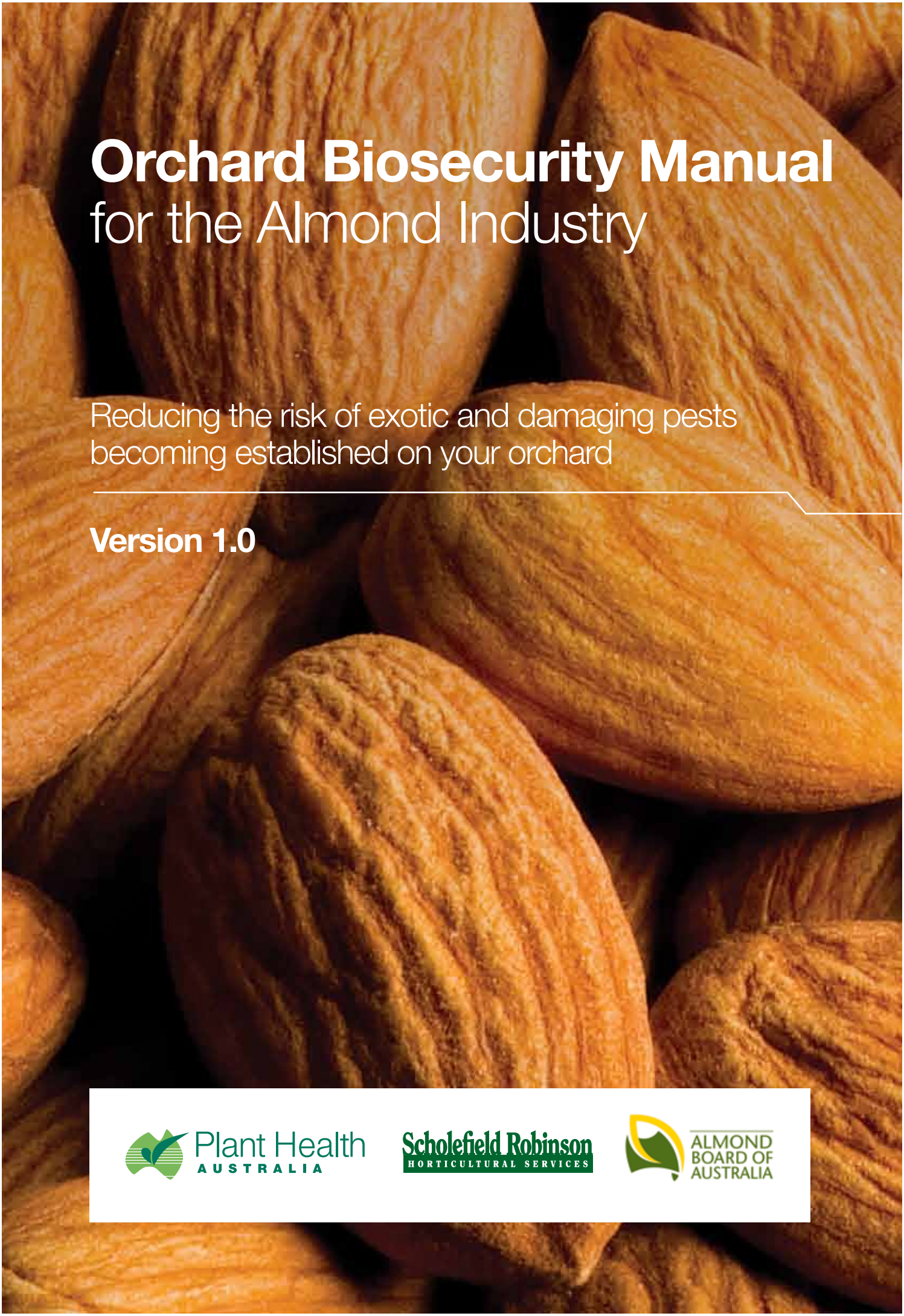

Orchard Biosecurity Manual
for the Almond Industry

Reducing the risk of exotic and damaging pests becoming established on your orchard

Version 1.0

Plant Health AUSTRALIA

Scholefield Robinson HORTICULTURAL SERVICES

ALMOND BOARD OF AUSTRALIA

Plant Health Australia (PHA) is the lead national coordinating body for plant health in Australia. PHA works in partnership with industry, governments, researchers and others, providing national coordination to improve biosecurity policy and practice across Australia's plant industries and to build capacity to respond to plant pest emergencies.
www.planthealthaustralia.com.au

The Almond Board Australia (ABA) is the peak almond industry body. The ABA represents and promotes the interests of Australian almond growers, processors and marketers. Membership is voluntary and currently encompasses more than 95% of the Australian almond production base. The ABA provides a channel for communication and dissemination of information between members of the Industry, governments and other sectors of horticulture; manages research and development and fosters industry growth, profitability and sustainability. The ABA is a member of PHA.
www.australianalmonds.com.au

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An electronic version of this manual is available from the website listed above.

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Six easy ways to protect your orchard

2 You have an important role to play in protecting your orchard and the almond industry from biosecurity threats

Here are six simple things you can do to reduce the threat of new pests entering and establishing in your orchard:

1. Be aware of biosecurity threats

Make sure you and your employees are familiar with the most important exotic almond pests.

2. Use high health status, pest-free propagation material from known sources

Ensure all propagation material and orchard inputs are fully tested and pest-free. Keep 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 decontaminated before they enter and leave your orchard.

4. Check your crop

Monitor your trees frequently. Knowing the usual appearance of your trees will help you recognise new or unusual symptoms and pests. Keep records of all unusual symptoms and pests.

5. Abide by the law

Support and be aware of laws and regulations established to protect the almond industry.

6. Report anything unusual

If you suspect a new pest – **report it immediately.**

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

EXOTIC PLANT PEST HOTLINE
1800 084 881

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Biosecurity overview

This manual is designed to assist you in protecting your almond orchard and the almond industry from new and invasive pests. By implementing the recommended measures in your day-to-day operations, you will enhance your biosecurity and that of your region, while minimising productivity losses and unnecessary costs.

What is biosecurity?

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

Biosecurity is a national priority, implemented at pre-border, border and post-border locations. It is essential for your business.

Australia's geographic isolation has meant that we have 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 ensures that our plant health status is maintained. This allows us to preserve existing trade opportunities, and provide evidence to support new market negotiations.

In addition, 'area freedom' from a number of endemic pests, is vital to the prosperity of the almond industry.

The definition of a **pest** used in this manual covers all insects, mites, snails, nematodes, pathogens (diseases) and weeds that are injurious to plants or plant products. **Exotic** pests are those not currently present in Australia. **Endemic** pests are established 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, producers play a key role in protecting the Australian almond 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.

More information on how to secure your orchard and secure your future can be found online at **www.farmbiosecurity.com.au** a joint initiative of Plant Health Australia and Animal Health Australia.

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Regional biosecurity

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 minimized.

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.

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

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

farmbiosecurity

Pests

The following are the high priority exotic pest threats for the Australian almond industry as decided through the development of the Industry Biosecurity Plan, and all would have serious consequences should they be introduced. These are not the only exotic pests of the Australian almond industry. The severity of the impact may be dependent on rootstock-scion combinations and the presence/absence of pathogen vectors.

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

High priority exotic pests of the almond industry

Almond leaf scorch

POTENTIAL ECONOMIC IMPACT – HIGH

- Bacterium – *Xylella fastidiosa*
- Found in North and South America, and the Mediterranean
- 'Burn' zones on leaves with golden margin; causing wilted, 'scorched' canopy resembling salt damage; and stunted trees
- Spread by sap-feeding leafhoppers or by grafting of infected planting material

J. K. Uyemoto

Glassy-winged sharpshooter

POTENTIAL ECONOMIC IMPACT – HIGH

- Sharpshooter insect (Hemiptera) – *Homalodisca vitripennis*
- Found in the USA, Mexico and some Pacific islands
- Vector of *X. fastidiosa* and also produces excrement showers
- Large (13-14 mm) and dark, with yellow dots on head
- Voracious feeder of a wide range of hosts
- Eggs laid in side-by-side rows on underside of leaves
- Good flyer that can spread quickly and eggs can also spread on plant material

J. N. Dell

Hyperplastic canker

POTENTIAL ECONOMIC IMPACT – HIGH

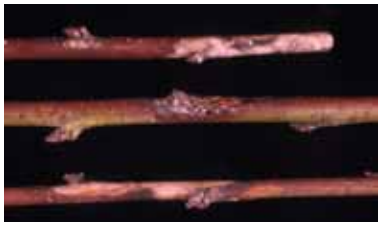
- Bacterium – *Pseudomonas amygdali*
- Found in Europe
- Swollen bark that cracks open longitudinally around buds and leaf scars on twigs and branches. Results in no bud burst in cankers and tree decline
- Spread by wind and rain from active cankers as well as in infected plant material

C. Panagopoulos

Phomopsis canker

POTENTIAL ECONOMIC IMPACT – HIGH

- Fungus – *Phomopsis amygdali*
- Found in Europe, the Mediterranean, USA and South America
- Dark lesions near buds, wilting of new growth, sunken cankers in summer and nuts shrivelled
- Spread in infected planting material



University of Georgia Plant Pathology Archive, Bugwood

Almond seed wasp

POTENTIAL ECONOMIC IMPACT – HIGH

- Wasp (Hymenoptera) – *Eurytoma amygdali*
- Found in Europe, Asia, Middle East and North America
- Eggs and larvae develop in mummies with a tiny circular hole evident
- Nut meat eaten

H. Dumas

Navel orangeworm

POTENTIAL ECONOMIC IMPACT – HIGH

- Larvae of moth (Lepidoptera) – *Amyelois transitella*
- Found in USA and Canada
- Moths lay eggs on new fruit or in mummies
- Larvae feed on nut meat, leaving webbing and frass
- Increases threat of aflatoxins in nuts
- Orchard hygiene important for control

J. K. Clark

Peach twig borer

POTENTIAL ECONOMIC IMPACT – MEDIUM-HIGH

- Larvae of moth (Lepidoptera) – *Anarsia lineatella*
- Found in North America, Europe and the Mediterranean
- Small brown caterpillar with black head and white bands between segments
- Bore under bark and leave chimneys of frass, damage crotch and developing limbs, new shoots wilt.
- Larvae feed on nuts
- Several generations each year

H. Audemard

Ten-lined June beetle

ECONOMIC IMPACT – MEDIUM

- Beetle (Coleoptera) – *Polyphylla decemlineata*
- Found in western USA in sandy soil
- Cream, C-shaped larvae
- Feeds on roots, resulting in clusters of weak trees
- Beetles are 2.5 cm long with white stripes on back and are attracted to light

Anthony Young

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European stone fruit yellows

POTENTIAL ECONOMIC IMPACT – MEDIUM

- Phytoplasma – European stone fruit yellows phytoplasma
- Found in Europe
- Infected trees have low vigour and leaf out before flowering
- Leaves are longitudinally-rolled and droop, and trees may defoliate early

B. Schneider

Almond brownline and decline, and Almond kernel shrivel

POTENTIAL ECONOMIC IMPACT – MEDIUM

- Phytoplasma - Peach yellow leafroll phytoplasma
- Found in Europe and USA
- Type of rootstock affects rate of decline
- On plum rootstock: yellow canopies, line of dead cells at union, small leaves and bark splits (Almond brownline and decline)
- On peach rootstock: delayed bud burst, stunted growth, pale leaves, kernels shrivelled (Almond kernel shrivel)
- Psyllid vectors likely

Jerry K. Uyemoto

Priority pests of pollination

Varroa mite

POTENTIAL ECONOMIC IMPACT – HIGH

- Mite of bees (Acarina) – *Varroa destructor* and *V. jacobsoni*
- Widespread, including recently arrived in New Zealand and Papua New Guinea
- Reddish, oval-shaped, pinhead-sized mites carried on European and Asian bees as external parasites
- Infest hives, introduce pathogens and damage developing bees
- Look for unusual bee behaviour

S. Bauer

Keep an eye out for anything unusual in your orchard. If a pest is found that is not normally present in your orchard, it may be new not only to your orchard, but to the region, state or even Australia.

Case Study – Navel orangeworm

The Australian almond industry has not yet experienced the impact of a pest like Navel orangeworm (NOW), but its capacity to reach our shores is in no doubt. NOW has been previously intercepted at our border on citrus imports.

In orchards overseas where this pest is established, it not only reduces almond yield and quality and increases operating costs, but also contributes to a food safety problem with trade and regulatory implications. Its management is onerous and demands high level orchard hygiene, including field monitoring of moth flights, spore traps and environmental conditions, together with additional well-timed insecticide applications and inspections and removal of mummies from trees.

NOW moths lay eggs in nuts and the resulting larvae consume the developing kernels, leaving frass and webbing behind. NOW-damaged nuts are more susceptible to attack by fungi. *Aspergillus* spp. fungi, which produce a toxin of human health concern, are commonly associated with NOW-damaged nuts and damp nuts in stockpiles. Food safety assurances for almonds must therefore be underpinned by good orchard hygiene, vigilant insect and mummy monitoring, as well as specific testing for aflatoxin presence.

Pest surveillance

Pest surveillance, or crop monitoring, involves looking for, recording and managing plant pests. Conducting regular surveys of your orchard gives you the best chance of spotting a new pest soon after its arrival. Surveillance can be incorporated into existing Integrated Pest Management (IPM) practices, quality assurance programmes, or as a component of best management practices.

Active pest surveillance is necessary because:

- Early detection of exotic pests improves the chance of eradication or containment within a region. 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.
- Depending on the type of pest and seasonal conditions, many pests can quickly build up to high levels. General management of established pests requires regular inspections to determine presence and population levels. IPM should be a fundamental part of your orchard management practices.

- Export destinations for almonds (and other nuts) require 'evidence of absence' data for exotic and some endemic pests that are of their concern. The Australian almond industry, in collaboration with governments, must prove through surveillance that exotic pests have been looked for and found to be absent. This underpins claims of 'area freedom' in that a pest is 'known not to occur'.
- 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 endemic) surveillance activities carried out on your property should be recorded. These records can be used in the response to a pest outbreak and provide support to industry surveillance activities. The addition of exotic pests to current datasheets used by consultants is an effective recording mechanism. An example pest surveillance datasheet is included in this manual (page 29).

Report suspect pests

Report any unusual or suspect plant pest immediately via the Exotic Plant Pest Hotline on 1800 084 881. Early detection and reporting may prevent or minimise long-term damage to, or quarantine period of, your orchard and the almond industry.

Calls to the Exotic Plant Pest Hotline will be forwarded to an experienced person in the department of primary industries in your state or territory, 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:

- Do not allow movement of people or equipment near the affected area.
- Wash hands, clothes and boots that have been in contact with affected plant material or soil.
- Do not touch, move or transport affected plant material. Incorrect handling could spread the pest further or render the samples unfit for diagnosis.

While waiting for the identification of the suspected exotic pest, the following measures should be put in place to contain the pest and protect other parts of your orchard:

- Mark the location of the pest detection.
- Limit access to the area.
- Restrict operations in the area.

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

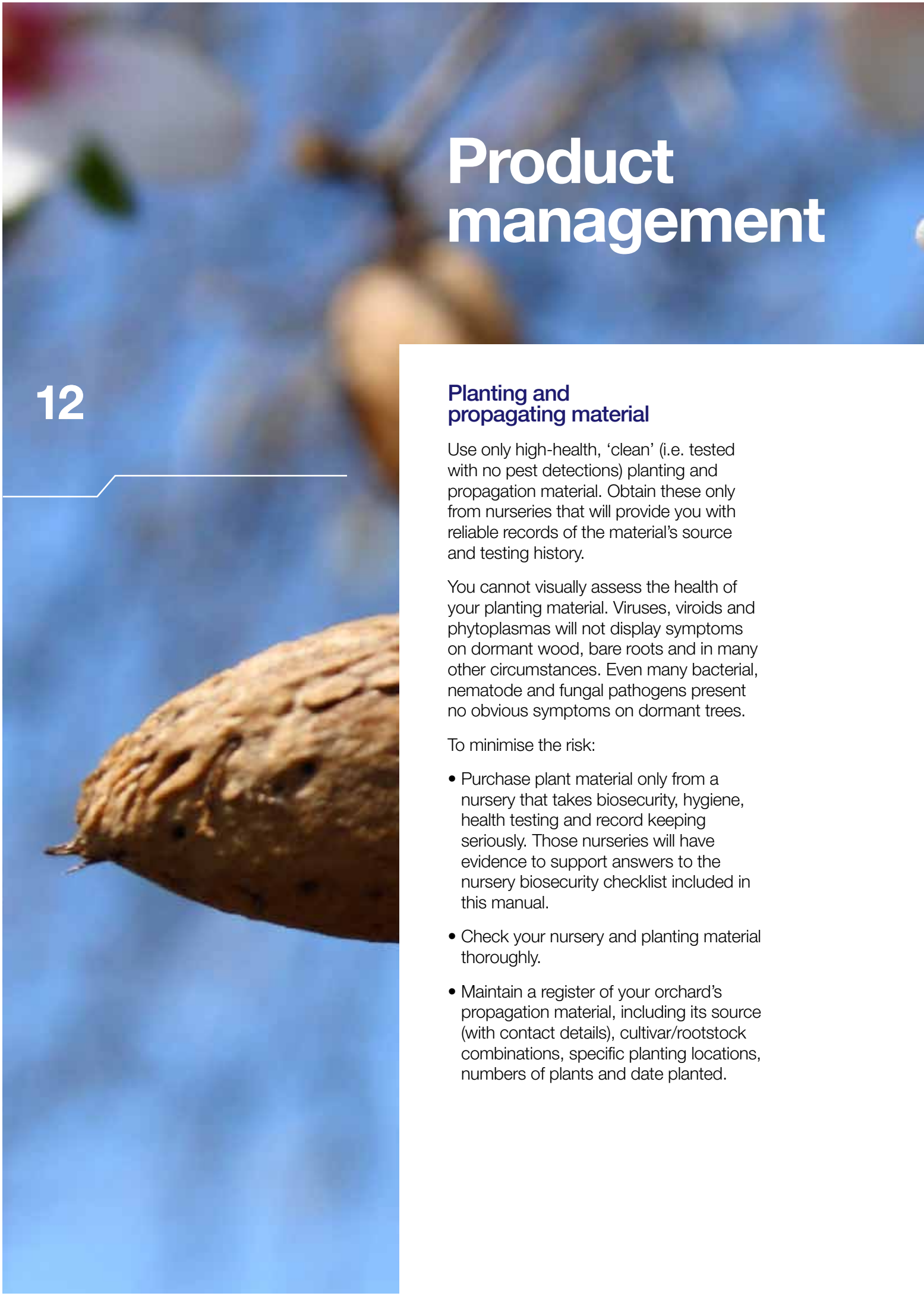
EXOTIC PLANT PEST HOTLINE
1800 084 881

The Emergency Plant Pest Response Deed (EPPRD) and the Almond Industry

The EPPRD is a formal legally binding document between Plant Health Australia, Australian and state/territory governments and plant industry signatories.
As a signatory to the EPPRD, the Almond Board of 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, almond industry members have 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 greater the chance it will be successful.

Within an approved Response Plan, grower reimbursement payments (Owner Reimbursement Costs - ORCs) for direct costs incurred as a result of eradication of a pest incursion are included.



Product management

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Planting and propagating material

Use only high-health, ‘clean’ (i.e. tested with no pest detections) planting and propagation material. 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 on dormant wood, bare roots and in many other circumstances. Even many bacterial, nematode and fungal pathogens present no obvious symptoms on dormant trees.

To minimise the risk:

- Purchase plant material only from a nursery that takes biosecurity, hygiene, health testing and record keeping seriously. Those nurseries will have evidence to support answers to the nursery biosecurity checklist included in this manual.
- 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.

When purchasing planting material, seek as much information as possible from your nursery, complete the nursery biosecurity checklist included in this manual, and request and retain all documentation. Information that should be requested includes:

- The source of budwood (and seed for rootstocks).
- Mother tree health testing regime and timetable (get in writing what virus testing was completed, by whom and when).
- If the cultivar or rootstock is a recent import, ask for its accession number, import date and source.
- Location of foundation material of new imports (should be in screen house or isolated area away from commercial production trees).
- Quality Assurance scheme or certification status of the nursery itself and planting material provided.

Australian Almond Budwood Scheme

The Australian almond industry has established its own budwood multiplication block at Monash, South Australia. The site is managed by staff of the Almond Board of Australia, the University of Adelaide and the Riverland Vine Improvement Committee. Mother trees were established as a source of virus-tested planting material for the industry and a pre-determined proportion of the trees are tested for virus presence each year. The production of clean stock is supported by the implementation of best management practices throughout the Monash orchard.

Budwood from this scheme is made available to industry through reputable nurseries. This scheme in combination with high levels of good nursery hygiene, has contributed to the existing high quality of almond plantings.

Additional information on the scheme is available on the Almond Board of Australia website **www.australianalmonds.com.au**

14 Almond (or other Prunus species) by-products

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 almonds.

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 harvesting the nuts.

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 traceback plant material on your orchard to its source (including the budwood sources, seed source, health testing specifics and authenticity records), to traceforward plant material or produce that has left your property, and provision of 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

16 Biosecurity signs

Well designed signage informs visitors that biosecurity in your orchard is a focus 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 sheds should direct visitors to contact the owner/orchard manager or formally register their presence, before entering any production areas. The signs should include important contact details, such as the home telephone number, mobile number and/or two-way channel.

Contact Plant Health Australia for further information on obtaining biosecurity signs for your property.

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 included in this manual).
- Inform all employees and visitors that their 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 such as disposable overalls, for people entering or leaving your orchard, or moving from contaminated to clean areas of the property.
- Ensure budding crews are particularly diligent about cleaning their knives and footwear between cuts. At a minimum, knives should be cleaned between each bundle.

- Train and motivate staff to be aware of all threats and biosecurity measures. Test them occasionally and reward biosecurity awareness and initiative.
- Brief all casual or itinerant workers, contractors and visitors on your orchard hygiene measures.
- Display biosecurity awareness material in staff rooms, trimming and packing sheds. Keep the messages simple and effective.

Overseas travellers

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

Several specimens carrying Prunus 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.

Casual workers and tourists

Itinerant workers (budding crews, contract harvest crews, backpackers, retirees, etc.) are often employed to assist with orchard budding, 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 (e.g. knives).

Before entering production areas or packing sheds, make sure itinerant 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.


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75
40 KM/H
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Equipment and vehicles

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 directly into previously pest-free plant material.

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

A simple additional measure to reduce the risk of direct pest transfer is to park equipment not in use in full sun on hot days.

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

Inspecting and cleaning machinery is more time and cost effective than managing a new pest introduced to your property.

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

- Keep orchard vehicles clean by clearing the vehicle floor of soil, weed seeds and insects, 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 to minimise the threat of spreading pests.
- Hose off and disinfect machinery in a designated wash-down area before moving between properties.
- Ensure contract mechanical pruners are washed down thoroughly to remove any plant material or soil before entering your orchard.
- Use high pressure water or air to remove plant material and soil from larger equipment and machinery. Ensure that waste water and debris don't enter production or storage areas.
- 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, palecons, cherry pickers, boxes, bags, trimmers and any other equipment used in the orchard, preferably with an antiseptic or bleach solution.

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Designated parking areas

A well sign-posted designated parking area should be provided for all visitors to your property. 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.

Designated parking areas serve to contain the entry of new pests to an area away from production sites. It also allows for the inspection of tyres, equipment, floor mats and boots for soil and plant material which may carry 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.

Wash-down facilities

A wash-down facility allows orchard employees, contractors and visitors to clean their vehicle and equipment in an easily managed area where wash water is contained.

Providing a high-pressure wash-down facility and cleaning equipment will assist you and your visitors to clean down vehicles and equipment.

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 should have a sump or water collection area. The sump and area surrounding the wash-down facility should be treated or checked regularly for the presence of pests and weeds.

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.

Wash-down areas 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 orchard.
- Have a sump or collection area for easy inspection.

Orchard biosecurity checklist

Orchard/property name:
Date of biosecurity check:

RECOMMENDED PRACTICES	YES	NO	Comments
Pests			
Commercial trees and neighbouring vegetation regularly inspected for pests			
Orchard staff know how and where to report pests			
Orchard staff are familiar with the high priority pest threats for the almond industry (see pages 6–8)			
Active pest surveillance is regularly conducted			
Survey activities and results are recorded, even when nothing is found			
Numbers of mummies left after harvest are minimised and those remaining are inspected			
Product management			
Propagation material is free from pests – visually and by documented testing			
Planting or propagation material is ‘certified’ or has defined health status			
Records of planting material and its source maintained			
Planting material without complete documentation not accepted on property			
Staff have specific knowledge of symptoms of almond pests spread in propagation material			
Effective monitoring/pest management program maintained			
No soil, plant material or insects left on equipment or in bins			
Almonds loaded and unloaded on paved or sealed pad away from production areas			
Fallen or waste almonds and packing shed waste disposed of away from production areas and irrigation sources			

RECOMMENDED PRACTICES	YES	NO	Comments
People movement			
Biosecurity signs are located at main entrances			
Visitors sign a Visitor Register on arrival			
Visitors, clothing, footwear and tools are free of loose soil or plant matter before entering or leaving the orchard			
All people recently returned from overseas have clean footwear and clothes before entering the orchard			
Footbaths and scrubbing brushes provided for visitors and staff moving from contaminated to clean areas of the orchard			
Orchard vehicles used to transport visitors around the property			
Orchard staff aware of biosecurity procedures in place			
Equipment and vehicles			
Designated parking area for non-orchard vehicles			
Cleaning and wash-down facilities, preferably on a concrete pad, provided for people, machinery and equipment			
High pressure water or air available for use to remove plant material and soil from equipment and machinery			
Sump installed in wash-down facility to catch unwanted weeds and stop run-off			
Orchard vehicles kept clean by regularly clearing the vehicle floor of soil, weed seeds and insects			
Vehicle movement kept to a minimum in production areas			
Borrowed and second-hand machinery and equipment is cleaned of all plant material and soil before use			
Secateurs and grafting knives are disinfected using a bleach solution between trees			
Machinery cleaned before being moved off property			

Nursery checklist

To be completed through discussion with your nurseryman when purchasing propagation material from a nursery, to reduce the risk of introducing new pests to your orchard.

Nursery name:
Date of propagation material purchase:
Propagation material purchased:

RECOMMENDED PRACTICES	YES	NO	Comments
Pests			
Nursery staff familiar with general biosecurity practices			
Nursery staff familiar with exotic and endemic threats of almonds			
Specific testing periods for mother plants and seed are programmed			
Test results are recorded and auditable			
Pest threat posters displayed			
Staff know how and where to report pests			
No unlabelled or material of unknown source accepted as propagation material			
An effective monitoring/pest management program maintained and recorded in 'spray diary' or similar			
Active surveillance is formally conducted – inspections, sticky cards, etc.			
Survey activities are recorded, even when nothing is found			
Product management			
Propagation material is free from pests			
Certified plant material is physically separated from non-certified plant material			
Register of planting material and its specific source maintained			
Member of Nursery and Garden Industry Australia and using NIASA and Biosecure *HACCP*			

RECOMMENDED PRACTICES	YES	NO	Comments
Product management cont.			
Register of plant material by accession number and date of importation maintained			
Staff are familiar with symptoms of almond pests transmissible in propagation material			
Pots and bins are regularly and thoroughly cleaned			
Plant debris and trimmings are disposed of appropriately			
Staff understand laws governing declaration and introduction of plant material			
People movement			
Biosecurity signs with contact details located at main entrance			
All visitors enter details into Visitor Register before moving about property			
All visitor and staff clothing, footwear and tools are free of loose soil or plant matter before entering and leaving the nursery			
All people recently returned from overseas are checked to ensure they have clean footwear and clothing before entering nursery			
Footbaths and scrubbing brushes are provided			
Staff trained in biosecurity measures and threats			
Staff understand neighbouring enterprises and their activities			
Equipment and vehicles			
Designated parking area provided for visiting vehicles and contractor equipment			
Paved, sealed or compacted walkways through the nursery propagation areas			
Suitable cleaning and wash-down facilities for in-field propagators			
Effective water treatment, recycling and run-off containment			
Vehicle and people movement minimised in production areas			
Borrowed and second-hand machinery and equipment is cleaned of all plant material and soil before entering production areas			
Root trimming secateurs, budding and grafting knives are disinfected (with bleach solution) between trees			

Useful contacts

Plant Health Australia

Phone: 02 6215 7700 **Email:** admin@phau.com.au
Website: www.planthealthaustralia.com.au

Almond Board of Australia

Phone: 08 8582 2055 **Email:** admin@australianalmonds.com.au
Website: www.australianalmonds.com.au

Scholefield Robinson Horticultural Services

Phone: 08 8373 2488 **Email:** srhs@srhs.com.au
Website: www.srhs.com.au

Australian Nut Industry Council

Phone: 08 8582 2055 **Email:** anic@riverland.net.au
Website: www.nutindustry.org.au

Australian Government

Department of Agriculture, Fisheries and Forestry (DAFF)
Phone: 02 6272 3933 **Website:** www.daff.gov.au

EXOTIC PLANT PEST HOTLINE
1800 084 881

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

State governments

New South Wales – Department of Primary Industry and Investment

Phone: 1800 808 095 **Email:** nsw.agriculture@dpi.nsw.gov.au
02 6391 3100 **Website:** www.dpi.nsw.gov.au

Queensland – Department of Employment, Economic Development and Innovation

Phone: 13 25 23 **Email:** ccemail@dpi.qld.gov.au
07 3404 6999 **Website:** www.dpi.qld.gov.au

Northern Territory – Department of Regional Development, Primary Industry, Fisheries and Resources

Phone: 08 8999 5511 **Email:** info.drdpifr@nt.gov.au
Website: www.nt.gov.au/d

Tasmania – Department of Primary Industries and Water

Phone: 1300 368 550 **Email:** PI.Enquiries@dpiw.tas.gov.au
03 6233 8011 **Website:** www.dpiw.tas.gov.au

Victoria – Department of Primary Industries

Phone: 13 61 86 **Email:** customer.service@dpi.vic.gov.au
03 5332 5000 **Website:** www.dpi.vic.gov.au

South Australia – Department of Primary Industries and Resources

Phone: 08 8226 0222 **Website:** www.pir.sa.gov.au

Western Australia – Department of Agriculture and Food

Phone: 08 9368 3333 **Email:** enquiries@agric.wa.gov.au
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 or mobile	Blocks visited	Location/date of last contact with commercial almonds or other Prunus species
	Arrival	Departure					

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

EXOTIC PLANT PEST HOTLINE
1800 084 881

Pest surveillance data 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 in your orchard call the Exotic Plant Pest Hotline on 1800 084 881

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


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Fact sheet

Hive biosecurity

Good orchard biosecurity protects your crops and livelihood from the threat of exotic pests. Orchard biosecurity is everyone's responsibility.

As the owner or manager of an orchard, you need to ensure that every person working or coming onto your property is well informed of your active biosecurity measures.

Orchard hygiene is critical to maintaining effective biosecurity. Ensuring that people, vehicles, machinery and equipment do not carry exotic pests onto your property will offer protection from the expense and potential devastation of an exotic pest incursion.

The pollination services used by orchardists bring a contractor with special biosecurity considerations onto your property. Minimising the risk of new pest introductions to the Australian honey bee industry through good hive biosecurity practices provides benefits to beekeepers and growers, and protects the honey and pollination-dependent industries.

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1800 084 881

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Scott Bauer

European honey bee with a Varroa mite on its back

Waugsberg

Varroa mite on a recently hatched western honey bee

Stephen Ausmus, USDA ARS, Bugwood

A young worker bee emerges from a brood cell with a mite on its back

Bee and hive threats

The Australian honey bee industry currently faces several key biosecurity threats. The highest priorities are Varroa mites (*Varroa destructor* and *V. jacobsoni*), which attack Asian and European honey bees. Other pests of honey bees that would have an economic impact if they entered Australia include Tropilaelaps mites and Tracheal mites. Establishment of exotic pest species of bees such as Asian honey bees (*Apis cerana*) and Giant earth bumblebee (*Bombus terrestris*) also pose a threat.

Varroa mite

What is it?

Varroa mites are external parasites that feed on both adult bees and brood (larvae and pupae). The mites are carried into hives on bees, where they leave the bee and invade brood cells. They are obligate parasites and do not survive many days away from bees. Mite feeding weakens adult bees and new bees emerging from mite infested brood cells are often deformed and die prematurely. Progressive loss of bees results in weakening of the hive and eventually colony death. In addition, movement of mites between hives and within the hive spreads any pathogens that they carry.

What to look for?

The mites are the size of a pinhead and hard to see with the naked eye. Detection of the mites is most easily achieved through other apparent signs of their presence, such as unusual bee behaviour (itchy bees trying to scratch off mites) and weak or deformed bees. The other major sign is a sudden decline in bee numbers in a colony or complete death of the colony. The weakened bees die and cannot be replaced at the rate required to maintain the hive. Honey production also drops as there are fewer bees capable of foraging.

Where are they found?

Varroa mites are present in most bee keeping countries of the world, except for Australia. The threat is as close as Indonesia, Papua New Guinea and New Zealand. Following arrival in New Zealand in 2000, they have had a significant economic impact on the honey bee and pollination-dependant industries.

Scott Bauer

An adult female Varroa mite feeds on a developing bee

Scott Bauer

Visible as a dark, oval shape, an adult female Varroa mite feeds on the midsection of a developing worker bee

Lilia De Guzman

Honey bee population infested with Varroa mites

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Early detection underpins effective eradication of these unwanted pests of honeybees and pest bee species.

What impacts would they have in Australia?

The potential impact on the Australian plant industries has been estimated at up to $50 million per year due to reduced and poor quality crop production. Effects would be most severe on pollination-dependent horticultural crops. There would also be direct effects on honey production and a requirement for additional chemical treatments to control Varroa mite.

Other bee and hive threats

Other threats not currently in Australia include:

- Tracheal mite (*Acarapis woodi*): Infestations result in sick adult bees that do not work as hard or live as long as healthy bees. The mite infests the trachea and air sacs, resulting in affected bees having difficulty in flying. Within the hive, spread occurs from adults to newly emerging bees. Spread to other hives occurs through drifting bees entering new hives and through beekeepers interchanging hive components or introducing infested queen bees. Detection is difficult because the signs are non-specific. Laboratory diagnosis is required.

- Tropilaelaps mite (*Tropilaelaps clarae*): These mites are external parasites affecting brood in the hive. They cause brood death or shortened life span for any bee that survives the brood phase. The brood appears to have an irregular sealed and unsealed brood pattern and newly emerged bees have deformities of wings, legs and abdomen. Normal hive management can spread these mites once they become established.

- Asian honey bees (*Apis cerana*): Asian honey bees are an exotic pest bee species, and are often linked with Varroa mite. They are aggressive competitors with European honey bees for floral resources but most strains are not good pollinators, produce only small amounts of honey and are too difficult to handle. Asian honey bees will rob honey from European honey bee hives and in large numbers are capable of starving them out.

Good biosecurity measures will also reduce the impact of pests already established in Australia, such as the Small hive beetle, American foulbrood and European foulbrood of honey bees.

What is the best protection for my orchard?

There are a number of things you can do to improve your orchard biosecurity and to help safeguard Australia's almond and honeybee industries.

As an almond producer reliant on bees for pollination, you should expect your hive provider to:	Working together, almond producers and hive providers should:
• Check the health of any newly purchased bees, including asking for a vendor declaration of health status. • Specifically check bees and brood for signs of disease. • Maintain strong hives that are not susceptible to pest attack. • Avoid placing hives in proximity of rubbish tips. • Avoid placing hives near abandoned hives, as these are more likely to be diseased. • Avoid placing hives near abandoned orchards which might have pests that can be carried by bees. • Regularly inspect bees for unusual behaviour. • Isolate captured swarms for six months to ensure they are free from pests before adding them to the main apiary. • Check swarms for unusual bees as they may be an exotic bee species. • Ensure all hives are registered and branded so there is no confusion about ownership.	• Ensure a clean water source is available for the bees. • Ensure all orchard and hive equipment is cleaned between uses. • Wash and disinfect hands before and after handling hives. • Ensure boots and clothing are free from plant material, soil, insects and other pests before entering and leaving orchards or handling hives. • Minimise the number of people that visit hives. • Prevent vehicles from driving close to hives. • Secure honey stores and sticky frames so robbing bees cannot gain access. • Check hives when monitoring the orchard and report any unexplained decline in bee numbers, crawling or dead bees near hive entrances or any unusual bee behaviour. • Advise your hive provider of any intended use of chemicals that might be harmful to bees.

Record keeping is an important aspect of good biosecurity practices. You should request and record information from your hive provider on the previous locations of their hives and their pest inspection program. Asking for this information shows that biosecurity is important to you and will help track and minimise any pest spread should there be a new pest incursion.

If you see any unusual symptoms or behaviours in your bees call the Emergency Animal Disease Watch Hotline on 1800 675 888. If you spot anything unusual in your orchards, call the Exotic Plant Pest Hotline on 1800 084 881.

EXOTIC PLANT PEST HOTLINE
1800 084 881

More information?

The Australian Honey Bee Industry Council (AHBIC), as the peak honey bee industry body, has a focus on protecting beekeepers and their hives through sound biosecurity practices. Visit **www.honeybee.org.au** or call **02 9221 0911**.

For more information on biosecurity and a range of tools to help you secure your farm and secure your future, visit **www.farmbiosecurity.com.au.**

Fact sheet

Almond leaf scorch (ALS)

What is it?

Xylella fastidiosa can infect almonds and cause leaf scorch (also called 'golden death'). Other strains infect grapes (Pierce's disease), citrus (variegated chlorosis), peach, pecans, plums, and some perennial ornamentals trees. No strains of this bacterium are present in Australia.

This bacterial pathogen is spread through grafting or by sap-feeding (xylem) insect vectors (such as spittlebugs, sharpshooters and leafhoppers). Vectors pick up the bacterium by feeding on infected plants.

It is possible that natural vectors of this pathogen may exist in Australia, but the most efficient vector overseas (Glassy-winged sharpshooter) is not currently found in Australia – and needs to be kept out. Green and red-headed sharpshooters are also proven vectors of the almond strain overseas.

What to look for?

Look for both the symptoms and the presence of sharpshooter or spittlebug vectors. These potential vectors are large enough to see with the naked eye.

Jack Kelly Clark, UC Statewide IPM Program

Almond leaf scorch symptoms showing zonate pattern

Jack Kelly Clark, UC Statewide IPM Program

Marginal scorching of leaves

Where is it found?

This pest occurs in North and South America, Europe and the Mediterranean and infects a variety of plant species. Winter severity affects bacterial and vector survival. Australian winters in all zones would allow both to persist.

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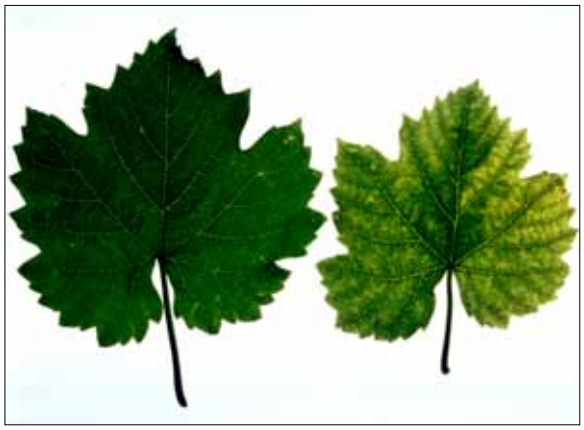
Rebecca A. Melanson

Leaf scorch symptoms on pecan trees



Alex H. Purcell, University of California

Pierce's disease symptoms in grapevine

ENSA – Montpellier archive

Yellowing and dessication of grapevine leaves, and wilting of bunchers, due to Pierce's disease

Glassy winged sharpshooter and other sharpshooter eggs may be laid on a wide range of plants and therefore any imported host plant material needs thorough inspection.

Almond leaf scorch symptoms first develop as 'burn and bleaching' at the leaf tip and margins. They progress towards the mid rib and leaf base, leaving zones of necrotic tissue and a golden band between the part of the leaf still green and the scorched area. Unlike salt burn, almond leaf scorch symptoms are not uniform along the leaf margin. Even when dead, the ALS-affected leaves stay attached until autumn. Infected trees are stunted, less productive, have reduced terminal growth and may also bloom and leaf out later than healthy trees.

What is the best protection for my orchard?

Ensure windbreaks and neighbouring ornamentals are not preferred hosts of either the bacterium or its vectors. Some reservoir hosts do not develop symptoms.

Inspect in-coming plant material thoroughly for any symptoms or egg masses. Keep delivery, label and health-status testing records. If a range of cultivar/rootstock combinations are received, keep a field map of their planting. This assists traceability to nurseries, should an incursion occur.

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

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

EXOTIC PLANT PEST HOTLINE
1800 084 881

Fact sheet

Glassy-winged sharpshooter (GWSS)

What is it?

This leafhopper causes direct damage through its feeding activities and excrement 'showers'. However, the greatest threat associated with this pest is as the highly efficient vector of *Xylella fastidiosa*, which causes Almond leaf scorch. It is a strong flier and can travel large distances directly or as a hitchhiker on plant material.

GWSS feeds and reproduces on a wide range of host plants, most of which can be infected by the pathogenic bacterium. The bacterium is delivered into the water conducting tissues of the host plants through the piercing and sucking feeding action of GWSS.

Phil A Phillips

Adult GWSS

What to look for?

Adult GWSS are 13-14 mm long and easily seen with the naked eye. They are dark brown-black with yellow dots on head and body (thorax). Their wings are translucent with reddish veins.

'Clutches' of up to 27 eggs are laid on the underside of leaves in a side-by-side arrangement. Eggs are deposited just under the leaf surface giving a blister-like appearance. Egg masses on imported plant material (especially ornamentals) are a significant threat.

Reyes Garcia III

Egg mass ready to hatch

Where is it found?

GWSS is found in eastern and western USA and in Mexico. Recently the GWSS has been detected in a number of new locations, including the neighbouring countries of Tahiti and the Cook Islands.

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Johnny N. Dell

Adult GWSS on leaf surface

PaDIL

Adult GWSS

Russ Ottens

Side view of adult GWSS on a plant stem

Crepe myrtles and many other commercial and ornamental woody and annual plants may harbour the insect. Commercial hosts like almonds, citrus and grapes would be threatened if GWSS became established, particularly if it carries *X. fastidiosa*.

What is the best protection for my orchard?

Limit unnecessary movement of landscape and commercial plant material in leaf. Thoroughly inspect plant material introduced to your orchard and residential surrounds for egg masses and insects. Dispose of all orchard waste plant material appropriately, through deep burial, burning or hot composting.

Report neglected orchards and feral almonds to your local department of primary industry.

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

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

EXOTIC PLANT PEST HOTLINE
1800 084 881

Fact sheet

Hyperplastic canker

What is it?

Hyperplastic canker is a disease caused by the bacterium *Pseudomonas amygdali*. Primary hosts of this bacterium are almonds and peach. Infection affects branches and twigs of the host plant and results in tree decline.

Short distance spread of the pest occurs from active cankers during wind and rain.

What to look for?

Symptoms of Hyperplastic canker infection can be detected from leaf emergence. Infected trees have swollen bark canker around leaf scars and wounds. As the symptoms progress a longitudinal crack develops in the swollen bark. These cankers look like the bark has been peeled back to show discoloured wood beneath.

C. Panagopoulos

Longitudinal crack with peeled bark symptoms caused by Hyperplastic canker

Where is it found?

Hyperplastic canker is currently found only in the European countries of Greece, Afghanistan and Turkey.

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C. Panagopoulos

Sparse foliage and cankers in infected tree

C. Panagopoulos

Discoloured wood visible underneath split bark

Check for soft, rough tissue at the margins of cankers. If there are multiple cankers they can girdle shoots. The buds in cankers will not develop so affected trees generally have little foliage. There are no specific leaf symptoms, however infected trees decline because of the lack of new growth.

Non-pareil shows some tolerance to this pest, so detection inspections should focus on other cultivars.

What is the best protection for my orchard?

Use clean planting material from a known source that utilises high health and hygiene strategies. Additional protection can be obtained by visually checking for cankers in all planting material before use.

Protect scars and wounds on tree stems and leaves to reduce the chance of infection.

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

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

EXOTIC PLANT PEST HOTLINE
1800 084 881

Fact sheet

Phomopsis canker

What is it?

Phomopsis canker (caused by the fungus *Phomopsis amygdali*) attacks almonds, peach and apricot. Infection results in lesions on limbs and wilted, yellow leaves.

Rain and warm temperatures during autumn promotes infections and the Australian almond production districts have suitable conditions to allow establishment of this pest if it were introduced. Spread of the fungus occurs through infected planting material.

Infected almond trees require additional treatments and pruning. Summer, autumn and spring chemical treatments are currently used in Europe, but none are fully effective in managing the fungus.

Themis J. Michailides

Longitudinal section through a canker of Phomopsis

Themis J. Michailides

Cankers of Phomopsis in cross-section of almond trunks

What to look for?

Symptoms of Phomopsis canker can be first detected in early spring. On affected limbs there may be dark, elliptical lesions visible around or near the buds. By late spring, a toxin produced by the fungus will cause leaves to wilt and turn yellow. New growth may die and by summer the lesions become sunken cankers that may have black dots (fruiting body of fungus) in their centre.

Infected hulls turn grey-brown and have shrivelled nuts inside.

Where is it found?

This fungus occurs in Europe, the Mediterranean, South America, and in the USA.

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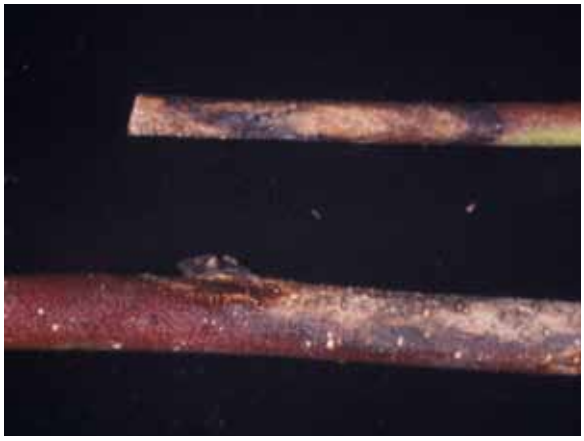

Themis J. Michailides

Pyenidia of Phomopsis on leaves dropped onto the ground

University of Georgia, Plant Pathology Archive, Bugwood

Phomopsis cankers and twig blights in peach

What is the best protection for my orchard?

Use clean planting material from a known source that utilises high health and hygiene strategies.

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

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

EXOTIC PLANT PEST HOTLINE
1800 084 881

Fact sheet

Almond seed wasp

What is it?

The Almond seed wasp (*Eurytoma amygdali*) is capable of infecting up to 80% of almond crops, resulting in reductions in both yield and quality of the crop.

This pest is difficult to control and if it were to become established in Australia there would be considerable additional management costs incurred for re-shaking orchards each year, monitoring, trapping and insecticidal applications. Organophosphates have not been successful in controlling the pest in Europe.

H. Dumas

Emergence of female Almond seed wasp from an almond

What to look for?

In Europe, the Almond seed wasp has one generation per year, with larvae overwintering in mummies. The adults emerge in spring through a tiny circular exit hole in the mummies. These holes are the best evidence of the presence of this pest.

The adults mate and lay eggs in the young, developing, green fruit. Larvae of this wasp remain in that fruit and are therefore protected from applied contact insecticide sprays. They eat the developing nuts.

H. Dumas

Female Almond seed wasp ovipositing in an almond

Where is it found?

The wasp is currently found in Europe, Asia, North America and the Middle East. It is thought to have originated in Asia and it arrived in France in 1980 where it has had a significant impact on their almond crops.

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ALMOND BOARD OF AUSTRALIA

H. Dumas

Almond seed wasp larva inside the almond

H. Dumas

Larva removed from an almond in winter

What is the best protection for my orchard?

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

Inspect all mummies and remove as many as possible following harvest. Neglected orchards and feral almonds should be reported to your local department of primary industries.

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

EXOTIC PLANT PEST HOTLINE
1800 084 881

Fact sheet

Naval orangeworm

What is it?

Navel orangeworm (*Amyelois transitella;* NOW) is a major moth pest wherever it is established. It attacks the nuts of almond, pistachio, macadamia and walnut, as well as citrus.

NOW larvae reduce yield through consuming the nut meat. The larvae also leave frass and webbing behind and the damage increases the likelihood of infection by aflatoxin-producing fungi, which further reduce quality and food safety. As NOW larvae are concealed within the shell, nuts-in-shell can continue to be spoilt post-harvest.

Jack Kelly Clark, UC Statewide IPM Program

Older Naval orangeworm larvae consume most of the nut

What to look for?

NOW larvae overwinter in mummy nuts left on the trees or on the ground. In spring, moths emerge and lay the first pink to orange eggs on or near other 'sticktight' nuts on the tree. Eggs may also be laid on new crop nuts after hull split. Larvae bore into the nuts or kernels damaged by sunburn or other pests.

Jack Kelly Clark, UC Statewide IPM Program

Naval orangeworm moth

Where is it found?

This pest is found in the USA and Canada where it causes damage to almond, pistachio, walnut, fig and orange crops. It is also known to attack macadamia and grapes. Current management requires well-timed applications of organophosphates and costly monitoring.

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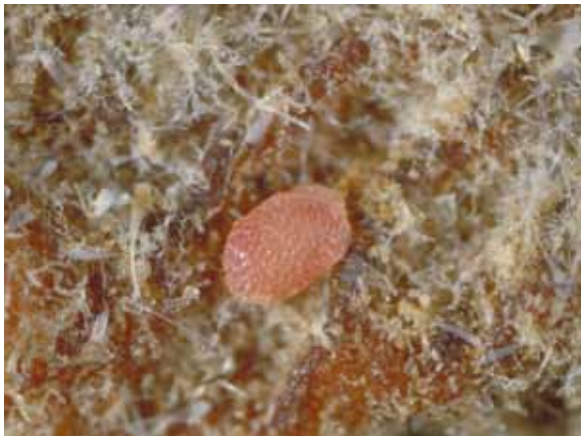

Jack Kelly Clark, UC Statewide IPM Program

Naval orangeworm eggs turn reddish orange before hatching

Jack Kelly Clark, UC Statewide IPM Program

Naval orangeworm larvae can be distinguished by a pair of crescent-shaped markings in the second segment behind the head

Jack Kelly Clark, UC Statewide IPM Program

Navel orangeworm pupae are encased in woven cocoons that may be found within webbing and frass inside nuts

Larvae are reddish-orange but become white or pale pink as they develop. The pupae are found within the nuts, with webbing. Checks for the presence of larvae and pupae in mummies should be completed during winter. Inspection of twigs for the presence of pink to orange eggs is another method of detection.

This pest has been intercepted by border quarantine on citrus imports from California demonstrating an ability to reach Australia.

What is the best protection for my orchard?

Remove as many mummies as possible from trees and the ground following harvest. Practice good orchard sanitation and complete harvest quickly. Regularly inspect nuts and mummies for the presence of any insect pests.

Neglected orchards and feral almonds should be reported to your local department of primary industries.

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

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

EXOTIC PLANT PEST HOTLINE
1800 084 881

Fact sheet

Peach twig borer

What is it?

The Peach twig borer (*Anarsia lineatella*) is a major pest of several tree crops, especially *Prunus* spp. In Californian almond orchards, control of this pest requires insecticide use during the dormant, post-bloom, and sometimes hull split stages.

The female moth lays pale yellow-orange oval eggs in fruit, twigs and leaves and the emerging larvae overwinter in holes bored under the bark of trunks and young (1-3 years) limb crotches. The larvae cause damage to growing shoot tips, developing scaffolds and to nuts. Direct feeding on nut meat causes the greatest economic damage, with soft-shelled almonds being the most susceptible.

The pupae shelter in crevices, curled leaves and debris, or between the hull and shell of old nuts. They can grow up to 1 cm in length.

What to look for?

The overwintering larvae produce small 'chimneys' of frass on bark surfaces. During early to mid-bloom (of Non-pareil), larvae can be seen leaving the bark and making their way towards young buds and leaves.

H. Audemard

Peach twig borer larvae

Jack Kelly Clark, UC Statewide IPM Program

Adult peach twig borer

Where is it found?

The Peach twig borer is found throughout North America, Europe and the Mediterranean.

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ALMOND BOARD OF AUSTRALIA

Jack Kelly Clark, UC Statewide IPM Program

Peach twig borer feeding damage on almond kernels

Jack Kelly Clark, UC Statewide IPM Program

Pile of frass at entrance of peach twig borer hibernaculum

Look for wilted strikes where the larvae have mined into young shoots. They are easiest to see on young trees and on water shoots. Cutting the infested shoots longitudinally will expose the larvae. The caterpillars are small with a brown body and a black head. White bands are present between each body segment.

If not detected and controlled early, the Peach twig borer produces obvious shallow channels in the nuts. These larvae do not form webbing in affected nuts, unlike the Naval orangeworm.

Adult moths are nocturnal, grow up to 11 mm long and have grey, mottled wings.

What is the best protection for my orchard?

Neglected orchards and feral almonds should be reported to your local department of primary industries.

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

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

EXOTIC PLANT PEST HOTLINE
1800 084 881

Fact sheet

Ten-lined June beetle

What is it?

The Ten-lined June beetle (*Polyphylla decemlineata*) is a very serious pest when it occurs, with control being difficult and expensive to implement.

The beetle larvae live in sandy soil and feed on the roots, weakening and sometimes killing infested trees. Adult beetles, which are about 2.5 cm in length, feed on foliage but this activity does not cause major losses. There is no effective control except for tree removal and fumigation of soil before replanting.

Eugene E. Nelson

Adult Ten-lined June beetle

What to look for?

This pest can infest a range of species, with almonds, most deciduous fruit tree, roses and potatoes the most susceptible.

The larvae are typical scarab larvae, cream in colour and C-shaped. Larvae have a brown head and may reach 50 mm in length.

Adult beetles are attracted to light and are active during summer nights. They are distinctive due to the longitudinal white stripes on their back and clubbed antennae.

Whitney Cranshaw

Ten-lined June beetle larvae

Where is it found?

The Ten-lined June beetle is currently found in western USA, where it is a serious problem, particularly on sandy soils.

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Calbas

Adults have distinctive longitudinal white strips and clubbed antennae

Cheryl Moorehead

Adult Ten-lined June beetle

Jack Kelly Clark, UC Statewide IPM Program

Almond trees dying from root damage by Ten-lined June beetle larvae

The death of a cluster of almond trees, especially in sandy soil, may indicate the presence of this pest. In these cases, trees should be investigated for the presence of larvae or evidence of its feeding in both the woody and young roots from the top 60 cm of soil. Because the life cycle of this beetle is long, infestations do not expand rapidly.

What is the best protection for my orchard?

Do not introduce soil to your orchard and all virgin soil (especially if sage bush has grown there previously), should be checked thoroughly before planting trees.

Neglected orchards and feral almonds should be reported to your local department of primary industries.

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

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

EXOTIC PLANT PEST HOTLINE
1800 084 881

Fact sheet

European stone fruit yellows

What is it?

European stone fruit yellows (ESFY) is caused by a pathogenic phytoplasma. It infects almonds in Spain, and feral and amenity almonds in Germany. Apricots, peaches, Japanese plums (European plums are symptomless hosts) and several weeds are also susceptible. Decline and death of affected Prunus trees has occurred within 24 months of first symptoms, however almonds do not appear to be as quickly or severely affected.

Natural spread of the pathogen occurs via vectors, with Cicadellids presumed to be the most important ones. Reservoir hosts of both the pathogen and the vector are important for pest spread.

There is no in-field control for infected trees, however management of vectors provides a reduction in pathogen spread.

What to look for?

An early sign of infection is the emergence of new growth during dormancy. Infected trees leaf out before flowers open.

B. Schneider

Necrosis of the vasculer tissue of an ESFY infected Prunus tree

B. Schneider

Chlorosis and rolling of peach leaves on a shoot affected by ESFY (right) compared to unaffected peach (left).

Where is it found?

This pathogen is prevalent throughout Europe. Wild and reservoir hosts maintain the pathogen which has epidemic potential in conducive conditions.

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B. Schneider

Prunus tree affected by ESFY (left) showing early defoliation and decline compared to an unaffected tree (right)

B. Schneider

Development of corky tissue along a lateral vein of a peach leaf affected by ESFY

In summer, look for pale, longitudinally-rolled leaves that droop downwards. They become thickened, and have a rough and stiff texture.

Infected trees defoliate early and over time lose their vigour. This can be followed by dieback within 2-5 years of the first symptoms.

The likelihood of early detection of the pest can be increased through surveillance of neighbouring native vegetation for potential vectors.

What is the best protection for my orchard?

Ensure planting material is pest-free, as infected budwood is the most likely entry pathway. Maintain good orchard hygiene practices to reduce potential vector levels.

Observe orchard trees closely for out-of-season leaf out, and monitor all neighbouring vegetation for increased vector levels.

Neglected orchards and feral almonds should be reported to your local department of primary industries.

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

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

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Fact sheet

Peach yellow leafroll phytoplasma

What is it?

This phytoplasma, which causes the diseases Almond brownline and decline (ABLD) and Almond kernel shrivel (AKS), is potentially transmitted by psyllids or, more frequently, through infected planting material. There are several strains of the pathogen with almond symptom development dependent on the scion/rootstock combinations.

What to look for?

Yellow, thinning canopies in almond orchards can be caused by infection by this phytoplasma.

The rootstock determines the rate of decline of infected trees. The plum rootstock Marianna promotes a rapid decline of infected almonds, particularly evident at the union as a brown line of dead cells, pitting of the wood under bark at the union, stunting, small leaves and bark splits (ABLD).

Infected almonds on peach rootstock, are more likely to produce symptoms of AKS. In these trees, budburst is delayed, new shoots can be stunted, leaves are pale and smaller, canopies are thin and the harvested kernels are shrivelled. However, the overall tree decline is slow.

Jerry K. Uyemoto

Symptoms of almond kernel shrivel on peach rootstock

Jerry K. Uyemoto

Almond trees on peach rootstock with kernel shrivel disease

Where is it found?

Peach yellow leafroll phytoplasma is found widely amongst tree fruits, but infections in almond are apparent only in the USA.

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Jerry K. Uyemoto

Small green leaves and stunted shoots caused by ABLD

Jerry K. Uyemoto

Pitting & necrosis along unions caused by ABLD

Jerry K. Uyemoto

Almond brown line and decline caused by ABLD

Transmission of the pathogen is most likely through the planting of infected material. However, since older trees may become infected, spread by insect vectors is also likely.

Best protection for my orchard?

Ensure that all planting stock is pest-free and that compatible rootstocks are used. Maintain good orchard hygiene practices to reduce potential vector levels.

Neglected orchards and feral almonds should be reported to your local department of primary industries.

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

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

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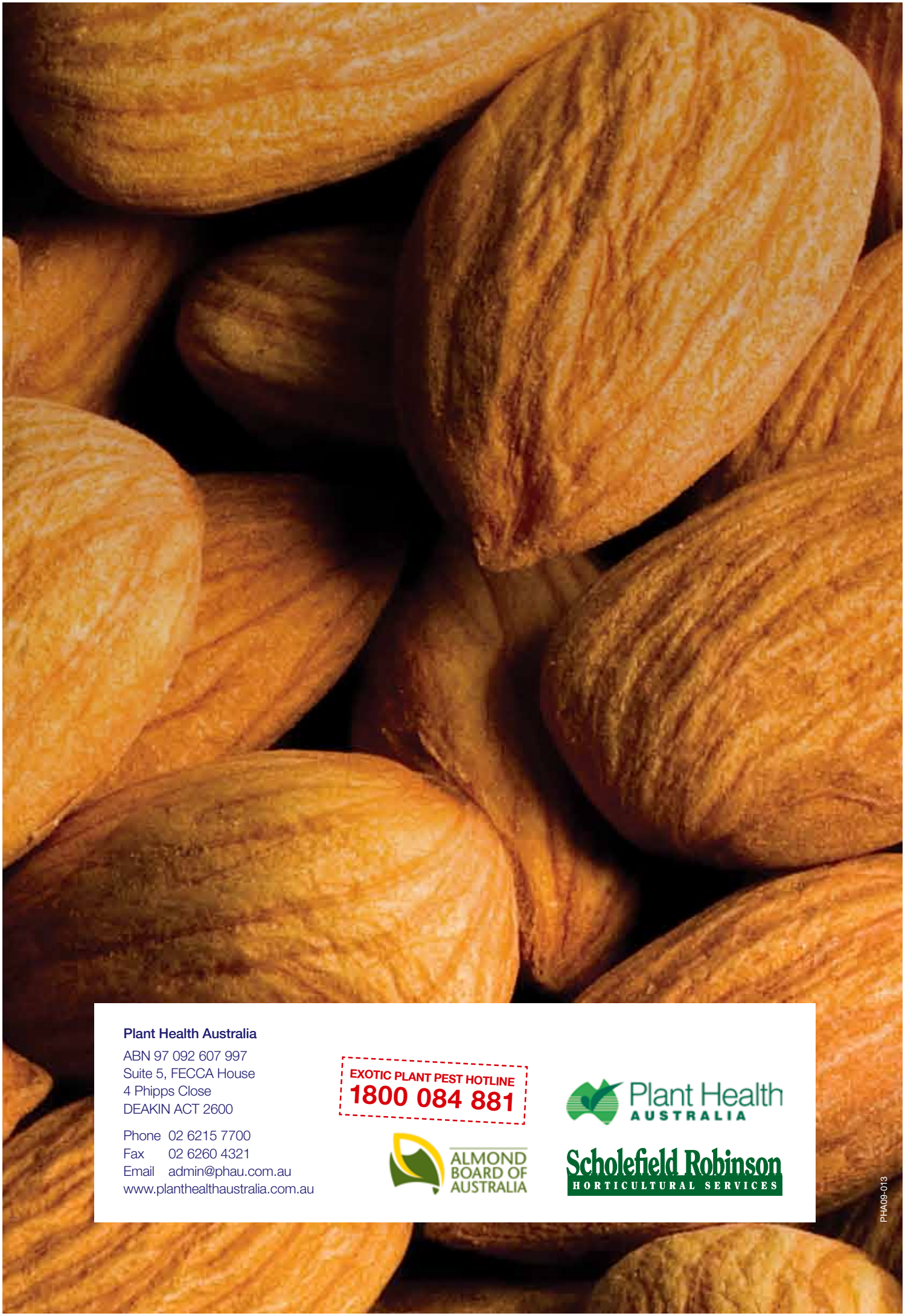

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