Industry Biosecurity Plan for the Citrus Industry

Version 3.0 July 2015

Plant Health AUSTRALIA

Citrus Australia

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Acknowledgements

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Endorsement

The *Industry Biosecurity Plan for the Citrus Industry* (Version 3.0) was formally endorsed by the citrus industry (through Citrus Australia) in September 2014, and all state and territory governments (through the Plant Health Committee). The Australian Government endorses the document without prejudice for the purposes of industries planning needs and meeting the Department's obligations under Clause 13 of the EPPRD. In providing this endorsement the Department notes page 33 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 IRA conducted by the Department of Agriculture which focus only on specific regulated import pathways.".

Table of contents

Figures

Tables

List of acronyms

ACPPO	Australian Chief Plant Protection Office
APVMA	Australian Pesticides and Veterinary Medicines Authority
AS/NZS	Australian Standard/New Zealand Standard
BOLT	Biosecurity On-Line Training
CCEPP	Consultative Committee on Emergency Plant Pests
CPHM	Chief Plant Health Manager
DAF Qld	Department of Agriculture and Fisheries, Queensland
DAFWA	Department of Agriculture and Food, Western Australia
DEDJTR	Department of Economic Development, Jobs, Transport and Resources, Victoria
DPI NSW	Department of Primary Industries, New South Wales
DPIF NT	Department of Primary Industry and Fisheries, Northern Territory
DPIPWE	Department of Primary Industries, Parks, Water and Environment, Tasmania
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
HAL	Horticulture Australia Limited
HLB	Huanglongbing
HPP	High Priority Pest
IBG	Industry Biosecurity Group
IBP	Industry Biosecurity Plan
ICA	Interstate Certification Assurance
ICON	Import Conditions Database
IPM	Integrated Pest Management
IPPC	International Plant Protection Convention
IRA	Import Risk Analysis
ISPM	International Standards for Phytosanitary Measures
MICoR	Manual of Importing Country Requirements
NAQS	Northern Australian Quarantine Strategy
NAPPO	North American Plant Protection Organization
NDP	National Diagnostic Protocol
NGIA	Nursery and Garden Industry Australia
NIASA	Nursery Industry Accreditation Scheme Australia

NMG	National Management Group
NPBDN	National Plant Biosecurity Diagnostic Network
NPSRT	National Plant Surveillance Reporting Tool
NT	Northern Territory
ORIA	Ord River Irrigation Area
PaDIL	Pest and Disease Image Library
PHA	Plant Health Australia
PHAC	Plant Health Assurance Certificate
PHC	Plant Health Certificate
PIDD	Pest Information Document Database
PIRSA	Primary Industries and Regions South Australia
RIFA	Red Imported Fire Ant
SA	South Australia
SARDI	South Australian Research and Development Institute
SDQMA	Subcommittee for Domestic Quarantine and Market Access
SOP	Standard Operating Procedure
SPHDS	Subcommittee on Plant Health Diagnostic Standards
SPS	Sanitary and Phytosanitary
TST	Threat Summary Table
Vic	Victoria
WA	Western Australia
WTO	World Trade Organization

Reporting suspect pests

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

EXECUTIVE SUMMARY

Executive Summary

To ensure its future viability and sustainability, it is vital that the Australian citrus industry minimises the risks posed by exotic pests and responds effectively to plant pest threats. The *Industry Biosecurity Plan for the Citrus Industry* is a framework to coordinate biosecurity activities and investment for Australia's citrus industry. It provides a mechanism for industry, governments and stakeholders to better prepare for and respond to, incursions of pests that could have significant impacts on the citrus industry. It aims to assist citrus producers to evaluate the biosecurity risks within their everyday farming and business activities, formally identify and prioritise exotic plant pests (not currently present in Australia), and focus on future biosecurity challenges.

The *Industry Biosecurity Plan for the Citrus Industry* was developed in consultation with the Industry Biosecurity Group (IBG), a select group of plant health and biosecurity experts. The IBG was coordinated by Plant Health Australia (PHA) and included representatives from Citrus Australia, the Australian Government, relevant state/territory agriculture agencies and PHA.

A key role of the industry biosecurity plan was the compilation of the threat summary tables, a list of more than 140 exotic plant pests and the potential biosecurity threat that they represent. Each pest was given an overall risk rating based on four criteria; entry, establishment, spread potential, and economic impact. Through this process, and further consultation, the highest rated pests were identified and highlighted for future surveillance, on-site biosecurity and awareness activities.

The *Industry Biosecurity Plan for the Citrus Industry* also details current surveillance activities being undertaken by Australia's states and territories, and identifies contingency plans, fact sheets and diagnostic protocols that have been developed for pests relevant to the citrus industry. This enables identification of gaps and prioritises actions that need to be taken to increase the industry's biosecurity preparedness.

This plan is principally designed for decision makers. It provides the citrus industry with a mechanism to identify exotic plant pests as well as the strengths and weaknesses in its current biosecurity activities.

INTRODUCTION

Introduction

Plant Health Australia

Plant Health Australia (PHA) is a public company, with members including the Australian Government, all state and territory governments and a range of plant industry organisations. The company was formed to address high 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 plant industries.

Citrus Australia

Citrus Australia Ltd is the recognised peak industry body representing the nation's commercial citrus growers. It was established in 2008 as a non-profit company limited by guarantee following a decision by growers across the country to create a new industry body. Citrus Australia commenced very modestly with an enthusiastic skill based board, 11 voluntary grower members, and a small team based in Mildura, Victoria. Today, they are supported by 250 grower members, 73 industry members and an expanding Citrus Australia team that provide vital services to the industry.

Citrus Australia's vision is to transform the industry to a unified structure ensuring better value and returns to growers. Their mission is to be a grower driven national organisation representing and leading the industry in:

- policy and advocacy
- research and innovation
- market access, development and promotion
- communication and information
- biosecurity.

Biosecurity planning

Industry biosecurity is the protection from risks posed by exotic pests through actions such as exclusion, eradication and control. Effective industry biosecurity relies on all stakeholders, including government agencies, industry, and the public (Figure 1).

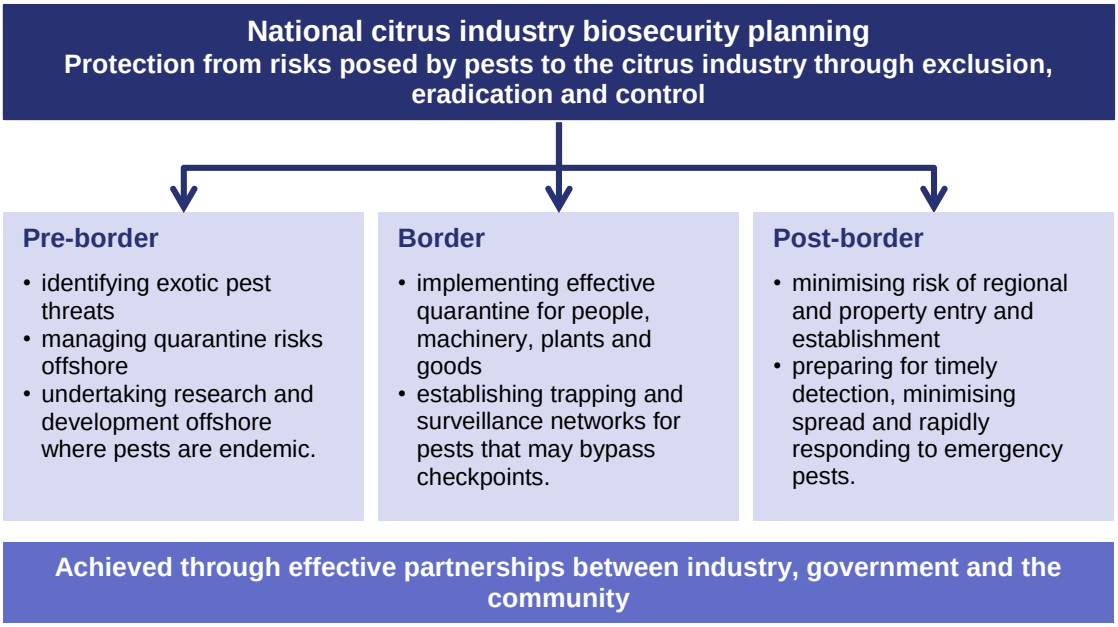


Figure 1. *Industry biosecurity: a shared responsibility*

Australia's geographic isolation and lack of shared land borders provide a degree of natural protection from exotic threats. Australia's national quarantine system also helps 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 or assisted dispersal as a result of increases in overseas tourism, imports and exports, mail and changes to transport procedures (e.g. refrigeration and containerisation of produce).

Biosecurity planning provides a mechanism for the citrus industry, government and other relevant stakeholders to actively determine pests of highest priority, analyse the risks they pose and put in place practices and procedures that would rapidly detect an incursion, minimise the impact if a pest incursion occurs and/or reduce the chance of pests becoming established.

Ensuring the citrus industry has the capacity to minimise the risks posed by pests, and to respond effectively to any pest threat, 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 social and economic costs of pest incursions on both growers and the wider community. The information gathered during these processes provides additional assurance that the Australian citrus 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.

Industry Biosecurity Plan development

With the assistance of Citrus Australia, an Industry Biosecurity Group (IBG), coordinated by PHA, was formed to review the Citrus Industry Biosecurity Plan (IBP). The IBG included representatives from Citrus Australia, Auscitrus and relevant state/territory agriculture agencies, as well as private consultants and researchers (Table 1).

Key steps in the development of the citrus IBP included:

- identifying and documenting key threats to the citrus industry
- confirming an agreed high priority pest (HPP) list
- documenting pest-specific fact sheets, contingency plans, diagnostic protocols and surveillance programs for HPPs
- documenting the roles and responsibilities of stakeholder groups.

Table 1. *Members of the citrus IBG*

Name	Organisation
Andrew Harty	Market Development Manager, Citrus Australia
Andrew Miles	Private consultant
Barbara Hall	South Australia Research and Development Institute
Brad Siebert	Plant Health Australia
Ceri Pearce	Department of Agriculture and Fisheries, Queensland
Felicity Andriunas	Plant Health Australia
Jianhua Mo	Department of Primary Industries, New South Wales
Judith Damiani	Chief Executive Officer, Citrus Australia
Nerida Donovan	Department of Primary Industries, New South Wales
Pat Barkley	Private consultant
Sonya Broughton	Department of Agriculture and Food, Western Australia
Steve Burdette	CostaGroup
Stuart Pettigrew	Citrus Biosecurity Manager
Tim Herrmann	Auscitrus

Review processes

With the support of Citrus Australia and PHA, this plan should be reviewed on a 4-5 year basis. The review process will ensure:

- threat summary tables (TST) are updated to reflect current knowledge
- pest risk assessments are current
- changes to biosecurity processes and legislation are documented

- contact details and the reference to available resources is accurate.

Background on the citrus industry

Citrus fruits have been grown in Australia ever since they were introduced with the First Fleet. Seeds and plants were collected en route from Rio de Janeiro and the Cape of Good Hope, and the first plantings of orange, lime and lemon were made near the Governor's house (now the corner of Phillip and Bridge Streets in Sydney) in 1788. In 1828, Sydney's Botanic Gardens had Maltese blood orange, Bahia navel (from Brazil), and various varieties collected through trade with China.

Development of commercial orchards followed soon after settlement. Citrus trees were planted in gardens and numerous commercial orchards along the Parramatta River were established during the Land Grants Period of 1792-1830.

The industry, however, was not free of pest and disease concerns. Between 1860 and 1870, hundreds of acres of orange trees along the Parramatta River died of root rot (probably *Phytophthora citrophthora*). Following investigations, a committee of enquiry recommended that Seville (sour) orange rootstock be trialled as it was found in Spain to be more tolerant to root rot. This action was not successful as *Citrus tristeza virus* (CTV) had been introduced around 1851, presumably in virus-infected trees, or with the vector, from China or South Africa. As a result, Seville orange rootstock could no longer be successfully used.

Further disease problems lead to the instigation of special quarantine measures, for both imported citrus and citrus within Australia. In 1912, citrus canker was detected in the Northern Territory (NT). As a result, in 1915 the Commonwealth Government issued a proclamation prohibiting the importation of citrus trees from any part of the world. In 1916 additional proclamations prohibited the importation into Australia of citrus fruits from countries known to be infected with citrus canker, as well as prohibiting the removal of citrus trees and fruits from the NT to elsewhere in Australia. Canker was only eradicated in NT in 1922 following the destruction of citrus to the 19th parallel. The Asian citrus psyllid was recorded in the Northern Territory, Australia (1915) during this incursion of citrus canker. It is assumed to have resulted from the introduction of citrus plants from Asia and was eradicated by chance during the 1916-1922 eradication campaign for citrus canker (Bellis *et al.* 2005). Occasional outbreaks of citrus canker have since occurred on Cocos Island (1981), Thursday Island (1984), Christmas Island (1985), and at Lambell's Lagoon near Darwin (1991 and 1993). The Thursday Island and Darwin outbreaks have since been eradicated, with the NT declared canker-free in 1995. The most recent outbreak of citrus canker occurred in 2004 at Emerald (Queensland) and following

the destruction of all citrus including commercial, backyard and some native citrus, the Emerald district was declared citrus canker-free in 2009.

Despite Australia's rigorous quarantine system, a variety of exotic pests still pose a threat to the Australian citrus industry. In countries to the north, such as Papua New Guinea, East Timor and Indonesia, exotic fruit flies occur along with the devastating bacterial diseases huanglongbing and citrus canker. There is a risk that these may be carried into Australia via air currents, air travellers, movements of people across the Torres Strait carrying citrus material or via illegally imported material of citrus and citrus relatives, as budwood, cuttings, fruit or leaves (e.g. leaves of the condiments kaffir lime and curry leaf).

There is a high level of citrus fruit and related items approaching the Australian border via airports. During the period January 2010 to April 2011, the Department of Agriculture Central East and South East Region airport quarantine officers seized 13,449 citrus fruit and related items from passengers (Dunn, 2011). Approximately 24 % of these items were not declared and therefore, if not for the screening process, would have entered Australia, potentially bringing exotic pests and/or diseases with them. The value of border screening by the Department of Agriculture is further highlighted by the interception in 2013, of air passengers carrying leaves and roots of the curry tree, which was infested with Asiatic citrus psyllid eggs and nymphs. This prevented a potential incursion of both the psyllid and the devastating citrus disease, huanglongbing, which is carried by the psyllid.

Although citrus imports also pose a potential risk, this is mitigated through import restrictions and mandatory phytosanitary measures (Table 10). Fresh citrus is permitted to be imported from a number of countries including parts of the US, New Zealand, Spain, Israel, Egypt, Italy, Thailand and New Caledonia. The volume of fresh citrus fruit imported in 2010-11 totalled 26,100 tonnes, with the majority of this total consisting of oranges (18,000 tonnes), and lemons and limes (5,400 tonnes) (FAO 2012). Budwood is the only citrus nursery stock permitted entry and there are a range of restrictions on the importation of semi-processed and dried citrus fruit and leaves (Table 10).

Currently around 12 million trees, covering about 29,780 hectares, form the base of the citrus industry in Australia. A large portion of citrus is bearing fruit (27,931 ha) and a further 1,845 ha is non-bearing. Individual farms are often mixed fruit growing operations and are relatively small (the average area harvested is 18 ha). The majority of growers (41 %) have total citrus areas of between 0.25 and 5 hectares. Citrus is produced commercially in all states except for Tasmania, with most of Australia's commercial citrus producers concentrated in the irrigated horticulture regions of southern Australia and Queensland (see Figure 2), including the:

- Riverina, situated in the Murrumbidgee River area of southern New South Wales
- Murray Valley growing area, located along both sides of the Murray River in north western Victoria, south western New South Wales and including Sunraysia
- Riverland, located along the Murray River in South Australia

- Central Burnett and Emerald regions in Queensland.

Smaller citrus growing areas are situated in various coastal and other locations in New South Wales (Central Coast, Narromine), the Northern Territory (Darwin, Katherine), Queensland (Bundaberg, Sunshine Coast, Mareeba area) and Western Australia (Carnarvon, Donnybrook, Gin Gin, Perth, Kununurra).

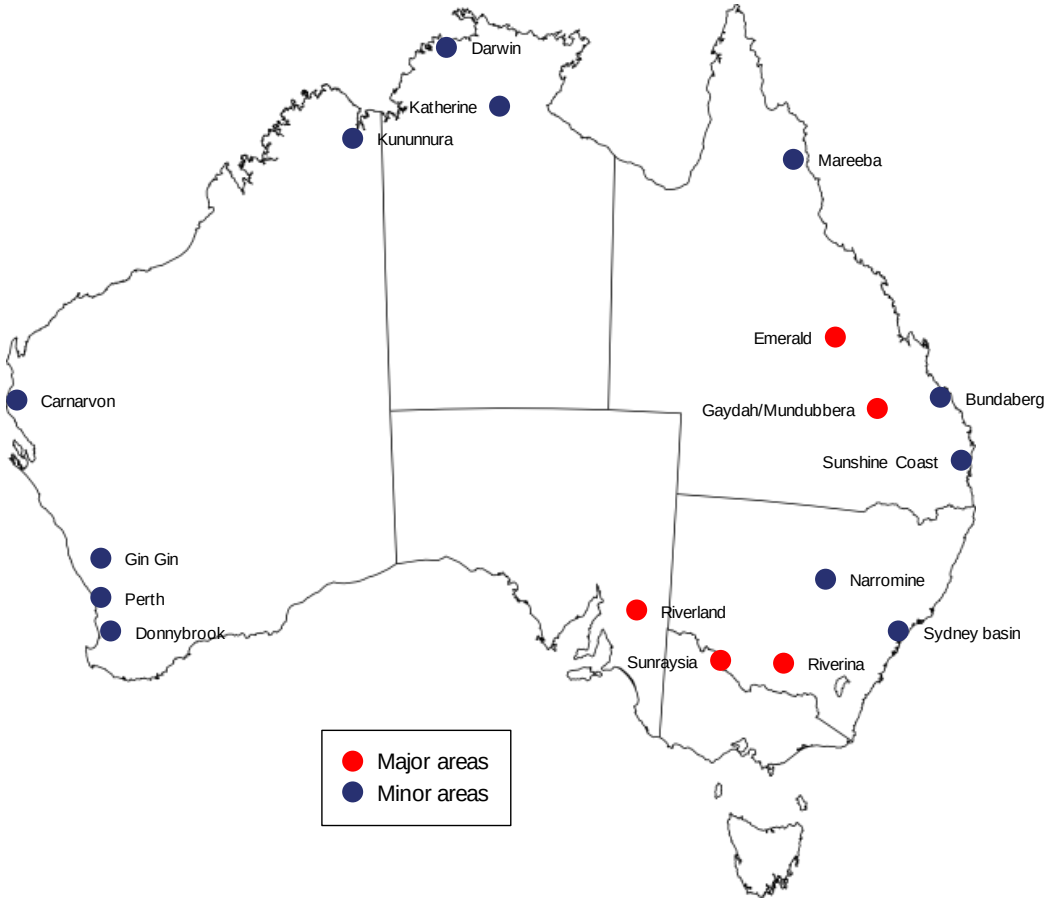


Figure 2. *Citrus production areas in Australia*

Since 2009, citrus production in Australia has remained fairly steady, except for a dip in production in 2010 (Figure 3). Over 580,000 tonnes of citrus fruit were produced in Australia in 2013, with over 600,000 tonnes predicted for 2014 (Table 2). In the southern hemisphere, Australia is ranked as the fifth largest producer of citrus, after Brazil, Argentina, South Africa and Peru (FAO 2012). On the global scene, however, Australia is a relatively small player, producing less than 1 % of the world's citrus (FAO 2012).

Oranges are the most commonly grown citrus fruit in Australia, followed by mandarins, lemons, grapefruit, tangelos and limes. Varieties produced vary according to region. While oranges are the main citrus crop grown in the southern irrigation areas, mandarin production is

dominant in Queensland. A summary of the main types of citrus fruit produced according to region is supplied in Table 2.

Table 2. *Citrus production in Australia (Citrus Australia)*

2013 Production (tonnes)								
Variety	**Sunraysia**	**Mid Murray**	**Riverland**	**Riverina**	**NSW other**	**Qld**	**WA**	**Total**
Navel	64,000	3,400	98,000	45,455		1,600	5,500	**217,955**
Valencia	25,500	5,500	50,000	100,000		500	2,700	**184,200**
Common orange				16,000	13,000			**29,000**
Imperial mandarin	9,500		11,000	200		25,250	1,500	**47,450**
Murcott mandarin	200		2,940			18,000	400	**21,540**
Afourer mandarin	12,800		10,500	1,000		3,000	100	**27,400**
Other mandarin	4,200		6,000			5,000	1,200	**16,400**
Lemon	1,500	400	5,000	1,000	1,000	10,000	1,000	**19,900**
Grapefruit	1,500	2,000	3,000	1,000		500	950	**8,950**
Tangelo	1,500		5,000					**6,500**
Lime	800		800	400	800	3,200	400	**6,400**
Total	**121,500**	**11,300**	**192,240**	**165,055**	**14,800**	**67,050**	**13,750**	**585,695**
Production estimate 2014 (tonnes)								
Variety	**Sunraysia**	**Mid Murray**	**Riverland**	**Riverina**	**NSW other**	**Qld**	**WA**	**Total**
Navel	65,000	3,500	105,000	58,000		1,500	5,500	**238,500**
Valencia	25,000	5,000	51,000	110,000		500	2,800	**194,300**
Common orange				20,000	13,000			**33,000**
Imperial mandarin	6,500		7,700	150		20,000	2,000	**36,350**
Murcott mandarin	200		3,000			22,000	400	**25,600**
Afourer mandarin	13,000		10,500	1,500		3,000	100	**28,100**
Other mandarin	4,500		6,000			5,000	1,300	**16,800**
Grapefruit	1,500	2,000	2,000	1,000		500	900	**7,900**

Tangelo	1,000		3,300					**4,300**
Lemon	1,500	400	6,000	1,500	1,000	12,000	1,000	**23,400**
Lime	800		800	400	800	3,200	400	**6,400**
Total	**119,000**	**10,900**	**195,300**	**192,550**	**14,800**	**67,700**	**14,400**	**614,650**

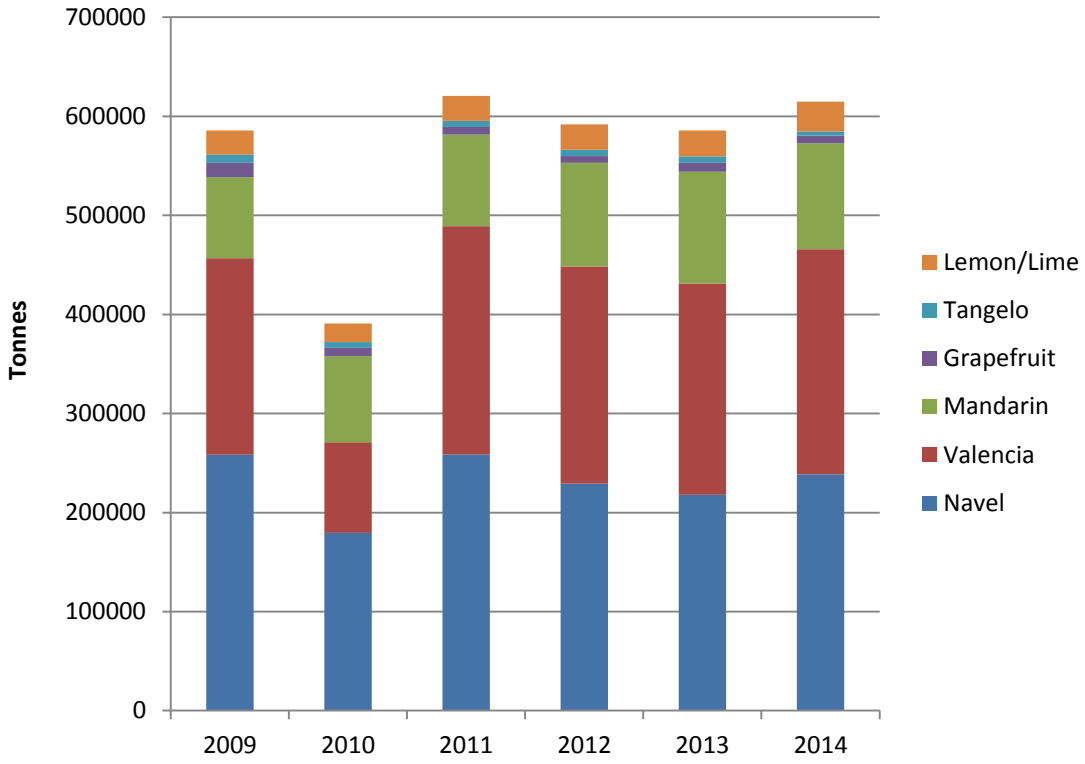


Figure 3. *Australian citrus production 2009 - 2014*

Citrus has grown to become Australia's largest fresh fruit exporting industry in terms of both tonnage and value. In 2013 oranges and mandarins made up the bulk of citrus exports, with smaller quantities of lemons, limes and grapefruit exported (Table 3). In the last 15 years there has also been an increasing trend in Australia towards the production of high quality fresh fruit for both domestic and export markets and production of fresh juices, with a shift away from production of juice concentrates.

Over a quarter of Australia's citrus is exported, representing about half of the total value of production (FAO 2012). Major markets for Australian oranges include Japan, Hong Kong, Malaysia, Singapore and the United States (Horticulture Australia Limited (HAL) 2013; also see Table 3). In contrast the majority of mandarins are exported to Indonesia, United Arab Emirates and New Zealand and the majority of lemons and limes are exported to Indonesia

and Canada (Table 3). Most of Australian grapefruit is exported to Canada, with New Zealand also receiving a large proportion of exports (Table 3).

As a result of the industry's strong fresh fruit export focus, significant investments are made in pest disinfestation research and field control of fruit fly to overcome overseas market access barriers. Maintaining 'area freedom' status for pests of concern to major overseas markets is also of high priority.

Table 3. *Australian citrus exports (tonnes) for 2013 (Citrus Australia)*

Region	Oranges	Mandarins	Lemons/ Limes	Grapefruit/ Other	Total
Asia					
Brunei	116	4	0	0	120
Hong Kong	30,966	1,406	76	0	32,448
India	1,292	82	0	0	1,374
Indonesia	3,879	4,950	434	6	9,269
Japan	34,583	2,678	42	0	37,303
Korea	631	0	0	0	631
Malaysia	12,019	443	38	1	12,501
Singapore	7,522	1,079	32	0	8,633
Taiwan	509	1,318	0	0	1,827
Thailand	2,070	2,880	0	0	4,950
Total	**93,587**	**14,840**	**622**	**7**	**109,056**
America					
USA	11,685	1,336	0	0	13,021
Canada	3,557	475	183	78	4,293
Caribbean	0	0	0	0	0
Total	**15,242**	**1,811**	**183**	**78**	**17,314**
Pacific					
Fiji	498	1	1	1	501
New Caledonia	67	106	21	7	201
New Zealand	4,365	5,342	51	59	9,817
Papua New Guinea	1,439	144	30	10	1,623
Other Pacific	589	171	26	0	786
Total	**6,958**	**5,764**	**129**	**77**	**12,928**

Region	Oranges	Mandarins	Lemons/ Limes	Grapefruit/ Other	Total
Middle East					
Kuwait	0	57	0	0	57
Bahrain	359	166	0	0	525
Qatar	153	146	0	0	299
Saudi Arabia	771	163	0	0	934
UAE	3,172	5,012	0	0	8,184
Total	**4,455**	**5,544**	**0**	**0**	**9,999**
Europe					
Netherlands	46	838	1	0	885
United Kingdom	253	1,058	0	0	1,311
Other Europe	88	0	0	0	88
Total	**387**	**1,896**	**1**	**0**	**2,284**
Africa					
Maldives	82	11	0	0	93
Seychelles	0	36	0	0	36
Cameroon	0	0	0	0	0
Total	**82**	**47**	**0**	**0**	**129**

The Emergency Plant Pest Response Deed

The Emergency Plant Pest Response Deed (EPPRD) has been negotiated between government and industry members of PHA to cover the management and funding arrangements of eradication responses to Emergency Plant Pest (EPP) Incidents. The EPPRD came into effect on October 26, 2005 and is a formal legally binding agreement between PHA, the Australian Government, all state and territory governments and 29 plant industry signatories, including Citrus Australia. The EPPRD is based on the following key principles:

- cost minimisation for all Parties
- reimbursement to growers whose crops or property are directly damaged or destroyed as a result of implementing an approved Response Plan
- early detection and response

- rapid responses to EPPs (excluding weeds)
- 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
- Cost Sharing of eligible costs
- an Agreed Limit for Cost Sharing (calculated as 2 % of the local value of production for one year of the Affected Industry Party or as defined in Schedule 14 of the EPPRD). The Agreed Limit can be exceeded with the agreement of Affected Parties.
- 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 **www.planthealthaustralia.com.au/epprd** and **www.planthealthaustralia.com.au/epprd-qa**.

The definition of a **pest** used in this document covers all insects, mites, snails, nematodes, pathogens and weeds that are injurious to plants, plant products or bees. **Exotic pests** are those not currently present in Australia. **Endemic pests** are those established within Australia.

Pest threats are those that have been or are being identified as significant to the industry. The most important threats are defined as **HPPs**.

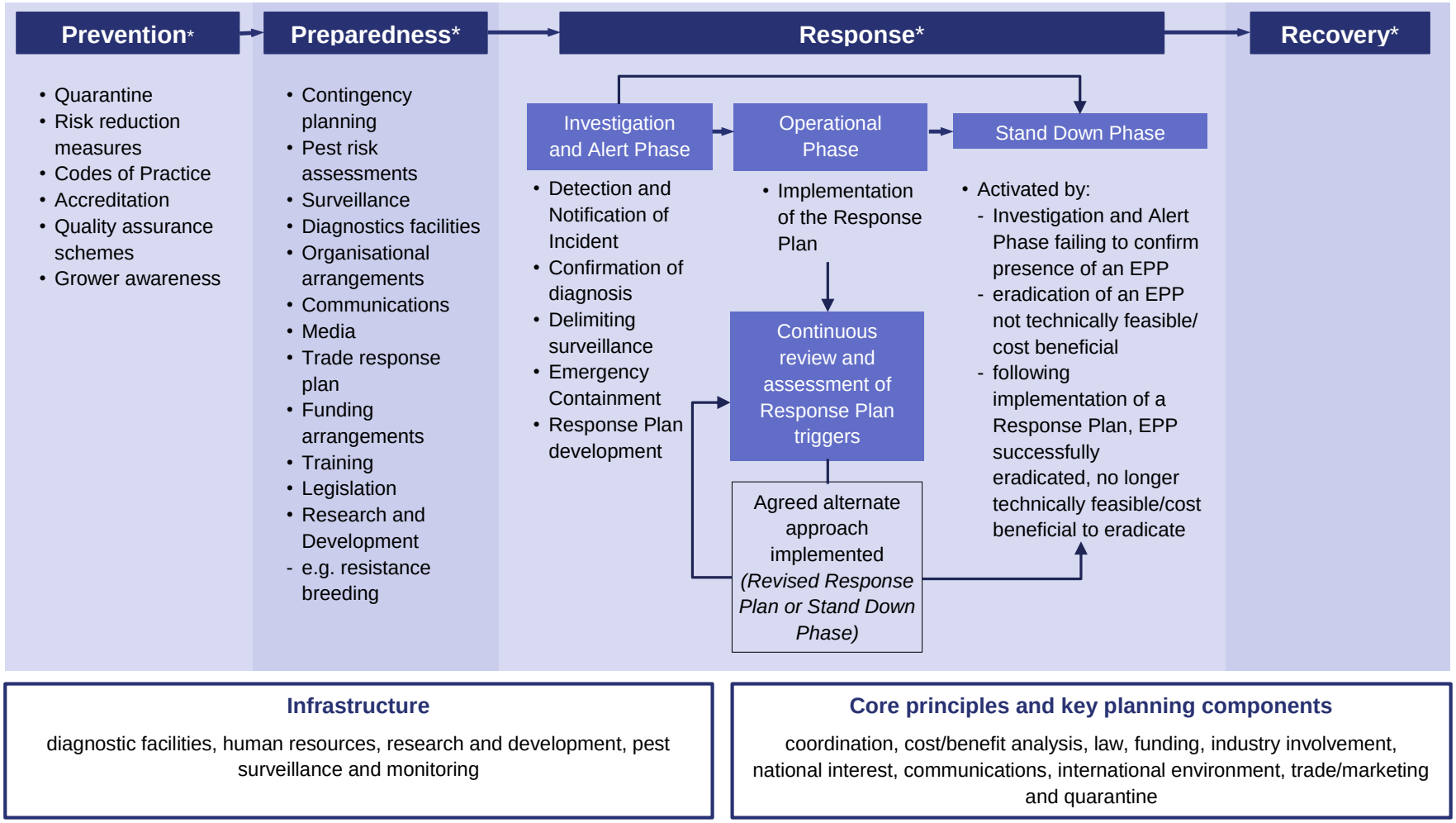
Under the arrangements of the EPPRD, EPPs are defined as those that meet one or more of the following criteria:

a) It is a **known exotic Plant Pest** the economic consequences of an occurrence of which would be **economically or otherwise harmful** for Australia, and for which it is considered to be in the regional and national interest to be free of the plant pest.
b) It is a **variant form of an established Plant Pest** which can be distinguished by appropriate investigative and diagnostic methods and which, if established in Australia, would have a regional and national impact.
c) It is a **serious Plant Pest of unknown or uncertain origin** which may, on the evidence available at the time, be an entirely new plant pest or one not listed in Schedule 13 and which if established in Australia is considered likely to have an adverse economic impact regionally and nationally.
d) It is a **Plant Pest of potential economic importance** to the area endangered thereby and **not yet present** there or widely distributed and being officially controlled, but is occurring in such a fulminant outbreak form, that an emergency response is required to ensure that there is not either a large scale epidemic of regional and national significance or serious loss of market access[1].

[1] Variation to this definition pending EPPRD Party approval as at March 2014

PLANTPLAN is the agreed technical Response Plan used by jurisdictions and industry in responding to an EPP Incident. It provides nationally consistent guidelines for response procedures under the EPPRD, outlining the phases of an incursion (investigation and alert, operational and stand down[2]), as well as the key roles and responsibilities of industry and government during each of these phases. The incursion management plan from PLANTPLAN (2013) has been summarised in Figure 4.

[2] The inclusion of an additional phase, Transition to Management, is pending as at March 2014



* stages of 'all hazards' approach adopted by Emergency Management Australia

Figure 4. *Summary of incursion management for plant industries according to PLANTPLAN (2013)*

Document overview

The biosecurity package developed for the Australian citrus industry focuses on a number of key areas.

Threat identification, pest risk assessments and categorisation

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 on productivity, sustainability, and marketability and to assess their potential impacts. This plan strengthens risk assessment work already being done both interstate and overseas. Key citrus biosecurity threats are detailed in the TST (Appendix 1) and HPP list (the top ranked threats to the citrus industry).

The EPPRD outlines a mechanism whereby Industry and Government Parties will contribute to the total cost of a response to an EPP Incident based on agreed Categories. The process used for categorisation of EPPs is included in this section of the IBP, along with a list of citrus EPPs that have been categorised to date.

Risk mitigation plan

This section provides a summary of activities to mitigate the impact of pest threats on the Australian citrus 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 suspect pests.

Contingency plans and response management

PHA has coordinated the development of PLANTPLAN, a generic emergency response plan for the Australian plant industries. This plan details the procedures required and the organisations responsible in the event of an incursion of an EPP. Pest-specific contingency plans may be developed as a result of the pest threats identified in this plan.

Biosecurity implementation

The citrus IBP provides a framework for the implementation of biosecurity practices within the industry. Currently a range of biosecurity practices are undertaken within the citrus industry and these are outlined in the Risk Mitigation Plan (page 50). Further implementation within the framework of the IBP, such as those practices outlined in Figure 5, should be investigated to increase preparedness in the industry. As highlighted in Figure 5, some of these implementation activities are currently being undertaken as part of the three year citrus biosecurity project entitled “Protecting Australia’s citrus industry from biosecurity threats”. This project aims to better coordinate and strengthen the industry’s biosecurity planning and preparedness activities and facilitate ongoing awareness of citrus pests and diseases. In addition to the review of the IBP, the project includes a review of the biosecurity manual and contingency plan for huanglongbing and vectors, a simulation exercise for an EPP incursion, development of an Owner Reimbursement Cost Framework, ongoing awareness training for the industry and the appointment of a dedicated citrus biosecurity manager. The project is funded by HAL using the citrus R&D levy and matched funds from the Australian Government.

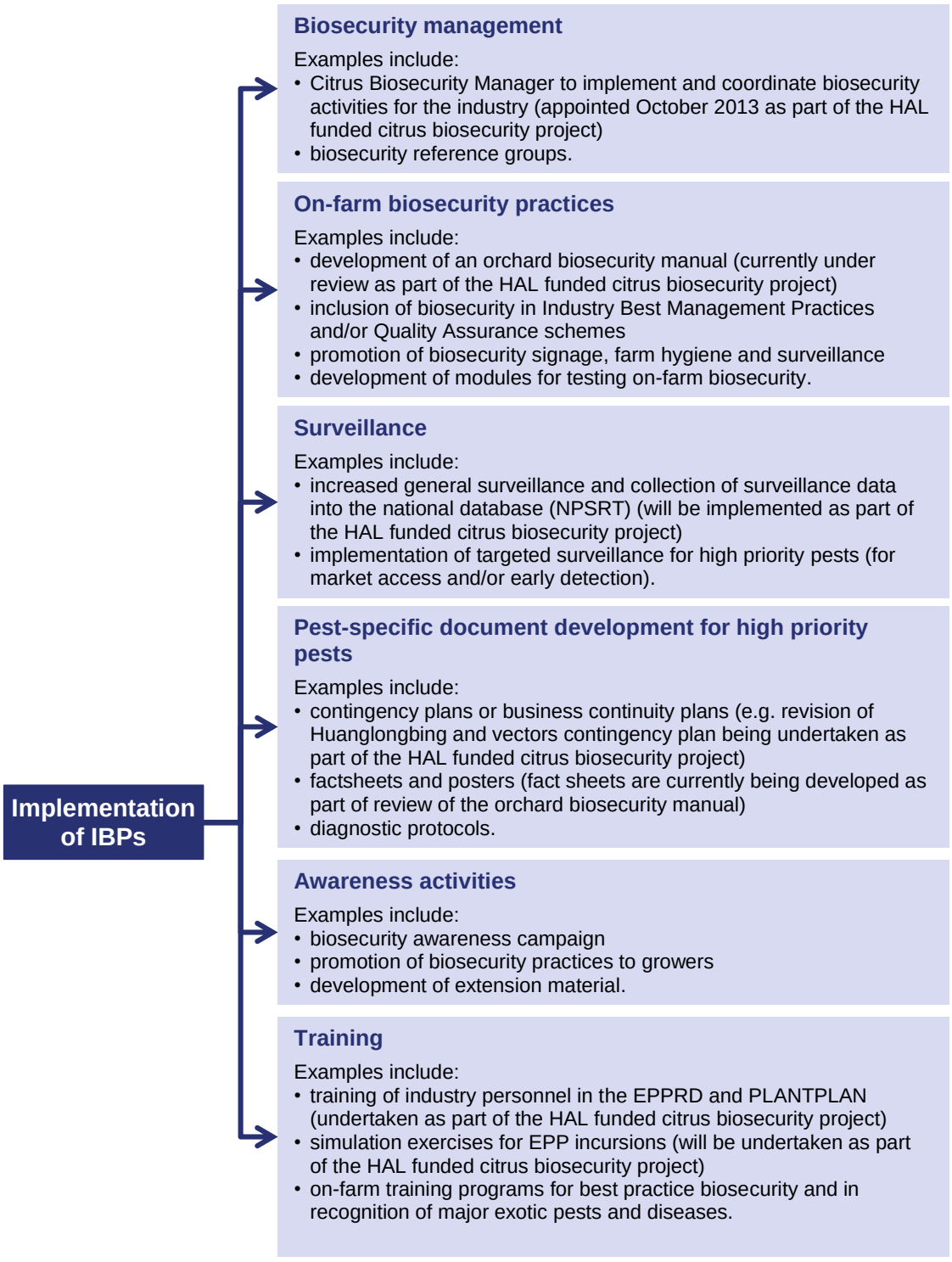


Figure 5. *Biosecurity implementation activities within the framework of the IBP*[3]

[3] Many of these activities are currently underway as part of the HAL funded citrus biosecurity project "Protecting Australia's citrus industry from biosecurity threats"

Through the development of the citrus IBP, a list of biosecurity action items to be considered by stakeholders in the industry has been developed (Table 4). This list is intended to provide proposed or potential biosecurity priorities for the citrus industry that are gaps in the current activities listed in the Risk Mitigation section of the IBP. Future versions of this document will contain information on the progress made on the listed items.

Table 4. *Biosecurity action items identified by the citrus industry*

Action item	Details
Legislation relating to neglected orchards	Improved and consistent legislation relating to the destruction of abandoned and neglected orchards and home garden trees to aid in limiting the spread of pests. Recommendations include the ability to destroy trees without the need to prove they are infected/infested during the response to an incursion.
Compulsory registration system for citrus growing properties and nurseries	Industry to work with State and Territory Departments towards a compulsory registration system for citrus growers (including nurseries), supported by legislation. This includes development of a central database of growers (location, contact details, areas under citrus cultivation, varieties and volumes of citrus grown). This would be used to facilitate industry planning, surveillance or pest control programs, policy development, communication of research outcomes and communication during an emergency response.
Legislated compulsory budwood scheme	Implementation of a process, supported by legislation, for a mandatory certified high health status budwood scheme.
Increased long-term capacity and capability in citrus biosecurity	Provision of training opportunities to develop or maintain expertise for exotic pests in Australia (e.g. overseas trips to develop diagnostic or management experience for exotic pathogens, e.g. huanglongbing (HLB)). Identification of long-term capacity building strategies to address declining capability in citrus biosecurity.
General biosecurity awareness material	Development and provision of new awareness material targeted to audience (e.g. nurseryman, orchardist, urban stakeholders) for the identification of exotic citrus pests.
Grower surveillance activities	Development and implementation of more general surveillance programs by growers and their staff and increasing the capacity of the industry to capture the data obtained.
Orchard and nursery biosecurity	Provision of increased training programs for staff in orchards and nurseries and Integrated Pest Management (IPM) scouts, including training in data recording.
Regularly update entry requirements for imported products of citrus and citrus relatives	Through consultation with the citrus industry, the entry requirements for fruit, kaffir lime and curry leaves should be regularly reviewed and updated by the Department of Agriculture in light of the rapid spread of HLB and its vector, the Asiatic citrus psyllid.
Emergency registration of chemicals for HPPs	Identification of chemical and alternative control requirements (such as biological controls) for citrus HPPs and their availability in Australia. Disease resistant budwood should also be investigated. Where required, advanced applications for emergency chemical registrations should be prepared and submitted to the Australian Pesticides and Veterinary Medicines Authority (APVMA). This should be a collaborative process between state governments and the citrus industry.

Action item	Details
Economic impact analysis of effects of HLB on whole of supply chain	Conduct an economic impact analysis of the impact of HLB on the citrus, nursery and allied industries to assess the cost of an incursion, to justify eradication and in the event eradication is not feasible, to assess costs of management strategies. This economic impact analysis should: • define how HLB will impact the operating and consuming environment for citrus; • estimate the multiplier effects of HLB from the citrus economy to the regional, state or national economies more generally through supplier, retailer and tertiary service businesses; and • provide easily-communicated, yet quantitative estimates of the nature and magnitude of the economic effects of HLB should an incursion occur in Australia.
Sustainable mechanism to fund biosecurity activities	Implementation of a sustainable mechanism to fund biosecurity activities into the future.

References

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THREAT IDENTIFICATION, PEST RISK ASSESSMENTS AND CATEGORISATION

Introduction

This section identifies high risk exotic pest threats to the citrus 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 citrus 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 if pest incursions occur. One such mechanism is the EPPRD that has been negotiated between PHA's government and industry members. The EPPRD ensures reliable and agreed funding arrangements are in place in advance of EPP incursions, and assists in the response to EPP incursions, particularly those identified as key threats.

Identification of high risk 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.

Threat identification

Information on biosecurity threats to the citrus industry described in this document came from a combination of:

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

At this time, only invertebrate pests (insects, mites, molluscs and nematodes) and pathogens (disease causing organisms) have been identified, although the issue of weeds may be revisited through future reviews of this plan.

Pest risk assessments

The assessment process used in this IBP was developed in accordance with the International Standards for Phytosanitary Measures (ISPM) No. 2 and 11 [Food and Agriculture Organization of the United Nations (FAO), 2004; 2007]. A summary of the pest risk analysis protocol followed in this IBP is shown in Table 5, and the complete protocol used for pest risk analysis in this IBP can be found on the PHA website[4].

While there are similarities in the ranking system used in this document and the Import Risk Analysis (IRA) process followed by the Department of Agriculture, 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 when compared with the Department of Agriculture's IRA process.

Modifications of the Department of Agriculture, Fisheries and Forestry (2011) protocol have been made to suit the analysis required in the IBP development process, including, but not limited to:

- **Entry potential:** The determination of entry potential in this IBP takes into account 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 by the Department of Agriculture in their IRA process, which only considers legal importation of plants or plant commodities.
- **Potential economic impact** of pest establishment in this document only takes into account the impacts on the citrus industry. The Department of Agriculture IRA process has a wider scope, including the effects to all of Australia's plant industries, trade, the environment and public health.
- **Risk potentials and impacts:** The number of categories used in this IBP for describing the entry, establishment, spread, and potential economic impact (see 'Description of terms used in pest risk tables', page 33) differs in comparison to that used in the Department of Agriculture IRA process.

[4] Available from **www.planthealthaustralia.com.au/biosecurity/risk-mitigation**

Table 5. *Summary of pest risk assessment process used in IBPs*

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 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 risk	• 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 risk	• Risk ratings should be reviewed with the IBP

The objective of risk assessment is to clearly identify and classify biosecurity risks and to provide data to assist in the evaluation and treatment 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 TSTs (Appendix 1) present a list of potential plant pest threats to the citrus 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 TSTs were identified through a process of qualitative risk assessment[5] and are listed in the HPP list (Table 6).

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 IRA conducted by the Department of Agriculture which focus 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 IBPs, sharing similar pest ratings. However the economic impact of a pest is considered at an industry specific level (i.e. for the citrus industry only in this IBP), and therefore this rating may differ between IBPs.

Description of terms used in pest risk tables

The descriptions below relate to terms in Table 6.

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.

[5] An explanation of the risk assessment method used can be found on the PHA website (**www.planthealthaustralia.com.au/biosecurity/risk-mitigation**)

Establishment potential

Negligible	The pest has limited potential to survive and become established within Australia given the combination of all known factors.
Low	The pest has the potential to survive and become established in approximately one-third or less of the range of hosts. The pest could have a low probability of contact with susceptible hosts.
Medium	The pest has the potential to survive and become established in between approximately one-third and two-thirds of the range of hosts.
High	The pest has potential to survive and become established throughout most or all of the range of hosts. Distribution is not limited by environmental conditions that prevail in Australia. Based upon its current world distribution, and known conditions of survival, it is likely to survive in Australia wherever major hosts are grown.
Unknown	The establishment potential of the pest 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.

Citrus industry high priority plant pest threat list

Table 6 provides an overview of the top ranked threats to the citrus industry. Further details on each pest along with the basis for the likelihood ratings are provided in the TSTs (Appendix 1). Assessments may change given more detailed research, and the priority list will be reviewed with the Biosecurity Plan on a 4-5 year basis. An explanation of the method used for calculating the overall risk can be found on the PHA website[6].

Table 6. *Citrus industry high priority plant pest threat list*

Scientific name	Common name	Host(s)[7]	Plant part affected	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
BACTERIA (including phytoplasmas)								
'*Candidatus* Liberibacter africanus'[8]	Huanglongbing/ citrus greening (African strain)	*Citrus* spp.[9]	Leaves, stems, flowers, fruit, roots, whole plant	HIGH	HIGH	HIGH	HIGH	**HIGH**
'*Candidatus* Liberibacter americanus'[10]	Huanglongbing/ citrus greening (American strain)	*Citrus* spp.[9]	Leaves, stems, flowers, fruit, roots, whole plant	HIGH	HIGH	HIGH	HIGH	**HIGH**

[6] Available from **www.planthealthaustralia.com.au/biosecurity/risk-mitigation**

[7] Refer to Appendix 2 for nomenclature of citrus species and hybrids

[8] Transmitted by African citrus psyllid (*Trioza erytreae*) and Asiatic/Asian citrus psyllid (*Diaphorina citri*); note that subspecies, '*Ca*. L. africanus subsp. capensis', has been found only in South Africa infecting an indigenous Rutaceous species, *Calodendrum capense* (Cape chestnut) but not citrus (Pietersen et al. 2010)

[9] Huanglongbing can affect almost all citrus cultivars; limes and lemons are much less sensitive than orange, tangelo, tangor and mandarin, while trifoliate orange is tolerant but not immune (Aubert 1990); field symptomology depends on a number of factors including whether a tree flushed during a period of psyllid activity (de Lange et al. 1985, Koizumi et al. 1994), the presence and severity of *Citrus tristeza virus* strains that may be present, the form of '*Ca*. Liberibacter' and the strain (of '*Ca.* L. asiaticus; Tsai et al. 2008); refer to Threat Summary Table and huanglongbing contingency plan available from **www.planthealthaustralia.com.au/pidd** for further information on hosts

[10] Transmitted by Asiatic citrus psyllid (*Diaphorina citri*)

Scientific name	Common name	Host(s)[7]	Plant part affected	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
'*Candidatus* Liberibacter asiaticus'[11]	Huanglongbing/ citrus greening (Asiatic strain)	*Citrus* spp.[12]	Leaves, stems, flowers, fruit, roots, whole plant	HIGH	HIGH	HIGH	EXTREME	**EXTREME**
Spiroplasma citri[13]	Citrus stubborn disease	Wide host range including grapefruit, lemon, orange, mandarin, tangelo (most susceptible); serious disease of weeds and several alternative hosts[14]	Whole plant	MEDIUM	HIGH	HIGH[15]	HIGH	**HIGH**
Xanthomonas citri* subsp. *citri[16] (syn. *X. axonopodis* pv. *citri*, *X. campestris* pv. *citri*)	Citrus canker	All *Citrus* spp. (e.g. grapefruit, lime, orange, trifoliate orange, lemon, pomelo, mandarin) and citrus relatives[17]	Whole plant	HIGH	HIGH	HIGH	HIGH	**HIGH**

[11] Transmitted by African citrus psyllid (*Trioza erytreae*), Asiatic/Asian citrus psyllid (*Diaphorina citri*) and *Cacopsylla citrisuga*

[12] Huanglongbing can affect almost all citrus cultivars; limes and lemons are much less sensitive than orange, tangelo, tangor and mandarin, while trifoliate orange is tolerant but not immune (Aubert 1990); field symptomology depends on a number of factors including whether a tree flushed during a period of psyllid activity (de Lange et al. 1985, Koizumi et al. 1994), the presence and severity of *Citrus tristeza virus* strains that may be present, the form of '*Ca*. Liberibacter' and the strain (of '*Ca.* L. asiaticus; Tsai et al. 2008); refer to Threat Summary Table and huanglongbing contingency plan available from **www.planthealthaustralia.com.au/pidd** for further information on hosts

[13] Transmitted by *Circulifer tenellus, Scaphytopius nitridus* and *S. acutus delongi* in California (these vectors shown to transmit from citrus to citrus as well as from herbaceous hosts to citrus); *Neoaliturus haematoceps* and *C. tenellus* in the Mediterranean area; none of these vectors are present in Australia

[14] Refer to Threat Summary Table for alternate hosts

[15] Spread potential high if vectors (*Circulifer tenellus, Scaphytopius nitridus* and *S. acutus delongi, Neoaliturus haematoceps*) enter Australia, however, other phloem feeders may transmit; can also be graft-transmitted

[16] There are at least three strains of citrus canker, with the Asiatic (A) strain being the most damaging; in addition there are variants of the A strain which differ in host range and distribution

[17] All *Citrus* spp. are natural hosts of the Asiatic strain, with grapefruit, Mexican lime, kaffir lime, sweet orange and trifoliate rootstock highly susceptible; sour orange, lemon and pomelo moderately susceptible; mandarin and Tahitian lime rated susceptible. Alternative hosts include *Atalantia citrioides*, *A. disticha, Balsamocitrus dawei, Citropsis schweinfurthii* (African cherry orange), *Citrus australasica* (Australian finger lime), *C. australis* (Australian round lime), *C. garrawayae, C. glauca* (Australian desert lime), *C. japonica* (oval, round, Meiwa and Hong Kong kumquats*), C. macroptera*, *Clausena lansium*, *Chaetospermum (Limonia) glutinosum, Evodia ridleyei, E. latifolia*, *Feroniella lucida*, *Hesperethusa crenulata, Limonia acidissima* (elephant apple), *Melicope triphylla, Murraya exotica* (orange jasmine), *Paramignya longipedunculata, P. monophylla*, *Toddalia asiatica.* The host range of the other two strains of Citrus canker is restricted mainly to Mexican lime (EPP Response Plan for citrus canker, 2006).

Scientific name	Common name	Host(s)[7]	Plant part affected	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Xylella fastidiosa* subsp. *pauca[18]	Citrus variegated chlorosis (CVC)/ pecosita (in Argentina)	CVC strain affects sweet orange, lemon, lime, mandarin, kumquat, grapefruit, trifoliate orange	Whole plant	HIGH	HIGH	HIGH	HIGH	**HIGH**
DIPTERA (Flies and midges)								
Anastrepha ludens*, *Bactrocera carambolae*, *B. dorsalis* (*B. invadens*, *B. papayae*, *B. philippinensis*)**[19]**, *B. kandiensis*, *B. occipitalis*, *B. trivialis	Fruit flies (various)[20]	Polyphagous including *Citrus* spp.	Fruit	MEDIUM - HIGH[21]	HIGH	HIGH	HIGH	**HIGH**
HEMIPTERA (Stink bugs, aphids, mealybugs, scale, whiteflies and hoppers)								
Diaphorina citri[22]	Asiatic/Asian citrus psyllid	*Citrus* spp. and citrus relatives[23]	Fruit, flowers, leaves, stems	HIGH	HIGH	HIGH	EXTREME[24]	**EXTREME[24]**
Homalodisca vitripennis[25] Synonym: *H. coagulata*	Glassy-winged sharpshooter	Highly polyphagous across >100 species including *Citrus* spp.	Leaves, stems	MEDIUM	HIGH	HIGH	HIGH[26]	**HIGH[26]**

[18] Experimentally vectored by glassy-winged sharpshooter, *Homalodisca vitripennis* and other sharpshooter leafhoppers (*Cicadellidae*) including *Acrogonia terminalis, Dilobopterus costalimai*, *Oncometopia nigricans* and *Oncometopia facialis*

[19] *B. dorsalis, B. invadens, B. papayae* and *B. philippinensis* are considered to be a single species, *B. dorsalis* in a recent publication (Schutze et al., 2014)

[20] Refer to Threat Summary Table for details on individual species

[21] Entry potential Medium for *Anastrepha ludens*; entry potential High for all other species listed

[22] Can transmit all three strains of huanglongbing (Asiatic, American and African strains)

[23] Host *Citrus* spp. include calamandarin, citron, grapefruit, kaffir lime, kumquat, lemon, mandarin, Mexican/key lime, orange, pomelo, rough lemon, tangelo, trifoliate orange; alternative hosts include genera *Aegle, Aeglopsis, Afraegle*, *Atalantia, Balsamocitrus, Bergera, Citropsis, Clausena, Limonia, Murraya* (including *Murraya paniculata* var *ovatifoliolata* – grows naturally in northern parts of Qld, NT and WA); for complete host list see Huanglongbing contingency plan available from **www.planthealthaustralia.com.au/pidd**

[24] Extreme impact if vectoring Asiatic strain of huanglongbing, High impact if vectoring African or American strains of huanglongbing

[25] Vector (experimental) of *Xylella fastidiosa* (citrus variegated chlorosis strain)

Scientific name	Common name	Host(s)[7]	Plant part affected	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Trioza erytreae[27]	African citrus psyllid	*Citrus* spp. and citrus relatives[28]	Leaves	MEDIUM	HIGH	HIGH	EXTREME[29]	**EXTREME[29]**
LEPIDOPTERA (Butterflies and moths)								
Citripestis sagittiferella	Citrus fruit borer	Specialist on Rutaceae, particularly *Citrus* spp.	Fruit	HIGH	MEDIUM - HIGH	HIGH	HIGH	**HIGH**
THYSANOPTERA (Thrips)								
Caliothrips fasciatus	Bean thrips	Polyphagous; breeds on >28 crop species including *Citrus* spp., cotton, grapevine and 48 wild/ornamental plants	Leaves, flowers, fruit	HIGH	HIGH	HIGH	HIGH	**HIGH**
Frankliniella bispinosa	Florida flower thrips	Polyphagous including *Citrus* spp., capsicum, strawberry, tobacco, avocado, wild radish, roses, wheat, rye	Leaves, flowers	HIGH	HIGH	HIGH	HIGH	**HIGH**

[26] High impact if transmits *Xylella fastidiosa* (citrus variegated chlorosis strain) to citrus

[27] Transmits African and Asiatic strains of huanglongbing

[28] Host *Citrus* spp. include Australian finger lime, citron, grapefruit, kumquat, lemon, mandarin, Mexican/key lime, orange, pomelo, tangelo, trifoliate orange; alternative hosts include *Calodendrum capense*, *Clausena anisata*, *Murraya exotica, Toddalia asiatica*, *Triphasia trifolia*, *Vepris lanceolata*, *Zanthoxylum capense*

[29] Extreme impact if vectoring Asiatic strain of huanglongbing, High economic impact if vectoring African strain of huanglongbing

Scientific name	Common name	Host(s)[7]	Plant part affected	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
VIRUSES								
***Citrus leprosis virus* (*Cilevirus*)**[30]	Citrus leprosis	*Citrus* spp. (sweet orange most susceptible, lemon, mandarin, grapefruit and hybrids, e.g. Murcott, less susceptible)	Leaves, stems, fruit, whole plant (dieback)	MEDIUM[31]	HIGH[32]	HIGH[33]	HIGH[34]	**HIGH**
***Citrus tristeza virus (Closterovirus)* (exotic strains)**[35]	Examples: mandarin stem pitting/ citrus tristeza	All *Citrus* spp. except trifoliate orange[36]	Leaves, stems, roots and fruit	HIGH	HIGH	HIGH	HIGH	**HIGH**

[30] There are nuclear and cytoplasmic morphological types with the cytoplasmic type (CiLV-C) being the more common form compared to the nuclear form (CiLV-N). Taxonomy previously considered *Rhabdovirus*-like, but research suggests it is the type member of a new genus of viruses termed *Cilevirus* (Locali-Fabris et al., 2006). There are potentially other exotic *Brevipalpus*-transmitted viruses causing leprosis like symptoms on citrus, including a Hawaiian isolate of *Hibiscus green spot virus*, recently reported from Hawaii on Volkamer lemon (Melzer et al., 2012) and a novel *Citrus leprosis virus* (cytoplasmic type 2), recently reported on sweet orange plants in Colombia showing leprotic symptoms (Roy et al., 2013).

[31] Pathogen not found in a country close to Australia; no previous quarantine interceptions recorded in intercepts database; movement in latently infected planting material is not likely to be a major pathway for CiLV

[32] More likely to establish in the presence of vector mites of the genus *Brevipalpus;* history of establishment overseas; medium detectability in the field; repeated infections are necessary to sustain the disease

[33] Transmitted by mite vectors including *Brevipalpus californicus, B. obovatus* and *B. phoenicis* that already occur in Australia; no natural enemies of vector known in Australia, warm, humid areas suitable for spread of vector; pathogen has a history of spread into new areas

[34] No effective or economically plausible control procedures available; control procedures unlikely to be compatible with current IPM strategies; no evidence of successful eradication; control of mite vectors highly important

[35] Transmitted by vector brown citrus aphid (*Toxoptera citricida*) and black citrus aphid (*Toxoptera aurantii*), both of which are present in Australia, hence spread could be rapid

[36] Host symptoms vary with rootstock and scion combinations, virus strain and environmental conditions. Alternative hosts (most experimental) include *Aeglopsis chevalieri, Afraegle paniculata, Atalantia monophylla, A. citroides, Aegle marmelos, A. glutinosa, Citropsis articulata*, *C. gilletiana, Citrus australis* (Australian round lime)*, C. glauca* (Australian desert lime)*, C. japonica* (kumquat)*, Clausera excavata, C. lansium, Clymenia, Limonia acidissima*, *Micromelum, Murraya, Pamburus missionis, Passiflora gracilis, Pleiospermium*

Current resources for detection and identification of HPPs

Diagnostic and surveillance capacity for the HPPs of the citrus industry (Table 7) supports Australia's preparedness and ability to respond to them should they be detected. A summary of this capacity is shown in Table 7, which lists the formal active surveillance programs and the status of national diagnostic protocols developed for each of the citrus HPPs.

Development of national diagnostic protocols is managed through the Subcommittee on Plant Health Diagnostic Standards (SPHDS). While diagnostic capacity may exist in Australia in the absence of these documents, an endorsed national diagnostic protocol provides a consistent and agreed diagnostic approach for identifying new pests. Further information on these documents can be found on page 89.

Table 7. *Diagnostic protocols and surveillance programs for HPPs*[37]

Scientific name	Common name	National diagnostic protocol	Surveillance programs
BACTERIA (including phytoplasmas)			
***Candidatus* Liberibacter asiaticus, *Ca.* L. americanus, *Ca* L. africanus**	Huanglongbing/ citrus greening	Endorsed (for *Ca.* L. asiaticus)	DAFWA multiple pest surveillance (South West of WA) DPIF NT citrus surveillance (Darwin, Katherine, Alice Springs) Northern Australia Quarantine Strategy (NAQS) pest and disease survey (Northern Australia) PIRSA huanglongbing surveillance (Adelaide metropolitan area)
Xanthomonas citri* subsp. *citri (syn. *X. axonopodis* pv. *citri*, *X. campestris* pv. *citri*)	Citrus canker	Endorsed	DPIF NT citrus surveillance (Darwin, Katherine, Alice Springs) NAQS pest and disease survey (Northern Australia) PIRSA citrus canker surveillance (Adelaide metropolitan area)
Spiroplasma citri	Citrus stubborn disease	Not developed	None known
Xylella fastidiosa	Citrus variegated chlorosis	Endorsed[38]	PIRSA citrus variegated chlorosis surveillance (Adelaide metropolitan area)

[37] Information presented has been taken from the National Plant Health Status Report 2013 and confirmed or updated in 2014 through either Plant Health Committee, the Subcommittee on Plant Health Diagnostic Standards, the Subcommittee on National Plant Health Surveillance or other stakeholders

[38] National diagnostic protocol developed for *Xylella fastidiosa* in grapevine (Pierce's disease)

Scientific name	Common name	National diagnostic protocol	Surveillance programs
DIPTERA (Flies and midges)			
Anastrepha ludens, Bactrocera carambolae, B. dorsalis, B. kandiensis, B. occipitalis, B. trivialis	Fruit flies	Draft[39]	DAF Qld exotic fruit fly trapping (Coastal towns/cities/Cape York Peninsula) DAFWA fruit fly port trapping DAFWA fruit fly surveillance in Ord River Irrigation Area (ORIA) DEDJTR fruit fly monitoring and surveillance (Melbourne ports) DPI NSW exotic fruit fly surveillance (Sydney basin) DPI NSW Riverina Production Area – Papaya fruit fly (Riverina) DPI NSW Riverina Production Area – exotic fruit flies attracted to Cuelure (Riverina) DPIF NT fruit fly monitoring – exotic fruit flies (Darwin, Katherine, Alice Springs) DPIPWE fruit fly trapping program (Statewide) NAQS exotic fruit fly trapping program (Northern Australia) NAQS pest and disease survey (Northern Australia) PIRSA exotic fruit fly surveillance (Adelaide port area)[40]
HEMIPTERA (Stink bugs, aphids, mealybugs, scale, whiteflies and hoppers)			
Diaphorina citri	Asiatic citrus psyllid	Draft	DPI NSW Asiatic citrus psyllid surveillance (Sydney basin) DPIF NT citrus surveillance (Darwin, Katherine, Alice Springs) NAQS pest and disease survey (Northern Australia) PIRSA huanglongbing surveillance (Adelaide metropolitan area)
Homalodisca vitripennis Synonym: *H. coagulata*	Glassy-winged sharpshooter	Endorsed	DPI NSW glassy-winged sharpshooter surveillance (Sydney basin)
Trioza erytreae	African citrus psyllid	Draft	None known
LEPIDOPTERA (Butterflies and moths)			
Citripestis sagittiferella	Citrus fruit borer	Draft	NAQS pest and disease survey (Northern Australia)
THYSANOPTERA (Thrips)			
Caliothrips fasciatus	Bean thrips	Not developed	None known
Frankliniella bispinosa	Florida flower thrips	Not developed	None known

[39] Draft National diagnostic protocol for Tephritid fruit flies

[40] Surveillance program covers *Bactrocera carambolae, B. dorsalis, B. invadens, B. papayae, B. philippinensis* and *B. trivialis*

Scientific name	Common name	National diagnostic protocol	Surveillance programs
VIRUSES			
***Citrus leprosis virus* (*Cilevirus*)**	Citrus leprosis	Not developed	None known
***Citrus tristeza virus* (*Closterovirus*) (exotic strains)**	Mandarin stem-pitting	Not developed	NAQS pest and disease survey (Northern Australia)

Formal Categorisation of pests for inclusion in the EPPRD

The following section outlines one aspect of the EPPRD – the categorisation of EPPs.

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

Pest categorisation

The EPPRD outlines a mechanism whereby Industry and Government Parties will contribute to the total cost of a response to an EPP Incident based on agreed Categories. These Categories determine the ratio each Party will pay under a Response Plan, based on the relative public and private benefits of EPP eradication. Four Categories are included in the EPPRD, as outlined in Table 8 and Figure 6.

Categorisation of a Plant Pest is carried out to determine the Parties that are Affected and who will therefore be the beneficiaries of an eradication response. 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.

Any Plant Pest considered by a Party to meet the definition of an EPP can be put forward for categorisation and inclusion in Schedule 13 of the EPPRD. Pests listed in the HPP threat list (Table 6) may provide a starting point for Industry to prioritise development of Categorisation requests as they have been determined to be of high priority to the Industry. Other pests identified in TSTs or identified via other means as being priority pests, may also be categorised if required. The process for requesting categorisation of a pest is set out in Schedule 3 of the EPPRD and the Guidelines for the Preparation of a Categorisation Request will be available from the PHA website **www.planthealthaustralia.com.au**.

Pests that enter Australia, but which have not been formally categorised may be deemed "*an uncategorised Plant Pest which is reasonably believed to be an EPP*[41], and from a Response Plan perspective, will be treated as belonging to Category 3 until an appropriate Category has been determined under formal categorisation processes.

The Categorisation Group will be responsible for determining a Cost Sharing Category applicable for EPPs. Only Plant Pests meeting the EPP criteria will be considered for categorisation. Taking into account relevant scientific and other knowledge and experience, the Categorisation Group will consider requests for pest categorisation, re-categorisation or removal from Schedule 13 of the EPPRD. Figure 6 outlines the decision-making process used by the Categorisation Group in deciding pest Categories. The Categorisation Group Operating Guidelines will be available from the PHA website **www.planthealthaustralia.com.au**.

When more than one Industry Party is Affected by an EPP, the Categorisation Group will also determine (and when requested, review) the Funding Weight for each Affected Industry. Funding Weights provide a means for calculating each Industry's Proportional Share of the total Industry contribution if an EPP Affects multiple Industry Parties.

Composition of the Categorisation Group

As described in Part 4 of Schedule 8 of the EPPRD, the membership of the Categorisation Group for each EPP will comprise (at a minimum):

- an independent chair from PHA
- one standing member representing Industry Parties nominated by the Board of PHA
- three technical experts (people with specific expertise in the relevant areas of plant pathology or entomology), one nominated by the Australian Government, one nominated by the States and Territories and one nominated by the Industry Parties
- a person with relevant economic expertise including social, trade and regional impact assessment nominated by the Chairman of PHA
- a nominee from each plant industry or industries Affected by the Plant Pest being categorised[42].

The Categorisation Group may also seek advice from:

- a person with human health expertise, if a public health risk may exist
- a conservation representative (e.g. Australian Government Department responsible for the environment) or
- other relevant members determined by the independent chair.

[41] Excerpt from the EPPRD definition of Incident - *Incident means the occurrence of a confirmed or reasonably held suspicion of an EPP or of an uncategorised Plant Pest which is reasonably believed to be an EPP (not including a Plant Pest investigation where the provisional finding or diagnosis is that the Plant Pest is established).*

[42] Part 4.5.1 of the EPPRD specifies the definition of a quorum of the Categorisation Group which varies depending on the number of Affected Industry Parties that are involved.

Advisers who have specific expertise may accompany members of the Categorisation Group, but will not be part of the decision-making process.

Table 8. *Cost sharing categories*

Category	Description	Funding share
Category 1: Very high public benefits	Pest which if not eradicated would: • cause major environmental damage to natural ecosystems; and/or • potentially affect human health or cause a major nuisance to humans; and/or • cause significant damage to amenity flora; and • have relatively little impact on commercial crops. • This category also covers situations where the pest has a very wide range of hosts including native flora and there is considerable uncertainty as to the relative impacts on the different crops. In short, it is almost impossible to properly determine which industries benefit from eradication and to what extent, and in any case, the incursion primarily affects native flora and/or amenity plants, and/or is a major nuisance if not a health risk to humans.	100 % Government
Category 2: High public benefits	Pest which if not eradicated would: • cause significant public losses either directly through serious loss of amenity and/or environmental values and/or effects on households or indirectly through very severe economic impacts on regions and the national economy, through large trade losses with flow on effects through the economy; and • also impose major costs on the industries concerned so that these industries would significantly benefit from eradication.	80 % Government 20 % Industry
Category 3: Moderate public benefits	Pest which if not eradicated would: • primarily harm the industries concerned but there would also be some significant public costs as well (that is, moderate public benefits from eradication). In this case the pest could adversely affect public amenities, households or the environment, and/or could have significant, though moderate trade implications and/or national and regional economic implications.	50 % Government 50 % Industry
Category 4: Mostly if not wholly private benefits	Pest which if not eradicated would: • have little or no public cost implications and little or no impacts on natural ecosystems. The affected commercial industries would be adversely affected primarily through additional costs of production, through extra control costs or nuisance costs; and • generally there would be no significant trade issues that would affect national and regional economies.	20 % Government 80 % Industry

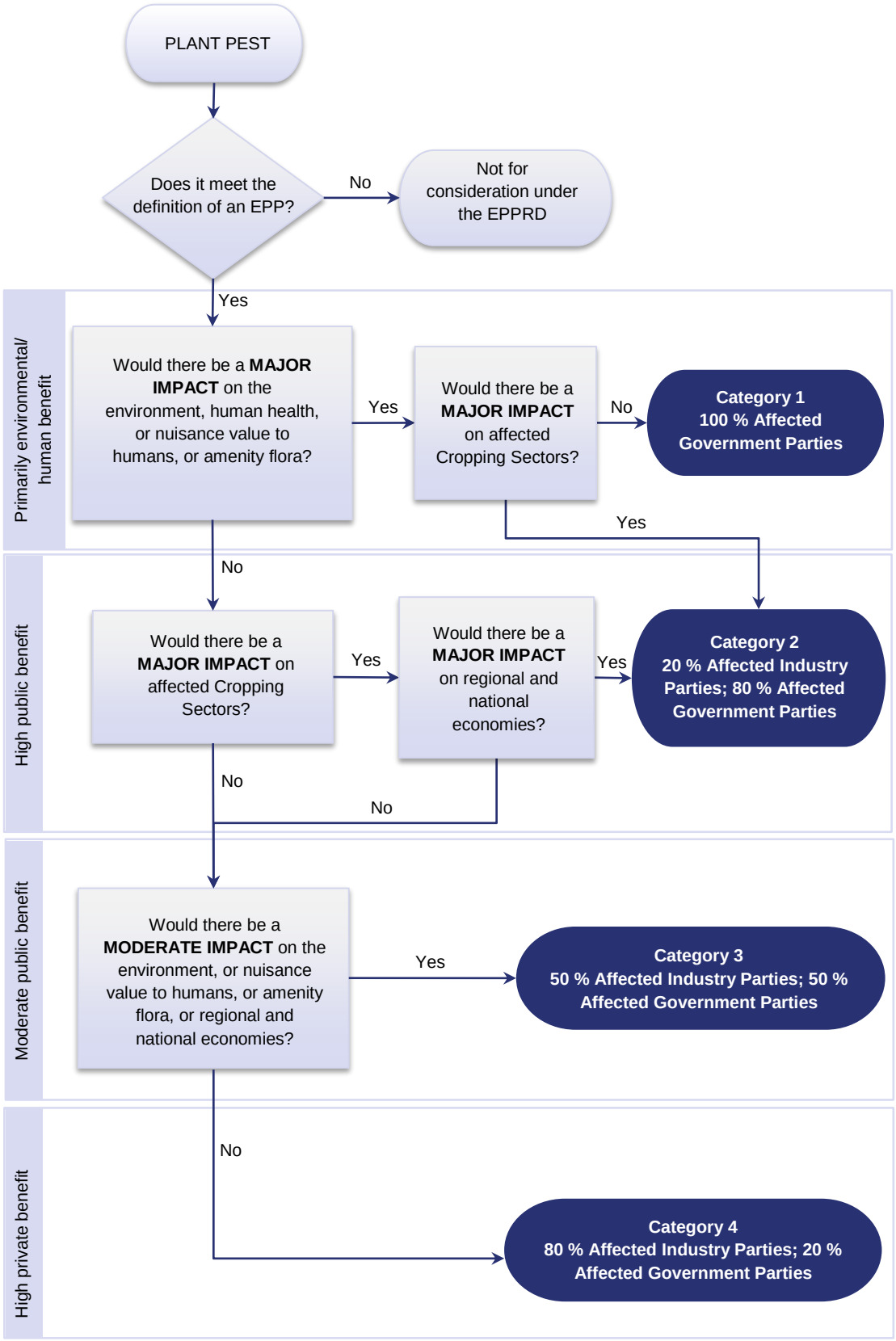

Figure 6. *Summarised pest categorisation decision tree*

Citrus EPPs categorised to date

EPPs for the citrus industry that have received formal pest categorisation (included within Schedule 13 of the EPPRD) are listed in Table 9. For the latest version of Schedule 13, refer to the EPPRD version found at **www.planthealthaustralia.com.au/epprd**.

Table 9. *Formal categories for pests of the citrus industry as listed in the EPPRD (as at August 4, 2014)*[43]

Formal Category	Scientific name	Common name
2	*Bactrocera dorsalis*	Oriental fruit fly
2	*Bactrocera papayae*	Papaya fruit fly
2	*Bactrocera philippinensis*	Philippine fruit fly
2	*Candidatus* Liberibacter asiaticus	Huanglongbing
2	*Cryptophlebia leucotreta*	False codling moth
2	*Phymatotrichum omnivorum* Synonym: *Phymatotrichopsis omnivora*	Texas root rot
2	*Xanthomonas axonopodis* pv. *citri* Synonym: *Xanthomonas citri* subsp. *citri*	Citrus canker
2	*Xylella fastidiosa*	Pierce's disease
3	*Amyelois transitella*	Navel orangeworm
3	*Diaphorina citri*	Citrus psyllid Synonym: Asiatic/Asian citrus psyllid
3	*Phoma tracheiphila*	Mal secco
3	*Scirtothrips aurantii*	South African citrus thrips

[43] Note scientific and common names are listed as they appear in the EPPRD

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RISK MITIGATION PLAN

Introduction

There are a number of strategies that can be adopted to help protect and minimise the risks of exotic and emergency pests under International Plant Protection Convention (IPPC) standards (**www.ippc.int/standards**) and Commonwealth and state/territory legislation.

Many pre-emptive practices can be adopted to reduce the risk of exotic pest movement for the citrus industry (Figure 7). Such risk mitigation practices are the 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 Government, state/territory governments, and citrus industry members. This section is to be used as a guide outlining possible activities that may be adopted by industry and growers to mitigate risk. Each grower will need to evaluate the efficacy of each activity for their situation.

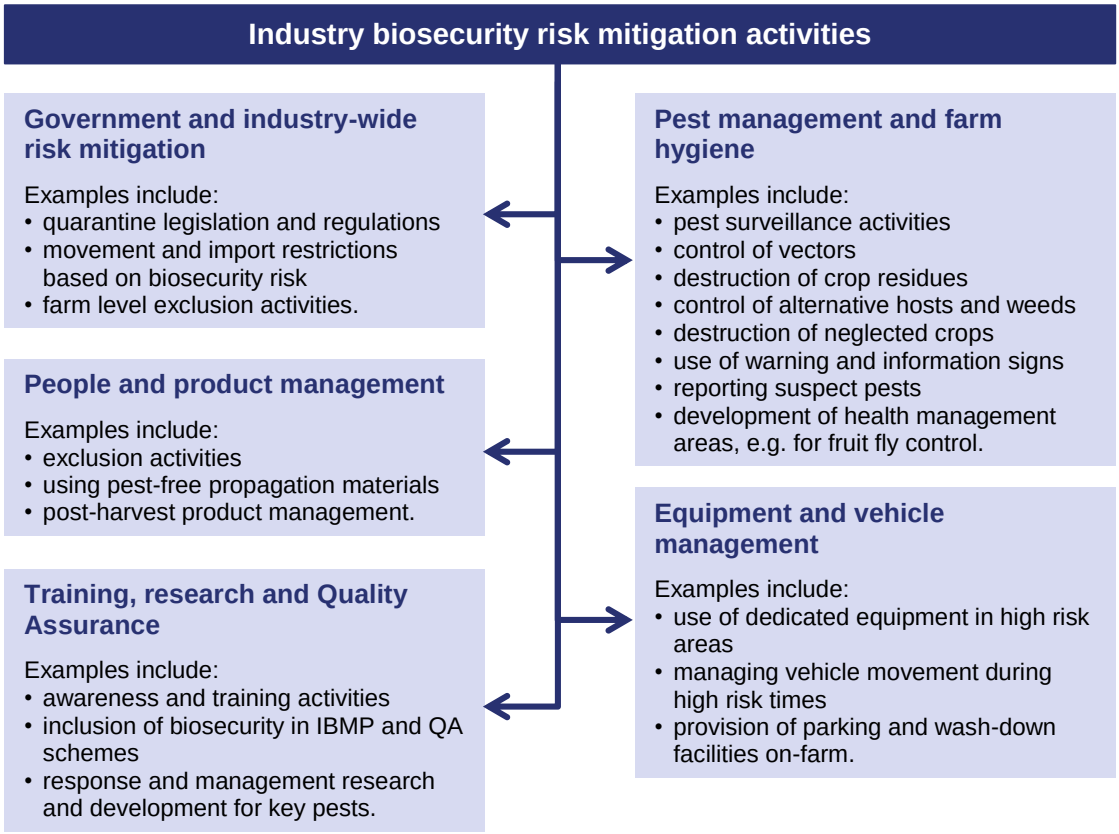

Figure 7. *Examples of biosecurity risk mitigation activities*

Barrier quarantine

Barrier quarantine should be implemented at all levels of the citrus industry including national, state, regional, and orchard levels.

National level – importation restrictions

Responsibility > Australian Government

The Department of Agriculture is the Australian Government department responsible for maintaining and improving international trade and market access opportunities for agriculture, fisheries, forestry, and food industries. The Department of Agriculture 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.

The Department of Agriculture is responsible for developing biosecurity (SPS) risk management policy and reviewing existing quarantine measures for the importation of live animals and plants, and animal and plant products. In particular, the Department of Agriculture undertakes import risk analyses to determine which products may enter Australia, and under what quarantine conditions. The Department of Agriculture 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, the Department of Agriculture assists Australia's export market program by negotiating other countries' import requirements for Australian animals and plants. Further information can be found at **www.agriculture.gov.au**.

The administrative authority for national quarantine is vested in the Department of Agriculture under the *Quarantine Act 1908*. Quarantine policies are developed on the basis of an IRA process. This process is outlined in the IRA Handbook 2011 (Department of Agriculture, Fisheries and Forestry, 2011). The Department of Agriculture maintains barrier quarantine services at all international ports 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 the Department of Agriculture.

The Schedule 5 "Permitted Seeds" list from the *Quarantine Proclamation 1998* is maintained on the Import Conditions (ICON) database at

http://apps.daff.gov.au/icon32/asp/ex_querycontent.asp. ICON 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. There are currently a number of cases for citrus listed on ICON (see Table 10). For export conditions see the Manual of Importing Country Requirements (MICoR) database at **http://micor.agriculture.gov.au/plants/Pages/default.aspx**.

Budwood and seed are the only citrus propagative material permitted entry into Australia. These are visually inspected by quarantine officers and subsequently destroyed if there are obvious signs of pests and/or diseases. Citrus budwood and seed undergo disease screening and testing at the Eastern Creek Post Entry Quarantine Station and are only released from quarantine if the plant material is found to be negative for quarantine pests and diseases.

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 the Department of Agriculture on (02) 6272 3933 or 1800 020 504, or visit the website at **http://www.agriculture.gov.au/import**.

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 **www.ippc.int**.

Table 10. *Import condition summary for citrus listed in ICON (as at July 2014)*[44]

Commodity	End use	Import status	Import permit	Additional comments
FRESH				
Calamondin - Fresh Cumquat - Fresh Grapefruit - Fresh Kaffir limes - Fresh Lemons - Fresh Limes - Fresh Mandarins or tangerines - Fresh Oranges, sour - Fresh Oranges, sweet - Fresh Pomelo - Fresh Rangpur limes - Fresh Tahitian limes - Fresh Tangelo - Fresh Tangor - Fresh	Human consumption	Permitted[45]	Required	Condition for import from New Zealand, Spain and the United States only. Phytosanitary certificate required for each consignment. An additional phytosanitary declaration is required for fresh citrus fruit from Arizona under the measures in place against sweet orange scab (*Elsinoë australis*). An additional declaration is required for citrus fruit from Arizona or California under the measures in place against the Asiatic citrus psyllid (*Diaphorina citri*).

[44] This is a summary only and should not be used as a substitute for consulting the ICON database (http://apps.daff.gov.au/icon32/asp/ex_querycontent.asp) or the Department of Agriculture directly to confirm the details of import conditions and any recent changes

[45] Fresh citrus fruit is not permitted entry from Texas under the measures in place against Asiatic/Asian citrus psyllid (*Diaphorina citri*)

Commodity	End use	Import status	Import permit	Additional comments
Grapefruit - Fresh Mandarins or tangerines - Fresh Oranges, sweet - Fresh Pomelo - Fresh Sweetie - Fresh Tangelo - Fresh Tangor - Fresh	Human consumption	Permitted	Required	Condition for import from Israel only. Phytosanitary certificate required for each consignment. Fruit must be sourced from orchards registered with the Israeli Plant Protection and Inspection Services.
Limes - Fresh Oranges, sweet - Fresh Tahitian limes - Fresh	Human consumption	Permitted	Required	Condition for import from Egypt only. Phytosanitary certificate required for each consignment. The Egyptian Central Administration of Plant Quarantine must ensure citrus is sourced from commercial orchards registered for export to Australia.
Etrogs - Fresh	All uses other than as animal foods, fertilisers or for growing purposes	Permitted	Required	Condition for import from Israel only. Fresh Etrogs may only be imported for ceremonial purposes undertaken during the annual Jewish holiday of Sukkot. A quarantine Entry must be lodged. Phytosanitary certificate required for each consignment.
Etrogs - Fresh	Human consumption	Permitted[46]	Required	Condition for import from Calabria, Italy only. Fresh Etrogs may be imported for use in Jewish religious ceremonies only. Phytosanitary certificate required for each consignment. Additional restrictions apply to imports. See ICON for details.
Oranges, sweet - Fresh	Human consumption	Permitted	Required	Condition for import from Italy only. Phytosanitary certificate required for each consignment. Sweet oranges for export to Australia must be sourced from orchards registered with the Italian Ministero Della Politiche Agricole e Forestali.
Pomelo - Chilled pulp	Human consumption	Permitted	Required	Condition for import from Thailand only. Phytosanitary certificate required for each consignment.

[46] Only permitted entry from Calabria, Italy

Commodity	End use	Import status	Import permit	Additional comments
Tahitian limes - Fresh	Human Consumption	Permitted	Required	Condition for import from New Caledonia only. Phytosanitary certificate required for each consignment. Fruit must be sourced from commercial orchards that are registered for export to Australia.
SEMIPROCESSED OR DRIED				
Citrus leaves and peel - Blanched, frozen and powder	Human consumption	Permitted	Not required	Condition for import from all countries. Blanched and frozen leaves and peel only permitted import if accompanied by commercial documentation to verify blanching treatment and frozen state of goods. Consignments of powder weighing more than 1 kg must meet commercial import conditions. See ICON for full details.
Citrus leaves, peel and pomander - Dried and unprocessed	Human consumption	Permitted	Required	Condition for import from all countries. Phytosanitary certificate required for each consignment.
Fruits - Dried and whole	Human consumption and all uses other than as animal foods, fertilisers or for growing purposes	Prohibited		This commodity is prohibited entry into Australia unless specified in an ICON case specific to that commodity (see commodities permitted entry below).
Eremocitrus spp., Dried (Herb, leaf, flower, fruit) *Microcitrus* spp. and *Monanthocitrus* spp., Dried - (Leaf, stem, twigs, floral parts, peel, fruit)	All uses other than as animal foods, fertilisers or for growing purposes	Permitted	Required	Condition for import from all countries. Phytosanitary certificate required for each consignment.
Fruits and Vegetables - Preserved/pickled or canned/aseptically packaged	Human consumption	Permitted	Not required	Condition for import from all countries. Both commercially prepared and home-made fruits and vegetables can be imported if they have been prepared using a method of preserving or pickling, and are contained in clean and new packaging.

Commodity	End use	Import status	Import permit	Additional comments
Herbal tea bags	Human consumption	Permitted	Not required[47]	Condition for import from all countries. Herbal tea bags must be commercially prepared, packaged and labelled and only contain ingredients of plant origin.
Herbal teas	Human consumption	Permitted	Required[48]	Consignments greater than 1 kg must meet commercial import requirements. See ICON for full details.
Lemons - Dried and whole Limes - Dried and whole	Human consumption	Permitted	Required	Condition for import from all countries. Phytosanitary certificate required for full container load consignments.
NURSERY STOCK AND SEEDS				
Citrus spp.	Nursery stock, Seeds for sowing	Permitted[49]	Required	Condition for import from all countries. Phytosanitary certificate required for each consignment.

[47] Import permit only required if tea bags contain prohibited seed that has not been subject to processing, such as roasting (e.g. rice , barley), or material of microbial or animal origin

[48] Import permit only required for commercial consignments in which the tea contains any of the plant materials (e.g. *Citrus* spp.) listed on ICON

[49] Budwood is the only nursery stock permitted entry

State and regional level – movement restrictions

Responsibility > state/territory government

The ability to control movement of materials that can carry and spread citrus pests is of high importance. Each state/territory has quarantine legislation in place to control the importation of citrus material interstate and intrastate, and to manage agreed pests if an incursion occurs (refer to Table 11). 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 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 state/territory 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 citrus (plants and fruit) can be obtained by contacting your local state or territory agriculture agency directly (see Table 11), or through the SDQMA website **www.domesticquarantine.org.au** which lists relevant contacts in each state/territory as well as Interstate Certification Assurance (ICA) documents relating to each state/territory.

The movement of orchard vehicles and equipment between states is also restricted because of the high risk of inadvertently spreading pests. Each state/territory has quarantine legislation in place governing the movement of machinery, equipment and other potential sources of pest contamination. Information on orchard vehicle and equipment movement restrictions can be obtained by contacting your local state/territory department of agriculture (Table 11).

Table 11. *Interstate and interregional movement of plant products – legislation, quarantine manuals and contact numbers*

State	Administering authority	Legislation	Links to quarantine manual[50]	Phone
ACT	Environment ACT **www.environment.act.gov.au**	*Plant Disease Act 2002* *Pest Plants and Animals Act 2005*	See NSW conditions	13 22 81
NSW	Department of Primary Industries **www.dpi.nsw.gov.au**	*Plant Diseases Act 1924* *Plant Diseases Regulation 2008* *Noxious Weeds Act 1993* *Noxious Weeds Regulation 2008*	**www.dpi.nsw.gov.au/biosecurity/plant**[51]	02 6391 3384
NT	Department of Primary Industry and Fisheries **www.nt.gov.au/d/Primary_Industry**	*Plant Health Act 2008* *Plant Health Regulations 2011*	**www.nt.gov.au/d/Primary_Industry/index.cfm?newscat1=&newscat2=&header=NT%20Quarantine**	08 8999 2118
Qld	Biosecurity Queensland, a part of the Department of Agriculture and Fisheries, Queensland **www.daf.qld.gov.au/biosecurity**	*Plant Protection Act 1989* *Plant Protection Regulation 2002*	**www.daf.qld.gov.au/plants/moving-plants-and-plant-products**	132 523[52] 07 3404 6999[53]
SA	Primary Industries and Regions SA **www.pir.sa.gov.au**	*Plant Health Act 2009* *Plant Health Regulations 2010*	**www.pir.sa.gov.au/biosecuritysa/planthealth/importers/plant_quarantine_standard**	08 8207 7820
Tas	Department of Primary Industries, Parks, Water and Environment **www.dpipwe.tas.gov.au**	*Plant Quarantine Act 1997* *Weed Management Act 1999*	**http://dpipwe.tas.gov.au/biosecurity/quarantine-tasmania/importing-plants/plant-quarantine-manual-2014**	1300 368 550
Vic	Department of Economic Development, Jobs, Transport and Resources **http://economicdevelopment.vic.gov.au/**	*Plant Biosecurity Act 2010* *Plant Biosecurity Regulations 2012*	**www.depi.vic.gov.au/psb**	136 186
WA	Department of Agriculture and Food **www.agric.wa.gov.au**	*Biosecurity and Agricultural Management Act 2007*	**www.agric.wa.gov.au/qtine/default.asp**	08 9334 1800

[50] If the link does not work, the relevant documents can be found by going to the department home page and checking the quarantine section of each website
[51] Click on the link to the Plant Quarantine Manual
[52] Within Qld
[53] Interstate

The following section includes information relevant to the movement of citrus plants, plant parts and/or fruit into each state/territory.

New South Wales

Information on pre-importation inspection, certification and treatment requirements may be obtained from DPI NSW Regulatory Services by phone 02 6391 3384 or by visiting the NSW Department of Primary Industries website **www.dpi.nsw.gov.au/biosecurity/plant** and clicking on the link to the Plant Quarantine Manual.

There are currently restrictions on the entry of citrus fruit into NSW (or specified parts of the State) to prevent the entry of the Mediterranean fruit fly (*Ceratitis capitata*) and Queensland fruit fly (*Bactrocera tryoni*). There are also restrictions on the entry of citrus plants and plant parts to prevent entry of the orange stem pitting strains of *Citrus tristeza virus* as well as the spiralling whitefly (*Aleurodicus dispersus*). Potted and bare-rooted plants are also restricted entry to prevent import of the green snail (*Cantareus apertus,* syn. *Helix aperta*). In addition, plants with soil attached are restricted import to prevent the entry of the red imported fire ant (RIFA; *Solenopsis invicta*), potato cyst nematode (*Globodera* species) and phylloxera (*Daktulosphaira vitifolii*). All consignments of citrus fruit and plant material must meet specific conditions and must be accompanied by a Plant Health Certificate (PHC) or Plant Health Assurance Certificate (PHAC).

Northern Territory

Administrative authority for regional quarantine in the Northern Territory (NT) is vested in the Department of Primary Industry and Fisheries (DPIF) 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 2118 or email **quarantine@nt.gov.au.**

There are currently restrictions on the entry of citrus fruit (or plants bearing fruit) into NT to prevent the entry and spread of Mediterranean fruit fly (*Ceratitis capitata*), Queensland fruit fly (*Bactrocera tryoni*) and Northern Territory fruit fly (*Bactrocera aquilonis*). There are also restrictions on the import of citrus plants to prevent the entry of the orange stem pitting strain of *Citrus tristeza virus*, melon thrips (*Thrips palmi*) and western flower thrips (*Frankliniella occidentalis*). There are also restrictions on the import of plants grown in potting mix to prevent entry of RIFA (*Solenopsis invicta*), yellow crazy ant (*Anoplolepis gracilipes*), argentine ant (*Linepithema humile*) and electric ant (*Wasmannia auropunctata*). Furthermore, any plant that is not completely free of soil is restricted import to prevent the entry of various soil borne pests and snails. The import of nursery stock is also restricted to prevent the entry of scale insects

and sucking insects. Citrus fruit, plants, plant parts and nursery stock must not be introduced into the NT unless certain conditions are met and they are accompanied by a PHC or PHAC.

For more information refer to the DPIF website (**www.nt.gov.au/d/Primary_Industry**) or the Plant Health Manual (see link in Table 11).

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 Queensland website (**www.daf.qld.gov.au/plants/moving-plants-and-plant-products**). Further details can be obtained from the DAF Queensland Customer Service Centre (13 25 23 within Queensland, or phone 07 3404 6999 or fax 07 3404 6900 interstate).

Queensland currently restricts the importation of citrus fruit, to prevent entry of Mediterranean fruit fly (*Ceratitis capitata*). Plants with soil attached are also restricted, to prevent the entry of the tropical fire ant (*Solenopsis geminata*) and other exotic pests. Where certification is required to move citrus fruit and plants, a business can become accredited under the ICA scheme, to certify that plants consigned to intrastate or interstate markets meet specified quarantine requirements. Alternatively, plants and their products can be certified by a Biosecurity Officer. Contact the DAF Queensland Customer Service Centre (13 25 23 within Queensland, or phone 07 3404 6999 or fax 07 3404 6900 interstate).

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 **www.pir.sa.gov.au/biosecuritysa/planthealth**.

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. There are currently restrictions on the movement of citrus fruit into SA to prevent the entry of Mediterranean fruit fly (*Ceratitis capitata*) and Queensland fruit fly (*Bactrocera tryoni*). The import of citrus plants (including nursery stock) and plant material (cuttings and budwood) is also restricted to prevent entry of the orange stem pitting strain of *Citrus tristeza virus,* citrus blight, citrus red mite (*Panonychus citri*) and green snail (*Cantareus apertus,* syn. *Helix aperta*). To prevent entry of RIFA (*Solenopsis invicta*), containerised plants are prohibited entry unless certified as meeting specific conditions of entry. All consignments of citrus fruit, plants and plant material (budwood, cuttings) must be accompanied by a PHC or PHAC issued by a departmental inspector or accredited business in the State of origin. The original certificate must accompany plants during transport. A transport manifest, detailing all

plant consignments, must be sent to PIRSA (fax 08 8124 1467 or email to **Pirsa.PlantHealthManifest@sa.gov.au**) prior to plants arriving in SA.

For further information on import conditions consult the Plant Quarantine Standard (**www.pir.sa.gov.au/biosecuritysa/planthealth/legislation**).

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 Quarantine Tasmania inspector not less than 24 hours prior to the importation. There are currently restrictions on the import of citrus fruit into Tasmania to prevent the entry of Mediterranean fruit fly (*Ceratitis capitata*) and Queensland fruit fly (*Bactrocera tryoni*). Plant material (including nursery stock and cuttings) and plants with attached potting media are restricted import into Tasmania to prevent the entry of the green snail (*Cantareus apertus,* syn. *Helix aperta*) and RIFA (*Solenopsis invicta*) respectively. Plants that have been grown in potato cyst nematode infested areas in Victoria are restricted entry. All consignments must be accompanied by a PHC or PHAC. For further information on import conditions consult the Plant Quarantine Manual (see link in Table 11).

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 Economic Development, Jobs, Transport and Resources (DEDJTR) website (see link in Table 11). Some items may need to be presented to a DEDJTR inspector or an accredited business, for checking of details such as correct certification, labelling or treatment.

There are prohibitions or restrictions on the entry of citrus material into all or part of Victoria for the following pests or diseases: Mediterranean fruit fly (*Ceratitis capitata*) and Queensland fruit fly (*Bactrocera tryoni*), citrus tristeza virus, citrus red mite (*Panonychus citri*), green snail (*Cantareus apertus*, syn. *Helix aperta*), spiralling whitefly (*Aleurodicus dispersus*), RIFA (*Solenopsis invicta*) and electric ant (*Wasmannia auropunctata*).

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 DEDJTR on the web at **www.depi.vic.gov.au/psb** or by phone 136 186.

Western Australia

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 in place for movement into and within the state.

For further information on requirements contact Quarantine WA on (08) 9334 1800 or fax (08) 9334 1880.

Orchard level – exclusion activities

Responsibility > state/territory government, industry/growers and nursery operators

A significant risk of spreading pests onto orchards 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 orchard level, as this will reduce the probability of an incursion 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 orchard level using exclusion practices. Further detail on potential strategies is included in the Orchard Biosecurity section (page 77). This could be used as a reference source for developing extension material for promoting good orchard hygiene.

Nurseries and retailers

Responsibility > state/territory government, industry/growers and nursery operators

Nurseries and retail outlets, including chain stores, can be the primary distributors of citrus nursery material in a region. It is vital to ensure that pests are not introduced into new areas as 'hitch-hikers' on nursery material.

Produce transporters and purchasers for retail outlets (e.g. Woolworths, Bunnings, Coles) must obtain advice from state quarantine authorities before moving citrus material between regions or interstate. Advice for all states/territories is available from the Domestic Quarantine website (**www.domesticquarantine.org.au**).

Nursery stock should be labelled in a manner that allows the source to be identified for trace-back purposes. Where pest or disease symptoms are found on nursery stock it is important to identify the causal agent. New or unfamiliar pests should be reported for identification (see Reporting Suspect Pests section on page 77).

Good nursery hygiene practices help to prevent pest spread. The Nursery and Garden Industry Australia (NGIA) Nursery Industry Accreditation Scheme Australia (NIASA) and similar schemes provide guidelines for nursery owners and growing media suppliers for maintaining hygiene standards. NIASA also assures other quality parameters are met, such as tree physical characteristics. Examples of relevant nursery hygiene practices include training of staff to recognise pest and disease symptoms, controlling pests in nursery crops, and sterilisation of growing media and equipment. Information on NIASA can be obtained from the NGIA (**www.ngia.com.au**) or the Nursery and Garden industry office in your state/territory.

Auscitrus™

A clean nursery stock program is the foundation of a robust citrus production industry. The citrus industry has the advantage of such a program through the Australian Citrus Propagation Association Incorporated (trading name Auscitrus™). Auscitrus™ is a national "not for profit" industry organisation responsible for the supply of citrus budwood and rootstock seed that is true to type and of high health status. Since its inception in 1927, Auscitrus™ have been at the forefront of addressing a number of biosecurity threats to the citrus industry, through the supply of resistant or tolerant rootstocks and the provision of pathogen-free budwood. Auscitrus™ routinely test budwood source trees for the presence of graft-transmissible diseases and can also test private budwood sources. For more information, see the Auscitrus™ website (**www.auscitrus.com.au**).

Surveillance

Surveys enhance prospects for early detection, minimise costs of eradication and are necessary to meet the treaty obligations of the WTO SPS Agreement with respect to the area freedom status of Australia's states, territories and 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 vegetables, 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 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.

There are currently no international standards for structured pest surveys. Their 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 and the costs of eradication.

Early detection of an exotic 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 for establishing whether particular pests are present in each state or region, and if so, where these occur.

Industry personnel can provide very effective general surveillance as part of their normal management procedures (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.

Improving the coordination of citrus surveillance activities will be undertaken as part of the HAL funded project "Protecting Australia's citrus industry from biosecurity threats". This will include development of support mechanisms for the collection targeted and general surveillance data to ensure a robust and uniform national record keeping system.

National surveillance programs

Responsibility > Australian Government, industry (national associations)

The Department of Agriculture maintains barrier quarantine services at all international ports and in the Torres Strait region. The Department of Agriculture 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). NAQS surveillance programs relevant to the citrus industry are listed in Table 12.

State surveillance programs

Responsibility > state/territory governments, industry/growers and nursery operators

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

The state/territory agriculture agency can provide:

- planning and auditing 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
- communication, training and extension strategies with industry
- biosecurity training
- reporting services to all interested parties (Department of Agriculture, national bodies, trading partners and industry).

Various pest surveillance programs are managed by the Department of Agriculture and the state/territory agriculture agencies. Many state/territory departments run general surveillance programs whereby suspect samples can be forwarded and diagnosed for the presence of exotic pests free of charge. Official surveillance programs that target pests of the citrus industry (exotic or those under official control in a region or state/territory) are shown in Table 12.

Table 12. *Official surveillance programs that target pests of the citrus industry (as at December 2013)*[54]

Surveillance program	Region	Pests targeted	Hosts targeted
Australian Government			
NAQS Pest and Disease Survey	Australia's northern coastline from Cairns to Broome (Qld, NT and WA), including the Torres Strait – natural environments, agricultural and community regions, ports of entry	Acuminate scale (*Kilifia acuminata*), Asiatic citrus psyllid (*Diaphorina citri*), black parlatoria scale (*Parlatoria ziziphi*), citrus blackfly (*Aleurocanthus woglumi*), citrus canker (*Xanthomonas citri* subsp. *citri*), citrus fruit borer (*Citripestis sagittiferella*), citrus mealybug (*Pseudococcus cryptus*), citrus powdery mildew (*Oidium tingitaninum, O. citri*), citrus rind borer (*Prays endocarpa*), citrus scab (*Elsinoë fawcettii* (exotic strains) and *Elsinoë australis*), citrus tristeza (*Citrus tristeza virus*), coffee carpenter (*Zeuzera coffeae*), coffee mealybug (*Planococcus lilacinus*), comstock's mealybug (*Pseudococcus comstocki*), exotic fruit flies (*Bactrocera carambolae, B. correcta, B. cucurbitae*, *B. dorsalis (B. papayae, B. philippinensis)*, *B. kirki*, *B. latifrons, B. occipitalis*, *B. passiflorae, B. trivialis, B. xanthodes, B. zonata*), fruit tree mealybug (*Rastrococcus invadens*), green snout weevil (*Hypomeces squamosus*), grey pineapple mealybug (*Dysmicoccus neobrevipes*), huanglongbing (*Candidatus* Liberibacter asiaticus), Japanese bayberry whitefly (*Parabemisia myricae*), mango mealybug (*Rastrococus iceryoides*), mealybug (*Maculicoccus malaitensis*), mirids (*Helopeltis* spp.), papaya mealy bug (*Paracoccus marginatus*)	Tropical horticultural and agricultural species
NAQS exotic fruit fly trapping program	Torres Strait	Exotic fruit flies (*Bactrocera* spp.)	Horticulture
New South Wales			
Asiatic citrus psyllid	Sydney basin	Asiatic citrus psylid (*Diaphorina citri*)	Horticulture
Exotic fruit flies	Sydney basin	Exotic fruit flies (*Bactrocera* spp.)	Horticulture
Exotic mites	Sydney basin	Various including *Brevipalpus* spp.	Various
Glassy-winged sharpshooter	Sydney basin	Glassy-winged sharpshooter (*Homalodisca vitripennis*), Malaysian fruit fly (*Bactrocera latifrons*)	Horticulture

[54] Information presented has been taken from the National Plant Health Status Report 2013, with the exception of NSW for which information was updated in September 2014

Surveillance program	Region	Pests targeted	Hosts targeted
Riverina Production Area – Mediterranean fruit fly	Riverina	Mediterranean fruit fly (*Ceratitis capitata*)	Horticulture
Riverina Production Area – papaya fruit fly	Riverina	Papaya fruit fly (*Bactrocera papayae*)	Horticulture
Riverina Production Area – surveillance	Riverina	Queensland fruit fly (*Bactrocera tryoni*) and exotic fruit flies attracted to Cuelure	Citrus and other susceptible fruit
Solenopsis mealy bug	Sydney basin	Solenopsis mealy bug (*Phenacoccus solenopsis*)	Horticulture
Northern Territory			
Citrus surveillance	Darwin, Katherine, Alice Springs	Asiatic citrus psyllid (*Diaphorina citri*), citrus canker (*Xanthomonas citri* subsp. *citri*) and huanglongbing (*Candidatus* Liberibacter africanus)	Citrus
Fruit fly monitoring – endemics	Darwin, Katherine, Alice Springs	Fruit flies (*Bactrocera cucumis*, *B. musae, B. neohumeralis*)	Horticulture and suburbs
Fruit fly monitoring – exotics	Darwin, Katherine, Alice Springs	Exotic fruit flies (*Bactrocera* spp., *Ceratitis* spp.)	Horticulture and suburbs
Queensland			
Exotic fruit fly trapping	Coastal towns/cities/Cape York Peninsula	Exotic fruit flies (*Bactrocera* spp., *Ceratitis* spp.)	Fruits and vegetables
Multiple pest surveillance	Brisbane and Gladstone	A range of species, including Asian and citrus longhorn beetle (*Anoplophora* spp.), drywood longicorn beetle (*Stromatium barbatum*)	Multiple crops including citrus
Urban surveillance program	Urban areas	A range of pests and diseases	Fruit including citrus
South Australia			
Citrus canker	Adelaide metropolitan area	Citrus canker (*Xanthomonas citri* subsp. *citri*)	Citrus
Huanglongbing	Adelaide metropolitan area	Huanglongbing (*Candidatus* Liberibacter asiaticus) and Asiatic citrus psyllid (*Diaphorina citri*)	Citrus
Citrus variegated chlorosis	Adelaide metropolitan area	Citrus variegated chlorosis (*Xylella fastidiosa*)	Citrus
Exotic fruit flies	Adelaide port area	Exotic fruit flies (*Bactrocera* spp. and *Ceratitis* spp.)	Horticulture

Surveillance program	Region	Pests targeted	Hosts targeted
Fruit flies	Riverland	Meditteranean fruit fly (*Ceratitis capitata*) and Queensland fruit fly (*Bactrocera tryoni*)	Horticulture
Tasmania			
Fruit fly trapping program	Statewide	Fruit fly (*Bactrocera tryoni, Ceratitis capitata, B. papayae, B. cucurbitae*)	Horticulture
Victoria			
Fruit fly monitoring and surveillance	Statewide	Mediterranean fruit fly (*Ceratitis capitata*)	Horticulture
Fruit fly monitoring and surveillance	Melbourne ports	Exotic fruit flies (*Bactrocera* spp., *Ceratitis* spp.)	Horticulture
Fruit fly monitoring and surveillance	Greater Sunraysia pest free area	Queensland fruit fly (*Bactrocera tryoni*)	Horticulture
Western Australia			
Fruit fly port trapping	Statewide	Fruit flies (*Bactrocera* spp., *Ceratitis* spp. and *Dacus* spp.)	Horticulture
Fruit fly surveillance in Ord River Irrigation Area (ORIA)	ORIA	Fruit flies (*Bactrocera* spp. and *Dacus* spp.)	Fruit
Mediterranean fruit fly area freedom surveillance in ORIA	ORIA	Mediterranean fruit fly (*Ceratitis capitata*)	Fruit
Multiple pest surveillance	South west of Western Australia	Multiple species including huanglongbing (*Candidatus* Liberibacter asiaticus)	Multiple crops including citrus
Queensland fruit fly surveillance	Statewide	Queensland fruit fly (*Bactrocera tryoni*)	Horticulture

Orchard and nursery surveillance activities

Responsibility > industry/growers and nursery operators

Orchard level surveillance involves the participation and interaction of growers, agribusiness and industry representative groups. Examples of the surveillance activities that can be carried out by each of these groups are outlined in Figure 8. Conducting regular surveys of orchards and nurseries provides the best chance of spotting new pests early and implementing eradication or management responses.

Nurseries operating to NIASA guidelines are required to monitor pest activity in the nursery, effectively control pests and keep a pest management record diary.

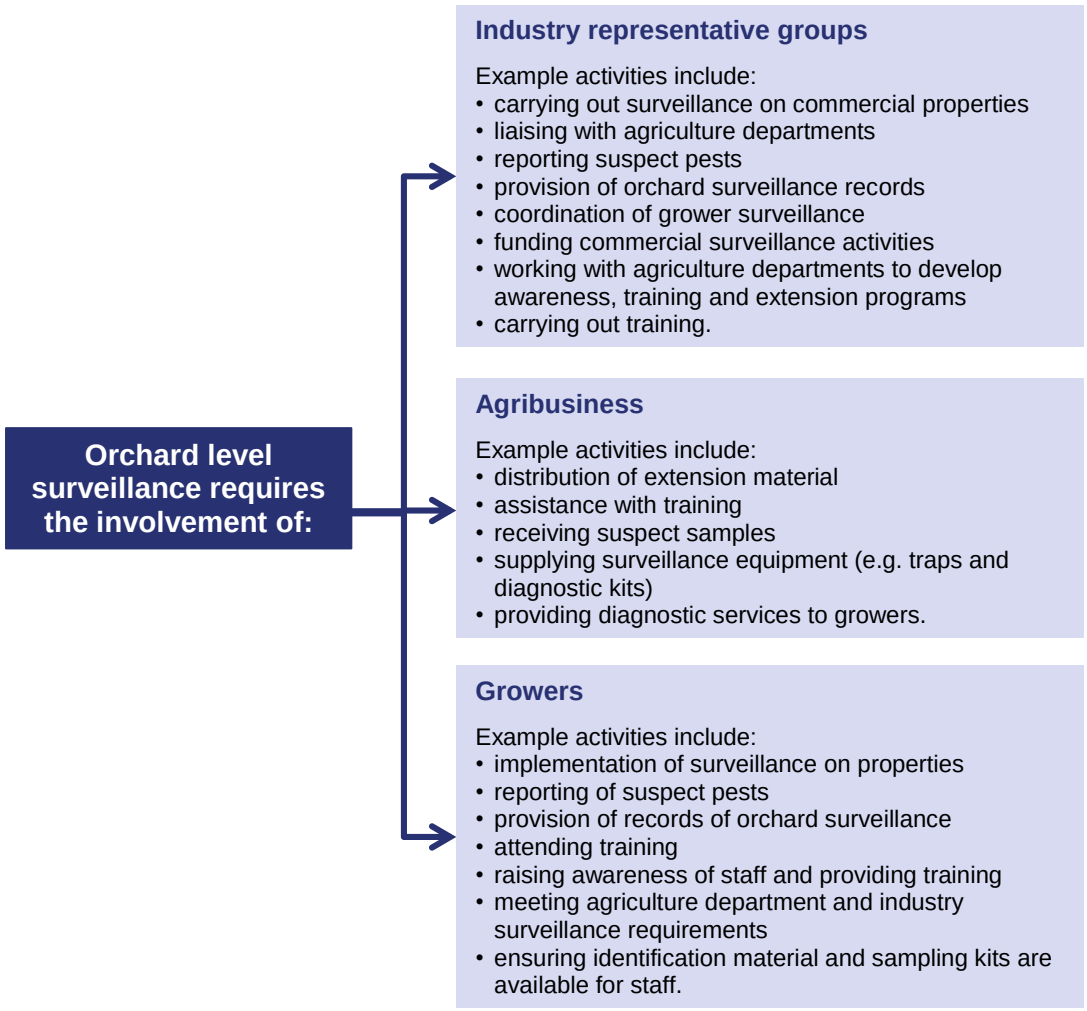

Figure 8. *Examples of orchard level surveillance activities*

Training

A key component of biosecurity preparedness is ensuring personnel engaged are suitable and effectively trained for their designated roles. Biosecurity preparedness training is the responsibility of all parties, government and industry, 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 have the skills and knowledge to effectively fulfil the roles and responsibilities of parties under 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 Local Control Centre.

In addition to face to face training delivered to members and the provision of simulation exercises, PHA also offers biosecurity training through BOLT, and online training platform. Access to BOLT is free and open to any stakeholder interested in biosecurity, and is available through **www.planthealthaustralia.com.au/bolt**.

As part of the HAL funded project “Protecting Australia’s citrus industry from biosecurity threats”, EPPRD training has been delivered to the Citrus Australia Board under the National EPP Training Program. A simulation exercise of an EPP incursion will also be undertaken to provide in depth practical training, assess the preparedness of the industry to a pest incursion, increase understanding of the required roles and resources, identify communication gaps and highlight the interaction between industry and governments during an incursion response.

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

Awareness

Early reporting enhances the chance of effective control and eradication. Awareness activities (such as the postcard shown in Figure 9) raise the profile of biosecurity and exotic pest threats to the citrus 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 agency.

As part of the HAL funded project “Protecting Australia’s citrus industry from biosecurity threats”, awareness material is being produced to support the development of a comprehensive biosecurity awareness training program. The main mechanism for improving grower awareness will be through distribution of an updated Citrus Biosecurity Manual. The manual will convey key biosecurity messages and provide clear information on how to put in place simple measures to protect orchards from pests. It will provide descriptions and images of key exotic pest threats to enhance pest awareness and recognition, thus increasing the chance of early reporting and eradication. Surveys aimed at growers and key stakeholders will also be conducted throughout the project to enable a clear measure of the program’s delivery and success.

Figure 9. *Examples of awareness material developed for the citrus industry*

High priority plant pest threat-related documents

Pests listed in Table 6 have been identified as high priority threats to the citrus industry by members of the IBG. 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 HPPs

In addition to the fact sheets listed in Table 18, the websites listed below (Table 13) contain information on pests across most plant industries, including the citrus industry.

Table 13. *Sources of information on HPPs for the citrus industry*

Source	Website
Department of Agriculture	**www.agriculture.gov.au**
Pest and Disease Image Library (PaDIL)	**www.padil.gov.au**
DAF Queensland A-Z list of significant plant pests and diseases	**www.daf.qld.gov.au/plants/health-pests-diseases/a-z-significant**
University of California Statewide Integrated Pest Management (IPM) Program	**www.ipm.ucdavis.edu/EXOTIC/exoticpestsmenu.html**
Knowledge Master[55]	**www.extento.hawaii.edu/Kbase/crop/crop.htm**
European and Mediterranean Plant Protection Organization (EPPO)	**www.eppo.int/DATABASES/pqr/pqr.htm**
Citrus Resource	**idtools.org/id/citrus/resource/index.php**

[55] Developed by University of Hawaii, College of Tropical Agriculture and Human Resources and Hawaii Department of Agriculture

Further information/relevant web sites

A range of government and grower organisation details and websites are provided below (Table 14) for persons seeking further information on citrus industry biosecurity.

Table 14. *Relevant sources of further biosecurity information for the citrus industry*

Agency	Website/email	Phone	Address
National			
Citrus Australia	**www.citrusaustralia.com.au**	(03) 5023 6333	Street address: 115 Lime Avenue Mildura VIC 3502 Postal address: PO Box 10336 Mildura VIC 3502
Auscitrus	**www.auscitrus.com.au**	(03) 5027 4411	Street address: 398 River Road Dareton NSW 2717 Postal address: PO Box 269 Dareton NSW 2717
Australian Government Department of Agriculture	**www.agriculture.gov.au**	(02) 6272 3933 1800 020 504	GPO Box 858 Canberra, ACT 2601
Plant Health Australia	**www.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	**www.dpi.nsw.gov.au/biosecurity/plant**	(02) 6938 1976	Locked Bag 21 Orange, NSW 2800

Agency	Website/email	Phone	Address
Queensland			
Biosecurity Queensland, a part of the Department of Agriculture and Fisheries, Queensland	**www.daf.qld.gov.au/biosecurity** **callweb@daf.qld.gov.au**	13 25 23[56] 07 3404 6999[57]	80 Ann Street Brisbane, QLD 4000
Northern Territory			
Department of Primary Industry and Fisheries	**www.nt.gov.au/d/Primary_Industry** **info.DPIF@nt.gov.au**	(08) 8999 5511	Berrimah Farm, Makagon Road Berrimah, NT 0828
South Australia			
Primary Industries and Regions SA	**www.pir.sa.gov.au** **www.pir.sa.gov.au/pirsa/content/customer_enquiry_form**	(08) 8226 0900	GPO Box 1671 Adelaide, SA 5001
Biosecurity SA-Plant Health	**www.pir.sa.gov.au/biosecuritysa/planthealth**	(08) 8207 7820	33 Flemington Street Glenside, SA 5065
South Australian Research and Development Institute	**www.sardi.sa.gov.au** **sardi@sa.gov.au**	(08) 8303 9400	2b Hartley Grove Urrbrae, SA 5064
Tasmania			
Department of Primary Industries, Parks, Water and Environment	**www.dpipwe.tas.gov.au** **BPI.Enquiries@dpipwe.tas.gov.au**	1300 368 550	GPO Box 44, Hobart, TAS 7001
Victoria			
Department of Economic Development, Jobs, Transport and Resources	**http://economicdevelopment.vic.gov.au/**	136 186	Plant Biosecurity and Product Integrity Private bag 15 Ferntree Gully Delivery Centre, Vic 3156

[56] Within Qld
[57] Interstate

Agency	Website/email	Phone	Address
Western Australia			
Department of Agriculture and Food	**www.agric.wa.gov.au** **enquiries@agric.wa.gov.au**	(08) 9368 3333	DAFWA 3 Baron-Hay Court South Perth, WA 6151

Orchard 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 citrus that Australia does not have.

Orchard biosecurity measures can be used to minimise the spread of such pests before their presence is known or after they are identified, and therefore can greatly increase the likelihood that they could be eradicated. PHA, in conjunction with Citrus Australia, has developed an Orchard Biosecurity Manual for the Citrus Industry (**www.planthealthaustralia.com.au/industries/citrus**) which outlines orchard biosecurity and hygiene measures that help reduce the impact of pests on the industry. The manual covers biosecurity aspects such as:

- recognising the HPPs of the citrus industry
- monitoring for the presence of pests
- reporting anything unusual
- the use of high health status orchard inputs such as certified propagation material
- quality and hygiene Best Management Practices
- disposal of waste fruit and plant material
- maintenance of records for trace-back and trace-forward purposes
- safe use of chemicals
- managing the movement of people
- visiting overseas farms/orchards – what to watch out for when you return
- the use of warning and information signs
- managing the movements of vehicles and machinery
- washdown facilities and designated parking areas.

Reporting suspect pests

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

Reporting an exotic plant pest carries serious implications and should be done only via the Exotic Plant Pest Hotline. Careless use of information, particularly if a pest has not been confirmed, can result in extreme stress for individuals and communities, and possibly damaging and unwarranted trade restrictions.

If you suspect a new pest, call the Exotic Plant Pest Hotline on 1800 084 881

Calls to the Exotic Plant Pest Hotline will be forwarded to an experienced person in the department of agriculture from the state of origin of the call, who will ask some questions about what you have seen and may arrange to collect a sample. Every report will be taken seriously, checked out and treated confidentially.

In some states and territories, the Exotic Plant Pest Hotline only operates during business hours. Where this is the case, and calls are made out of hours, callers should leave a message including contact details and staff from the department of agriculture will return the call the following business day.

Some citrus pests are notifiable under each state or territory's quarantine legislation. The complete list of notifiable pests can be downloaded from the PHA website[58]; however, each state's list of notifiable pests are subject to change over time so contacting your local state/territory agricultural agency (details in Table 11) will ensure information is up to date. Landowners and consultants have a legal obligation to notify the relevant state/territory agriculture agency of the presence of those pests within a defined timeframe (Table 15).

Table 15. *Timeframe for reporting of notifiable pests as defined in state/territory legislation*

State/territory	Notifiable pest must be reported within
NSW	24 hours
NT	24 hours
Qld	24 hours
SA	Immediately
Tas	As soon as possible
Vic	Without delay
WA	24 hours

Suspect material should not generally be moved or collected without seeking advice from the relevant state/territory agriculture agency, as incorrect handling of samples could spread the pest or render the samples unsuitable for diagnostic purposes. State/territory agriculture officers will usually be responsible for sampling and identification of pests.

[58] Available from **www.planthealthaustralia.com.au/biosecurity/notifiable-pests**

Reference

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

CONTINGENCY PLANS AND RESPONSE MANAGEMENT

Introduction

Gathering information, developing procedures, and defining roles and responsibilities during an emergency 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 Parties involved in an incursion response.

The following section includes key contact details and communication procedures that should be used in the event of an incursion in the citrus industry. 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 citrus industry they will be included in this document and made available through the PHA website.

PLANTPLAN

PLANTPLAN and its supporting documents provide a description of the management structures and information flow systems for the handling of a plant pest emergency at national, state/territory and district levels as well as guidelines, standard operating procedures (SOPs), forms/templates and jobcards. Guidance is provided for the operation of control centres, as well as outlining principles for the chain of responsibility, functions of sections, and role descriptions. PLANTPLAN is a general manual for use by all Government and Industry Parties during Plant Pest emergencies.

PLANTPLAN and its supporting documents are regularly reviewed and updated, and addition supporting documents are developed where needs are identified. This ensures that the best possible guidance is provided to plant industries and governments in responding to serious Plant Pests. The most recent version of PLANTPLAN and its supporting documents can be downloaded from the PHA website at **www.planthealthaustralia.com.au/plantplan**.

Following the detection of a suspect EPP, the relevant state agency should be immediately notified either directly or through the Exotic Plant Pest Hotline. Within 24 hours of the initial identification, the agency, through the State Chief Plant Health Manager (CPHM), will inform the Australian Chief Plant Protection Office (ACPPO) who will notify all state agencies, relevant industry representatives and PHA (this process is outlined in Figure 10).

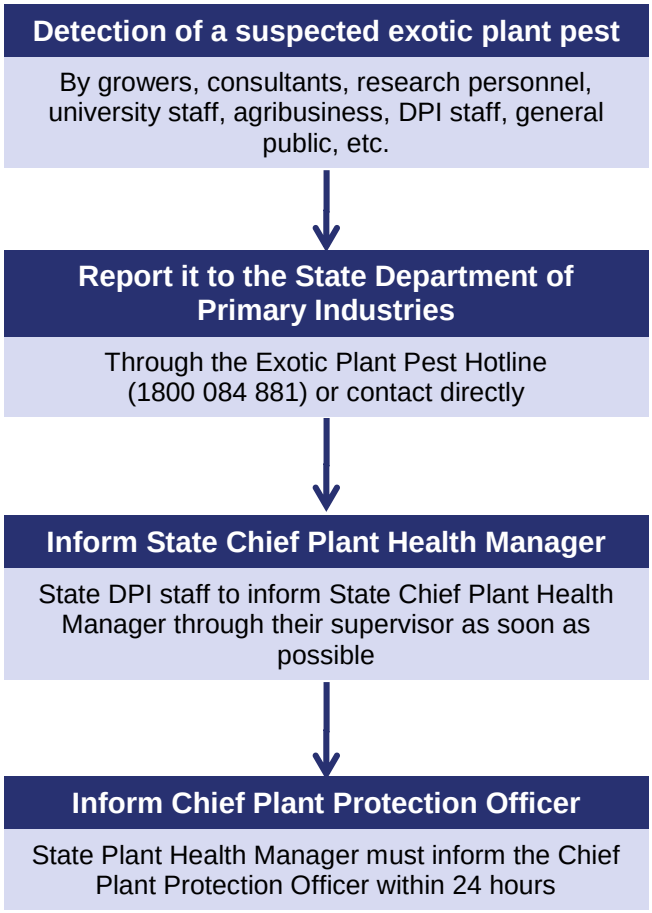

Figure 10. *Suspect exotic plant pest detection reporting flowchart*

Following the detection or reporting of the pest, the relevant state/territory agriculture agency will seek a confirmatory diagnosis from another laboratory, usually within a different jurisdiction. If the pest is suspected to be an EPP (meeting one of the four main criteria within the EPPRD), the general process (as described in PLANTPLAN) is as outlined in Figure 11.

If the pest is considered potentially serious and/or suspected to be an EPP, the relevant state/territory agriculture department will usually adopt precautionary emergency containment measures. These measures, depending on the Plant Pest, may include:

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

If an EPP is confirmed, technical and economic considerations are reviewed, and a decision made on whether to eradicate (managed under the EPPRD and a Response Plan) or take another course of action (potentially to contain or do nothing - long term management). Under

the EPPRD all decisions are made by Committees with government and industry representation. At the Consultative Committee on Emergency Plant Pests (CCEPP) level, these decisions relate to the technical feasibility of eradication of the EPP in question. From a National Management Group (NMG) perspective, they relate to technical advice from the CCEPP as well as financial considerations.

During the Investigation and Alert Phase (Figure 11), the Affected area will be placed under quarantine until a decision is made on whether to eradicate the pest or not. If a decision has been made to pursue eradication and a Response Plan under the EPPRD is approved by the NMG, efforts enter the Operational Phase (Figure 11). Eradication methods used will vary according to the nature of the EPP involved and infested/infected material will be destroyed where necessary. All on ground response operations are undertaken by the relevant state agricultural department(s) in accord with the approved Response Plan and the relevant state/territory legislation.

In the Stand Down Phase (Figure 11), all operations are wound down. Where a plant pest emergency is not confirmed, those involved will be advised that the threat no longer exists. Where the EPP is successfully eradicated, the situation should begin to return to ‘normal’. Where the EPP is not able to be eradicated, future long term management and control options may be investigated. In all cases, the response is reviewed and any lessons learnt will be used to improve the system for the future.

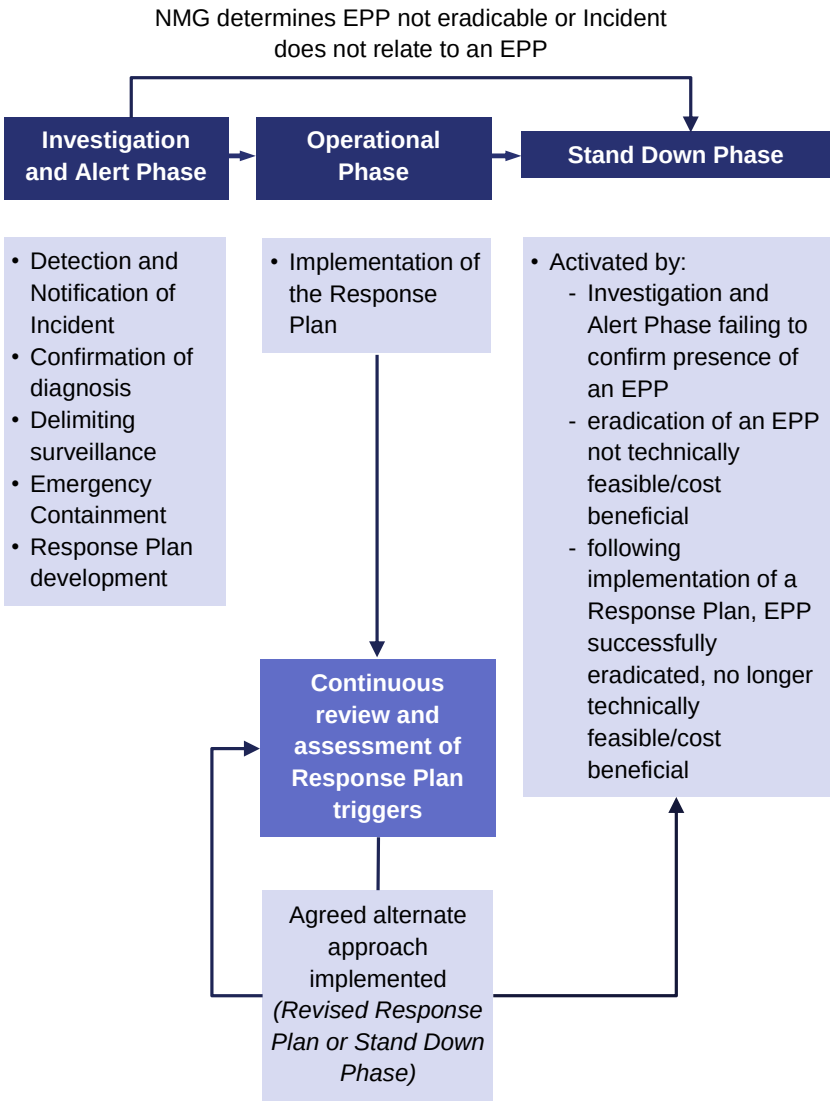

Figure 11. *General decision making and communication chain for a plant pest emergency response*

Industry specific response procedures

Industry communication

Citrus Australia will be the key industry contact point if an incursion Affecting the citrus industry is detected, and will have responsibility for relevant industry communication and media relations (see PLANTPLAN for information on approved communications during an incursion).

The contacts nominated for the CCEPP and the NMG by Citrus Australia should be contacted immediately (Table 16) regarding any meetings of the CCEPP or NMG. It is important that all Parties to the EPPRD ensure their contacts for these committees are nominated to PHA and updated swiftly when personnel change.

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

Table 16. *Contact details for Citrus Australia*

Website	**www.citrusaustralia.com.au**	
Postal address	PO Box 10336, Mildura, VIC 3502	
Street address	115 Lime Avenue, Mildura, VIC 3500	
Contacts	Judith Damiani (Chief Executive Officer)	Andrew Harty (Market Development Manager)
Email	**judith.damiani@citrusaustralia.com.au**	**andrew.harty@citrusaustralia.com.au**
Phone	(03) 5023 6333	(03) 5023 6333
Mobile	0418 891 814	0410 746 374

Counselling and support services

Whilst incursion response procedures, including quarantines, are critical in preventing a pests' further spread, such activities can impose a significant emotional and financial strain on citrus growers and their businesses. Provision for counselling and advice on financial support for growers is made available through various agencies as listed in Table 17. Up-to-date information relating to mental health can be found at **www.health.gov.au/mentalhealth**. Local providers of counselling services can be found through contacting your local state or territory agriculture agency (Table 11) or your growers association (Table 16).

Table 17. *Counselling and financial counselling services*

Organisation	Contact
Lifeline	**13 11 14** (24 hours) **www.lifeline.org.au** Anyone can call Lifeline. The 13 11 14 service offers a counselling service that respects everyone's right to be heard, understood and cared for. We also provide information about other support services that are available in communities around Australia.
Mensline	**1300 789 978** (24 hours) **www.menslineaus.org.au** Mensline Australia is a dedicated service for men with relationship and family concerns.
Kids Help Line	**1800 551 800** (24 hours) **www.kidshelpline.com.au** Kids Help Line is Australia's only free, confidential and anonymous, telephone and online counselling service specifically for young people aged between 5 and 25.
BeyondBlue	**1300 224 636** **www.beyondblue.org.au** Beyondblue is an independent, not-for-profit organisation working to increase awareness and understanding of depression, anxiety and related substance-use disorders throughout Australia and reduce the associated stigma.
Centrelink	**13 23 16** (Drought Assistance Hotline) **www.humanservices.gov.au/customer/subjects/drought-assistance** The Exceptional Circumstances Relief Payment is delivered by Centrelink on behalf of the Department of Agriculture. The payment provides assistance to farmers living in 'exceptional circumstances' affected areas who are having difficulty meeting family and personal living expenses.

Pest-specific emergency response and information documents

As part of the implementation of the IBP, pest-specific information and emergency response documents, such as fact sheets and contingency plans should be developed over time for all medium to high risk pests listed in the TSTs (Appendix 1). Currently, a number of documents have been developed for pests of the citrus industry (Table 18) and are available for download from the Pest Information Document Database (PIDD) at **www.planthealthaustralia.com.au/pidd** or by contacting state/territory agriculture agencies. Additional fact sheets can be accessed through the Department of Agriculture and state/territory agriculture agency websites (Table 19).

Table 18. *Pest-specific information documents for the citrus industry*[59]

Scientific name	Common name	Fact sheet	Contingency plan	Pest risk review[60]
Aleurocanthus woglumi	Citrus blackfly	✓		
Amblypelta cocophaga	Coconut bug	✓		✓
Amyelois transitella	Navel orangeworm	✓		
Anastrepha ludens	Mexican fruit fly	✓		
Anastrepha suspensa	Caribbean fruit fly	✓		
Anoplophora chinensis	Citrus longicorn/longhorn beetle	✓	✓[61]	
Argyrotaenia citrana	Orange tortrix	✓		
Bactrocera carambolae	Carambola fruit fly	✓		✓
Bactrocera cucurbitae	Melon fruit fly	✓	✓[62]	✓
Bactrocera dorsalis	Oriental fruit fly	✓	✓[63]	✓
Bactrocera melanotus	Fruit fly			✓
Bactrocera occipitalis	Fruit fly	✓		✓
Bactrocera passiflorae	Fijian fruit fly	✓		✓
Bactrocera trivialis	New Guinea fruit fly	✓		✓
Bactrocera tryoni	Queensland fruit fly	✓	✓[64]	
Bactrocera zonata	Peach fruit fly	✓		
Candidatus Liberibacter asiaticus, *Ca.* L. africanus, *Ca.* L. americanus	Huanglongbing (Asiatic, African, American strains)	✓	✓[65]	✓
Caliothrips fasciatus	Bean thrips	✓		
Ceratitis capitata	Mediterranean fruit fly	✓	✓[66]	
Citrus tristeza virus (Closterovirus) (mandarin stem-pitting strain)	Mandarin stem-pitting	✓		✓
Citripestis sagittiferella	Citrus fruit borer	✓		
Cryptophlebia leucotreta	False codling moth	✓		
Diaphorina citri	Asiatic citrus psyllid	✓	✓[65]	

[59] Copies of these documents are available from **www.planthealthaustralia.com.au/pidd** or by contacting the relevant state/territory agriculture agency

[60] The development of pest specific contingency plans will replace any future development of pest risk reviews

[61] Developed for the nursery & garden industry

[62] Document held by DAF Qld (national plan)

[63] Contingency plans developed for *B. papayae*, now considered to be the same species as *B. dorsalis*; documents held by DAF Qld (national plan) and PIRSA (state plan)

[64] Documents held by PIRSA (state plan) and DPIPWE (state plan)

[65] A contingency plan was developed by DAF Qld for the nursery & garden industry and another is currently being developed that will cover both the citrus and nursery & garden industries. Both contingency plans include all three strains of huanglongbing and the vectors *Diaphorina citri* and *Trioza erytreae*.

[66] Document held by PIRSA (state plan) and DPIPWE (state plan)

Scientific name	Common name	Fact sheet	Contingency plan	Pest risk review[60]
Elsinoë australis	Sweet orange scab	✓		✓
Frankliniella bispinosa	Florida flower thrips	✓		
Homalodisca vitripennis	Glassy-winged sharpshooter	✓	✓[67]	✓
Oribius spp.	Oribius weevils			✓
Paracoccus marginatus	Papaya mealy bug	✓	✓[68]	
Parasa lepida	Blue-striped nettle grub	✓		✓
Phoma tracheiphila	Mal secco	✓		✓
Phymatotrichopsis omnivora	Texas root rot	✓		
Platynota stultana	Omnivorous leaf roller	✓		
Pseudococcus maritimus	Bakers/Grape mealybug			✓
Spiroplasma citri	Citrus stubborn disease	✓		✓
Stromatium barbatum	Drywood longicorn beetle			✓
Tetranychus pacificus	Pacific spider mite	✓		
Tetranychus turkestani	Strawberry spider mite	✓		
Trioza erytreae	African citrus psyllid	✓	✓[65]	
Xanthomonas citri subsp. *citri*	Citrus canker	✓	✓[69]	✓
Xylella fastidiosa	Citrus variegated chlorosis	✓	✓[70]	✓

[67] Developed for nursery & garden industry
[68] Developed for papaya industry
[69] Document held by DAF Qld (state plan for citrus industry)
[70] Developed for nursery & garden industry (national plan)

Table 19. *Fact sheets on exotic citrus pests available from state/territory agriculture agencies and the Department of Agriculture*

Scientific name	Common name	Organisation	Document link
Amyelois transitella	Navel orangeworm	DAF Qld	**www.daf.qld.gov.au/plants/health-pests-diseases/a-z-significant**
		NSW DPI	**www.dpi.nsw.gov.au/__data/assets/pdf_file/0004/432643/Exotic-Pest-Alert-Navel-orangeworm.pdf**
Bactrocera cucurbitae	Melon fruit fly	DAFWA	**www.agric.wa.gov.au/PC_92872.html**
Bactrocera papayae	Papaya fruit fly	DAF Qld	**www.daf.qld.gov.au/plants/health-pests-diseases/a-z-significant**
		DAFWA	**www.agric.wa.gov.au/PC_92872.html**
Candidatus Liberibacter asiaticus, *Ca.* L. africanus, *Ca.* L. americanus	Huanglongbing (Asiatic, African, American strains)	Department of Agriculture	**www.daff.gov.au/biosecurity/quarantine/naqs/naqs-target-lists/huanglongbing**
		DAF Qld	**www.daf.qld.gov.au/plants/health-pests-diseases/a-z-significant**
		DPIF	**www.nt.gov.au/d/Content/File/p/Plant_Pest/Citrus%20HLB%20factsheet.pdf**
		NSW DPI	**www.dpi.nsw.gov.au/__data/assets/pdf_file/0009/432297/Exotic-pest-alert-huanglongbing.pdf**
Ceratitis rosa	Natal fruit fly	DAFWA	**www.agric.wa.gov.au/PC_91710.html**
Citripestis sagittiferella	Citrus fruit borer	Department of Agriculture	**www.daff.gov.au/biosecurity/quarantine/naqs/naqs-target-lists/pests_of_plants_citrus_fruit_borer**
		DAF Qld	**www.daf.qld.gov.au/plants/health-pests-diseases/a-z-significant**
Citrus tristeza virus (*Closterovirus*) (mandarin stem-pitting strains)	Citrus tristeza virus (mandarin stem-pitting strains)	DAF Qld	**www.daf.qld.gov.au/plants/health-pests-diseases/a-z-significant**
Diaphorina citri	Asiatic/Asian citrus psyllid	Department of Agriculture	**www.daff.gov.au/biosecurity/quarantine/naqs/naqs-target-lists/pests_of_plants_asian_citrus_psyllid**
		DAF Qld	**www.daf.qld.gov.au/plants/health-pests-diseases/a-z-significant**
		NSW DPI	**www.dpi.nsw.gov.au/__data/assets/pdf_file/0005/432626/Exotic-Pest-Alert-Asiatic-citrus-psyllid.pdf**
Elsinoë australis	Sweet orange scab	DAF Qld	**www.daf.qld.gov.au/plants/health-pests-diseases/a-z-significant**
Homalodisca vitripennis/coagulata and *Xylella fastidiosa*	Glassy-winged sharpshooter and Pierce's disease	DAFWA	**www.agric.wa.gov.au/PC_91710.html**

Scientific name	Common name	Organisation	Document link
Oidium citri and *Oidium tingitaninum*	Citrus powdery mildew	DAF Qld	**www.daf.qld.gov.au/plants/health-pests-diseases/a-z-significant**
Phoma tracheiphila	Mal secco	DAF Qld	**www.daf.qld.gov.au/plants/health-pests-diseases/a-z-significant**
		NSW DPI	**www.dpi.nsw.gov.au/__data/assets/pdf_file/0019/433360/Exotic-plant-pest-mal-secco.pdf**
Scirtothrips auranti	South African citrus thrips	NSW DPI	**www.dpi.nsw.gov.au/__data/assets/pdf_file/0020/441515/Exotic-Pest-Alert-South-African-citrus-thrips.pdf**
Trioza erytreae	African citrus psyllid	DAF Qld	**www.daf.qld.gov.au/plants/health-pests-diseases/a-z-significant**
		NSW DPI	**www.dpi.nsw.gov.au/__data/assets/pdf_file/0020/432614/Exotic-Pest-Alert-african-citrus-psyllid.pdf**
Xanthomonas citri subsp. *citri*	Citrus canker	Department of Agriculture	**www.daff.gov.au/biosecurity/quarantine/naqs/naqs-target-lists/citrus-canker**
		DAF Qld	**www.daf.qld.gov.au/plants/health-pests-diseases/a-z-significant**
		DAFWA	**www.agric.wa.gov.au/PC_91710.html**
		DEDJTR	**www.depi.vic.gov.au/agriculture-and-food/pests-diseases-and-weeds/plant-diseases/fruit-and-nuts/citrus-diseases/citrus-canker**
		DPI NSW	**www.dpi.nsw.gov.au/__data/assets/pdf_file/0013/432310/Exotic-pest-alert-citrus-canker.pdf**

National Diagnostic Protocols

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

Australia has a coherent and effective system for the development of NDPs for plant pests managed by the Subcommittee on Plant Health Diagnostic Standards (SPHDS). NDPs are peer reviewed and verified before being endorsed by Plant Health Committee.

Endorsed NDPs are available on the National Plant Biosecurity Diagnostic Network (NPBDN) website (**www.plantbiosecuritydiagnostics.net.au**), together with additional information regarding their development and endorsement. Thus far, NDPs relevant to the citrus industry have been developed for citrus canker (*Xanthomonas citri* subsp. *citri*), huanglongbing

(*Candidatus* Liberibacter asiaticus), mal secco (*Phoma tracheiphila*), glassy-winged sharpshooter (*Homalodisca vitripennis*) and *Xylella fastidiosa*[71]. Diagnostic information for some citrus pests is available from the EPPO, North American Plant Protection Organization (NAPPO) and PaDIL websites (see Table 20) or through draft protocols available from the PHA website (**www.planthealthaustralia.com.au/pidd**; see Table 20). For diagnostic information on fruit flies, refer to the Australian Handbook for the Identification of Fruit Flies, available from the PHA website (see Table 20).

Table 20. *Citrus pests for which draft diagnostic protocols or diagnostic information exists*

Scientific name	Common name	Document link
Anastrepha spp., *Bactrocera* spp., *Ceratitis* spp. (various species)	Fruit fly	**www.planthealthaustralia.com.au/wp-content/uploads/2012/12/Australian-Handbook-for-the-Identification-of-Fruit-Flies.pdf**
Bactrocera zonata	Peach fruit fly	**http://archives.eppo.int/EPPOStandards/diagnostics.htm**
Candidatus Liberibacter americanus	Huanglongbing (American strain)	**www.nappo.org/en/?sv=&category=Standards+Decisions&title=authors+HLB**
Candidatus Liberibacter asiaticus	Huanglongbing (Asiatic strain)	**www.padil.gov.au/pests-and-diseases/pest/main/136651**
Candidatus Phytoplasma aurantifolia	Witches' broom disease of lime	**http://archives.eppo.int/EPPOStandards/diagnostics.htm**
Citripestis sagittiferella	Citrus fruit borer	**www.padil.gov.au/pests-and-diseases/Pest/Main/142287**
Citrus tristeza virus (Closterovirus)	Mandarin stem-pitting and others	**http://archives.eppo.int/EPPOStandards/diagnostics.htm** **www.nappo.org/en/data/files/download/Protocols/PD%2001-CTV%20Citrus-05-03-13-e.pdf**
Diaphorina citri	Asiatic citrus psyllid	**http://archives.eppo.int/EPPOStandards/diagnostics.htm**
Homalodisca vitripennis	Glassy-winged sharpshooter	**www.planthealthaustralia.com.au/wp-content/uploads/2013/03/Glassy-winged-sharpshooter-DP-2002.pdf**
Phoma tracheiphila	Mal secco	**http://archives.eppo.int/EPPOStandards/diagnostics.htm** **www.padil.gov.au/pests-and-diseases/pest/main/136626**
Scirtothrips auranti	South African citrus thrips	**http://archives.eppo.int/EPPOStandards/diagnostics.htm**
Tetranychus spp.	Spider mites	**www.planthealthaustralia.com.au/wp-content/uploads/2013/03/Spider-mites-DP-2005.pdf**

[71] This Diagnostic protocol was developed for *Xylella fastidiosa* on grapevine (Pierce's disease), however much of the content is relevant to detection of *X. fastidiosa* in citrus

Scientific name	Common name	Document link
Trioza erytreae	African citrus psyllid	**http://archives.eppo.int/EPPOStandards/diagnostics.htm**
Xanthomonas citri subsp. *citri*	Citrus canker	**http://archives.eppo.int/EPPOStandards/diagnostics.htm**
Xylella fastidiosa	Pierce's disease/ citrus variegated chlorosis	**http://archives.eppo.int/EPPOStandards/diagnostics.htm**

Reference

Plant Health Australia (2013) PLANTPLAN: Australian Emergency Plant Pest Response Plan. Plant Health Australia, Canberra, ACT. (**www.planthealthaustralia.com.au/plantplan**)

APPENDIX 1: THREAT SUMMARY TABLES

Citrus industry threat summary tables

The information provided in the TSTs (invertebrates, Table 21; pathogens and nematodes, Table 22) is an overview of exotic plant pest threats to the citrus industry. Summarised information on entry, establishment and spread potentials and economic consequences of establishment are provided where available. Pests under official control[72] or eradication may be included in these tables where appropriate. However, citrus pests that are endemic but regionalised within Australia are not covered by IBPs, 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 33. An explanation of the method used for calculating the overall risk can be found on the PHA website[73]. Additional information on a number of the pests listed in the TSTs can be found in pest-specific information documents (Table 18).

Invertebrates

Table 21: *Citrus invertebrate threat summary table*

Scientific name	Common name	Host(s)[74]	Affected plant part	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
ACARI (Mites e.g. spider and gall mites)								
Aculops pelekassi	Pink citrus rust mite	*Citrus* spp.[75]	Leaves, stems	HIGH[76]	HIGH	HIGH[77]	MEDIUM[78]	**MEDIUM**

[72] 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
[73] Available from **www.planthealthaustralia.com.au/biosecurity/risk-mitigation**
[74] Refer to Appendix 2 for nomenclature of citrus species and hybrids
[75] Prefer "loose skin" oranges, mandarins and clementines
[76] Small and likely to escape detection on imported plant material
[77] Small and difficult to detect; easily spread by wind and may spread via movement of host material
[78] Affects fruit quality and quantity

Scientific name	Common name	Host(s)[74]	Affected plant part	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Calacarus citrifolii	Citrus grey mite/ citrus blotch mite	Polyphagous including *Citrus* spp., papaya, passionfruit, *Brunfelsia* spp., *Euphorbia pulcherrima, Musa paradisiaca*	Leaves, fruit	HIGH	HIGH[79]	HIGH	MEDIUM[80]	**MEDIUM**
Eotetranychus kankitus	Citrus yellow mite	Primary hosts are *Citrus* spp., other hosts are grapevine, apricot, pear, *Rosa* spp., willows, *Eleusine indica*	Leaves, stems, fruit	MEDIUM	MEDIUM[81]	MEDIUM[81]	MEDIUM	**LOW**
Eutetranychus africanus	Citrus brown mite	Primary hosts include *Citrus* spp., durian	Leaves, stems, fruit	MEDIUM	HIGH	MEDIUM	MEDIUM	**LOW**
Eutetranychus banksi	Texas citrus mite	*Citrus* spp., chayote		MEDIUM	MEDIUM - HIGH[82]	HIGH	MEDIUM	**LOW - MEDIUM**
Tetranychus pacificus	Pacific spider mite	Polyphagous including *Citrus* spp., melon, apple, pear, cotton, almond, walnut, strawberry, bean, grapevine, *Prunus* spp.	Leaves	MEDIUM	MEDIUM - HIGH	MEDIUM - HIGH	MEDIUM	**LOW - MEDIUM**
Tetranychus turkestani	Strawberry spider mite	Polyphagous including *Citrus* spp., apple, pear, cherry, peach, cotton, almond, strawberry, rose, soybean, maize, pepper	Leaves	MEDIUM	MEDIUM	MEDIUM	MEDIUM	**LOW**
COLEOPTERA (Beetles, weevils, etc.)								
Agrilus occipitalis	Citrus bark borer	*Citrus* spp.	Trunk	MEDIUM[83]	MEDIUM	MEDIUM	MEDIUM	**LOW**

[79] High reproductive rate and numerous alternative hosts
[80] High economic impact through feeding damage and also believed to incite concentric ring blotch disease
[81] Limited host range, but does occur on weedy species; mite population growth linked closely to abiotic factors
[82] Numerous alternative hosts and spreads by wind and human-assisted movement
[83] May enter via Torres Strait

Scientific name	Common name	Host(s)[74]	Affected plant part	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Anoplophora chinensis	Citrus trunk borer/ citrus longicorn beetle/ citrus longhorn beetle	Polyphagous attacking living trees including *Citrus* spp., *Acacia* spp., apple, pear, willow, lychee, fig, poplar, maple, rose	Trunk	MEDIUM[84]	HIGH[85]	LOW[86]	HIGH[87]	**MEDIUM**
Diaprepes abbreviatus	Citrus weevil/ West Indian weevil/ sugarcane rootstalk borer	Polyphagous (across over 50 families) including *Citrus* spp., sugarcane, corn, sorghum, sweet potato	Flowers, leaves, roots	MEDIUM	HIGH[88]	MEDIUM[89]	HIGH[90]	**MEDIUM**
Hypomeces squamosus	Green snout weevil	Adults and larvae polyphagous including rice, maize, *Citrus* spp., sugarcane, tobacco, cotton	Leaves, roots, growing points	LOW	HIGH[91]	HIGH[91]	MEDIUM	**LOW**
***Oribius* spp. (exotic species)**	Oribius weevils	Polyphagous including *Citrus* spp., avocado, banana	Leaves, stems, branches, fruit	HIGH	MEDIUM – HIGH	MEDIUM - HIGH	MEDIUM[92]	**LOW - MEDIUM**
Podagricomela nigricollis	Hong Kong beetle	*Citrus* spp.	Leaves	LOW	MEDIUM	LOW	LOW	**NEGLIGIBLE**
Stromatium barbatum	Drywood longicorn beetle/ teak trunk borer	Polyphagous including *Citrus* spp., grapevine and 350 species of seasoned hardwood and softwood timber and plywood (e.g. eucalyptus, pine, elm, oak)	Branches	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN[93]	**UNKNOWN**

[84] Can be imported through wooden crate packaging and in illegal budwood
[85] Polyphagous, therefore host plant material would not be limiting
[86] Distribution limited with no known history of rapid spread outside of this range; the movement of freshly felled trees bearing larvae would pose the most likely threat
[87] Most destructive cerambycid in China; tree death is frequent in attacked groves
[88] Wide host range; widely distributed species; has a high fecundity (ability to reproduce)
[89] Wide host range however adults don't fly far from the spot where they emerge from the soil
[90] Capable of serious economic damage to citrus; reduces vigour to host plant; may encourage infection by *Phytophthora*
[91] Wide host range, so host plant material would not be limiting; hitchhiker
[92] Impacts on fruit yield (Wesis et al., 2010)
[93] Attacks living trees, often those 12 years or more of age, leading to branch death

Scientific name	Common name	Host(s)[74]	Affected plant part	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
DIPTERA (Flies and midges)								
Anastrepha fraterculus	South American fruit fly	Polyphagous including Myrtaceae (preferred hosts), *Citrus* spp., *Prunus* spp. (especially peach), guava, mango, apple	Fruit	LOW	HIGH	HIGH[94]	HIGH[95]	**MEDIUM**
Anastrepha ludens	Mexican fruit fly	Polyphagous including *Citrus* spp.[96], mango, peach, avocado, passionfruit, pear, apple	Fruit	MEDIUM	HIGH	HIGH[94]	HIGH[95]	**HIGH**
Anastrepha serpentina	Sapodilla fruit fly	Polyphagous including sapodilla, *Citrus* spp., peach, apple, passionfruit, cherry, mango, avocado	Fruit	HIGH[97]	HIGH[98]	HIGH[99]	MEDIUM[100]	**MEDIUM**
Anastrepha suspensa	Caribbean fruit fly	Polyphagous; preferred hosts are peach, guava, *Eugenia uniflora* (Cayenne cherry), *Syzygium jambos* (roseapple), *Terminalia catappa* (tropical almond); other hosts include orange, pomelo, grapefruit, papaya, mango	Fruit	LOW	HIGH[101]	MEDIUM - HIGH[102]	MEDIUM[100]	**LOW**
Bactrocera carambolae	Carambola fruit fly	Highly polyphagous including grapefruit, orange, lemon, lime, mandarin, soursop, carambola, mango, guava, passionfruit, papaya, banana, avocado	Fruit	HIGH	HIGH	HIGH	HIGH	**HIGH**
Bactrocera caryeae		*Cucurbita* spp., pomelo, mandarin, mango, guava, sapote, golden apple	Fruit	LOW	HIGH	HIGH	HIGH	**MEDIUM**

[94] There is evidence that adults of *Anastrepha* spp. can fly for as far as 135km and therefore natural movement is an important means of spread
[95] *Anastrepha* spp. are the most serious fruit fly pests in the tropical Americas
[96] All *Citrus* spp. affected except lemon and Mexican/key lime; grapefruit is the preferred host, with oranges second
[97] Frequent interceptions in the US on various hosts from several countries
[98] Wide host range, female may oviposit up to 600 eggs, present in variety of climate zones
[99] Larger wingspan than *A.ludens* and potential to disperse over 100 km
[100] Citrus not the preferred host, however presence may seriously impact market access
[101] Female fecundity is high with several generations per year; lives in similar environmental conditions to those found in Australia; able to breed on a variety of cultivated and native hosts
[102] Adults are strong flyers but available information indicates that they have restricted movements, and no long distance dispersal has yet been recorded

Scientific name	Common name	Host(s)[74]	Affected plant part	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Bactrocera correcta	Guava fruit fly	Polyphagous including *Citrus* spp., guava, cherry, mango, sapodilla, cashew nut, jujube, *Syzygium* spp.	Fruit	HIGH	HIGH	HIGH	MEDIUM	**MEDIUM**
Bactrocera cucurbitae	Melon fruit fly	Polyphagous including *Citrus* spp., avocado, cherry, lychee, cucurbits, beans, papaya, tomato, guava, passionfruit	Fruit	HIGH	HIGH	HIGH	MEDIUM	**MEDIUM**
Bactrocera curvipennis		Polyphagous including *Citrus* spp., mango, papaya, grape, tomato, bell pepper, nectarine, peach, plum	Fruit	MEDIUM	UNKNOWN	UNKNOWN	UNKNOWN	**UNKNOWN**
Bactrocera diversa		*Citrus* spp., papaya, gourd, pumpkin, banana, guava, jamun	Fruit	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	**UNKNOWN**
Bactrocera dorsalis (*B. invadens, B. papayae, B. philippinensis*)[103]	Oriental fruit fly	Highly polyphagous including *Citrus* spp., lychee, avocado, banana, papaya, mango, pineapple, melon, apple, carambola	Fruit	HIGH	HIGH	HIGH	HIGH	**HIGH**
Bactrocera facialis	Tongan fruit fly/ tropical fruit fly	Polyphagous including *Citrus* spp., mango, papaya, avocado, passionfruit, peach, capsicum, tomato	Fruit	HIGH	HIGH	HIGH	UNKNOWN	**UNKNOWN**
Bactrocera kandiensis		Polyphagous including pomelo, calamandarin, mango, papaya, carambola, avocado, pomegranate, guava	Fruit	HIGH	HIGH	HIGH	HIGH	**HIGH**
Bactrocera kirki		Polyphagous including pomelo, mandarin, sweet orange, mango, papaya, pumpkin, avocado, passionfruit, bell pepper	Fruit	HIGH	HIGH	HIGH	UNKNOWN	**UNKNOWN**
Bactrocera latifrons	Malaysian fruit fly/ solanum fruit fly	Polyphagous including Solanaceae, cucurbits, *Citrus* spp.	Fruit	MEDIUM	HIGH	HIGH	MEDIUM[104]	**MEDIUM**

[103] *B. dorsalis, B. invadens*, *B. papayae* and *B. philippinensis* are considered to be a single species, *B. dorsalis* in a recent publication (Schutze et al., 2014)
[104] Rarely attacks citrus, however presence may seriously impact market access

Scientific name	Common name	Host(s)[74]	Affected plant part	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Bactrocera melanotus	Asian papaya fruit fly	Polyphagous including papaya, mango, guava	Fruit	HIGH	HIGH	HIGH	UNKNOWN	**UNKNOWN**
Bactrocera minax	Chinese citrus fruit fly	*Citrus* spp., kumquat, trifoliate orange	Fruit	UNKNOWN	UNKNOWN	UNKNOWN	HIGH[105]	**UNKNOWN**
Bactrocera occipitalis		*Citrus* spp., mango, carambola, mandarin, sapodilla, guava, red mombin	Fruit	HIGH	HIGH	HIGH	HIGH	**HIGH**
Bactrocera oleae	Olive fruit fly	Polyphagous including olive, *Citrus* spp., fig, apple, pear, apricot, cherry, peach, plum, crape myrtle, ornamental plum, crabapple	Fruit	MEDIUM	HIGH	HIGH	UNKNOWN	**UNKNOWN**
Bactrocera passiflorae	Fijian fruit fly	Polyphagous including mango, avocado, *Citrus* spp., cashew	Fruit	HIGH	HIGH	HIGH	UNKNOWN	**UNKNOWN**
Bactrocera psidii	South sea guava fruit fly	Mango, pomelo, cashew, custard apple, granadilla, guava, papaya, carambola, peach, plum, grape	Fruit	HIGH	HIGH	HIGH	UNKNOWN	**UNKNOWN**
Bactrocera trivialis	New Guinea fruit fly	Grapefruit, sweet orange, chilli, peach, guava, mango, tropical almond	Fruit	HIGH	HIGH	HIGH	HIGH	**HIGH**
Bactrocera tsuneonis	Japanese orange fly	Orange, mandarin, kumquat	Fruit	MEDIUM[106]	LOW[107]	LOW[108]	HIGH	**LOW**
Bactrocera xanthodes	Pacific fruit fly	Polyphagous including mango, papaya, passionfruit, pomelo, mandarin, bell pepper, tomato	Fruit	HIGH	HIGH	HIGH	UNKNOWN	**UNKNOWN**
Bactrocera zonata	Peach fruit fly/ guava fruit fly	Polyphagous including *Citrus* spp., papaya, mango, peach, guava, pomegranate, apple	Fruit	MEDIUM	HIGH	HIGH	MEDIUM	**MEDIUM**

[105] Reported to be one of the most destructive pests of citrus in China (Huasong et al., 1998)
[106] Could enter through importation of mandarins
[107] Only attacks thin skinned citrus
[108] Limited host range

Scientific name	Common name	Host(s)[74]	Affected plant part	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Ceratitis rosa	Natal fruit fly	Polyphagous including *Citrus* spp., coffee, apple, apricot, avocado, mango, blackberry, nectarine, peach, plum, papaya	Fruit	LOW	HIGH	MEDIUM	HIGH[109]	**MEDIUM**
Dacus ciliatus	Lesser melon fly/ lesser pumpkin fly	*Citrus* spp., watermelon, melon, pumpkin, cucumber, tomato, ornamental gourd	Fruit	LOW	MEDIUM	MEDIUM	UNKNOWN	**UNKNOWN**
HEMIPTERA (Stink bugs, aphids, mealybugs, scale, whiteflies and hoppers)								
Aleurocanthus woglumi	Citrus blackfly	Preference for *Citrus* spp., many alternative hosts[110]	Leaves, stems	MEDIUM[111]	MEDIUM	HIGH	HIGH[112]	**MEDIUM**
Aleurodicus dugesii	Giant whitefly	Polyphagous including *Citrus* spp., banana, avocado, passionfruit, willow, geranium, ivy, liquidambar, boxwood and many other ornamentals	Leaves	MEDIUM[113]	HIGH[114]	HIGH[115]	LOW[116]	**LOW**
Aleurothrixus floccosus	Woolly whitefly	Polyphagous including *Citrus* spp.[117]	Fruit, flowers, leaves, stems	LOW	HIGH[118]	LOW - MEDIUM[119]	MEDIUM[120]	**VERY LOW - LOW**

[109] High economic importance; more serious pest than *C. capitata* in many warmer areas and with wide host range

[110] Secondary hosts include *Ardisia swartzi,* cashew nut, *Annona,* carambola, *Buxus sempervirens*, coconut, *Cestrum*, papaya, coffee, quince, *Eugenia, Hibiscus* (rosemallows), lychee, *Laurus nobilis* (bay laurel), mango, sapodilla, mulberrytree, banana, *Murraya,* passionfruit, avocado, frangipani, poplars, common guava, pomegranate, pear, rose, *Vitis,* ginger

[111] Unlikely to be on harvested fruit; possible entry via Torres Strait

[112] Reduces fruit set (up to 80 % or more); in Mexico, threat to citrus and other crops such as mangoes, pears or coffee grown adjacent to heavily infested citrus; a constant menace to citrus and other crops in the USA and Venezuela; serious citrus pest in India; severe pest of coffee in the New World

[113] Recent rapid spread in North America, present in Indonesia, can be carried on a large range of nursery material

[114] Numerous alternative hosts - according to a report from the centre of invasive species research in California, the potential host list is around 200 plants in at least 35 families and it can reproduce rapidly; recent history of spread in North America; suitable environmental conditions in Australia

[115] Wide host range and potential to move via domestic movement of nursery material

[116] Citrus is not the preferred host, only leaves affected

[117] Recorded on more than 20 different plant genera of various families, however, in the Mediterranean region where the whitefly was introduced, it infests almost exclusively species of the genus *Citrus*. Secondary and wild hosts include *Anacardium,* arabica coffee, mango, common guava, aubergine, *Annona reticulata* (bullock's heart), *Baccharis genistelloides*, bougainvillea, *Coccoloba uvifera* (Jamaican kino), *Diospyros kaki* (oriental persimmon), *Eugenia uniflora* (Brazil cherry), *Guaiacum officinale*, frangipani, *Gloriosa superba*, *Licania tomentosa*, and *Triplaris surinamensis*.

[118] Wide geographic distribution

[119] Wide host range, slow spread

[120] Young plants particularly affected by heavy infestation

Scientific name	Common name	Host(s)[74]	Affected plant part	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Aleurotuberculatus acubae	Coral whitefly/ Japanese laurel whitefly	*Citrus* spp. (mandarin) and many ornamentals[121]	Leaves	LOW	HIGH	HIGH	MEDIUM[122]	**LOW**
Cacopsylla citrisuga[123]	Pomelo psyllid	*Citrus* spp. (including: pomelo, mandarin, citron, lemon, trifoliate orange)	Leaves	LOW	UNKNOWN	UNKNOWN	HIGH[123]	**UNKNOWN**
Ceroplastes brevicauda	Citrus wax scale	Polyphagous including orange, pomelo, acacia	Leaves, stems	LOW	HIGH[124]	MEDIUM[125]	LOW - MEDIUM	**VERY LOW - LOW**
Ceroplastes cirripediformis	Barnacle scale	Polyphagous including *Citrus* spp., ginger, guava[126]	Leaves, stems	LOW	MEDIUM	MEDIUM	MEDIUM[127]	**LOW**
Ceroplastes japonicus	Tortoise wax scale	Highly polyphagous; primary hosts include *Citrus* and other Rutaceous species	Leaves, stems, growing points, fruit	LOW	HIGH[128]	HIGH[128]	HIGH[129]	**MEDIUM**
Circulifer tenellus[130]	Beet leafhopper	Polyphagous including sugarbeet, horseradish, tomato. *Citrus* spp. are secondary hosts.	Leaves	LOW	HIGH[131]	HIGH	MEDIUM[132]	**LOW**
Coccus celatus	Coffee green scale/ wax scale	Coffee, *Citrus* spp., gardenia, casuarina, *Syzygium*	Leaves	UNKNOWN	UNKNOWN	UNKNOWN	LOW	**UNKNOWN**
Dialeurodes citri	Citrus whitefly	Polyphagous including *Citrus* spp., pear, persimmon, pomegranate, jasmine, gardenia, crape myrtle, coffee	Fruit, flowers, leaves, stems	LOW[133]	HIGH	HIGH	HIGH[134]	**MEDIUM**

[121] Numerous ornamental hosts including hawthorn, *Ficus*, mulberry, honeysuckle, hackberry, hawthorn, privet, ivy, mulberry, *Osmanthus*, elm, *Phellodendron, Pittosporoum, Prunus, Pyracantha, Xylosoma*
[122] Important pest in south China
[123] Transmits *Candidatus* Liberibacter asiaticus
[124] High reproductive rate and known to feed on significant genera of Australian native plants
[125] Dispersal may be subject to wind conditions; first instars (crawlers) dispersed by wind and active wandering; place of permanent settlement is the position of the first moult
[126] Other hosts include jasmine, Bay laurel, Brazilian pepper, loquat, *Gardenia, Ficus, Strelitzia, Monstera, Fuchsia, Pittosporum, Tabebuia, Nandina, Rhus, Shefflera, Melaleuca, Pinus, Ravenearivularis, Phoenix roebelenii*
[127] Soft scale is a pest of citrus and many ornamentals; heavy infestations create an unsightly appearance on plants in addition to the damage from removal of large quantities of plant sap
[128] Polyphagous with approximately 100 alternative hosts; high fecundity, tolerance to unfavourable conditions and crawlers disperse readily
[129] Major pest in some countries
[130] Transmits Citrus stubborn disease (*Spiroplasma citri*)
[131] Wide host range
[132] Citrus feeding is incidental and leafhopper cannot be reared solely on citrus; however transmits stubborn (*Spiroplasma citri*)
[133] Unlikely to be on harvested and treated fruit

Scientific name	Common name	Host(s)[74]	Affected plant part	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Dialeurodes citrifolii	Cloudy winged whitefly	*Citrus* spp., fig, *Gardenia*, *Nephthytis*	Fruit, flowers, leaves, stems	LOW[135]	MEDIUM[136]	MEDIUM[137]	MEDIUM[138]	**LOW**
Diaphorina citri[139]	Asiatic/Asian citrus psyllid	*Citrus* spp. including calamandarin, citron, grapefruit, kaffir lime, kumquat, lemon, mandarin, Mexican/key lime, orange, pomelo, rough lemon, tangelo, trifoliate orange, citrus relatives[140] and some Australian native citrus	Fruit, flowers, leaves, stems	HIGH[141]	HIGH[142]	HIGH	EXTREME[143]	**EXTREME[143]**
Diaphorina communis[144] Synonym: *D. mathuri*	Black psyllid	Curry leaf (*Bergera koenigii*), *Murraya paniculata,* occasionally *Citrus* spp.	Leaves	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	**UNKNOWN**
Dysmicoccus neobrevipes	Grey pineapple mealybug	Highly polyphagous including pineapple, *Citrus* spp., apple, banana, cotton, tomato, vegetables, maize, sugarcane, avocado, mango, ginger, clover	Foliage, stems, aerial roots, fruits	MEDIUM	HIGH[145]	HIGH[145]	MEDIUM[146]	**MEDIUM**

[134] One of the most important pests of citrus; heavy infestations may cause deterioration of trees and crop failure; chemical resistance

[135] Unlikely to be on harvested and treated fruit

[136] Lives in similar environmental conditions to those found in Australia

[137] Species is not an effective flyer and has limited ability to direct their flight. Short range dispersal occurs close to the ground, where direction and movement is determined by wind. No real evidence of long range migrations (greater than 100km), although most movement of this type is probably human-assisted. First instars (crawlers) are able to disperse within the host plant.

[138] Based on family characteristics, heavy infestations may cause rapid tree deterioration and crop failure

[139] Can transmit all three strains of huanglongbing (Asiatic, American and African strains)

[140] Including genera *Aegle, Aeglopsis, Afraegle*, *Atalantia, Balsamocitrus, Bergera, Citropsis, Clausena, Limonia, Murraya* (including *Murraya paniculata* var *ovatifoliolata* which grows naturally in northern parts of Qld, NT and WA); for complete host list see Huanglongbing contingency plan available from **www.planthealthaustralia.com.au/pidd**

[141] Low probability of eggs and nymphs on harvested fruit unless populations are high; more likely to enter on Rutaceae foliage as eggs or nymphs; present in Papua New Guinea, Indonesia and East Timor and may enter Australia via Torres Strait

[142] High reproductive rate and long-lived adults; live in similar environmental conditions to those found in Australia

[143] Extreme impact if vectoring asiatic strain of huanglongbing, High economic impact if vectoring American or African strains of huanglongbing

[144] Associated with huanglongbing (*Candidatus* Liberibacter asiaticus), vector testing underway (Donovan et al., 2012)

[145] Wide host range

[146] Pest in Thailand in absence of natural enemies

Scientific name	Common name	Host(s)[74]	Affected plant part	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Dysmicoccus nesophilus	Mealybug	Polyphagous including sweet orange, grapefruit, lemon, papaya, mango, avocado	Foliage, fruit, leaves	HIGH[147]	HIGH	HIGH	MEDIUM	**MEDIUM**
Empoasca citrusa Synonym: *E. distinguenda*	Green citrus leafhopper	Polyphagous, including lemon, pomelo, grapefruit, mandarin, sweet orange, *Esculentus belmoschus,* cotton, tomato, *Phaseolus* spp., castor bean, faba bean, potato, cowpea	Leaves, fruit	LOW	MEDIUM	HIGH[148]	MEDIUM[149]	**LOW**
Hishimonus phycitis[150]		*Citrus* spp., *Ziziphus* spp., pigeon pea, eggplant	Leaves	LOW	UNKNOWN	UNKNOWN	MEDIUM[150]	**UNKNOWN**
Homalodisca vitripennis[151] Synonym: *H. coagulata*	Glassy-winged sharpshooter	Highly polyphagous across >100 species including *Citrus* spp., *Prunus* spp., macadamia, pistachio, grapevine, blackberry, bottlebrush, bougainvillea, camellia, acacia, chrysanthemum and other ornamentals	Leaves, stems	MEDIUM[152]	HIGH[153]	HIGH[153]	HIGH[154]	**HIGH[154]**
Kilifia acuminata	Acuminate scale	Polyphagous including lemon, mango, guava, Brazilian pepper, *Gardenia* spp., Bay laurel, *Eugenia* spp., *Anthurium* spp.	Foliage, stems	MEDIUM	MEDIUM[155]	MEDIUM[155]	MEDIUM[156]	**LOW**
Leptoglossus phyllopus	Leaf footed bug	*Cirsium* spp., *Citrus* spp.	Fruit	LOW[157]	LOW	MEDIUM	MEDIUM[158]	**VERY LOW**

[147] Wide host range and could be imported on fruit and flowers from the south Pacific region
[148] Very active species; adults can fly; is easily moved on air currents when in flight and may travel several metres during one flight
[149] Occasional pest of citrus
[150] Likely vector of '*Candidatus* Phytoplasma aurantifolia' (Salehi et al., (2007)
[151] Vector (experimental) of *Xylella fastidiosa* (citrus variegated chlorosis strain)
[152] Eggs unlikely to be on fruit; immature and adult leafhoppers could possibly enter as contaminants in fruit, especially on leaf or stem material
[153] Numerous alternative hosts; recent history of spread in USA, especially on nursery stock
[154] High impact if transmits *Xylella fastidiosa* (citrus variegated chlorosis strain) to citrus
[155] Wide host range; moderate fecundity; abiotic factors important to prevalence
[156] Moderate economic impact; minor citrus pest in Florida
[157] Easily detected because of large size
[158] Populations seldom develop to sufficient numbers to be a problem, but when they do a major portion of the crop may be lost within a matter of weeks; adults puncture fruit rinds providing access for various fungal diseases and insects

Scientific name	Common name	Host(s)[74]	Affected plant part	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Maculicoccus malaitensis		*Citrus* spp., *Eucalyptus deglupta*, coconut, Tahitian chestnut, cocoa tree	Fruit	MEDIUM[159]	HIGH	HIGH	MEDIUM	**MEDIUM**
Neoaliturus haematoceps[160]		*Citrus* spp., apricot, sesame, periwinkle, *Matthiola incana,* various weeds[161]		UNKNOWN	UNKNOWN	UNKNOWN	MEDIUM[160]	**UNKNOWN**
Parabemisia myricae[162]	Japanese bayberry whitefly	Polyphagous including *Citrus* spp., avocado, peach, gardenia, *Morus alba, Rhododendron* spp., *Salix* spp.	Fruit, leaf, wood	LOW	HIGH	MEDIUM	HIGH[163]	**MEDIUM**
Paracoccus burnerae	Oleander mealybug	Polyphagous including orange, asparagus, potato, passionfruit, coffee, *Nerium oleander, Hibiscus fuscus*	Fruit, leaves, stems	MEDIUM[164]	HIGH	HIGH[165]	MEDIUM[166]	**MEDIUM**
Paracoccus marginatus	Papaya mealy bug	Polyphagous including *Citrus* spp., papaya, avocado, mango, cherry, pineapple, pomegranate, hibiscus, cotton, tomato, eggplant, capsicum, bean, pea, sweet potato	Leaves, stems, fruit	MEDIUM-HIGH	HIGH	HIGH	LOW	**LOW**
Parlatoria ziziphi	Black parlatoria scale/ citrus scale	Polyphagous including *Citrus* spp., privet, *Ziziphus*	Fruit, leaves, stems	MEDIUM	HIGH	HIGH	MEDIUM	**MEDIUM**
Phenacoccus madeirensis	Cassava mealybug	Polyphagous including *Citrus* spp., oat, cassava, potato, eggplant, pepper, cotton, rosemallow, lantana	Leaves, stems	LOW	HIGH[167]	MEDIUM	MEDIUM[168]	**LOW**

[159] Wide host range and could be imported on fruit other than citrus imported from South Pacific region
[160] Citrus feeding incidental, however transmits stubborn (*Spiroplasma citri*)
[161] *Matthiola sinuata*, *Malva sylvestris, Portulaca oleracea, Raphanus raphanistrum, Salsola kali*, *Sorghum halepense* and *Xanthium strumarium*
[162] Transmits citrus chlorotic dwarf disease
[163] Heavy infestations can cause tree defoliation; transmits citrus chlorotic dwarf
[164] Adults and crawlers likely to be on harvested fruit
[165] Crawlers dispersed on wind/ nursery material
[166] High economic impact; said to be among the three most important pest species on citrus in South Africa; however, sometimes confused with another serious pest, *Planococcus citri*
[167] Wide host and distribution range
[168] Moderate economic importance on citrus; insignificant damage where natural predators exist

Scientific name	Common name	Host(s)[74]	Affected plant part	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Planococcus lilacinus	Coffee mealybug	Polyphagous including soursop, *Citrus* spp., coffee, guava, cocoa	Leaves, stems, flowers, fruit	MEDIUM[169]	HIGH	HIGH[169]	LOW	**LOW**
Protopulvinaria pyriformis	Heart-shaped scale	*Citrus* spp., cinnamon, *Gardenia*, acerola, *Pachystachys lutea,* avocado, frangipani, common guava, rose apple, malay-apple, dallis grass, black plum	Leaves, stems	LOW	HIGH[170]	HIGH[170]	MEDIUM[171]	**LOW**
Pseudococcus comstocki	Comstock's mealybug	Polyphagous including lemon, banana, peach, pear, apricot, cherry, catalpa, fig, coffee, mulberry	Leaves, stems, fruit	MEDIUM[172]	HIGH[173]	HIGH[174]	LOW[175]	**LOW**
Pseudococcus cryptus Synonym: *Pseudococcus citriculus*	Citrus mealybug/ citriculus mealybug/ cryptic mealybug	Polyphagous including mango, *Citrus* spp., lychee, grapevine, *Amorphophallus* spp., coconut, coffee	Fruit, leaves, stems	HIGH	HIGH[176]	HIGH[176]	MEDIUM[177]	**MEDIUM**
Pseudococcus maritimus	Bakers mealybug/ grape mealybug	Known from over 80 hosts, including *Citrus* spp., apple, damson, peach, plum, pear, grapevine	Leaves, stems	HIGH[178]	HIGH[179]	HIGH[180]	MEDIUM[181]	**MEDIUM**

[169] Unlikely to be on harvested fruit; crawlers dispersed on wind or nursery material
[170] Wide host range; high fecundity and several overlapping generations per year in California; parthenogenic
[171] A serious pest in areas absent of natural enemies
[172] Adults and crawlers likely to be on harvested fruit
[173] Wide host range; crawlers dispersed on wind or nursery material; overwinters on host; species appears to prefer hot dry climatic conditions for optimum development
[174] All stages are mobile throughout their life span; crawlers dispersed on wind or nursery material
[175] Occasionally a serious pest in citrus orchards; injury occurs by the production of sap which leads to the development of sooty mould; parasitoid *Occophagus gurneyi*, attacks adults and nymphs and is present in Australia
[176] Wide distribution and host range
[177] Common and damaging pest of citrus in Israel; attacks all parts of plant, including roots; causes heavy fouling with honeydew
[178] Should be easily detected at inspection with special attention being paid to the calyx and navel regions of the fruit
[179] High reproductive rate, wide host range
[180] Eggs and early instars (crawlers) are wind-borne dispersed, but only on a localised (within orchard) level
[181] Packing house procedures of washing and waxing should give good control of this species

Scientific name	Common name	Host(s)[74]	Affected plant part	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Pulvinaria aurantii Synonym: *Chloropulvinaria aurantii*	Orange pulvinaria	*Citrus* spp.	Leaves, stems	LOW	HIGH	MEDIUM[182]	LOW[183]	**VERY LOW**
Pulvinaria citricola	Cotton citrus scale	*Citrus* spp.		LOW	MEDIUM	MEDIUM	MEDIUM	**LOW**
Rastrococcus invadens	Fruit tree mealybug	Polyphagous, including breadfruit, *Citrus* spp., *Ficus* spp., mango, banana, frangipani	Leaves, stems, flowers, fruit	MEDIUM	HIGH[184]	HIGH[184]	LOW	**LOW**
Rastrococcus iceryoides	Mango mealybug	Polyphagous including *Citrus* spp., coffee, cotton, mango, cocoa	Leaves, stems, flowers, fruit	MEDIUM	HIGH[185]	HIGH[185]	MEDIUM	**MEDIUM**
Rastrococcus spinosus	Mango mealybug	*Citrus* spp., mango, coffee, cocoa	Leaves, stems, flowers, fruit	MEDIUM	HIGH	HIGH	UNKNOWN	**UNKNOWN**
Rhynchocoris humeralis Synonym: *R. poseidon*	Citrus stink bug	*Citrus* spp.	Young shoots, fruits	LOW	MEDIUM - HIGH	MEDIUM	LOW[186]	**VERY LOW**
Saissetia somerini	Somerini scale	Polyphagous including *Citrus* spp.	Leaves	UNKNOWN	UNKNOWN	UNKNOWN	MEDIUM	**UNKNOWN**
Scaphytopius acutus delongi[187]		Polyphagous including *Citrus* spp., strawberry, common choke cherry tree, stone fruit, blueberry, clover	Leaves	UNKNOWN	UNKNOWN	UNKNOWN	HIGH[188]	**UNKNOWN**
Scaphytopius nitridus[187]		Polyphagous including *Citrus* spp., rice, barley, corn, sugarcane, wheat, sorghum, apple, pear, grapevine, carrot, potato, tomato, papaya, peach, strawberry, *Rubus* spp., ornamentals and weeds	Leaves	UNKNOWN	UNKNOWN	UNKNOWN	HIGH[188]	**UNKNOWN**

[182] Crawlers dispersed by wind and by active wandering
[183] Many natural enemies and, in general, is not an important pest. It may be abundant in certain groves or parts of a grove where it causes the growth of sooty mould and feeding damage.
[184] Wide host range; high fecundity and dispersal ability
[185] Moderate host range; high fecundity and high dispersal ability
[186] *R. humeralis* is one of the major causes of fruit drop in mandarins in the western development region of Nepal
[187] Transmits stubborn (*Spiroplasma citri*)
[188] Citrus feeding incidental, however transmits stubborn (*Spiroplasma citri*)

Scientific name	Common name	Host(s)[74]	Affected plant part	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Selenaspidus articulatus	West Indian red scale	Highly polyphagous. Primary hosts include *Citrus* spp., mango, jasmine, olive, avocado, roses	Most growing parts, leaves, fruit	LOW[189]	HIGH[190]	HIGH[190]	HIGH[191]	**MEDIUM**
Trioza erytreae[192]	African citrus psyllid	*Citrus* spp. including Australian finger lime, citron, orange, grapefruit, tangelo, kumquat, lemon, mandarin, Mexican/key lime, pomelo, trifoliate orange; and citrus relatives *Calodendrum capense, Clausena anisata, Murraya exotica, Toddalia asiatica, Triphasia trifolia, Vepris lanceolata, Zanthoxylum capense*	Leaves[193]	MEDIUM	HIGH	HIGH	EXTREME[194]	**EXTREME[194]**
Unaspis yanonensis	Arrowhead scale	Specialist on *Citrus* spp.	Leaves, stems, fruit	LOW	HIGH	MEDIUM[195]	MEDIUM[196]	**LOW**
HYMENOPTERA (Ants and wasps)								
***Atta saltensis, Atta* sp.**	Leaf cutting ant	Almost all types of vegetation	Leaves	LOW	LOW[197]	HIGH[198]	LOW[199]	**NEGLIGIBLE**
Bruchophagus muli	Gall wasp	Lime		HIGH[200]	HIGH	HIGH	MEDIUM[201]	**MEDIUM**

[189] Aggregates on fruit and leaves; minute size of insect reduces likelihood of detection
[190] High fecundity/generation turnover; wide host range
[191] Economically important and chemical resistance
[192] Transmits African and Asiatic strains of huanglongbing
[193] Disfigures leaves of citrus nursery stock making them unsaleable
[194] Extreme impact if vectoring Asiatic strain of huanglongbing, High economic impact if vectoring African strain of huanglongbing
[195] Abiotic factors important to prevalence; species overwinters on host; high reproductive ability, low juvenile mortality
[196] Economic importance variable but can cause loss of fruit and plant dieback
[197] Only small numbers of winged females would survive to produce a colony
[198] If the colony establishes it is likely to multiply quickly, reach high population densities and produce large numbers of winged males and queens
[199] Larger ants would be easily detected; smaller ants that may escape detection will not survive away from the fungus garden and cannot establish
[200] Likely entry via Torres Strait
[201] Host range restricted to limes, however difficult to control

Scientific name	Common name	Host(s)[74]	Affected plant part	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Solenopsis xyloni	Southern fire ant	Polyphagous including *Citrus* spp.	Seedlings, stems	HIGH[202]	HIGH[203]	HIGH[204]	LOW	**LOW**
LEPIDOPTERA (Butterflies and moths)								
Amyelois transitella	Navel orange worm	*Citrus* spp., Carpathian walnut, pistachio, almond, grapevine	Fruit, leaves	MEDIUM[205]	HIGH	HIGH[206]	MEDIUM[207]	**MEDIUM**
Argyrotaenia citrana	Orange tortrix	Polyphagous across over 80 species including lemon, grapefruit, rough lemon, sweet orange, blackberry, raspberry, blueberry, grapevine, apple, avocado, stone fruit[208]	Leaves, stems, growing points, flowers, fruit	MEDIUM[209]	HIGH[210]	MEDIUM[211]	MEDIUM[212]	**LOW**
Citripestis sagittiferella	Citrus fruit borer	Specialist on Rutaceae, particularly *Citrus* spp.	Fruit	HIGH[213]	MEDIUM - HIGH	HIGH[214]	HIGH[215]	**HIGH**
Cryptoblabes gnidiella	Rind boring orange moth	Highly polyphagous including *Citrus* spp., avocado, macadamia, grapevine, sorghum, rice	Flower, fruit, seed, leaf	HIGH[216]	MEDIUM - HIGH[217]	HIGH	HIGH	**HIGH**

[202] Red imported fire ant (closely related and with similar geographic distribution) was introduced into Queensland in 2001
[203] High reproductive rate only when mated queen(s) are present or a nest contains both males and females; species has potential to establish in irrigated or other areas where the average minimum temperatures are above -12°C (10°F) and rainfall is greater than 254mm (10 inches) per year
[204] Winged adults are able to disperse long distances with wind assistance
[205] Has been intercepted on citrus imports from California
[206] Strong dispersal capability; small insects with high reproductive output
[207] Reduces fruit quality; a number of natural enemies have been identified including parasitoids and pathogens
[208] Hosts also include green house and native Australian species, especially fern generas
[209] Infested fruit would be easily detected at inspection as eggs are laid in batches and the larvae construct feeding shelters from silk and rolled leaves and are mostly surface feeders
[210] High reproductive rate; development of generations is continuous as long as favourable temperature conditions prevail
[211] Adults are capable of extended flights
[212] Fruit would be discarded due to quality issues as burrowing larvae make holes in fruit and often cause fungal infections
[213] Illegal transport most likely pathway; natural dispersal possible through Torres Strait
[214] Adults are strong fliers
[215] Larvae attack fruit causing fruit drop
[216] Many possible entry pathways
[217] Polyphagous; wide distribution; high fecundity

Scientific name	Common name	Host(s)[74]	Affected plant part	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Cryptophlebia leucotreta	False codling moth	Highly polyphagous including *Citrus* spp., pineapple, capsicum, cotton, lychee, mango, avocado, peach, maize	Leaves, fruit, seed	HIGH	HIGH[218]	MEDIUM[219]	HIGH[220]	**HIGH**
Parasa lepida	Blue-striped nettle grub	*Citrus* spp., mango, banana, capsicum, coconut, rubber, cassava, tea, gardenia, *Eugenia, Cassia, Gliricidia*	Leaves, fruit	MEDIUM	HIGH	HIGH	UNKNOWN	**UNKNOWN**
Platynota stultana	Omnivorous leaf roller	*Citrus* spp., bell pepper, cotton, lucerne, pomegranate, pear, grapevine, peach, maize	Leaves, flowers, fruit	HIGH	HIGH	HIGH	UNKNOWN	**UNKNOWN**
Prays citri	Citrus flower moth	*Citrus* spp.	Leaves, flowers, fruit	HIGH	MEDIUM	MEDIUM	HIGH[221]	**MEDIUM**
Prays endocarpa	Citrus rind borer	*Citrus* spp.	Fruit	HIGH	MEDIUM	MEDIUM	MEDIUM	**LOW**
Setora nitens[222]	Coconut nettle caterpillar/ nettle grub	*Citrus* spp., coconut, coffee, tea, *Cinchona* spp., African oil palm, sago palm, cocoa	Leaves	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	**UNKNOWN**
Zeuzera coffeae	Coffee carpenter/ red borer	Polyphagous including *Citrus* spp., lychee, longan, grapevine, walnut, tea, coffee, cotton, apple, cassava, avocado	Stems, branches	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	**UNKNOWN**
THYSANOPTERA (Thrips)								
Caliothrips fasciatus	Bean thrips	Polyphagous; breeds on >28 crop species including *Citrus* spp., cotton, grapevine and 48 wild/ornamental plants	Leaves, flowers, fruit	HIGH[223]	HIGH[224]	HIGH[225]	HIGH[226]	**HIGH**

[218] Polyphagous; high fecundity; five or six generations per year
[219] High fecundity with five or six generations per year; however unlikely to be capable of long distance dispersal; restricted to tropical and subtropical environments
[220] Serious South African pest
[221] Significant losses have been experienced on lemon crops
[222] The name *Setora nitens* as used in the literature embraces a complex of half a dozen or more species
[223] A significant quarantine risk as detected many times on citrus from California
[224] Species overwinters on host; polyphagous with high fecundity, dependent on temperature climatic factors (dry weather, but not extreme drought, appears to favour increase in pest)
[225] Polyphagous with high fecundity; can fly about 1m without being blown; further distances are dependent on wind conditions
[226] Cosmetic damage to fruit; contaminates the navel of navel oranges impacting on market access; serious pest in California prior to better crop management practices

Scientific name	Common name	Host(s)[74]	Affected plant part	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Frankliniella bispinosa	Florida flower thrips	Polyphagous including *Citrus* spp., capsicum, strawberry, tobacco, avocado, wild radish, roses, wheat, rye	Leaves, flowers	HIGH	HIGH[227]	HIGH	HIGH[228]	**HIGH**
Frankliniella insularis	Blossom thrips	Polyphagous, *Citrus* spp. are primary hosts	Leaves, flowers	HIGH	HIGH[227]	HIGH	UNKNOWN	**UNKNOWN**
***Scirtothrips aurantii* (exotic biotypes)**	South African citrus thrips	Polyphagous across more than 50 plant species including lemon, navel orange, mango, asparagus, grevillea, acacia, tea, cotton, macadamia, banana, castor bean, grapevine, pomegranate, silky oak, groundnut, glory lily	Fruit, leaves, growing points	HIGH	HIGH[229]	MEDIUM	HIGH[230]	**MEDIUM**
Scirtothrips citri	California citrus thrips	Lime, mandarin, cotton, date, mango, pistachio, pecan, lucerne, privet, blueberry, grapevine, magnolia, rose	Leaves, fruits	HIGH[231]	HIGH	MEDIUM	HIGH[232]	**HIGH**

[227] Wide host range and distribution
[228] Damages young fruit causing premature drop and cosmetic scarring and can also exacerbate reduced fruit set caused by post bloom fruit drop (Childers, 1999)
[229] Numerous alternative hosts
[230] Has been known to have a significant economic impact; largely cosmetic damage but rendering fruit unsuitable for market (especially export)
[231] Small, difficult to spot, eggs laid inside leaves, fruit and twigs
[232] Largely cosmetic damage but renders fruit unsuitable for market (especially export) due to halo scars on fruit

Pathogens and nematodes

Table 22. *Citrus pathogen and nematode threat summary table*

Scientific name	Common name	Host(s)[233]	Affected plant part	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
BACTERIA (including phytoplasmas)								
Burkholderia andropogonis	Brown leaf spot			LOW	LOW	LOW	LOW	**NEGLIGIBLE**
'*Candidatus* Liberibacter africanus'[234]	Huanglongbing/ citrus greening (African strain)	*Citrus* spp.[235] (sweet orange, sour orange, grapefruit, tangelo, mandarin, trifoliate orange, lemon, lime, kumquat, Australian native citrus), *Clausena* and *Vepris lanceolata*[236]	Leaves, stems, flowers, fruit, roots, whole plant	HIGH[237]	HIGH[238]	HIGH[239]	HIGH	**HIGH**
***'Candidatus* Liberibacter americanus'**[240]	Huanglongbing/ citrus greening (American strain)	*Citrus* spp.[235] (sweet orange, sour orange, grapefruit, tangelo, mandarin, trifoliate orange, lemon, lime, kumquat), orange jasmine (*Murraya exotica*)	Leaves, stems, flowers, fruit, roots, whole plant	HIGH	HIGH	HIGH[241]	HIGH	**HIGH**

[233] Refer to Appendix 2 for nomenclature for citrus species and hybrids

[234] Transmitted by African citrus psyllid (*Trioza erytreae*), Asiatic/Asian citrus psyllid (*Diaphorina citri*); note that subspecies, '*Ca*. L. africanus subsp. capensis', has been found only in South Africa infecting an indigenous Rutaceous species, *Calodendrum capense* (Cape chestnut) but not citrus (Pietersen et al. 2010)

[235] Huanglongbing can affect almost all citrus cultivars; limes and lemons are much less sensitive than orange, tangelo, tangor and mandarin, while trifoliate orange is tolerant but not immune (Aubert 1990); field symptomology depends on a number of factors including whether a tree flushed during a period of psyllid activity (de Lange et al. 1985, Koizumi et al. 1994), the presence and severity of *Citrus tristeza virus* strains that may be present, the form of '*Ca*. Liberibacter' and the strain (of '*Ca.* L. asiaticus; Tsai et al. 2008); refer to huanglongbing contingency plan available from **www.planthealthaustralia.com.au/pidd** for further information on hosts

[236] Korsten et al. (1996)

[237] Australia imports budwood from affected countries; pathogen survives pre-shipment treatment, transport and quarantine import treatment and is difficult to detect at entry points

[238] Climate suitable for establishment; establishment overseas is difficult to reliably identify in the field; vector injury characteristic; eradication is not impossible if the disease or vector is found early; management once established would be difficult

[239] High spread potential if vectors African citrus psyllid (*Trioza erytreae*) or Asiatic/Asian citrus psyllid (*Diaphorina citri*) present; pathogen has a history of spread into new areas and climate is suitable for spread

[240] Transmitted by Asiatic/Asian citrus psyllid (*Diaphorina citri*)

[241] High spread potential if vector Asiatic/Asian citrus psyllid (*Diaphorina citri*) present

Scientific name	Common name	Host(s)[233]	Affected plant part	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
***'Candidatus* Liberibacter asiaticus'**[242]	Huanglongbing/ citrus greening (Asiatic strain)	*Citrus* spp.[243] (mandarin, sweet orange, sour orange, grapefruit, tangelo, trifoliate orange, lime, lemon, kumquat, Australian native citrus), *Atalantia* spp., *Murraya exotica*, *Clausena* and other rutaceous plants including ornamentals	Leaves, stems, flowers, fruit, roots, whole plant	HIGH[244]	HIGH[245]	HIGH[246]	EXTREME[247]	**EXTREME**
***'Candidatus* Phytoplasma aurantifolia'**[248]	Witches' broom disease of lime	Limes and citron in the field and experimentally to other citrus but not sweet orange, mandarin or grapefruit	Whole plant	LOW[249]	MEDIUM	MEDIUM[250]	MEDIUM	**LOW**
***'Candidatus* Phytoplasma asteris'**[251] Synonym: *Candidatus* Phytoplasma asteri		Citrus spp. including sweet orange, mandarin, pomelo, grapefruit		UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	**UNKNOWN**
***'Candidatus* Phytoplasma phoenicium'**[252]	Almond witches' broom	Almond, peach, nectarine, *Citrus* spp.		UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	**UNKNOWN**

[242] Transmitted by African citrus psyllid (*Trioza erytreae*), Asiatic/Asian citrus psyllid (*Diaphorina citri*) and *Cacopsylla citrisuga*

[243] Huanglongbing can affect almost all citrus cultivars; limes and lemons are much less sensitive than orange, tangelo, tangor and mandarin, while trifoliate orange is tolerant but not immune (Aubert 1990); field symptomology depends on a number of factors including whether a tree flushed during a period of psyllid activity (de Lange et al. 1985, Koizumi et al. 1994), the presence and severity of *Citrus tristeza virus* strains that may be present, the form of '*Ca.* Liberibacter' and the strain (of '*Ca.* L. asiaticus; Tsai et al. 2008); refer to and huanglongbing contingency plan available from **www.planthealthaustralia.com.au/pidd** for further information on hosts

[244] High chance of survival in budwood; difficult to detect at entry points; Asiatic strain is the most widespread of the *Candidatus* Liberibacter species; its presence in locations of close proximity to Australia (Indonesia, East Timor and Papua New Guinea) increases the probability of entry of this strain

[245] Climate suitable for establishment; history of establishment overseas; difficult to recognise in the field; eradication is not impossible if the disease or vector is found early; management once established would be difficult and costly

[246] High spread potential if vectors African citrus psyllid (*Trioza erytreae*) or Asiatic/Asian citrus psyllid (*Diaphorina citri*) present; pathogen has a history of spread into new areas and climate is suitable for spread

[247] Extremely difficult to control; no evidence of successful eradication

[248] Suspected to be vectored by leafhopper (*Hishimonus phycitis*)

[249] Australia does not import budwood from affected countries; travel frequency between Australia and affected countries is low; no previous quarantine interceptions recorded in intercepts database; pathogen not found in a country close to Australia, however high chance of survival during pre-shipment, transport and quarantine import treatment (budwood); difficult to detect at entry points; may also be seed transmitted

[250] Australian climate is suitable for spread; pathogen has a history of spread into new areas; graft and possibly vector transmitted, however suspected leafhopper vector (*Hishimonus phycitis*) not present in Australia

[251] Strains of *Candidatus* Phytoplasma asteris (Onion yellows, Aster yellows and Valeriana yellows) are possibly associated with huanglongbing in China (Chen et al., 2009) and Mexico (Arratia-Castro et al 2014)

[252] Associated with huanglongbing symptoms in Brazil

Scientific name	Common name	Host(s)[233]	Affected plant part	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Spiroplasma citri[253]	Citrus stubborn disease	Wide host range including grapefruit, lemon, orange, mandarin, tangelo (most susceptible); serious disease of weeds and several alternative hosts[254]	Whole plant	MEDIUM[255]	HIGH[256]	HIGH[257]	HIGH[258]	**HIGH**
Xanthomonas alfalfae* subsp. *citrumelonis Synonym: *X. axonopodis* pv. *citrumelo*	Bacterial spot	Most *Citrus* spp., nursery stock of *Swingle citrumelo*, trifoliate orange, grapefruit scions most susceptible	Whole plant (under nursery conditions)	MEDIUM[259]	MEDIUM[260]	HIGH[261]	MEDIUM[262]	**LOW[262]**

[253] Transmitted by *Circulifer tenellus, Scaphytopius nitridus* and *S. acutus delongi* in California (these vectors shown to transmit from citrus to citrus as well as from herbaceous hosts to citrus); *Neoaliturus haematoceps* and *C. tenellus* in the Mediterranean area; none of these vectors are present in Australia

[254] Alternative and secondary hosts include calamondin, rough lemon, *Limonia acidissima* (elephant apple), sweet lime, *Citroncirus webberi, Armoracia rusticana,* pomelo, *Amaranthaceae, Chenopodiaceae, Brassicaceae, Raphanus raphanistrum, Sorghum halepense, Plantaginaceae, Capsella bursa-pastoris, Cynodon dactylon, Digitalis purpurea, Plantago ovata*

[255] The most likely entry pathways are via illegally imported budwood or imports of alternative hosts; Australia imports commodities from affected countries (fruit, budwood); travel frequency between Australia and affected countries is moderate; pathogen exists in an area from which illegal/traditional trade with Australia is known to occur (e.g. the Mediterranean); high chance of survival during pre-shipment treatment, transport and quarantine import treatment; difficult to detect at entry points

[256] Climate suitable for establishment; medium detectability in the field and would be a problem in the drier inland citrus growing regions of Australia

[257] Spread potential high if vectors (*Circulifer tenellus, Scaphytopius nitridus* and *S. acutus delongi, Neoaliturus haematoceps*) enter Australia, however, other phloem feeders may transmit; can also be graft-transmitted

[258] Difficult to control; no effective or economically plausible control procedures available; control procedures unlikely to be compatible with current IPM strategies; no evidence of successful eradication

[259] Australia imports commodity from affected country (however only occurs in Florida); travel frequency between Australia and affected countries is moderate; high chance of survival during pre-shipment treatment, transport and quarantine import treatment; difficult to detect at entry points

[260] Low in orchards, high in nurseries

[261] Australian climate is suitable for spread (in humid regions and in nurseries); pathogen has a history of spread into new areas

[262] High only in nurseries as disease only affects citrus in nurseries, not mature plants in orchards (except Flying Dragon fruit); difficult to control with no evidence of successful eradication

Scientific name	Common name	Host(s)[233]	Affected plant part	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Xanthomonas citri* subsp. *citri[263] (syn. *X. axonopodis* pv. *citri*, *X. campestris* pv. *citri*)	Citrus canker	All *Citrus* spp. (e.g. grapefruit, lime, orange, trifoliate orange, lemon, pomelo, mandarin) and citrus relatives[264]	Whole plant	HIGH[265]	HIGH[266]	HIGH[267]	HIGH[268]	**HIGH**
Xylella fastidiosa* subsp. *pauca [269]	Citrus variegated chlorosis (CVC)/ pecosita (in Argentina)	CVC affects sweet orange, lemon, lime, mandarin, kumquat, grapefruit, trifoliate orange	Whole plant	HIGH[270]	HIGH[271]	HIGH[272]	HIGH[273]	**HIGH**
	Citrus rubbery wood phytoplasma	Sweet orange, lemon, lime, mandarin	Braches, leaves, flowers, fruit	LOW[274]	HIGH	HIGH[275]	UNKNOWN	**UNKNOWN**

[263] There are at least three strains of citrus canker, with the asiatic (A) strain being the most damaging; in addition there are variants of the A strain which differ in host range and distribution

[264] All *Citrus* spp. are natural hosts of the asiatic strain, with grapefruit, Mexican lime, kaffir lime, sweet orange and trifoliate rootstock highly susceptible; sour orange, lemon and pomelo moderately susceptible; mandarin and Tahitian lime rated susceptible. Alternative hosts include *Atalantia citrioides*, *A. disticha, Balsamocitrus dawei, Citropsis schweinfurthii* (African cherry orange), *Citrus australasica* (Australian finger lime), *C. australis* (Australian round lime), *C. garrawayae, C. glauca* (Australian desert lime), *C. japonica* (oval, round, Meiwa and Hong Kong kumquats*), C. macroptera*, *Clausena lansium*, *Chaetospermum (Limonia) glutinosum, Evodia ridleyei, E. latifolia*, *Feroniella lucida*, *Hesperethusa crenulata, Limonia acidissima* (elephant apple), *Melicope triphylla, Murraya exotica* (orange jasmine), *Paramignya longipedunculata, P. monophylla*, *Toddalia asiatica.* The host range of the other two strains of citrus canker is restricted mainly to Mexican lime (EPP Response Plan for Citrus canker, 2006).

[265] Has entered Australia previously (2004); Australia imports commodity from affected countries (budwood, fruit, leaf); travel frequency between Australia and affected countries is high; pathogen exists in an area from which illegal/traditional trade with Australia is known to occur (e.g., Thailand, and/or Vietnam); can survive pre-shipment treatment, transport and import treatment with medium detectability at entry points; debate on risk of entry of asymptomatic fruit from canker countries

[266] Climate suitable for establishment in all citrus growing regions of Australia; history of establishment in Australia and/or overseas

[267] Pathogen has a history of spread into new areas; spread occurs via infected propagating material such as budwood, rootstock seedlings or budded trees from nurseries and mechanical transfer e.g. tools and machinery; can also be spread by wind-blown rain and rain splash (tree to tree)

[268] Medium to difficult to control; has been successfully eradicated from Emerald, Qld (2009)

[269] Experimentally vectored by Glassy-winged sharpshooter, *Homalodisca vitripennis* and other sharpshooter leafhoppers (*Cicadellidae*) including *Acrogonia terminalis, Dilobopterus costalimai*, *Oncometopia nigricans* and *Oncometopia facialis*

[270] Previous quarantine interceptions recorded in intercepts database; evidence of interceptions/incursions overseas; difficult to detect at entry points; seed transmission at a high level has been demonstrated; a widely used rootstock in Brazil (Rangur lime) is symptomless for CVC, is a sought after rootstock for use in the Open Hydroponic System and is not readily available in Australia

[271] Establishment potential high if native vectors are present; climate suitable for establishment; history of establishment overseas; likely to be difficult to detect in the field

[272] Australian climate is suitable for spread; pathogen has a history of spread into new areas; vector transmitted (Glassy-winged sharpshooter, *Homalodisca vitripennis*), and vector has not been reported in Australia; other potential vectors such as the citrus jassid from the sub-family Cicadellidae occur in Australia and feed on citrus

[273] Difficult to control; no effective or economically plausible control procedures available; no evidence of successful eradication

[274] Occurs in India

[275] Graft-transmitted, natural vector suspected

Scientific name	Common name	Host(s)[233]	Affected plant part	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
FUNGI								
Alternaria limicola	Mancha foliar/ citrus leaf spot	Primarily affects Mexican/key lime	Leaves, stems	LOW[276]	HIGH[277]	HIGH[277]	MEDIUM[278]	**LOW**
Ceratocystis radicicola		Date palm, pine, lemon, mandarin, grapefruit, sweet orange, sour orange, lime	Fruit[279]	LOW	HIGH	LOW[280]	MEDIUM	**VERY LOW**
Pseudocercospora angolensis *Synonyms: Cercospora angolensis, Phaeoramularia angolensis*	Leaf spot of citrus/ cercospora spot	All *Citrus* spp. susceptible including lime, sour orange, mandarin, rough lemon, Tahitian lime, lemon, pomelo, citron, mandarin, sweet orange, satsuma, grapefruit, kumquat	Leaves, stems, fruit	LOW[281]	MEDIUM[282]	HIGH[283]	MEDIUM[284]	**LOW**
***Colletotrichum acutatum* (KLA strain)**	Lime anthracnose	Mexican/key lime	Leaves, flowers, branches, fruit	LOW[285]	MEDIUM[286]	LOW	MEDIUM[287]	**VERY LOW**
***Colletotrichum acutatum* (SGO strain)**	Post bloom fruit drop	All *Citrus* spp.	Flowers, fruit	MEDIUM[288]	HIGH[289]	HIGH[289]	HIGH[290]	**HIGH**

[276] Australia does not import commodity from affected countries; travel frequency between Australia and affected countries is low; pathogen not found in a country close to Australia; no previous quarantine interceptions recorded in intercepts database; high chance of survival in fruit during pre-shipment treatment, transport and quarantine import treatment; difficult to detect at entry points

[277] Climate in coastal areas and the Central Burnett suitable for establishment and spread and not likely to be easily detected in the field

[278] Difficult to control; no effective or economically plausible control procedures available; control procedures likely to be incompatible with current IPM strategies; no evidence of successful eradication

[279] Causes fruit rot following wounding (Mirzaee et al., 2009)

[280] Spread potential will be higher if date is located near citrus

[281] Australia does not import commodity from affected countries; travel frequency between Australia and affected countries is low; no previous quarantine interceptions recorded in intercepts database; pathogen not found in a country close to Australia; low chance of survival during pre-shipment treatment, transport and quarantine import treatment

[282] Establishment potential higher in warm humid areas; appears to be restricted to the humid tropics in Africa, between altitudes of 80 and 1500m; disease is favoured by prolonged wet weather conditions followed by dry spells coupled with moderately cool temperatures of 22-26°C; disease incidence varies with the amount of rainfall

[283] High spread potential in humid areas; pathogen has a history of spread into new areas overseas

[284] Economically plausible control procedures available, however control procedures likely to be incompatible with current IPM strategies and little evidence of successful eradication overseas

[285] Australia does not import commodity from affected countries; travel frequency between Australia and affected countries is low; no previous interceptions recorded in intercepts database; pathogen not found close to Australia; medium chance of survival during pre-shipment treatment, transport and import treatment; low detectability at entry points

[286] Most Mexican limes are grown in the Northern Territory and humid climates are suitable for establishment; other factors limit establishment (low host availability) and it is likely to be easily detected in the field

[287] Difficult to control; no effective or economically plausible control procedures available; control procedures likely to be incompatible with current IPM strategies

[288] Australia imports budwood from affected countries; travel frequency between Australia and affected countries is moderate; no previous quarantine interceptions recorded in intercepts database however evidence of interceptions/incursions overseas; pathogen not found close to Australia; medium survival during pre-shipment treatment, transport and import treatment of fruit; difficult to detect at entry points; fruits with quiescent infection not eliminated by packing house treatments eg SOPP or chlorine

[289] High chance of establishment and spread in humid areas

[290] High impact in humid areas only; may cause 100 % fruit drop under certain climatic conditions; could be a problem if introduced to tropical areas; medium to difficult to control; effective and economically plausible control possible if predictive models are used to determine need and timing of fungicides

Scientific name	Common name	Host(s)[233]	Affected plant part	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Elsinoë australis **(pathotypes affecting citrus)**	Sweet orange scab	Mandarin, sweet orange, lime, lemon, satsuma, kumquat, grapefruit	Fruit, flowers and also leaves, stems (rarely)	LOW[291]	MEDIUM[292]	MEDIUM[292]	MEDIUM[293]	**LOW**
Elsinoë fawcettii **(exotic strains)**[294]	Citrus scab	Sour orange, sweet orange, trifoliate orange, rough lemon, lemon, grapefruit, tangelo, *Clausena, Toddalia*	Leaves, stems, fruits, flowers	MEDIUM[295]	MEDIUM [296]	MEDIUM[296]	MEDIUM[297]	**LOW**
Meliola citricola, M. butleri	Black mildew/ black mould	Sweet orange, sour orange, pomelo, citron, tangor, grapefruit, mandarin, Mexican lime, mandarin, calamondin, *Murraya, Glycosmis, Atalantia*	Leaves, fruit	MEDIUM	HIGH	HIGH	VERY LOW[298]	**VERY LOW**
Mycosphaerella horii	Greasy spot	*Citrus* spp.	Leaves, fruit	LOW[299]	LOW	LOW	LOW[300]	**NEGLIGIBLE**
Oidium tingitaninum, O. citri	Powdery mildew	*Citrus* spp. (mandarin and sweet orange most susceptible), golden apple, *Pleiospermium alatum, Atalantia buxifolia, Murraya* (excluding Bergera)	Whole plant	MEDIUM[301]	HIGH[302]	HIGH[302]	HIGH[303]	**HIGH**

[291] Australia has imported propagation material from Brazil where this pathogen occurs

[292] In humid areas only; coastal areas and the Central Burnett are most suitable for establishment and spread as disease development is favoured by moist conditions

[293] In humid areas only

[294] There are various exotic strains with a wider host-range than those already present in Australia

[295] Australia imports commodity from affected countries (budwood); travel frequency between Australia and affected countries is high; pathogen exists in an area from which illegal/traditional trade with Australia is known to occur (e.g., Thailand, and/or Vietnam); previous interceptions recorded in intercepts database (e.g. in air baggage and air cargo); pathogen found in PNG; medium chance of survival during pre-shipment treatment, transport and import treatment; easy to detect at entry points; unlikely to be introduced by fruit which have gone through a packing shed with post-harvest treatments eg SOPP

[296] Coastal climate suitable for establishment and spread; a narrow host range pathotype occurs in Australia; easily detected in the field

[297] The Florida Broad Host Range pathotype has a wider host range than pathotypes currently in Australia and therefore could cause greater losses

[298] Wind dispersed during wet weather, mostly saprophytic not severe pathogen

[299] Australia imports commodity from affected country (budwood); travel frequency between Australia and affected countries is moderate; no previous quarantine interceptions recorded in intercepts database; pathogen not found in a country close to Australia; low chance of survival during pre-shipment treatment, transport and quarantine import treatment; medium detectability at entry points

[300] Easy to control; effective and economically plausible control procedures available; control procedures likely to be compatible with current IPM strategies

[301] Australia imports budwood from affected countries; travel frequency between Australia and affected countries is high; pathogen exists in an area from which illegal/traditional trade with Australia is known to occur (e.g. Thailand, and/or Vietnam); no previous quarantine interceptions recorded in intercepts database; pathogen found in close proximity to Australia (Indonesia); medium chance of survival during pre-shipment treatment, transport and quarantine import treatment; difficult to detect at entry points; pathway of entry could be cyclones and clothing of people who have been in contact with infected trees in Asia

[302] High establishment and spread in humid regions only; history of establishment and spread overseas; spread is via wind-borne spores

[303] No effective or economically plausible control procedures available; control procedures unlikely to be compatible with current IPM strategies; likely to be a problem in very humid areas of the NT, Kununurra and Nth Queensland; where conditions are suitable pathogen causes severe dieback and fruit drop

Scientific name	Common name	Host(s)[233]	Affected plant part	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Phoma tracheiphila	Mal secco	*Citrus* spp., including bergamot, lime, sour orange, lemon and citron. More severe on lemon and citron.	Leaves and stems	MEDIUM[304]	MEDIUM[305]	MEDIUM[306]	HIGH[307]	**MEDIUM**
Phyllosticta citriasiana		Pomelo[308]	Leaves, fruit	MEDIUM[309]	LOW	LOW	LOW	**NEGLIGIBLE**
Phyllosticta citrichinaensis		Mandarin, pomelo, orange, lemon[308]	Leaves, fruit	MEDIUM[309]	LOW	LOW	LOW	**NEGLIGIBLE**
Phymatotrichopsis omnivora Synonym: *Phymatotrichum omnivorum*	Phymatotrichum root rot/ Texas root rot	Broad host range[310]	Leaves, stems, and roots	LOW	MEDIUM[311]	MEDIUM[311]	LOW	**VERY LOW**
NEMATODES								
Radopholus citrophilus	Citrus spreading decline nematode/ burrowing nematode	Important pest of banana and citrus. Over 200 plants act as secondary hosts, many of these are ornamentals.	Roots	MEDIUM	HIGH	HIGH	LOW	**LOW**
Radopholus similis **(Citrus biotype)**	Spreading decline of citrus/ citrus burrowing nematode	Florida biotype favours citrus	Whole plant	LOW	HIGH[312]	HIGH	HIGH[313]	**MEDIUM**
VIRUSES and VIROIDS								
Algerian navel orange virus				UNKNOWN	UNKNOWN	UNKNOWN [314]	LOW	**UNKNOWN**

[304] Australia imports fruit and budwood from affected countries; travel frequency between Australia and affected countries is high; pathogen exists in an area with which illegal/traditional trade with Australia is known to occur (e.g. the Mediterranean); may not show visible symptoms in roots, fruit and seeds; high chance of survival during pre-shipment, transport and quarantine import treatment; difficult to detect at entry points

[305] Climate suitable for establishment; requires injury for infection but can also enter through stomata

[306] Climate suitable for spread; pathogen has a history of spread into new areas; no confirmed vectors however insects and birds may help spread the disease; long-range movement is typically via movement of propagative material and plants

[307] In the Mediterranean region *P. tracheiphila* is the most destructive fungal disease of lemons; up to 100 % of trees in a lemon orchard of a susceptible cultivar can be affected; difficult to control; no effective or economically plausible control procedures available; no evidence of successful eradication

[308] Wang et al., 2012

[309] Distribution restricted to South-East Asia

[310] Primary hosts include Fabaceae (leguminous plants), Juglandaceae, Malvaceae, Rosaceae, Umbelliferae (plants of the parsley family), okra, groundnut, sugarbeet, pecan, fig, soyabean, cotton, Carpathian walnut, apple, lucerne, beans, poplars, almond, peach, European pear, willow, elms, grapevine

[311] Climate suitable for establishment and spread; difficult to detect in the field; extremely wide host range including plants from many different families

[312] Establishment potential high in well drained sandy soils only; subtropical and tropical growing areas are most at risk

[313] Causes severe tree decline in Florida

[314] Graft-transmissible

Scientific name	Common name	Host(s)[233]	Affected plant part	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
***Citrus chlorotic dwarf-associated virus* (unassigned)**[315]	Citrus chlorotic dwarf	All *Citrus* spp., worse on lemons, grapefruit, some mandarins and tangelos	Leaves, whole plant (stunting)	LOW[316]	MEDIUM	HIGH[317]	HIGH[318]	**MEDIUM**
***Citrus exocortis viroid* (exotic strains and variants)**[319]	Exocortis	All *Citrus* spp.	Trunk	MEDIUM	MEDIUM	MEDIUM	MEDIUM	**LOW**
***Citrus leprosis virus* (*Cilevirus*)**[320]	Citrus leprosis	*Citrus* spp. (sweet orange most susceptible, lemon, mandarin, grapefruit and hybrids, e.g. Murcott, less susceptible)	Leaves, stems, fruit, whole plant (dieback)	MEDIUM[321]	HIGH[322]	HIGH[323]	HIGH[324]	**HIGH**
Citrus seed-borne virus			UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	**UNKNOWN**
***Citrus sudden death-associated virus* (*Marafivirus*)**[325]	Sudden death/ sudden wilt	All citrus varieties on Rangpur lime rootstock and to a lesser extent on Volkamer lemon	Whole plant	LOW	LOW	LOW	HIGH	**LOW**

[315] Transmitted by Japanese bayberry whitefly (*Parabemisia myricae*); molecular features strongly support *Citrus chlorotic dwarf-associated virus* is a geminivirus, however differences in genome size and structure, and distant phylogenetic relationships with other members of the *Geminiviridae* family, does not allow its allocation in any of the existing genera of this family (Loconsole et al., 2012)

[316] Australia does not import citrus from affected area; low travel frequency between Australia and affected area; not recorded in customs interception database; no alternative hosts; not found in a country in close proximity to Australia, however could enter via illegal budwood from Turkey

[317] Spread potential high if Japanese bayberry whitefly (*Parabemisia myricae*) enters Australia; other unknown whitefly vectors may be present in Australia

[318] Pathogen causes high yield losses and increased production costs; eradication more likely to be possible if no vectors are present in a region

[319] A number of citrus viroids are present in Australia, however there are exotic variants of these viroids (eg Citrus viroid I-LSS variants from citrus in Pakistan and China) and other exotic strains that pose a risk to the citrus industry

[320] There are nuclear and cytoplasmic morphological types with the cytoplasmic type (CiLV-C) being the more common form compared to the nuclear form (CiLV-N). Taxonomy previously considered *Rhabdovirus*-like, but research suggests it is the type member of a new genus of viruses termed *Cilevirus* (Locali-Fabris et al., 2006). There are potentially other exotic *Brevipalpus*-transmitted viruses causing leprosis like symptoms on citrus, including a Hawaiian isolate of *Hibiscus green spot virus*, recently reported from Hawaii on Volkamer lemon (Melzer et al., 2012) and a novel *Citrus leprosis virus* (cytoplasmic type 2), recently reported on sweet orange plants in Colombia showing leprotic symptoms (Roy et al., 2013).

[321] Pathogen not found in a country close to Australia; no previous quarantine interceptions recorded in intercepts database; movement in latently infected planting material is not likely to be a major pathway for CiLV

[322] More likely to establish in the presence of vector mites of the genus *Brevipalpus;* history of establishment overseas; medium detectability in the field; repeated infections are necessary to sustain the disease

[323] Transmitted by mite vectors including *Brevipalpus californicus, B. obovatus* and *B. phoenicis* that already occur in Australia; no natural enemies of vector known in Australia, warm, humid areas suitable for spread of vector; pathogen has a history of spread into new areas

[324] No effective or economically plausible control procedures available; control procedures unlikely to be compatible with current IPM strategies; no evidence of successful eradication; control of mite vectors highly important

[325] Phylogenetic analysis revealed that this virus is a new member of the genus *Marafivirus* (Family – *Tymoviridae)* (Maccheroni et al., 2005)

Scientific name	Common name	Host(s)[233]	Affected plant part	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
***Citrus tristeza virus (Closterovirus)* (exotic strains)**[326]	Examples: mandarin stem pitting/ citrus tristeza	All *Citrus* spp. except trifoliate orange[327]	Leaves, stems, roots, and fruits	HIGH[328]	HIGH[329]	HIGH[330]	HIGH[331]	**HIGH**
Citrus yellow mosaic virus (Badnavirus)	Citrus yellow mosaic	Sweet orange, lemon, grapefruit, mandarin, lemandarin, calamondin, pomelo	Leaves, fruit (reduces juice and ascorbic acid)	LOW[332]	LOW	MEDIUM[333]	MEDIUM[334]	**VERY LOW**
Citrus yellow vein clearing virus (Mandarivirus)	Citrus yellow vein clearing disease	Lemon, sour orange, Etrog citron, lemandarin	Leaves	MEDIUM	MEDIUM	MEDIUM	MEDIUM	**LOW**
Indian citrus ringspot virus (Mandarivirus)	Indian citrus ringspot	Mandarin, sweet orange, sour orange, lemandarin, lime	Leaves	LOW	MEDIUM	MEDIUM	MEDIUM	**LOW**
Satsuma dwarf virus (Nepovirus) Synonym: *Citrus leathery leaf virus*	Dwarf disease of satsuma/ citrus mosaic/ natsudaidai dwarf/ navel orange infectious mottling	Satsuma, kumquat, mandarin, sweet orange, trifoliate orange, common bean, sesame, cowpea, *Chenopodium quinoa, Physalis floridana, Vigna odoraissimus*	Whole plant, leaves, stems, and fruits	MEDIUM[335]	MEDIUM	MEDIUM[336]	MEDIUM[337]	**LOW**

[326] Transmitted by vector brown citrus aphid (*Toxoptera citricida*) and black citrus aphid (*Toxoptera aurantii*), both of which are present in Australia, hence spread could be rapid

[327] Host symptoms vary with rootstock and scion combinations, virus strain and environmental conditions. Alternative hosts (most experimental) include *Aeglopsis chevalieri, Afraegle paniculata, Atalantia monophylla, A. citroides, Aegle marmelos, A. glutinosa, Citropsis articulata*, *C. gilletiana, Citrus australis* (Australian round lime)*, C. glauca* (Australian desert lime)*, C. japonica* (kumquat)*, Clausera excavata, C. lansium, Clymenia, Limonia acidissima*, *Micromelum, Murraya, Pamburus missionis, Passiflora gracilis, Pleiospermium*

[328] Pathogen found in close proximity to Australia; travel frequency between Australia and affected countries is high; pathogen exists in an area from which illegal/traditional trade with Australia is known to occur; high chance of survival in budwood and may enter from illegal importations of budwood or from infected aphids blown in from Indonesia; previous quarantine interceptions recorded in intercepts database; low chance of survival during pre-shipment treatment, transport and quarantine import treatment

[329] Climate suitable for establishment; history of sweet orange stem pitting strain establishment in Australia and difficult to detect in the field; mandarin stem pitting strains could arise in Australia due to recombination of endemic strains

[330] Australian climate is suitable for spread; pathogen has a history of spread into new areas; transmitted by vector present in Australia (brown citrus aphid; *Toxoptera citricidus*) and hence spread would be rapid

[331] High impact in mandarins (mandarin stem pitting strain); difficult to control, particularly once established; eradication would require clean budwood sources

[332] Australia does not import commodity from affected country; travel frequency between Australia and affected countries is low; no previous quarantine interceptions recorded in intercepts database; pathogen not found in a country close to Australia

[333] Australian climate is suitable for spread, transmitted by the citrus mealybug *Planoccocus citri,* present in Australia

[334] Difficult to control; no effective or economically plausible control procedures available except the use of clean budwood; control procedures likely to be compatible with current IPM strategies; no evidence of successful eradication

[335] Australia imports commodity from affected country (budwood); travel frequency between Australia and affected countries is moderate; high chance of survival during pre-shipment treatment, transport and quarantine import treatment (budwood); difficult to detect at entry points

[336] History of spread into new areas via budwood transmission; possibly also vector transmitted; also mechanically and soil transmitted

[337] Difficult to control; no effective or economically plausible control procedures available; control procedures likely to be compatible with current IPM strategies; no evidence of successful eradication; clean budwood essential

Scientific name	Common name	Host(s)[233]	Affected plant part	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
UNKNOWN								
Unknown[338]	Concentric ring blotch	Sweet orange, rough lemon, grapefruit	Leaves, stems, fruit	HIGH	HIGH	HIGH	MEDIUM	**MEDIUM**
Unknown (virus suspected)	Citrus impietratura	All citrus but most damaging on sweet orange and grapefruit	Fruit, whole plant (wilting in summer)	LOW	MEDIUM[339]	LOW	MEDIUM[340]	**VERY LOW**

[338] Disease is transmitted to citrus by the citrus grey mite (*Calacarus citrifolii*). Toxic saliva from the mite fundamentally affects young tissues and in strong growth involves young leaves, shoots, branches and fruits, while the mature leaves and shoots can be exempt. Can be serious in nurseries and young plants and can lead to death of entire shoots or branches, predominantly on sun-exposed surfaces (Vacante, 2010)

[339] Climate suitable for establishment; history of establishment overseas; symptoms relatively easy to detect in the field (once trees are mature)

[340] Infection results in off-season fruit drop and unmarketability of affected fruit; in some cases 80 % of fruits have been recorded as affected; has been successfully eradicated in the past; impietratura free budwood available

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APPENDIX 2: CITRUS NOMENCLATURE

Table 23. *Citrus species and common hybrids (adapted from Beattie and Barkley, 2009 in which classification was based on Mabberley, 1997, 1998, 2004, 2008, Scott et al. 2000, Samuel et al. 2001 and Bayer et al. 2009)*

Scientific name	Common name
***Citrus* species**	
Citrus amblycarpa (Hassk.) Ochse (a possible hybrid)	nasnaran, nasnaran mandarin, sambal, djerook leemo, 'Celebes' papeda
Citrus australasica F. Muell.	Australian finger lime
Citrus australis (Mudie) Planch.	Australian round lime, dooja
Citrus cavaleriei H. Léveillé ex Cavalerie *(C. ichangensis* Swingle)	Ichang (Yichang) papeda/lime/lemon
Citrus fragrans (Montr.)	fragrant oxanthera
Citrus garrawayi F. M. Bailey	Mount White lime, Garraway's Australian wild lime
Citrus glauca (Lindley) Burkill	Australian desert lime
Citrus gracilis Mabb.	Humpty Doo lime
Citrus halimii BC Stone	sultan lemon, limau kadangsa, limau kedut kera
Citrus hystrix DC. (*C. macroptera* Montrouz.)	leech lime, limau purut, limau hantu, kaffir lime, Mauritius papeda
Citrus inodora F. M. Bailey	Russell River lime, large leaf Australian wild lime
Citrus japonica Thunb. syn. *Fortunella*	kumquat
Citrus maxima (Burm.) Merr.	pomelo (pummelo); cultivars include Chandler
Citrus medica L.	citron; cultivars include Etrog, Buddha's hand/Fingered citron
Citrus neocaledonica Guill.	false orange, large-leaf oxanthera
Citrus oxanthera Beauvisage	orange flower oxanthera
Citrus polyandra Tanaka syn. *Clymenia*	
Citrus reticulata Blanco syn. *C. nobilis, C. deliciosa*	mandarin, tangerine, clementine , satsuma: includes *C*. x *suhuiensis* Hort. ex Tanaka, known as Canton mandarin, shatangju, sz-wei-kom, som keo wan, siem, xiem, limau langkat
Citrus trifoliata L. syn. *Poncirus*	trifoliate orange
Citrus undulata Guill.	
Citrus warburgiana F. M. Bailey	Milne Bay lime, New Guinea wild lime
Citrus wintersii Mabb. syn. *Microcitrus papuana* H. F. Winters	Brown River finger lime
Common hybrids within the *Citrus* genus	
Citrus x *aurantiifolia* (Christm.) Swingle	lime; cultivars include Mexican/Key lime
Citrus x aurantium L. (syn. *C. aurantium* L. and *C. sinensis* (L.) Osbeck)	sour, sweet, Valencia and navel oranges; grapefruit; tangor; tangelo
Citrus x indica Tanaka	Indian wild orange

Scientific name	Common name
Citrus x insitorum Mabb. (*x Citroncirus webberi* J. Ingram and H. E. Moore)	citrange
Citrus x *limon* (L.) Osbeck	lemon
Citrus x macrophylla Wester	alemow
Citrus x microcarpa Bunge	calamondin, calamandarin, calamansi
Citrus x taitensis Risso (syn *C. x jambhiri* Lush., *C. x limonia* Osbeck)	rough lemon (referred to as 'bush lemons in Australia', 'lemandarins' of Swingle, mandarin lime, Rangpur lime)
Citrus x latifolia (Yu. Tanaka) Tanaka	Tahitian lime
Citrus x virgata Mabb.	Sydney hybrid

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