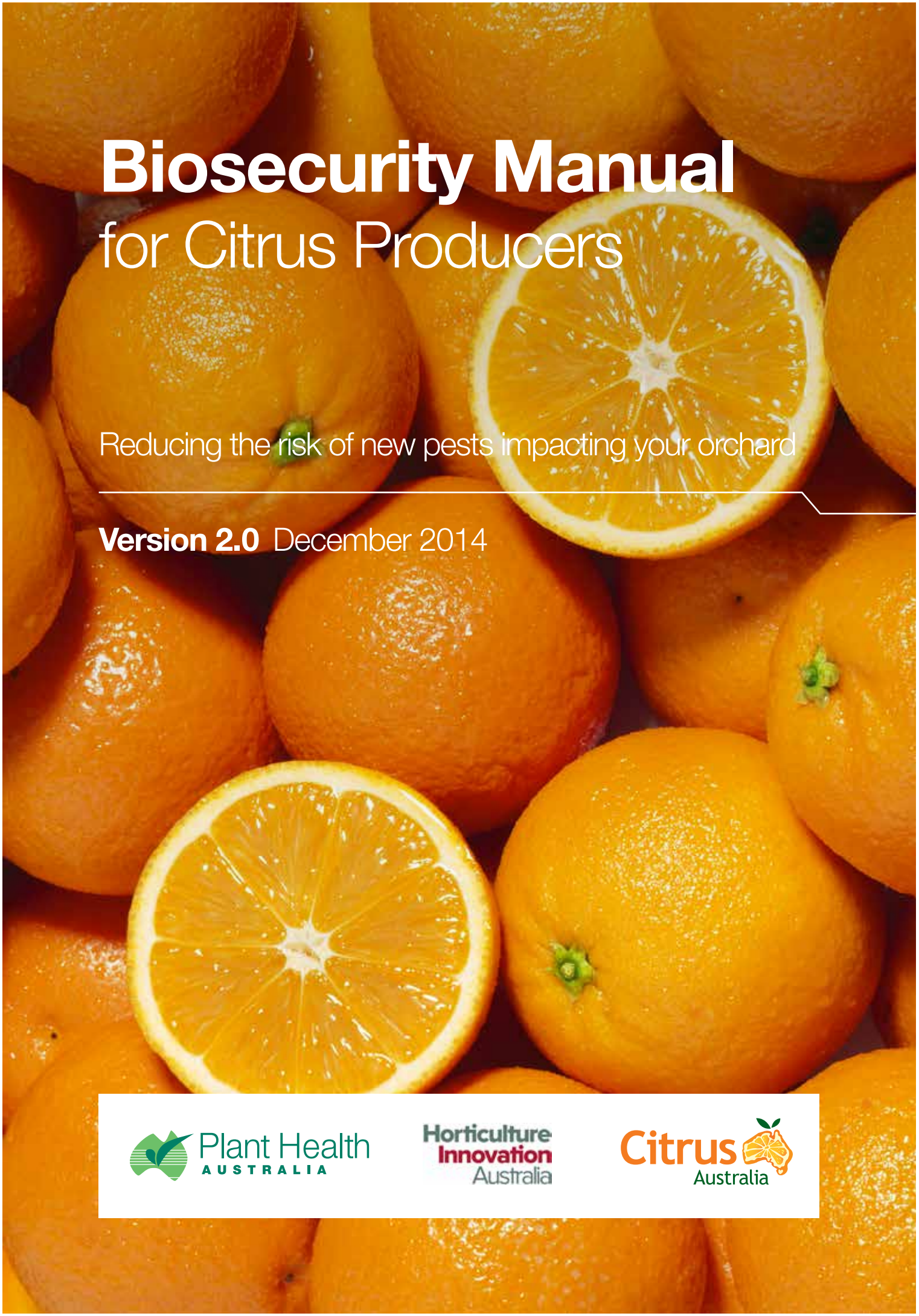

Biosecurity Manual
for Citrus Producers

Reducing the risk of new pests impacting your orchard

Version 2.0 December 2014

Plant Health AUSTRALIA

Horticulture Innovation Australia

Citrus Australia

Plant Health Australia (PHA) is the national coordinator of the government-industry partnership for plant biosecurity in Australia. As a not-for-profit company, PHA services the needs of Members and independently advocates on behalf of the national plant biosecurity system. PHA's efforts help minimise plant pest impacts, enhance Australia's plant health status, assist trade, safeguard the livelihood of producers, support the sustainability and profitability of plant industries and the communities that rely upon them, and preserve environmental health and amenity.
www.planthealthaustralia.com.au

Citrus Australia is the national peak industry body representing the Australian citrus growing industry, and is a not-for-profit industry-owned company supported by 250 grower members and 73 industry affiliate members. Citrus Australia provides a channel for communication, research, development and marketing for the industry, and is a member of PHA.
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Plant Health Australia Ltd (2014) *Biosecurity Manual for the Citrus Industry* (Version 2.0 December 2014). Plant Health Australia, Canberra, ACT.

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ISBN: 978-0-9872309-6-6

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Introduction

You have an important role to play in protecting your orchard, your region and the citrus industry from biosecurity threats.

This manual highlights simple orchard biosecurity practices that will help you keep your property free from new pests, diseases and weeds. It also describes the symptoms and appearance of exotic pest threats to the citrus industry to give the best chance that any incursion into Australia is quickly detected and controlled.

By implementing the recommended measures in your day-to-day operations, you improve your orchard's biosecurity, and that of your whole region, while minimising costs and production losses.

Every orchard is different, so the general principles recommended in this manual will need to be tailored to your needs. The practices you choose will vary from site-to-site depending on factors such as the size of your orchard(s), the facilities available, risks and day-to-day management of operations.

Simple preventative measures, together with monitoring and reporting will help reduce the risk of a new pest, disease or weed establishing in your orchard.

At the back of this manual (page 31) there is a Biosecurity Best Practice Checklist that you can use to assess your current arrangements and identify any gaps that you can improve.

If you would like assistance with biosecurity planning, contact the Citrus Biosecurity Manager (contact details are on page 35).

An electronic copy of this manual is available from the Plant Health Australia (PHA) website **planthealthaustralia.com.au** the Farm Biosecurity website **farmbiosecurity.com.au** and the Citrus Australia website **www.citrusaustralia.com.au/policy/quarantine-biosecurity.htm**

If you see anything unusual, call the Exotic Plant Pest Hotline.

EXOTIC PLANT PEST HOTLINE
1800 084 881

Farm Biosecurity is a joint initiative of Plant Health Australia and Animal Health Australia and provides reliable biosecurity advice for plant and animal production, including resources such as videos, recording sheets and manuals for particular industries.

Six easy ways to protect your orchard

4 **Pests, weeds and diseases can severely affect production if they enter and establish on your orchard. It makes good business sense to take measures to improve biosecurity.**

Here are six simple, routine orchard practices that can be embedded in everyday management activities to reduce the threat of new pests.

1. Monitor your orchard for the presence of pests

Check your orchard regularly for pests. Record your monitoring. Be aware of the serious exotic pests of citrus and the symptoms they cause. Keep written and photographic records of all unusual observations. Constant vigilance is vital for early detection of any exotic plant pest threat.

2. Report anything unusual

If you suspect a new pest – report it immediately to the Exotic Plant Pest Hotline. Early detection provides the best chance of eradicating a new pest.

EXOTIC PLANT PEST HOTLINE
1800 084 881

3. Use pest-free propagation material

Ensure seed, budwood, nursery trees and other orchard inputs are purchased from reputable sources and are fully tested and pest-free. Keep good records that allow full traceability of propagation material.

4. Manage produce carefully

Maintain good hygiene when dealing with fruit and fruit by-products and dispose of waste fruit and plant material carefully. Obtain training and advice on the safe use of pesticides and follow label regulations and withholding periods. Ensure that Quality Assurance schemes and orchard records allow full traceability of produce.

5. Manage people movements

People can inadvertently carry pests with them as they move about. Use orchard biosecurity signs to direct all visitors to notify you of their presence, record visits and make sure visitors have clean footwear and clothing. On entry and exit from the orchard take particular care with contractors, utility providers and visitors from overseas.

6. Reduce risks posed by vehicles and equipment

Direct all visitors to park in a designated parking area that can be monitored for new pests. Ensure that all machinery and vehicles that enter and exit production areas are clean. A wash-down facility provides good protection.

To learn more about protecting your property from biosecurity risks visit the Farm Biosecurity website **farmbiosecurity.com.au.**

Biosecurity overview

What is biosecurity?

Biosecurity is the management of risks to the economy, the environment and the community, from pests and diseases entering, establishing and spreading.

Biosecurity is a national priority, implemented off-shore, at national and state borders and on-farm.

Due to Australia's geographic isolation we have relatively few of the pests that affect plant industries overseas. Freedom from these exotic pests is a vital part of the future profitability and sustainability of Australia's plant industries. Biosecurity allows us to preserve existing trade opportunities and provide evidence to support new market negotiations.

What is orchard biosecurity?

Orchard biosecurity is a set of management practices and activities carried out on an orchard to protect a property from the entry and spread of pests. Orchard biosecurity is essential for your business. It is your responsibility and that of every person visiting or working on your property.

Growers can play a key role in protecting themselves and the Australian citrus industry from exotic pests by implementing effective orchard biosecurity.

Orchard biosecurity makes good business sense. If a new pest becomes established on your orchard, costs will increase due to:

- Reduced productivity in terms of yield, quality or both.
- Potential loss of access to some export markets.
- Necessary changes to production such as using additional chemical controls.

Orchard biosecurity practices will help to protect you from established pests of all kinds, including weeds, as well as from exotic pests in the event of an incursion.

More information on how to secure your orchard and secure your future can be found online at **farmbiosecurity.com.au**.

The definition of a **pest** used in this manual covers all insects, mites, snails, nematodes, pathogens (diseases) and weeds that may harm plants or plant products. **Exotic** pests are those not currently present in Australia. **Established** pests are those present within Australia.

Regional biosecurity

Pests don't respect orchard boundaries or state borders. Biosecurity threats can be introduced from neighbouring orchards and farms, either active or abandoned, garden and roadside plantings and native vegetation. Producers are encouraged to identify these risk areas and talk to their state agency about the measures that can be taken to reduce the threat.

You can further strengthen biosecurity for your enterprise by collaborating with others in your area. Consider starting biosecurity meetings and activities to promote biosecurity at the regional level to reduce biosecurity threats to all local properties.

Promotion of biosecurity at the regional level is enhanced through understanding the region, the source and nature of potential threats, and having knowledge of the expertise and resources available to the region. This is supported by a commitment from everyone to implement biosecurity measures, carry out surveillance and report suspect pests.

Biosecurity starts at the farm gate

Pests

8 High priority exotic pest threats of the citrus industry

The following are some key exotic pests that are a major threat to the Australian citrus industry. The climate of the Australian citrus production regions would allow each of these pests to survive, spread and establish with serious consequences, should they make it through border controls.

Make sure that you and your staff are familiar with these pests. Any suspicious pests or symptoms should be reported to the **Exotic Plant Pest Hotline on 1800 084 881** or to your state or territory department of agriculture.

Additional information on these pests is included in the fact sheets at the back of this manual and on the Plant Health Australia, Farm Biosecurity and Citrus Australia websites.

Huanglongbing (*Candidatus* Liberibacter africanus, *Ca*. L. americanus and *Ca*. L. asiaticus)

- Devastating bacterial disease of citrus that leads to tree decline and death
- Causes chlorosis and mottling of leaves, branch dieback and small, lopsided, bitter-tasting fruit that remains partially green
- Spread by the Asiatic and African citrus psyllids and movement of plants and plant material
- Asiatic strain present close to Australia in Indonesia, East Timor and Papua New Guinea

H.D. Catling, Bugwood.org

Asiatic and African citrus psyllids (*Diaphorina citri* and *Trioza erytreae*)

- Sap-sucking psyllids that are serious pests of citrus
- Transmit the devastating disease Huanglongbing
- Commonly found on young, tender flush leading to deformation and leaf drop
- Spread locally by flight and over long distances via movement of plant material and strong winds
- Asiatic citrus psyllid is present close to Australia in Indonesia, East Timor and Papua New Guinea
- Asiatic citrus psyllid has previously entered Australia and was eradicated

Jeffrey W. Lotz, Florida Department of Agriculture and Consumer Services, Bugwood.org

Citrus canker (*Xanthomonas citri* subsp. *citri*)

- Bacterium that infects plants through wounds and natural openings on leaves, stems, thorns and fruit
- Causes brown, raised, spongy lesions which are surrounded by a yellow halo on leaves and fruit
- Feeding by citrus leaf miner (*Phyllocnitis citrella*) exacerbates symptoms
- Spread by wind-blown rain or the movement of plant material and equipment
- Has previously entered Australia and was eradicated

Florida Division of Plant Industry Archive, Florida Department of Agriculture and Consumer Services, Bugwood.org

Citrus fruit borer (*Citripestis sagittiferella*)

- Adults are grey-brown moths about 10 mm in length
- Larvae tunnel into fruit causing pock marks on rind, deformation and premature rotting
- Spread by flight, wind and movement of plants, plant products and soil
- Present close to Australia in Indonesia, Malaysia, Singapore, Vietnam and Thailand

P.A.C. Ooi, Tropical Press Sdn Bhd

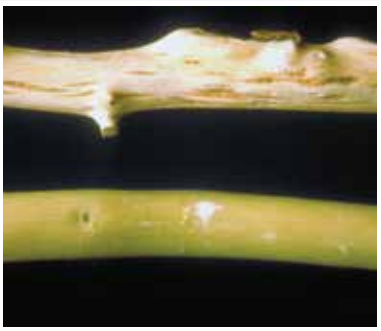
Citrus stubborn disease (*Spiroplasma citri*)

- Bacterial disease that leads to reduced fruit quality and yield
- Symptoms include stunted growth; short, broad and upright leaves; lopsided or acorn-shaped fruit with possible inverted or uneven colouration
- Transmitted between plants by feeding activities of leafhoppers or through transportation of infected plant material
- Found throughout the Mediterranean basin and the Middle East, as well as parts of the USA, South America and northern Africa

J.M. Bové, INRA Centre de Recherches de Bordeaux, Bugwood.org

Citrus tristeza virus (mandarin stem-pitting strain)

- Economically important virus with many strains that vary in severity
- Grapefruit and sweet orange stem-pitting strains occur in Australia; however, the mandarin stem-pitting strain is absent from Australia
- Leads to pitting and gumming of wood, stunted growth and reduced fruit size
- Spread by aphid vectors (brown and black citrus aphids) that are present in Australia and through graft transmission or movement of infected plant material



L. Navarro, Instituto Valenciano de Investigaciones Agrarias, Bugwood.org

Citrus variegated chlorosis (*Xylella fastidiosa* subsp. *pauca*)

- Caused by a bacterium that lives in the water conducting system (xylem) of citrus plants
- Citrus plants show symptoms of zinc deficiency, particularly leaf yellowing, but also stunted growth, leaf lesions and small fruit with a hard rind
- Can be spread via infected propagation material and potentially by leafhopper vectors such as the exotic glassy-winged sharpshooter (*Homalodisca vitripennis*)
- Present in North America, Central America and some regions of South America

Alexander Purcell, University of California, Bugwood.org

Exotic fruit flies (*Anastrepha* and *Bactrocera* species)

- There are a number of *Anastrepha* and *Bactrocera* species not present in Australia which would have a severe impact on citrus and other industries and cause major restrictions on trade if they established here
- Flies damage citrus through larval feeding that leads to rotting and may lead to premature fruit drop
- Spread via flight or wind currents or via the movement of fruit infested with larvae
- Some are present in regions close to Australia, including Indonesia, East Timor and Papua New Guinea

Jeffrey W. Lotz, Florida Department of Agriculture and Consumer Services, Bugwood.org

Exotic thrips (multiple species)

- Can seriously impact fruit quality, yield and market access
- Are tiny (about 1 mm) with four wings and typically yellow/orange or greyish/black in colour
- Can lead to brown scarring, curling and distortion of leaves, grey or brown scarring of fruit, premature flower and fruit drop
- Spread by wind or via the movement of infected plants or plant material including fruit

Joseph Morse, University of California – Riverside

Glassy-winged sharpshooter (*Homalodisca vitripennis*)

- Large xylem feeding leafhopper (about 12 mm) that causes direct damage to citrus through feeding activities
- Vector of citrus variegated chlorosis (*Xylella fastidiosa* subsp. *pauca*), which is a serious disease of citrus
- Spread through flight and via the movement of plants and propagation material infested with eggs and nymphs
- Present throughout eastern and western USA, Mexico, French Polynesia Tahiti, Hawaii, Easter Island and the Cook Islands

Charles Ray, Auburn University US, Bugwood.org

Priority citrus pests already present in Australia

Sweet orange stem-pitting (*Citrus tristeza virus* (*Closterovirus*))

- Sweet orange stem-pitting strain found in Queensland.
- Infects all citrus, but principally damages sweet orange.
- Leaves are distorted with the leaf margins curled upwards and crinkled.
- Branches are brittle and readily break.
- Elongated pits are evident in the wood which has a yellow/orange staining due to gum impregnation.
- Severely affected trees are stunted with a bushy appearance, reduced fruit size and numerous fine pits.
- Spread by the Brown citrus aphid (*Toxoptera citricida*) and Black citrus aphid (*Toxoptera aurantii*), both of which are present in Australia.

DPI NSW

DPI NSW

Queensland fruit fly (*Bactrocera tryoni*) and Mediterranean fruit fly (*Ceratitis capitata*)

- Queensland fruit fly (Qfly) and Mediterranean fruit fly (Medfly) are significant threats to citrus production with serious consequences for trade, both locally and internationally.
- Larvae feed in the fruit and contaminate it, causing secondary infections that lead to rot and decay and premature fruit drop.
- Qfly is wasp-like, about 7-8 mm long, reddish-brown in colour with yellow markings. Medfly is about 3-5 mm long, with a light brown body and mottled wings that have distinctive brown bands extending to the tips.
- Qfly is widespread throughout Queensland and has a limited distribution in the Northern Territory and south-eastern Australia. Medfly is restricted to parts of Western Australia. It is most active from October through to May.
- Qfly is most prevalent from September through to May and prefers humid conditions.
- Most citrus varieties can be attacked by Qfly, in particular Meyer lemons, mandarin and grapefruit. All citrus varieties can be attacked by Medfly except some lemon varieties. Mandarins are particularly susceptible.

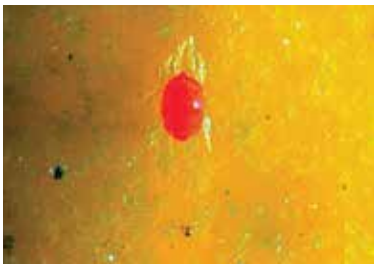
James Niland, Wikimedia commons

Scott Bauer, USDA Agricultural Research Service, Bugwood.org

Citrus red mite (*Panonychus citri*)

- Red to purple coloured, oval shaped mite that attacks all species and varieties of citrus.
- Measures about 0.5 mm in length with four pairs of legs and bristles arising from bumps on the body.
- Restricted in distribution to the Sydney metropolitan area and Central Coast of NSW.
- Damages leaves, green bark and fruit and prefers light green, maturing foliage.
- Scratch-like feeding marks lead to grey or silvery spots (stippling) on leaves and immature fruit, leading to an overall pale appearance, while injured mature oranges and lemons turn a pale straw yellow.
- Severe infestations are more likely to occur in dry conditions and can lead to premature leaf and fruit drop as well as twig and branch dieback.
- Spread via infested plant material such as citrus nursery trees and budwood.

David Rosen, UC Statewide IPM Program



Jim Baker, North Carolina State University, Bugwood.org

Remain observant for anything unusual in your orchard and packing facilities. If a pest is found that is not normally present in your orchard, it may be new not only to your orchard, but to the region, state or even Australia. **Report anything unusual to the Exotic Plant Pest Hotline 1800 084 881.**

Biosecurity practices

12 Orchard monitoring for the early detection of pests

Early detection is important for controlling pests

Monitoring the health of your crops is a fundamental part of orchard management providing the best chance of spotting a new pest soon after it arrives. You, your workers or a pest monitoring scout should be looking over your orchard on a regular basis.

Pay particular attention to high risk areas where pests are most likely to enter and establish on your property such as along public roads, areas that flood periodically or spots that may be missed when spraying such as along fence lines.

Monitoring your crops provides the best protection against pests.

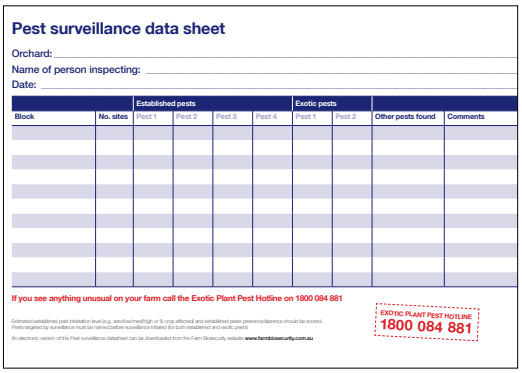
Keep records of monitoring activity

Pest surveillance involves looking for pests, any symptoms of pests, or plant health issues in your crop, and recording their presence and population levels or their absence. A suitable pest surveillance record sheet is provided on page 35.

In addition to assisting with orchard management, pest surveillance is important for the biosecurity status of the citrus industry.

Maintaining market access

Export destinations often require 'evidence of absence' data for particular exotic and established pests of citrus. The Australian citrus industry, in collaboration with governments, must prove through surveillance that certain pests have been looked for and found to be absent. Pest surveillance can assist in providing evidence of absence and keep trade markets for Australian citrus open.



Pest surveillance data sheet

Orchard: _____

Name of person inspecting: _____

Date: _____

		Established pests				Exotic pests			
Block	No. sites	Pest 1	Pest 2	Pest 3	Pest 4	Pest 1	Pest 2	Other pests found	Comments

If you see anything unusual on your farm call the Exotic Plant Pest Hotline on 1800 084 881

Estimated established pest infestation level (e.g. zero/low/med/high or % crop affected) and established pests presence/absence should be scored. Pests targeted by surveillance must be named before surveillance initiated (for both established and exotic pests)

An electronic version of this Pest surveillance datasheet can be downloaded from the Farm Biosecurity website www.farmbiosecurity.com.au

EXOTIC PLANT PEST HOTLINE 1800 084 881

Detecting exotic pests

Should an exotic pest make it into Australia, pest surveillance increases the chances that a new pest is detected early and can be contained and eradicated. A new pest in your orchard might not only be new to your property but also new to the region or even the country.

Huanglongbing and its vector the Asiatic citrus psyllid

Huanglongbing (HLB) is a highly destructive disease of citrus. Trees infected at an early age may fail to come into production while more mature trees rapidly become unproductive. There is no effective treatment.

S.Pettigrew

HLB is the primary cause of losses in citrus production in Asia and its presence in Brazil led to the elimination of 3 million diseased trees between 2004 and 2008. In Florida HLB is estimated to have increased production costs by approximately 40% and the volume of citrus produced in 2014 may be as little as 50% of the 2007 production. In California, massive resources have been mobilised to combat the 2008 incursion of the Asiatic citrus psyllid (ACP) that vectors HLB. Despite this effort, ACP continues to spread across urban and commercial production areas, laying the foundations for rapid HLB spread. In the presence of the HLB psyllid vectors, similar losses could be expected in Australia.

S.Pettigrew

The threat from HLB and ACP to the Australian industry is real. Both HLB and ACP are present in countries to our immediate north including East Timor, PNG and Indonesia. ACP has previously been found in northern Australia, but was subsequently eradicated. ACP has also been found on material intercepted at border inspections.

Whilst continued strong border and pre-border biosecurity is essential, our industry must also be proactive and vigilant. If an incursion does eventuate, we must be able to detect it early if we are to have any chance of eradication. Increasing coordinated surveillance across all regions, engaging with urban stakeholders, raising industry awareness and working with researchers to improve our preparedness are all elements of the industry's response to this threat.

If a new pest becomes established, it nearly always increases orchard costs through the use of additional chemical controls and other management treatments. However, if a new pest can be detected early enough it may be eradicated or contained for a fraction of the cost of ongoing management.

14 Reporting suspect pests

Along with crop monitoring and pest surveillance, prompt reporting is vital to minimise the long-term impact of exotic pests on your orchard and the citrus industry as a whole.

Australia has one of the strictest border control systems in the world but there is always the chance that an exotic pest will make it into the country. The numbers of passengers and imported goods is increasing, and a serious exotic pest of the citrus industry might only be a day's flight away.

What do I do if I find a suspect pest?

If you find a suspected exotic plant pest (or suspect symptoms), take the following precautions to contain the pest and protect other parts of your orchard:

- Mark the site of the pest detection and limit access to the area.
- Do not touch, move, or transport affected plant material.
- Wash hands, clothes and footwear that have been in contact with affected plant material or soil.
- Call the Emergency Plant Pest Hotline on 1800 084 881, report it to your state/territory department of agriculture or speak to your local agronomist.
- Restrict the movement of people, stock and equipment near the affected area.
- Restrict operations in the area while waiting for identification.

Citrus growers have an important role to play in reporting any suspicious pest immediately to minimise any potential damage. All reports will be checked out and treated confidentially.

Report any suspect pests without delay.

If you see anything unusual, call the Exotic Plant Pest Hotline

EXOTIC PLANT PEST HOTLINE
1800 084 881

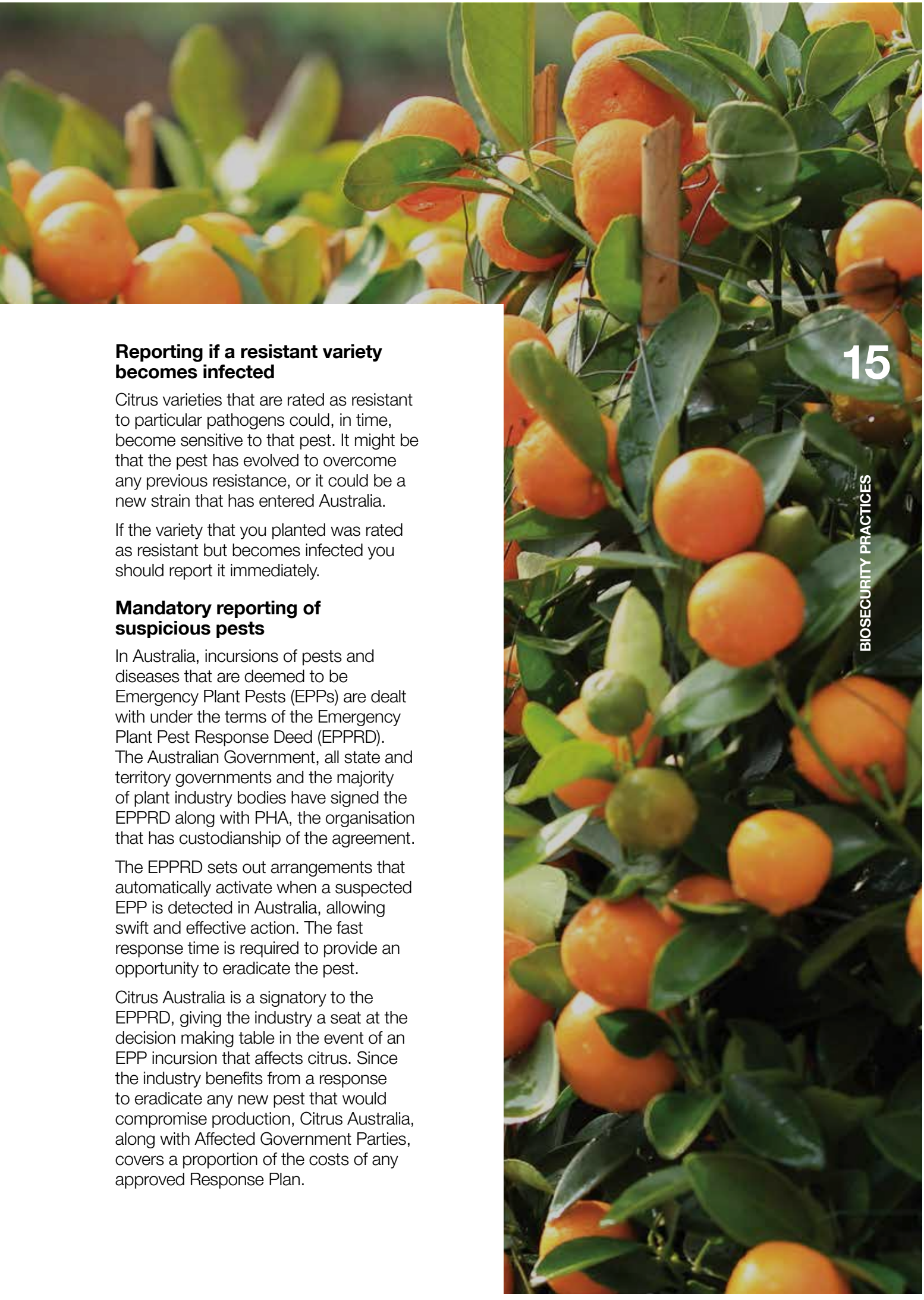
What happens if I call the Exotic Plant Pest Hotline?

Calls to the Exotic Plant Pest Hotline are confidential. Your call will be forwarded to an experienced person in your state or territory government, who will ask some questions and arrange for an assessment of what you've found.

If the hotline in your state operates only during business hours, leave your full contact information and a brief description of the issue and your call will be followed up as soon as possible.

Do not send samples until you have received advice on the correct protocol for sampling, packaging, handling and transport to the laboratory assigned for diagnosis.

Incorrect handling could spread the pest further or render the sample unfit for diagnosis so always speak to an expert before taking a sample of the pest.



Reporting if a resistant variety becomes infected

Citrus varieties that are rated as resistant to particular pathogens could, in time, become sensitive to that pest. It might be that the pest has evolved to overcome any previous resistance, or it could be a new strain that has entered Australia.

If the variety that you planted was rated as resistant but becomes infected you should report it immediately.

Mandatory reporting of suspicious pests

In Australia, incursions of pests and diseases that are deemed to be Emergency Plant Pests (EPPs) are dealt with under the terms of the Emergency Plant Pest Response Deed (EPPRD). The Australian Government, all state and territory governments and the majority of plant industry bodies have signed the EPPRD along with PHA, the organisation that has custodianship of the agreement.

The EPPRD sets out arrangements that automatically activate when a suspected EPP is detected in Australia, allowing swift and effective action. The fast response time is required to provide an opportunity to eradicate the pest.

Citrus Australia is a signatory to the EPPRD, giving the industry a seat at the decision making table in the event of an EPP incursion that affects citrus. Since the industry benefits from a response to eradicate any new pest that would compromise production, Citrus Australia, along with Affected Government Parties, covers a proportion of the costs of any approved Response Plan.

Reimbursements for producers affected by an eradication response

Without early reporting, eradication efforts are often futile as the pest is too widespread and established in the environment. In these cases, growers then have to manage the pests leading to permanently increased production costs.

To encourage early reporting and increase the chance of successful eradication, the EPPRD allows for payments to growers who have demonstrated losses or costs incurred during an Emergency Plant Pest (EPP) eradication effort. Owner Reimbursement Costs (ORCs) cover certain costs associated with Response Plan actions including the destruction of crops, enforced fallow periods and additional chemical treatments. Their purpose is to reduce the financial impact of the eradication response on growers.

ORCs apply only to approved Response Plans aimed at eradication, and only to industries that are signatories to the EPPRD, like the citrus industry. The formulae used to determine ORCs are found in the EPPRD. ORC Evidence Frameworks are developed for each Cropping Sector to provide extra guidance and a hierarchy of evidence used to determine specific ORC valuations. Approved ORC Evidence Frameworks can be found at **planthealthaustralia.com.au/orc.**

Reporting of suspicious pests is mandatory in Australia under the national agreement for dealing with EPP incursions.

Also under the conditions of the EPPRD, **the citrus industry has a responsibility to report suspect pests**. This is because the earlier a new pest is detected, the greater the chance an eradication response will be mounted and the more likely it will be successful.

For more information on the EPPRD go to **planthealthaustralia.com.au/epprd.**

If you see anything unusual, call the Exotic Plant Pest Hotline

EXOTIC PLANT PEST HOTLINE
1800 084 881

Citrus canker case study

Citrus canker is a contagious disease of citrus caused by the bacterium *Xanthomonas citri* subsp. *citri*. Trees infected with canker develop unsightly lesions on leaves, twigs and fruit. Lesions first appear as pin-point, tan to brown coloured spots that become slightly raised pustules or blister-like eruptions that often have a water soaked margin and are surrounded by a yellow halo. Infection can lead to dieback, blemished, unmarketable fruit and premature leaf and fruit drop. The growth of young trees can be severely affected.

Citrus canker can be spread by wind-blown rain, insects, workers and equipment or via infected plant material.

S. Pettigrew

Citrus canker has previously entered Australia. It was detected in Emerald, Queensland in 2004, resulting in restrictions in trade and an eradication operation removing all citrus trees, including production and native citrus, from the area. Australia was declared free of the pest in 2009.

S. Pettigrew

The EPPRD and the associated framework for ORCs was not in place for the outbreak of citrus canker in Queensland in 2004, resulting in significant hardships for the growers involved. With the nationally agreed system now in operation, the citrus industry has a say in the decision making process and growers are entitled to ORCs for eradication activities carried out if a Response Plan is approved.

M. Goto, Bugwood.org

18 Planting and propagating material

Purchase seed, budwood and nursery stock from a reputable source

Infected, infested or contaminated propagation material such as budwood, seeds and nursery trees is a major route for the introduction of pests, including weeds, onto an orchard. A visual inspection of propagation material is not sufficient since in many cases pests show no symptoms for several years. Material that looks clean may harbour pests such as viruses and viroids.

Ensure that you source seed, budwood and nursery trees from reputable suppliers and ask where the nursery obtained their seed and budwood. To minimise the risk:

- Ensure all trees purchased from nurseries have been sourced from an accredited supplier of high-health citrus seed and budwood that has been tested for graft-transmissible diseases. Currently the only such source in Australia is Auscitrus. The nursery should be able to provide paperwork to prove the budwood was purchased from Auscitrus.
- Purchase quality assured planting material from nurseries accredited under the Nursery Industry Accreditation Scheme Australia (NIASA) and BioSecure *HACCP* (see page 19).
- Check nursery trees for signs of pests before taking delivery. Pay special attention to the root system.
- Maintain a register of your orchard's propagation material to allow full traceability. Information recorded should include the source of the material and contact details, cultivar, number of plants obtained, rootstock, areas on the property where the material was planted and the date planted.

Never use poor quality or pest-affected planting material, as it has the potential to infect your entire orchard and threaten your livelihood.

Auscitrus

Auscitrus is the trading name of the Australian Citrus Propagation Association Incorporated, a national industry organisation responsible for the supply of citrus budwood and rootstock seed that is true to type and of high health status.

Auscitrus has been at the forefront in addressing a number of biosecurity threats to the citrus industry, by routinely testing budwood source trees for the presence of graft-transmissible diseases and the supply of resistant or tolerant rootstocks.

For more information on Auscitrus and their services to the citrus industry go to **www.auscitrus.com.au**.

Always keep certification reports to assist with any trace-back activities should a new pest be found.

Planting and propagating material is a biosecurity risk

NIASA and BioSecure *HACCP*

The Nursery Industry Accreditation Scheme Australia (NIASA) provides accreditation for wholesale and production nurseries that operate in accordance with the NIASA Best Practice Management Guidelines. NIASA accredited nurseries can obtain BioSecure *HACCP* certification, which provides an on-farm biosecurity program for production nurseries in Australia. The program is designed to assist growers in assessing their current and future pest, disease and weed risks, and guide businesses in the implementation of management strategies at critical control points.

For more information on NIASA and BioSecure *HACCP* go to **www.ngia.com.au**.

20 Product management

Chemical residues

Since most citrus produce is consumed, inappropriate use or application of pesticides during production can pose a risk to human health. Consequently, the presence of chemical residues can result in citrus produce being rejected from export and domestic markets.

Pesticides must be used in accordance with label instructions, even in the event of a new pest outbreak. In most states and territories, farmers/orchardists and contractors who apply pesticides must complete an accredited chemical training course (e.g. ChemCert® or SMARTtrain) to gain the appropriate training, knowledge base and legal requirements for the safe use of pesticides.

Don't put your livelihood or the industry at risk through poor or illegal practice. Always follow label regulations and withholding periods.

Details about regulations for agricultural and veterinary chemicals can be found through the Australian Pesticides and Veterinary Medicines Authority website **www.apvma.gov.au** or from relevant state agencies. Maximum residue limits for all citrus markets are regularly updated on the Citrus Australia website **www.citrusaustralia.com.au**. Be aware that regulations change over time, so you need to check for updates regularly.

Don't put your livelihood or the industry at risk through poor or illegal practice. Always follow label regulations and withholding periods.

Maintaining good hygiene

Maintaining good orchard and packing facility hygiene is important to reduce breeding environments for pests and to minimise cross-contamination.

It is particularly important to keep storage and handling equipment clean.

Fruit should be loaded and unloaded on compacted surfaces away from production areas. Bins, containers and bags of fruit should be kept clean and covered during transport.

Dispose of waste fruit and plant material away from orchard areas, water sources and packing sheds.

Ensure that healthy plants are not exposed to potentially infected or infested plant material.

Additional precautions should be taken when dealing with any material, including fruit, that has suspected pest damage.

Appropriate disposal mechanisms include burning and deep burial away from production areas.

Quality Assurance and traceability

Quality Assurance (QA) schemes strengthen the citrus industry's potential to detect, control and eradicate plant pest outbreaks rapidly, before extensive damage occurs. QA schemes, and achievement of membership to them, is beneficial in terms of biosecurity, market access (both internationally and domestically), and meeting product specifications, food safety requirements and customer expectations.

Ensure that your scheme and records allow full traceability. You need to be able to trace-back plant material on your orchard to its source (including budwood sources, seed source, health testing specifics and authenticity records), trace-forward plant material and produce that has left your property, and have records of surveillance and pest management practices undertaken on your property.

If your orchard or nursery provider uses a QA scheme, such as Freshcare **www.freshcare.com.au** or the Woolworths QA standard **www.bsigroup.com/en-AU/WQA** it is likely that fundamental techniques of biosecurity best practice are being applied. This includes practices relating to product identification for traceability and recall, as well as integrated pest management and surveillance.

22 Managing people movement

People can carry pests (including diseases and weeds) onto and around your property without realising it. Pests can be spread in soil and on plant material that adheres to vehicles, equipment, footwear and clothing.

Anyone visiting your property is a potential biosecurity threat. This includes guests, people living on the property, workers, and all visitors such as suppliers, contractors, researchers, transporters and consultants.

There are simple steps that you can take to minimise the risk these movements pose.

Control people movements

Controlling and limiting access to production areas is key to minimising biosecurity risks. Make sure that you limit access points to the property – ideally there should be only one.

Direct all visitors to a designated parking area away from production areas and ask everyone to notify you of their presence. This gives you a chance to assess people and their vehicles for any potential risks.

Stick to paths and designated roadways when moving around the property whenever possible. Limit visitor contact with crops or plant materials as much as possible.

Keep a record of visitors

It's good practice to maintain a visitor register to document who has been on your property. A suitable recording sheet is provided on page 36.

A visitor record is one of the most useful tools in the event of a serious pest incursion in a region. It allows trace-back and trace-forward to pinpoint the origin and spread of an incursion.

Visitor register

Please enter your details to assist us with our farm biosecurity records

Date	Time on property		Name	Reason for visit	Vehicle registration and mobile phone	Blocks visited on this property	Location/date of last contact with crops
	Arrival	Departure					

If you see anything unusual, call the Exotic Plant Pest Hotline 1800 084 881

Come clean: go clean

Since weed seeds and pests can enter on footwear and clothing, it helps to have a clean clothes and boots policy for employees and visitors. Provide scrubbing brushes and footbaths for people arriving with muddy or dusty boots, or give them alternative footwear if they need to access production areas. Footwear should also be washed when people leave your property.

Boot covers and protective clothing should also be used in areas of the property that you know to be contaminated.

Inform visitors of your requirements

Make sure that staff, guests, regular visitors, and anyone entering your property knows about your biosecurity requirements. Biosecurity signs are a good way to alert them to your requirements and of the potential risk that their visit poses to your business. Parking restrictions will limit any problems posed by their vehicles.

Make sure workers know about any biosecurity risks in the region or issues on the property. They should also be familiar with everyday pests on the property and know how to report anything unusual.

If you hold a field day or equipment demonstrations on your property, clearly indicate any entry requirements and be especially vigilant in checking for new pests afterwards.

Biosecurity signage

Well-designed signs demonstrate your commitment to orchard hygiene. They also serve to alert people to the potential impact of their visit, and remind them that they share responsibility for maintaining biosecurity.

Signs should be placed at the main gate, external entrances, in visitor parking areas and wash-down facilities.

Signs at entrances or near storages should direct visitors to contact the owner or orchard manager to formally register their presence, before entering any production areas. Include contact details, such as the home telephone number, mobile number and/or UHF channel.

For further information on obtaining biosecurity signs for your property, contact the Citrus Biosecurity Manager, details on page 35.

You can download a template to produce your own sign from the Citrus Australia website **www.citrusaustralia.com.au/policy/quarantine-biosecurity.htm** or the Farm Biosecurity website **farmbiosecurity.com.au/toolkit**.

24 Managing high-risk visitors

You should make an assessment of the level of risk that each visitor to your orchard poses. There is a risk classification explanation at **farmbiosecurity.com.au** to help you. You can then take additional steps to reduce the chance of any high-risk visitors bringing new pests onto the orchard.

Overseas travellers

People returning from overseas to your orchard may pose a high biosecurity threat, especially if they have visited crops, farms, orchards or markets where plant or animal material was sold.

Great care should be taken to prevent the accidental introduction of overseas citrus pests into Australia. Clothes, hair and even watchbands can carry fungi (causing phytophthora root and collar rots) or bacteria (such as citrus canker), and weed seeds can easily lodge in clothes and pant cuffs.

Ideally, visitors from overseas or family members and employees returning from overseas, should ensure that clothing, hair and footwear has been washed before they come onto your property. Check that they have not brought any plant or animal material with them.

Contractors, itinerant workers and utility providers

Anyone who travels from property-to-property and region-to-region poses an increased biosecurity risk to your orchard.

Notable examples are contractors, itinerant workers, earthmoving companies, utility providers such as power, water, gas and communications employees, research personnel, consultants and mining operators, any of whom might enter properties in their day-to-day operations.

Pests can be easily spread from and to susceptible host plants on a visitor's clothing, equipment and vehicles. Plant debris still in contractors' machinery when they arrive at your orchard is a common problem.

Control the movement of these visitors with signs, designated parking areas, dedicated vehicles where possible, and use a visitor register.

Where possible, engage contractors who are signatories to an industry recommended hygiene protocol or program.

You have the right to request that visitors to your property and their vehicles and equipment are clean and free from pests, weed seeds and plant material. Providing a suitable wash-down facility away from production areas is an easy way to ensure that this requirement is complied with.

Clean footwear is particularly important for high-risk visitors

To ensure that your property does not become the source of pest infections for others, you have a responsibility to inform contractors of any declared or notifiable pests present on your orchard, so that they can take steps to avoid transferring them to the next place.

A Contractor Biosecurity Checklist is available from the Citrus Australia website **www.citrusaustralia.com.au/policy/quarantine-biosecurity.htm**.

You can provide this information to visitors when they sign in, or leave copies at external gate entrances to help raise awareness of orchard hygiene.

26 Managing vehicles and equipment

Any machinery coming onto your property, whether it is hired, borrowed, second-hand, contractor's machinery, or privately owned machines moved from property to property, could spread pests, diseases and weeds between properties. Vehicles too can spread pests in soil and plant material adhering to them.

It is impractical to stop all vehicle and equipment movement on and around the property, but there are steps you can take to minimise the entry and spread of pests, diseases and weeds.

Reducing risks posed by vehicles

Unless vehicles are kept clean they pose a biosecurity risk. Having all vehicles parked in a designated area gives you more control over risks. It gives you the opportunity to contain any potential pests away from production sites. It also allows for the inspection of tyres, equipment, floor mats and boots for soil and plant material.

You can inspect vehicles, talk to the driver about where they've come from and decide whether they are an acceptable risk.

Use a dedicated vehicle to move through production areas whenever possible; otherwise offer the use of a wash-down facility to clean vehicles before allowing them access to production areas. Recommended specifications for a wash-down facility are given below.

In production areas, keep vehicle movement to a minimum, especially on wet soil. Stick to regular pathways to minimise the threat of spreading pests and inspect these areas regularly for any problems.

Reducing risks posed by machinery and equipment

Soil and plant material containing pests and weeds can be carried on and inside equipment such as tractors, sprayers, pruning equipment and field bins.

Keep all equipment clean and ensure that any machinery brought onto your property doesn't pose a risk. Find out what crops the machine last operated on, any pests and weeds that were in that area and when the machine was last cleaned.

It's best practice to keep records of where the machine has recently worked and cleaning regime with the machine.

Providing places for visitor parking helps to reduce the risk to production areas

Do not allow the movement of machinery through designated visitor parking areas.

Regularly clean all tools and equipment of soil and plant residues, preferably with an antiseptic or bleach solution.

While it may seem like a lot of effort, inspecting and cleaning vehicles and machinery is more time and cost effective than managing a new pest.

A wash-down facility allows farm employees, contractors and visitors to clean their vehicles and equipment in an easily managed area

Cleaning vehicles and equipment

Wash-down facilities

A dedicated area for cleaning vehicles and equipment provides a great deal of protection against the introduction of new pests and weeds onto your property.

High pressure water or compressed air allows easy cleaning of all vehicles and equipment, and any visitor vehicles that need to enter production areas.

Locate a wash-down area between the driveway and property roads, and away from production areas. A sealed (concrete or bitumen) surface or a pad of packed gravel is ideal, with a sump to collect waste water and debris. Make sure mud, soil and plant material are kept away from crops, storage areas and waterways.

Inspect the wash-down facility regularly for the presence of pests and weeds, and treat as required.

The wash-down area may be the same as that used for wash-down of vehicles and equipment after applying chemicals. If so, all occupational health and safety issues associated with chemical wash-down areas must be taken into account.

Tips for effective cleaning

- While compressed air might be best for cleaning radiators and some machinery, anything with mud or dirt attached will need to be cleaned with high-pressure water.
- Clean machinery from the top down to avoid contaminating areas already cleaned.
- For additional protection, an added detergent-based degreaser or disinfectant (for example, Septone Truckwash®, Castrol Farmcleanse® or Virkon®) may be appropriate. Seek advice from re-sellers on the best product for your situation. For best results, remove as much soil and plant material as possible from the equipment before using the disinfectant.
- Dismantle vehicles and equipment as far as possible to give access to internal spaces.
- Leave covers off after cleaning to allow inspection and to dry.
- Get a second opinion – a fresh look will often pick up contamination you may have missed.

Ensure that orchard employees, contractors and visitors can clean their vehicles and equipment in an easily managed area

Citrus Biosecurity Manager raising awareness of orchard biosecurity and hygiene practices at a field day in Queensland

Managing risks posed by field days

Field days and on site trials provide valuable information to citrus producers, however they can also be the perfect occasion to spread unwanted diseases, pests and weeds. Become biosecurity aware when visiting or running a field day. Remember, you are at the forefront of good biosecurity practice.

The key biosecurity risks of field days and trials are:

- Introducing an unwanted pest or disease to the field site.
- Attendees taking a pest or disease back to their property.
- Pest or disease spreading throughout the district or even further.

Managing these risks can be simple, safeguarding all involved in hosting and attending field days.

For further information see the fact sheet available from the Citrus Australia website **www.citrusaustralia.com.au/policy/quarantine-biosecurity.htm**.

Biosecurity best practice checklist

To ensure your property has the best protection against the introduction and spread of new pests, use the following self-assessment questions to identify the strengths and weaknesses of your orchard activities.

This process forms the basis of an orchard biosecurity action plan which will allow you to systematically address any risks that you have identified. You can get further information and help to improve the biosecurity practices on your property from the Citrus Biosecurity Manager and at **farmbiosecurity.com.au**.

Date of biosecurity check: _____

RECOMMENDED PRACTICES	YES	COMMENTS
Monitoring crops and reporting anything unusual		
Orchard regularly inspected for exotic pests and anything unusual.		
Active pest surveillance is regularly conducted, with activities and results recorded, even when nothing is found.		
You, your staff and family are familiar with common established and exotic pests of citrus.		
You, your staff and family know how to report suspect pests.		
Pest awareness material is available to staff and family.		
Using pest-free planting and propagating material		
Propagation material fully tested, pest-free and purchased from nurseries that source their material from Auscitrus.		
Seed, budwood and nursery trees are thoroughly checked for pests and diseases upon arrival.		
Records of seed, budwood and nursery trees and their source maintained.		

RECOMMENDED PRACTICES	YES	COMMENTS
Managing produce carefully		
Accredited chemical training undertaken for the safe use of pesticides.		
Pesticide labels and withholding periods adhered to.		
Equipment used to store or transport propagation material or fruit is cleaned on arrival and exit from the property.		
Fruit is covered during transport.		
Fruit is loaded on compacted surfaces away from production areas.		
Fallen or waste fruit, packing shed waste and plant trimmings are disposed of away from production areas and irrigation sources.		
Records of the movement of plant material and produce that has left your property maintained.		
Managing people movement		
Biosecurity signs with contact details are located at all entrances to the property.		
Visitor access is restricted to designated parking areas.		
Only on-site vehicles are used to transport visitors and equipment around the orchard. Otherwise visitor vehicles pass inspection prior to entry.		
Visitors sign a visitor register on arrival to track movements on orchard and for trace-back purposes.		
All visitor and staff clothing, footwear and tools are inspected for loose soil or plant matter before entering and leaving the orchard.		
All visitors and workers recently returned from overseas are checked to ensure they have clean footwear and clothing before entering the orchard.		
Staff trained in biosecurity measures and orchard hygiene practices.		
Contractor entry to orchard is conditional on being made aware of orchard biosecurity plans and hygiene protocols.		
Hygiene supplies available for use where appropriate (e.g. hand sanitiser, gloves, masks, disinfectant footbaths and scrubbing brushes).		
Contractors/visitors made aware if property has a declared or notifiable pest.		

RECOMMENDED PRACTICES	YES	COMMENTS
Reducing risks posed by vehicles and equipment		
Designated parking area for visitors and contractors is available and clearly signposted. Area checked regularly for new pests.		
Cleaning and wash-down facilities, preferably on a concrete pad, provided for people, machinery and equipment and clearly signposted with instructions.		
High pressure water or air available for use to remove plant material and soil from equipment and machinery.		
Sump installed in wash-down facility to catch unwanted weeds and stop run-off into waterways.		
Wash-down facility and surrounds inspected on a quarterly basis (i.e. check that everything works, clean the sump and check it for unwanted pests). Records kept and updated.		
Machinery entering the property is inspected for pests, soil and plant material prior to entering production areas.		
Vehicle movement is kept to a minimum in production areas.		
Secateurs used for trimming roots, budding and grafting knives are disinfected between trees.		
Borrowed and second-hand machinery and equipment is cleaned and disinfected before use.		
Machinery and equipment cleaned before being moved off property.		

Further information

34 Useful contacts

More information on biosecurity, farm/orchard hygiene, pests and the citrus industry can be found through the following sources.

Contact details	
Organisation	
Citrus Australia Ltd.	**Phone:** 03 5023 6333 **Email:** admin@citrusaustralia.com.au **Website:** www.citrusaustralia.com.au
Auscitrus (Australian Citrus Propagation Association Inc.)	**Phone:** contact@auscitrus.com.au **Email:** contact@auscitrus.com.au **Website:** www.auscitrus.com.au
Plant Health Australia (PHA)	**Phone:** 02 6215 7700 **Email:** biosecurity@phau.com.au **Website:** www.planthealthaustralia.com.au
Farm Biosecurity	**Phone:** 02 6215 7700 **Email:** info@farmbiosecurity.com.au **Website:** www.farmbiosecurity.com.au
Government	
Australian Government – Department of Agriculture	**Phone:** 02 6272 3933 **Website:** www.daff.gov.au
New South Wales – Department of Primary Industries	**Phone:** 1800 808 095 or 02 6391 3100 **Website:** www.dpi.nsw.gov.au
Northern Territory – Department of Primary Industry and Fisheries	**Phone:** 1800 808 095 or 08 8999 5511 **Website:** www.nt.gov.au/d
Queensland – Department of Agriculture, Fisheries and Forestry	**Phone:** 13 25 23 or 07 3404 6999 **Website:** www.daff.qld.gov.au
South Australia – Department of Primary Industries and Regions SA	**Phone:** 1300 666 010 or 08 8226 0995 **Website:** www.pir.sa.gov.au
Tasmania – Department of Primary Industries, Parks, Water and Environment	**Phone:** 1300 368 550 **Website:** www.dpipwe.tas.gov.au
Victoria – Department of Environment and Primary Industries	**Phone:** 13 61 86 or 03 5332 5000 **Website:** www.depi.vic.gov.au
Western Australia – Department of Agriculture and Food	**Phone:** 08 9368 3333 **Website:** www.agric.wa.gov.au

Citrus Biosecurity Manager

The Citrus Biosecurity Manager is employed under the Citrus Biosecurity Program, an initiative to improve the management of, and preparedness for, biosecurity risks that threaten the citrus industry. Launched in 2013, the program is managed by PHA and funded by growers through Horticulture Innovation Australia using the citrus industry R&D levy and matched funds from the Australian Government.

The Citrus Biosecurity Manager coordinates industry biosecurity activities, delivers training and develops material to raise awareness to growers, consultants and other industry stakeholders. PHA manages the national program and assists the Biosecurity Manager to deliver key messages by producing communication tools such as biosecurity signs, fact sheets and media releases.

For more information about the Citrus Biosecurity Program contact the Citrus Biosecurity Manager or email **biosecurity@phau.com.au**.

Citrus Biosecurity Officer	Phone	Email
Stuart Pettigrew	0429 936 812	stuart@agdynamics.com.au

If you see anything unusual call the Exotic Plant Pest Hotline 1800 084 881

EXOTIC PLANT PEST HOTLINE
1800 084 881

Visitor register

Please enter your details to assist us with our orchard biosecurity records

Date	Time on property		Name	Reason for visit	Vehicle registration and mobile	Blocks visited	Location/date of last contact with citrus plants in the last 8 days
	Arrival	Departure					

If you see anything unusual, call the Exotic Plant Pest Hotline on 1800 084 881

An electronic version of this Visitor register can be downloaded from the Farm Biosecurity website **www.farmbiosecurity.com.au**

EXOTIC PLANT PEST HOTLINE
1800 084 881

Pest surveillance data sheet

Orchard: _____

Name of person inspecting: _____

Date: _____

		Established pests				Exotic pests			
Block	No. sites	Pest 1	Pest 2	Pest 3	Pest 4	Pest 1	Pest 2	Other pests found	Comments

If you see anything unusual on your farm call the Exotic Plant Pest Hotline on 1800 084 881

EXOTIC PLANT PEST HOTLINE
1800 084 881

Estimated established pest infestation level (e.g. zero/low/med/high or % crop affected) and established pests presence/absence should be scored.
Pests targeted by surveillance must be named before surveillance initiated (for both established and exotic pests)

An electronic version of this Pest surveillance datasheet can be downloaded from the Farm Biosecurity website **www.farmbiosecurity.com.au**

Production record

Keeping comprehensive records of production value and costs will increase the accuracy of Owner Reimbursement Cost calculations if required during an eradication campaign for an Emergency Plant Pest under an approved Response Plan (see page 16 for details). A production value summary template can be downloaded from the Biosecurity toolkit at **farmbiosecurity.com.au/industry/fruit-and-nuts/fruit-nuts**. A list of the common items that should be included in your records is provided below.

Crop value (including breakdown by variety)

AREA CROPPED Total area cropped _____ (eg. ha)

Variety	Location	Area cropped

YIELD Total yield _____ (eg. mt)

Variety	Yield	Comments

MARKET PRICE Total cost $ _____

Market location	Variety	Price
		$ Evidence (e.g.receipts)
		$ Evidence (e.g.receipts)
		$ Evidence (e.g.receipts)
		$ Evidence (e.g.receipts)

ITEMS INSTALLED ON SITE
Total cost depreciation on capital items $ _____

Item details	Amount	Cost (depreciated)

STOCKTAKE OF CITRUS TREES
Total tree cost $ _____

Variety	Number of trees	Tree costs (each season)

PRODUCTS STORED

Variety	Amount	Time period of storage

Pruning and harvesting costs			Net profit from season		
COSTS FOR PRUNING AND HARVESTING Total cost $ _____			TOTAL SALES $ _____	TOTAL COSTS $ _____	TOTAL NET PROFIT $ _____
Time (staff hrs for harvest & pruning)	Machinery costs (to run or hire)	Contractor costs (if used)			

Additional copies of this production value summary can be downloaded from **www.farmbiosecurity.com.au/crops**

If you see anything unusual on your farm call the Exotic Plant Pest Hotline on 1800 084 881

EXOTIC PLANT PEST HOTLINE
1800 084 881

Huanglongbing

What is huanglongbing?

Huanglongbing (HLB), also known as citrus greening is a devastating disease of citrus and other Rutaceae species that leads to tree decline and death. There are three strains of bacteria that cause the disease, *Candidatus* Liberibacter asiaticus, *Ca.* L. africanus and *Ca*. L americanus. HLB is transmitted by the Asiatic citrus psyllid (*Diaphorina citri*) and African citrus psyllid (*Trioza erytreae*). All commercial citrus are affected as well as Australian native citrus and some ornamentals in the Rutaceae family including orange jasmine (*Murraya*). The disease affects all plant parts and growth stages of citrus and there is currently no cure.

Mottled leaves and partially green fruit

What should I look for?

Symptoms vary with season and between citrus species and varieties. Common symptoms include complete yellowing of leaves and growing shoots or chlorosis and mottling of leaves that crosses leaf veins and is asymmetrical on the leaf blade. Branch dieback and thickening of midribs and veins may also be observed.

Other symptoms include unseasonal and heavy flowering on diseased branches and out of phase flushing. Chronically infected trees are sparsely foliated with extensive twig and limb dieback and small, upright leaves with compressed internodes. Eventually the tree may go into complete decline and die. Fruit may be small, lopsided, hard and bitter-tasting with dark, aborted seeds. Fruit may also remain partially green or ripen backwards and excessive fruit drop may also be observed.

Chlorotic leaves with green islands

What can it be confused with?

HLB can be confused with mineral deficiencies, particularly zinc, however, mottling of leaves crosses veins in HLB and is asymmetrical, whereas in zinc deficiency, mottling occurs symmetrically between or along leaf veins. In addition, in mineral deficiency yellowing is distributed uniformly throughout the

Small lopsided fruit

canopy, whereas in HLB it appears randomly arranged in the canopy. HLB may also be confused with other diseases such as Australian citrus dieback, citrus tristeza virus, Phytophthora root rot and citrus blight.

How does it spread?

Short distance spread occurs via the Asian and African citrus psyllid vectors. Movement of these vectors on wind currents can also lead to long distance spread of HLB. Other routes of spread are through the movement of HLB-infected citrus plants or plant material (budwood, cuttings, rootstock) and also plants and plant material (e.g. leaves) infested with Asian or African citrus psyllid eggs or nymphs that are infected with HLB. This includes host plants such as orange jasmine (*Murraya*) and curry leaf (*Bergera koenigii*).

Where is it now?

The Asiatic strain of HLB (*Ca.* L. asiaticus) is present throughout Asia, in the Middle East, South America, Central America, the Caribbean and some southern states of the USA. Regions close to Australia where it is present include Indonesia, East Timor and Papua New Guinea. The African strain (*Ca.* L. africanus) is found in Africa and the Middle East and the American strain (*Ca.* L. americanus) is found in Brazil.

How can I protect my orchard from huanglongbing?

Ensure propagation material is purchased from suppliers that source their budwood from Auscitrus. Check your orchard frequently for the presence of new pests and investigate any sick plants for unusual symptoms. Keep records of anything unusual and ensure that all staff and visitors adhere to orchard biosecurity and hygiene practices.

If you see anything unusual, call the Exotic Plant Pest Hotline

EXOTIC PLANT PEST HOTLINE
1800 084 881

Pomelo tree showing dieback

Leaves showing blotchy mottling

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Asiatic and African citrus psyllids

What are Asiatic and African citrus psyllids?

The Asiatic citrus psyllid (*Diaphorina citri*) and African citrus psyllid (*Trioza erytreae*) are sap-sucking bugs that are serious pests of citrus. Their feeding causes direct damage to citrus plants, however it is their ability to transmit the bacterial disease huanglongbing that is most damaging. All commercially grown citrus are hosts, as well as some Australian native citrus and citrus relatives that are distributed widely in native or naturalised vegetation, home gardens and parks (e.g. *Murraya* – native and ornamental varieties of orange jasmine and curry tree). Neither of these psyllids nor huanglongbing are present in Australia, however they would present a major economic threat to citrus growers if they became established. The Asiatic citrus psyllid has previously entered Australia and was eradicated.

African citrus psyllid adult and eggs

What do they look like?

Adult Asiatic citrus psyllids are about 3-4 mm long with a mottled brown body and a light brown head. The forewing is mottled and has a brown band extending around the periphery of the outer half of the wing. Antennae have black tips with two small light brown spots on the middle segments. Adult African citrus psyllids are about 4 mm long with a light brown-grey body and a black head. They have large transparent forewings with clearly outlined veins. Antennae are almost entirely black. The psyllids may be covered with a whitish, waxy secretion making them appear dusty.

Asiatic citrus psyllid eggs, nymphs and white waxy secretions

What can they be confused with?

Psyllids can be confused with aphids, however psyllids are more active and jump at the slightest disturbance compared to aphids which are more sluggish. Psyllid nymphs (immature stages) can also be confused with soft scale insects, such as soft brown scale (*Coccus hesperidum*), a common pest of citrus throughout Australia, although on close examination the psyllid nymphs have clear body parts compared with scale.

What should I look for?

Any psyllid found on citrus should be considered suspect as there are no psyllids found on citrus in Australia. When present, Asiatic and African citrus psyllids are commonly found aggregated on young, tender flush. When young flush is not available, psyllid adults can usually be found on the underside of leaves feeding in the area of the midvein. They have a distinctive feeding stance with their head down and body raised from the surface at a 45 degree angle.

New leaf growth is most severely damaged, and may show curling, notching and deformation, as well as leaf drop and sometimes death of shoots. For Asian citrus psyllids, long, white, waxy secretions are a clear indicator of this species. For both species, honeydew

may also be present that can lead to black sooty mould development. African citrus psyllid nymphs also produce characteristic cup-shaped, open galls on the under surface of young leaves. Also look for signs of huanglongbing infection which include yellowing of shoots, chlorosis and mottling that crosses leaf veins, out of phase flushing, branch dieback, lopsided, hard, bitter-tasting fruit and excessive fruit drop.

Look for eggs of *D. citri* which are bright yellow/orange, about 0.3 mm long and laid in groups on buds and young flush, on the tips of growing shoots, and on and between unfurling leaves, with the long axis vertical to the surface. Eggs of *T. erytreae* are yellow or orange, about 0.5 mm long, cylindrical shaped with an upturned sharp point. Eggs are laid mostly along the edges or midribs of young, tender, actively growing flush, with the long axis horizontal to the surface, as well as occasionally being laid on flower buds and young fruit.

How do they spread?

Psyllids are spread locally by flight and over longer distances via the movement of plant material infested with eggs or nymphs. Strong winds, such as those associated with storms and cyclones can also lead to long distance spread.

African citrus psyllid nymphs and galls

Asiatic citrus psyllid adults

Where are they now?

The Asiatic citrus psyllid occurs widely throughout Asia, in parts of South America, Central America, the Caribbean, Mexico, southern USA and the islands of Mauritius and Reunion. Regions closer to Australia where it is found include Indonesia, East Timor and Papua New Guinea. The African citrus psyllid has a more restricted distribution, occurring widely throughout sub-Saharan Africa, on some islands in the Atlantic and Indian Oceans, in Saudi Arabia, Yemen, Portugal and Spain.

How can I protect my orchard from the Asiatic and African citrus psyllids?

Check your orchard frequently for the presence of new pests and unusual symptoms. Make sure you are familiar with common citrus pests so you can tell if you see something different.

If you see anything unusual, call the Exotic Plant Pest Hotline

EXOTIC PLANT PEST HOTLINE
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Citrus canker

What is citrus canker?

Citrus canker is a serious disease of citrus and is caused by the bacterium *Xanthomonas citri* subsp. *citri* (also known as *X. axonopodis* pv. *citri*, and *X. campestris* pv. *citri*). Citrus canker infects a plant through wounds and natural openings on leaves, stems, thorns and fruit. The disease presents as lesions or cankers at infection sites and severely impacts fruit quality and yield. Symptoms are exacerbated by injury caused by feeding activity of the citrus leaf miner (*Phyllocnitis citrella*), the larvae of a small moth widely distributed in Australia. Citrus canker is not currently present in Australia, but has previously entered the country and was eradicated.

Cankers on citrus fruit surrounded by yellow halo

Thick and spongy lesions of citrus canker

Citrus canker infected fruit, stems and leaves

What should I look for?

The characteristic symptom of citrus canker is the formation of lesions on above-ground parts of citrus such as the leaves, stems, thorns and fruit. The lesions are initially tiny pin-point blemishes that are tan in colour and transition to brown or grey. Lesions expand over time to a maximum size of approximately 2-10 mm in diameter and become thick and spongy. Lesion margins have a watery or oily appearance, and on leaves and fruit, are surrounded by a yellow halo. Premature fruit drop can also occur, along with defoliation, twig dieback and general tree decline. In severe cases citrus canker can lead to tree death. The disease is more obvious and severe in tropical and subtropical areas or in the presence of the citrus leaf miner.

What can it be confused with?

Citrus canker could be confused with the disease lemon scab (*Elsinoe fawcettii*) which occurs in coastal areas of Australia, however, lesions of lemon scab are drier than those of citrus canker and lack the characteristic yellow halo. Citrus bacterial spot (*Xanthomonas alfalfae* subsp. *citrumelonis*), which is currently present in the USA (Florida), also has similar leaf symptoms to citrus canker; however, the lesions are flat and rarely form on citrus fruit.

How does it spread?

Citrus canker can be spread rapidly over short distances, particularly in tropical and subtropical climates, through water splash caused by wind-blown rain or even by overhead irrigation systems. Long distance spread occurs through flooding, cyclones, or through human assisted movement of infected plant material or equipment. While citrus canker is exacerbated by leaf miners, the leaf miner is not a vector of the disease.

Citrus canker lesions on a leaf

Where is it now?

Citrus canker is present throughout Asia and South America, on some islands in the Pacific and Indian Oceans, as well as some parts of the Middle East and in the USA (Florida).

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Tree stem infected by citrus canker

How can I protect my orchard from citrus canker?

Ensure propagation material is purchased from suppliers that source their budwood from Auscitrus. Check your orchard frequently for the presence of new pests and investigate any sick plants for unusual symptoms. Make sure you are familiar with common citrus pests so you can tell if you see something different. Keep records of anything unusual and ensure that all staff and visitors adhere to orchard biosecurity and hygiene practices.

Lesions on citrus fruit, leaves and stems

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Citrus fruit borer

What is the citrus fruit borer?

The citrus fruit borer (*Citripestis sagittiferella*) is a serious exotic pest of citrus that causes direct damage to fruit through the feeding activities of larvae. Larvae cause damage by tunnelling into fruit, producting deformation and premature rotting. This leads to reduced yield and quality as well as loss of market access.

Larval with damaged fruit and frass

What can it be confused with?

The sting marks left on fruit rind by fruit flies could be confused with the pock marks left by newly hatched citrus fruit borer larvae burrowing into the fruit. Fruit fly larvae (maggots), however, can be easily distinguished from citrus fruit borer larvae because the maggots are much smaller (6-8 mm) and are white or pale yellow in colour. Also, fruit fly larvae do not produce the loosely woven silken tube within the fruit.

The citrus fruit borer could also be confused with the orange fruit borer (*Isotenes miserana*), present in Queensland, NSW and NT, however the larvae of this borer are coloured brown on top, light grey underneath with a pair of brown stripes along the body.

Wing of Citrus fruit borer moth

What does it look like?

Larvae of the citrus fruit borer are reddish-yellow in colour transitioning to a darker reddish-brown towards pupation. At their largest, larvae grow to be about 18-21 mm in length. Adults are grey-brown moths approximately 10 mm in length with a wing span of 27 mm. The wings of adult moths are yellowish-brown at the front mottled with darker scaled markings, while the hind wings are almost transparent.

Citrus fruit borer moth on leaf

What should I look for?

Look for deformed fruit which is prematurely rotting and dropping. On closer inspection of fruit, the rind will be pock marked and there could be frass or gumming outside the hole. Egg clusters may be observed on the underside of citrus fruit as well as silken tubes woven loosely around larvae as they burrow into the pulp of the fruit. Larvae may be observed dropping to the ground on silken threads in order to burrow into the soil to pupate. In addition, larvae are fast moving and will jump or twist when touched or disturbed.

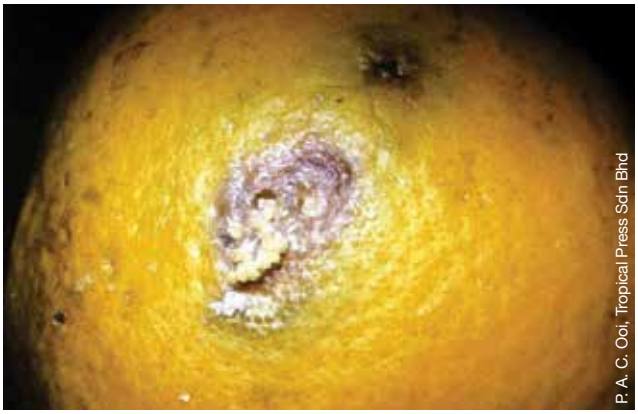
Citrus fruit borer larva

How does it spread?

Adult citrus fruit borer moths are strong flyers, particularly in the evening. It is possible that wind could disperse the moths over longer distances. Eggs, larvae and pupae can be transferred to different regions on plants and plant products as well as in soil.

Where is it now?

Citrus fruit borer is not known to occur in Australia. However, it is currently found in some of our closest neighbours, including Indonesia, Malaysia, Singapore, Vietnam and Thailand.



Orange fruit damaged by larva

How can I protect my orchard from the citrus fruit borer?

Check your orchard frequently for the presence of new pests and unusual symptoms. Make sure you are familiar with common citrus pests so you can tell if you see something different. Keep records of anything unusual and ensure that all staff and visitors adhere to orchard biosecurity and hygiene practices.

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Citrus stubborn disease

What is Citrus stubborn disease?

Citrus stubborn disease is a serious disease of citrus that leads to reduced fruit quality and yield. It is caused by the bacteria *Spiroplasma citri.* The disease gets its name from the persistence of infection when a tree is 'top-worked' with healthy budwood. All citrus can be infected by the disease, however, grapefruit, lemon, orange, mandarin and tangelo are most susceptible. There are numerous alternative hosts including many ornamentals and brassicaceous plants. Stubborn is transmitted by leafhopper vectors, and although none of the recorded vectors are present in Australia, it is possible that local leafhoppers could transmit the disease.

Stunted growth of infected citrus tree (right)

Infected tree carries fruit at all stages of development

Abnormal fruit development and uneven rind distribution

What should I look for?

Symptoms are variable and include short, broad leaves that are cup shaped and sit abnormally upright. Under very hot conditions, leaves on some shoots may have misshaped, blunted or heart shaped yellow tips. Leaves also show yellow mottling, similar to nutritional deficiencies and have shortened internodes leading to bunchy type growth. Trees may also flower out of season and carry fruit at all stages of development. Fruit produced by the plant may prematurely drop and can be lopsided or acorn-shaped, due to a thicker rind at the base and thinner rind at the tip. Fruit colouration may be inverted, lopsided or uneven. Severely affected trees are stunted with thin canopies, tip dieback, bitter tasting fruit and aborted seeds.

What can it be confused with?

Symptoms of Citrus stubborn disease can somewhat resemble the symptoms of huanglongbing, as well as nutrient deficiencies, frost damage and insect damage. However, the combined occurrence of several of the disease symptoms will provide a significant degree of confidence that Citrus stubborn disease is present.

How does it spread?

Citrus stubborn disease spreads via feeding activities of leafhopper vectors and over longer distances through the transportation of infected plant material, such as budwood.

Where is it now?

Citrus stubborn disease is more prevalent in hot, dry conditions but can still be present in cold climates. It is found in a number of countries, particularly the Mediterranean basin and the Middle East. It has also been detected in parts of the USA, South America and northern Africa.

How can I protect my orchard from Citrus stubborn disease?

Ensure propagation material is purchased from suppliers that source their budwood from Auscitrus. Check your orchard frequently for the presence of new pests and investigate any sick citrus plants for unusual symptoms. Make sure you are familiar with common citrus pests so you can tell if you see something different. Keep records of anything unusual and ensure all staff and visitors adhere to orchard biosecurity and hygiene practices.

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Normal citrus seeds (top) and partially or fully aborted seeds (bottom)

Infected fruit are coloured unevenly and remain small

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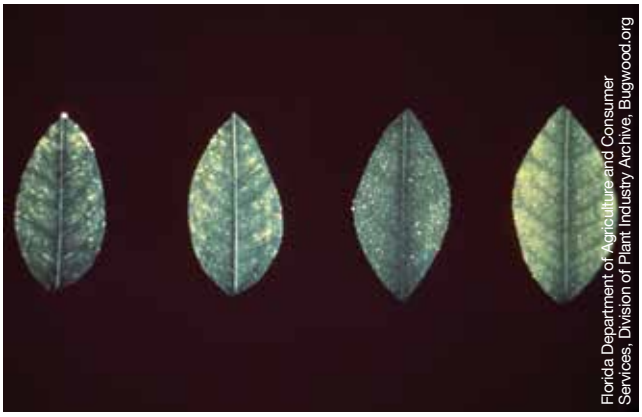
Citrus tristeza virus

What is citrus tristeza virus?

Citrus tristeza virus (*Closterovirus*) (CTV) is an economically important and destructive viral pathogen of citrus. There are many different strains which vary in severity and citrus species and cultivar-susceptibility. Several strains already occur in Australia, including sweet orange stem-pitting found in Queensland and grapefruit stem-pitting widely distributed in Australia. The mandarin stem-pitting strain is not present in Australia and has a severe impact on mandarins. CTV is spread by the brown citrus aphid (*Toxoptera citricida*) and black citrus aphid (*Toxoptera aurantii*), both of which are present in Australia.

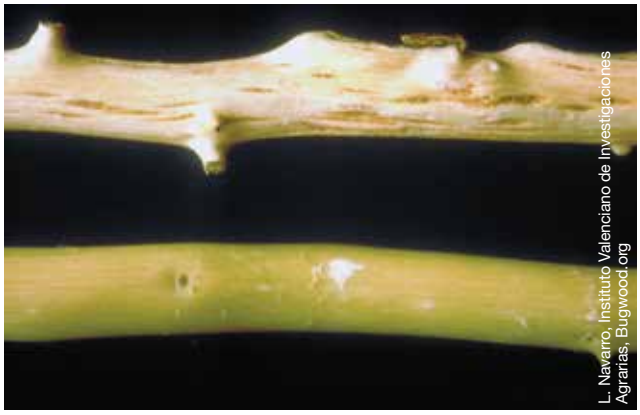
Infected tree (right) beside healthy tree (left)



Chlorosis and flecking of leaves

What does it look like?

Infected plants show pitting and gumming of the wood and as a result, twigs and branches become brittle. Leaves may show chlorotic flecking, vein clearing, leaf cupping and corking of veins. Limbs and trunks of chronically infected or larger trees may be bumpy or ropy in appearance. In severe cases trees show stunted growth and have fewer fruit of smaller size. In addition, numerous fine pits in severely affected trees may lead to a honeycomb appearance. The severity of stem-pitting symptoms varies from a few small pits, to many fine sandpaper-like pits overlaid by abnormally thickened bark. Early stages of stem-pitting are only visible if the bark is removed. If these symptoms are observed on any citrus other than grapefruit outside of Queensland, they should be reported to the state/territory department of agriculture.



Pitting on branch

What can it be confused with?

The symptoms of CTV are similar to root injury, particularly when looking at the condition of a whole tree. However, if the bark of a branch or stem is stripped back, the pitted appearance of the wood will clearly distinguish CTV from typical root injury.

How does it spread?

CTV is spread via local and wind-assisted movement of aphid vectors, through graft-transmission, and the movement of infected budwood or plant material infested with aphid vectors.

Where is it now?

CTV is distributed worldwide, and some strains already occur in Australia, including the grapefruit stem-pitting and sweet orange stem-pitting strains. The mandarin stem-pitting strain occurs in Indonesia, Japan, Malaysia and Thailand.

Reduced fruit size caused by CTV

Bumpy and ropey trunk caused by CTV

How can I protect my orchard from citrus tristeza virus?

Ensure propagation material is purchased from suppliers that source their budwood from Auscitrus. Check your orchard frequently for the presence of new pests and investigate any sick citrus trees for unusual symptoms. Make sure you are familiar with common citrus pests so you can tell if you see something different. Keep records of anything unusual and ensure all staff and visitors adhere to on farm biosecurity and hygiene practices.

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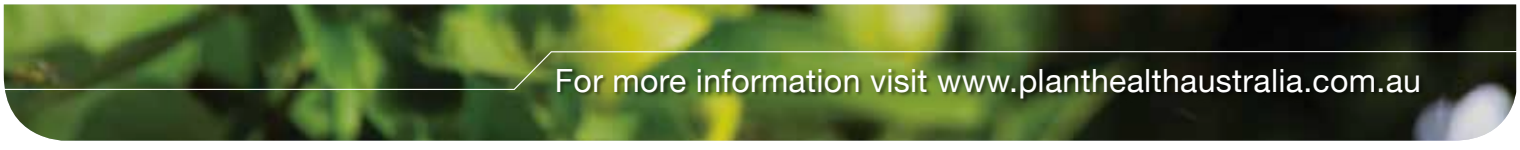

Citrus variegated chlorosis

What is citrus variegated chlorosis?

Citrus variegated chlorosis (CVC) is a serious disease of citrus caused by the bacterium *Xylella fastidiosa* subsp. *pauca*. This bacterium lives in the water conducting system (xylem) of the plant and is transmitted by xylem-feeding leafhoppers known as sharpshooters. Most citrus species and hybrids are susceptible, although the severity of symptoms is variable. It can spread rapidly and results in significant economic losses.

Tree symptoms showing yellowing of leaves

Clustered fruit which fails to ripen

Significantly reduced size of infected fruit

What should I look for?

Plants infected with CVC show symptoms similar to zinc deficiency, including yellowing and loss of leaves. The yellowing occurs on the upper surface of maturing leaves, particularly between the veins. As the leaf matures, small, slightly raised lesions appear on the underside of the leaf that correspond to the yellowing on the upper side. The lesions are initially light brown in colour and transition to dark brown, and can become necrotic. Affected trees may exhibit reduced vigour and growth, and may appear stunted, with defoliation at terminal twigs as well as small leaves. However, trees do not usually die.

Fruit may exhibit sunburn damage due to defoliation at branch terminals. In addition, fruit size is significantly reduced, and fruit may change colour early, have hard rinds, lack juice and have an acidic flavour. In some cases fruit can develop in clusters, resembling grapes.

Symptoms are usually more noticeable in trees between 7 to 10 years of age and will be aggravated when plants are stressed by high temperatures or drought conditions.

What can it be confused with?

Foliar symptoms of CVC may be confused with zinc deficiency, anthracnose and greasy spot. Fruit symptoms can be confused with sunburn.

Underside of leaf showing yellowing between veins and brown speckling

How does it spread?

CVC is transmitted through seed and grafting. It can also be spread via the movement of infected citrus nursery stock and plant material (budwood, cuttings, rootstock). CVC can also be spread by xylem-feeding vectors, such as the glassy-winged sharpshooter.

Upper surface of leaf showing yellowing between veins

Reduced fruit size and hard rind in infected fruit

Where is it now?

CVC infects citrus plants in parts of Central and South America, particularly in Brazil.

How can I protect my orchard from citrus variegated chlorosis?

Ensure propagation material is purchased from suppliers that source their budwood from Auscitrus. Check your orchard frequently for the presence of new pests and investigate any sick citrus plants for unusual symptoms. Make sure you are familiar with common citrus pests so you can tell if you see something different. Keep records of anything unusual and ensure all staff and visitors adhere to on farm biosecurity and hygiene practices.

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Exotic fruit flies

What are exotic fruit flies?

There are many fruit flies (FF) not currently present in Australia that would present a major risk to the citrus industry if they entered and became established. Some of these species include Mexican FF (*Anastrepha ludens*), Caribbean FF (*A. suspensa*), New Guinea FF (*Bactrocera trivialis*) and Oriental FF (*B. dorsalis*). The majority have wide host ranges and cause major economic impacts through production losses and restrictions on local trade and international market access.

Mexican fruit fly adult female; note the long ovipositor

Caribbean fruit fly adult female

Oriental fruit fly adults

What do they look like?

Mexican and Caribbean FF have yellow to brown bodies with long patterned wings. As with other *Anastrepha* spp., the wing pattern is characteristic, with the apical half of the wing having two inverted 'V'-shaped markings. Mexican fruit fly can be distinguished from *A. suspensa* by its wing band colour (pale yellow in Mexican fruit fly vs. dark brown in Carribean FF) and the long ovipositor of the Mexican FF female. In addition, the Mexican FF is about 7-11 mm long, while the Caribbean FF is about 12-14 mm long.

The Oriental FF is about 8 mm in length with clear wings and a slender, sharply pointed ovipositor. The colour of the fly is variable; however, there are prominent dark brown to black and yellow markings on the thorax. The abdomen is generally pale, with two horizontal black stripes and a longitudinal stripe in the middle which may form a distinctive dark coloured T-shaped marking. In contrast the New Guinea FF does not have this distinctive marking. It has a body that is black or a mixture of black and yellow, a thorax that is black with whitish-yellow markings, a predominantly black or yellow to orange-brown abdomen and clear wings.

What can they be confused with?

There are several species of fruit fly already present in Australia found on citrus. These include Mediterranean FF, present in parts of Western Australia and Queensland FF which is widespread throughout Queensland and has a limited distribution in the Northern Territory and south-eastern Australia. Any FF that looks different to those regularly encountered should be reported and further examined by an entomologist.

Caribbean fruit fly larvae in fruit

What should I look for?

As well as looking for adults (described left), look for larvae in suspect fruit which are the typical white colour and cylindrical shape of maggots and at full size measure about 7 mm. These appear following the laying of white banana shaped eggs beneath the skin of ripening fruit. Emerging larvae tunnel into the fruit to feed and contaminate it with frass. They leave holes when exiting to the ground to pupate in soil.

Fruit should be inspected for symptoms of infestation, such as puncture marks and black or brown lesions resulting from the associated decomposition of fruit. Infested fruit appears water soaked or distorted and considerable damage can occur inside the flesh before obvious signs of infestation can be seen on the fruit. Premature fruit drop may also occur.

New Guinea fruit fly adult

How do they spread?

Adult fruit flies can disperse over long distances by flight or wind currents and can also spread via the movement of fruit infested with larvae.

Where are they now?

Mexican FF is present in Central America, the Caribbean and Mexico. The Caribbean FF is present in the Greater Antilles, Virgin Islands, Bahamas and USA (Florida). The Oriental FF is widespread in mainland Asia, parts of south-east Asia (including Indonesia) and parts of the South Pacific. New Guinea FF is present in Papua New Guinea and Indonesia.

How can I protect my orchard from exotic fruit flies?

Check your orchard frequently for the presence of new pests and unusual symptoms. Make sure you are familiar with common citrus pests so you can tell if you see something different.

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Exotic thrips

What are thrips?

Thrips are tiny insects that feed and reproduce on a wide range of economically and environmentally important plant species including citrus. Several of these species affect multiple crops and could be introduced and spread rapidly on various host plants. Thrips can seriously affect citrus by contaminating fruit, reducing fruit quality and quantity and impacting market access.

Of particular concern to citrus are the exotic bean thrips (*Caliothrips fasciatus*), Florida flower thrips (*Frankliniella bispinosa*), blossom thrips (*F. insularis*) and California citrus thrips (*Scirtothrips citri*). Although South African citrus thrips (*S. aurantii*) is present in Australia, in Queensland, this particular biotype does not appear to have a strong preference for citrus, and therefore it is likely there are more damaging biotypes not present in Australia that pose a serious risk to citrus.

Blemishing on rind of fruit caused by South African citrus thrips

What do they look like?

Exotic thrips species all differ slightly in appearance but all are tiny (about 1 mm in length) and have four wings (adults), with the front wings typically fringed and folded back over the body when at rest. Immature thrips resemble adults but are typically smaller, wingless and yellow or orange in colour. Adult thrips can retain the yellow or orange colouration (such as Florida flower thrips, blossom thrips, California citrus thrips and South African citrus thrips), although they often develop some darker markings or transition to a dark greyish-black or brown colour (such as bean thrips).

Adult South African citrus thrips

What can they be confused with?

There are several species of thrips found in Australia on citrus, although many of these do not cause obvious damage. Kelly's citrus thrips (*Pezothrips kellyanus*) is the only thrips species present in Australia that cause halo marks on citrus fruit. The exotic California citrus thrips, South African citrus thrips and Florida flower thrips also leave similar scars on fruit; however, they have a yellowish coloured body compared to Kelly's citrus thrips, which is black and roughly double the size (2 mm). Due to the difficulty differentiating between thrips species without microscopic examination, it is recommended that all thrips symptoms be investigated further.

What should I look for?

Thrips feeding on young leaves can lead to curling, distortion and brown scarring. The rinds of citrus fruit attacked by California citrus thrips or South African citrus thrips also show grey or brown scarring which may appear as a halo around the apex. Flowers damaged by Florida flower thrips and blossom thrips typically turn brownish-yellow before turning black and dropping off the plant prematurely. Florida flower thrips also damage young fruit leading to premature drop and cosmetic scarring. Bean thrips adults shelter within the cavities of navel oranges leading to cosmetic damage and impacts on market access. As it is difficult to identify different thrips species, any change in scarring from thrips feeding should be investigated further.

How do they spread?

Adult thrips can fly, however, dispersal over larger areas is typically caused by wind systems or through the human movement of infested plants or plant material. Bean thrips can spread over long distances via the movement of fruit.

Where are they now?

Most of the thrips species mentioned in this fact sheet are found throughout Central and South America, with the exception of South African citrus thrips which are widespread in South Africa and parts of North Africa. Although they have also been found in Queensland, the biotype of South African citrus thrips present appears to only affect the pasture weed mother of millions and has not been detected on citrus.

How can I protect my orchard from thrips?

Check your orchard frequently for the presence of new pests and unusual symptoms. Make sure you are familiar with common citrus pests so you can tell if you see something different.

Adult bean thrips

Adult California citrus thrips

Immature and wingless thrips on leaf

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Glassy-winged sharpshooter

What is the glassy-winged sharpshooter?

The glassy-winged sharpshooter (GWSS) (*Homalodisca vitripennis*) is a xylem feeding leafhopper that causes direct damage to citrus plants through its feeding activities. However, the greatest threat is its potential to vector the bacterium *Xylella fastidiosa* subsp. *pauca* which causes citrus variegated chlorosis. Over 100 plant species are hosts of GWSS including many commercial hosts like grape, almond and peach as well as several ornamentals. These hosts would be severely threatened if GWSS became established in Australia, particularly if it is carrying *X. fastidiosa*.

Adult GWSS on leaf surface

Adult GWSS on stem

Adult GWSS showing white spots of excrement

What does it look like?

Adult GWSS are easily visible with the naked eye, measuring about 12-14 mm long with a dark brown to black colouring and a lighter underside. The upper parts of the head and back are dotted with ivory or yellowish spots and their wings are partly transparent with reddish veins. Watery excrement often collects on the sides of the insect, appearing as large white spots.

Clutches of up to 27 eggs are laid on the underside of leaves of citrus plants in a side-by-side arrangement and are dusted with a layer of whitish powder. Following hatching they change in appearance from green water blisters to tan or brown scars on the leaves. The immature nymphs that hatch from the eggs are wingless.

What can it be confused with?

Australian leafhoppers from the Auchenorrhyncha suborder share some features with GWSS including larger size, brown colouration and large head with prominent eyes.

What should I look for?

GWSS excretes copious amounts of liquid that can make leaves, stems and fruit appear white washed when dry. Look for egg masses that are usually laid into recently expanded foliage. Older foliage will contain the distinctive tan or brown scars left after the eggs have hatched. If *X. fastidiosa* enters Australia with the GWSS, the symptoms of citrus variegated chlorosis, such as leaf yellowing, brown lesions on the underside of leaves, leaf drop and small, hard fruit may be observed.

GWSS egg mass on leaf ready to hatch

How does it spread?

Adult GWSS are strong fliers and can move rapidly from plant to plant. Nymphs are wingless but can spread throughout the orchard by walking and jumping through the canopy or along the ground to a new host. Most rapid and long distance movement occurs through the transportation of viable egg masses on nursery stock of either crop or ornamental plants.

Where is it now?

GWSS is found in eastern and western USA, Mexico, Tahiti, French Polynesia and Hawaii. It has most recently spread to Easter Island and the Cook Islands.

Yellowing of leaves in citrus infected with citrus variegated chlorosis

How can I protect my orchard from the Glassy-winged sharpshooter?

Check your orchard frequently for the presence of new pests and unusual symptoms. Make sure you are familiar with common citrus pests so you can tell if you see something different. Keep records of anything unusual and ensure that all staff and visitors adhere to orchard biosecurity and hygiene practices.

If you see anything unusual, call the Exotic Plant Pest Hotline

EXOTIC PLANT PEST HOTLINE
1800 084 881

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PHA14-016