

Biosecurity Manual for the Papaya Industry

Reducing the risk of pests entering and becoming
established in your orchard

Version 1.0



Plant Health
AUSTRALIA



Horticulture 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



Papaya Australia is the peak industry body for the Australian papaya industry whose aim is to encourage the growth and development of the industry. Papaya Australia aims to supply Australian consumers with high-quality, papaya all year-round, while delivering a good return on investment for growers. The industry highly values the spirit of cooperation and sharing between growers; the benefits of united activities such as research and development and marketing; its relationship with local communities; care for the environment; and the general camaraderie and goodwill of its people.

www.australianpapaya.com.au



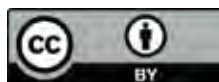
Horticulture Australia

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www.horticulture.com.au

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An electronic copy of this manual is available from the website listed above and from the Farm Biosecurity website www.farmbiosecurity.com.au

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Six easy ways to protect your farm

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You have an important role to play in protecting your property and the entire papaya industry from biosecurity threats.

Here are six easy ways you can reduce the threat of new pests entering and establishing on your property. Each of these pest management practices should be embedded in your orchard's everyday operations and management. Don't put your livelihood at risk by neglecting farm biosecurity.

1. Be aware of pests that pose a risk to papaya

Make sure you and your orchard workers are familiar with the most important exotic papaya pest threats. See page 6 for high priority pest threats to the papaya industry.

2. Keep it clean

Practice good farm hygiene to reduce the risk of pests entering and spreading around your property. Provide cleaning facilities so workers and visitors can clean hands and feet before entering or leaving your property. Vehicles and equipment can harbour pests and transfer them within and between orchards. Have a designated parking area, provide wash-down facilities, and use clean equipment on-farm. Ensure all planting and propagating material is from trusted sources and dispose of waste fruit and plant material carefully.

3. Monitor your orchard

Constant vigilance is vital for early detection of any exotic plant pest threat. Check your trees frequently. Knowing the usual appearance of your crops together with any common pests will help you recognise anything unusual.

4. Train, plan and record

Ensure that staff are well trained and that you keep records of purchases, sales and movements on and off your property. Consider any potential biosecurity weaknesses and plan to improve practices.

5. Abide by the law

Be aware of and abide by laws and regulations that have been established to protect the papaya industry, Australian agriculture, and your region. Your state or territory department of agriculture is the best source of information on movement restrictions and other requirements.

6. 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.

To learn more about protecting your property from biosecurity risks visit the farm biosecurity website www.farmbiosecurity.com.au



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Biosecurity overview

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This manual is designed to assist you in protecting your property and the papaya industry from new and invasive pests. By implementing the recommended measures in your day-to-day operations, you will improve your own biosecurity and that of your region, while minimising produce losses, unnecessary costs and the risk of losing export markets.

What is biosecurity?

Biosecurity is about the protection of livelihoods, lifestyles and the natural environment, which could be harmed by the introduction of new pests.

Biosecurity is a national priority, implemented off-shore, at the border and on-farm.

Australia's geographic isolation has meant that 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.

All Australians have a role to play in biosecurity: governments, industries, communities, individual producers as well as travellers and farm visitors.

Biosecurity is everybody's business.

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.

What is orchard biosecurity?

Orchard biosecurity is a set of measures designed to protect a property from the entry and spread of pests. Orchard biosecurity is your responsibility, and that of every person working on or visiting your property.

Growers can play a key role in protecting the Australian papaya industry from exotic pests. If a new pest becomes established in your orchard, it will affect your business through increased orchard costs (for additional monitoring and chemical use, alternative production practices, and the associated labour costs), reduced productivity (yield and/or quality reductions) and, potentially, reduced market access opportunities.

Early detection and immediate reporting of all exotic pests or diseases increases the chance of effective and efficient eradication of pests new to Australia or to your region.

Regional biosecurity

Biosecurity in your region can be strengthened through a collaborative approach. Engagement of the community, together with an understanding of the region's vulnerabilities and the potential source and nature of threats can focus regional efforts. Biosecurity awareness in your region can be supported by a commitment from all stakeholders to implement biosecurity measures, carry out surveillance and report suspect pests.

Potential biosecurity threats in your region might include neighbouring orchards, particularly where these are abandoned, as well as nurseries, other commercial plantings, native vegetation and/or peri-urban residential or amenity plantings.

Consider highlighting local biosecurity issues and activities at community meetings to promote public biosecurity awareness and strengthen regional biosecurity practices.

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

EXOTIC PLANT PEST HOTLINE
1800 084 881

Pests

High priority exotic pest threats of the papaya industry

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The following pests are the exotic pests that pose the greatest threat to the Australian papaya industry. The climate of Australia's papaya producing regions would allow each of these pests to survive, spread, and establish, should they be introduced, causing serious problems for producers.

Make sure that you and your workers are familiar with these pests and monitor your orchard regularly. Any suspicious plant/fruit symptoms or insect pests you have not seen before should be reported immediately to the Exotic Plant Pest Hotline on 1800 084 881, or to your state/territory department of agriculture.

More information on these pests are included in the fact sheets at the back of this manual.

Papaya mealy bug (*Paracoccus marginatus*)

OVERALL RISK – HIGH

- Small yellow-white insect that feeds on the sap of papaya and numerous other plants.
- Feeding causes leaf chlorosis, leaf distortions and can cause early fruit fall.
- While feeding, the mealy bugs produce honeydew which encourages sooty mould to develop. This reduces the marketability of fruit.
- The Papaya mealy bug occurs in southern and south eastern Asia, Central America, Mexico and Florida as well as some African countries.
- The pest could be introduced on plants and plant material from overseas and potentially people who have recently visited an infected papaya orchard.
- A Contingency Plan specific to Papaya mealy bug is available on the PHA website www.planthealthaustralia.com.au



Peggy Greb, USDA Agricultural Research Service, Bugwood.org

Oriental fruit fly complex (*Bactrocera papayae*, *B. dorsalis* and *B. carambolae*)

OVERALL RISK – HIGH

- Includes Oriental, Papaya and Carambola fruit flies.
- Found in Asia, Papua New Guinea, the Pacific and South America.
- Adults 6-8 mm long with a narrow brown band along the edge of the wings.
- Abdomen has a black T-shaped mark, which is similar to a number of other endemic species.
- Larval feeding can result in rotting of fruit and may cause fruit to drop.

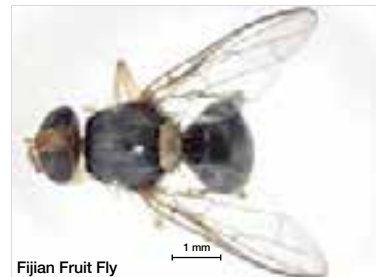


Scott Bauer, USDA Agricultural Research Service, Bugwood.org

Fijian fruit fly (*Bactrocera passiflorae*)

OVERALL RISK – HIGH

- The Fijian fruit fly is a 6-8mm long, black-coloured fruit fly.
- Causes damage to a range of fruit including papaya.
- Currently in Fiji, Tonga, Tuvalu and Western Samoa.
- Could potentially be introduced by the importation of fruit containing fly larvae.
- Once in Australia it would be capable of causing significant damage to tropical and subtropical fruit production areas.



Fijian Fruit Fly

Ken Walker Museum Victoria, PaDL

Papaya fly (*Toxotrypana curvicauda*)

OVERALL RISK – HIGH

- The Papaya fly is a yellow-brown-coloured fly that is approximately 8-12.5 mm long with a 11-13.5 mm long ovipositor that attacks papaya fruit.
- Losses of up to 30% have been reported from Florida.
- The Papaya fly is found in tropical and subtropical areas of the Americas from the southern USA to Venezuela.
- Could potentially enter Australia as larvae in infected fruit.
- If introduced it would severely affect the Australian papaya industry.



Papaya fly

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

Philippine fruit fly (*Bactrocera philippinensis*)

OVERALL RISK – HIGH

- Larvae attack a wide range of hosts including papaya.
- Occurs in the Philippines and Palau.
- Methyl eugenol traps can be used to attract male fruit fly which will help to detect the pest.
- The fly can enter Australia as larva in infected fruit.
- If it enters Australia it is likely to have a significant impact on the papaya industry.



Philippine fruit fly

Anthony O'Toole, Secretariat of the Pacific Community (SPC)

Melon fruit fly (*Bactrocera cucurbitae*)

OVERALL RISK – HIGH

- The Melon fruit fly is a 6-8mm long small orange-brown-coloured fly with distinctive brown spots on its wings.
- It affects a number of crops including melons, citrus and papaya.
- The fly could enter Australia as larva in infected fruit.
- Currently occurs in Northern Africa, southern Asia, Southeast Asia and Hawaii.
- Has the potential to affect Australia's fruit producers, including papaya growers.



Melon fruit fly

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



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Exotic spider mites (*Tetranychus* spp. including: *T. piercei* and *T. truncatus*)

OVERALL RISK – MEDIUM/HIGH

- Papaya is affected by a number of endemic (e.g. Two spotted spider mite *T. urticae*) and exotic spider mites (e.g. *T. piercei* and *T. truncatus* which both occur in Asia).
- Spider mites feed on the plant's sap causing leaves to become covered with spots of lighter green. Spider mites also produce silk webs on the undersides of leaves. Together these symptoms are diagnostic of spider mites.
- Feeding also causes reduced fruit quality and yield.
- All spider mites are very small (usually only 0.5 mm long). The colour of adults can assist in identification – Adult *T. urticae* are a yellow-green or red colour with two dark spots, while adult *T. piercei* and *T. truncatus* are usually a dark red colour without spots.
- If you see an unusual mite contact your state/territory department of agriculture or the Exotic Plant Pest Hotline on 1800 084 881.



Spider mites

David Cappaert, Michigan State University, Bugwood.org

Bacterial crown rot (*Erwinia papayae*)

OVERALL RISK – HIGH

- The bacteria cause the leaves of the papaya plant to yellow and die.
- Stems and crown often develop discoloured, water-soaked areas.
- Fruit can also be infected and become water-soaked and unsaleable.
- Disease is responsible for significant losses overseas and occurs in Malaysia, the Caribbean and the Mariana islands.
- Could be introduced on plant material or by visitors who have come into contact with infected plants.
- A Contingency Plan specific to Bacterial crown rot is available on the PHA website www.planthealthaustralia.com.au.



Erwinia papayae

L. Vawdrey and R. Fullerton

These high priority exotic pests were identified through the development of the *Industry Biosecurity Plan for the Papaya Industry*. See this document for a complete list of exotic pest threats, available from Papaya Australia admin@australianpapaya.com.au.

Papaya pests already present in Australia

If pests or plant symptoms are found that are not normally present on your property, they may be new not only to your property, but to the region, or even Australia. Knowing how to recognise their presence and promptly report new pests is essential for containment and eradication programs.

Endemic fruit flies

The Queensland fruit fly (Qfly) (*Bactrocera tryoni*) and Mediterranean fruit fly (Med fly) (*Ceratitis capitata*) are significant threats to papaya production and accessing vital export markets. Qfly is widespread throughout Queensland and has a limited distribution through south-eastern Australia. Medfly is restricted to Western Australia. Further information can be found at www.preventfruitfly.com.au.

Papaya ringspot virus (*Potyvirus*) – Strain P

- Disease is caused by a virus that is spread by various aphids or by planting diseased plants.
- Virus causes yellow patterns to develop on leaves and leaf rolling to occur. Green ring-shaped markings develop on the skin of infected fruit and oily streaks develop on the plant's stem. Trees may also become stunted if infected when young.
- Some mites may also cause leaf yellowing but obvious rings on fruit are tell-tale signs of the virus.
- Infection causes reduced fruit set and reduced vigour as well as reducing fruit quality and taste.
- There is no cure for this disease.
- Virus affects papaya, watermelon, pumpkins and cucurbits.
- Occurs in most tropical and subtropical countries including Australia.
- In Australia the virus is restricted to south east Queensland.
- A quarantine area exists in the south eastern corner of Queensland extending from the border north to Lowmead (24°30' S) and from the coast west to near Theodore (150° E) see http://www.daff.qld.gov.au/4790_20407.htm for details.
- If you see symptoms of Papaya ring spot in plants that are outside the quarantine area, contact your state or territory department of agriculture or call the Exotic Plant Pest Hotline on 1800 084 881.



Papaya ring spot – fruit symptoms



Papaya ring spot – plant symptoms

Dr Jorge A. M. Pezende ESALQ, padli.gov.au

L. Vawdrey

Your local department of agriculture (listed on page 28) will be able to provide further information on these and other papaya pests which are under active control programs.

Early detection and reporting of pests

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Orchard monitoring and surveillance involves looking for and recording the presence, absence and population levels of pests. Regular monitoring is a fundamental part of orchard management practices and gives the best chance of spotting and reporting a new pest soon after it arrives. Together with early reporting, monitoring your trees provides the best protection against new pests.

Monitoring your orchard

Checking trees regularly for pests is important for:

- **Market access:** Export destinations for papaya can require 'evidence of absence' data for exotic, and some established, pests of concern. The Australian papaya industry, in collaboration with governments, must prove through surveillance that exotic pests have been looked for and found to be absent.
- **Exotic pest eradication:** Early detection of exotic pests improves the chance of eradication or containment within a region. However, if eradication or containment is not feasible, early detection, in conjunction with contingency planning and preparedness by government and industry bodies (e.g. preparing emergency chemical registrations, permits for importation of biocontrol agents, awareness material and training in pest diagnostics) assists with a more rapid and effective response.

- **Improved pest management:** Regular inspections of orchards to determine pest presence and population levels will inform management practices.
- **Pest status information:** Surveillance at the orchard level contributes essential information to regional biosecurity efforts and ultimately to the national status (presence/absence) of a pest.

Record all monitoring activities. These records can be used in the response to a pest incursion and can support industry surveillance activities.

An example of a suitable Pest monitoring sheet is included on page 31 of this manual.



What to do if you find something unusual

Early detection and reporting through regular crop monitoring may prevent or minimise long-term damage to your orchard and the papaya industry. If you observe something you are not familiar with, you should have it checked. Obvious plant symptoms, such as reductions in tree health, may not appear until pest populations have built up to uncontrollable levels, by which time eradication may be more difficult or require more extreme measures.

If you have found a suspected exotic plant pest, report it immediately to the Exotic Plant Pest Hotline on 1800 084 881.

Calls to this number will be forwarded to an experienced person in your state or territory government who will ask questions about what you have seen and may arrange to collect a sample.

In some states, the Exotic Plant Pest Hotline operates only during business hours. Outside these hours, leave your full contact information and a brief description of the issue and your call will be followed up as soon as possible. Every report will be taken seriously, investigated and treated confidentially.

Do not send samples off the property without first speaking to someone from your state/territory department of agriculture to discuss the correct type of sample, its packaging, handling and

transport to the laboratory assigned for diagnosis. Incorrect handling could spread the pest further or render the samples unfit for diagnosis.



Date E. Meyerdik, USDA-APHIS PPQ, Bugwood.org

Inspect underperforming trees for signs of pests

Take the following general precautions to contain the pest and protect other parts of your orchard:

- Mark the location of the pest and limit access to the area for both people and equipment.
- Wash and sanitise hands, clothes and boots that have been in contact with affected plant material or soil.
- Restrict operations in the area while waiting for the identification of the suspected exotic pest.

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

**EXOTIC PLANT PEST HOTLINE
1800 084 881**

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The Emergency Plant Pest Response Deed

While every effort is taken, the risk of Emergency Plant Pest (EPP) incursions in Australia cannot be eliminated entirely, so governments and some industries have agreed to share responsibility for responding to EPP incursions when they occur. The Emergency Plant Pest Response Deed (EPPRD) is the formal, legally binding agreement between Plant Health Australia (PHA), the Australian government, all state and territory governments, and plant industry signatories, which sets out how incursions of Emergency Plant Pests are handled in Australia. Being a signatory to the EPPRD confers rights and responsibilities, providing industries with a seat at the decision making table and a standardised cost-sharing arrangement for any approved Response Plan that is implemented to eradicate an EPP. More information on the EPPRD is at www.planthealthaustralia.com.au/epprd

Owner Reimbursement Costs

An underlying principle of the EPPRD is that growers are not worse off as a result of reporting a suspect EPP. The agreement allows for grower reimbursement payments, known as Owner Reimbursement Costs (ORCs), for direct costs incurred as a result of the implementation of an approved Response Plan. ORCs may cover direct grower costs or losses through such actions as the destruction of crops, enforced fallow periods, replacement of trees and additional chemical treatments.

ORCs only apply to approved Response Plans aimed at eradication, and only apply to industries that are signatories to the EPPRD.



Bugwood.org



People and biosecurity

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People moving onto and around your property are a biosecurity threat. There are simple steps that you can take to minimise the risk these movements pose.

Biosecurity signs

Well-designed farm biosecurity signs inform visitors to your property that biosecurity is important and that they share responsibility for maintaining it. The signs serve to alert people to the potential impact of their visit and demonstrate your commitment to orchard hygiene. Typically they are posted at the main gate as well as other external entrances, visitor parking areas and wash-down facilities.

Signs should direct visitors to contact the owner or orchard manager to formally register their presence before entering any production areas. Provide contact details, such as the home telephone number, mobile number or UHF channel.



You can download the template for this farm biosecurity sign from www.farmbiosecurity.com.au.

Managing threats from people movement

People moving between orchards, nurseries and other horticultural regions can spread pests on clothing, footwear, and equipment. Even hair and watchbands can carry fungal spores or bacteria between properties. Threats from human activity can be reduced by monitoring movements and raising awareness of hygiene practices on your property.

Maintain a visitor register (example on page 30) to record visitor movements and help manage safety issues. Make sure that all workers, contractors, casual workers and visitors are aware of your orchard biosecurity requirements.

Ensure that employee and visitor footwear and clothing is free of soil and plant material before entering or leaving the orchard. Ideally, provide scrubbing brushes, footbaths, boot covers, rubber boots and protective clothing for people entering or leaving your orchard, or moving from contaminated to clean areas of the property.



Cleaning footwear reduces the risk of spreading pests



Footbaths located at the entrance to production areas must contain strong concentrations of disinfectant that is replenished regularly as the build-up of mud, organic matter and rain into these solutions will lower their effectiveness.

Ensure that fruit pickers are diligent about cleaning their tools and footwear regularly (e.g. between rows) as cutting tools and mud on boots can spread pests and diseases around your orchard.

Keep biosecurity awareness high among workers by displaying simple biosecurity material such as posters in staff rooms and packing sheds.



Wash tools regularly to prevent spreading diseases

Casual workers and tourists

Casual workers such as contract harvest crews and backpackers employed to assist with planting, harvesting/picking and packing can pose a particular biosecurity threat because they move from orchard-to-orchard and from region-to-region. They can potentially carry and spread pests on their clothing, footwear, gloves, equipment and tools.

Make sure casual workers are well briefed on biosecurity measures at your property and have changed or cleaned and disinfected their clothes, boots, and all tools and equipment. Where possible, provide workers with hand tools that are dedicated to the property.

Overseas travellers

People returning from overseas are a potential biosecurity threat, particularly if they have visited orchards, nurseries, or markets where plant material and produce was sold.

To protect your orchard from overseas pests, ensure that all people who have recently returned from overseas have cleaned their boots and clothes before entering the orchard. Air travel means exotic plant pests might be only a few hours away.

16 Contractors and utility providers

Like casual workers, contractors pose a significant risk because they move between properties. This includes utility providers, orchard contractors, earthmoving companies, research personnel or anyone who enters an orchard in their day-to-day business.

To minimise the risk, place biosecurity signs on external property gates to alert contractors of the need to contact you before entering production areas. This provides you with an opportunity to inspect vehicles and equipment and to register visitors.



Request that all vehicles and equipment are cleaned before starting work on your property. Ideally, provide access to a well-equipped wash-down bay to assist you and your visitors to remove any foreign organic matter that may harbour pests, diseases or weed seeds.



Post-harvest operations and transport providers can pose a risk of transferring pests between properties. Ensure that any equipment entering your property, from hand tools to harvest bins, are clean and free of any organic matter that could introduce pests.

As an incursion in your region may not be identified straight away, you should introduce a procedure that allows you or your staff to always inspect these items before they enter your property.

To ensure 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 already present in your orchard.







Vehicles and equipment

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Pests and weeds can enter a farm and be spread by equipment and vehicles, either directly or on adhering soil and plant material. It is important to maintain equipment hygiene and ensure all vehicles that visit your property are clean and well maintained. Recording vehicle and equipment cleaning is also recommended.

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

Vehicle access

It is impractical to stop all vehicle movement on and off the property, but there are steps you can take to manage the risk.

Display biosecurity signs, with clear instructions and contact details, at all vehicle access points. Keep a visitor record. Knowing who has entered your property allows possible sources of diseases, pests or weeds to be tracked.

Manage vehicle access by reducing the number of vehicle entry points to your property. Consider the risk each entry poses to production, especially proximity to orchards.

Once on your property contain vehicles and any pests they may bring by providing a well sign-posted designated parking area for all visitors away from production sites. This is particularly

important when properties are open to the public or have visits from other growers for field days or at equipment demonstrations. In addition to restricting movement around the property, a designated car park provides an opportunity for inspection of the vehicle for soil and plant material. The parking area should be regularly monitored for the presence of new pests. Don't move orchard machinery through this higher risk area.

Where possible, use a dedicated farm vehicle to carry visitors around your orchard. Keep vehicle movement to a minimum in these sensitive areas, especially on wet soil and stick to regular pathways through the orchard.

Clearly sign and lock restricted access areas.



Signs with clear instructions make people aware of your farm biosecurity practices



20 Vehicle hygiene

Request that all vehicles including delivery trucks, contractors, re-sellers, service providers, harvesters, sprayers, and earth moving equipment is cleaned before entering your orchard. These vehicles are likely to have come directly from another property and so pose a particular risk of spreading pests.

Ideally, establish a vehicle high pressure wash-down facility well away from the orchard to clean vehicles and equipment that need to enter the property. Pay particular attention to soil and plant material that may have accumulated on tyres, undercarriages, grills, floors and trays.

Follow any wash down with a broad spectrum disinfectant. This will further reduce the risk of introducing less visible threats like bacteria, viruses, and spores onto your property.



Equipment hygiene and storage

Any equipment used on the property can harbour pests.

Regularly clean all tools and equipment, including pallets, pallets, cherry pickers, boxes, bags, trimmers and any other equipment used in the orchard, preferably with a disinfectant or bleach solution. Store them away from potential contaminants.

Hose off and disinfect machinery in a designated wash-down area before moving between properties. Clean machinery from the top down and dismantle it as far as possible to gain access to internal spaces.

Regularly clean and disinfect all storage containers. The regular use of a suitable disinfectant is important and most effective when applied to a visually clean surface.

Ensure that any equipment used by contractors is washed down thoroughly to remove any plant material or soil before entering your orchard. Deny access to dirty machinery if necessary.

Always make sure that borrowed and second-hand equipment and machinery is cleaned of all plant material and soil before moving them into your orchard.

Keep records of equipment cleaning to ensure that it occurs regularly.

Dedicated equipment for high risk areas

Where possible, use dedicated orchard tools and equipment, even clothing and footwear, particularly in pest affected areas. The equipment used in infected or infested areas should not be reused in clean areas, and vice versa.

Wash-down facilities

A wash-down facility allows orchard employees, contractors and visitors to clean their vehicles and equipment (including hand tools) in an easily managed area where wash water is contained. This will ensure that plant material, insects and soil are not moved into or out of your orchard.

Wash-down areas should:

- Be readily accessible and located between the driveway and orchard roads.
- Be isolated from production areas.
- Have access to high-pressure water capable of dislodging caked mud from equipment/machinery.
- Have a sealed (concrete or bitumen) or packed gravel surface.
- Not drain into a waterway or production area.
- Have a sump or collection area for easy inspection and waste management.



Have a sump or collection area for easy inspection and waste management

Clean machinery from the top down to avoid contaminating areas already cleaned. Consider less obvious areas of equipment and vehicles not usually accessible for inspection where soil or plant fragments from other properties may have accumulated.

For additional protection, follow any wash down with a broad-spectrum disinfectant product. Disinfectants are most effective when used on visually clean surfaces so remove as much soil and plant material as possible before applying. Read all instructions and labels on the product before use as some disinfectants can be corrosive to some surfaces such as paints.

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



Production management

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Good biosecurity practices are important at every step of product management, from ensuring clean planting and propagating material to responsible use of chemicals on trees and safe disposal of waste fruit and plant material.

Planting and propagating material

Infected, infested or contaminated seed and seedlings can be a major source of new pests to an orchard. Only obtain planting and propagation material from nurseries or suppliers that will provide you with reliable records of the material's source and history.

Since the health of planting material can't always be assessed visually, purchase plant material only from a nursery that takes biosecurity, hygiene, health testing and record keeping seriously. Under some conditions, bacteria, viruses and other disease causing pathogens remain dormant for extended periods of time within or on the surface of plant tissues (including seed) before showing any obvious visual symptoms.

To minimise the risk of bringing pests into your orchard always source planting and propagating material from reputable or certified nurseries. Request detailed information on the source of any propagation material including the health and testing regime of the source plants.

Purchase locally sourced seed as seed from overseas or unknown sources carries a higher risk. Any quantity of imported seed or nursery stock requires an import permit. If sourcing propagation material from overseas see the Department of Agriculture Fisheries and Forestry (DAFF) ICON website for import conditions: www.daff.gov.au/biosecurity/import/icon-icd.

Biosecurity and Quality Assurance

If your orchard or the nursery providing your trees is accredited (i.e. maintains a Quality Assured scheme such as ISO 9000, Freshcare or Woolworths Quality Assurance Scheme), it is likely that some fundamental techniques of biosecurity best practice are already being applied.

Record keeping is important for biosecurity. Ensure that your scheme and your records allow full traceability. Keep records of all plant material brought into the orchard, including seed sources, health testing and authenticity records, to allow trace-back to its source. Keep records of produce that has left your property to allow trace-forward, and record surveillance and pest management practices undertaken on your property.

Auditable Quality Assurance schemes and achievement of membership to them, is beneficial in terms of biosecurity, market access, meeting specifications and customer expectations and food safety.

Chemical residues

Chemical residues on papaya produce can result in rejection from export and domestic markets, particularly as these residues can pose a risk to human health.

Make sure you have received appropriate training and advice on the safe use of pesticides prior to chemical control of pests and always follow label regulations and withholding periods. Don't put your livelihood or the industry at risk through poor or illegal practice.

In most states and territories, growers and contractors who apply pesticides must complete an accredited chemical training course such as ChemCert or SMARTtrain to gain appropriate knowledge about safe use of pesticides and the legal requirements.

Details about regulations for agricultural and veterinary chemicals can be obtained from the Australian Pesticides and Veterinary Medicines Authority (APVMA) at www.apvma.gov.au or from relevant state agencies. Chemical regulations are subject to change over time so be sure to consult these sources frequently.



Lynton Vawdrey, QLD DAFF

Waste fruit and plant material

Maintaining good orchard and nursery hygiene can minimise cross-contamination and breeding environments for pests. It is particularly important to dispose of waste fruit and all plant material carefully.

Waste plant material should be disposed of away from nurseries, orchard areas and water sources. Additional precautions should be taken when dealing with any material (including fruit) removed due to suspected pest damage to ensure that healthy plants are not exposed to potentially infected plant material.

Appropriate disposal mechanisms include:

- deep burial (away from production areas)
- burning
- hot composting.

Ensure that any machinery and equipment, including vehicles and hand tools, used when dealing with potentially infected plant material are thoroughly cleaned of all soil and plant residues prior to being used elsewhere on your property.

Biosecurity Best Practice checklist

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To ensure that 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 biosecurity activities.

Simple and effective procedures can be implemented to strengthen any risk areas that you identify. While changing everyday practices takes effort in the short term, with time they become second nature and will be easier and cheaper than dealing with the introduction of a new pest.

For further information and help to improve the biosecurity practices on your property see the farm biosecurity website www.farmbiosecurity.com.au.



Date of biosecurity check: _____

RECOMMENDED PRACTICES	YES	TO DO	COMMENTS
Pests			
Orchard staff are familiar with common established pests and the high priority exotic pests of papaya			
Pest monitoring conducted regularly, with activities and results recorded even when nothing is found			
Orchard staff know how and where to report pests			
Commercial trees, amenity plants and neighbouring vegetation are regularly inspected for pests			
Pest awareness material is available to staff			
Product management			
Planting or propagation material is either 'certified' or its origin is thoroughly investigated – seed purchased from overseas carries high risks			
Propagation material is thoroughly checked upon arrival			
Records of planting material and its source are maintained			
Equipment used to store or transport propagation material or fruit is cleaned upon arrival to, or exit from the property			
Fallen or waste fruit, packing shed waste and plant trimmings are disposed of away from production areas and irrigation sources			
People movement			
Biosecurity signs with contact details are located at main entrance			
Staff are trained in biosecurity measures and farm hygiene practices			
All visitors sign a visitor register on arrival			
All visitor and staff clothing, footwear and foreign tools are free of loose soil or plant matter before entering and leaving the orchard			
All people recently returned from overseas are checked to ensure they have clean footwear and clothing before entering orchard			
Footbaths and scrubbing brushes are provided prior to entering production areas			
Staff understand neighbouring enterprises and their activities			

RECOMMENDED PRACTICES	YES	TO DO	COMMENTS
Equipment and vehicles			
Designated parking area provided for visitors and contractors and clearly sign posted			
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 is available to remove plant material and soil from equipment and machinery			
Sump installed in wash-down facility to catch unwanted weeds and stop run-off			
Machinery entering production areas is inspected for pests, soil and plant material.			
Borrowed and second-hand machinery and equipment is cleaned and disinfected before use			
Vehicle movement is kept to a minimum in production areas			
Cutting tools such as secateurs, knives etc. are disinfected between rows			





Further information

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

Contact details	
Papaya Australia	Phone: 07 4092 7536 Website: www.australianpapaya.com.au
Plant Health Australia	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
Australian Government	
Department of Agriculture, Fisheries and Forestry	Phone: 02 6272 3933 Website: www.daff.gov.au
State Government	
New South Wales – Department of Primary Industries	Phone: 1800 808 095 or 02 6391 3100 Website: www.dpi.nsw.gov.au
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	Phone: 1300 666 010 or 08 8168 5200 Website: www.pir.sa.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
Northern Territory – Department of Primary Industry and Fisheries	Phone: 08 8999 5511 Website: www.nt.gov.au/d

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

EXOTIC PLANT PEST HOTLINE
1800 084 881



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	Blocks visited	Location/date of last contact with commercial papaya plants
	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



Pest monitoring sheet

Orchard: _____
Scout: _____
Date: _____

		Endemic 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 infestation level (e.g. zero/low/med/high or % trees affected) of established pests and presence/absence of exotic pests 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 monitoring sheet can be downloaded from the Farm Biosecurity website www.farmbiosecurity.com.au



Papaya mealy bug

What is the Papaya mealy bug?

Papaya mealy bug (*Paracoccus marginatus*) is a small oval-shaped sap-sucking insect. The bug causes damage to papaya plants and heavy infestations can cover a large proportion of the leaves. Feeding introduces a toxin into the plant that causes chlorosis, leaf distortions and early fruit fall. The bug also produces honey dew which can cause Sooty mould to develop reducing the quality of the fruit.

What does it look like?

The bug is approximately 2.2 mm long and 1.4 mm wide. It is a yellow colour but is usually covered in a white waxy substance. The bugs cluster and can be seen on the underside of papaya leaves and on fruit.

What can it be confused with?

Other mealy bugs can potentially be confused with this species, especially on alternative hosts. If you see any unusual symptoms or pests in your orchard, consult an agronomist or contact the Exotic Plant Pest Hotline on 1800 084 881.

What should I look for?

To protect your orchard from Papaya mealy bug you should look for clusters of the white coloured insects on papaya plants. Also check any plants that show distorted leaves or chlorosis as these are symptoms of the pest feeding on the plant. When examining plants for Papaya mealy bug pay particular attention to the undersides of leaves and fruit as this is where the bugs often congregate.



Peggy Greb, USDA Agricultural Research Service, Bugwood.org

Adult Papaya mealy bug (note yellow body with white wax) and several nymphs (the smaller insects)



Dale E. Meyerdirk, USDA APHIS PPQ, Bugwood.org

Heavy infestation of Papaya mealy bug on papaya fruit



Dale E. Meyerdirk, USDA APHIS PPQ, Bugwood.org

Infestation of Papaya mealy bugs on the underside of a papaya leaf. Note how they cluster together to form a white mass



How does it spread?

In order to spread to your orchard the Papaya mealy bug has to enter the country and find your trees. The bug feeds on a variety of plants although it prefers papaya. It is possible that garden or papaya plants or plant products, from overseas could bring the pest into Australia. Visitors who have recently visited overseas papaya orchards could also accidentally bring the pest into Australia.

Where is it now?

Papaya mealy bug is found in Bangladesh, Cambodia, India, Indonesia, Malaysia, Philippines, Sri Lanka, Taiwan and Thailand. It is also found in parts of North and Central America including: USA (Florida and Hawaii), Mexico and various Caribbean countries. The pest also occurs in some West African countries such as Ghana.

How can I protect my orchard from Papaya mealy bugs?

Source plant material only from clean, accredited suppliers, and preferably obtain material that is certified. Check your orchard frequently for the presence of new pests and unusual symptoms. Make sure you are familiar with common Papaya insect pests so you can tell if you see something different.

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



Dale E. Meyerdirk, USDA APHIS PPQ, Bugwood.org

Distorted leaves caused by Papaya mealy bugs feeding on the plant



Dale E. Meyerdirk, USDA APHIS PPQ, Bugwood.org

Papaya plant damaged by Papaya mealy bugs feeding on the plant. Note: chlorotic leaves



Dale E. Meyerdirk, USDA APHIS PPQ, Bugwood.org

Infected papaya plant

Oriental fruit fly complex

What is the Oriental fruit fly complex?

Papaya fruit fly (*Bactrocera papayae*), Oriental fruit fly (*Bactrocera dorsalis*) and Carambola fruit fly (*Bactrocera carambolae*) are all part of the Oriental fruit fly complex. All three species look extremely similar and can only be distinguished by a fruit fly expert.

Fruit flies are major pests and have been recorded on over 200 types of fruit and vegetables and can cause losses of up to 100% in unprotected fruit.

What does it look like?

Fruit flies are about the same length as a common housefly but more slender. They grow to 6-8 mm in length and have clear wings, generally black chests and paler abdomens with a distinctive black T-shaped marking. The Queensland fruit fly, by comparison, is much the same size but is an overall reddish-brown colour. An expert eye is needed to identify Oriental fruit flies under a microscope.

Pupae are white to yellow-brown in colour and barrel shaped, whilst larvae are about 10 mm long and creamy white. Eggs are white, elongate and elliptical measuring about 0.9 x 0.2 mm.

What can they be confused with?

Symptoms are similar to those caused by endemic flies such as Queensland fruit fly or Mediterranean fruit fly. Papaya, Oriental, and Carambola fruit flies look very similar to each other. Any fruit flies that look different from those regularly encountered should be reported and further examined by an entomologist.

What should I look for?

Adult female flies have exceptionally long ovipositors, allowing them to lay their eggs just under the skin of fruit, depositing fruit-decaying bacteria at the same time. Within one or two days, the eggs hatch into maggots (larvae) which feed on the decaying fruit, causing premature fruit drop.



Scott Bauer

The female has a serrated-tip ovipositor for penetrating the skin of fruit



Merle Shepard, Gerald R. Carner, and P.A.C. Ooi, Bugwood.org

Adults are about the same length as a housefly but are more slender bodied



William M. Brown Jr., Bugwood.org

Damage caused by Oriental fruit fly on papaya fruit



Considerable damage can occur inside the flesh before obvious signs of infestation can be seen on the fruit. The most obvious signs of infestation are small discoloured patches on the skin, which develop from punctures or stings made by the female as she lays her eggs.

Infested young fruit becomes distorted, callused and usually drop; mature fruit develop a water-soaked appearance. The larval tunnels provide entry points for bacteria and fungi that cause the fruit to rot.

How does it spread?

Adult flies can disperse over long distances through flight, while the transport of larvae in infested fruit can result in global movement.

Where is it now?

Papaya fruit fly is native to and widespread in south-east Asia (Thailand, Malaysia, Borneo, Singapore and Indonesia). It is present in most provinces of mainland Papua New Guinea. It was detected in Cairns, Australia in October 1995 and was eradicated.

Oriental fruit fly is widely spread throughout Asia and parts of the South Pacific.

Carambola fruit fly is found in South America.

How can I protect my orchard from fruit flies?

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

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



The thorax has yellow stripes on top and yellow marks on each side

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



A T-shaped mark is often visible on the thorax

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



Adult flies have a narrow brown band along the edge of their wings

Pest and Diseases Image Library, Bugwood.org

Fijian fruit fly

What is the Fijian fruit fly?

Fijian fruit fly (*Bactrocera passiflorae*) is a small fly that attacks a range of fruit including papaya. Like all fruit flies, it can cause a significant amount of damage to fruit and make fruit unmarketable. This pest has the potential to have a significant impact on the Australian papaya industry.

What does it look like?

The Fijian fruit fly has a black coloured body with a black abdomen and clear wings. It is approximately 6-8mm long. Accurate diagnosis requires expert examination of the fly under a microscope.

What can it be confused with?

At first glance most fruit flies are very similar. The Fijian fruit fly can be differentiated from other fruit flies by its predominantly black colour. If you see any unusual fruit flies consult an agronomist or contact the Exotic Plant Pest Hotline on 1800 084 881.

What should I look for?

Adult Fijian fruit flies are visible to the naked eye so you should keep a look out for small black coloured fruit flies, especially around fallen or damaged fruit. Traps placed in your orchard may also help you look for fruit flies. You should also look for distorted, dropped or rotten fruit as these symptoms can be caused by fruit flies. Report any unusual fruit flies in your orchard to the Exotic Plant Pest Hotline on 1800 084 881.

How does it spread?

Adult Fijian fruit fly can disperse over long distances through flight, while the transport of larvae in infested fruit can result in the global movement of the pest.



Dorsal view of adult Fijian fruit fly

Ken Walker Museum Victoria, PaDiL



Lateral view of Fijian fruit fly. Note: fly is predominantly black in colour

Ken Walker Museum Victoria, PaDiL



Where is it now?

As the name suggests the Fijian fruit fly is native to Fiji. It also occurs in Tonga, Tuvalu and Western Samoa. This species of fruit fly is not known to occur in Australia. If it enters Australia many tropical and subtropical fruit producing areas could be put at risk.

How can I protect my orchard from Fijian fruit flies?

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

Maintain good hygiene and ensure that fallen fruit is collected and disposed of so that it cannot harbour fruit flies.

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

EXOTIC PLANT PEST HOTLINE
1800 084 881



Adult Fijian fruit flies

S. Wilson, Secretariat of the Pacific Community (SPC)



Adult Fijian fruit flies

S. Wilson, Secretariat of the Pacific Community (SPC)

Papaya fly

What is the Papaya fly?

Papaya fly (*Toxotrypana curvicauda*) is a small fruit fly that specifically attacks papaya fruit. Losses of up to 30% have been recorded in Florida, meaning that it poses a significant risk to papaya growers and the papaya industry in Australia.

What does it look like?

The Papaya fly is a yellow-brown coloured fly. It is approximately 8-12.5mm long. Females possess a long ovipositor, 11-13.5mm, the most diagnostic feature of the Papaya Fly.

What can it be confused with?

At first glance most fruit flies are very similar. The Papaya fly is able to be distinguished from other species by the female's long ovipositor, but an expert is required for correct identification to a species level. If you see any unusual fruit flies consult an agronomist or contact the Exotic Plant Pest Hotline on 1800 084 881.

What should I look for?

The Papaya fly is visible to the naked eye and can be identified by its yellow-brown colour and long ovipositor. If you think you see something that could be a Papaya fly it should be reported as soon as possible. Any unusual insects, particularly fruit flies, should be reported as they pose significant risks to fruit producers in Australia.

How does it spread?

Adult Papaya fly can disperse over long distances through flight, while the transport of larvae in infested fruit can result in global movement.



Female Papaya fly. Note long ovipositor

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



Females laying eggs on papaya fruit

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



The Papaya fly can be identified by its long ovipositor which is approximately the same length as the fly's body

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



Where is it now?

The Papaya fly is found in tropical and subtropical areas of the Americas where papayas are grown, and has been reported from southern USA south to Venezuela. It is not known to occur in Australia.

How can I protect my orchard from Papaya flies?

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

Maintain good hygiene and ensure that fallen fruit is collected and disposed of so that it cannot harbour fruit flies.

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



Adult Papaya fruit fly on papaya fruit

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



Adult female laying eggs in developing papaya

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

Philippine fruit fly

What is the Philippine fruit fly?

The Philippine fruit fly (*Bactrocera philippinensis*) is a tropical fruit fly that attacks a range of fruit including papaya. Like all fruit flies, it can cause a significant amount of damage to fruit and can make fruit unmarketable. This means that if the fruit fly enters Australia it could have a significant impact on papaya growers and other tropical and subtropical fruit industries.

What does it look like?

The Philippine fruit fly has a yellow and black coloured body with a black and tan banded abdomen. It is approximately 8mm long and has clear wings.

What can it be confused with?

At first glance most fruit flies are very similar. The Philippine Fruit Fly belongs to the Oriental fruit fly complex and is difficult for non-entomologists to identify. If you see any unusual fruit flies consult an agronomist or contact the Exotic Plant Pest Hotline on 1800 084 881.

What should I look for?

The Philippine fruit fly is visible to the naked eye. So you should keep a look out for small yellow-brown coloured flies, especially around fallen or damaged fruit. Traps baited with Methyl eugenol may be useful as they can attract male fruit flies and allow them to be identified. If you see any unusual fruit flies in your orchard contact the Exotic Plant Pest Hotline on 1800 084 881.



Lateral view of adult fruit fly

Ken Walker Museum Victoria, PaDIL



Dorsal view of adult fruit fly

Ken Walker Museum Victoria, PaDIL



How does it spread?

Adult Philippine fruit fly can disperse over long distances through flight, while the transport of larvae in infested fruit can result in the global movement of the pest.

Where is it now?

As the name suggests the Philippine fruit fly is native to the Philippines. The Philippine fruit fly has also been introduced to Palau (a small country 800km east of the Philippines). The fruit fly is not known to occur in Australia. If it enters Australia many tropical and subtropical fruit producing areas could be put at risk.



Anthony O'Toole, Secretariat of the Pacific Community (SPC)

Adult Philippine fruit fly

How can I protect my orchard from Philippine fly?

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

Maintain good hygiene and ensure that fallen fruit is collected and disposed of so that it can not harbour fruit flies.

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



Melon fruit fly

What is the Melon fruit fly?

Melon fruit fly (*Bactrocera cucurbitae*) is a small fruit fly that attacks a range of fruit including melon, citrus and papaya. Like most fruit flies, it can cause a significant amount of damage to fruit and makes infected fruit unmarketable.

What does it look like?

The Melon fruit fly has a predominantly orange-brown coloured body and abdomen. It is approximately 6-8 mm long. The wings have two distinctive smoky-brown coloured spots (one on the tip and one on the rear of the wing).

What can it be confused with?

At first glance most fruit flies are very similar. The Melon fruit fly can be differentiated from other fruit flies by its overall orange-brown colour together with the brown coloured spots on the wings. However expert diagnosis is required for correct identification. If you see any unusual fruit flies consult an agronomist or contact the Exotic Plant Pest Hotline on 1800 084 881 as soon as possible.

What should I look for?

The Melon fruit fly is visible to the naked eye so you should keep a look out for small orange-brown coloured fruit flies, especially around fallen or damaged fruit. Traps may also help you look for fruit flies in your orchard. If you see any unusual fruit flies in your orchard contact the Exotic Plant Pest Hotline on 1800 084 881 as soon as possible.



Live adult

Scott Bauer, USDA Agricultural Research Service, Bugwood.org



Adults laying eggs (ovipositing) on a citrus fruit

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



Adult Melon fruit fly

Merle Shepard, Gerald R. Carner, and P.A.C. Ooi, Insects and their Natural Enemies Associated with Vegetables and Soybean in Southeast Asia, Bugwood.org



How does it spread?

Adult Melon fruit fly can disperse over long distances through flight, while the transport of larvae in infested fruit can result in the global movement of the pest.

Where is it now?

The Melon fruit fly has a wide distribution and is found in parts of north Africa, southern Asia, China and south eastern Asia and Hawaii. The fruit fly is not known to occur in Australia. If it enters Australia many tropical and subtropical fruit producing areas could be put at risk.

How can I protect my orchard from Melon fruit flies?

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

Maintain good hygiene and ensure that fallen fruit is collected and disposed of so that it cannot harbour fruit flies.

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



Adult Melon fruit fly. Note smoky-brown wing markings

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



Dorsal view of adult Melon fruit fly

Ken Walker Museum Victoria, PaDIL



Lateral view of adult Melon fruit fly

Ken Walker Museum Victoria, PaDIL

Bacterial crown rot

What is Bacterial crown rot?

Bacterial crown (*Erwinia papayae*) rot is a disease caused by a bacterium called *Erwinia papayae*. The bacteria causes papaya plants to die back and causes significant yield losses in countries where it occurs. If it enters Australia it is likely to have a significant impact on Australia's papaya industry.

What does it look like?

Bacterial crown rot causes the plants leaves to yellow and die. This is followed by darkened, water-soaked areas forming where the leaves join the stem, the crown or the midrib of the leaves. Fruit can also become infected and take on a water-soaked appearance.

What can it be confused with?

Other, less studied, exotic bacteria belonging to the *Erwinia* genus can also cause significant damage to papaya plants. Symptoms include dark coloured cankers forming in the leaf axils and the leaves of young seedlings showing small wet lesions. If you see any unusual symptoms consult an agronomist or contact the Exotic Plant Pest Hotline on 1800 084 881.

What should I look for?

To protect your orchard from Bacterial crown rot you should look for signs of the disease. These include yellowing or dying leaves and any plant tissues that appear to be water-soaked.

How does it spread?

Bacterial crown rot is caused by a bacterium that could potentially enter the country on papaya plants and plant material from infected countries, on second hand machinery from infected countries or with people who have visited infected orchards while overseas. Maintaining good hygiene, such as disinfecting boots and machinery, will help minimise the risk of this pathogen entering the country.



Water-soaked lesion developing in leaf axil

L. Vawdrey and R. Fullerton



Where is it now?

Bacterial crown rot was first identified in the Caribbean and has since been described from Malaysia. A similar disease was also reported from the Mariana Islands north of Indonesia. This disease is not known to occur in Australia but it is reported in 23 countries as listed below.

Reported occurrences of Bacterial crown rot

Anguilla	Montserrat
Antigua	North Mariana Islands
Barbados	Philippines
Barbuda	St Croix
Brazil	St Kitts & Nevis
Dominica	St Lucia
Grenadines	Taiwan
Guadeloupe	Tonga
Indonesia	Trinidad and Tobago
Japan	Venezuela
Malaysia	Virgin Islands
Martinique	

Further countries, in addition to those officially recognised as having the disease, may pose a high risk of introducing this pathogen to Australia. If purchasing overseas propagation material ensure you follow all of the requirements listed on the DAFF ICON website. See www.daff.gov.au/biosecurity/import/icon-icd for details.



Infected fruit. Note discoloured flesh

L. Vawdrey and R. Fullerton

How can I protect my orchard from Bacterial crown rot?

Source plant material only from clean, accredited suppliers and preferably obtain material that is certified.

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

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

**EXOTIC PLANT PEST HOTLINE
1800 084 881**

Exotic spider mites

What are Spider mites?

Spider mites are very small (usually less than 0.5 mm long) arachnids that feed on the sap of plants. Papaya plants are affected by a number of endemic (such as the Two spotted spider mites (*Tetranychus urticae*)) and exotic spider mites such as Pierce's spider mite (*T. piercei*) and Cassava spider mite (*T. truncatus*).

What do they look like?

Spider mites feed on the plant's sap causing leaves to become covered with spots of lighter green giving the plant a mottled appearance. Spider mites also produce silk webs on the undersides of leaves, although the amount of silk produced varies between species.

Spider mites are very small (usually only 0.5 mm long). The colour of adults can assist in identification. Adult Two spotted spider mites (which occur in Australia and affect papaya) are a yellow-green or red colour with two darker spots on their bodies, while the exotic *T. piercei* and *T. truncatus* are usually a dark red colour without obvious spots. A magnifying glass (x 10) is needed to accurately look at spider mites.

What can they be confused with?

As spider mites are very small, exotic spider mites are often hard distinguish from endemic species. The colour and markings of the mite can help identify different species, as can the amount of silk produced by the mite.

What should I look for?

As spider mites are very small you are most likely to see their symptoms before seeing the actual spider mites. While feeding, spider mites damage the plant's leaves and this causes spots and mottling to occur.



Frank Peairs, Colorado State University, Bugwood.org

Two spotted spider mites are endemic. Note darker spots on the side of the body



Sonya Broughton, Department of Agriculture & Food Western Australia, Bugwood.org

Red form of the Two spotted spider mite



Daren Mueller, Iowa State University, Bugwood.org

Typical spider mite symptoms include mottling and spotting of the leaves, in this case on a soybean plant



If you see these symptoms it is important to have a closer look at the plant to see if it is being attacked by spider mites. Look for signs of silk or the mites themselves, especially on the underside of leaves.

If you see any unusual spider mites, or evidence of their presence, consult an agronomist, your state/territory department of agriculture or contact the Exotic Plant Pest Hotline on 1800 084 881.

How do they spread?

Spider mites are able to be spread over long distances by hitch-hiking on plant material and contaminated machinery. Spider mites can also be spread by the wind allowing them to spread over long distances.

Where are they now?

Tetranychus piercei occurs in tropical and subtropical areas in eastern and south eastern Asia including: China, Japan, Taiwan, Thailand, Vietnam, Philippines, Malaysia, Indonesia and Papua New Guinea.

Tetranychus truncatus also occur in south eastern Asia including: China, Japan, Korea, Mariana Islands, Philippines, Taiwan, Thailand and Indonesia.

How can I protect my orchard from exotic spider mites?

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

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

EXOTIC PLANT PEST HOTLINE
1800 084 881



David Cappaert, Michigan State University, Bugwood.org

Look for signs of silk and spider mites on the underside of leaves especially on trees that show spotted or mottled leaves



O.P. Sharma, NCIPM, New Delhi, India, Bugwood.org

Inspect plants carefully and report unusual spider mites





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