

Potato Growers' Biosecurity Manual

A guide to farm biosecurity measures to reduce the risks of pests, diseases and weeds impacting your production

Version 1.1 August 2018



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POTATO –
FRESH FUND

POTATO –
PROCESSING FUND



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.

planhealthaustralia.com.au



AUSVEG is the prescribed peak industry body for the Australian vegetable and potato industries. It provides agripolitical advocacy and representation on behalf of vegetable and potato growers, as well as research, development and extension associated services provision in the horticulture industry.

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Hort Innovation
Strategic Levy Investment

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This project has been funded by Hort Innovation using the fresh potato research and development levy and funds from the Australian Government. For more information on the fund and strategic levy investment visit horticulture.com.au

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Image courtesy of AUSVEG

Introduction

If you grow potatoes this manual is designed for you and your staff, as well as contractors, researchers and consultants working in the industry. It outlines simple procedures that can be used to minimise the risk of introducing and spreading pests, diseases or weeds on-farm.

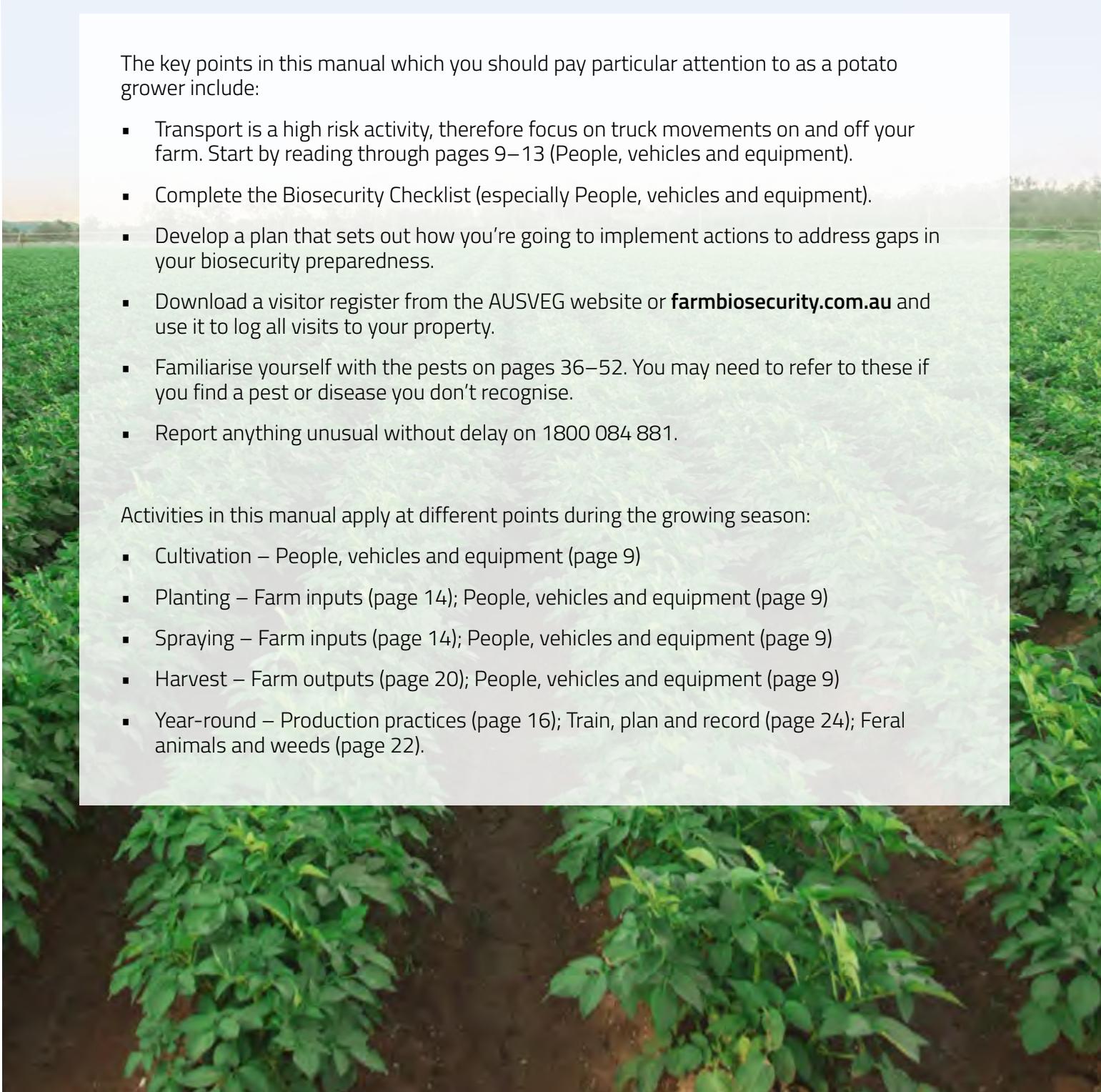
You have an important role to play in protecting your farm, your region and the potato industry from biosecurity threats.

The key points in this manual which you should pay particular attention to as a potato grower include:

- Transport is a high risk activity, therefore focus on truck movements on and off your farm. Start by reading through pages 9–13 (People, vehicles and equipment).
- Complete the Biosecurity Checklist (especially People, vehicles and equipment).
- Develop a plan that sets out how you're going to implement actions to address gaps in your biosecurity preparedness.
- Download a visitor register from the AUSVEG website or farmbiosecurity.com.au and use it to log all visits to your property.
- Familiarise yourself with the pests on pages 36–52. You may need to refer to these if you find a pest or disease you don't recognise.
- Report anything unusual without delay on 1800 084 881.

Activities in this manual apply at different points during the growing season:

- Cultivation – People, vehicles and equipment (page 9)
- Planting – Farm inputs (page 14); People, vehicles and equipment (page 9)
- Spraying – Farm inputs (page 14); People, vehicles and equipment (page 9)
- Harvest – Farm outputs (page 20); People, vehicles and equipment (page 9)
- Year-round – Production practices (page 16); Train, plan and record (page 24); Feral animals and weeds (page 22).



Working together to protect your enterprise and Australia

While many people think of biosecurity as quarantine restrictions imposed by the Australian Government at international border entry points, biosecurity is actually a multi-layered activity and every Australian has a part to play.

The diagram below shows how the biosecurity system is made up of three components and many activities carried out by multiple people, including farmers. Protection from pests, diseases and weeds is only possible if everyone works together.

The Australian Government plays a key role pre-border, working with exporting nations to minimise risks before product leaves a country.

Much of the Australian Government's work is at the border, where international movements of people and goods are regulated.

In Australia, biosecurity involves three layers of protection

PRE-BORDER



- Analysing pest risks associated with proposed imports
- Inspecting, verifying and auditing overseas exporters
- Undertaking pest surveillance overseas

- Developing international standards
- Building capacity overseas
- Anticipating pest threats by gathering global pest intelligence
- Negotiating export market access

- Maintaining the Manual of Importing Country Requirements (MICoR) and Export Documentation System (EXDOC) to facilitate exports

AT THE BORDER



- Inspecting and monitoring arrivals of people, cargo, mail and plant products
- Raising awareness of plant pests and movement restrictions
- Imposing biosecurity measures at ports

- Encouraging the reporting of suspected new pests by port workers and importers
- Protecting Australia's north from exotic pests with the Northern Australia Quarantine Strategy (NAQS)

- Enforcing border restrictions
- Isolating newly arrived plant material in post-entry quarantine
- Prioritising exotic pests to target with preparedness and prevention activities

POST-BORDER



- Preventing spread of regionalised pests
- Providing early warning of incursions of exotic pests with surveillance
- Eradicating exotic pests under the Emergency Plant Pest Response Deed
- Managing risks under the control of everyday Australians

- Encouraging the reporting of anything unusual
- Managing established pests
- Maintaining the ability to diagnose plant pests
- Maintaining emergency response capacity

- Responding to environmental threats with the National Environmental Biosecurity Response Agreement
- Protecting farms with on-farm biosecurity measures
- Managing pest fruit flies on a national basis
- Managing weeds

These activities aim to prevent entry and establishment of exotic pests and diseases.

Within Australia, post-border biosecurity measures aim to prevent the spread of regionalised weeds, pests and diseases, and to contain and eradicate any new pest that may enter Australia.

Post-border biosecurity relies on the activities of state governments, local governments and everyday Australians.

The roles of everyday Australians, including potato growers, are to:

- Protect areas within their control from weeds, pests and diseases.
- Obey the law, particularly those about movement restrictions.
- Report any sightings of possible exotic pests, weeds or diseases.

Biosecurity overview

By implementing the recommended measures in day-to-day operations you will improve your farm's biosecurity and that of your region, minimising crop losses and additional costs.



The risk is real

Potato growers face different types of biosecurity risks:

- **Exotic pests and diseases** – that are not in Australia yet (pages 36–44).
- **Regionalised pests and diseases** – that are already in Australia but are restricted to particular regions or can be kept off your farm through biosecurity practices (pages 45–52).

On-farm biosecurity practices like those in this manual will help to protect your property from biosecurity risks.

Why on-farm biosecurity matters

On-farm biosecurity practices help to protect you from weeds, established pests and diseases and, in the event of new pest entry into Australia, from exotic pests.

These practices make good business sense since new pest entries reduce yield and increase production costs. In the case of potato cyst nematode (page 21) good biosecurity contributed to its eradication from Western Australia and containment of the pest in Victoria.

In addition to being best practice, state legislation is changing to make it a legal requirement that everyone, including potato growers, reduce risks under their control. See page 7 for information on new laws already in force in Queensland and NSW. Other states and territories are expected to follow suit.

Protecting market access

Biosecurity is also crucial for protecting markets for your produce. The presence of weeds, pests and diseases can mean that certain markets will not be willing to receive products grown in particular regions.

These might be interstate buyers in regions that are free from the threat, or overseas markets.

Maintaining a favourable pest status underpins the future profitability and sustainability of the Australian potato industry.

Area wide management

Since weeds, pests and diseases can spread to your property from neighbouring areas, it makes sense to work with others on regional approaches to pest management wherever possible.

Pests, diseases and weeds can be harboured in the backyards of nearby towns where potatoes and other Solanaceae crops are grown. Other nearby properties may also pose a risk, especially abandoned or neglected farms. Sometimes native vegetation can host pests and diseases as well.

It pays to contact others in your area to develop a shared understanding of local threats and local expertise or resources that can help.

On-farm biosecurity is most effective if all practices are of a high standard and adhered to. Failure to carry out a single practice can potentially lead to the introduction of a new pest or disease.

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



The presence of weeds, pests and diseases can mean that certain markets will not be willing to receive products grown in particular regions.

Every potato growers' responsibility

The following pages suggest ways to reduce the vulnerability of your enterprise. Every farm is different, so the general principles described here will need to be tailored to your needs.

It is useful to start with a map of your property to consider risk areas, and the best places to locate biosecurity zones and checkpoints.

This could include signs at entrances to the property, parking areas near the house or site office, the location of deliveries and pick-ups in relation to storage facilities, vehicle wash-down areas, and existing roads or tracks for movement within the property. Think about what you can do to minimise the risk of introducing diseases, pests and weed seeds at each point.

The priority should be to minimise the biosecurity risks in the production areas.

On pages 26–33 there is a **Biosecurity Checklist** that will help you to assess the strengths and weaknesses of your current arrangements and plan improvements.

The checklist provides three levels of biosecurity activities – baseline, industry standard and above industry standard – to allow for continual improvement in practices. Any legal requirements are also stipulated.

The practices you choose may vary from paddock to paddock, depending on factors such as the size and location of your property, the facilities available, and the risks that need to be addressed.

Limit access to areas known to be clean to stop them becoming infected. In particular, apply rules for vehicle and equipment movements in production areas known to be infected to stop further spread of pests or weeds.

The **pests and weeds of greatest concern to potato growers** are described at the back of this manual, beginning with exotic pests on page 36. Each pest summary indicates how the weed, pest or disease threat can be managed through biosecurity practices.

Exotic pests are those not currently present in Australia. **Established** pests are already within Australia although some are contained to particular regions.

The biosecurity essentials

When thinking about implementing biosecurity measures on farm, the six biosecurity essentials are a good place to start. They are:

1. People, vehicles and equipment
2. Farm inputs
3. Production practices
4. Farm outputs
5. Feral animals and weeds
6. Train, plan and record

The Farm Biosecurity website has a series of short videos on the six biosecurity essentials that show how easy it can be to implement simple but effective biosecurity measures on your farm. Go to farmbiosecurity.com.au/videos.

Movement of people poses a particular risk to your farm because weeds and some plant pests and diseases can be spread in soil and plant material which can stick to tyres, truck bodies, trays, as well as crates and bins.

New biosecurity laws

Everyone has a role to play in safeguarding Australia from weeds, pests and diseases. All states have legislation for biosecurity management which include requirements for reporting new pests and diseases. Potato growers in NSW or Queensland have particular duties.

Queensland: the general biosecurity obligation

The Queensland *Biosecurity Act 2014* came into effect on 1 July 2016. Under the new Act, everyone needs to take an active role in managing biosecurity risks that are within their control.

The general biosecurity obligation in the Act means that everyone must take all reasonable steps to ensure that they do not spread a pest, disease, weed seeds or contaminants. Everyone therefore has a responsibility to report unusual events that might be related to biosecurity.

You are not expected to know everything about all biosecurity risks, but you are expected to know about risks associated with your work or day-to-day activities.

For example, farmers are expected to be aware of the pests and diseases that affect their crops and manage them appropriately, including reporting unusual symptoms or pests.

Further information is available from the Queensland Department of Agriculture and Fisheries: daf.qld.gov.au/biosecurity/about-biosecurity/Biosecurity-Act-2014.

New biosecurity laws for Queensland

Biosecurity is the protection of the economy, the environment and the community from animal and plant pests, diseases and contaminants. It is critical to market access and the survival and sustainability of our industries. It also supports Queensland's natural assets, our health and our way of life.

The Biosecurity Act 2014 (the Act) came into effect on 1 July 2016. This brochure outlines how this new Act will affect you.

Why change Queensland's biosecurity laws?

Queensland's former biosecurity legislation consisted of many different Acts and was developed independently over the past 100 years. Because of this, it did not always adequately serve as well as laws that were not flexible enough to meet the challenges of today's biosecurity environment.

Queensland is facing more biosecurity threats more often. Global import, trade in animals and plant products, and diversity of land use – all of which increase biosecurity risk – continue to grow. Also, Queensland's environmental diversity and unique climate mean we are more likely to experience exotic pests and diseases, so we can expect more biosecurity incursions than any other state in Australia. To cope, we need more flexible and responsive laws.

The new Act will improve Queensland's biosecurity preparedness and response capabilities. Under the Act, we will now be able to focus on biosecurity risks that impact our economy, our agriculture, our environment and our community and lifestyle. We will also be able to better manage the health risks associated with potential disease threats between animals and people.

What has changed?

The new Act replaced a lot of legislation you might be familiar with, such as the Biocontrol Act. The Act follows a harmonised, risk-based and less anthropocentric approach to biosecurity in Queensland.

The Queensland Government will continue to take immediate action to manage biosecurity risks. In fact, under the new Act, action can be taken if there is a reasonable belief that a serious risk exists, without having to wait for scientific confirmation.

The Act speaks with pests (such as wild dogs and weeds), diseases (such as foot-and-mouth disease) and contaminants (such as lead in grazing land).

Decisions made under the Act depend on the likelihood and consequences of the risk. This will mean risks are managed more systematically.

All Queenslanders need to take an active role in managing biosecurity risks under their control. Under the Act, individuals and organisations whose activities pose a biosecurity risk have greater legal responsibility for managing them. This **general biosecurity obligation** means they must take all reasonable steps to ensure they do not spread a pest, disease or contaminant.

Queenslanders need to report unusual events that might be related to biosecurity, for example abnormally high mortality or morbidity rates in animals and soldiers, unexplained falls in production. They also have obligations for registering some animals and reporting their movements to allow for disease tracing.

Biosecurity zones have been introduced by Regulation and used to manage, reduce or eradicate pests or diseases (such as the pine and banana diseases) as part of the cost.

New South Wales: the general biosecurity duty

The NSW *Biosecurity Act 2015* supports the principle that biosecurity is a shared responsibility between government, industry and the community.

The inclusion of a general biosecurity duty in the legislation means that any person who deals with a biosecurity matter and who knows, or ought to know, about the biosecurity risk has a responsibility to ensure that, so far as is reasonably practicable, the biosecurity risk is prevented, eliminated or minimised.

The new legislation came into effect on 1 July 2017. Further information can be obtained from the NSW Department of Primary Industries: dpi.nsw.gov.au/biosecurity/biosecurity-act-2015.

GENERAL BIOSECURITY DUTY

WHAT IS MY DUTY?

- Prevent Biosecurity Risks
- Eliminate Risks
- Minimise Risks

As much as is reasonable

WHEN DO I HAVE A DUTY?

If you deal with, or deal with a carrier of biosecurity matter you have a duty
e.g. weeds, animals, plants or machinery...

And if you should know that there is a risk

HOW DO I FULFILL MY DUTY?

By referring to:

- State Strategic Plans
- Regional Strategies
- Local Plans
- Guidelines & Advisory Material
- Codes of Practice & Industry Standards
- Mandatory Measures

How will the General Biosecurity Duty apply to me?

You are not expected to know about all biosecurity risks, but you are expected to know about risks associated with your industry, business, day-to-day work and your hobbies.

Farm biosecurity practices

This section outlines the recommended biosecurity practices for all potato growers.

Every farm is different. Assess the strengths and weaknesses of your current arrangements using the Biosecurity Checklist on pages 26 to 33.



People, vehicles and equipment

People, vehicles and equipment can carry diseases, insects and weed seeds onto and around your farm.

Inform visitors of your biosecurity requirements

Make sure that staff, regular visitors, and anyone else entering your property knows about your biosecurity requirements.

Biosecurity signs, like those available from farmbiosecurity.com.au or ausveg.com.au, help to control movement onto and around your property. Signs can be obtained by contacting AUSVEG, or the file can be downloaded for printing locally.

Signs at the main entrance to your property alert visitors to the need to comply with the measures you have in place. Other signs can show visitors where to park and where to clean down their vehicle or equipment, if needed.

Consider erecting signs in another language if regular visitors are speakers of languages other than English. Khmer and Vietnamese signs can be obtained from ausveg.com.au.

When new staff or groups of people arrive, hold an induction session to explain biosecurity measures in place on the farm. This can include workplace health and safety as well as biosecurity requirements, including specific detail relating to the areas of the farm they will access.

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

If you hold events on your farm, such as field days, equipment demonstrations or research trials, clearly indicate any entry requirements and be especially vigilant in checking for new pests and diseases afterwards.

Truck drivers may not be aware of the risks associated with their load or with the movement of their vehicles into different areas. Signage and registers can help everyone to be more informed about the risks.

Use a visitor register

It is good practice to maintain a visitor register to document who has been on your property, where they have come from, and where they are going on the farm and after they leave. This can serve as a health and safety function, and potentially improve on-farm biosecurity.

Visitor or contractor records are useful tools in the event of a new pest entry into Australia or a new region within Australia because they can allow investigators to trace the origin and spread of a pest or disease.

A visitor register template can be obtained from farmbiosecurity.com.au or ausveg.com.au.

If your agronomist has visited 10 other properties before arriving on yours, what might their boots and tyres be bringing to your farm?



Control access by people

Controlling and limiting access to production areas such as paddocks is the best way to minimise biosecurity risks from the movement of people.

Visitors include farm contractors, consultants or agronomists, backpackers, employees of utility providers and research personnel. Busloads of visitors such as grower groups or students might also require special precautions.

Ideally, there should be only one access point to the property. This makes it easier for you to monitor and control the movement of people. Boundary fencing and gates are recommended to help control access.

Providing a designated parking area away from production areas and asking all visitors to let you know when they arrive will also help you to manage who is coming onto your property.

Assess the risks that each visitor poses. Get into the habit of asking visitors where they have been recently and take actions appropriate to the risk, as explained on the following pages.

If you cannot reduce the risk presented by a visitor by implementing some of the suggestions outlined in this manual, you can refuse access to your property.

Take particular care with high risk visitors – anyone who has recently arrived from overseas, particularly from rural areas, people who have travelled from another potato farm, and any visitor who moves from farm-to-farm and region-to-region.

Ask all visitors to stay on paths and designated roadways as much as possible when moving around the farm.

Also consider how to manage people who come on farm to buy produce. Appropriate signs might be required to manage this risk.

Limit machinery and equipment entry to your farm

Any machinery coming onto your property poses a risk of spreading pests and weed seeds. This is particularly the case with contractors involved in harvesting, planting or fertilising who have travelled from farms where potatoes are grown. Don't forget about machinery that is being used for other activities such as sowing, spraying or harvesting other crops as part of a rotation.

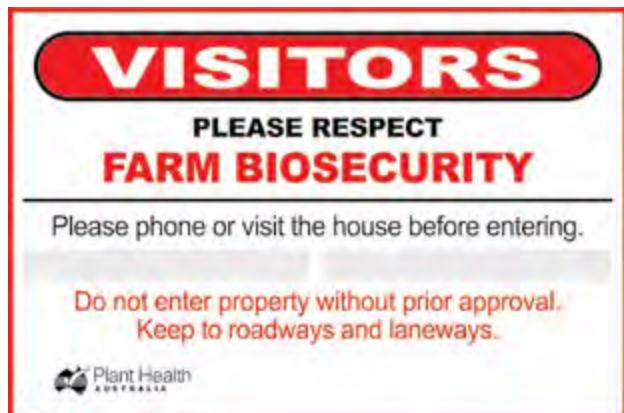
If sales people want to demonstrate machinery on your farm it is essential that the machinery is washed down and disinfected before it arrives on farm as this type of scenario poses significant risks.

You have the right to ask contractors to clean machinery before entering (and leaving) your farm.

Another alternative is to only engage contractors who are signatories to an industry recommended hygiene protocol or program.

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

The person who reads the water meter on your irrigation system could be a significant risk to your business if they don't undertake appropriate clean down activities prior to coming onto your property.



Use signs to direct visitors to designated parking or reception areas. Access to production fields should be limited to a restricted range of personnel only.

Limit vehicle movements in production areas

It is often impractical to stop all movements of vehicles onto and around the property, but there are steps you can take to minimise the risks that they pose.

Best practice is to make sure that all vehicles are either restricted to a designated parking area or cleaned before entering production areas. Having a parking area on the property allows you to inspect a vehicle and decide what, if any, action you need to take. Get into the habit of doing a quick and simple risk assessment for vehicles and equipment by asking the operator where they have been recently.

Wherever possible, use dedicated farm vehicles to move through production areas. A dedicated farm vehicle should stay on farm, to minimise the risk of bringing a pest back with it if it leaves the property. Otherwise provide a wash-down facility to clean vehicles before allowing access to production areas.

Establish zones around your farm and limit access according to the risk status of the area. Limit access to areas known to be clean to stop them becoming infected. In particular, apply rules for vehicle and equipment movements in production areas known to be infected to stop further spread.

Any equipment that moves from farm-to-farm and region-to-region and accesses your production areas is an increased biosecurity risk to your property. This could include harvesters and contract sprayers.

Non-production vehicles should stay on designated roadways as much as possible when moving around the farm.



Without signage, visitors and staff may be unaware of the biosecurity procedures enforced on your property.

Clean boots and clothes

Since weed seeds and pathogens like rusts can enter on people's footwear and clothing, it helps to have a policy of clean clothes and boots for employees and visitors.

Boots present more of a risk than clothes because they have direct contact with the soil. Provide hot soapy water, scrubbing brushes and disinfectant for people arriving with muddy boots, or give them boots to wear while in your production areas. People should also use a footbath when leaving your property.

People who have recently returned from overseas pose an increased potential risk, particularly if they have been in regions where potatoes are grown and exotic pests are present. Make sure that they have clean footwear and clothes before entering your farm.

Additional protective measures may be required in areas contaminated with pests or diseases to limit further spread. Provide hygiene supplies such as hand sanitiser, gloves, disinfectant foot scrubbers, disposable over boots and overalls for use where appropriate.

Foot baths are a simple way to manage biosecurity risks associated with soil-borne pests and weed seeds being carried in dirt and mud. Footbaths need to be maintained well to be effective. See farmbiosecurity.com.au/biosecurity-basics-make-your-own-footbath.



Pests, disease causing organisms and weed seeds can be present on hands, clothing, footwear and personal items.

Establish wash down and disinfecting facilities

All vehicles and equipment entering production areas can be easily cleaned using high pressure water and a detergent/degreaser such as Bio-Cleanse™ or compressed air.

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

Inspect the area around the wash down facility regularly for the presence of pests or weeds, and treat or report as required.

The wash down area may be the same as that used for chemical wash down of vehicles and equipment since both require a separate waste water holding pond. If so, all occupational health and safety issues associated with chemical wash down areas must be taken into account.

Washing all planting and harvesting equipment with a detergent/degreaser such as Bio-Cleanse™ and water, and then disinfecting with a product such as Sporekill™ or Virkon™ will provide additional protection from potato diseases.

95 per cent of the job of washing a vehicle to decrease the biosecurity risk is in getting the mud off. A disinfectant or sanitiser finishes the job off.

Washing down your tractor and sprayer regularly keeps dust from building up and caking onto electronics, keeps mud off the roads and decreases the risk of spreading pests and diseases of potatoes.

Wash down bay designs

In the wake of the entry of Panama disease tropical race 4, (a non-eradicable disease of bananas) in Northern Queensland in 2016, Biosecurity Queensland's Panama TR4 Program developed some new wash-down bay designs for growers.

The designs are ideal for use by potato growers since Panama TR4 is a soil borne disease, which makes it similar to bacterial wilt of potatoes (page 50).

For more information go to Wash-down designs to combat Panama disease tropical race 4 farmbiosecurity.com.au/wp-content/uploads/Wash-down-designs-for-TR4.pdf

Automatic wash down areas are both easy and efficient systems to use. Costs are higher with these systems than non-automated ones, but improved protection from soil borne diseases may be had (if designed and maintained well) due to greater contact of water with the under side of the vehicle.

The wash down facility illustrated below is designed for vehicles with a medium to high level of soil and plant contamination. Vehicles are submerged up to the axles and some of the underbody, and a high pressure hose is provided for specific washdown of other parts of the vehicle or machinery as required.

This type of wash down bay should be used for all vehicles and machinery entering the property, so it needs to be wide enough for a B-Double to pass through.

Use a disinfectant solution that kills the bacterial or fungal pests you're trying to keep off your farm, but that is also safe for regular use on your vehicle and machinery. Speak to your agronomist or ag-reseller to find a suitable product.



An automatic vehicle wash down bay provides protection against soil borne diseases.

Used with permission, from Wash-down designs to combat Panama disease tropical race 4, Queensland Department of Agriculture and Fisheries, 2017

Restrictions on movements in potato biosecurity areas

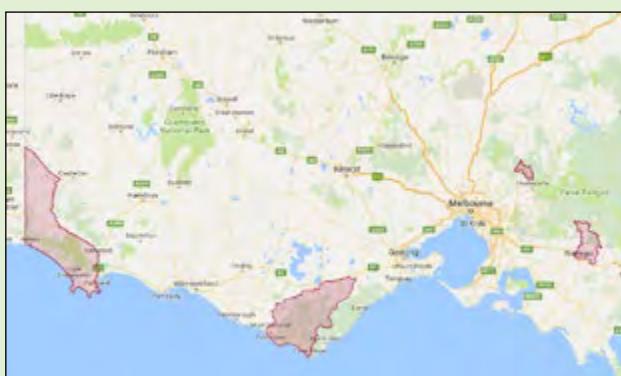
There are a number of regions within Australia where there are restrictions on the movement of fresh potatoes, potato plant material, and soil and machinery that has been in contact with potatoes.

Movement of these items either into or out of these areas is controlled in order to limit the spread of pests and diseases such as potato cyst nematode (PCN) and potato spindle tuber viroid (PSTVd). While there are state and federal laws which ultimately specify what can and can't be moved from one location to another, it is in the interests of the industry as a whole to limit the spread of pests of biosecurity significance which might impact the ability for Australian potato growers to access certain domestic or overseas markets.

As a potato grower you should familiarise yourself with the restrictions that exist in your state and any state you currently trade with (or intend to trade with in the future).

General information on interstate quarantine requirements relating to quarantine zones can be found by visiting interstatequarantine.org.au/travellers/quarantine-zones/.

In Victoria there are currently four potato plant protection districts. More information on these, including the Toolangi plant protection district, can be found by visiting agriculture.vic.gov.au.



South Australia restricts the movement of plant material and equipment to Kangaroo Island, and potatoes are prohibited unless they have been washed or brushed free of soil and are in new packaging. More information can be found at pir.sa.gov.au/biosecurity/plant_health.

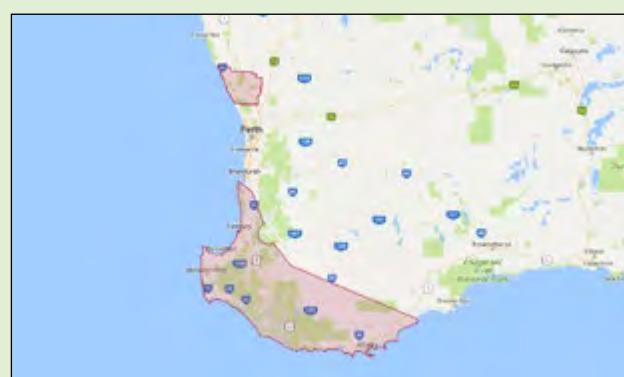
There are no potato specific quarantine zones in Queensland but there are zones within which movement of other crops is restricted.

Potato growers moving machinery should be aware of these areas if their equipment is used on more than one crop. More information is at daf.qld.gov.au.

The whole of NSW is a potato biosecurity zone and within that are two seed potato protected areas. More information on these can be found by visiting dpi.nsw.gov.au.



Ware potatoes that are permitted entry to Western Australia from another state or territory (except Tasmania and South Australia) are not allowed into the Gin Gin and south-west areas. More information at dpird.wa.gov.au.



There are extensive restrictions on the movement of plant products and machinery into Tasmania, including for potatoes. More information can be found at dpipwe.tas.gov.au/biosecurity-tasmania/.

Bringing certain types of plants, fruits and vegetables and agricultural equipment into the Northern Territory is restricted. Make yourself aware of restrictions which might affect you by visiting nt.gov.au/industry/agriculture/food-crops-plants-and-quarantine/plants-and-quarantine.

Farm inputs

Anything moved onto your property can be a potential source of weeds, pests and diseases.

Monitor the sources of everything that comes onto your farm including deliveries and water, as these can also bring weeds, pests and diseases.

Purchase planting material from reputable sources

Infected seed potatoes can spread many pests and diseases, especially viruses, but potentially also late blight and other pests.

In most cases, you will not be able to assess the quality of seed just by looking at it. It may pay to source certified seed potatoes from accredited suppliers.

There are a number of seed potato certification schemes in Australia including Victorian Certified Seed Potato Authority (ViCSPA) Seed Potato Certification Scheme, Tasmanian Certified Seed Potato Scheme (TasSeed), The Western Australian Certified seed potato scheme.

Request documents showing the source and testing history of planting material and keep them on file to allow the origin of new diseases, pests or weeds to be determined. Record information like the variety, crop class, the purchase date, the source of seed, the area planted, and the block where the seed was planted.

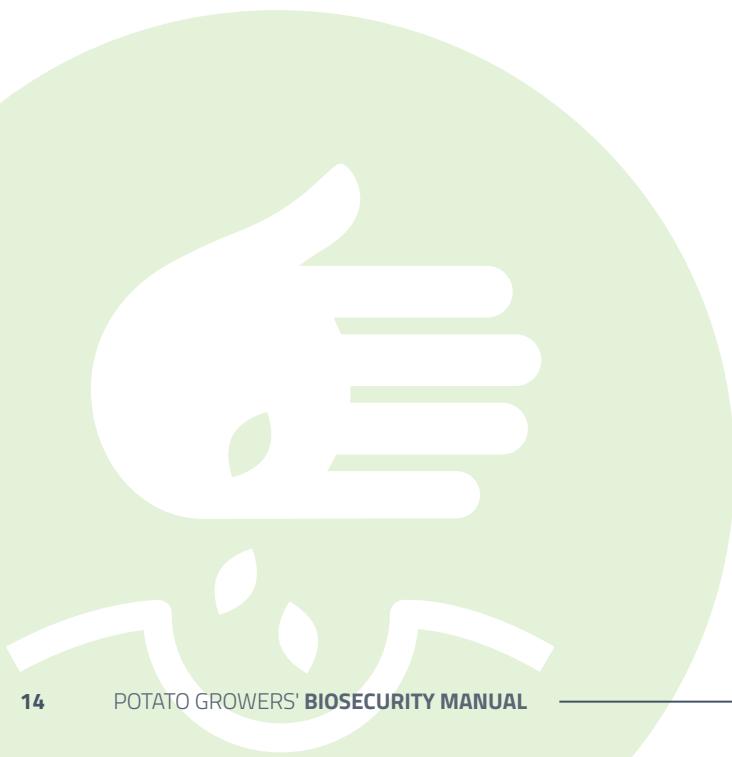
Once planted, regularly monitor growing plants for signs of pests or disease and report any potential seed borne issues to the certifying authority of your seed potatoes for established pests (pages 45–52) and the plant pest hotline (page 17) for potential exotic pests (pages 36–44).

Never use poor quality or diseased seed as it has the potential to infect your entire crop.

It is not safe to cut seed potatoes as there is a risk that you may spread a disease like bacterial wilt or PSTVd if your knife or cutter is contaminated.

Consider the inputs for other crops or livestock on your property, as you may inadvertently bring a pest or disease onto your farm through another part of your enterprise.

For example, seed for another crop, livestock movements and feed such as hay are all potential ways in which pests, diseases and weeds can be introduced.



Check water sources regularly

Dams, rivers and channels have the potential to be reservoirs and conduits for weeds and pests including bacterial wilt.

Monitor the quality of water used for irrigation and the vegetation along the edges of water courses and dams. This can provide early warning of new weeds, pests and diseases brought on to the farm in water. It can also reveal increased pest pressure on crops due to a build-up of insects or diseases in or near a water course.

If an outbreak of a water-borne disease has been recorded on nearby properties, other measures can be considered. For example, testing by a state department plant health diagnostic laboratory is advised.

More care is needed where water that drains from a paddock into a dam is recycled back onto the crop. Additional measures may be needed to treat the water in the event of a disease outbreak on your farm or a neighbouring farm.

On-farm biosecurity is not necessarily expensive or difficult. Often, reducing risk is a simple matter of adjusting the way that production activities are done.

Protect water sources from contamination as much as possible by making yourself aware of where inflows to your irrigation sources come from. Consider treating water which has flowed off a potentially contaminated potato crop, or aerating stagnant bodies of water such as dams to prevent outbreaks of blue-green algae.



Many pest and disease-causing organisms can survive for a long time in water sources until they find a suitable host.

Use certified fertiliser

Fertilisers are another input that can potentially introduce diseases, pests and weeds to your farm when applied to a crop as part of your rotations. In particular, organic fertilisers such as manure and compost can be a source of pests such as root knot nematode as well as weed seeds.

Reduce the risk of purchasing contaminated or non-compliant fertiliser by ensuring that the supplier is following the Fertilizer Industry Federation of Australia (FIFA) Purchasing Code of Practice or has equivalent quality controls in place. See fertilizer.org.au for more information.

Look for compliance with the Australian Standard AS4454-2012 that applies to compost, soil conditioners and mulches.

It is best practice to ask suppliers of compost for a testing history or other assurance of quality.

When batches are used on-farm, keep a record of the source and where it was applied. Check the area for signs of new pests, diseases or weeds.

If you make your own compost, don't include source material that you know comes from diseased plants. It is also important to monitor the temperature and make sure that thresholds for pest destruction are achieved at all points in the pile of composting material.



Organic fertilisers such as manure and compost can be a source of weeds if not composted thoroughly.

Production practices

You can reduce the risk of spreading pests and diseases by including simple biosecurity measures as part of your everyday farm management practices.

Monitor crops and fallow areas for pests and diseases

Monitoring your crops and fallow areas provides the best protection against new pests, diseases and weeds. Any unusual pests or symptoms should be reported on 1800 084 881.

Monitoring the health of your crop is a fundamental part of farm management and gives the best chance of spotting a new pest soon after it arrives. You, your employees, contractors or consultants should be looking over your farm on a regular basis for established pests and exotic pests.

Pay particular attention to high risk areas where pests are most likely to enter and establish, such as loading areas (sidings or pads), near wash down areas, and along roads, creeks and channels.

Fallow areas should also be monitored for signs of new weeds, or volunteer plants of other crops, which can shelter pests between growing periods.

Finding something new to your property early gives you the best chance of controlling it.

Record the results of monitoring activities

Surveillance involves looking for pests and diseases, any symptoms, or plant health issues on your farm, and recording their presence and population levels, or their absence.

In addition to assisting with farm management, pest surveillance is important for maintaining the pest-free trading status of the Australian potato industry.

An example of a pest surveillance record sheet is provided on farmbiosecurity.com.au.

Recording that a pest is absent is just as important as recording what you do see.



The optimum frequency of monitoring depends on the type of crop being managed, and the production intensity.

Learn about exotic pests

Pest surveillance increases the chances that a new pest is detected early enough to be contained and eradicated. A new pest on your farm might also be new to the region or even the country.

To increase the chances of early detection, make yourself familiar with established pests and the exotic pests that pose the greatest risk to the Australian potato industry.

Display shed posters where staff will see and learn to recognise key pests or can refer to if they find something unusual.

At the back of this manual there is a series of fact sheets on exotic pests and some significant established pests, showing what they look like or the symptoms that they cause.

Prompt reporting of anything unusual is vital. Only if new problems are found early can they be contained or eradicated.

While Australia has one of the strictest border control systems in the world, there is always the chance that an exotic pest will make it into the country. The number of passenger arrivals and imported goods continues to increase so a serious exotic pest of the potato industry might only be a day's flight away.

There is also a constant risk of pests and diseases moving by natural pathways from Papua New Guinea and the Torres Strait south onto mainland Australia, for example the A2 mating type of late blight.

Farmers, contractors and consultants have an important role to play in reporting suspicious pests immediately to minimise potential damage. All reports will be investigated and treated confidentially.

Growers are often the first to notice the presence of a new biosecurity problem, so it pays to be familiar with the worst exotic and regionalised weed, pest and disease threats.

In addition to state general biosecurity obligations, potato growers have a legal responsibility to report suspect pests because the potato industry is a signatory to the Emergency Plant Pest Response Deed (see page 19).

If you find a pest that you think might be exotic, take the following precautions to contain it and protect other parts of your farm:

- Mark the site where you saw the pest.
- Do not touch, move, or transport affected plant material.
- Take a photo of the pest or disease symptoms. Pests that move too quickly to be photographed can be captured in a well sealed glass jar and frozen before taking a photo of them.
- Restrict the movement of people, animals and equipment near the affected area while waiting for identification.
- Wash your hands, clothes and footwear that have been in contact with affected plant material or soil.
- Without delay, call the Exotic Plant Pest Hotline on 1800 084 881 to report it to your state department of agriculture.

Incorrect handling could spread the pest further or make the samples unfit for diagnosis so always seek advice before taking a sample.

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

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

**IF YOU SEE ANYTHING UNUSUAL,
CALL THE EXOTIC PLANT PEST HOTLINE**

1800 084 881

Fences and property cleanliness

Secure boundary fences make it easier to control the movement of people, vehicles and equipment onto and around your property, minimising the risk of diseases, pests and weeds from entering and becoming established.

Fencing can also limit access by wild or feral animals that can carry pests, diseases and weeds. For example, feral pigs can pick up potato pests and diseases as well as weed seeds while foraging elsewhere and carry them onto your property in the soil and mud attached to their coat.

Make sure that waste is dealt with responsibly. Rubbish dumps can attract pests or wild animals that carry diseases onto your property, so remove or contain anything that is likely to act as an attractant.

Effective waste management strategies include a waste pit away from production areas, composting, using waste for power generation, burning, deep burial or feeding to livestock. Records of how waste is disposed of should be maintained in case of a pest outbreak.

Monitor neglected farms

Neglected farms potentially pose a high biosecurity risk to the potato industry, as they may allow pests to multiply, become established and spread.

Monitoring of neglected farms, including hobby farms should be proactive to reduce the risk of establishment and spread of new pests.

Report any farms that you suspect are neglected to your state department of agriculture to reduce risks of biosecurity threats spreading.

Isolation of early generations

It is important to isolate seed potato crops away from commercial crops so that aphids can be controlled. Aphids can spread viruses and viroids between plants.

Isolation also allows special hygiene measures to be applied to machinery and equipment used on seed potato crops.

A thorough clean down is recommended for all movements from commercial to seed potato areas to prevent the spread of a range of potato pests and diseases to the seed crop.

Agvet chemicals

Always use chemicals in accordance with the label. In addition to problems with safety, inappropriate or persistent use of chemicals can produce resistance in insects and weeds. This can cause more widespread and ongoing biosecurity problems.

Be sure to follow the instructions and observe withholding periods. Seek training in appropriate use of agvet chemicals (eg AusChem or ChemCert™ training).

Keep a record of chemical treatments in a spray diary, specifying application rates and weather conditions.



Potatoes which escape from paddocks can pose a risk.

The Emergency Plant Pest Response Deed

The Emergency Plant Pest Response Deed (EPPRD) is the formal, legally binding agreement between Plant Health Australia (PHA), the Australian Government, all state and territory governments, and plant industry signatories. It sets out how pest incursions are handled in Australia, and how the cost of a response is shared between industry and governments.

Having signed the EPPRD, AUSVEG (as the prescribed peak industry body for the Australian potato industry) has a seat at the decision making table in the event of an emergency plant pest incursion.

If a response plan is agreed by the signatories to the EPPRD, AUSVEG will have a say in what happens. The industry may also have to contribute funds to implement an approved Response Plan.

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

More information on the EPPRD is at planhealthaustralia.com.au/epprd.

Owner Reimbursement Costs

An underlying principle of the EPPRD is that growers are not better or worse off as a result of reporting an Emergency Plant Pest.

The agreement allows for payments to growers, known as Owner Reimbursement Costs (ORCs), for direct costs incurred as a result of the implementation of an approved Response Plan.

ORCs may cover direct grower costs or losses as a result of the destruction of crops, enforced fallow periods, replacement of crops and additional chemical treatments.

Calculation of ORCs is prescribed in the EPPRD, with different formulae being used depending on the type of crop grown, and a specific formula is being developed for potatoes. For more information, see: planhealthaustralia.com.au/owner-reimbursement-costs.

It is important to remember that ORCs only apply to approved Response Plans aimed at eradication, which is more likely to occur if a pest is found and reported early.



Image courtesy of David Gale

Farm outputs

Responsibility for biosecurity does not end when a crop leaves your property. The measures in place on your farm support biosecurity in your region.

Maintain good farm hygiene

Maintaining good hygiene practices on farm can help to minimise the spread of pests around your farm.

Disposing of production waste carefully, especially where there is a suspected or known incidence of insect infestation or disease infection, can limit the spread on the farm.

Composting of healthy waste can serve as a useful nutrient source but composting of diseased waste is not recommended.

In addition to cleaning machinery before it is used on your property, it is also important to clean machinery before it leaves your property to avoid inadvertently taking pests and weeds off your property.

Vehicles that transport potatoes may move from farm-to-farm posing a significant biosecurity risk that should be managed appropriately through the use of wash down and designated pick-up facilities.

Don't let trucks that travel from farm-to-farm into your production areas. Collect produce from the field in harvest bins or trailers and take it to a shed for transport off farm.

Ensure that trucks come onto the property via a single road and take produce from a loading dock or shed.

Post harvest risks

There is a risk of spreading weeds, pests and diseases after harvest. Make sure that harvesters moved between blocks and farms are cleaned and disinfected.

Crates used to store potatoes in the field and sometimes moved off farm, pose a significant risk and it is essential that they are free of plant material and disinfected between crops.

Also make sure that trucks carrying potatoes to another property for packing are cleaned.

Biosecurity doesn't only apply in the field. Some post harvest diseases can be spread by air movement in packing sheds. An assessment of the risks is therefore recommended for the whole production chain.

Other post harvest and farm output considerations

When aggregation of produce from multiple farms takes place in a packing shed to meet consignment quantities, special care should be taken to manage waste to avoid introducing a new pest to your farm.

Take care when transporting undersized potatoes and other waste that is fed to cattle or sheep (common in some areas). Diseases such as late blight or nematodes could be spread to crops on nearby properties since these diseases are spread by spores that can be blown off a passing truck.

It is recommended that waste potatoes are properly disposed of as they can serve as a reservoir for pests and diseases.

Case study - The importance of biosecurity: Potato cyst nematode eradication from Western Australia and official control in Victoria

Potato cyst nematode (PCN) was first discovered in Western Australia in 1986. Subsequent detections occurred in Victoria in 1991, 2004 and 2008. In Western Australia, an extensive surveillance program, coupled with official control and removal of all production in the affected area, saw eradication declared in this state in 2010. Monitoring to confirm area freedom in Western Australia is ongoing. Seed potato certification schemes in Australia look for PCN to ensure it is not spread by this pathway.

PCN is a microscopic eel-worm which feeds on the potato root system. It is restricted mainly to Solanaceae crops such as potato, eggplant and tomato but hosts can include Solanaceae weeds such as nightshade.

PCN cysts are actually dead females filled with up to 400 eggs. Each egg contains a dormant juvenile that is stimulated to hatch in the presence of a potato crop. In the absence of a host, approximately 10 per cent of eggs will still hatch every year, but cysts with viable eggs have been shown to be viable in the soil for up to 20 years.

PCN cysts can be carried on seed potatoes, bulbs, soil, machinery and even blown by wind and in water. PCN is subject to stringent quarantine and regulatory procedures which are critical to preventing spread.



Cleaning down machinery is an important measure to limit the spread of pests and diseases between farms.

PCN causes a significant decrease in yield and increase in production costs and its presence can result in trade restrictions being imposed.

Given how easily it can be spread on seed potatoes, soil, machinery, wind and water, effective biosecurity practices continue to play a key role in limiting the spread of this pest.

Practices such as cleaning down machinery, boot washing when arriving and leaving properties, and most importantly, certification of seed as being free of PCN, are important measures to limit the spread between farms over long distances.

More information on on-farm hygiene practices can be found at agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/pest-insects-and-mites/potato-cyst-nematode/on-farm-hygiene-practices.

More details on PCN as an established pest of biosecurity significance can be found on page 51.



Foot brushes and baths are a simple way to manage biosecurity risks associated with soil-borne pests and weed seeds being carried in dirt and mud.

Feral animals and weeds

Feral animals pose a risk to your property through direct impact on production but can also carry diseases, pests and weed seeds onto and around your property.

Vernon such as rats can damage crops, spread animal diseases and contaminate water sources. Weeds too, are a significant problem in their own right, reducing yields.

In addition to their direct effects, feral animals and weeds can spread and harbour plant pests and diseases, providing additional reasons to manage them.

Wild and feral animal access

Feral and wild animals pose a particular threat to potato production because many diseases are spread in soil, which animals may take with them when they move to other properties.

Fencing that prevents animal movements will provide some protection. It is therefore important to check and mend broken boundary fences.

Develop and implement an integrated wild and feral animal control program. For best results, work with neighbours and other growers in your local area to implement a coordinated approach to feral animal control.

Ensure farm buildings are in good repair and remove any sources of feed for animals. Dispose of any animal carcasses properly and promptly.

Volunteer plants and weeds

Weeds, especially Solanaceae species such as night shade, and volunteer potato and other crop plants that have escaped from production areas can create a 'green bridge' that can harbour pests or diseases between seasons. Pests then have the potential to infect the early stages of growth of the next crop.

Where necessary, control volunteers and weeds within the paddock and externally, such as along roadways and boundary fence lines.

Establish a weed management plan for your property, including plans to eradicate, contain or manage current weeds on your property, and to prevent the introduction of new ones.

You are likely to need a combination of practices to manage existing weeds, including herbicides and cultural practices like strategic tillage and farm hygiene.

Property and land damage

Fires, floods and storms can provide an opportunity for pests and weeds to become established, and for feral animals to enter.

Make regular inspections of your property for the presence of diseases, pests, weeds and feral animals.

Pay particular attention to areas that have been recently excavated such as new roads or dams and anywhere that has been damaged in storms or flooding. Keep an eye out for new weeds in the areas where flood waters may have run across your land from neighbouring properties and treat them before they flower and produce seeds.



Train, plan and record

Make sure that biosecurity procedures and threats are included in staff training and that biosecurity is part of farm planning activities. Record keeping is also an important part of managing your business, providing the ability to trace where planting material and other inputs came from and where produce goes.

Train staff

Since many people are not aware of how easily diseases, pests and weeds can spread, anyone coming onto your property, particularly into your production areas, needs to be informed. It's important that everyone who comes onto the property, including staff, friends, family and contractors, are aware of the risks, and know about your procedures to prevent the spread of biosecurity risks.

Inform staff of the biosecurity standards they need to adhere to, and provide formal training or instruction if required. Staff can help monitor crops and keep an eye open for any problems but education is important in preparing them to do this well.

Make sure employees and family members keep a lookout for unusual pests. In particular, make sure that they can recognise established and key exotic pests, and that they know how to report them.

This is especially important for people working on grading lines. Any pest or disease damaged potato not suitable for sale should be brought to the attention of a supervisor and, if necessary, be referred for outside advice.

If the damage is suspected of being the result of an exotic pest the exotic plant pest hotline should be called on 1800 084 881.

Posters in sheds featuring established and exotic pests can build awareness and serve as a reminder.

If you build your farm biosecurity measures around daily, monthly or yearly farm routines, then it should become a habit which is easily maintained.



Planning is an essential part of integrating biosecurity into your everyday farm activities.

Make a biosecurity plan for your property

An on-farm biosecurity plan will help you prioritise the implementation of biosecurity practices relevant to your property.

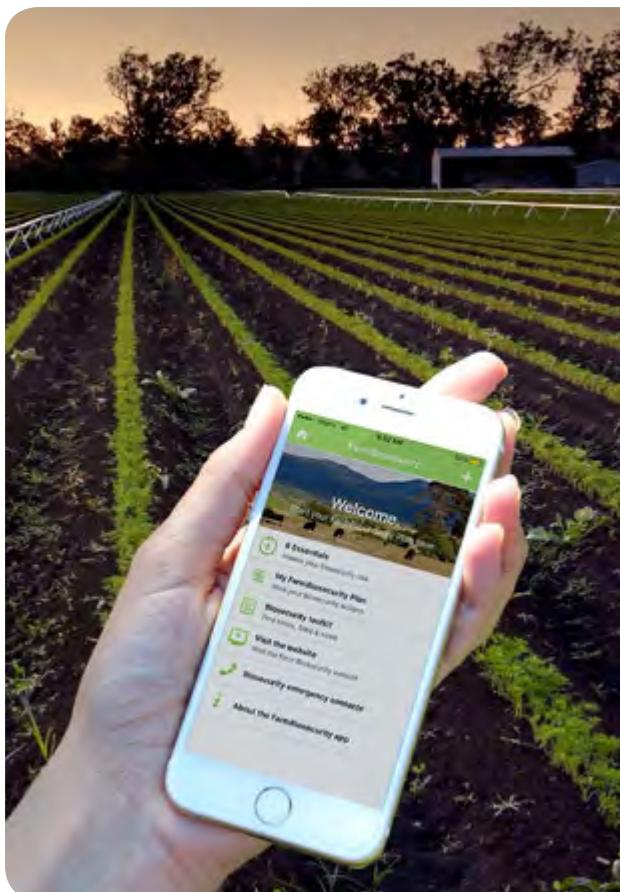
Use the checklist on pages 26 to 33 to identify gaps in your biosecurity preparedness.

Alternatively, use the free FarmBiosecurity app to create your own tailor-made plan. It is based on the six biosecurity essentials used in this manual.

Making a biosecurity plan using the FarmBiosecurity app is easy. Simply select the actions that apply to you from the suggestions, or type in your own actions. Your selections become a to-do list that you can share with others. You can attach photos as reminders or to let others know what needs to be done.

If you have multiple properties or sites, that's not a problem. You can add as many as you like.

The FarmBiosecurity app is available for free from the App Store or Google Play.



Keep records

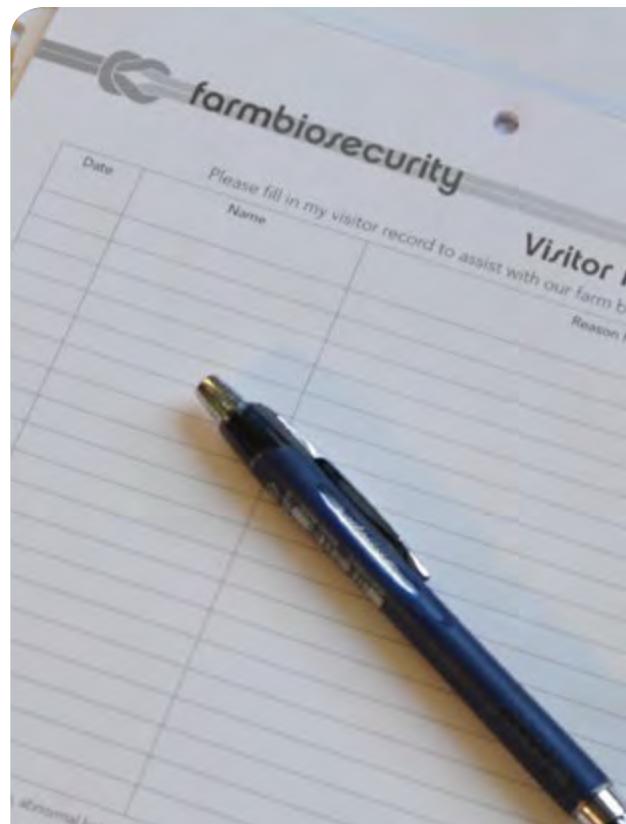
It is good practice to maintain records as a matter of course. This includes a visitor register to trace people movements.

In the event of a new pest entry that prompts an emergency response, valuable time can be lost trying to determine how far the disease or pest may have spread. Sound record keeping can speed up this process and prevent further spread.

Download, print and use templates for record keeping from farmbiosecurity.com.au or ausveg.com.au.

It is important to keep records of the sources of all inputs. In addition to fertiliser and seeds, record the movements of contractor machinery as well as where products and other material, such as waste for sheep feed, are shipped to.

Additionally, if you have problems with seed or fertiliser you will be able to use the records to demonstrate the effects on your property to the supplier.



You should be able to 'track back' and 'trace forward' if there is a disease, pest or weed entry on your property.

Biosecurity checklist

The following checklist can be used to identify the strengths and weaknesses of your farm biosecurity activities.



The checklist provides options to assess yourself and your business against different levels of a set of biosecurity practices, from baseline activities to above industry standard.

This system of levels allows you to incrementally improve your biosecurity preparedness over time as necessary, practical and affordable.

Self-assessment will allow you to quickly establish where current practices are working well, and where improvements are needed.

The checklist will also help you to prioritise areas for improvement and can be used to plan and implement your on-farm biosecurity activities.

It should be revisited and updated as part of your annual farm planning activities to ensure that your day-to-day farm activities reflect the highest practical level of biosecurity preparedness.

Completion of this checklist is not compulsory and, except where stated, is not a legal requirement.

You can include the checklist as part of your QA reporting to demonstrate your compliance with good farm management principles.

Levels of biosecurity practice

In collaboration with AUSVEG, four levels of biosecurity practice have been developed:

L1. Baseline – minimal biosecurity practices are used and improvements should be made to minimise risks.

L2. Industry standard – biosecurity practices that reduce the risk of introducing new pests and diseases to a property are in use, however improvements could be made.

L3. Above industry standard - high level biosecurity practices that are consistently applied to minimise the risk of introducing new pests to, or spreading pests within, a property.

LR Legal requirement – in some cases there are legal requirements which must be met before best practice management is considered. Any legal requirements must be met.

Copies of this checklist can be downloaded from ausveg.com.au.

People, vehicles and equipment	Yes	No	N/A	Action
Biosecurity awareness				
L1 Signs at entry and control points				
L2 Farm biosecurity information sheet signed by visitors on entry				
L3 Training of all permanent and casual staff, and management of visitors ie supervised access to the property				
LR N/A				
Biosecurity signs				
L1 Signs at gates				
L2 Signs at gates and critical points on farm				
L3 Signs as above in other languages to cater for non-English speaking people who visit regularly for example English, Vietnamese, Khmer				
LR N/A				
People and vehicle access				
L1 Single point of entry, gate sign and requirement to report to office or house				
L2 Visitor register used				
L3 Visitor register includes recent (the previous 48 hours to one week) visits to other farms or potato growing areas				
LR N/A				
Clothes and shoes				
L1 Clothes and shoes checked and cleaned				
L2 In addition to L1, boot covers used in higher risk areas				
L3 Clothes and boots provided to visitors and employees for use on farm				
LR N/A				

Equipment access (for example harvesters, contract sprayers, bins, utility providers)					
	Farm inputs	Yes	No	N/A	Action
Propagation material (seeds)					
	L1 Seed potatoes sourced from a reputable supplier				
	L2 In addition to L1, seed retreated with an appropriate fungicide and/or insecticide in-furrow where appropriate				
	L3 In addition to L2, material supplied by an authorised producer of clean seed				
LR N/A					
Organic fertilisers					
	L1 Sourced from reputable provider				
	L2 Sourced from reputable provider and visually inspected for contaminants				
	L3 Sourced from a provider of certified fertiliser meeting AS4454 (2012)				
LR N/A					
Water (dams, channels and ground water used for irrigation) and natural weather events					
	L1 Water courses mapped and checked for weeds and feral plants which could harbour pests and diseases. Weather events recorded				
	L2 In addition to L1, active monitoring of paddocks and water courses undertaken after major weather events				
	L3 Structured surveillance undertaken around water courses or after significant weather events and records made of the details of the weather event such as wind direction, speed and anything different noticed in the days, weeks and months after the weather event				
LR N/A					

Production practices	Yes	No	N/A	Action
Insect and disease plant pests				
L1 Crop monitoring undertaken and observations of pest presence and absence recorded in order to control pests at critical points or thresholds				
L2 Pest levels recorded for established pests. Management programs implemented on property boundaries for regionally established pests and diseases				
L3 Crop monitoring (including pest levels) and treatment activities recorded. Absence of exotic pests recorded				
LR Report anything unusual				
Volunteer plants of Solanaceae crops				
L1 Throughout your property and boundaries are occasionally monitored				
L2 Solanaceae crops throughout your property and close to property boundaries are monitored regularly and records kept				
L3 Regional approach to management of volunteer plants and weeds is undertaken				
LR N/A				
Effective use of chemicals				
L1 Chemicals applied according to the label				
L2 Awareness of resistance issues and chemical types rotated accordingly				
L3 Resistance management strategy in place for herbicides, insecticides and fungicides. Records kept of pest populations before and after treatments				
LR Chemicals applied according to state legalisation				
Biosecurity zones				
L1 Discrete blocks or paddocks identified on farm map				
L2 Movement plan developed and restrictions on movement from high risk areas of the property (or between linked properties)				
L3 Clean down of equipment between blocks (as appropriate) based on a risk assessment				
LR N/A				

Farm outputs	Yes	No	N/A	Action
Waste management				
L1 Waste tubers and plant material are cultivated back into the field				
L2 Waste tubers and plant material are removed from the field to a designated on-farm disposal site				
L3 All tuber and plant waste is removed from the field and destroyed by composting, burial or burning, or taken off-farm and fed to animals				
LR N/A				
Harvest management				
L1 Visual inspection of harvest equipment before entry into each paddock (including own equipment)				
L2 Wash down of harvest equipment before movement between blocks or paddocks				
L3 Wash down machinery between blocks followed by use of a suitable disinfectant. Blocks suspected of infection with disease harvested last. Records kept of all treatments and movements of equipment and machinery				
LR N/A				
Packing shed management				
L1 Sorting/packing shed cleaned routinely and waste disposed of in a pit away from production areas				
L2 Packing shed cleaned regularly and waste deep buried				
L3 Packing shed cleaned regularly according to schedule with records kept. Waste disposed of away from the field or off-farm				
LR N/A				
Waste management for packing shed processing other people's tubers				
L1 Waste disposed of in a pit away from production areas				
L2 Waste deep buried				
L3 Full destruction (for example burning) or deep burial and records kept on all waste removals and treatments				
LR N/A				

Feral animals and weeds	Yes	No	N/A	Action
Weeding or spraying				
L1 Spraying equipment is cleaned with high pressure water and visually checked before each use				
L2 Weeding or spraying equipment is cleaned with a suitable detergent/degreaser and treated with a suitable disinfectant between blocks				
L3 Weeding or spraying equipment is cleaned with a suitable detergent/degreaser and treated with a suitable disinfectant between blocks. Records of movement and cleaning kept				
LR N/A				
Wild and feral animal management				
L1 Identification of new pests determined by an agronomist or other expert, or by using a pictorial key				
L2 Some pest management activities conducted (for example baiting, trapping and shooting). Risks for disease or insect pest introduction assessed				
L3 Regional vertebrate management plan developed and implemented with neighbours or wider farming community				
LR N/A				
Abandoned farms				
L1 Aware of risks in area				
L2 Regular monitoring of crops near fence lines				
L3 Regional pest management strategies in place with monitoring and reporting to stop pests or disease build-up				
LR State biosecurity obligations - control endemic pests and report suspected exotic pests				

Train, plan and record	Yes	No	N/A	Action
Biosecurity planning				
L1 The <i>Farm Biosecurity Action Planner</i> or the <i>FarmBiosecurity</i> app is used as part of annual farm planning activities				
L2 In addition to L1, a farm map and biosecurity plan has been developed and is referred to when undertaking annual farm planning activities				
L3 A farm map has been developed. A biosecurity plan is developed in consultation with an agronomist or consultant as part of annual farm planning				
LR N/A				
Staff training				
L1 Shed posters are displayed to draw staff attention to potential pest risks				
L2 Biosecurity training included as part of induction of all staff and family				
L3 External training is provided to staff on biosecurity management, including risk minimisation, exotic pest ID and reporting				
LR N/A				
Record keeping				
L1 General records are kept about the timing of farm management activities including the arrival of new inputs, staff and equipment				
L2 Specific records of all movements on and off the property are kept. Records kept of pest presence				
L3 In addition to general farm management activities, records are made of surveillance activities including pest absence.				
LR Spray records are maintained in line with state requirements for agvet chemical use				

Pest and disease threats



Exotic pests

Potato growers need to be familiar with the most serious exotic pests and diseases because there is always a chance that a disease could make its way past border controls into Australia.

The most serious exotic threats to the potato industry – known as High Priority Pests – are described here.

Note that this list may change in time, as the High Priority Pest list is reviewed annually by a potato industry biosecurity reference panel. For the most up to date information visit the AUSVEG website.

Information on exotic pests of the potato industry described here has come from a combination of:

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

Established pests

Established pests of biosecurity significance are pests that are contained within one or more regions, have market access implications, and a significant impact on production, but can be kept off a property through on-farm biosecurity practices.

How pests are assessed

Each pest is assessed on the following criteria and given an overall risk rating. Pests rated a high risk are designated High Priority Pests, which have been agreed by the potato industry and governments so that biosecurity efforts can be coordinated.

For High Priority Pests

Entry potential: There is a risk of introduction through a number of possible pathways including the legal importation of plant material as well as illegal pathways, contamination and through natural means such as wind.

Spread: The natural spread of the pest to most production areas would be largely unhindered or as a contaminant would be difficult to manage hitch-hiking.

Establishment: The pest would be able to survive (establish) in environment conditions that prevail in Australia in the majority of regions where the host is grown.

Economic impact: The pest would severely impact production, including host mortality or significant impacts on either crop quality or storage losses, or severe impacts on market access.

Unless attributed otherwise all information is taken from Version 3 of the Biosecurity Plan for the Potato Industry.



Colorado potato beetle

Leptinotarsa decemlineata



Plant Health
AUSTRALIA

EXOTIC PEST – CALL THE EXOTIC PLANT PEST HOTLINE IF SUSPECTED

What crops does it affect?

Solanaceae including potato, tomato and eggplant.

What does it look like?

Adult beetles are about 10mm in length. They have five dark lines on each wing cover, with a yellow to red underlying colour.

The larvae are also brightly coloured and grow to 15mm in length. Initially they are bright red with a black head and legs, but this changes to a pale orange before pupation.



Immature Colorado potato beetle (larvae).

Which part of the plant will be damaged?

Above-ground plant parts.



Close up of Colorado potato beetle.

How does it spread?

Adults can fly short distances within a host crop but have been known to travel up to 160km when assisted by strong winds. The larvae and adults can be transported as 'hitch-hikers' on plant material, produce, machinery and packaging.



Colorado potato beetle.

IF YOU SEE ANYTHING UNUSUAL,
CALL THE EXOTIC PLANT PEST HOTLINE

1800 084 881

C. Trouvé, Service de la Protection des Végétaux, Bugwood.org

Serpentine leaf miner

Liriomyza huidobrensis



Plant Health
AUSTRALIA

What crops does it affect?

Affects 15 plant families but is a key pest of potato.

What does it look like?

The black flies are just visible (<3mm in length) and have yellow spots on their head and chest.

Which part of the plant will be damaged?

Leaves.

What should I look for?

Adult flies and larvae are not likely to be seen due to their small size. A serpentine leafminer infestation would most likely be detected through the presence of the mines in leaf tissue. Leaf mines, caused by larval feeding, are usually white with black and dried brown areas. They are typically serpentine or irregular in shape and increase in size as the larvae mature.

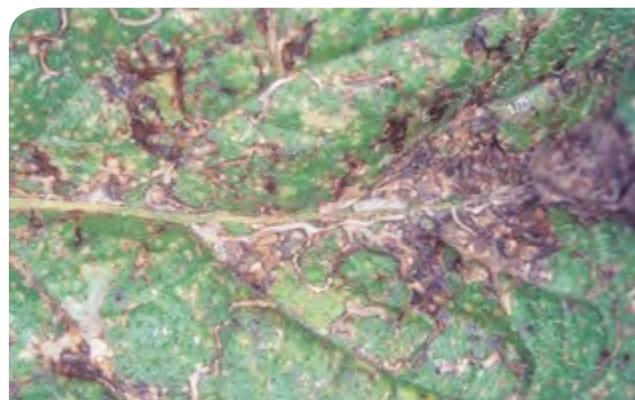
How does it spread?

Within the crop the insects spread by flying. Long distance transport is likely to occur through the movement of infested plants, plant tops, soil or packaging.



The small adult fly is predominately black with some yellow markings.

Central Science Laboratory, Harpenden Archive, British Crown, Bugwood.org



Damage to a potato leaf caused by larval feeding.

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



Serpentine leafminer pupae.

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

**IF YOU SEE ANYTHING UNUSUAL,
CALL THE EXOTIC PLANT PEST HOTLINE**

1800 084 881

EXOTIC PEST – CALL THE EXOTIC PLANT PEST HOTLINE IF SUSPECTED

Vegetable leafminer

Liriomyza sativae



Plant Health
AUSTRALIA

EXOTIC PEST – CALL THE EXOTIC PLANT PEST HOTLINE IF SUSPECTED

What crops does it affect?

Wide range of vegetable and flower crops including potatoes, onions, eggplant, beans, celery, peas and tomatoes.

What does it look like?

Body length <2mm and wingspan <2mm. The head (including the antenna and face) is bright yellow. The abdomen is largely black with yellow sides. Vegetable leafminers don't often fly, and in crops showing active mining many flies may be seen walking rapidly over the leaves with only short jerky flights to adjacent leaves.



Adult vegetable leaf miner.

Pest and Diseases Image Library, Bugwood.org

Which part of the plant will be damaged?

Leaves and flowers.



Larvae tunnel in onion leaf.

Whitney Cranshaw, Colorado State University, Bugwood.org



Vegetable leafminer pupae.

Whitney Cranshaw, Colorado State University, Bugwood.org

IF YOU SEE ANYTHING UNUSUAL,
CALL THE EXOTIC PLANT PEST HOTLINE

1800 084 881

American serpentine leaf miner

Liriomyza trifolii



Plant Health
AUSTRALIA

What crops does it affect?

Wide host range of over 400 species of plants in 28 families. The main host families and species include Solanaceae (for example potato, tomato, eggplant), Asteraceae, Alliaceae, Cucurbitaceae and Fabaceae.

What does it look like?

Adult flies are small, yellow and black. Although female adults are larger and more robust than males, their small size still limits field identification. The larval stages are not usually seen as they remain inside the leaf tissue. The mines can be seen and are evidence of larvae presence.

Which part of the plant will be damaged?

Leaves.

What should I look for?

Numerous small dots or holes in the leaves (as upper leaf cells are destroyed), white or greenish-white mines (lines) and blotches on leaves. Fungal infection may also occur, as the feeding damage increases susceptibility to secondary infections.

How does it spread?

Within a crop the insects are spread by flying. Long distance transport is likely to occur through the movement of infested plants, plant tops, soil or packaging.



American serpentine leaf miner.

Central Science Laboratory, Harpenden Archive, British Crown, Bugwood.org



Adult male American serpentine leaf miner.

SRPV, Poitiers, Les Services Régionaux de la Protection des Végétaux, Bugwood.org

**IF YOU SEE ANYTHING UNUSUAL,
CALL THE EXOTIC PLANT PEST HOTLINE**

1800 084 881

EXOTIC PEST – CALL THE EXOTIC PLANT PEST HOTLINE IF SUSPECTED

Black bean aphid

Aphis fabae

EXOTIC PEST – CALL THE EXOTIC PLANT PEST HOTLINE IF SUSPECTED

What crops does it affect?

This aphid is a major pest of bean crops where it colonises in large numbers, but it has a very broad host range with over 80 host species including potato, cabbage, cauliflower, radish, celery, capsicum, eggplant, cucumber, beets, cucurbits, chilli, and grain. In addition to the direct damage that aphid feeding does to plants, aphids can transmit plant viruses (many species including potato virus Y), making its potential arrival in Australia a problem for many plant industries, including potatoes.

What does it look like?

Black bean aphid is <4mm long, is completely black (or very dark green) in appearance and is usually found clustered together in large numbers.

Which part of the plant will be damaged?

Whole plant. Along with some feeding damage and secretion of honeydew that causes sooty mould, the main harm that this aphid would bring to potato growers is that it transmits viruses, including potato virus Y (PVY), potato leaf roll virus (PLRV) and potato virus A (PVA).

What should I look for?

Black bean aphids are usually noticed on plants because of their contrasting colour and the presence of ants. Aphids feed by sucking plant sap, so infested growth is often yellowed and curled.

How does it spread?

Within a crop the pest spreads by flying. Long distance transport is likely to occur through the movement of infested plants, plant tops, soil or packaging. The aphid overwinters on European spindle plants (commonly found in Australia) and winged aphids spread to host plants in the warmer months.



Black bean aphids.

Mourad Louadfel, Bugwood.org



Black bean aphid infestation.

Ansel Oommen, Bugwood.org

There are a range of exotic aphids which are not yet present in Australia. If you find an aphid which causes more damage than normal or does not respond to the usual management strategies, including chemical controls or use of beneficial insects, you should call the Exotic Plant Pest Hotline on 1800 084 881.

**IF YOU SEE ANYTHING UNUSUAL,
CALL THE EXOTIC PLANT PEST HOTLINE**

1800 084 881



Plant Health
AUSTRALIA

Zebra chip

Candidatus Liberibacter solanacearum (with known vector) (syn. *Candidatus Liberibacter psyllaorous*)

What crops does it affect?

There are five types of *Candidatus Liberibacter solanacearum*. Types A and B affect Solanaceae (for example potato, tomato, tobacco, capsicum). Types C, D and E affect Apiaceae (carrots and celery).

Which part of the plant will be damaged?

Whole plant.

What should I look for?

Foliage symptoms in potato plants include stunting, yellowing, swollen nodes causing a zig-zag appearance of the upper growth, proliferated auxiliary buds, aerial tubers and leaf scorching that leads to early dieback.

Underground symptoms include enlarged lenticels and shortened or collapsed stolons. Tubers tend to be smaller and misshapen but more numerous and have rough skin. When tubers are cut in cross-sections, necrotic flecking and brown discolouration of the vascular ring can be seen.

Tuber dormancy is affected by this disease which results in premature sprouting, internal sprouting and tuber chaining. Affected tubers are unacceptable for planting.

Infected tubers are not hazardous to human health but are visually unappealing. The disease becomes most distinctive when potatoes are processed – a striped pattern of discolouration appears in fried cross-sections of potato tubers giving rise to the name zebra chip. Potato crisps made with infected potatoes have a burnt appearance and taste and are unmarketable.

The severity of symptom expression varies because the bacterium is unevenly distributed throughout the plant. The stage of growth when the plant becomes infected influences whether symptoms are evident in the tubers before they are processed.

How does it spread?

Zebra chip is spread by tomato potato psyllids (page 47). The disease is not present in Australia and at the time of writing the psyllid was only in Western Australia.

It is not known if other psyllids that are present in Australia could spread this disease if it entered Australia. High risk pathways for the entry of the disease into Australia are via infected psyllids or infected plant material.

The disease complex is unlikely to spread mechanically through handling, pruning or other cultivation practices.



Potato leaves showing stunting, yellowing and a zig-zag of the upper growth.

Whitney Cranshaw, Colorado State University, Bugwood.org

**IF YOU SEE ANYTHING UNUSUAL,
CALL THE EXOTIC PLANT PEST HOTLINE**

1800 084 881

EXOTIC PEST – CALL THE EXOTIC PLANT PEST HOTLINE IF SUSPECTED

Late blight

Phytophthora infestans (A2 mating type)

EXOTIC PEST – CALL THE EXOTIC PLANT PEST HOTLINE IF SUSPECTED

What crops does it affect?

Solanaceous species including potato, tomato, eggplant and tobacco.

Which part of the plant will be damaged?

Whole plant.

What should I look for?

Symptoms of the A2 mating type are similar to those of the established A1 mating type but are more severe and may show resistance to Metalaxyl. These symptoms include small brown-black spots on the leaves often surrounded by a pale halo, while the underside of the leaves may take on a white, downy appearance in wet weather.

Blight can spread quickly, causing the complete collapse of foliage within a few days. In severe cases the tubers can become infected, giving rise to sunken patches and a brown rot. This usually leads to secondary infection by other bacteria and fungi resulting in an unpleasant smell as potatoes turn into a mushy mess.

Outbreaks of late blight occur when night temperatures are cool, followed by warm days with mists and rains. Under those conditions the disease spreads rapidly and fields of potatoes can be destroyed in less than two weeks.

How does it spread?

Spread of late blight over short to moderate distances between plants and fields occurs by wind or wind-driven rain and can travel as far as 15–20km. Spread over longer distances, across countries and continents, occurs in seed potatoes.

The A2 mating type of late blight could arrive in Australia through spores blown in the wind or transported on clothing, through soil on equipment or on illegally smuggled crops. If they arrive in Australia, new strains of late blight could rapidly spread through airborne means and then establish in volunteer crops or overwinter in plant debris or soil for years.



Leaves of a late blight affected plant.

Nancy Gregory, University of Delaware, Bugwood.org



Late blight of potato.

Penn State Department of Plant Pathology & Environmental Microbiology Archives, Bugwood.org

**IF YOU SEE ANYTHING UNUSUAL,
CALL THE EXOTIC PLANT PEST HOTLINE**

1800 084 881

Pale potato cyst nematode

Globodera pallida



Plant Health
AUSTRALIA

What crops does it affect?

Potato, tomato and eggplant.

Which part of the plant will be damaged?

Roots and tubers. Plant parts above the ground also show signs of disease due to root damage.

What should I look for?

Potato cyst nematodes are microscopic and worm-like. They feed on the roots of potato, tomato, eggplant and other plants from the Solanaceae family including night shade. The symptoms of attack by *Globodera* species are not specific. Symptoms may appear similar to water or nutrient deficiencies or wilt diseases because infested potato plants have a reduced root system. The root system also becomes abnormally branched and brownish in colour.

Growth is stunted, leaves yellow early or turn a dull colour, flowering is delayed and plants may wilt and die. During or after flowering very tiny white, yellow or brown cysts about the size of a pin head (0.5mm) might be seen on the outside of roots.

How does it spread?

Potato cyst nematode can spread on anything contaminated with infested soil including seed potatoes, potted nursery stock and packaging, soil, flower bulbs, any other unwashed root crops for consumption or processing, footwear, livestock, farming equipment and waste from potato grading operations. Potato cyst nematode can survive as cysts in the soil for up to 20 years in the absence of host species.



Cysts on the outside of a heavily infected potato.

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



Above ground damage resulting from pale potato cyst nematode infection.

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

**IF YOU SEE ANYTHING UNUSUAL,
CALL THE EXOTIC PLANT PEST HOTLINE**

1800 084 881



Plant Health
AUSTRALIA

Root knot nematode

Meloidogyne enterolobii (syn. *Meloidogyne mayaguensis*)

EXOTIC PEST – CALL THE EXOTIC PLANT PEST HOTLINE IF SUSPECTED

What crops does it affect?

Many hosts including potato, tomato, eggplant and solanaceous weeds, onions, lucerne, tobacco, cabbages, wheat and corn, although the preferred host is potato.

Which part of the plant will be damaged?

Roots and tubers.

What should I look for?

Infested plants are stunted and may wilt; leaves may yellow or display a dull colour. Affected plants have a reduced root system which is abnormally branched and brownish in colour. At flowering or later, minute white, yellow or brown spheres or cysts, about the size of a pin head (0.5mm) may be seen on the outside of roots.

Damage to the crop varies from small patches of poor growing plants to complete crop failure. Infected plants first occur in isolated patches and these become larger with each new crop if potatoes are continually grown on the infested site.

In light infestations, potato plants may show no above ground symptoms, but yield can be reduced. Light infestations can reduce tuber size, whereas heavy infestations reduce both number and size of tubers. Affected plants can occur in patches bordered by relatively healthy plants.

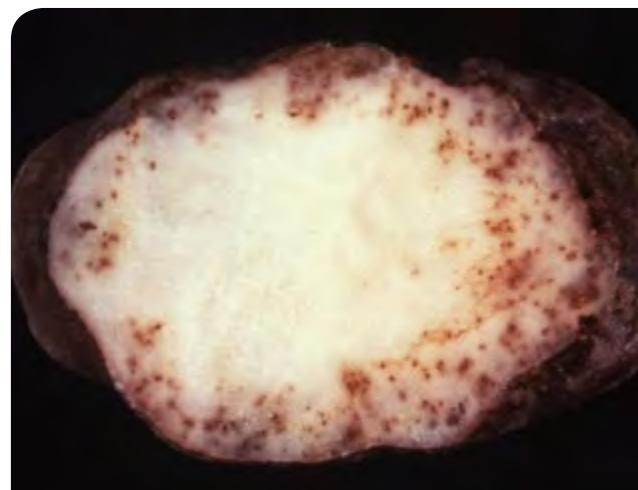
How does it spread?

As a soil-borne pest it is spread by transport of infested soil. For example, cysts can be carried in soil adhering to seed potatoes, farm machinery, implements, boots, bins and plants. Cysts can also be transported by wind and flood water.



Knot in a root hair caused by root knot nematode.

Onions Australia Poster, 2018



Nematode damage to a potato.

DAFF Archive, Bugwood.org

**IF YOU SEE ANYTHING UNUSUAL,
CALL THE EXOTIC PLANT PEST HOTLINE**

1800 084 881



African black beetle

Heteronychus arator

What crops does it affect?

Potato, pineapple, eucalypts, sugarcane, grapevine and maize.

What does it look like?

Larvae are a white to creamy-white, soft bodied curl grub up to 25mm long. Adult beetles are a shiny jet-black scarab beetle with serrated front legs up to 15mm long.

Which part of the plant will be damaged?

Stems.

What should I look for?

Most damage is caused by adults feeding on the underground stems of young plants, often killing growing points so that the central shoots wither and the plants become dead-hearted.

Older plants usually survive, but remain weak and are liable to lodging. Beetles are often found near the base of damaged plants. Damaged young plants usually produce suckers. Soil sampling will indicate the presence of beetles.

How does it spread?

Beetles crawl on the soil or pasture surface at night. Large scale flights are sporadic and may be localised within a district, making them difficult to predict. Although the triggers for flight are not known, weather conditions associated with summer thunderstorms seem to promote swarming flights of beetles and most flight activity occurs in late summer-autumn, which coincides with the emergence of the new generation of adults.

Distribution in Australia

All states and territories except Northern Territory and Tasmania.

State movement controls or impacted markets

No specific movement controls exist but spread of this pest onto your property can be limited through implementation of biosecurity measures.



Dorsal/back view of adult African black beetle.

Hanna Royals, Bugwood.org



Lateral/side view of adult African black beetle.

Pest and Diseases Image Library, Bugwood.org

Green peach aphid

Myzus persicae

What crops does it affect?

Very broad host range including potato, tomato, eggplant, cabbage, cauliflower, capsicum, cut flowers, citrus, cucurbits, carrot, cotton, lettuce, apples, avocado, beans, peas, and stone fruit.

Green peach aphids often cause less direct feeding damage than other aphid species, but are significant in the spread of plant viruses. The aphids spread viruses by probing and feeding as they move between plants within or between paddocks.

What does it look like?

Green peach aphids grow up to 3mm long and vary in colour from shiny pale yellow-green, green, orange or pink. Adults are oval-shaped and can be winged or wingless. Winged adults have a dark patch on the abdomen, while wingless adults are usually quite uniform in colour. Juveniles are similar to wingless adults but smaller in size.

Which part of the plant will be damaged?

Above ground plant parts.

What should I look for?

Aphids will generally move into paddocks from host weeds or volunteer plants located on roadsides, paddock edges or neighbouring paddocks. Damage often appears initially on crop edges, which should be monitored. Inspect the underside of plant leaves. Aphid distribution may be patchy, therefore inspect at least 20 plants at each of five representative sampling points across the paddock. Symptoms of virus infections are highly variable.

How does it spread?

Winged aphids migrating from weeds start colonies in autumn. Populations peak in late winter and early spring; development rates are particularly favoured when daily maximum temperatures reach 20–25°C.

Distribution in Australia

All states and territories except Northern Territory.

Note: Resistant biotypes of green peach aphid are present in some parts of Australia.

State movement controls or impacted markets

No specific movement controls exist but spread of this pest onto your property can be limited through implementation of biosecurity measures.



Adult and nymph green peach aphids.

David Cappaert, Michigan State University, Bugwood.org

There is a range of exotic aphids that are not yet present in Australia. If you find an aphid which causes more damage than normal or does not respond to the usual management strategies, including chemical controls or use of beneficial insects, you should call the Exotic Plant Pest Hotline on 1800 084 881.

Tomato potato psyllid

Bactericera cockerelli



Plant Health
AUSTRALIA

What crops does it affect?

Solanaceae species including potato, tomato, capsicum, eggplant and Convolvulaceae species including sweetpotato.

What does it look like?

The psyllid is a tiny sap-sucking insect that goes through three stages of development – egg, nymph and adult.

Adult psyllids resemble small winged cicadas and are about 3mm long. The body is brownish and has white or yellowish markings on the chest and a broad white band on the abdomen. Wings are transparent and held vertically over the body.

Eggs are <1mm long and are white when first laid, then turn yellow to orange after a few hours.

Nymphs are up to 2mm long, oval shaped, flattened and scale-like in appearance.

Which part of the plant will be damaged?

Above ground then whole plant.

What should I look for?

Symptoms of psyllid feeding include the appearance of 'psyllid sugar', yellowing or purpling of the midribs and leaf margins. The leaves are often cupped, narrow and point upright giving the plant a feathery appearance. Psyllid yellows, a syndrome that can develop during psyllid infestation, can be easily confused with the symptoms of the exotic disease zebra chip (page 41).

Any signs of yellowing, stunting, leaf narrowing, curling or cupping, leaf purpling, fruit distortion and shortened internodes in your potato crop should be investigated closely due to the risk of infection by the disease zebra chip (currently exotic).

How does it spread?

The psyllid can spread through the movement of plants and plant materials including fruit, vegetables and nursery stock, on horticultural machinery and equipment, and also by wind and flight.

Adult psyllids are capable of flight and move short distances. Wind currents can carry adult psyllids long distances as can machinery and vehicles. Juvenile psyllids do not fly and can be transported via infested plant material. Zebra chip requires the tomato potato psyllid as a vector for movement from plant to plant.

Distribution in Australia

Western Australia (since February 2017).

State movement controls or impacted markets

Movement controls exist for various plant products leaving Western Australia destined for South Australia, New South Wales, Victoria, Queensland and Tasmania. Movement controls also exist in Western Australia to prevent further spread within the state.



Adult tomato potato psyllid.

Whitney Cranshaw, Colorado State University, Bugwood.org

ESTABLISHED PEST



Plant Health
AUSTRALIA

Cluster caterpillar

Spodoptera litura

ESTABLISHED PEST

What crops does it affect?

Wide host range including potato, tomato, eggplant, onion, cauliflower, cabbage, citrus, chilli, coffee, soybean, cut flowers, apple, lucerne, tobacco, peppers, cocoa, grapevine and maize.

What does it look like?

Eggs are laid in a fuzzy cream mass on the underside of leaves.

Young **larvae** 'cluster' together and are translucent green with a darker chest. Medium-sized larvae are variable in colour, smooth-skinned with a pattern of red, yellow and green lines, a dark patch on the hump behind the head and dark spots along each side. Large larvae are initially brown with three thin pale lines down their back. They have a row of black dots along each side, and a row of dark half-moons along the back. In the final larval stage caterpillars are dark and can exceed 50mm in length.

Adult moths have brown forewings with criss-cross cream streaks and translucent white hindwings edged with brown. They have a wingspan of 30–45mm.

Eggs hatch in two to seven days and the caterpillar stage lasts two to six weeks depending on temperatures. The life cycle, egg to adult, takes about 30 days in warm weather and up to eight weeks in cooler conditions.

Which part of the plant will be damaged?

Leaves.

What should I look for?

Moths lay clusters of eggs on the underside of the leaf. Young larvae feed in close groups and destroy one side of the leaf leaving the opposite side intact. Damaged areas appear clear at first but quickly turn brown. When larger and more solitary, larvae feed on the rolled up 'cigar leaf' and a 'shot hole' effect becomes apparent when this leaf expands. Defoliation of crops can occur quickly in hot weather.

How does it spread?

The moths are strong fliers and can invade crops any time from emergence through to harvest.

Distribution in Australia

Found in the Australian Capital Territory and limited distribution in New South Wales, Queensland and Western Australia.

State movement controls or impacted markets

No specific movement controls exist but spread of this pest onto your property can be limited through implementation of biosecurity measures.



Adult cluster caterpillar moth.

Natasha Wright, Cook's Pest Control, Bugwood.org



Cluster caterpillar with distinctive row of black dots along each side, and a row of dark half-moons along the back.

K. Kiritani, Bugwood.org



Potato tuber moth

Phthorimaea operculella

What crops does it affect?

Potato, tomato, eggplant, capsicum and tobacco.

What does it look like?

A small moth, measuring about 10mm in length when at rest, coloured pale brown with darker marbling. Wingspan 15–17mm. The head and chest are pale brown. The front wings are pale brown with small blotches of mid-brown, and hind wings are pale grey.

Which part of the plant will be damaged?

Leaves, roots and stems.

What should I look for?

On growing plants, leaf mines show the presence of larvae, and the stem is weakened or broken. On tubers, detection is more difficult without them being cut open when larvae will be apparent within the potatoes.

How does it spread?

Adults disperse in short 'hopping' flights near the ground, with the aid of prevailing winds. The moths can move up to 250m to infest plants or tubers, although it has been observed that they do not move from potato fields unless the field is harvested. Dispersal over long distances is on potato tubers, which has facilitated the spread of the moth around the globe.

Distribution in Australia

Present in all states and territories.

State movement controls or impacted markets

No specific movement controls exist but spread of this pest onto your property can be limited through implementation of biosecurity measures.



Adult of *Phthorimaea operculella*, showing narrow, markedly fringed wings.

Central Science Laboratory, Harpenden, Bugwood.org



Potato tuber moth on a leaf.

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

Bacterial wilt

Ralstonia solanacearum

What crops does it affect?

Bacterial wilt attacks more than 200 species. These include economically important hosts such as potato, tobacco, tomato, eggplant, pepper, banana, peanut and beans. Thorn apple and nightshade are two common weed hosts that can harbour the disease.

Which part of the plant will be damaged?

Roots and tubers, but can lead to wilting of whole plant.

What should I look for?

Typical symptoms are wilting, yellowing and some stunting of the plants, which eventually die back. Wilting is first seen as a drooping of the tip of some of the lower leaves similar to that caused by a temporary shortage of water. Affected leaves later become permanently wilted and roll upwards and inwards from the margins. The wilting then extends to leaves further up the stem, followed by yellowing.

Brownish-grey areas can be seen on the outside of tubers, especially near the point of attachment of the stolon. Cut tubers may show pockets of white to brown pus or browning of the vascular tissue which, if left standing, may exude dirty white globules of bacteria. As the disease progresses bubbly globules of bacteria may exude through the eyes; soil will often adhere to the exuded bacteria, hence the name 'sore eyes' or 'jammy eyes'!

How does it spread?

Infected seed potatoes are a significant route of dissemination, both locally and over considerable distances. It is not the heavily infected tubers that are the problem since these generally rot away, only contaminating the land in which they were grown. However, lightly infected tubers, which show no visible symptoms, pose a serious threat of spreading the disease to new areas.

If a paddock is infected with bacterial wilt the disease may remain in it for five or six years after the initial outbreak. Bacteria can also be spread to clean tubers from an infected seed-cutter or knife. There is also a danger of infection if second hand bags are used or if bins have held infected potatoes and not been cleaned properly. Growers should be aware of these risks and take precautionary measures. Spread between areas usually involves vegetative propagating material that carries latent infections or is contaminated with the pathogen.

Distribution in Australia

Occurs in NSW (excluding the NSW Seed Protected Areas), Queensland and Koo Wee Swamp district of Victoria.

State movement controls or impacted markets

Harvested seed or ware potatoes from all states and territories (except Victoria) must be inspected by an authorised officer in the Department of Agriculture of the originating State or Territory and found to be free from Bacterial Wilt (*Ralstonia solanacearum* aka *Pseudomonas solanacearum*).



Symptoms of bacterial wilt on a potato plant.

National Plant Protection Organization, The Netherlands, Bugwood.org

There are bacterial wilts of potatoes which are not yet present in Australia. If you observe bacterial wilt symptoms which cause more damage than normal or do not respond to the usual management strategies you should call the Exotic Plant Pest Hotline on 1800 084 881.

Golden potato cyst nematode

Globodera rostochiensis RO1 strain



Plant Health
AUSTRALIA

What crops does it affect?

Potato, tomato and eggplant.

Which part of the plant will be damaged?

Roots.

What should I look for?

Nematodes are small worm-shaped organisms, <1mm in length, which inhabit soil and attack plant roots. The cysts of golden potato cyst nematode are white, yellow or golden in colour when they first form on roots and become tan brown in colour when they mature.

Look for leaf wilting and discoloration, root cysts and reduced root system, yield reduction and smaller potatoes, dwarfing of plants and early senescence. At flowering or later, minute white, yellow or brown spheres or cysts about the size of a pin head (0.5mm) can be seen on the outside of roots. Damage to the crop varies from small patches of poor growing plants to complete crop failure. Potato cyst nematode is not greatly influenced by soil type and temperature because the nematode thrives wherever potatoes are grown.

How does it spread?

Potato cyst nematode is a soil-borne pest and is spread by transport of infested soil. For example, cysts can be carried in soil adhering to seed potatoes, farm machinery, implements, boots, crates and plant material, particularly bulbs. Cysts can also be transported by wind and flood water. Locally, potato cyst nematode is usually dispersed by farming activities including sharing farm equipment contaminated with infested soil.

Distribution in Australia

Occurs in Victoria and linked land in SA.

State movement controls or impacted markets

Seed and ware potatoes entering Western Australia must be inspected according to the import requirements listed at agric.wa.gov.au/iaquarantine.



Potato plant on right infected with the potato cyst nematode compared to healthy plant on left.

Christopher Hogger, Bugwood.org



Comparison of *Globodera rostochiensis* and *Globodera pallida*: females of *G. pallida* turn directly to brown cysts whereas *G. rostochiensis* females change from yellow to gold before they turn brown.

Ulrich Zunke, Bugwood.org

There are strains of golden potato cyst nematodes which are not yet present in Australia. If you observe nematode symptoms which cause more damage than normal or do not respond to the usual management strategies you should call the Exotic Plant Pest Hotline on 1800 084 881.

ESTABLISHED PEST

Potato spindle tuber viroid (PSTVd)

Potato spindle tuber Pospiviroid



Plant Health
AUSTRALIA

What crops does it affect?

The primary natural host of PSTVd is potato, but the viroid also affects tomato and other Solanaceae plants.

Which part of the plant will be damaged?

Whole plant.

What should I look for?

There are both mild and severe strains. Symptoms may be confused with those of nutrient imbalance, spray damage, insect damage or other plant diseases such as true viruses.

Symptoms become more pronounced in warm conditions and under high light intensity. Foliage symptoms are often difficult to recognise and are rarely distinguishable before maturity. Stems remain upright and internodes are longer and more slender than normal. Leaflets are slightly smaller in size with fluted margins. Leaves near ground level are held in an upright position, in contrast to healthy plant leaves that often rest on the ground.

Infected tubers have pointed ends, giving them a spindle shape with a round cross-section. Infected tubers are also often smaller than healthy ones. Eyes are deep, more prominent and surface cracking occurs. Tubers of some cultivars develop knobs and swellings and are severely misshapen. With some strains, foliage and tuber symptoms are mild versions of the above, or may not be visible. The foliage and tuber symptoms become progressively more severe with each generation.

How does it spread?

PSTVd is a highly contagious disease, transmitted between plants by touch. The use of cutting or pruning tools, contaminated machinery or any form of physical contact between plants can result in disease transmission. PSTVd is also reported to have been transmitted by green peach aphid from plants that are co-infected with potato leafroll virus.

In potatoes the most important means of PSTVd spread from one generation to the next is via infected seed potatoes. It is transmitted through seed potatoes at varying rates depending on the host cultivar and the strain of PSTVd present. PSTVd can also survive in dried potato sap for more than eight weeks and in infected leaf debris for over six months.

Potato seeds, that is those from fruit originating from a flower, and tomato seeds can also spread PSTVd.

Distribution in Australia

Present in Queensland and WA (distribution restricted to within a 50 km radius of detection in Carnarvon). PSTVd has been detected in SA and Victoria which has not been confirmed as eradicated at the time of writing.

State movement controls or impacted markets

Movement of potatoes, or machinery or soil that when moving has come into contact with potatoes, is restricted into various potato plant protection districts in Victoria and specific parts of south-east, central-west and northern New South Wales. Potatoes must be washed or brushed free of soil and in new packaging before being allowed onto Kangaroo Island (South Australia).



Typical leaf symptoms of potato spindle tuber viroid on potato: cultivar Kennebec (right), healthy plant (left).

R. P. Singh, Bugwood.org





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