

Orchard Biosecurity Manual

for the Avocado Industry

Reducing the risk of new pests
impacting on your orchard

Version 1.0





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



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Avocados Australia is the peak industry body for the Australian avocado industry. Our members include avocado growers, associated businesses and industry personnel. We provide a range of services, including guiding an annual five million 'research and development' and 'promotion' program, to assist sustainable growth and development within the Australian avocado industry.
avocado.org.au/industry

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Table of contents

Six easy ways to protect your property	2
Biosecurity overview	4
What is biosecurity?	4
What is orchard biosecurity?	5
Regional biosecurity	5
Pests	6
High priority exotic pest threats of the avocado industry	6
Pest surveillance	8
Report suspect pests	8
The Emergency Plant Pest Response Deed	10
Owner Reimbursement Costs	10
Product management	12
Planting and propagating material	12
Chemical residues	12
Waste fruit and plant material	13
Biosecurity and Quality Assurance	13
People and biosecurity	14
Biosecurity signs	14
Managing people movement	14
Casual workers and tourists	15
Overseas travellers	15
Contractors and utility providers	15
Equipment and vehicles	16
Movement of vehicles and machinery	16
Wash-down facilities	17
Designated parking areas	17
Biosecurity best practice checklist	18
Further information	20
Example records	22
Visitor register	22
Pest surveillance data sheet	23
Fact sheets	24
Avocado leaf scorch	24
Avocado scab	26
Avocado seed moth	28
Avocado sunblotch	30
Avocado thrips	32
Laurel wilt	34
Oriental fruit fly complex	36
Persea mite	38
Trunk canker	40

Six easy ways to protect your property

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

Here are six easy ways you can reduce the threat of new pests impacting on your livelihood. Each of these practices should be embedded in your orchard's everyday management as they make good business sense by reducing the risk of spreading pests. Don't put your livelihood at risk by neglecting orchard biosecurity.

1. Be aware of biosecurity threats

Make sure you and your orchard workers are familiar with the most important exotic avocado pest threats. Conduct a biosecurity induction session to explain required hygiene practices for people, equipment and vehicles in your orchard.

2. Use pest-free propagation material

Ensure all propagation material is from trusted sources and orchard inputs are fully tested, pest-free and preferably certified. Keep good records of your orchard inputs.

3. Keep it clean

Practicing good sanitation and hygiene will help prevent the entry and movement of pests onto your property. Workers, visitors, vehicles and equipment can spread pests, so make sure they are clean before entering and leaving your property. Have a designated visitor's area and provide vehicle and personnel wash-down facilities.

4. Check your orchard

Monitor your trees frequently. Knowing the usual appearance of your orchard and trees will help you recognise new or unusual events and pests. Keep written and photographic records of all unusual observations. Constant vigilance is vital for early detection of any exotic plant pest threat.

5. Abide by the law

Respect and be aware of laws and regulations established to protect the avocado industry, Australian agriculture, and your region.

6. Report anything unusual

If you suspect a new pest – **report it immediately to the Exotic Plant Pest Hotline.**

EXOTIC PLANT PEST HOTLINE
1800 084 881



Biosecurity overview

4

This manual is designed to assist you in protecting your property and the avocado 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 and unnecessary costs.

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. Biosecurity is essential for your business.

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 our plant industries. Biosecurity allows us to preserve existing trade opportunities and provide evidence to support new market negotiations.





The definition of a **pest** used in this manual covers all insects, mites, snails, nematodes, pathogens (diseases) and weeds that are injurious to plants, plant products or bees. **Exotic** pests are those not currently present in Australia, while **established** (and **endemic**) 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 visiting or working on your property.

Through the implementation of orchard biosecurity measures, growers play a key role in protecting the Australian avocado industry from exotic pests. If a new pest becomes established in your orchard, it will affect your business through increased orchard costs (for monitoring, cultural practices, additional chemical use and labour to apply them), reduced productivity (yield and/or quality reductions) or loss of markets.

Early detection and immediate reporting increase the chance of effective and efficient eradication.

Regional biosecurity

5

To strengthen the biosecurity measures implemented on your property, consider initiating biosecurity meetings and activities to promote biosecurity at the regional level. Through this collaborative approach, biosecurity threats to all properties in your region can be minimised.

Potential sources of biosecurity threats may be neighbouring orchards (operating or abandoned), nurseries, other commercial plantings, native vegetation and/or peri-urban residential or amenity plantings.

Promotion of biosecurity at the regional level is enhanced through broad engagement of the community, understanding the region's vulnerability, and the source and nature of threats, knowledge of the expertise base and resources available to the region, and a commitment from stakeholders to implement biosecurity measures, surveillance and reporting.

Implementation of orchard biosecurity underpins regional biosecurity, which in turn underpins national biosecurity.

If orchard measures are supported by community based measures, a regional framework for biosecurity can be coordinated and is achievable.

Pests

High priority exotic pest threats of the avocado industry

6

The following are some key exotic pest threats for the Australian avocado industry as identified through the development of the Avocado Industry Biosecurity Plan (IBP). Any of these pests would have serious consequences should they enter and become established in Australia. For a complete list of exotic pest threats for the avocado industry, refer to the Avocado IBP available from www.phau.com.au/biosecurity/avocados.

The climate of Australian avocado production regions would allow each of these pests to survive, spread and establish, should they be introduced. Additional information on these and a further two pests is included in the fact sheets at the back of this manual.

Avocado scab (*Sphaceloma perseae*)

OVERALL RISK – HIGH

- Fungal disease causing fruit drop and marking of mature fruit
- Discrete spots appear on the leaves along the midrib, which may merge into star-like patterns
- As disease progresses leaves become distorted and stunted
- Symptoms on fruit appear as corky, raised brown to purplish brown spots which enlarge to form large rough areas
- Long distance dispersal likely through infested propagation material



Cesar Calderon, USDA APHIS PPQ, Bugwood.org

Avocado seed moth (*Stenoma catenifer*)

OVERALL RISK – HIGH

- Pest of avocados in Latin America causing large yield losses
- Early instar larvae are white but become violet in later instars
- Adult moths have a 'C' shape of black dots across the forewings
- Moths form galleries in branches causing them to wither
- Larvae penetrate fruit and destroy seed and pulp through feeding
- Frass can be seen in fruit when opened, and oozing of a white exudate may occur externally



Mark S. Hoddle, University of California

Avocado sunblotch (*Avocado sunblotch viroid*)

OVERALL RISK – HIGH

- Found sporadically in some areas of Australia
- Fruit are small and deformed with sunken pale blotches
- Discolouration and streaking occurs on stems
- A range of symptoms are seen on leaves though some infected trees remain symptomless
- Spread through infected seed or using infected scions for grafting



David Rosen, University of California Statewide IPM Project



Avocado thrips (*Scirtothrips perseae*)

OVERALL RISK – HIGH

- Emerging insect pest causing large economic losses in California
- Adults are straw coloured with dark lines across the abdomen
- Causes bronzing along leaf veins or over entire leaves under severe infestation
- Fruit are scarred with a characteristic ‘alligator skin’ appearance
- Scars elongate as fruit develops causing lower quality fruit
- Disseminated over long distances on infested avocado plant material



Mark S. Hoddle, University of California

Laurel wilt (*Raffaelea lauricola*)

OVERALL RISK – HIGH

- Emerging fungal disease of avocado trees in Florida
- Spread by the tiny (2 mm long) Redbay ambrosia beetle (exotic)
- Leaves wilt and foliage drop may follow
- Xylem tissue becomes dark brown or black
- Dying trees attract beetles in large numbers and small strings of wood fibre may be seen protruding from bore holes



Andrew Gaering, QAAFI

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

OVERALL RISK – HIGH

- Includes Oriental, Papaya and Carambola fruit flies
- Found in Asia, Papua New Guinea, the Pacific, South America
- Adults 6-8 mm long with a narrow brown band along edge of 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

Persea mite (*Oligonychus perseae*)

OVERALL RISK – UNKNOWN

- Serious pest in California with a wide host range
- Adult females are yellowish green with several dark spots in the abdominal region
- Males are smaller with yellow, pear-shaped bodies
- Nests form along midribs and veins on the underside of leaves
- Symptoms can also be seen as necrotic spots covered with a dense protective webbing
- Defoliation occurs in heavy infestations with a litter of yellow-spotted green leaves under trees



Jack Kelly Clark, University of California Statewide IPM Project

Remain observant for anything unusual in your orchard and storage facilities.

If a pest is found that is not normally present on your property, it may be new not only to your property, but to the region, state or even Australia.



8

Pest surveillance

Orchard monitoring and surveillance involves looking for and recording the presence, absence and population levels of pests. Conducting regular monitoring is a fundamental part of orchard management practices and gives the best chance of spotting a new pest soon after it arrives.

Pest surveillance is necessary because of:

- **Market access:** Export destinations for avocados can require 'evidence of absence' data for exotic and some established pests that are of concern. The Australian avocado 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.

All pest (exotic and established) surveillance activities on your property should be recorded. These records can be used in the response to a pest incursion and provide support to industry surveillance activities. The addition of exotic pests to current data sheets used by consultants is an effective recording mechanism. An example pest surveillance data sheet is included in this manual (see page 23).

Report suspect pests

Early detection and reporting may prevent or minimise long-term damage to, or the quarantine period of, your orchard and the avocado industry.

Report any unusual or suspect plant pest immediately via the **Exotic Plant Pest Hotline on 1800 084 881**.

Calls to the Exotic Plant Pest Hotline will be forwarded to an experienced person in your state or territory government, who will ask some questions about what you have seen and may arrange to collect a sample.



Do not send samples without first speaking to someone from the state department, who can discuss the correct type of sample, its packaging, handling and transport to the laboratory assigned for diagnosis.

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, checked out and treated confidentially.

If you have found a suspected exotic plant pest, the following general precautions should be taken immediately to contain the pest and protect other parts of your orchard:

- Mark the location of the pest or symptoms and limit access to the area for both people and equipment.
- Wash 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**

10 The Emergency Plant Pest Response Deed (EPPRD)

The EPPRD is a formal, legally binding document between Plant Health Australia (PHA), Australian and state/territory governments, and plant industry signatories. As a signatory to the EPPRD, Avocados Australia has a seat at the decision making table and also contributes to funding if an approved Response Plan is implemented to eradicate an Emergency Plant Pest (EPP).

Under the EPPRD, the avocado industry has a responsibility to report suspect pests. 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.



Avocados Australia

Owner Reimbursement Costs

Under the EPPRD, grower reimbursement payments (Owner Reimbursement Costs; ORCs) are included 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.

Calculation of ORCs is prescribed in the EPPRD, including the different formulae used to accommodate the wide range of crops grown by Industry signatories. Avocado ORCs are calculated using the "Perennial Trees" formula. To ensure that these calculations are accurate, growers should keep records of key information.

It is important to remember that ORCs only apply to approved Response Plans aimed at eradication, which are more likely to be developed following early reporting.

For more information on the EPPRD refer to www.phau.com.au/epprd.



Product management

12 Planting and propagating material

Use only clean planting and propagation material (i.e. tested with no pest detections). Obtain these only from nurseries that will provide you with reliable records of the material's source and testing history.

You cannot visually assess the health of your planting material. Viruses, viroids and phytoplasmas will not display symptoms under some circumstances.

To minimise the risk:

- Purchase plant material only from a nursery that takes biosecurity, hygiene, health testing and record keeping seriously.
- Check your nursery and planting material thoroughly.
- Maintain a register of your orchard's propagation material, including its source (with contact details), cultivar/rootstock combinations, specific planting locations, numbers of plants and date planted.
- Request information on the source of budwood, mother tree health testing regime and timetable, location of foundation material of new imports and the Quality Assurance scheme or certification status of the nursery itself and the planting material provided.

Chemical residues

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

Appropriate training and advice on the safe use of pesticides should be obtained 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 (for example ChemCert or SMARTtrain) to gain the appropriate knowledge base on the 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; www.apvma.gov.au) or from relevant state agencies. Consult these sources frequently for information regarding chemical regulations as these may change.

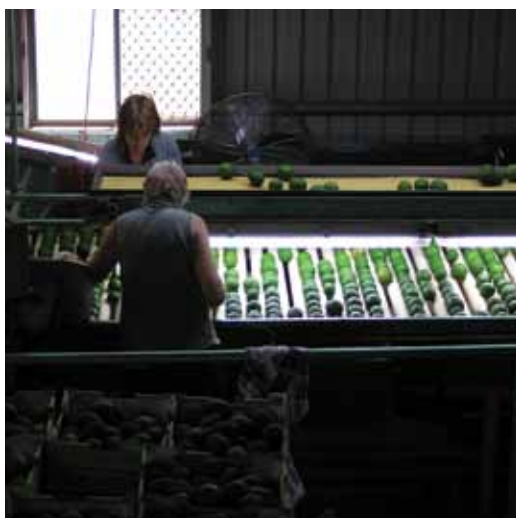


Waste fruit and plant material

Maintaining good orchard and nursery hygiene can minimise cross-contamination and breeding environments for pests. This should be achieved in combination with an effective monitoring/pest management program. A ‘spray diary’ record should accompany each consignment of avocado fruit.

Collect all plant waste and dispose of it away from nursery and orchard areas and water sources. Appropriate disposal mechanisms for plant waste include deep burial (away from production areas), burning or hot composting.

Ensure that no soil, plant material or insects are left adhering to vehicles, bins, and other equipment (including hand tools) used for the harvesting of fruit.



Avocados Australia

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, SQF 2000, NIASA, Freshcare or Woolworths Quality Assurance Scheme), it is likely that some fundamental techniques of biosecurity best practice are already being applied.

Ensure that your scheme and your records allow full traceability. That is, the ability to trace-back plant material on your orchard to its source (including the budwood sources, health testing and authenticity records), to trace-forward plant material or produce that has left your property, and records of 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.



People and biosecurity

14 Biosecurity signs

Well designed signage informs visitors that biosecurity on your property is important and that they share responsibility for maintaining it. The signs serve to alert people to the potential impact of their visit.

Signs also demonstrate your commitment to orchard hygiene, safety and auditable systems. Biosecurity signage should be placed at the main gate, external entrances, visitor parking areas and wash-down facilities.

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



A template for the above sign is available for download from www.phau.com.au/biosecurity

Managing people movement

People moving between orchards, nurseries and other horticultural regions can spread pests on vehicles, equipment, boots and clothing. Even hair and watchbands can carry fungal spores or bacteria. The most obvious risks are pests carried in soil and plant material.

Implementing the following measures will reduce the threat of human activity introducing new pests into your orchard:

- Maintain a visitor register (example on page 22), which will record visitor movements and help manage safety issues.
- Brief all workers, contractors, casual workers and visitors about your orchard biosecurity measures.
- Employee and visitor footwear and clothing must be free of soil and plant material before entering or leaving the orchard.
- 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.
- Ensure grafting crews are particularly diligent about cleaning their knives and footwear between cuts. At a minimum, knives should be cleaned between each bundle.
- Display biosecurity awareness material in staff rooms, trimming and packing sheds. Keep the messages simple and effective.



Casual workers and tourists

Casual workers (e.g. contract harvest crews, backpackers, retirees, etc.) are often employed to assist with orchard topworking, pruning, harvesting/picking and packing. While their contribution is highly valued, they are a particular biosecurity threat because they move orchard-to-orchard and region-to-region. They can potentially carry and spread pests from and to susceptible hosts on their clothing, footwear, gloves, and equipment.

Before entering production areas or packing sheds, make sure casual workers are well briefed on biosecurity measures at your property, have changed or washed their clothes and boots, and all tools and equipment are cleaned and disinfected.

Overseas travellers

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

Several specimens carrying avocado fruit pests have been intercepted at the Australian border and overseas travellers have unknowingly brought in pests in the past. Air travel means exotic plant pests are only a few hours away.

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. Great care should be taken to prevent the introduction of plant pests into Australia.

Contractors and utility providers

The term 'contractors' includes utility providers, orchard contractors, earthmoving companies and research personnel who enter an orchard in their day-to-day operations. As with casual workers, contractors pose a significant risk because of their movement between properties.

Placing biosecurity signs on external property gates can play an important part in raising biosecurity awareness with contractors, especially providers of power, water, gas and communications. Limit the risk of contractors introducing new pests, by requesting all contractors' vehicles and equipment be cleaned before starting work on your property. Provide a suitable wash-down bay to complete this task.

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.

Equipment and vehicles

16 Movement of vehicles and machinery

Vehicles and orchard equipment such as sprayers, tractors and hand tools can carry pests in adhering soil, sap and plant material. Pests can then be introduced to a previously clean property or crop.

It is impractical to stop all vehicle and equipment movement on and off the property, but using dedicated orchard vehicles, washing down machinery on concrete pads and denying access of dirty machinery can reduce the spread of pests.

Contractors, re-sellers, service providers and drivers of delivery trucks (nursery stock, fertiliser, etc.) and earth moving equipment should be requested to clean their vehicles and equipment before entering your orchard. Orchards open to the public and those open to growers (e.g. for field days, equipment demonstrations, etc.) have a heightened risk and therefore designated parking areas away from production sites are important.



Weedstop

Inspecting and cleaning machinery is more time and cost effective than managing a new pest

Measures to reduce the risk of pest entry on equipment and vehicles include:

- Cleaning vehicle floors and tyres of soil, plant material and pests, especially after visiting other properties.
- Where possible, use your own vehicle to carry visitors around your orchard.
- In production areas, keep vehicle movement to a minimum, especially on wet soil. Stick to regular pathways through the orchard.
- Hose off and disinfect machinery in a designated wash-down area (see page 17) before moving between properties.
- Ensure contractor equipment is washed down thoroughly to remove any plant material or soil before entering your orchard.
- 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.
- 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.



Wash-down facilities

A wash-down facility allows orchard employees, contractors and visitors to clean their vehicle 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.

A wash-down area should:

- Be readily accessible and located between the driveway and orchard roads.
- Be isolated from production areas.
- Have access to power and high-pressure water.
- 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.

Clean machinery from the top down to avoid contaminating areas already cleaned, and consider the following points:

- Dismantle as far as practically possible to give access to internal spaces.
- Leave covers off after cleaning to allow inspection.
- Get a second opinion – a fresh look will see contamination you may have missed.

For additional protection, an added detergent-based degreaser or disinfectant (for example, Septone Truckwash®, Castrol Farmcleanse® or Virkon®) may be appropriate. For best results, seek advice from re-sellers on the best product, and remove as much soil and plant material as possible from the equipment before using the disinfectant.

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

Designated parking areas

A well sign-posted designated parking area should be provided for all visitors. Ideally, dedicated orchard vehicles should be used for transport around your property with other vehicle movement limited to direct entry to a designated visitor parking area only.

Parking areas serve to contain the entry of new pests away from production sites. They also allow for the inspection of tyres, equipment, floor mats and boots for soil and plant material which may carry new pests. This area should be regularly monitored for the presence of new pests.

A biosecurity sign in the parking area will remind visitors of the threat of spreading pests between properties.

Do not allow the movement of orchard machinery through the parking area.

Biosecurity best practice checklist

18

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

Once identified, a few simple and practical procedures can be implemented to strengthen areas that pose the greatest risk. While changing everyday practices can take more effort in the short term, these will become second nature with time and are easier and cheaper than dealing with the introduction of a new pest.



Natalie Moore

Date of biosecurity check: _____

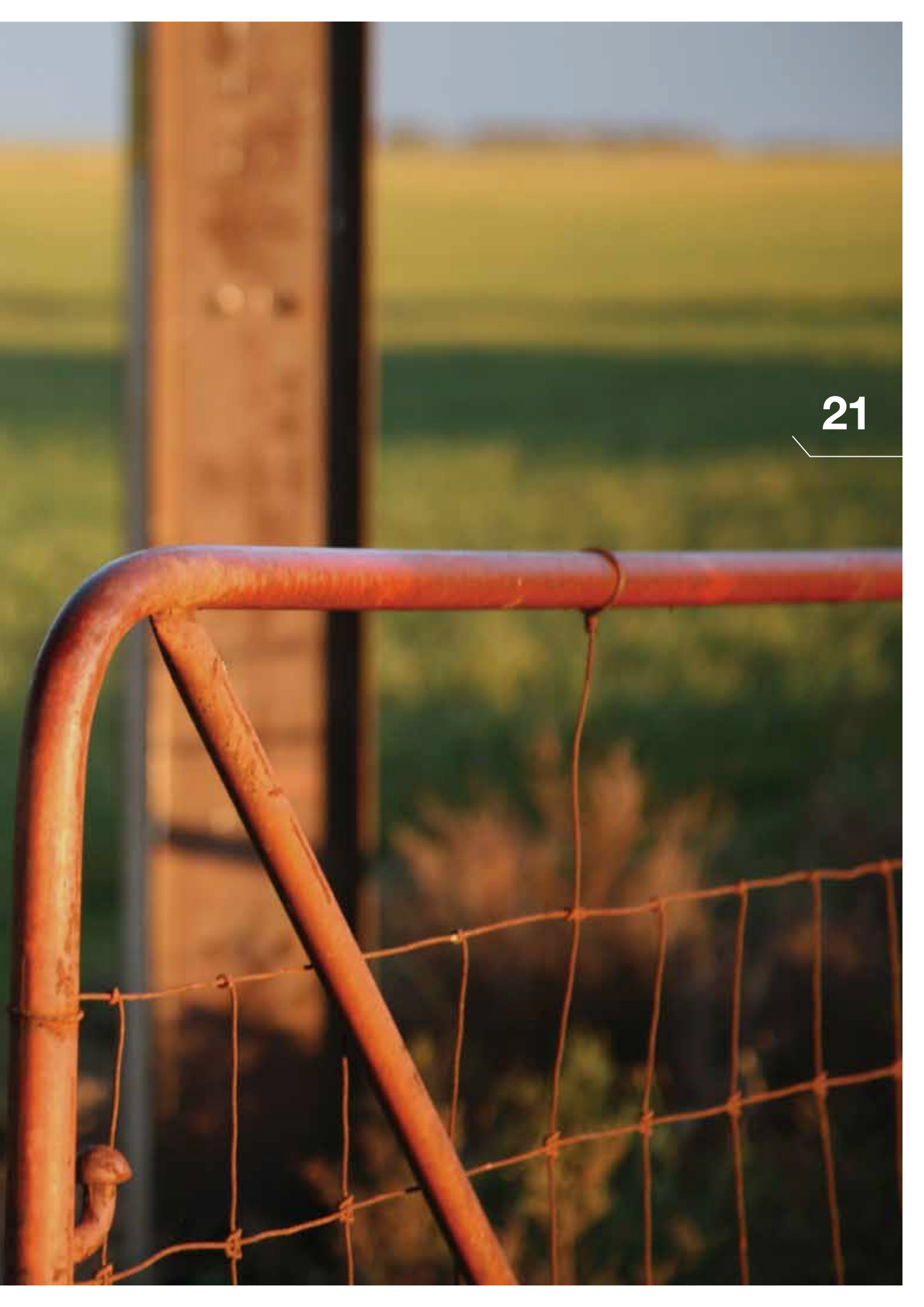
RECOMMENDED PRACTICES	YES	NO	COMMENTS
Pests			
Orchard staff know how and where to report pests			
Pest surveillance regularly conducted, with activities and results recorded even when nothing is found			
Orchard staff are familiar with common established pests and the high priority exotic pests of avocado			
Commercial trees and neighbouring vegetation regularly inspected for pests			
Pest threat posters displayed			
Product management			
Planting or propagation material is 'certified' or has a defined and documented health status			
Propagation material thoroughly checked upon receipt			
Records of planting material and its source are maintained			
Staff are aware of symptoms of avocado fruit pests spread with propagation material			
No soil, plant material or insects left on equipment or bins			
Fruit loaded and unloaded on paved or sealed pad away from production areas			
Fallen or waste fruit, packing shed waste and plant trimmings disposed of away from production areas and irrigation sources			
People and biosecurity			
Biosecurity signs with contact details located at main entrance			
Staff trained in biosecurity measures and threats			
All visitors sign a visitor register on arrival			
All visitor and staff clothing, footwear and 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			
Staff understand neighbouring enterprises and their activities			
Equipment and vehicles			
Designated parking area for visitors and contractor's equipment available and clearly signed			
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 pests and weeds, and stop run-off			
Machinery entering the property inspected for pests, soil and plant material prior to entering production areas			
Borrowed and second-hand machinery and equipment is cleaned and disinfected before use			
Vehicle movement kept to a minimum in production areas			
Root trimming secateurs, budding and grafting knives are disinfected between trees			

Further information

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

20

	Useful contacts	Contact details
ORGANISATION	Avocados Australia	Phone: 07 3846 6566 Website: avocado.org.au/industry
	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
GOVERNMENT	Australian Government – Department of Agriculture, Fisheries and Forestry	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
	Queensland – Department of Employment, Economic Development and Innovation	Phone: 13 25 23 or 07 3404 6999 Website: www.deedi.qld.gov.au
	South Australia – Department of Primary Industries and Resources	Phone: 1300 666 010 or 08 8168 5200 Website: www.pir.sa.gov.au
	Victoria – Department of Primary Industries	Phone: 13 61 86 or 03 5332 5000 Website: www.dpi.vic.gov.au
	Western Australia – Department of Agriculture and Food	Phone: 08 9368 3333 Website: www.agric.wa.gov.au



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 phone	Blocks visited	Location/date of last contact with commercial avocado plants
	Arrival	Departure					

EXOTIC PLANT PEST HOTLINE
1800 084 881

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

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

Avocado leaf scorch

What is Avocado leaf scorch?

Leaf scorch is caused by a strain of the bacterium *Xylella fastidiosa* that colonises the water conducting tissue of the tree and impairs its normal function. The bacterium exists as various strains which differ in host range. Diseases include Pierce's disease of grapevine, Coffee leaf scorch and Citrus variegated chlorosis.

What does it look like?

Canopies of affected trees have deformed leaves with scorched margins, chlorotic mottling, defoliation, shortened internodes and branch dieback.

What can it be confused with?

Leaves with scorched margins can be confused with chloride toxicity.

What should I look for?

Deformed leaves with leaf scorch and chlorotic mottling; stunted branches with twig dieback. Leaf scorch symptoms may also be observed on other nearby crops such as coffee, citrus or grapevines.

How does it spread?

It can be transmitted by grafting and sap-sucking leafhoppers.

Where is it now?

Leaf scorch in avocado is only known to be present in Costa Rica where it is also found on coffee and citrus.



Tony Cooke, DEEDI

Leaf scorch symptoms



ENSA-Montpellier Archive, Ecole nationale supérieure agronomique de Montpellier, Bugwood.org

Symptoms of leaf scorch (Pierce's disease) on grapes



Alex. H. Purcell, University of California, Bugwood.org

Leaf symptoms of Citrus variegated chlorosis





How can I protect my orchard from Avocado leaf scorch?

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

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Leaf scorch symptoms on citrus

Alex. H. Purcell, University of California, Bugwood.org

Avocado scab

What is Avocado scab?

Avocado scab (*Sphaceloma perseae*) is a widespread fungal disease of avocado that causes severe losses from fruit drop and reduces fruit quality by marking fruit.

What does it look like?

Leaf symptoms begin as small discrete lesions which are often concentrated along the midrib and main veins, but lesions may coalesce into star-like patterns. Shot-holes may also develop. As the disease progresses, leaves become distorted and stunted. Lesions may also occur on leaf petioles, twigs and fruit pedicels.

Symptoms on fruit initially appear as corky, raised, oval or irregular shaped brown to purplish-brown spots. As the disease progresses, spots enlarge and coalesce to form large rough areas over the fruit surface. Cracking of these rough areas may allow secondary organisms to penetrate and rot the fruit.

What can it be confused with?

Avocado scab can be confused with physiological damage such as fruit rub.

What should I look for?

Look for brown or purple-brown lesions or rough, cracked scabby areas on fruit and distortion of leaves.

How does it spread?

S. perseae can be spread locally by wind, rain and insects. Insect wounds can increase entry of the pathogen and make scab development worse. Long distance transport is possible through fruit movement but most likely in infected propagation material.



Cracked scabby areas develop on fruit

Cesar Calderon, USDA APHIS PPQ, Bugwood.org



Corky, raised, spots appear on fruit

Randy Ploetz, University of Florida



Scabs may be brown, purplish or pink in appearance

Ken Pegg, DEEDI





Where is it now?

Avocado scab is present in South Africa, North America, Central America, West Indies, South America, Morocco and the Philippines.

How can I protect my orchard from Avocado scab?

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

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Spots begin to coalesce

Ken Pegg, DEEDI



Leaves can become distorted and stunted

Ken Pegg, DEEDI



Spots enlarge and coalesce to form large rough areas

Randy Ploetz, University of Florida

For more information visit www.planthealthaustralia.com.au

Avocado seed moth

What is Avocado seed moth?

Avocado seed moth (*Stenoma catenifer*) is a key pest of avocados in Latin America and can cause catastrophic yield losses.

What does it look like?

Moths are about 1 cm long and yellow when they first emerge, but they turn greyish-brown as they age. The forewings have 25 dark spots that form a “C” shape across the wing. There are five larval instars. Early instars are whitish in colour, while the later stages are pink or reddish coloured. The egg is oval in shape, 0.6 mm long and light green in colour and are usually laid on the fruit.

What can it be confused with?

Other moths from the Stenomatinae family can look similar to the Avocado seed moth but *S. catenifer* can be readily identified by the “C” shape formed by the dark spots on the forewing.

What should I look for?

In branches, moths form galleries which result in branches withering and reduced flowering. Moth larvae can penetrate fruit of any size and destroy the seed and pulp through feeding. Symptoms in fruit include easily observable holes, appearance of a white exudate oozing out and accumulation of frass. When opened, fruit may have frass accumulation in the void that forms around the seed. As the fruit matures, the pulp can separate from the seed, the seeds can be damaged with feeding holes, or the seeds can be completely destroyed by larval feeding inside the fruit.

How does it spread?

The moths disperse locally through flight and fruit movement. Longer distance spread will most likely be from fruit movement.



Adult moths are greyish brown in colour

Mark S. Hoddle, University of California



Larvae can bore into branches as well as fruit

Mark S. Hoddle, University of California



Frass accumulation around exit holes

Mark S. Hoddle, University of California





Where is it now?

Avocado seed moth is found in Mexico, Central and South America including Panama, Peru, Brazil, Guyana, Argentina and the Galapagos Islands.

How can I protect my orchard from Avocado seed moth?

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

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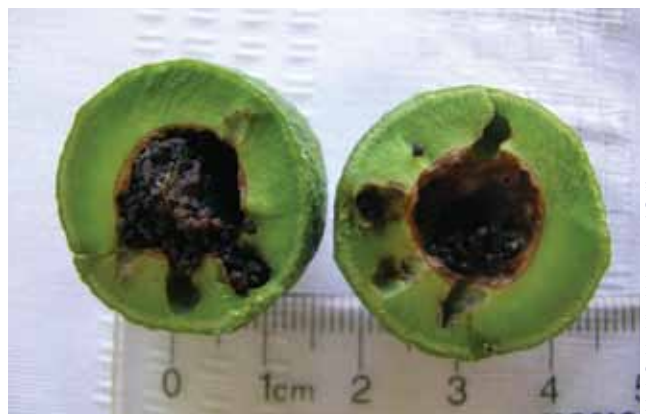
Frass accumulation can also be seen in infested branches

Mark S. Hoddle, University of California



Exit holes in fruit are an obvious symptom of moth presence

Mark S. Hoddle, University of California



Young fruit are also susceptible to damage

Mark S. Hoddle, University of California

For more information visit www.planthealthaustralia.com.au

Avocado sunblotch

What is Avocado sunblotch?

Avocado sunblotch is a disease caused by *Avocado sunblotch viroid* (ASBVd).

What does it look like?

Symptoms of avocado sunblotch include discoloured and depressed stem streaks, grooves on older branches, lesions and discolouration of the fruit, and a variety of foliar symptoms. Some infected trees remain symptomless. Symptoms are influenced by host cultivar, the environment and the strain of the viroid agent.

What should I look for?

The most consistent initial symptom of sunblotch infection is the appearance of narrow white, yellow or pink streaks on the surface of green twigs or young stems. Fruit produced from infected trees usually develop sunken white, yellow or pink blotches or streaks and are usually small, deformed and unmarketable. The bark on the trunk or larger branches can have a rectangular cracked appearance.

How does it spread?

Avocado sunblotch has no known insect vector and the principal means of transmission is in seed used to propagate rootstocks, in scion material used for grafting, and via root grafts. Sunblotch can be transmitted on sap-contaminated pruning blades, harvesting clippers and injection equipment. It can be transmitted in pollen, but only the developing fruit, and not the fruit-bearing tree, are infected.



Fruit from infected trees are small and deformed with sunken lesions

David Rosen, University of California Statewide IPM Project



Fruit is discoloured, showing sunken white/yellow blotches

David Rosen, University of California Statewide IPM Project



Foliage is discoloured and deformed

Andrew Gaering (CAAFI)





Where is it now?

Avocado sunblotch was first recorded in California in 1932 and has subsequently been reported in most avocado-growing areas. It is possible that the disease is more widespread because of symptom variability and the presence of symptomless carriers of the causal agent. It is considered a minor problem in countries where tree registration programs exclude the pathogen from propagating material.

It has been recorded in Australia but has limited distribution.

How can I protect my orchard from Avocado sunblotch?

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

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Yellow streaks and blotches occur on fruit and leaves

Tony Cooke, DEEDI



Sunblotch on Hass avocado fruit

Tony Cooke, DEEDI



Trees may be stunted and exhibit a sprawling prostrate architecture

Ken Pegg, DEEDI

Avocado thrips

What is Avocado thrips?

Avocado thrips (*Scirtothrips perseae*) is the major thrips pest of avocados in California, where it causes large economic losses.

What does it look like?

Adults are small (approximately 1 mm long), straw yellow in colour, and have thin dark lines running across the upper surface of the abdomen. The wings are brown in colour when folded over the abdomen. Immature pale yellow thrips develop through two larval stages. The eggs are kidney-shaped and whitish yellow in colour.

What can it be confused with?

Scirtothrips perseae is similar in colour to the Californian species *S. aceri*. However, this species is also exotic to Australia so any thrips fitting the above description should be sent to an entomologist for proper identification. *S. perseae* is also different from most thrips in that adult and immature stages are readily observed on upper leaf surfaces.

What should I look for?

Observation of adult or larval stages of the thrips can be seen on leaves. Symptoms of leaf damage appear along leaf veins, and as the population increases bronzing is observed in random patterns between leaf veins. Severe infestation can also cause leaf drop.

Damage to the fruit shows up as brown surface scarring which, when severe enough, covers the entire fruit surface resulting in the characteristic 'alligator skin' appearance. When Avocado thrips damage young fruit, elongate scarring results as the fruit continue to grow.



Brown surface scarring can cover the entire fruit surface

Mark S. Hoddle, University of California



Adults are straw coloured with thin dark lines across the abdomen. The wings appear dark brown when folded

Jack Kelly Clark, UC Statewide IPM Program



Initial scars on young fruit can continue to grow with the fruit

Jack Kelly Clark, UC Statewide IPM Program





How does it spread?

Over short distances, thrips are poor flyers, but they can be transported by winds. Over long distances, spread is likely to be the result of movement of infested avocado plants.

Where is it now?

S. perseae is found in Mexico and Guatemala, and was recently introduced into California.

How can I protect my orchard from Avocado thrips?

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

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Characteristic 'Alligator skin' from thrips damage

David Rosen, University of California Statewide IPM Project



Bronzing may be observed in random patterns between leaf veins

Mark S. Hoddle, University of California

Laurel wilt

What is Laurel wilt?

Laurel wilt is a fungal disease (*Raffaelea lauricola*) of redbay (*Persea borbonia*) and other trees in the Lauraceae (Laurel) family. Avocado was first recognised as a host in 2006 and the disease is now a huge threat to avocado trees in Florida.

Laurel wilt is spread by the Redbay ambrosia beetle (*Xyleborus glabratus*) which attacks healthy trees.

What does it look like?

After fungal infection, trees wilt rapidly, often in only a portion or one branch of a tree. Leaves become oily green and then dry brown as they die. Defoliation usually occurs within 3–4 months. Symptoms spread throughout the canopy, and although trees may re-sprout, they often die. Internally, affected sapwood is a reddish brown colour with greyish caste.

The Redbay ambrosia beetle is cylinder shaped, brown to black in colour and 2 mm long. Female adults can fly and are much more numerous than the smaller, flightless adult males.

What can it be confused with?

Symptoms resemble those of Verticillium wilt (caused by *Verticillium dahliae*). However, complete recovery of trees from Verticillium wilt is common, whereas those affected by Laurel wilt usually do not.

The Redbay ambrosia beetle is similar in appearance to other ambrosia beetles (*Xyleborus* spp.) present in Australia; however, these ambrosia beetles do not cause Laurel wilt. The death of smaller branches can be similar to damage caused by the Black twig borer (*Xylosandrus compactus*), but these beetles are not present in Australia. Any abnormal death or wilting of outer branches should be reported and inspected by a pathologist.



Andrew Geering, DEEDI Qld

Redbay ambrosia beetle spreads the disease



Andrew Geering, DEEDI Qld

Randy Pleetz, University of Florida

(Left) External damage from the beetle – note strings of ejected wood fibre (frass). (Right) Internal damage from Redbay ambrosia beetle – note bore holes



Andrew Geering, DEEDI Qld

Early symptoms on avocado





What should I look for?

The first obvious symptoms of Laurel wilt are likely to be wilted leaves. Leaf drop may soon follow. A diagnostic feature of Laurel wilt is a black to brown vascular discolouration of the xylem (the sapwood beneath the bark), which runs parallel to the grain of the wood.

Following wilting, beetles often attack the dying tree in larger numbers. Small strings of ejected wood fibre may be seen protruding from bore holes on the trunk and branches.

How does it spread?

The fungus is carried by the Redbay ambrosia beetle which carries fungal spores. When the beetles bore into trees, they inoculate the tunnels with the fungal spores. The beetle is likely to be dispersed over large distances in infested wood or wood products. The disease is also capable of moving to healthy trees via root grafts.

Where is it now?

The disease is only known to occur in the USA. The fungus is presumed to have been introduced to the USA with the beetle. The beetle is native to India, Japan, Myanmar, and Taiwan.

How can I protect my orchard from Laurel wilt?

Source plant material only from clean, accredited suppliers, and preferably material that is certified. Check your orchard frequently for the presence of new pests and unusual symptoms.

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Defoliation of upper canopy and symptoms developing in lower portions of the tree

Randy Floetz, University of Florida



Internal vascular discolouration of an avocado stem

Randy Floetz, University of Florida



Development of laurel wilt on part of a tree

Jonathan Crane, University of Florida

Oriental fruit fly complex

What is Oriental fruit fly complex?

Papaya fruit fly (*Bactrocera papayae*), Oriental fruit fly (*B. dorsalis*) and Carambola fruit fly (*B. 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 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 Med 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 to two days, the eggs hatch into maggots (larvae) which feed on the decaying fruit, causing premature fruit drop.



Scott Bauer

The female has a long ovipositor for penetrating the skin of fruit



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

A T-shaped mark is often visible on the abdomen



Pest and Diseases Image Library, Bugwood.org

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





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 become 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 in the north of South America and parts of the South Pacific. Carambola fruit fly is found in South America.

How can I protect my orchard from fruit flies?

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



Adults grow up to 6-8mm in length

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



The thorax (chest) 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

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Persea mite

What is Persea mite?

Persea mite (*Oligonychus perseae*) is a serious pest with a wide host range that causes defoliation of avocado trees in California.

What does it look like?

Adults grow to approximately 0.5 mm in size. Females have an oval-shaped body that is slightly flattened, and is yellowish green in colour with several small dark spots located in the abdominal region. The male is smaller than the female and has a pear-shaped body that is slightly flattened and yellowish in colour. Occasionally, it has small dark spots in the abdominal region. Old females are dark green in colour, inactive, and the body is reduced in size.

Immature stages are yellowish or greenish in colour, with two or more small dark spots in the abdominal region.

What can it be confused with?

Persea mites look similar to the Six-spotted mites (*Eotetranychus sexmaculatus*) which are present in Australia and also feed on the underside of leaves. However, Six-spotted mite colonies do not form densely layered web canopies, and Persea mites prefer to feed adjacent to the midrib and large lateral veins causing irregular purplish, necrotic spotting.

What should I look for?

Look for nests that are formed along midribs and veins on the undersides of leaves. Symptoms of leaf damage can also be seen as necrotic spots covered with protective webbing. Upper leaf surfaces have a yellow spotting pattern. As Persea mite populations increase, feeding damage causes leaves to drop. A heavily infested tree will have a litter of yellow-spotted leaves on the ground.



Discrete circular necrotic spots can be seen on leaves

Scott Nelson, University of Hawaii



Feeding on upper leaf surfaces causes a yellow spotting pattern.

Scott Nelson, University of Hawaii



Leaf drop may occur in heavy infestations

Scott Nelson, University of Hawaii





The mite is most damaging to the cv. Hass, but it also attacks cvs. Gwen and Reed. Fewer symptoms are seen on Mexican varieties such as Fuerte, Bacon and Zutano.

How does it spread?

Persea mites can be dispersed by wind, and on infested plants.

Where is it now?

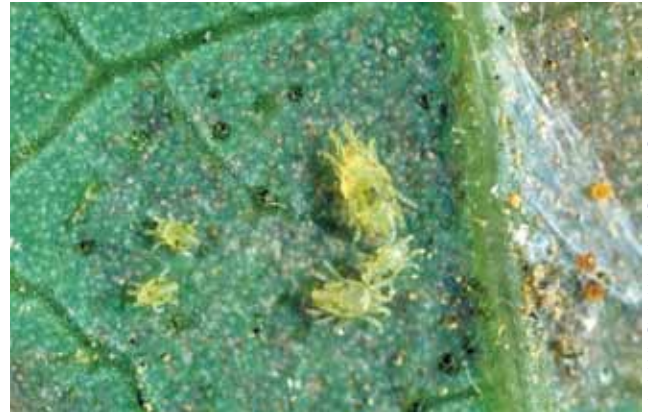
Persea mite occurs in most avocado-growing areas of California except the Central Valley.

How can I protect my orchard from Persea mite?

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

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Immature stages are yellowish or greenish in colour

Jack Kelly Clark, University of California Statewide IPM Project

Trunk canker

What is Trunk canker?

Trunk canker is caused by several species of *Phytophthora*, only some of which are widely distributed. *Phytophthora cinnamomi* is responsible for the disease in Australia. *P. menzei* is a serious canker pathogen on avocado in California and Mexico and is not present in Australia.

What does it look like?

Unlike cankers caused by *P. cinnamomi*, which are usually confined to the lower trunk, *P. menzei* invades the large structural roots, the trunk and may extend into the lower limbs. The bark may be discoloured, cracked or fissured at or below ground level and symptoms may extend as far as 3 metres up the trunk and branches. It can also invade avocado fruit.

What can it be confused with?

Symptoms of *P. menzei* resemble those caused by *P. cinnamomi*, however, a major difference is that symptoms of *P. menzei* spread further up the trunk and into lower branches.

What should I look for?

Look for cankers extending into lower branches, defoliation and twig dieback. Accurate identification of the pathogen is essential.

How does it spread?

P. menzei is a soilborne pathogen. It is spread in surface water, infested soil and infected nursery plants.



Ken Pegg, DEEDI

Symptoms of stem canker caused by *P. cinnamomi*



John Menge, University of California

External symptoms caused by *P. menzei* – note the sugary material exudate as a viscous liquid



John Menge, University of California

Canker caused by *P. menzei* with a brown necrotic lesion on the inner bark





Where is it now?

Trunk canker disease caused by *Phytophthora menzei* has limited distribution and is only found in California and Mexico.

How can I protect my orchard from Trunk canker?

Source plant material only from clean, accredited suppliers, and preferably material that is certified. Avoid flooding, drought and salinity as these stresses predispose trees to infection. Do not wet trunks from sprinkler systems. Check your orchard frequently for the presence of new pests and unusual symptoms. Make sure you are familiar with common avocado diseases so you can tell if you see something different.

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(Left) Basal bark cracking. (Right) Canker caused by *P. menzei* extending into lower branches and trunk

Randy Floetz, University of Florida

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