, stem, fruit	Infested plant material and machinery, adults capable of flight.	Fiji, Tonga	MEDIUM	LOW	HIGH	MEDIUM	LOW
Corynothrips stenopterus	Cassava thrips	Papaya, cassava	Leaves, stems, fruit		North America (Antigua and Barbuda, Barbados, Dominica, Grenada, Guadeloupe, Martinique, Mexico, Montserrat, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago) South America (Guyana, Suriname)	MEDIUM	MEDIUM	MEDIUM	LOW	LOW
Diaprepes abbreviatus	Citrus weevil, West Indian weevil, sugarcane rootstalk borer	Wide host range including citrus, sugarcane, vegetables, potato, papaya, guava, woody field grown ornamentals strawberry, sweetpotato, mahogany, containerized ornamentals, non-cultivated wild plants	Flowers, leaves, roots	Infested plant material, contaminated soil, tools and machinery. Pupation occurs in the soil.	North America (Antigua and Barbuda, Barbados, Costa Rica, Dominica, Dominican Republic, Grenada, Guadeloupe, Haiti, Jamaica, Martinique, Montserrat, Puerto Rico, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago, United States) South America (French Guiana)	MEDIUM	HIGH	HIGH	LOW	LOW
Oligonychus gossypii	Spider mite; cotton red mite	Polyphagous including Papaya, cotton, cassava, beans, peach, citrus, okra, peanut, and a range of ornamentals including rose	Leaves		Africa (Benin, Republic of Congo, Gabon, Nigeria, Angola, Cameroon, Chad, Ivory Coast, Kenya, Madagascar, Senegal, Sierra Leone,	MEDIUM	HIGH	HIGH	LOW	LOW

[80]https://www.agriculture.gov.au/sites/default/files/sitecollectiondocuments/ba/plant/2013/islandcabbage/Final-PRA-Island-Cabbage.pdf

					Tanzania, Uganda) South America (Brazil, Venezuela, Colombia, Ecuador), Central America (Costa Rica, Honduras)					
Trialeurodes variabilis (Syn. *Aleurochiton variabilis, Aleurodes variabilis, Aleurodicus variabilis, Asterochiton variabilis, Metaleurodicus variabilis, Trialeurodes caricae*)	Papaya whitefly	Polyphagous: Papaya, cassava	Leaves		North America (Cuba, Trinidad and Tobago)South America (Colombia)	LOW	MED	HIGH	MED	LOW
Veneza zonatus (Syn. *Leptoglossus zonatus*)	Western leaf-footed bug; large-legged bug	Passionfruit (*Passiflora spp.*), pecan, lime, navel orange, melon, pumpkin, cotton, jatropha, avocado, guava, pomegranate, tomato, eggplant, sorghum, maize, peach, watermelon	Leaves, fruit		North America (Mexico, United States) Central America (Nicaragua, Honduras, El Salvador) South America (Brazil, Venezuela, Colombia)	LOW	MEDIUM	MEDIUM	MEDIUM - HIGH	LOW - MEDIUM
Oligonychus annonicus	Spider mite	Papaya, *Annona* spp., *Erythrina* spp., coffee	Leaves	Infested plant material and soil	South America (Ecuador)	MEDIUM Papaya	HIGH Papaya	HIGH Papaya	LOW Papaya	LOW Papaya
Frankliniella insularis (Syn. *Euthrips insularis, Frankliniella fortissima, Franklinothrips insularis, Franklinothrips caribae)*[81]	Blossom thrips, Cuban flower thrips, West Indian flower thrips, bean-flower thrips	Pigeon pea, capsicum, papaya, citrus, coconut, sweetpotato, banana, tobacco, beans, tomato	Whole plant, above ground, Leaves, flowers	Infested plant material, contaminated soil, tools and machinery. Pupation occurs in the soil.	Asia (Singapore) North America (Barbados, Bermuda, Cuba, Guadeloupe, Jamaica, Martinique, Mexico, Puerto Rico, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago, United States) South America (Guyana) Oceania (Fiji)	LOW Papaya	HIGH Papaya	HIGH Papaya	LOW Papaya	LOW Papaya
Crypticerya multicicatrices	Multicicatrices fluted scale	Breadfruit, papaya, mango, avocado, soursop, coconut,	Leaves, branches		South America (Colombia)	LOW	MEDIUM	MEDIUM	HIGH	MEDIUM
Davara caricae	Papaya webworm	Papaya	Stem, fruit		North America (Cuba, USA)	MEDIUM	HIGH	HIGH	MEDIUM	MEDIUM
Empoasca papayae	Papaya leaf hopper	Papaya	Leaves, stem (known vector of bunchy top)		North America (Antigua and Barbuda, Barbados, Grenada, Montserrat, Saint Kitts and Nevis, Saint Vincent and the Grenadines, Trinidad and Tobago)	LOW	MEDIUM	MEDIUM	HIGH	MEDIUM
Empoasca stevensii	Stevens leaf hopper	Polyphagous; Papaya, avocado, plumeria	Leaves, stem (known secondary vector of		North America (Antigua and Barbuda, Barbados, Grenada, Montserrat, Saint Kitts and Nevis, Saint Vincent and the Grenadines, Trinidad and Tobago)	LOW	MEDIUM	MEDIUM	HIGH	MEDIUM

[81] Frankliniella insularis is a vector of plant viruses (Bailey 1935)

			bunchy top)							
Eutetranychus africanus	Spider mite, citrus brown mite, African red mite, Texas citrus mite, Oriental red mite, Oriental mite [125]	Polyphagous; Papaya, citrus, cotton, cassava, castor bean, pea, peach, durian, apple, grape, guava, eggplant, sweet potato, fig, corn, and a variety of ornamentals	Leaves, stem, fruit		Africa (Reunion, Comoros, Kenya, Madagascar, Mauritius, Mayotte, Mozambique, South Africa) Asia (Iran, Japan, Taiwan, Thailand, India, Myanmar-Burma, Egypt) Oceania (Papua New Guinea, French Polynesia, Vanuatu) South America (Bolivia, Brazil, Chile, Colombia, Peru)	MEDIUM	HIGH	HIGH	MEDIUM	MEDIUM
Eutetranychus banksi (Syn. *Tetranychus banksi*)	Citrus mite	Polyphagous including Papaya, breadfruit, castor bean, *Citrus* spp., lima bean, plumeria, lablab bean leaves, *Annona* spp. (sousop, sugar apple, cherimoya, wild sweetsop, pond apple), oleander, taro, elephant ear (arrowroot/coco yam), curcubits, purple yam, *Euphorbia*, cassava, castor oil plant, peanut, *Bauhinia* spp., pigeon pea, cotton, Hibiscus, cocoa, black pepper, coffee, black nightshade, grapevine; many other ornamentals and economic plants including: date palm (*Phoenix dactylifera*)	Leaves		North America (Costa Rica, Cuba, Mexico, Colombia, Cuba, Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua, Panama, USA) South America (Venezuela, Argentina, Brazil, Peru, Paraguay, Uruguay) Africa (Mozambique), Egypt, Iran, Portugal, Spain	MEDIUM	HIGH	HIGH	MEDIUM	MEDIUM
Scaphytopius nitridus[82]	Leafhopper	Polyphagous including *Citrus* spp., rice, barley, corn, sugarcane, wheat, sorghum, apple, pear, palms, grapevine, carrot, potato, tomato, papaya, peach, strawberry, *Rubus* spp., ornamentals, weeds, other grasses and cereals	Leaves	Infested plant parts (leaves and fruit), soil and hitchhiking	Asia (Turkey)North America (Mexico, USA)	LOW	HIGH	HIGH	MEDIUM to HIGH	MEDIUM
Toxotrypana curvicauda (*Syn. T. fairbatesi Munro*)	Papaya fly	Papaya, mango	Fruit, seed	Infested plant material (fruit). Adults capable of flight.	North America (Bahamas, Belize, Costa Rica, Cuba, Dominican Republic, El Salvador, Guatemala, Haiti, Honduras, Mexico, Netherlands Antilles, Nicaragua, Panama, Puerto Rico, Saint Kitts and Nevis, Trinidad and Tobago, US Virgin Islands, USA) South America (Colombia, Venezuela)	LOW Papaya	HIGH Papaya	HIGH Papaya	HIGH Papaya	MEDIUM Papaya
Tetranychus bastosi	Spider mite	Polyphagous: reported from 25 plant species including papaya, bean, cassava, sweet potato	Leaves		South America (Brazil)	MEDIUM	HIGH	HIGH	MEDIUM - HIGH	MEDIUM - HIGH
Tetranychus macfarlanei	Spider mite	Papaya, grapefruit, manihot spp.,	Leaves		Asia (India)	MEDIUM	HIGH	HIGH	MEDIUM -	MEDIUM -

[82] Vector of Western X-disease phytoplasma 16SrIII-A
https://www.catalogueoflife.org/col/details/species/id/527ea2303b252ef8238450f44d185708

(Syn. *T. malaysiensis*) *Tetranychus malaysiensis* (Syn. *T. macfarlanei*). This should be the other way around i.e., *T. malaysiensis* is a junior synonym of *Tetranychus macfarlanei*		argyreia spp., chempedak, gumbo, okra, cotton, eggplant			Europe (Spain), Africa (Madagascar, Mauritius), Asia (Bangladesh, China, India, Malaysia, Philippines, Thailand)				HIGH	HIGH
Tetranychus merganser	Spider mite	Polyphagous: Papaya, Capsicum, prickly pear, squash, cassava, European privet, strawberry, jasmine, desert ash, blackberry nightshade	Leaves		Asia (China, Thailand) North America (Mexico, USA)	MEDIUM	HIGH	HIGH	MEDIUM - HIGH	MEDIUM - HIGH
Tetranychus nakahari	Spider mite	Papaya, cocoa, cassava, okra (gumbo), *Citrus* spp., *Citrofortunella* spp.	Leaves		North America (El Salvador, Guatemala, Suriname, Trinidad and Tobago)	MEDIUM	HIGH	HIGH	MEDIUM - HIGH	MEDIUM - HIGH
Tetranychus papayae	Spider mite	Papaya	Leaves		Asia (India)	MEDIUM	HIGH	HIGH	MEDIUM - HIGH	MEDIUM - HIGH
Tetranychus paraguayensis	Spider mite	Papaya, citrus	Leaves		South America (Paraguay)	MEDIUM	HIGH	HIGH	MEDIUM - HIGH	MEDIUM - HIGH
Tetranychus puschelii	Spider mite	Polyphagous; Papaya, capsicum, Cucurbits, bottle gourd, basil, *Ranunculus* spp., okra, jasmine, Capsicum, *Cannabis sativa,*	Leaves		Africa (South Africa) Asia (India)	MEDIUM	HIGH	HIGH	MEDIUM - HIGH	MEDIUM - HIGH
Tetranychus recki	Spider mite	Papaya, chenille	Leaves		North America (Costa Rica, Honduras)	MEDIUM	HIGH	HIGH	MEDIUM - HIGH	MEDIUM - HIGH
Tetranychus truncatus	Spider mite	Polyphagous: peanut, melon, carrot, cotton, cassava, castor bean, eggplant, maize, white mulberry, papaya, bean, rice, corn, cabbage, canola, *Citrus* spp., soybean, garden pea, mung bean, capsicum, tomato, grapevine, cowpea, sweetpotato, brown mustard, cauliflower, watermelon, muskmelon, cucumber, squash, silky gourd (ridged gourd, chinese okra), castor bean/castor oil plant, common bean, lima bean, winged bean, broad bean, mung bean, okra, neem tree, moringa (horseradish tree), guava, sesame, rice, jujube, Asian pear, *Rosa hybrida*, sweet peppers, chili peppers, black nightshade, garlic	Leaves		Asia (Bangladesh, China, India, Iran, Japan, Malaysia, Philippines, Republic of South Korea, Taiwan, Thailand, Vietnam, Indonesia) North America (USA) Oceania (Guam)	MEDIUM	HIGH	HIGH	MEDIUM - HIGH	MEDIUM - HIGH
Tetranychus mexicanus	Spider mite	Polyphagous; Papaya, cotton, lychee, passionfruit, Spanish cedar, Citrus, Cocoa, pecan, coconut, avocado, banana, peanut, guava, sugar cane, strawberry, pear, apple, peach, star	Leaves		Central America and Caribbean (Barbados, Costa Rica, Cuba, Nicaragua, El Salvador, Honduras, Guadeloupe, Martinique) South America (Brazil, Suriname,	MEDIUM Lychee, Papaya, Passionfruit	HIGH Lychee, Papaya, Passionfruit	HIGH Lychee, Papaya, Passionfruit	MEDIUM Lychee, Papaya, Passionfruit	MEDIUM Lychee, Papaya, Passionfruit

		fruit, bean, cassava; wide range of ornamental plants			Argentina, Columbia, Paraguay, Peru, Uruguay, Venezuela)					
Oligonychus (Tetranychus) bicolor[83] *Oligonychus yothersi (Syn. Tetranychus yothersi*	Spider mite; avocado red mite	Polyphagous; Lychee, grape, oak, chestnut, hickory, maple, spruce, birch, papaya, mango, coffee, castor bean, *Eucalyptus* spp.	Leaves, foliage	Infested plant material and soil	Asia (Iran, Taiwan)North America (Canada, United States)Central America and Caribbean (Costa Rica, Cuba)	MEDIUM Lychee, Papaya	HIGH Lychee, Papaya	HIGH Lychee, Papaya	MEDIUM Lychee, Papaya	MEDIUM-Lychee, Papaya
Oligonychus yothersi (Syn. *Tetranychus yothersi*)	Spider mite; avocado red mite	Polyphagous including lychee, papaya, mango, coffee, avocado, banana, cassava, pomegranate, grape, castor bean, *Eucalyptus grandis* and *Eucalyptus urophylla,* other *Eucalyptus* spp., *Grevillea* sp., *Camellia sinensis;* also, a range of ornamental plants	Leaves Foliage	Infested plant material and soil	Asia (Iran) North America (USA [Hawaii]), , Central America and Caribbean (Costa Rica, Cuba, Nicaragua), South America (Argentina, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru), China	MEDIUM Lychee, Papaya	HIGH Lychee, Papaya	HIGH Lychee, Papaya	MEDIUM Lychee, Papaya	MEDIUM Lychee, Papaya
Tetranychus tumidus	Spider mite	Wide host range including papaya, Araceae, sweetpotato, banana, corn, cotton, bean, canola, common bean, cassava, cotton, garlic, taro, celery, coconut, maize, potato, tomato, sunflower, mint	Leaves	Infested plant material, and hitchhiking. Wind dispersal for localised spread.	North America (Antigua and Barbuda, Barbados, Cuba, Saint Lucia, USA, American Samoa, Guam, Costa Rica, Panama, Puerto Rico) South America (Colombia) Europe (Greece)	MEDIUM Papaya	HIGH Papaya	HIGH Papaya	MEDIUM Papaya	MEDIUM Papaya
Tetranychus cinnabarinus. This species is a synonym of *Tetranychus urticae* which is an endemic species in Australia with a very wide host range. Hence, this species information can be removed from here.	Carmine spider mite	Okra, onion, garlic, peanut, broccoli, tea, peppers, papaya, chrysanthemum, watermelon, Citrus, taro, morning glory, melon, cucumber, pumpkin, marrow, cucurbits, carnation, yam, strawberry, soyabean, cotton, sweetpotato, apple, cassava, lucerne, banana, beans, common beans, peach, castor bean, tomato, eggplant, potato, sorghum, spinach, cowpea, grapevine, elephant ear, maize, common jujube	Leaves	Infested plant material, machinery, personal effects, hitchhiking. Wind dispersal for localised spread.	Africa (Cape Verde, Egypt, Kenya, Libya, Morocco, South Africa, Togo, Tunisia, Uganda, Zimbabwe) Asia (China, India, Indonesia, Iran, Israel, Japan, Malaysia, Singapore, Taiwan, Thailand, Turkey) Europe (Austria, Bulgaria, France, Montenegro, Poland, Portugal, Spain, United Kingdom) North America (Costa Rica, Mexico, United States) South America (Brazil, Colombia, Peru, Venezuela)	MEDIUM Papaya	HIGH Papaya	HIGH Papaya	MEDIUM Papaya	MEDIUM Papaya
Calacarus citrifolii	Citrus grey mite/ citrus blotch mite	Polyphagous including Citrus, banana, cotton, peanut, passionfruit, papaya, cassava, beans, sugarcane, pigeon pea, okra, sweetpotato, soursop, Tannia, eggplant, capsicum, tomato, taro, pumpkin, giant passionfruit, *Poinsettia* spp., *Rhus* spp., *Holmskioldia* spp., *Brunsfelsia* spp., *Pappea capensis*, *Rhamnus prinoides*, *Lippia javanica*, *Duranta repens*, *Mimusops seyheri*, *Euphorbia pulcherrima*, Musa paradisiaca, *Capsicum chinense* (chilli	Leaves, fruit, twigs	Infested plant material and machinery.	South Africa, India, Taiwan, Cuba, Angola, Zimbabwe, Mozambique, Zambia, Nigeria	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN

[83] The environment in parts of Australia is likely to be suitable for the establishment of O. yothersi.

		pepper)								
Adoretus versutus	Rose beetle	Polyphagous: Lychee, Acacia, cashew nut, groundnut, camel's foot, Bougainvillea, papaya, Citrus spp., coffee, taro, yam, fig, sweetpotato, apple, plantain, banana, avocado, beans, longan, plum, guava, pear, radish, roses, sugarcane, aubergine, sorghum, Malay apple, Singapore almond, cocoa, cowpea, cowpea, grape, ginger, Eucalyptus	Leaves Foliage (adults), roots (larvae) for cut flowers inflorescence	Infested plant material and machinery, adults capable of flight, eggs and larvae are soilborne	Asia (Bangladesh, British Indian Ocean Territory, India, Indonesia, Malaysia, Pakistan, Sri Lanka), Africa (Madagascar, Mauritius, Réunion, Saint Helena, Seychelles) Oceania (American Samoa, Cook Islands, Fiji, Samoa, Tonga, Vanuatu, Wallis and Futuna Islands)	MEDIUM Lychee UNKNOWN Papaya	MEDIUM Lychee UNKNOWN Papaya	MEDIUM Lychee UNKNOWN Papaya	HIGH Lychee UNKNOWN Papaya	MEDIUM Lychee UNKNOWN Papaya
Eotetranychus lewisi[84]	Lewis spider mite	Polyphagous; Papaya, citrus, grape, castor bean, poinsettia, clover, peach, pear, Rosa species, strawberry, olive, cotton, *Ipomoea* sp., *Cucurbita* sp., *Euphorbia* spp., *Acacia* spp., *Pinus* spp., *Rubus* spp., *Solanum* spp.	Leaves, fruit	Infested plant material, soil and machinery. Can be transported in wind currents.	Africa (Libya, South Africa, Asia (Taiwan, Philippines), Iran,Europe (Austria, Netherlands, Portugal [Madeira I], United Kingdom)North America (Canada, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, United States)South America (Bolivia, Brazil, Chile, Colombia, Ecuador, Peru)	MEDIUM Papaya	HIGH Papaya	HIGH Papaya	MEDIUM Papaya	MEDIUM Papaya
Dasineura papivora	Papaya midge	Papaya	Fruit		Asia (India)	LOW	Low	LOW	LOW	NEGLIGIBLE
Aphis middletonii	Erigeron root, aphid	Papaya	Roots, trunk, stem, leaves		Asia (Turkey) North America (El Salvador, USA)	LOW	LOW	MEDIUM	LOW	NEGLIGIBLE
Aspidiotus excisus (Syn. Aglaonema scale; Cyanotis scale (*Temnaspidiotus excisus*)	Green scale	Polyphagous including banana, *Citrus* spp., papaya, coconut, *Ipomoea* spp., sugar apple, pineapple, orchids, grapevines, eggplant	Above ground plant parts	Infested plant material and machinery.	Widespread throughout South, Central and North America, Asia (India), South America (Suriname)and the Pacific[157][158]	MEDIUM	LOW	LOW	LOW	NEGLIGIBLE
Leptostylus praemorsus	Boring beetle	Papaya, Citrus	Trunk, stems		North America (Antigua and Barbuda, Barbados, Bermuda, Dominica, Mexico, Saint Lucia)	LOW	LOW	MEDIUM	LOW	NEGLIGIBLE
Pseudaulacaspis papayae (Syn. *Phenacaspis papayae*; *Chionaspis papayae*)[205]	No common name	Papaya	Leaves, fruit		Asia (Indonesia, Thailand)	LOW	LOW	LOW	LOW	NEGLIGIBLE
Spodoptera eridania	Southern armyworm	Okra, onion, Welsh onion, garlic, red ginger, celery, peanut, asparagus, beetroot, *Brassica napus* var. oleifera, black mustard, cabbages, cauliflowers, collards, cruciferous crops, bell pepper, papaya, quinoa, chickpea, watermelon,	Fruits, leaves		Africa (Benin, Cameroon, Gabon, Nigeria) Europe (Denmark, Netherlands, Slovenia) North America (Antigua and Barbuda, Bahamas, Barbados, Bermuda, Costa	LOW	LOW	LOW	LOW	NEGLIGIBLE

[84] https://www1.montpellier.inra.fr/CBGP/spmweb/notespecies.php?id=168

		Citrus, lemon, navel orange, coffee, coriander, melon, cucumber, pumpkin, carrot, carnation, yam, Eucalyptus, soyabean, cotton, sunflower, kenaf, China-rose, sweetpotato, lettuce, lavender, leucaena, flax, apple, cassava, lucerne, mints, Peppermint, Spear mint, banana, watercress, oleander, tobacco, rice, passionfruit, elephant grass, avocado, beans, lima bean, common bean, pea, Poaceae (grasses), guava, European pear, rhubarb, castor bean, roses, raspberry, willows, Brazilian pepper tree, tomato, eggplant, potato, spinach, dandelion, clovers, blueberry, cranberry, faba bean, cowpea, grapevine, cocoyam, maize			Rica, Cuba, Dominica, Dominican Republic, El Salvador, Grenada, Guadeloupe, Honduras, Jamaica, Martinique, Mexico, Nicaragua, Panama, Puerto Rico, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago, United States) South America (Argentina, Brazil, Chile, Colombia, Ecuador, French Guiana, Guyana, Paraguay, Peru, Suriname, Uruguay, Venezuela)					
Thaumatotibia leucotreta (Syn. *Cryptophlebia roerigii; Cryptophlebia leucotreta; Olethreutes leucotreta; Thaumatotibia roerigii*)[85]	False codling moth	Polyphagous: Lychee, pineapple, carambola, cotton, Citrus spp., capsicum, cotton, mango, avocado, peach, maize, soursop, guava, lima bean, common bean, sorghum, cowpea, olive, *Prunus* spp., cherry, macadamia, castor bean, pomegranate, Australian brush-cherry, water apple, tomato (secondary host)	Leaves, fruit, seed	Infested plant material and soil. Adults capable of flight.	Asia (Israel), Africa (Angola, Benin, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Congo Democratic Republic, Côte d'Ivoire, Eritrea, Ethiopia, Gambia, Ghana, Kenya[14], Madagascar, Malawi, Mali, Mauritius, Mozambique, Niger, Nigeria, Réunion, Rwanda, Saint Helena, Senegal, Sierra Leone, Somalia, South Africa, Sudan, Swaziland, Tanzania, Togo, Uganda, Zambia, Zimbabwe), Europe (Denmark, Finland, Germany, Italy, Netherlands, Spain, Sweden, UK)	LOW Lychee	LOW Lychee	HIGH Lychee	MEDIUM Lychee	VERY LOW Lychee
Aponychus sulcatus[86]	No common name	Papaya, tar vine, giant reed, wild sugarcane, giant cane (elephant grass)	Leaves		India, Pakistan	LOW	LOW	LOW	LOW	NEGLIGIBLE
Amorbia emigratella	Mexican leafroller	Polyphagous including avocado, broccoli, cocoa, Citrus spp., cotton, eggplant, green beans, guava, macadamia, orchids, papaya, passionfruit, potato, rose, sweetpotato, tomato, pineapple, other ornamentals, shrubs, fruit trees and indigenous plants in the mountains, corn, blackberry, peanut, gorse	Leaves, fruit, flowers, shoots	Infested soil and plant material. Adults are capable of flight	North America (Costa Rica, Hawaii, Mexico, USA)	LOW Papaya Passionfruit	LOW Papaya Passionfruit	MEDIUM Papaya Passionfruit	LOW Papaya Passionfruit	NEGLIGIBLE Papaya Passionfruit

[85] Intercepted only in Denmark, Finland, Italy, Spain, Sweden and UK. Eradicated from Netherlands

[86] Bolland, H. R., Gutierrez, J., & Flechtmann, C. H. (1998). World catalogue of the spider mite family (Acari: Tetranychidae). Brill. https://www1.montpellier.inra.fr/CBGP/spmweb/notespecies.php?id=30

Acicnemis crassiusculus	Weevil	Papaya	Foliage		Oceania (Fiji, French Polynesia, Tonga, Vanuatu)	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN
Bemisia tabaci (MED) [(Syn. Bemisia tabaci biotype Q, Bemisia tabaci Q, Mediterranean (MED) species (Bemisia tabaci)]	Silverleaf whitefly	Okra, maples, cauliflower, cruciferous crops, Capsicum (bell pepper), papaya, pumpkin, Bourbon cotton, lettuce, cassava, Passifloraceae, Rosaceace, tomato, eggplant	Leaves, stems, whole plant (early senescence)		Africa (South Africa) Asia (China, Israel, Japan, South Korea, Turkey) Europe (Finland, Greece, Italy, Sweden, United Kingdom) North America (Bermuda, Canada, Costa Rica, Guatemala, Mexico, United States) South America (Argentina, Brazil, Uruguay)	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN
Attacus atlas	Atlas moth	Lychee, papaya, mango, avocado, guava, water apple, citrus, soursop, sugar apple, jackfruit, tea, camphor, cinnamon, coffee, turmeric, cardamon, pepper, castor bean, big leaved mahogany, cocoa, carambola, cinchona	Leaves	Flight, machinery and infested plant material.	Asia (Bangladesh, Brunei Darussalam, Cambodia, China, India, Indonesia, Japan, Laos, Malaysia, Myanmar, Nepal, Philippines, Singapore, Taiwan, Thailand, Vietnam)	MEDIUM Lychee UNKNOWN Papaya	HIGH Lychee UNKNOWN Papaya	HIGH Lychee UNKNOWN Papaya	UNKNOWN Lychee, Papaya	UNKNOWN Lychee, Papaya
Adoxophyes cyrtosema	Citrus brown banded tortrix	Polyphagous: Lychee, Citrus, Dimocarpus longan, groundnut, Juglans, Clerodendrum, Morus alba, tea	Leaves	Plant material, adults are capable of flight	Asia (China), Oceania (Tonga, New Hebrides, New Guinea)	LOW	MEDIUM	MEDIUM	LOW	VERY LOW
Bagrada hilaris[87]	Bagrada bug ; Painted stink bug	Broccoli, cabbage, mustard, cauliflower, kale, turnip, radish, canola, swede, bok choy, Chinese cabbage, purple-vein rocket, black gram, maize, sorghum, potato, cotton, sunflower, papaya, pea, wheat, bean, shepherds' purse and others	Whole plant, above ground		Africa (Angola, Botswana, Cape Verde, Congo, Democratic Republic of the, Djibouti, Egypt, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Senegal, Seychelles, Somalia, South Africa, Sudan, Tanzania, Uganda, Zambia, Zimbabwe) Asia (Afghanistan, India, Iran, Iraq, Myanmar, Nepal, Pakistan, Sri Lanka, Yemen) Europe (Italy, Malta) North America (Mexico, United States) South America (Chile)	MEDIUM	MEDIUM	MEDIUM	LOW	VERY LOW
Corythucha gossypii	Cotton lacebug; bean lacebug	Polyphagous including okra, peanut, pigeon pea, bell pepper, papaya, cassava, banana, beans, castor bean, sugarcane, eggplant, sweetpotato, soursop, *Tannia*, capsicum, tomato,	Leaves	Infested plant material and machinery, adults capable of flight.	North America (Antigua and Barbuda, Barbados, Belize, Carribean, Costa Rica, El Salvador, Cuba, Dominica, Dominican Republic, Guadeloupe, Guatemala, Haiti, Honduras,	LOW	MEDIUM	MEDIUM	LOW	VERY LOW

[87] LeVeen, E., & Hodges, A. C. (2014). Bagrada bug, painted bug, Bagrada hilaris Burmeister (Insecta: Hemiptera: Pentatomidae). Department of Entomology and Nematology, UF/IFAS Extension. Available in: http://edis. ifas. ufl. edu.(Sin fecha de consulta).
Native to Africa, also present in southern Asia and Europe and recently (2008) introduced into the United States (Le Veen and Hodges 2014)
Spread with infested material. Reported to be found on trucks travelling between states in the United States (Le Veen and Hodges 2014)

		eggplant, cotton, pumpkin, giant passionfruit, taro, pumpkin, Breadfruit, soursop and sweet potato			Nicaragua, Panama, Jamaica, Martinique, Montserrat, Puerto Rico, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago, USA) South America (Colombia, Venezuela)					
Darna diducta	Nettle caterpillar	Annona spp. (soursop, sugar apple), sugar plum, tea, papaya, coconut, banana, cocoa	Leaves		Asia (Indonesia, Malaysia, Philippines, Thailand)	LOW	MEDIUM	MEDIUM	LOW	VERY LOW
Elytrurus griseus[88]	Weevil	Papaya, Hibiscus, *Citrus* spp.	Leaves, young stem		Oceania (Fiji)	LOW	MEDIUM	MEDIUM	LOW	VERY LOW
Empoasca fabalis[89]	Leafhopper	Pigeon pea, sweetpotato, beans, Ipomoea spp., Japanese honeysuckle, morning glory, white clover, cotton, maize, papaya, bean, beet, carrot, cowpea, melon, malojillo, potato, tomato	Leaves	Infested plant material. Adults are capable of flight.	North America (Barbados, Haiti, Puerto Rico, USA) South America (Argentina, Brazil, Colombia, Peru)	LOW	MEDIUM	MEDIUM	LOW	VERY LOW
Empoasca solana[90]	Southern garden leafhopper	Sweetpotato, beans, banana, beet, blackeye bean, celery, cowpea, cucumber, eggplant, garden bean, green bean, lettuce, lima beans, melon, papaya, peanut, potato, summer squash, Swiss chard, tomato, watermelon. Yellow cosmos and other ornamental plants. Several weeds, such as amaranth, castor bean, and Datura, are reservoir hosts of this pest.	Leaves	Infested plant material. Adults are capable of flight.	Widespread throughout North America (Barbados, Haiti, United States), Central and South America, Europe, Asia and South Africa	LOW	HIGH	HIGH	LOW	VERY LOW
Erinnyis alope	Papaya hornworm	Papaya, cassava	Leaves		Europe (Austria, Netherlands, Portugal, United Kingdom)	LOW	HIGH	HIGH	LOW	VERY LOW
Erinnyis ello	Cassava hornworm	Papaya, rubber, cassava, sesame, guava	Leaves		North America (Antigua and Barbuda, Bahamas, Barbados, Belize, British Virgin Islands, Canada, Cayman Islands, Costa Rica, Cuba, Dominica, Dominican Republic, El Salvador, Grenada, Guadeloupe, Guatemala, Haiti, Honduras, Jamaica, Martinique, Mexico, Montserrat, Nicaragua, Panama, Puerto Rico, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago,	LOW	HIGH	HIGH	LOW	VERY LOW

[88] http://www.padil.gov.au/maf-border/pest/host%20family-maf-border/142444
[89] https://www.discoverlife.org/20/q
http://dmitriev.speciesfile.org/taxahelp.asp?hc=19748&key=Erythroneura&lng=En
[90] http://www.extento.hawaii.edu/kbase/crop/Type/e_solana.htm

					U.S. Virgin Islands, United States) Oceania (Papua New Guinea) South America (Argentina, Bolivia, Brazil, Colombia, Ecuador, French Guiana, Guyana, Paraguay, Peru, Suriname, Uruguay, Venezuela)					
Icerya samaraia	Steatococcus scale	Papaya, Acacia, soursop, pigeon pea, *Citrus* spp., coconut, coffee, taro, mango, banana, guava, Rosa (roses), cocoa	Leaves, fruit	Plant materials, adults are usually stationary or completely immobile on the host plant; Hitchhiker; Seedlings, Micro propagated plants	Asia (Indonesia) Oceania (Federated states of Micronesia, Guam, New Caledonia, Northern Mariana Islands, Palau, Papua New Guinea, Solomon Islands)	LOW	LOW	LOW	MEDIUM	VERY LOW
Oryctes rhinoceros (Syn. *Oryctes stentor; Scarabaeus rhinoceros*)	Coconut rhinoceros beetle; Asiatic rhinoceros beetle; black beetle; coconut black beetle; coconut palm rhinoceros beetle; date palm beetle; dung beetle; rhinoceros beetle; scarab beetle	Coconut, pineapple, palms (including oil palm, date palm, sago palm), taro, sugarcane, lantana, plantain, banana, papaya, pine	Leaves	Infested plant material and machinery, adults capable of flight.	Africa (Mauritius, Réunion)Asia (Bangladesh, British Indian Ocean Territory, Brunei, Cambodia, China, Cocos Islands, Hong Kong, India, Indonesia, Iran, Japan, Laos, Malaysia, Maldives, Myanmar, Oman, Pakistan, Philippines, Singapore, Sri Lanka, Taiwan, Thailand, Vietnam, Yemen)North America (United States)Oceania [American Samoa, Federated States of Micronesia, Fiji, Guam, Niue, Northern Mariana Islands, Palau, Papua New Guinea, Samoa, Solomon Islands, Tokelau, Tonga, (Wallis and Futuna), Vanuatu]	MEDIUM	MEDIUM	MEDIUM	LOW	VERY LOW
Pseudoparlatoria ostreata	Acalypha scale	Papaya, agave, banana, *passiflora laurifolia*, pepper, Vitis; avocado	Leaves, stem	Infested plant material and machinery.	Africa (Democratic Republic of the Congo) Europe (United Kingdom) North America (Cuba)	LOW	MEDIUM	MEDIUM	LOW	VERY LOW

*Transmitted by infested plant material, contaminated soil tools and machinery, water and hitchhiking.

Pathogens

Table 17. Papaya industry pathogen threat summary table.

SCIENTIFIC NAME	COMMON NAME	PRIMARY HOSTS	AFFECTED PLANT PART	MOVEMENT & DISPERSAL	GEOGRAPHIC RANGE	ENTRY POTENTIAL	EST. POTENTIAL	SPREAD POTENTIAL	ECONOMIC IMPACT	OVERALL RISK
Bacteria										
Rickettsia spp.	Papaya bunchy top	Papaya	Leaves, stems		Africa (Sudan, Tanzania) Asia (India, Sri Lanka) North America (Antigua and Barbuda, Barbados, Costa Rica, Cuba, Dominica, Dominican Republic, Grenada, Haiti, Jamaica, Montserrat, Netherlands Antilles, Puerto Rico, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago, USA) South America (Guyana, Suriname)	LOW	MEDIUM	LOW	MEDIUM	LOW
Enterobacter cloacae (Jordan)	Internal yellowing	Papaya	Fruit	Fruit flies, other insects	North America (USA-Hawaii)	LOW	MEDIUM	MEDIUM	MEDIUM	LOW
Erwinia mallotivora[91]	Bacterial crown rot (aka papaya bacterial canker)	Papaya, known to survive on the leaves of cowpea, tomato and rockmelon for at least 14 days.	Leaves, fruit, stems		DAFF lists as: Anguilla; Antigua and Barbuda; Barbados; Dominica; Grenada; Guadeloupe; Indonesia; Japan; Malaysia; Martinique; Montserrat; Northern Mariana Islands; Philippines; Saint Kitts and Nevis; Saint Lucia; Saint Vincent and the Grenadines; Tonga; Trinidad and Tobago; Venezuela, Bolivarian Republic of; and Virgin Islands, United States of America.	LOW	HIGH	HIGH	HIGH	MEDIUM
Erwinia mallotivora	papaya dieback	Papaya, Mallotus japonicus Alternate hosts weeds; *Amaranthus viridius, Amaranthus spinosus, Syndrella nodiflora Achelpha indica and Commelina benghalensis*	Leaves, stem and flowers, whole plant	Vegetative propagative material	DAFF lists as: Anguilla; Antigua and Barbuda; Barbados; Dominica; Grenada; Guadeloupe; Indonesia; Japan; Malaysia; Martinique; Montserrat; Northern Mariana	LOW	HIGH	HIGH	HIGH	MEDIUM

[91] In the Biosecurity Reference Panel meeting #4 the scientific name of Bacterial crown rot was updated from *Erwinia papaya*.

					Islands; Philippines; Saint Kitts and Nevis; Saint Lucia; Saint Vincent and the Grenadines; Tonga; Trinidad and Tobago; Venezuela, Bolivarian Republic of; and Virgin Islands, United States of America.					
Pantoea cypripedii (aka Erwinia cypripedii)[92]	black rot of papaya	papaya				UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN
Erwinia herbicola (exotic strains)	Purple stain fruit rot	Papaya, pineapple, golden-fruited palm; the species affects a very wide host range and survives well in the environment	Fruit		North America (USA-Hawaii), South America (Brazil): the species is globally distributed	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN
Fungi										
Phytophthora tropicalis[93]		Cherimoya, breadfruit, papaya, carnation, macadamia nut, black pepper, apricot, rosemary, sesame, eggplant, cocoa, vanilla, periwinkle, rubber, Leucoedema, cyclamen, verbena, camellia, rhododendron	Foliage, Leaves, stems, whole plant (wilting)		Asia (Taiwan, Vietnam) Europe (Germany, Italy, Netherlands, Poland, Spain) North America (Mexico, USA) Oceania (French Polynesia) South America (Brazil)	LOW	MEDIUM	MEDIUM	MEDIUM	LOW
Ovulariopsis papayae	Papaya powdery mildew	Papaya	Leaves		South Africa	LOW	LOW	LOW	LOW	NEGLIGIBLE
Phyllosticta caricae-papayae	Target spot	Papaya	Leaves		Asia (India)	LOW	LOW	LOW	LOW	NEGLIGIBLE
Pseudomonas carica papayae - reclassified as Pseudomonas syringae phylogroup 6	Leaf spot	Papaya	Leaves		South America (Brazil)	NEGLIGIBLE	LOW	MEDIUM	LOW	NEGLIGIBLE
Armillaria tabescens, A. mellea, A. socialis[94]	Armillaria root rot Wood rot (Summerfruit) Clitocye root rot (Tea Tree, Truffles)	Papaya, lychee, Aleurites, Carya (hickories), Casuarina (beefwood), *Casuarina equisetifolia* (casuarina), mandarin lime, navel orange, *Eucalyptus*, lychee, *Melaleuca quinquenervia* (paperbark tree), oleander, pines, almond, peach,	Leaves, fruit, Whole plant Roots and collar region (Truffles)	Infected Plant	Asia (China, India, Japan, Republic of Korea, Malaysia, Nepal, Turkey) Africa (Madagascar, Malawi, Mauritius, Tanzania, Zimbabwe) North America (Mexico, USA) Central America and Caribbean	LOW Lychee, Papaya	MEDIUM Lychee, Papaya	MEDIUM Lychee, Papaya	LOW Lychee, UNKNOWN Papaya	NEGLIGIBLE Lychee UNKNOWN Papaya

[92] https://gd.eppo.int/taxon/ERWICY, https://www.cabi.org/ISC/abstract/19811376771

[93] This is likely to have a similar impact on the 4 other species of Phytophthora in Australia that affect carnation.

[94] Widespread. Similar impact to other Armillaria spp. in Australia. Established Armillaria spp. are not economically significant in tea tree plantations. Unlikely to be a problem on mulch from tea tree as it is heated for oil extraction prior to use.

		Japanese plum, guava, *Vitis spp. (grape)*, oak, *Acacia* spp., blueberry, common Jujube, banana, plantain, coffee, macadamia, pear, apple, apricot, plum, summerfruit, persimmon, loquat, hickories, range of Australian native trees including Rosaceous species, Ornamental trees, shrubs and fruit crops.			(Panama, Trinidad and Tobago) South America (Brazil) Europe (Albania, Czech Republic, France, Germany, Greece, Italy, Montenegro, Netherlands, Portugal, Serbia, Slovakia, Slovenia, Spain, UK) Oceania (Fiji)					
Colletotrichum magna		Papaya	Fruit		South America (Brazil)	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN
Guignardia spp.	Guignardia spot	Papaya	Leaves		Hawaii	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN
Oidium caricae-papayae	Powdery mildew: Papaya	Papaya	Leaves		Asia (India, Taiwan) North America (Canada)	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN
Cercospora papayae	Black spot disease of papaya	Papaya	Leaves, fruit		Hawaii, Caribbean region, Central America, South America	LOW	MEDIUM	MEDIUM	LOW	VERY LOW
Pseudoidium neolycopersici	Tomato powdery mildew	Papaya, ornamental croton, tomato	Leaves, stems		Africa (South Africa, Tanzania)Asia (Bhutan, China, Hong Kong, India, Iran, Japan, Malaysia, Nepal, South Korea, Thailand, Turkey)Europe (Bulgaria, Croatia, Czechia, Denmark, France, Germany, Greece, Hungary, Italy, Netherlands, Poland, Serbia, Spain, Switzerland, United Kingdom)North America (Canada, Guadeloupe, Jamaica, Mexico, United States)South America (Argentina, Colombia, Venezuela)	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN
Nematodes										
Hoplolaimus pararobustus	Lance nematode	Papaya, banana, oil palm, cotton, citrus, coffee, cowpea, grapevine, guava, mango, rice, plantain, pineapple, roses, sorghum, sugarcane, tea, wheat	Root		Africa (Angola, Burkina Faso, Cameroon, Congo, Democratic Republic of the, Côte d'Ivoire, Egypt, Gambia, Guinea, Kenya, Madagascar, Malawi, Mozambique, Namibia, Niger, Nigeria, Réunion, Rwanda, São Tomé and Príncipe, Senegal, South Africa, Tanzania, Togo, Uganda, Zimbabwe) Asia (China, Pakistan, Sri Lanka) North America (Dominica,	LOW	HIGH	MEDIUM	MEDIUM	LOW

					Grenada, Saint Lucia, Saint Vincent and the Grenadines)					
Meloidogyne enterolobii (Syn. *Meloidogyne mayaguensis*)	Pacara earpod tree root-knot nematode	Papaya, herbaceous and woody plants. Principal hosts are coffee, mango, pineapple, cashew, cucurbits, peanut, broccoli, capsicum, papaya, carrot, Eucalyptus, *Gossypium* spp., sweetpotato, lettuce, lantana, bean, cotton, eggplant, guava, pepper, potato, soybean, tobacco, tomato, ginger, watermelon[14]	Roots		Africa (Burkina Faso, Côte d'Ivoire, Kenya, Malawi, Niger, Nigeria, Senegal, South Africa, Togo) Asia (China, India, Singapore, Thailand, Vietnam) Europe (Switzerland) North America (Costa Rica, Cuba, Guadeloupe, Guatemala, Martinique, Mexico, Puerto Rico, Trinidad and Tobago, USA). South America (Brazil, Venezuela)	HIGH (Papaya)	HIGH (Papaya)	HIGH (Papaya)	HIGH (Papaya)	HIGH (Papaya)
Scutellonema clathricaudatum		Okra, onion, peanut, cabbages, cauliflowers, pigeon pea, papaya, lemon, melon, cucumber, carrot, yam, strawberry, Bourbon cotton, lettuce, cassava, banana, tobacco, rice, pearl millet, pepper, tomato, eggplant, potato, wheat, mung bean, cowpea, grapevine, maize	Leaves, roots		Africa (Benin, Burkina Faso, Cameroon, Central African Republic, Congo, Democratic Republic of the, Congo, Republic of the, Côte d'Ivoire, Ethiopia, Ghana, Guinea, Kenya, Malawi, Mali, Mozambique, Niger, Nigeria, Sierra Leone, South Africa, Sudan, Tanzania, Togo, Uganda) Asia (China, India, Thailand) North America (Cuba)	MEDIUM	MEDIUM	MEDIUM	MEDIUM	LOW
Phytoplasmas and viruses										
Cotton leafcurl virus complex (Begomovirus)	Cotton leaf curl Alabad virus (India/Pakistan), cotton leaf curl Bangalore virus, Cotton leaf curl Gezira virus (Africa), Cotton leaf curl Kokhran virus (India/Pakistan). Cotton leaf curl Multan virus (India/Pakistan/China), Cotton leaf curl Rajasthan virus (India), Cotton leaf curl Shahdapur virus, Papaya leaf curl virus (India/Pakistan), Tomato leaf curl	Cotton. Additional hosts include Hibiscus, Okra, tobacco, radish, tomato, French bean, chilli, papaya and many weeds	Leaves symptomatic, whole plant affected		Asia (Oman)	MEDIUM	HIGH	HIGH	HIGH	HIGH

	Bangalore virus (India/Pakistan), Okra enation leaf curl virus (Pakistan)									
Papaya lethal yellowing virus	Papaya lethal yellowing disease	Papaya	Leaves, fruit		South America (Brazil)	LOW	MEDIUM	MEDIUM	LOW-MEDIUM	LOW
Papaya droopy necrosis virus (PDNV); Papaya apical necrosis virus (PANV)[37]		Papaya	Leaves		North America (USA) South America (Venezuela)	LOW	LOW	LOW	LOW	LOW
Papaya lethal yellowing virus	Papaya lethal yellowing disease	Papaya	Leaves, fruit		South America (Brazil)	LOW	MEDIUM	MEDIUM	LOW-MEDIUM	LOW
Moroccan watermelon mosaic virus		Papaya, marrow	Leaves		Africa (Democratic Republic of Congo, Nigeria, South Africa, Tunisia) Asia (Iran) Europe (France, Greece, Italy)	LOW	LOW	MEDIUM	LOW	LOW
Papaya leaf medium distortion mosaic virus (Potyvirus)	Papaya leaf medium distortion mosaic virus	Papaya, oriental pickling melon, cucumber, spiked/horned melon	Leaves, fruit		North America (Mexico)	LOW	MEDIUM	MEDIUM	MEDIUM	LOW-MEDIUM
Papaya leaf curl virus (several Reoviruses can cause this disease)	Papaya leaf curl virus	Papaya	Leaves		Asia (India)	LOW	MEDIUM	MEDIUM-HIGH	MEDIUM-HIGH	MEDIUM
Croton yellow vein mosaic Begomoviral	Croton yellow vein mosaic virus	Solanaceae, beetroot, papaya, peas and beans	Leaves		Asia (India)	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM
Papaya leaf curl Guangdong virus		Papaya, passionfruit, bell pepper, tobacco	Systemic infection		Asia (South Korea, Taiwan)	LOW	MEDIUM	MEDIUM	MEDIUM	MEDIUM
Papaya leaf curl virus (several Begomoviruses can cause this disease)	Papaya leaf curl virus	Papaya	Leaves		Asia (India)	LOW	MEDIUM	MEDIUM-HIGH	MEDIUM-HIGH	MEDIUM
Tomato leaf curl Albatinah virus		Papaya, tomato	Systemic infection		Asia (Oman)	LOW	MEDIUM	MEDIUM	MEDIUM	MEDIUM
Tobacco leaf curl virus (syn. Tobacco leaf curl bigeminivirus,	Tobacco leaf curl virus (TLCV)	Tomato, capsicum, papaya, tobacco, spinach and *Zinnia elegans*	Leaves, stem, fruit, flowers, whole plant (dwarfing)		Africa (Burkina Faso, Cameroon, Comoros, Democratic Republic of the Congo, Egypt, Ghana, Madagascar, Malawi, Mauritius,	LOW Papaya	MEDIUM Papaya	MEDIUM Papaya	LOW Papaya	VERY LOW Papaya

Tobacco cabbaging virus, Tobacco curly leaf virus, Tobacco frenching virus, Tobacco leaf curl begomovirus, Tobacco leaf curl bigeminivirus, Tobacco leaf curl geminivirus, Tobacco leaf curl virus 1, Tomato yellow dwarf virus)					Morocco, Mozambique, Nigeria, Sierra Leone, South Africa, Sudan, Tanzania, Uganda, Zambia, Zimbabwe) Asia (Cambodia, China, Georgia, India, Indonesia, Iraq, Japan, Malaysia, Myanmar, Pakistan, Philippines, South Korea, Sri Lanka, Taiwan, Thailand, Yemen) Europe (Denmark, Romania, Spain, Switzerland) North America (Cuba, Jamaica, Panama, Puerto Rico, United States) Oceania (Papua New Guinea, South America, Colombia, Venezuela)					
Papaya mosaic virus (Potexvirus)	Papaya mosaic virus	Papaya	Leaves, whole plant (dwarfing)		Africa (Tanzania) Asia (India, Philippines) North America (Dominica, Mexico, Saint Vincent and the Grenadines, Trinidad and Tobago, USA) Oceania (Guam) South America (Brazil, Venezuela)	LOW	LOW	LOW	LOW	NEGLIGIBLE
Papaya leaf curl Guandong virus		Papaya, passionfruit, bell pepper, tobacco	Systemic infection		Asia (South Korea, Taiwan)	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN
Tomato leaf curl Albatinah virus		Papaya, tomato	Systemic infection		Asia (Oman)					
Chickpea chlorotic dwarf virus		Beetroot, bell pepper, papaya, chickpea, watermelon, cucumber, cotton, lentil, common bean, pea, tomato, spinach, faba bean	Leaves, whole plant (stunting)		Africa (Egypt, Ethiopia, Nigeria, Sudan) Asia (India, Iran, Iraq, Oman, Pakistan, Syria, Yemen)	MEDIUM	MEDIUM	MEDIUM	LOW	
Okra enation leaf curl virus		Papaya, okra,	Systemic infection		Asia (India, Pakistan)	LOW-MEDIUM	MEDIUM	MEDIUM	LOW-MEDIUM	
Candidatus Phytoplasma asteris 16SrI	Yellow disease phytoplasmas	Onion, garlic, celery, asparagus, oats, beetroot, Bougainvillea, canola, cabbages, cauliflowers, broccoli, turnip, pigeon pea, bell pepper, papaya, safflower, *Citrus* spp., coconut, coriander, pumpkin, marrow, carrot, loquat, Eucalyptus, Euphorbia round kumquat, strawberry, soyabean, cotton, china-	Fruit, growing point, inflorescence leaves, roots, stems	Latent infection of propagation material - cuttings	Africa (Mozambique, South Africa, Zambia) Asia (China, India, Indonesia, Iran, Israel, Japan, Lebanon, Malaysia, Myanmar, South Korea, Taiwan, Thailand, Turkey, Pakistan) Europe (Belarus, Belgium, Czechia, Finland, France,	LOW	MEDIUM	MEDIUM	HIGH	MEDIUM

		rose, barley, hop, lettuce, larches, lily, loofah, lupins, macadamia nut, apple, mallow, mango, cassava, lucerne, bitter gourd, Japanese mulberry, wild banana, myrtle, watercress, basil, European olive, prickly pear, common poppy, passionfruit, pearl millet, parsley, common bean, date-palm, black pepper, poplars, primrose, apricot, cherries, peach, nectarine, Japanese plum, European pear, common oak, radish, blackcurrant, red currant, roses, blackberry, raspberry, willows, sesame, tomato, eggplant, potato, spinach, lilac, marigold, pyrethrum, dandelion, clovers, wheat, blueberries, grapevine, maize, zinnia			Germany, Greece, Hungary, Italy, Lithuania, Poland, Portugal, Russia, Spain, Ukraine, United Kingdom) North America (Bermuda, Canada, Cuba, Guatemala, Mexico, Saint Vincent and the Grenadines, United States) South America (Argentina, Brazil, Colombia, Peru) Oceania (Futuna islands)					
Candidatus Phytoplasma solani 16SrXII-A	Stolbur phytoplasma	Kiwifruit, celery, beetroot, cabbages, cauliflowers, bell pepper, papaya, chicory, carrot, common fig, strawberry, apple, lucerne, Peppermint, tobacco, parsnip, avocado, parsley, common bean, pea, broad-leaved plantain, stone fruit, American plum, sweet cherry, plum, European pear, radish, blackberry, tomato, eggplant, black nightshade, potato, Johnson grass, dandelion, thyme, red clover, lavender, maize	Fruit, inflorescence, leaves, stems, vegetative organs, whole plant	Parasitic plants and latently infected vegetative propagation material	Africa (Niger) Asia (Armenia, Azerbaijan, China, Georgia, India, Iran, Israel, Jordan, Kyrgyzstan, Lebanon, Saudi Arabia, South Korea, Syria, Tajikistan, Turkey, Uzbekistan) Europe (Albania, Austria, Bosnia and Herzegovina, Bulgaria, Croatia, Czechia, France, Germany, Greece, Hungary, Italy, Moldova, Montenegro, North Macedonia, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Switzerland, Ukraine, United Kingdom) South America (Chile)	LOW	MEDIUM	MEDIUM	HIGH	MEDIUM
Polygala phyllody phytoplasma (16SrII)	Polygalla phyllody phytoplasma	papaya, Beach naupaka (Scaevola taccada) .	stems		Cuba	LOW	MEDIUM	LOW	UNKNOWN	UNKNOWN
Candidatus Phytoplasma caricae (16SrXVII)		papaya	stems		Cuba	LOW	MEDIUM	LOW	UNKNOWN	UNKNOWN
Candidatus Liberibacter crescens		papaya	stems		Puerto Rico	LOW	MEDIUM	LOW	UNKNOWN	UNKNOWN
Candidatus	Papaya bunchy top	Papaya, red hibiscus (*Hibiscus rosa-*	stem		Peru, Brazil, Costa Rica	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN

phytoplasma brasiliense	disease	*sinensis* L.), sunn hemp (Croalaria juncea L.), Cuban jute (Sida rhmobifolia L.), cauliflower (Brassica oleraceae), bastard cedar trees (Guazuma ulmifolia Lam.), grapevine								

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