Biosecurity Plan
for the Potato Industry

A shared responsibility between government and industry

Version 3.0 February 2019

Plant Health AUSTRALIA

Hort Innovation
Strategic levy investment

POTATO – FRESH FUND

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ACT GOVERNMENT

Queensland Government

Northern Territory Government

Endorsement

The *Biosecurity Plan for the Potato Industry* (Version 3.0) was formally endorsed by the Potato industry (through AUSVEG) in January 2018, and all state and territory governments (through the Plant Health Committee) in December 2018. The Australian Government endorses the document without prejudice for the purposes of industry's planning needs and meeting the Department's obligations under Clause 13 of the EPPRD. In providing this endorsement the Department notes page 61 of the Plan which states: "This Document considers all potential pathways by which a pest might enter Australia, including natural and assisted spread (including smuggling). This is a broader view of potential risk than the IRA conducted by the Department of Agriculture and Water Resources which focus only on specific regulated import pathways."

Reporting suspect pests

Any unusual plant pest should be reported immediately to the relevant state/territory agriculture department through the Exotic Plant Pest Hotline (1800 084 881). Early reporting enhances the chance of effective control and eradication.

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List of acronyms

ACPPO	Australian Chief Plant Protection Office
APVMA	Australian Pesticides and Veterinary Medicines Authority
AS/NZS	Australian Standard/New Zealand Standard
BICON	Australian Biosecurity Import Conditions Database
BIG	Biosecurity Implementation Group
BP	Biosecurity Plan
BOLT	Biosecurity On-Line Training
CCEPP	Consultative Committee on Emergency Plant Pests
CPHM	State Chief Plant Health Manager
DAF Qld	Department of Agriculture and Fisheries, Queensland
DPI NSW	Department of Primary Industries, New South Wales
DEDJTR	Department of Economic Development, Jobs, Transport and Resources, Victoria
DPIR NT	Department of Primary Industry and Resources, Northern Territory
DPIPWE	Department of Primary Industries, Parks, Water and Environment, Tasmania
DPIRD	Department of Primary Industries and Regional Development, WA
EPP	Emergency Plant Pest
EPPO	European and Mediterranean Plant Protection Organization
EPPRD	Emergency Plant Pest Response Deed
FAO	Food and Agriculture Organization of the United Nations
HACCP	Hazard Analysis Critical Control Point
HPP	High Priority Pest
ICA	Interstate Certification Assurance
IGAB	Intergovernmental Agreement on Biosecurity
IPM	Integrated Pest Management
IPPC	International Plant Protection Convention
IRA	Import Risk Analysis
ISPM	International Standards for Phytosanitary Measures
MICoR	Manual of Importing Country Requirements
NAQS	Northern Australian Quarantine Strategy
NDP	National Diagnostic Protocol
NGIA	Nursery and Garden Industry Australia
NMG	National Management Group
NPBDN	National Plant Biosecurity Diagnostic Network

NPBRDE IC	National Plant Biosecurity Research, Development and Extension Strategy. Implementation Committee
NPBS	National Plant Biosecurity Strategy
NSW	New South Wales
NT	Northern Territory
ORC	Owner Reimbursement Costs
PaDIL	Pest and Disease Image Library
PHA	Plant Health Australia
PHC	Plant Health Committee
PIC	Property Identification Code
PIRSA	Primary Industries and Regions South Australia
QA	Quality Assurance
QLD	Queensland
RDC	Research and Development Corporation
RD&E	Research, Development and Extension
SA	South Australia
SARDI	South Australian Research and Development Institute
SDQMA	Sub-Committee for Domestic Quarantine and Market Access
SNPHS	Sub-Committee for Plant Health Surveillance
SPHD	Subcommittee on Plant Health Diagnostic
SPS	Sanitary and Phytosanitary
TEG	Technical Expert Group
TST	Threat Summary Table
Vic	Victoria
WA	Western Australia
WA DPIRD	Western Australia Department of Primary Industries and Regional Development
WTO	World Trade Organization

Definitions

The definition of a plant pest used in this document are insects, mites, snails, nematodes or pathogens (diseases) that have the potential to adversely affect food, fibre, ornamental crops, bees and stored products, as well as environmental flora and fauna. Exotic pests are those not currently present in Australia. Endemic pests are those established within Australia.

EXECUTIVE SUMMARY

Executive Summary

To ensure its future viability and sustainability, it is important that the Australian potato industry, represented by AUSVEG as the peak industry body, minimises the risks posed by exotic pests and responds effectively to plant pest threats. This plan is a framework to coordinate biosecurity activities and investment for Australia's potato industry. It provides a mechanism for industry, governments and stakeholders to better prepare for and respond to, incursions of pests that could have significant impacts on the potato industry. It identifies and prioritises exotic plant pests (not currently present in Australia) and established pests of biosecurity concern, and focus on future biosecurity challenges.

The Biosecurity Plan for the Potato Industry was developed in consultation with the Technical Expert Group (TEG) and Biosecurity Implementation Group (BIG), which consisted of plant health and biosecurity experts and industry representatives. These groups were coordinated by Plant Health Australia (PHA) and included representatives from AUSVEG, relevant state and territory agriculture agencies and PHA.

The development of Threat Summary Tables (TSTs), constituting a list of more than 200 exotic plant pests and the potential biosecurity threat that they represent to the Australian potato industry was key to the industry biosecurity planning process. Each pest on the list was given an overall risk rating based on four criteria; entry, establishment, spread potential, and economic impact. In this biosecurity plan, established pests of biosecurity significance for the potato industry were also identified (Table 2) as good biosecurity practice is beneficial for the ongoing management and surveillance for these pests.

The Biosecurity Plan for the Potato Industry also details current mitigation and surveillance activities being undertaken and identifies contingency plans, fact sheets and diagnostic protocols that have been developed for pests relevant to the potato industry (Table 5). This enables identification of gaps and prioritises specific actions, as listed in the Biosecurity Implementation Table (Table 4). The development of this table will increase the potato industry's biosecurity preparedness and response capability by outlining specific areas of action which could be undertaken through a government and industry partnership.

This biosecurity plan is principally designed for decision makers. It provides the potato industry and government with a mechanism to identify exotic plant pests as well as to address the strengths and weaknesses in relation to the potato industry's current biosecurity position. It is envisaged that annual reviews of this BP will be undertaken with another formal review conducted in 5 years.

The biosecurity plan is a document outlining the commitment to the partnership between the potato industry and government to improve biosecurity for the potato industry and is supported by the industry biosecurity statement (Page 50).

SIGNIFICANT BIOSECURITY THREATS

Document overview

Biosecurity for the Australian potato industry focuses on five key areas to identify the components to be implemented through the life of the biosecurity plan 2017-2022. These five areas are outlined in the sections below.

High priority exotic pests, established pests and weeds of biosecurity significance

A key outcome of this biosecurity plan is the identification of the exotic high priority pests, established pests and weeds of biosecurity significance for the Australian potato industry (Page 16). This section includes:

- the High Priority Pests (HPPs), are the most significant exotic threats affecting the potato industry as identified through a prioritisation process.
- the established pests of biosecurity significance, which have been identified in consultation with industry
- the established weeds of biosecurity significance, as identified by industry and government.

The exotic HPP list, established pests and weeds of biosecurity significance will allow industry and government to better prioritise preparedness activities and will assist in the implementation of effective grower and community awareness campaigns, targeted biosecurity education and training programs for growers, development of surveillance programs, diagnostic protocols as well as development of pest-specific mitigation activity.

Implementing biosecurity for the Australian Potato Industry 2017-2022

This section (Page 30) includes the biosecurity implementation plan and a gap analysis of the current level of preparedness for HPPs of the potato industry. The Biosecurity Implementation Group (BIG), comprised of both industry and government representatives, developed the implementation plan that sets out shared biosecurity goals and objectives over the next five years. It is intended that the biosecurity implementation plan is revisited by the Biosecurity Reference Panel regularly over the next five years to maintain its relevance.

Threat identification and pest risk assessments

Guidelines are provided for the identification and ranking of biosecurity threats through a process of qualitative risk assessment. The primary goal is to coordinate identification of exotic pest threats that could impact productivity, or marketability. This plan strengthens risk assessment work already being done both interstate and overseas. All exotic potato biosecurity threats considered in the biosecurity plan are detailed in threat summary tables (TST; Appendix 2). From the prioritisation process undertaken in the TST, pests with an overall high rating were identified as a HPP (Table 1). Established pests and weeds of biosecurity significance are also listed.

Risk mitigation and preparedness

This section provides a summary of activities to mitigate the impact of pest threats on the Australian potato industry, along with a set of guidelines for managing risk at all operational levels. Many pre-emptive practices can be adopted by plant industries and government agencies to reduce risks. The major themes covered include:

- Barrier quarantine
- Surveillance
- Training
- Awareness
- Farm biosecurity
- Reporting of suspect pests

A summary of pest-specific information and preparedness documents, such as fact sheets, contingency plans and diagnostic protocols are also described to outline activities industry has undertaken to prepare for an exotic pest incursion. Information for industry on how to align preparedness activities with R,D&E, such as researching IPM strategies, resistance breeding and chemical control is also provided.

Response management

Provides a summary of the processes in place to respond to Emergency Plant Pest (EPP)[1] incursions that would affect the Australian potato industry. Areas covered in this section include the Emergency Plant Pest Response Deed (EPPRD), PLANTPLAN (outlines the generic approach to response management under the EPPRD), categorisation of pests under the EPPRD, industry specific response procedures and industry communication.

[1] Refer to the PHA website for details of what an EPP is **http://www.planthealthaustralia.com.au/biosecurity/emergency-plant-pests/**

Pests and Weeds of Biosecurity Significance Overview

A key component of this biosecurity plan is to identify the exotic and established pests and weeds of biosecurity significance to the Australian potato industry. This section provides information on the High Priority Pest list, the established pests of biosecurity significance and the established weeds of biosecurity significance to the potato industry. These pest lists, provide the Australian potato industry, governments and other stakeholders with the information needed to prioritise resources for biosecurity risk management.

Potato industry high priority exotic pests

Table 1 provides an overview of the top ranked threats to the potato industry for invertebrates, and pathogens and nematodes respectively. Further details on each pest along with the basis for the likelihood ratings are provided in the threat summary tables (Appendix 2). Assessments may change given more detailed research, and the priority list will be formally reviewed along with the Biosecurity Plan on an annual basis through the biosecurity reference panel. An explanation of the method used for calculating the overall risk can be found on the PHA website[2].

Table 1. *Potato industry high priority pest threat list*

Common name (Scientific name)	Host(s)	Affected plant part	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
INVERTEBRATES								
COLEOPTERA (Beetles and weevils)								
Colorado potato beetle (*Leptinotarsa decemlineata*)	Solanaceae including tomato, potato and eggplant	Above-ground plant parts	Widespread in Asia and Europe, present in North and Central America.	MEDIUM	MEDIUM	HIGH	EXTREME[3]	**EXTREME**
DIPTERA (Flies and midges)								
Serpentine leaf miner (*Liriomyza huidobrensis*)	Polyphagous including potato, beets, spinach, lupin, faba bean, field pea, cow pea, common bean	Leaves	Worldwide[4] excluding Australia and New Zealand	HIGH[5]	HIGH	HIGH	HIGH	**HIGH**

[2] Available from **www.planthealthaustralia.com.au/biosecurity/risk-mitigation**
[3] *L. decemlineata* is one of the most economically damaging pests of potato worldwide (Hare 1990) and is resistant to many insecticides (CABI)
[4] Found in Indonesia
[5] Has been intercepted coming into Australia

Common name (Scientific name)	Host(s)	Affected plant part	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
American leaf miner, vegetable leaf miner (*Liriomyza sativae)*	Wide host range including potato, *Allium* spp., bean, pea, eggplant, pumpkin, cucumber, beets, lettuce, celery	Leaves	Worldwide[6] excluding Australia[7] and New Zealand	HIGH[8]	HIGH	HIGH	HIGH	**HIGH**
American serpentine leaf miner (*Liriomyza trifolii*)	Wide host range over 400 species of plants in 28 families. The main host families and species including Alliaceae, Cucurbitaceae, Fabaceae and Solanaceae (including potato)	Leaves	Worldwide excluding Australia and New Zealand. Present in South Pacific and has been intercepted at Australian borders	HIGH	HIGH	HIGH	HIGH[9]	**HIGH**
HEMIPTERA (Stink bugs, aphids, mealybugs, scale, whiteflies and hoppers)								
Black bean aphid (*Aphis fabae*)	Very broad host range with over hosts including cabbage, cauliflower, radish, celery, capsicum, eggplant, cucumber, beets, broad beans, bean, peas, cucurbits, chilli, potato, grain, legumes	Whole plant	Widespread distribution across Asia, Africa, Europe, North and South America	HIGH	HIGH	HIGH	HIGH[10]	**HIGH**

[6] Present in New Calendonia, PNG, Vanuatu therefore a natural dispersal risk

[7] Detected in Queensland Cape York Peninsula (Far Northern Biosecuirty zone 1). Eradication is not considered feasible but measures are being undertaken to prevent further spread.

[8] Is established in the Torres Strait and phytosanitary measures are in place to ensure it does not spread to the Australian mainland and Tasmania (IPPC 2014)

[9] Is known to vector plant viruses (Zitter et al 1980)

[10] Under warm spring temperatures can multiply very rapidly (CABI). Primary impact comes from direct feeding damage, but can also vector viruses (CABI)

Common name (Scientific name)	Host(s)	Affected plant part	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Cotton aphid, melon aphid (*Aphis gossypii* (exotic strains))	Highly polyphagous including potato, cotton, papaya, citrus, capsicum, melon, cucumber, pumpkin, carnation, sunflower, jasmine, lettuce, lychee, macadamia, apple, passionfruit, avocado, tomato, maize	Leaves, inflorescences, stems	Worldwide	HIGH	HIGH	HIGH	HIGH[11]	**HIGH**
PATHOGENS								
BACTERIA (including phytoplasmas)								
Zebra chip *(Candidatus Liberibacter solanacearum* (with known vector) (syn. *Candidatus Liberibacter psyllaurous*))	Haplotypes A and B affect Solanaceae (potato, tomato, tobacco, capsicum etc). Haplotypes C, D and E affect Apiaceae (carrots and celery)	Whole plant	Africa, Oceania, North and Central America, Europe	HIGH	HIGH	HIGH	EXTREME	**EXTREME**
Bacterial wilt, brown rot (*Ralstonia syzigii* (syn. *Ralstonia solanacearum* Race 4, *Pseudomonas solanacearum*))[12]	Over 450 species affected including potato, tomato, ginger, banana	Roots and rhizome leading to whole plant wilting	Worldwide[13]	HIGH	HIGH	HIGH	HIGH	**HIGH**

[11] Due to its extreme polyphagy it can transmit a wide variety of viruses (including potato leafroll virus and potato virus Y, making it an environmental as well as economic concern (CABI)

[12] One isolate of *R. solanacearum* phylotype IV has been found on tomato in Darwin in 1979. It has not been isolated since and it is not known if this isolate is considered to be *R. syzygii*.

[13] Present in NZ, PNG, New Calendonia, Vanuatu and therefore a natural dispersal risk

Common name (Scientific name)	Host(s)	Affected plant part	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
OOMYCETES								
Late blight (*Phytophthora infestans* (A2 mating type and exotic strains of the A1))	Solanaceous species including potato, tomato, eggplant, tobacco	Whole plant	Both A1 and A2 mating types of *P. infestans* have spread worldwide. All A2 strains are exotic to Australia. Australia only has one A1 strain.	MEDIUM	HIGH	HIGH	HIGH	**HIGH**
NEMATODES								
Pale potato cyst nematode (*Globodera pallida*)	Potato, tomato, eggplant	Roots	Worldwide, including New Zealand	HIGH	MEDIUM	HIGH[14]	HIGH	**HIGH**
Golden potato cyst nematode (*Globodera rostsochiensis* (Pathotypes RO2, RO3, RO4 and RO5))	Potato, tomato, eggplant	Roots	Worldwide, including New Zealand	HIGH	MEDIUM	HIGH	HIGH	**HIGH**
Root knot nematode (*Meloidogyne enterolobii* (syn. *Meloidogyne mayaguensis*))	Wide host range including potato, tomato, onion, tobacco, cabbage, wheat, corn, eggplant, capsicum, coffee, cucumber, soybean, lettuce, guava	Roots	Asia (China, Vietnam), sub-Saharan Africa, United States, Central America and the Caribbean, South America, Europe	MEDIUM	HIGH	HIGH	HIGH	**HIGH**
VIRUSES AND VIROIDS								
Potato spindle tuber viroid (PSTVd) (exotic strains) *(Potato spindle tuber viroid* (Pospiviroid))	Solanaceae (including Potato, tomato)	Whole plant	Worldwide	HIGH	HIGH	HIGH	HIGH	**HIGH**

[14] Cysts are very difficult to detect and are resistant to mot disinfestation methods (M. Hodda, pers. comm.)

Established pests of biosecurity significance

Introduction

This section identifies established pests of biosecurity significance for the potato industry in Australia. By identifying and prioritising established pests which potato producers already have to manage, mechanisms can be put in place to better align industry and government resources and provide a stronger base for biosecurity risk management for the potato industry.

Identification of established pests of significance will also assist in the implementation of effective grower and community awareness campaigns, targeted biosecurity education and training programs for growers, surveillance coordinators, diagnosticians and development of pest-specific mitigation activity.

Threat identification

Information on established pests of the potato industry described in this document came from a combination of:

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

Prioritising pest threats

Although established pests listed in this plan (Table 2) had to meet the criteria listed below for establishment, spread and economic impact, these pests did not undergo a formal pest risk assessment. These pests were considered in an effort to prioritise investment.

Spread: The natural spread of the pest to most production areas is largely unhindered and assisted spread within Australia is also difficult to manage. There may be state or territory specific regulations in place to prevent the pest spreading.

Establishment: The pest has the potential to survive and become established throughout most or all of the range of hosts. Distribution is not limited by environment conditions that prevail in Australia. Based upon its current distribution in Australia, and known conditions of survival, it is likely to survive in Australia in the majority of regions where the host is grown.

Economic Impact: There are severe impacts on production including host mortality and/or significant impacts on either crop quality or storage losses, and/or severe impacts on market access.

Table 2. Established pests of biosecurity significance

Common name (Scientific name)	Hosts	Affected plant part	Distribution in Australia	State movement controls or markets impacted by pest	Factsheets	Comments
INVERTEBRATES						
COLEOPTERA (Beetles, weevils)						
African black beetle (*Heteronychus arator*)	Potato, pineapple, eucalyptus, sugarcane, grapevine, maize	Stems	NT, NSW, QLD, SA, VIC, WA		**http://dpipwe.tas.gov.au/Documents/africanblackbeetle.pdf** **www.pir.sa.gov.au/__data/assets/pdf_file/0008/274715/African_Black_Beetle.pdf**	Consistently a significant potato pest in south-western Australia. Reduces yield by reducing stand density and can lower market value by feeding on tubers.
HEMIPTERA (Stink bugs, aphids, mealybugs, scale, whiteflies, hoppers)						
Tomato potato psyllid (*Bactericera cockerelli*)	Convolvulaceae and Solanaceae including capsicums, eggplants, peppers	Whole plant, above ground	WA	Various movement restrictions apply to a range of plants entering QLD, NSW, SA and VIC. Movement controls also exist within WA.	**www.planthealthaustralia.com.au/wp-content/uploads/2017/04/Zebra-chip-tomato-potato-psyllid-FS.pdf**	An insect that can spread *Candidatus* Liberibacter solanacearum (CLso), a bacterium that lives in the phloem of plants and causes serious disease in tomato, potato and carrot. The tomato-potato psyllid is native to North America and can cause a syndrome on plants known as psyllid yellows in the absence of CLso. Psyllid yellows can cause a significant reduction in tomato yield and quality.
LEPIDOPTERA (Butterflies and moths)						
Cluster caterpillar (*Spodoptera litura*)	Highly polyphagous including potato, tomato, eggplant, onion, cauliflower, cabbage, citrus, chilli, coffee, soybean, cut flowers, apple, lucerne, tobacco, peppers, cocoa, grapevine, maize	Leaves	ACT, WA and restricted distribution within NSW and QLD		Not developed	Can be severe leaf defoliators if conditions are favourable to them, with studies reporting 20-100% damage to potato crops depending on water availability.

Common name (Scientific name)	Hosts	Affected plant part	Distribution in Australia	State movement controls or markets impacted by pest	Factsheets	Comments
Potato tuber moth (*Phthorimaea operculella*)	Potato, tomato, eggplant, capsicum, tobacco	Leaves, roots, stems	ACT, NSW, QLD, SA, TAS, VIC and restricted distribution within WA		**www.agric.wa.gov.au/potatoes/potato-tuber-moth-potato-pest-indonesia-and-western-australia**	A significant pest both pre- and post-harvest
PATHOGENS						
BACTERIA						
Bacterial wilt (*Ralstonia solanacearum*)	Over 450 known hosts including potato, tomato, banana, ginger	Roots and rhizome (can lead to wilting of whole plant)	ACT, NSW, QLD, SA, VIC, NT, WA	Entry conditions apply for potatoes imported into Western Australia[15]	**http://extension.psu.edu/pests/plant-diseases/all-fact-sheets/ralstonia** (international fact sheet)	Best control is to ensure seed potatoes are sourced from disease-free stock
NEMATODES						
Golden potato cyst nematode (*Globodera rostochiensis* RO1 strain)	Tomato, potato, eggplant	Roots	RO1 strain is the only known pathotype present in Australia and is restricted to Victoria	Potatoes imported into Western Australia from another state or territory (except Tasmania) are not allowed into the Gin Gin and South-west potato growing areas of the state. This is to protect against the introduction of potato cyst nematode (*Globodera rostochiensis*).	**www.dpi.nsw.gov.au/__data/assets/pdf_file/0010/433909/Exotic-Pest-Alert-Potato-cyst-nematodes.pdf** **http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/plant-diseases/vegetable/potato-diseases/potato-cyst-nematode**	

[15] **https://www.agric.wa.gov.au/organisms/109248?search_string=Phytophthora%20infestans%20%28Mont.%29%20de%20Bary%201876&per-page=20&sort-by=taxon&order-by=asc**

Common name (Scientific name)	Hosts	Affected plant part	Distribution in Australia	State movement controls or markets impacted by pest	Factsheets	Comments
VIRUS AND VIROIDS						
Potato spindle tuber viroid (PSTVd) (*Potato spindle tuber Pospiviroid*)	The primary natural host of PSTVd is potato, but the viroid also affects tomato and other Solanaceae plants	Whole plant	QLD and restricted distribution in WA	Potato planting material or soil that has been in contact with potato planting material may not be brought into parts of south-eastern, central west and northern regions of NSW. Potatoes are prohibited onto Kangaroo Island (SA) unless they have been washed or brushed free of soil and are in new packaging. Potato Plant Protection Districts (PPDs) are established around some Victorian seed potato production regions in order to reduce biosecurity threats. Signs on major roads indicate when you are entering a PPD and what restrictions on potato movement apply.	**www.planthealthaustralia.com.au/wp-content/uploads/2013/01/Potato-spindle-tuber-viroid-FS.pdf**	

Established weeds of biosecurity significance

Introduction

This section identifies established weeds of biosecurity significance for the potato industry. By identifying and prioritising weeds which potato producers already have to manage, or may have to deal with in the future, mechanisms can be put in place to better align industry and government resources and provide a strong base for biosecurity risk management for the potato industry.

Although weeds were not formally included in the EPPRD at the time that this biosecurity plan was released, exotic weeds may be responded to in a similar way to exotic plant pests in the future. Therefore, it is critical that the potato industry start reviewing the threat of weeds to their production system.

Identification of weeds of significance will also assist in the implementation of effective grower and community awareness campaigns, targeted biosecurity education and training programs for growers and botanists, and development of specific incursion response plans if an incursion of the weed occurs, or if the weed spreads further in production regions of Australia.

Threat identification

Information on weeds of the potato industry described in this document came from a combination of:

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

Prioritising weed threats

Although established weeds listed in this plan (Table 3) had to meet the criteria listed below for establishment, spread and economic impact, these pests did not undergo a formal pest risk assessment. These weeds were considered in an effort to prioritise investment.

Spread: The natural spread of the weed to most production areas is largely unhindered and assisted spread within Australia is also difficult to manage. There may be state or territory specific regulations in place to prevent the pest spreading.

Establishment: The weed has the potential to survive and become established throughout most or all of the range of hosts. Distribution is not limited by environment conditions that prevail in Australia. Based upon its current distribution in Australia, and known conditions of survival, it is likely to survive in Australia in the majority of regions where the host is grown.

Economic Impact: There are severe impacts on production including host mortality and/or significant impacts on either crop quality or storage losses, and/or severe impacts on market access.

Table 3. Established weeds of biosecurity significance

Common name (Scientific name)	Distribution in Australia	State movement controls or markets impacted by weed	Factsheets	Additional comments
Blackberry (*Rubus spp.)*	Across southern Australia including southern QLD, NSW, VIC, parts of SA, WA and TAS	Movement controls described in the Blackberry control manual[16]. Restricted weed in Qld	**http://www.environment.nsw.gov.au/pestsweeds/BlackberryFactsheet.htm** **http://weeds.ala.org.au/WoNS/blackberry/docs/blackberry-control-manual-intro.pdf**	Highly invasive. Forms impenetrable thickets and mounds that degrade productive land. Thickets contain dry material and thus are a fire hazard. Livestock and other large animals may be trapped in the thickets.
Branched broomrape (*Orobanche ramosa)*	South Australia	State prohibited weed in NSW, Qld and Vic.		Parasitic plant that can cause wilting, yellowing and necrosis of foliage and reduced root system
Caltrop (*Tribulus spp*)	ACT, NT, NSW, VIC, SA, WA, QLD	VIC state prohibited weed. SA declared plant with regional management strategies in place. Eradication and control programs in place in NT.		Forms mat-like cover over large areas and may also release allelopathic chemicals inhibiting growth of neighbouring plants. Summer-growing, thrives in moist, bare soil
Fireweed (*Senecio madagascariensis*)	South-eastern coast of Australia (QLD, NSW, VIC)	ACT notifiable and prohibited weed. Restricted weed in Qld	**www.legislation.act.gov.au/ni/2014-333/current/pdf/2014-333.pdf**	Highly invasive and quickly establishes anywhere where ground has been cultivated or disturbed or where groundcover competition is reduced. Toxic to livestock
Lantana (*Lantana camara*)	Present in all states and territories as an ornamental plant, is a weed in NSW, QLD, NT, WA and SA	Sale and movement of lantana is prohibited in SA. Restricted weed in Qld	**http://pir.sa.gov.au/__data/assets/pdf_file/0020/137351/common_lantana_policy.pdf**	Highly invasive and quickly establishes anywhere where ground has been cultivated or disturbed or where groundcover competition is reduced. Toxic to livestock
Mexican poppy (*Argemone mexicana*)	Nationwide	WA prohibited pest.	**www.agric.wa.gov.au/organisms/77657**	Can inhibit germination and seedling growth of vegetables. Toxic to livestock.
Nut grass (*Cyperus* spp.)	Nationwide			Highly invasive. Can grow in all soil types and survive high temperatures. Transported in contaminated soil. Is tolerant to many herbicides.
Parthenium weed (*Parthenium* spp.)	NT, QLD, NSW	Restricted weed in Qld		Releases allelopathic chemicals into soil that inhibit germination and growth of crops.

[16] **http://weeds.ala.org.au/WoNS/blackberry/docs/blackberry-control-manual-intro.pdf**

Common name (Scientific name)	Distribution in Australia	State movement controls or markets impacted by weed	Factsheets	Additional comments
Serrated tussock (*Nassella trichotoma*)	NSW, VIC, TAS	**Regionally prohibited** in the Mallee, Wimmera, North Central, Glenelg Hopkins, Goulburn Broken, North East, and East Gippsland Catchments. Regionally controlled in the Corangamite, West Gippsland, Port Phillip and Western Port Catchments.	**http://agriculture.vic.gov.au/agriculture/pests-diseases-and-weeds/weeds/a-z-of-weeds/serrated-tussock**	Outcompetes grasses and pasture plants and greatly reduces production capacity due to its low grazing value.
Skeleton weed (*Chondrilla juncea*)	ACT, NSW, VIC, SA, WA, QLD	Regionally prohibited and controlled in Victoria. Various regional management strategies in South Australia. Management/eradication plan in place in Western Australia. Declared weed in Tasmania.	**www.agric.wa.gov.au/invasive-species/skeleton-weed-declared-pest**	Outcompetes host crops for moisture and nutrients, particularly nitrogen. Tough, wiry stems can interfere with harvesting equipment. Summer-growing, thrives in moist, bare soil.
Thornapple (*Datura stramonium*)	Nationwide	WA declared pest under official management. Lord Howe Island regionally controlled weed.	**http://weeds.dpi.nsw.gov.au/Weeds/Details/296** **www.agric.wa.gov.au/organisms/91959**	Can compete with crops season-long, resulting in decreased yields. Is an alternate host for many important pests and pathogens of Solanaceous crops, including potato moth (*Phthorimaea operculella*). Is highly toxic to humans and livestock.
Yellow Nutsedge (*Cyperus esculentus*)	QLD, NSW, VIC, SA, TAS		**http://dpipwe.tas.gov.au/invasive-species/weeds/weeds-index/declared-weeds-index/yellow-nut-grass-yellow-nut-sedge**	Produces tubers that can compete with and damage tuber/root crops.

Implementing biosecurity for the Australian potato industry 2017-2022

Following the prioritisation and gap analysis through the Biosecurity Implementation Group (BIG) biosecurity planning process, both industry and government have developed an implementation plan that sets out shared biosecurity goals and objectives. This section contains a Biosecurity Implementation Table which should act as a guide for biosecurity activities for the potato industry and the government for 2017-2022. It is intended that the plan is monitored using annual review by the Biosecurity Reference Panel.

Biosecurity Implementation Table

The Biosecurity Implementation Table aims to build upon the themes outlined in the Intergovernmental Agreement on Biosecurity (IGAB)[17] and the National Plant Biosecurity Strategy (NPBS)[18] by providing a clear line of sight between the development of this Biosecurity Plan and broader plant health policy and legislation.

This table aims to provide the focus and strategic direction for plant biosecurity activities relating to the potato industry over the next five years (i.e. the life of this Biosecurity Plan). The table provides specific recommendations on potential biosecurity activities identified by both industry and government to improve biosecurity preparedness for pest threats.

This table has been developed in recognition that biosecurity is a shared responsibility between the potato industry and governments, and for this reason, the Biosecurity Implementation Table has been produced to help coordinate actions and resources in the biosecurity system, with the view of creating an effective and productive biosecurity partnership. Activities may require additional funding to be sourced prior to commencement. By implementing the specific actions listed in the Biosecurity Implementation Table, it will not only strengthen the potato biosecurity system, but also the broader plant biosecurity system. Future versions of this table will contain information on the progress made by governments and industry on the Biosecurity Implementation Table (Table 4).

[17] For more information visit **www.agriculture.gov.au/animal-plant-health/pihc/intergovernmental-agreement-on-biosecurity**
[18] For more information visit **www.planthealthaustralia.com.au/national-programs/national-plant-biosecurity-strategy/**

Table 4. The Biosecurity Implementation Table for the Australian Potato Industry (2017-2022)

Strategy: Capacity and Capability

Aligns with Strategy 4 of NPBS, Schedule 6 of IGAB

Details	Responsible party	Involved Parties	Due date	Current activities
a) Establish a biosecurity reference panel to help coordinate industry's future biosecurity activities, develop key biosecurity messages/materials and to review the implementation plan annually.	PHA	Potato Industry, Hort Innovation, State and Territory Government, Commonwealth Government (PHC, ACPPO), PHA	2017 and then annually	Biosecurity reference panel will run as part of the Hort Innovation funded vegetable biosecurity plan update
b) Develop a framework to prioritise within High Priority Pests (HPP) list and between implementation activities (Note sectoral differences may be important and better understanding of production and trade impacts will be important)	Biosecurity Reference Panel	Biosecurity Reference Panel, Potato Industry, PHA	Ongoing (Assess progress annually)	
c) Ensure that biosecurity reference panel priorities feed through to the relevant funding body (e.g. RDC) or committee (e.g. fruit fly council, NPBRDES IC, SPHD, SNPHS)	PHA	Biosecurity Reference Panel, Hort Innovation, relevant committees, PHA	Annually	This will commence once the reference panel is confirmed.
d) Undertake deed training by PHA for AUSVEG board members and potato industry liaison officers/coordinators	AUSVEG	AUSVEG, PHA	Reviewed annually	AUSVEG Activities: Vegetable and Potato biosecurity officers have undertaken deed training.
e) Develop and deliver a biosecurity content/capability training program for potato growers. An example training program would be a biosecurity workshop that would go through the steps to develop your own farm biosecurity plan for potential integrated with a quality assurance scheme.	AUSVEG	AUSVEG, PHA	Ongoing (Assess progress annually)	AUSVEG Activity: Potato biosecurity officer currently performs extension activities
f) Establish a network of biosecurity champions within the industry to foster good biosecurity practices	AUSVEG	AUSVEG, PHA	Ongoing (Assess progress annually)	AUSVEG Activities: Vegetable and Potato biosecurity officers promote good biosecurity.

Details	Responsible party	Involved Parties	Due date	Current activities
g) Integrate best biosecurity practice principles into sectoral and cross-sectoral quality assurance programs e.g. myBMP, Smartcane, Freshcare	Potato Industry	Potato Industry, Quality assurers, PHA	To be determined at first reference panel meeting	AUSVEG Activities: Update of the biosecurity component in EnviroVeg has commenced. EnviroVeg is currently undergoing alignment with Freshcare ENV3.
h) The potato industry to request potential for involvement in SNPHS sub-committee	Potato Industry	Potato Industry, SNPHS	Ongoing	
i) Develop a potato industry owner reimbursement cost (ORC) framework	Potato Industry	Potato Industry, PHA	Ongoing (assess progress annually)	

Strategy: Plant Biosecurity Education and Awareness

Aligns with Strategy 7 of NPBS, Schedule 6 of IGAB

	Details	Responsible Party	Involved Parties	Due Date	Current Activities
a)	Promote, disseminate and demonstrate biosecurity to industry through industry forums, newsletters, road shows, field days, social media, networks and/or workshops (hardcopy and online): - On-farm Biosecurity Planning - Reporting anything unusual - Promotion (through certification scheme) of clean seed potatoes - Best biosecurity practice such as hygiene principles - Develop a shed poster on exotic and established pests to be on the lookout for to encourage monitoring and reporting if found. - Raise industry-wide awareness of the EPPRD and ORC framework (once finalised). - A targeted approach to raising awareness of biosecurity is required to ensure risks are mitigated throughout the supply chain (growers, contractors, agronomists, processors etc.). Delivered through the Vegetable and Potato Biosecurity Program	AUSVEG	AUSVEG, PHA	Ongoing	AUSVEG Activities: Vegetable and Potato biosecurity officers routinely disseminate biosecurity awareness material and information on ORCs and the EPPRD and include information on reporting, biosecurity BMPs, and the EPPRD in each biosecurity workshop with industry.
b)	Raise community awareness of biosecurity risks	PHA	Hort Innovation, State and Territory Governments, Commonwealth government, PHA	Ongoing	
c)	Raise understanding of risk pathways (i.e. areas of vulnerability for the industry e.g. seed, an open domestic industry that shares equipment, planting materials, contractors and the distribution of waste post-processing)	Potato Industry	Potato Industry, PHA	To be determined at first reference panel meeting	AUSVEG Activities: Vegetable and Potato biosecurity officers raise an understanding of risk pathways.

	Details	Responsible Party	Involved Parties	Due Date	Current Activities
d)	Raise awareness of the economic case for good biosecurity practice (e.g. what is the cost of a specific incursion at a regional level and across the supply chain?)	Potato Industry	Potato Industry, Hort Innovation, Commonwealth Government (ABARES), PHA	Ongoing	
e)	Review and develop the potato biosecurity manual and distribute 500 copies to growers through awareness activities in growing regions while also providing an electronic version on the PHA and Farm biosecurity websites.	PHA	Potato Industry, Hort Innovation, PHA	2018	AUSVEG Activities: Biosecurity officers have developed an industry specific Action Planner.
f)	Develop good news stories in relation to biosecurity	Potato Industry	Potato Industry	Ongoing	
g)	Conduct workshops regarding what good biosecurity for the potato industry entails	Potato Industry	Potato Industry	Ongoing	
h)	Prioritise, review and develop detailed factsheets on the following HPPs: **Pathogens:** Bacterial wilt/Brown rot (*Ralstonia szygii*) Late Blight (*Phtyopthora infestans* Mating type A2) PSTVd (Potato spindle tuber viroid) Pale potato cyst nematode (*Globodera pallida*) Golden potato cyst nematode (*G. rostochiensis* exotic pathotypes) Root knot nematode (*Meloidogyne enterolobii*) **Invertebrates:** Black bean aphid (*Aphis fabae*)	Potato Industry, PHA	Potato Industry, Hort Innovation, PHA	To be determined at first reference panel meeting	
i)	Ensure HPP factsheets on pests and weeds are made available on industry and farm biosecurity websites	Potato Industry, PHA	Potato Industry, PHA	Ongoing	

	Details	Responsible Party	Involved Parties	Due Date	Current Activities
j)	Identify industry biosecurity training and extension needs, recommend priorities	PHA	Biosecurity Reference Panel, PHA	Ongoing (Assess progress annually)	PHA provided this information at the implementation meeting and will review it annually at the biosecurity reference panel meetings
k)	Consider simulation activities to test industry preparedness for HPP incursions (e.g. Considering regulation of movement, ensuring continuity of trade, predicting impacts etc.)	AUSVEG	AUSVEG, Hort Innovation, PHA	Ongoing	
l)	Raise awareness of new pathways - long distance natural dispersal of potato pests and pathogens. Certain taxa present in NZ, PNG, Indonesia and the closer Pacific Islands may "wind disperse" into Australia increasing the potential entry risk.				

Strategy: Preparedness and Response

Aligns with Strategy 3 of NPBS, Schedule 7 of IGAB

	Details	Responsible party	Involved Parties	Due date	Current Activities
a)	Prioritise then develop an industry specific contingency plan for the following high priority pests: - Colorado potato beetle (*Leptinotarsa decemlineata*) - Late blight (*Phytophthora infestans* Mating type A2) - PSTVd (Potato spindle tuber viroid) - Golden potato cyst nematode (*Globodera rostochiensis* exotic pathoypes) - Root knot nematode (*Meloidogyne enterolobii*)	Biosecurity Reference Panel	Biosecurity Reference Panel, Potato Industry, Hort Innovation, PHA	To be determined at first reference panel meeting	
b)	Prioritise then develop a cross-sectoral contingency plan for the following high priority pests: - Exotic *Liriomyza* spp. (Onions, Melons, Grains, Tomato, Nursery and Garden and/or Government) - Cotton aphid (exotic strains) (*Aphis gossypii*) (Cotton, Nursery and Garden) - Bacterial wilt/brown rot (*Ralstonia syzygii*) (Banana, Ginger) - Pale potato cyst nematode (*Globodera pallida*) (Tomato, Nursery and Garden and/or Government)	Biosecurity Reference Panel	Biosecurity Reference Panel, Potato Industry, Hort Innovation, PHA	To be determined at first reference panel meeting	
c)	To investigate the development of shelf/emergency permits with the APVMA for high priority pests of the Australian potato industry. If required identify trial work required to acquire a permit and ensure residue levels are considered to allow continued trade	Potato Industry, Hort Innovation, State and Territory Governments	Potato Industry, Hort Innovation, Commonwealth Government and State and Territory Governments, PHA	2018	

	Details	Responsible party	Involved Parties	Due date	Current Activities
d)	Undertake preparedness activities including chemical control, contingency planning, surveillance strategy and diagnostic protocols for *Liriomyza spp.* (leafminer).	AUSVEG	AUSVEG, State and Territory Government, Hort Innovation, PHA	To be determined at first biosecurity reference panel meeting	AUSVEG Activities: AUSVEG and four other project partners have funding from the vegetable and nurseries industry levies to conduct research, development and extension on *Liriomyza sativae*, in preparation for its spread from the north.
e)	Develop Contingency Plans that assist industry in getting back to business quickly after a biosecurity incident, taking into account the impact of movement controls and capacity to supply propagation material within and across borders.	Plant Health Committee	Biosecurity Reference Panel, State and Territory Governments, Commonwealth Government, PHA	Ongoing	
f)	Maintain an industry member database to facilitate and disseminate critical information in the event of an emergency response	Potato Industry	Potato Industry	Ongoing	
g)	Undertake preparedness and response activities for *Candidatus* Liberibacter solanacearum (CLso).	AUSVEG	AUSVEG, Biosecurity Reference Panel, Hort Innovation, State and Territory Government, Researchers	To be determined at first biosecurity reference panel meeting	AUSVEG Activities: AUSVEG has been working closely with federal and state departments to support an effective response to tomato potato psyllid (TPP). AUSVEG has received funding from Hort Innovation to run a National TPP Coordinator project. Vegetable Industry Activities: Hort Innovation has funded several other projects relating to surveillance, diagnostics and extension to prepare for TPP.

	Details	Responsible party	Involved Parties	Due date	Current Activities
h)	Consider categorisation of the following High Priority Pests in the Emergency Plant Pest Response Deed - *Liriomyza huidobrensis* - *Liriomyza trifolii* - *Aphis fabae* - *Aphis gossypii* (exotic strains) - *Ralstonia syzygii* - *Phytophthora infestans* (A2 mating type) - *Globodera pallida* - *Meloidogyne enterolobii*	AUSVEG, State and Territory Government, Commonwealth Government	Potato Industry, Affected industries, State and Territory Governments, Commonwealth Government, PHA	To be determined at first biosecurity reference panel meeting	

Strategy: Surveillance

Aligns with Strategy 2 of NPBS, Schedule 4 of IGAB

	Details	Responsible Party	Involved Parties	Due Date	Current Activities
a)	Raise industry awareness of HPPs, exotic and established pests, to ensure better monitoring across the industry and an understanding of the importance of monitoring records regardless of whether a pest is found or not.	Potato Industry, State and Territory Governments	Potato Industry, State and Territory Governments, PHA	2017-2021	Plant RDCs and several other project partners have launched a RRD4P project that will enable development of a national plant pest surveillance system. AUSVEG activities: The Vegetable and Potato Biosecurity Program actively raises awareness of exotic pests throughout industry communications and engagement channels.
b)	Understand what surveillance is taking place for HPPs (exotic and established) and develop a surveillance strategy (in a workshop) that links industry and government efforts and ensures industry HPPs are adequately considered.	PHA, State and Territory Governments	Potato Industry, State and Territory Governments, Commonwealth government (SNPHS), PHA	To be determined at first reference panel meeting	Plant RDCs and several other project partners have launched a RRD4P project that will enable development of a national plant pest surveillance system.
c)	Work with the Subcommittee on National Plant Health Surveillance (SNPHS) to recommend surveillance for industry's HPPs. The biosecurity reference panel to engage annually with SNPHS regarding surveillance priorities.	PHA	Biosecurity Reference Panel, Commonwealth Government (SNPHS), PHA	Annually	Plant RDCs and several other project partners have launched a RRD4P project that will enable development of a national plant pest surveillance system. AUSVEG Activities: AUSVEG has supplied a representative to sit on SNPHS (in relation to the TPP response) and the National Plant Pest Surveillance Committee during 2017.

	Details	Responsible Party	Involved Parties	Due Date	Current Activities
d)	Facilitate and capture data from industry initiated surveillance activities.	Potato Industry, State and Territory Governments	Potato Industry, State and Territory Governments, PHA	To be determined at first reference panel meeting	Plant RDCs and several other project partners have launched a RRD4P project that will enable development of a national plant pest surveillance system.
e)	Facilitate and engage with surveillance hub initiative	AUSVEG	AUSVEG, other plant based industries, RDCs, Commonwealth Government (Rural R&D for Profit), State and Territory Government, PHA	2017-2021	AUSVEG is a service provider of the surveillance hub initiative. The vegetable industry is a partial funder of the initiative.
f)	Consider adoption of a surveillance tool to capture industry surveillance data that can be nationally collated (e.g. an existing or new app).	Potato Industry	Potato Industry, Hort Innovation, PHA	To be determined at first reference panel meeting	Plant RDCs and several other project partners have launched a RRD4P project that will enable development of a national plant pest surveillance system.
g)	Facilitate industry surveillance initiatives eg. TIA	Potato Industry	Potato Industry	Ongoing	
h)	Investigate opportunities for third party accreditation of crop monitoring and training	Potato Industry	Potato Industry	2019	

Strategy: Diagnostics

Aligns with Strategy 5 of NPBS, Schedule 4 of IGAB

	Details	Responsible Party	Involved Parties	Due Date	Current Activities
a)	Request SPHD to consider HPPs of potatoes and provide feedback in relation to diagnostic priorities and potential research priorities	Biosecurity Reference Panel	Potato Industry, Biosecurity Reference Panel, Commonwealth Government (SPHD)	2018	
b)	Prioritise, review, develop and submit final National Diagnostic Protocols for High Priority Pests to SPHD for endorsement: **Invertebrates** Black bean aphid (*Aphis fabae*) – Potato Cotton aphid (exotic strains) (*Aphis gossypii*) – Cotton, Nursery and Garden **Pathogens** Bacterial wilt/Brown rot (*Ralstonia syzygii*) – Banana, Ginger Root knot nematode (*Meloidogyne enterolobii*) – Potato[19]	Potato industry	Potato industry, other affected industries, RDCs, Commonwealth Government (SPHD), PHA	To be determined at first reference panel meeting	

[19] To be given priority in Biosecurity Reference Panel discussions owing to its ability to cause severe decreases in tuber quality (Hodda, pers. comm.)

	Details	Responsible Party	Involved Parties	Due Date	Current Activities
c)	To raise diagnostic priorities with SPHD on an annual basis where priorities change	Biosecurity Reference Panel, State and Territory Governments	Biosecurity Reference Panel, State and Territory Governments, Commonwealth government (SPHD)	Annually	
d)	Consider opportunities to develop in field diagnostics, molecular diagnostics, alternative diagnostics and/or cross-sectoral industry pest diagnostics	Biosecurity Reference Panel, State and Territory Governments	Biosecurity Reference Panel, Hort Innovation, State and Territory Government, Commonwealth government (SPHD)	To be determined at first biosecurity reference panel meeting	Initiatives being funded by Hort Innovation, PB CRC and private agricultural companies, such as ADAMA.
e)	Ensure diagnostic capacity can meet rapid response and monitoring needs (bearing in mind the need for positive controls, reference samples, availability of collections and both capability and experience in a minimum of two laboratories in Australia).	Commonwealth Government (SPHD)	Potato industry, State and Territory Government, Commonwealth government (SPHD)	2017	

Strategy: Established Pests and Weeds

Aligns with Strategy 6 of NPBS, Schedule 5 of IGAB

	Details	Responsible Party	Involved Parties	Due Date	Current Activities
a)	Raise industry awareness of pests and weeds of biosecurity significance, and demonstrate how best biosecurity practice has direct relevance to day to day operations for pests already within Australia as well as exotic pests.	Potato Industry	Potato Industry, PHA	Ongoing	
b)	Once agreed, include weeds and established pests of significance in the potato biosecurity manual and other biosecurity awareness material.	PHA	Potato Industry, State and Territory Governments, PHA	2018	AUSVEG activities: The Vegetable and Potato Biosecurity Program actively raises awareness of exotic pests throughout industry communications and engagement channels.
c)	Integrate management of established pests, diseases and weeds in best practice guides eg. BMP Smartcare	Potato Industry	Potato Industry, Hort Innovation	2019	
d)	Undertake targeted surveillance for established pests of market concern for the potato industry (noting existing and potential markets).	Potato Industry, State and Territory Governments	Potato Industry, State and Territory Governments	To be determined at first reference panel meeting	

Strategy: Biosecurity Research, Development and Extension (RD&E)

Aligns with Strategy 8 of NPBS, Schedule 8 of IGAB

	Details	Responsible Party	Involved Parties	Due Date	Current Activities
a)	Prioritise biosecurity RD&E annually to feed into Hort Innovation plant biosecurity RD&E priorities.	PHA	Biosecurity Reference Panel, PHA	Annually	
b)	Consider collaborative opportunities to maximise R&D investment in biosecurity.	Biosecurity Reference Panel	Biosecurity Reference Panel, Hort Innovation, NPBRDES IC, FF advisory council	Annually	

Strategy: Legislative and Regulatory Issues of Importance

Aligns with Strategy 1 of NPBS

	Details	Responsible Party	Involved Parties	Due Date	Current Activities
a)	Raise awareness that everyone has a responsibility to practice good biosecurity under the Biosecurity Act 2015. Some states may have quite specific legislative approaches whilst others have a more general approach, e.g. The General Biosecurity Obligation (in QLD), General Biosecurity Duty (NSW).	Potato Industry, State and Territory Government	Potato Industry, State and Territory Government, Commonwealth Government, PHA	Ongoing	AUSVEG activities: The Vegetable and Potato Biosecurity Program actively raises awareness of legal responsibilities pertaining to biosecurity best practice.
b)	States to inform industry and in turn industry to raise awareness with growers on each state's legislative requirements in relation to pest reporting and management of neglected farms.	State and Territory Governments, Potato Industry	Potato Industry, State and Territory Governments, PHA	To be determined at first reference panel meeting	
c)	Consider the constraints and benefits of Property Identification Codes (PICs) for the potato industry.	Potato Industry, State and Territory Governments	Vegetable industry, other plant based industries, State and Territory Government, Commonwealth Government, PHA	2017-2021	

Australian Potato industry - biosecurity preparedness

This document represents the third industry biosecurity planning process undertaken for the Australian industry.

The following table (Table 5) has been populated with the high priority pests of the potato industry. The aim of this table is to document the current preparedness documents and activities which are available and are currently being undertaken. This will allow industry, governments and RD&E agencies to better prepare for these high priority pests and align future activities as listed in the Biosecurity Implementation Table (Table 4).

Table 5. *Documents and activities currently available for high priority pests of the Potato Industry*[20] [21]

Common name (Scientific name)	National diagnostic protocol	Surveillance programs	Fact sheets[22]	Contingency Plan	EPPRD Category [23]	DAWR National Priority Plant Pest[24]	Affected Industries[25]	Primary Experts
COLEOPTERA (Beetles and weevils)								
Colorado potato beetle (*Leptinotarsa decemlineata*)	Yes - NDP 22	Not covered by a pest specific surveillance program	**www.planthealthaustralia.com.au/wp-content/uploads/2013/01/Colorado-potato-beetle-FS.pdf**	Not developed	3	Not listed	No other affected parties	
DIPTERA (Flies and midges)								
American leafminer, serpentine vegetable leafminer, vegetable leafminer (*Liriomyza sativae*) [26]	Not developed	Yes – Australian Government, NSW, Qld	**www.planthealthaustralia.com.au/wp-content/uploads/2015/08/Vegetable-leaf-miner-FS-Vegetables.pdf** **www.planthealthaustralia.com.au/wp-content/uploads/2013/01/Exotic-leaf-miners-FS-Vegetable.pdf**	Yes – Grains industry	3	Yes - 20	Onion, Melon, Tomato, Nursery and Garden, Vegetable	Peter Gillespie (general expert)
American serpentine leafminer (*Liriomyza trifolii*)	Yes – NDP 27	Yes – Australian Government, NSW, Qld	**www.planthealthaustralia.com.au/wp-content/uploads/2013/01/Exotic-leaf-miners-FS-Vegetable.pdf**	Yes – Grains industry	Not categorised	Yes - 20	Grains, Cut Flower, Melon, Tomato	Peter Gillespie (general expert)

[20] Copies of these documents are available from **www.planthealthaustralia.com.au/pidd**
[21] Information presented has been taken from the National Plant Health Status Report 2016 and confirmed or updated through either Plant Health Committee, the Subcommittee on Plant Health Diagnostic Standards, the Subcommittee on National Plant Health Surveillance or other stakeholders
[22] Where an industry is listed the factsheet can be found at the PHA website. Other Australian factsheets are listed where available
[23] For further information please refer to Schedule 13 of the EPPRD. Available from: **www.planthealthaustralia.com.au/biosecurity/emergency-plant-pest-response-deed/**.
[24] The National Priority Plant Pest List was developed by the Department of Agriculture and Water Resources. Available from: **www.agriculture.gov.au/pests-diseases-weeds/plant**
[25] This column includes other industries that have this pest in their biosecurity plan and affected governments.
[26] Note: Detected in Queensland but a quarantine area has been established in the far northern biosecurity zone to restrict the spread of the pest.

Common name (Scientific name)	National diagnostic protocol	Surveillance programs	Fact sheets[22]	Contingency Plan	EPPRD Category [23]	DAWR National Priority Plant Pest[24]	Affected Industries[25]	Primary Experts
Pea leafminer, potato leafminer, serpentine leafminer (*Liriomyza huidobrensis*)	Draft available	Yes – Australian Government, NSW, Qld	**www.planthealthaustralia.com.au/wp-content/uploads/2013/01/Exotic-leaf-miners-FS-Vegetable.pdf**	Yes – Grains industry	Not categorised	Yes - 20	Nursery and Garden, Vegetables, Grains, Cut Flower, Melon, Tomato	Peter Gillespie (general expert)
HEMIPTERA (Stink bugs, aphids, mealybugs, scale, whiteflies and hoppers)								
Black bean aphid (*Aphis fabae*)	Not developed	Yes – Broad aphid surveillance, NSW	**www.toxipedia.org/display/ipmopedia/Black+Bean+Aphid**	Yes – Grains industry	Not categorised	Not listed	No other affected parties	Peter Gillespie (general expert)
Cotton aphid, melon aphid (exotic strains) (*Aphis gossypii* (exotic strains))	Not developed	Not covered by a pest specific surveillance program	**www.planthealthaustralia.com.au/wp-content/uploads/2013/01/Cotton-aphid-FS.pdf**	Not developed	Not categorised	Not listed	Cotton, Nursery and Garden	
PATHOGENS AND NEMATODES								
BACTERIA (including phytoplasmas)								
Bacterial wilt, brown rot (*Ralstonia syzygii*)	Not developed	Not covered by a pest specific surveillance program	Not developed	Not developed	Not categorised	Not listed	Banana, Ginger	
Zebra chip (*Candidatus* Liberibacter solanacearum)	Yes - NDP 18	Yes[27]	**www.planthealthaustralia.com.au/wp-content/uploads/2017/04/Zebra-chip-tomato-potato-psyllid-FS.pdf**	Yes – Potato industry	2	Yes - 11	Vegetable and Nursery and Garden industries. Commonwealth, all state and territory agriculture departments	

[27] Following on from the Tomato Potato Psyllid detection in WA the statement below was given concerning Zebra chip surveillance; "Additional surveillance will also take place to provide confidence to industry that the bacterium, which is associated with Zebra chip disease in potatoes, is not present in Australia" (National Talking Points, 27 April 2017).

Common name (Scientific name)	National diagnostic protocol	Surveillance programs	Fact sheets[22]	Contingency Plan	EPPRD Category [23]	DAWR National Priority Plant Pest[24]	Affected Industries[25]	Primary Experts
FUNGI								
Late blight (exotic strains) (*Phytophthora infestans* (A2 mating type))	Draft available	Not covered by a pest specific surveillance program	Not developed	Not developed	Not categorised	Yes - 36	No other affected parties	
NEMATODES								
Golden potato cyst nematode (exotic pathotypes) (*Globodera rostochiensis* (exotic pathotypes))	Draft available	Not covered by a pest specific surveillance program	**www.dpi.nsw.gov.au/__data/assets/pdf_file/0010/433909/Exotic-Pest-Alert-Potato-cyst-nematodes.pdf**	Not developed	3	Yes - 19	No other affected parties	Mike Hodda, Andrew Daly
Pale potato cyst nematode (*Globodera pallida*)	Draft available	Not covered by a pest specific surveillance program	**www.dpi.nsw.gov.au/__data/assets/pdf_file/0010/433909/Exotic-Pest-Alert-Potato-cyst-nematodes.pdf**	Not developed	Not categorised	Yes -19	No other affected parties	Mike Hodda, Andrew Daly
Root knot nematode (*Meloidogyne mayaguensis*)	Not developed	Not covered by a pest specific surveillance program	**www.plantwise.org/KnowledgeBank/Datasheet.aspx?dsid=33248**	Not developed	Not categorised	Not listed	No other affected parties	Mike Hodda, Andrew Daly
VIRUSES AND VIROIDS								
Potato spindle tuber (PSTVd) (exotic strains) (*Potato spindle tuber viroid* (Pospiviroid))	Yes - NDP 7	Yes - SA	**www.planthealthaustralia.com.au/wp-content/uploads/2015/08/Potato-spindle-tuber-viroid-FS.pdf** **www.dpi.nsw.gov.au/biosecurity/plant/established-plant-pests-and-diseases/pstvd**	Yes	3	Not listed	No other affected parties	

AUSVEG industry biosecurity statement

All EPPRD Parties are required under clause 13 of the EPPRD to produce a Biosecurity statement, the purpose of which is to provide acknowledgement of and commitment to risk mitigation measures and preparedness activities related to plant biosecurity. The Biosecurity statement will inform all Parties of activities being undertaken by the Industry Party to meet this commitment. Parties are required to report to PHA each year any material changes to the content of, or the Party's commitment to, the Party's Biosecurity statement. Biosecurity statements are included in schedule 15 of the EPPRD, which can be found on the PHA website at
www.planthealthaustralia.com.au/biosecurity/emergency-plant-pest-response-deed/

NATIONAL BIOSECURITY SYSTEM

What is biosecurity and why is it important?

Plant biosecurity is a set of measures which protect the economy, environment and community from the negative impacts of plant pests. A fully functional and effective biosecurity system is a vital part of the future profitability, productivity and sustainability of Australia's plant production industries and is necessary to preserve the Australian environment and way of life.

Plant pests are insects, mites, snails, nematodes or pathogens (diseases) that have the potential to adversely affect food, fibre, ornamental crops, bees and stored products, as well as environmental flora and fauna. For agricultural systems, if exotic pests enter Australia they can reduce crop yields, affect trade and market access, significantly increase costs to production and in the worst-case scenario, bring about the complete failure of a production system. Historical examples present us with an important reminder of the serious impact that exotic plant pests can have on agricultural production.

Australia's geographic isolation and lack of shared land borders have, in the past, provided a degree of natural protection from exotic plant pest threats. Australia's national quarantine system also helps to prevent the introduction of harmful exotic threats to plant industries. However, there will always be some risk of an exotic pest entering Australia, whether through natural dispersal (such as wind) or assisted dispersal as a result of increases in international tourism, imports and exports, mail and changes to transport procedures (e.g. refrigeration and containerisation of produce).

The plant biosecurity system in Australia

Australia has a unique and internationally recognised biosecurity system to protect our plant production industries and the natural environment against new pests. The system is underpinned by a cooperative partnership between plant industries and all levels of government.

The framework for managing the cooperative partnership for delivering an effective plant biosecurity system is built on a range of strategies, policies and legislation, such as the Intergovernmental Agreement on Biosecurity[28] and the National Plant Biosecurity Strategy[29].

[28] For more information visit **www.agriculture.gov.au/animal-plant-health/pihc/intergovernmental-agreement-on-biosecurity**
[29] For more information visit **www.planthealthaustralia.com.au/national-programs/national-plant-biosecurity-strategy/**

These not only provide details about the current structure, but provide a vision of how the future plant biosecurity system should operate.

Australia's biosecurity system has been subject to several reviews in recent times, with the recommendations recognising that a future-focused approach is vital for maintaining a strong and resilient biosecurity system that will protect Australia from new challenges. As a result, there is a continuous improvement from industry and governments to Australia's plant biosecurity system, with the key themes including:

- Targeting what matters most, including risk based decision making and managing biosecurity risks across the biosecurity continuum (pre-border, border and post-border).
- Good regulation, including reducing regulatory burden and having effective legislation in place.
- Better processes, including service delivery modernisation with electronic, streamlined systems.
- Sharing the responsibility, including maintaining productive relationships with all levels of government, primary industries and the wider Australian public.
- Maintaining a capable workforce.

Through these themes, a focus on the biosecurity continuum better supports consistent service delivery offshore, at the border, and onshore, and provides an effective biosecurity risk management underpinned by sound evidence and technical justification.

The benefits of the modern biosecurity system are realised by industry, government and the community, with positive flow on effects to the economy more generally. This is through streamlined business processes, productivity improvements and reduced regulatory burden in a seamless and lower cost business environment, by emphasising risk based decision making and robust partnerships.

Potato Peak Industry Body

AUSVEG is the peak industry body for the potato industry. They are a signatory to the EPPRD and are the key industry contact point if a suspect Emergency Plant Pest affecting the potato industry is detected. For further information about AUSVEG in relation to response procedures following the identification of a suspect exotic pest refer to page 94. For a background on the potato industry refer to page 101.

Plant Health Australia

Plant Health Australia (PHA) is the national coordinator of the government-industry partnership for plant biosecurity in Australia.

PHA is a not-for-profit, subscription-funded public company based in Canberra. PHA's main activities are funded from annual subscriptions paid by members. The Australian Government, state and territory governments and 39 plant industry organisations are all members of PHA and each meet one third of the total annual membership subscription. This tripartisan funding model ensures the independence of the company.

The company was formed to address priority plant health issues, and to work with all its members to develop an internationally outstanding plant health management system that enhances Australia's plant health status and the sustainability and profitability of plant industries. Through PHA, current and future needs of the plant biosecurity system can be mutually agreed, issues identified, and solutions to problems found. PHA's independence and impartiality allow the company to put the interests of the plant biosecurity system first and support a longer-term perspective.

For more information about PHA visit **www.planthealthaustralia.com.au**

The Biosecurity Plan

The Biosecurity Plan for the Potato Industry was developed in consultation with the Technical Expert Group (TEG) and Biosecurity Implementation Group (BIG), which consisted of plant health and biosecurity experts and industry representatives. These groups were coordinated by Plant Health Australia (PHA) and included representatives from AUSVEG, relevant state and territory agriculture agencies and PHA.

The biosecurity plan not only details exotic pest threats of the Australian potato industry but also contains information on the current mitigation and surveillance activities being undertaken and identifies contingency plans, fact sheets and diagnostic protocols that have been developed for pests relevant to the potato industry.

This plan is a framework to coordinate biosecurity activities and investment for Australia's potato industry and to address the strengths and weaknesses in relation to industry's current biosecurity position. It provides a mechanism for industry, governments and stakeholders to better prepare for and respond to, incursions of pests that could have significant impacts on the potato industry.

Biosecurity planning

Biosecurity planning provides a mechanism for the potato industry, government and other relevant stakeholders to actively determine pests of highest priority, analyse the risks they pose and put in place practices and procedures that would rapidly detect an incursion,

minimise the impact if a pest incursion occurs and/or reduce the chance of pests becoming established. Effective industry biosecurity planning relies on all stakeholders, including government agencies, industry, and the public (Figure 1).

Ensuring the potato industry has the capacity to minimise the risks posed by pests, and to respond effectively to any pest threats is a vital step for the future sustainability and viability of the industry. Through this pre-emptive planning process, the industry will be better placed to maintain domestic and international trade, and reduce the social and economic costs of pest incursions on both growers and the wider community. The information gathered during these processes provides additional assurance that the Australian potato industry is free from specific pests and has systems in place to control and manage biosecurity risks, which assists the negotiation of access to new overseas markets.

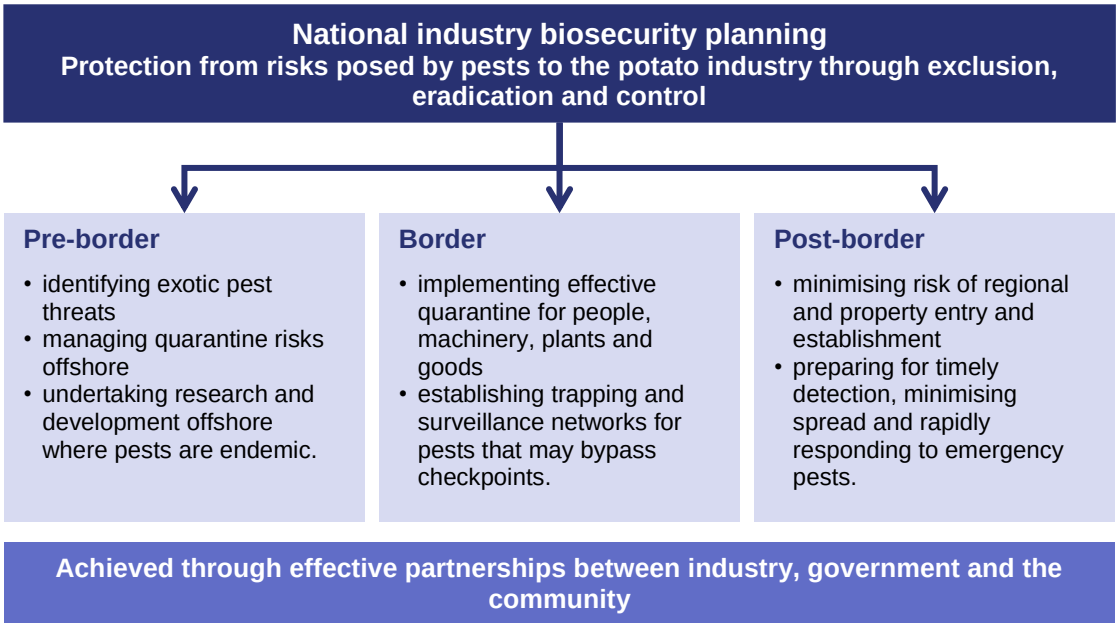


Figure 1. *Industry biosecurity: a shared responsibility*

Biosecurity Plan development

With the assistance of AUSVEG, a Technical Expert Group (TEG) and a Biosecurity Implementation Group (BIG) were formed to work on the review the Biosecurity Plan for the Potato Industry (BP). These groups were coordinated by Plant Health Australia (PHA) and included representatives from AUSVEG, relevant state and territory agriculture agencies and PHA (Table 6 and Table 7).

Key roles of the technical expert group for the potato BP included:

- identifying and documenting key threats to the potato industry
- confirming an agreed high priority pest (HPP) list

Key roles of the biosecurity implementation group for the potato BP included:

- documenting pest-specific fact sheets, contingency plans, diagnostic protocols and surveillance programs for HPPs
- documenting the roles and responsibilities of stakeholder groups.
- developing a biosecurity implementation table for future biosecurity related work to be conducted over the life of this biosecurity plan

Table 6. *Members of the technical expert group and/or biosecurity implementation group*

Name	Organisation	Area of expertise	Member of Technical Expert Group	Member of Biosecurity Implementation Group
Toni Chapman	NSW DPI	Bacteriology	✓	✓
Mandy Christopher	QDAF	Risk analysis	✓	✓
Kevin Clayton-Greene	Vegetable Biosecurity Advisor	Industry		✓
Fiona Constable	DEDJTR	Virologist		✓
Rosa Crnov	DEDJTR	Biosecurity		✓
Nigel Crump	Vic SPA	Industry- seed potato	✓	✓
Dolf de Boer	DEDJTR	Pathology	✓	
Jacky Edwards	DEDJTR	Pathology	✓	
Kyla Finlay	DEDJTR	Entomology / Wind dispersal	✓	
Callum Fletcher	AUSVEG	Industry	✓	✓
Barbara Hall	SARDI	Pathology	✓	
Stephen Harper	QDAF		✓	
Richard Haynes	Elders and Potatoes SA	Industry		✓
Lionel Hill	TAS DPI	Entomology	✓	
Mike Hodda	CSIRO	Nematology		✓
Michael Holmes	Plant Health Australia	Biosecurity	✓	✓
Stu Jennings	Young Potato People	Industry		✓
Darren Long	MG Farm Produce	Industry		✓
Joanne Lee	PHA	Biosecurity		✓
Jessica Lye	AUSVEG	Industry		✓
Gary O'Neill	Mitolo Group	Industry		✓
Pennie Patane	Patane Produce	Industry		✓
Brendan Rodoni	DEDJTR	Pathology	✓	
Nader Sallam	DAWR		✓	
Tonya Wiechel	DEDJTR		✓	
Alison Saunders	Plant Health Australia	Biosecurity	✓	✓

Table 7. *Scientists and others who contributed information for review of the biosecurity plan*[30]

Name	Organisation	Area of expertise
Rohan Burgess	Plant Health Australia	Biosecurity
Tomas Langley	Plant Health Australia	Biosecurity
Victoria Ludowici	Plant Health Australia	Biosecurity
Natalie O'Donnell	Plant Health Australia	Biosecurity
Jenny Shanks	Plant Health Australia	Biosecurity

Review processes

With the support of the relevant potato industry bodies and PHA this plan should be reviewed on a 5 year basis. The review process will ensure:

- Threat Summary Tables are updated to reflect current knowledge
- pest risk assessments are current
- changes to biosecurity processes and legislation is documented
- contact details and the reference to available resources is accurate

In addition to the formal review process above, the document should be reviewed/revisited annually by a Biosecurity Reference Panel comprised of industry, government and PHA to ensure currency and relevance and to monitor progress with implementation. As an example, the industry biosecurity priorities identified within the plan could feed directly into industry R&D priority setting activities on an annual basis.

Opportunities to make out of session changes to the biosecurity plan, including the addition/subtraction of high priority pests or changes to legislation are currently being investigated. Such changes would need to include consultation and agreement of industry and government. This flexibility will facilitate the plan's currency and relevance.

[30] These people did not attend the technical expert group or biosecurity implementation group meetings but were approached for assistance during the biosecurity plan review process.

THREAT IDENTIFICATION AND PEST RISK ASSESSMENTS

Introduction

This section identifies high risk exotic pest threats to the potato industry, and presents a framework for assessing the potential economic, social and environmental impacts associated with each threat. This part of the biosecurity plan uses a nationally consistent and coordinated approach to threat identification and risk assessment to provide a strong base for future risk management in the potato industry.

By identifying key threats a pre-emptive approach may be taken to risk management. Under this approach, mechanisms can be put into place to increase our response effectiveness if pest incursions occur. One such mechanism is the EPPRD that has been negotiated between PHA's government and industry members. The EPPRD ensures reliable and agreed funding arrangements are in place in advance of EPP incursions, and assists in the response to EPP incursions, particularly those identified as key threats.

Identification of high risk exotic pests will also assist in the implementation of effective grower and community awareness campaigns, targeted biosecurity education and training programs for growers and diagnosticians, and development of pest-specific incursion response plans.

Established pests and weeds of biosecurity significance have also been listed in this plan. It is well understood that good biosecurity practice is beneficial for the ongoing management of established pests and weeds, as well as for surveillance and early detection of exotic pests. Established pests cause ongoing hardships for growers and these pests have been listed with the support of industry and government in recognition that they need a strategic, consistent, scientific and risk-based approach to better manage these pests for the potato industry.

Exotic pests of the potato industry

Threat identification

Information on exotic pest threats to the potato industry described in this document came from a combination of:

- past records
- existing industry protection plans
- industry practice and experience
- relevant published literature

- local industry and overseas research
- specialist and expert judgment.

At this time, only invertebrate pests (insects, mites, molluscs and nematodes) and pathogens (disease causing organisms) have been identified, for risk assessment as these are what are responded to under national agreed arrangements, under the EPPRD. If exotic weeds were to be included in the EPPRD then this would be revisited through future reviews of the plan.

Pest risk assessments

The assessment process used in this BP was developed in accordance with the International Standards for Phytosanitary Measures (ISPM) No. 2 and 11 [Food and Agriculture Organization of the United Nations (FAO), 2004; 2007]. A summary of the pest risk analysis protocol followed in this BP is shown in Table 8, and the complete protocol used for pest risk analysis in this BP can be found on the PHA website[31].

While there are similarities in the ranking system used in this document and the Import Risk Analysis (IRA) process followed by the Department of Agriculture and Water Resources (DAWR), there are differences in the underlying methodology and scope of consideration that may result in different outcomes between the two assessment systems. This includes different guidance to assignment of qualitative probabilities when compared with DAWR's IRA process.

Modifications of the DAWR (Department of Agriculture Fisheries and Forestry, 2011) protocol have been made to suit the analysis required in the BP development process, including, but not limited to:

- **Entry potential:** The determination of entry potential in this BP takes into account multiple possible pathways for the legal importation of plant material as well as illegal pathways, contamination and the possibility of introduction through natural means such as wind. Therefore, the scope is wider than that used by the DAWR in their IRA process, which only considers legal importation of plants or plant commodities.
- **Potential economic impact** of pest establishment in this document only takes into account the impacts on the potato industry. The DAWR IRA process has a wider scope, including the effects to all of Australia's plant industries, trade, the environment and public health.
- **Risk potentials and impacts:** The number of categories used in this BP for describing the entry, establishment, spread, and potential economic impact (see 'Description of terms used in pest risk tables', page 62) differs in comparison to that used in the DAWR Resources IRA process.

[31] Available from **www.planthealthaustralia.com.au/biosecurity/risk-mitigation**

Table 8. *Summary of pest risk assessment process used in BPs*

Step 1	Clearly identify the pest	• Generally, pest defined to species level • Alternatively, a group (e.g. family, genus level) can be used • Sub-species level (e.g. race, pathovar, etc.) may be required
Step 2	Assess entry, establishment and spread likelihoods	• Assessment based on current system and factors • Negligible, low, medium, high or unknown ratings
Step 3	Assess likely consequences	• Primarily based on likely economic impact to industry based on current factors • Negligible, low, medium, high, extreme or unknown ratings
Step 4	Derive overall risk	• Entry, establishment and spread likelihoods are combined to generate a likelihood score • Likelihood score combined with the likely economic impact to generate an overall risk score
Step 5	Review the risk	• Risk ratings should be reviewed with the BP

The objective of risk assessment is to clearly identify and classify biosecurity risks and to provide data to assist in the evaluation and treatment of these risks. Risk assessment involves consideration of the sources of risk, their consequences, and the likelihood that those consequences may occur. Factors that affect the consequences and likelihood may be identified and addressed via risk mitigation strategies.

Risk assessment may be undertaken to various degrees of refinement, depending on the risk information and data available. Assessment may be qualitative, semi-quantitative, quantitative, or a combination of these. The complexity and cost of assessment increase with the production of more quantitative data. It is often more practical to first obtain a general indication of the level of risk through qualitative risk assessment, and if necessary, undertake more specific quantitative assessment later [Australian Standard/New Zealand Standard (AS/NZS) ISO 31000, 2009].

Ranking pest threats

Key questions required for ranking the importance of pests include the following:

- What are the probabilities of entry into Australia, establishment and spread, for each pest?
- What are the likely impacts of the pest on cost of production, overall productivity and market access?
- How difficult is each pest to identify and control and/or eradicate?

The TSTs (more information in Appendix 2) present a list of potential plant pest threats to the potato industry and provide summarised information on entry, establishment and spread potential, the economic consequences of establishment and eradication potential (where available). The most serious threats from the TSTs were identified through a process of qualitative risk assessment[32] and are listed in the HPP list (Table 1).

This document considers all potential pathways by which a pest might enter Australia, including natural and assisted spread (including smuggling). This is a broader view of potential risk than the IRA conducted by the Department of Agriculture and Water Resources which focus only on specific regulated import pathways.

When a pest that threatens multiple industries is assessed, the entry, establishment and spread potentials take into account all known factors across all host industries. This accurately reflects the ability of a pest to enter, establish and spread across Australia and ultimately results in different industries, and their BPs, sharing similar pest ratings. However, the economic impact of a pest is considered at an industry specific level (i.e. for the potato industry only in this BP), and therefore this rating may differ between BPs.

Description of terms used in pest risk tables

The descriptions below relate to terms in Table 1 and elsewhere in the document.

Entry potential

Negligible	The probability of entry is extremely low given the combination of all known factors including the geographic distribution of the pest, quarantine practices applied, probability of pest survival in transit and pathways for pest entry and distribution to a suitable host.
Low	The probability of entry is low, but clearly possible given the expected combination of factors described above.
Medium	Pest entry is likely given the combination of factors described above.
High	Pest entry is very likely and potentially frequent given the combination of factors described above.
Unknown	The pest entry potential is unknown or very little of value is known.

[32] An explanation of the risk assessment method used can be found on the PHA website (**www.planthealthaustralia.com.au/biosecurity/risk-mitigation**)

Establishment potential

Negligible	The pest has limited potential to survive and become established within Australia given the combination of all known factors.
Low	The pest has the potential to survive and become established in approximately one-third or less of the range of hosts. The pest could have a low probability of contact with susceptible hosts.
Medium	The pest has the potential to survive and become established in between approximately one-third and two-thirds of the range of hosts.
High	The pest has potential to survive and become established throughout most or all of the range of hosts. Distribution is not limited by environmental conditions that prevail in Australia. Based upon its current world distribution, and known conditions of survival, it is likely to survive in Australia wherever major hosts are grown.
Unknown	The establishment potential of the pest is unknown or very little of value is known.

Spread potential

Negligible	The pest has very limited potential for spread in Australia given the combination of dispersal mechanisms, availability of hosts, vector presence, industry practices and geographic and climatic barriers.
Low	The pest has the potential for natural or assisted spread to susceptible hosts within Australia yet is hindered by a number of the above factors
Medium	The pest has an increased likelihood of spread due to the above factors
High	The natural spread of the pest to most production areas is largely unhindered and assisted spread within Australia is also difficult to manage
Unknown	The spread potential is unknown or very little of value is known.

Economic impact

Negligible	There are very minor, often undetectable, impacts on production with insignificant changes to host longevity, crop quality, production costs or storage ability. There are no restrictions to market access.
Very low	There are minor, yet measurable, impacts on production including either host longevity, crop quality, production costs or storage ability. There are no restrictions to market access.
Low	There are measurable impacts to production including either host mortality, reduction in yield, production costs, crop quality, storage losses, and/or minimal impacts on market access.
Medium	There are significant impacts on production with either host mortality, reduction in yield, production costs, crop quality, storage losses, and/or moderate impacts on market access.
High	There are severe impacts on production including host mortality and significant impacts on either crop quality or storage losses, and/or severe impacts on market access.
Extreme	There is extreme impact on standing crop at all stages of maturity, with high host mortality or unmanageable impacts to crop production and quality, and /or extreme, long term, impacts on market access.
Unknown	The economic potential of the pest is unknown or very little of value is known.

References

AS/NZS ISO 31000:2009 Risk management - Principles and guidelines. Standards Australia, Sydney, and Standards New Zealand, Wellington.

DAFF (2011) Import Risk Analysis Handbook 2011. Australian Government Department of Agriculture, Fisheries and Forestry, Canberra.

FAO (2004) Pest risk analysis for quarantine pests including analysis or environmental risks and living modified organisms. International Standards for Phytosanitary Measures No. 11. Secretariat of the International Plant Protection Convention, Food and Agriculture Organization of the United Nations, Rome.

FAO (2007) Framework for pest risk analysis. International Standards for Phytosanitary Measures No. 2. Secretariat of the International Plant Protection Convention, Food and Agriculture Organization of the United Nations, Rome.

RISK MITIGATION AND PREPAREDNESS

Introduction

There are a number of strategies that can be adopted to help protect and minimise the risks of Emergency Plant Pests under International Plant Protection Convention (IPPC) standards (**www.ippc.int/standards**) and Commonwealth and State/Territory legislation.

Many pre-emptive practices can be adopted to reduce the risk of exotic pest movement for the potato industry (Figure 2). Such risk mitigation and preparedness practise are the responsibility of governments, industry and the community.

A number of key risk mitigation areas are outlined in this guide, along with summaries of the roles and responsibilities of the Australian Government, state/territory governments, and potato industry members. This section is to be used as a guide outlining possible activities that may be adopted by industry and growers to mitigate the risk and prepare for an incursion response. Each grower will need to evaluate the efficacy of each activity for their situation.

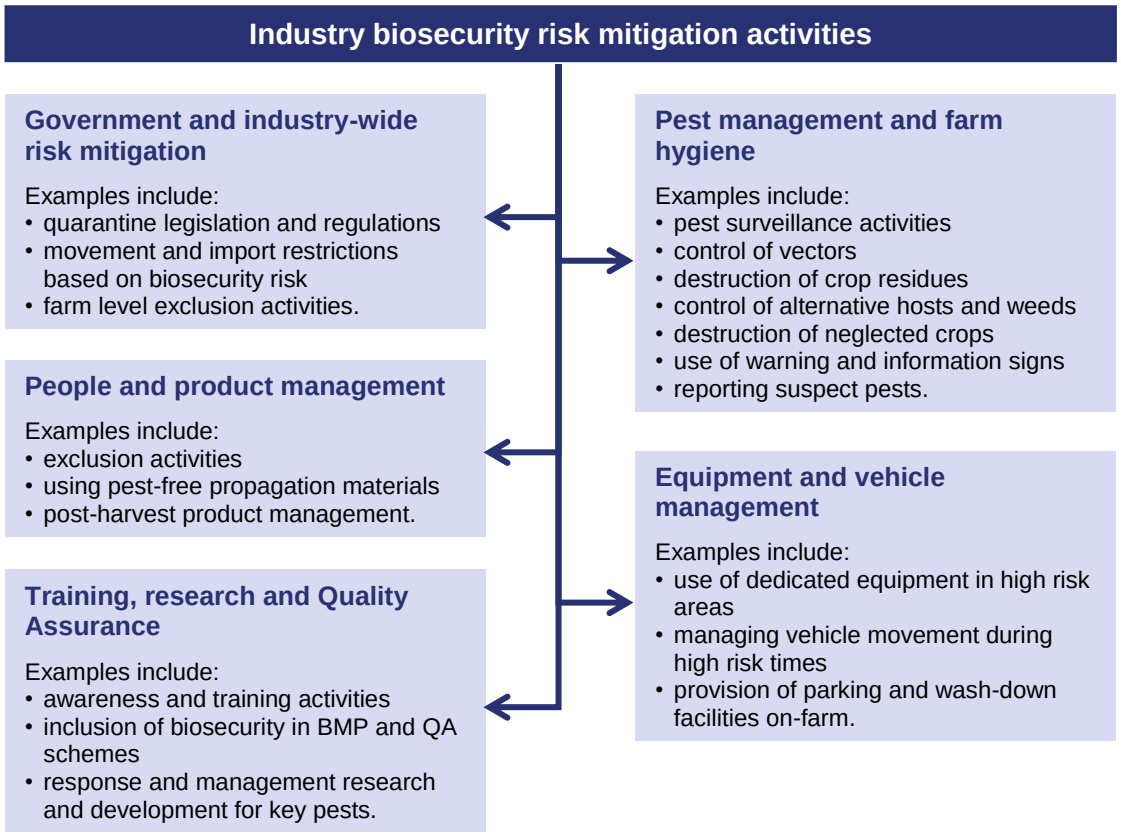


Figure 2. *Examples of biosecurity risk mitigation activities*

Barrier quarantine

Barrier quarantine refers to the biosecurity measures implemented at all levels of the potato industry including national, state, regional, and farm levels.

National level – importation restrictions

The Department of Agriculture and Water Resources (DAWR) is the Australian Government department responsible for maintaining and improving international trade and market access opportunities for agriculture, fisheries, forestry, and food industries. DAWR achieves this through:

- establishment of scientifically-based quarantine policies
- provision of effective technical advice and export certification services
- negotiations with key trading partners
- participation in multilateral forums and international sanitary and phytosanitary (SPS) standard-setting organisations
- collaboration with portfolio industries and exporters.

DAWR is responsible for developing biosecurity (SPS) risk management policy and reviewing existing quarantine measures for the importation of live animals and plants, and animal and plant products. In particular, DAWR undertakes import risk analyses to determine which products may enter Australia, and under what quarantine conditions. DAWR also consults with industry and the community, conducting research and developing policy and procedures to protect Australia's animal and plant health status and natural environment. In addition, DAWR assists Australia's export market program by negotiating other countries' import requirements for Australian animals and plants. Further information can be found at **www.agriculture.gov.au**.

The administrative authority for national quarantine is vested in DAWR under the *Biosecurity Act 2015*. Quarantine policies are developed on the basis of an IRA process. This process is outlined in the IRA Handbook 2011 (Department of Agriculture, Fisheries and Forestry, 2011). DAWR maintains barrier quarantine services at all international ports and in the Torres Strait region. The management of quarantine policy, as it relates to the introduction into Australia of fruit, seed, or other plant material, is the responsibility of DAWR.

The schedule 5 “Permitted Seeds” list from the *Quarantine Proclamation 1998* is maintained on the Import Conditions (BICON) database at **www.agriculture.gov.au/import/online-services/bicon**

BICON contains the current Australian import conditions for more than 20,000 foreign plants, animal, mineral and human products and is the first point of access to information about Australian import requirements for a range of commodities. It can be used to determine if a commodity intended for import to Australia requires a quarantine import permit and/or treatment or if there are any other quarantine prerequisites. There are currently a number of cases for potatoes listed on BICON (see Table 9). For export conditions see the Manual of Importing Country Requirements (MICoR) database at **www.agriculture.gov.au/micor/plants**.

The Australian Government is responsible for the inspection of machinery and equipment being imported into Australia. Any machinery or equipment being imported into Australia must meet quarantine requirements. If there is any uncertainty, contact DAWR on (02) 6272 3933 or 1800 020 504, or visit the website at **www.agriculture.gov.au/biosecurity/import**.

The World Trade Organization (WTO) SPS Agreement facilitates international trade while providing a framework to protect the human, animal and plant health of WTO members. SPS measures put in place must minimise negative effects on trade while meeting an importing country’s appropriate level of protection. For plant products, these measures are delivered through the IPPC standard setting organisations and collaboration with portfolio industries and exporters. For more information on the IPPC visit **www.ippc.int**.

Table 9. *Product types for which import conditions are listed in BICON (as at September 2017)*[33]

Crop	Product type
Potato	*Solanum tuberosum* for use as nursery stock
	Fruit and vegetable plant species requiring further assessment
	Dried vegetable for human consumption
	Frozen fruit, vegetables and herbs for human consumption
	Solanum tuberosum seed for sowing
	Pet food, supplements and ingredients of plant origin
	Stock feed, supplements and ingredients of plant origin
	Highly refined organic chemicals and substances
	Cooked fruit and vegetables for human consumption
	Processed grain and seed products for human consumption
	Dried herbs (including leaves, spices, roots, crushed nut sheels)
	Processed tuber and corn products for human consumption
	Restricted legume seed for sowing

State and regional level – movement restrictions

The ability to control movement of materials that can carry and spread potato pests is of high importance. Each state/territory has quarantine legislation in place to control the importation of potato material interstate and intrastate, and to manage agreed pests if an incursion occurs (refer to Table 10). Further regulations have been put in place in response to specific pest threats and these are regularly reviewed and updated by state/territory authorities and the Sub-Committee for Domestic Quarantine and Market Access (SDQMA).

Moving plant material between states/territories generally requires permits from the appropriate authority, depending on the plant species and which territory/state the material is being transferred to/from. Moving plant material intrastate may also require a permit from the appropriate authority. Information on pre-importation inspection, certification and treatments and/or certification requirements for movement of potatoes can be obtained by contacting your local state or territory agriculture department directly (see Table 10), or through the SDQMA website **www.domesticquarantine.org.au** which lists relevant contacts in each state/territory as well as Interstate Certification Assurance (ICA) documents relating to each state/territory.

The movement of farm vehicles and equipment between states is also restricted because of the high risk of inadvertently spreading pests. Each state/territory has quarantine legislation in place governing the movement of machinery, equipment and other potential sources of pest contamination. Further information can be obtained by contacting your local state/territory Department of Agriculture and Water Resources (Table 10).

[33] Please note, this is a summary only. Conditions change overtime and BICON (**www.agriculture.gov.au/import/bicon**), or the Department of Agriculture and Water Resources will need to be consulted to confirm the specific conditions that apply to a given situation.

Table 10. *Interstate and interregional movement of plant products – legislation, quarantine manuals and contact numbers*

State	Administering authority	Legislation	Links to quarantine manual[34]	Phone
ACT	Environment ACT **www.environment.act.gov.au**	*Plant Disease Act 2002* *Pest Plants and Animals Act 2005*	See NSW conditions	13 22 81
NSW	Department of Primary Industries **www.dpi.nsw.gov.au**	*Plant Diseases Act 1924* *Plant Diseases Regulation 2008* *Noxious Weeds Act 1993* *Noxious Weeds Regulation 2008*	**www.dpi.nsw.gov.au/aboutus/about/legislation-acts/plant-diseases**	02 6391 3384
NT	Department of Primary Industry and Fisheries **https://dpir.nt.gov.au/**	*Plant Health Act 2008* *Plant Health Regulations 2011*	**https://nt.gov.au/industry/agriculture/food-crops-plants-and-quarantine/plants-and-quarantine**	08 8999 2118
QLD	Biosecurity Queensland, a part of the Department of Agriculture and Fisheries, Queensland **www.daf.qld.gov.au/biosecurity**	*Biosecurity Act 2014* *Biosecurity Regulation 2016*	**www.daf.qld.gov.au/plants/moving-plants-and-plant-products**	132 523[35] 07 3404 6999[36]
SA	Primary Industries and Regions SA **www.pir.sa.gov.au**	*Plant Health Act 2009* *Plant Health Regulations 2010*	**www.pir.sa.gov.au/biosecurity/plant_health/importing_commercial_plants_and_plant_products_into_south_australia**	08 8207 7820
TAS	Department of Primary Industries, Parks, Water and Environment **www.dpipwe.tas.gov.au**	*Plant Quarantine Act 1997* *Weed Management Act 1999*	**http://dpipwe.tas.gov.au/biosecurity-tasmania/plant-biosecurity/plant-biosecurity-manual**	1300 368 550
VIC	Department of Economic Development, Jobs, Transport and Resources **www.economicdevelopment.vic.gov.au/**	*Plant Biosecurity Act 2010* *Plant Biosecurity Regulations 2012*	**www.agriculture.vic.gov.au/psb**	136 186
WA	Department of Primary Industries and Regional Development **www.agric.wa.gov.au/**	*Biosecurity and Agricultural Management Act 2007*		08 9334 1800

New South Wales

Information on pre-importation inspection, certification and treatment requirements may be obtained from NSW DPI Regulatory Services by phone 02 6391 3384 or by visiting the NSW Department of Primary Industries website **www.dpi.nsw.gov.au/aboutus/about/legislation-acts/plant-diseases**.

Northern Territory

Administrative authority for regional quarantine in the Northern Territory (NT) is vested in the Department of Primary Industry and Resources (DPIR) under the *Plant Health Act 2008* and *Plant Health Regulations 2011*. The Act enables notifiable pests to be gazetted, quarantine areas to be declared and inspectors appointed to carry out wide ranging control and/or eradication measures. Plant import requirements for particular pests, plants or plant related materials are identified in the Regulations. Further information on NT import requirements and treatments can be obtained by contacting NT Quarantine on (08) 8999 5511 or email **quarantine@nt.gov.au.**

For more information refer to the DPIR website (**https://dpir.nt.gov.au/**).

Queensland

Information on specific pre-importation inspection, treatments and/or certification requirements for movement of any fruit or plant material into Queensland, as well as maps of pest quarantine areas, may be obtained from the Biosecurity Queensland part of the DAF Queensland website (**www.daf.qld.gov.au/plants/moving-plants-and-plant-products**).

Further details can be obtained from the DAF Queensland Customer Service Centre (13 25 23 within Queensland, or phone 07 3404 6999 or fax 07 3404 6900 interstate).

South Australia

Information on pre-importation inspection, certification and treatments and/or certification requirements for movement of fruit or plant material in South Australia (SA) may be obtained from Biosecurity SA - Plant Health by phone (08) 8207 7820 or fax (08) 8207 7844. Further information can be found at **www.pir.sa.gov.au/biosecurity/plant_health**.

Primary Industries and Regions South Australia (PIRSA) have strict regulations and requirements regarding the entry of plant material (fruit, vegetables, flowers, plants, soil and seeds) into the State.

For further information on import conditions consult the Plant Quarantine Standard (**www.pir.sa.gov.au/biosecurity/plant_health/importing_commercial_plants_and_plant_products_into_south_australia**).

Tasmania

Information on specific pre-importation inspection, treatments and/or certification requirements for movement of any fruit or plant material into Tasmania may be obtained from the Department of Primary Industries, Parks, Water and Environment (DPIPWE) Biosecurity website (**www.dpipwe.tas.gov.au/biosecurity**) or by phoning 1300 368 550.

General and specific import conditions apply to the importation of plant material into Tasmania to prevent the introduction of pests and diseases into the State. Plants and plant products must not be imported into Tasmania unless State import requirements are met and a Notice of Intention to import has been provided to a Biosecurity Tasmania inspector not less than 24 hours prior to the importation.

For further information on import conditions consult the Plant Quarantine Manual (**http://dpipwe.tas.gov.au/biosecurity-tasmania/plant-biosecurity/plant-biosecurity-manualhttp://dpipwe.tas.gov.au/biosecurity/plant-biosecurity/plant-biosecurity-manual**).

Victoria

The movement into Victoria of plants and plant products may be subject to a prohibition, or to one or more conditions which may include chemical treatments. These prohibitions and conditions are described on the Department of Economic Development, Jobs, Transport and Resources (DEDJTR) website (see link in Table 10). Some items may need to be presented to a DEDJTR inspector or an accredited business, for checking of details such as correct certification, labelling or treatment.

Further information on pre-importation inspection, certification and treatments and/or certification requirements for movement of fruit or plant material into or within Victoria may be obtained from DEDJTR on the web at **www.agriculture.vic.gov.au/psb** or by phone 136 186.

Western Australia

The lead agency for agricultural biosecurity in Western Australia is the Department of Primary Industries and Regional Development (WA DPIRD). Western Australia is naturally free from a large number of pests and diseases that are present in many other parts of the world. WA's geographical isolation in conjunction with a robust plant biosecurity system including border and intrastate regulations, industry and public awareness campaigns and surveillance programs maintains this status.

There are general and specific legislative requirements which underpin Western Australian plant biosecurity. Amongst other things the legislation regulates movement of potential carriers (such as plant material, honey, machinery, seeds etc.) into and within the state.

General conditions include (but are not limited to the following):

- The requirement for all potential carriers to be presented to an inspector for inspection upon arrival in WA
- Soil is prohibited entry and imported goods, including containers, must be free from soil
- Freedom from pests and diseases of quarantine concern to WA

In addition to the general requirements, specific requirements are also in place for movement into and within the state.

For further information on requirements contact Quarantine WA on (08) 9334 1800 or fax (08) 9334 1880.

Farm level – exclusion activities

A significant risk of spreading pests onto farms arises when propagation material, people, machinery and equipment move from property to property and from region to region. It is the responsibility of the industry and the owner/manager of each property to ensure these risks are minimised.

It is in the interests of industry to encourage and monitor the management of risk at the farm level, as this will reduce the probability of an incursion and increase the probability of early detection. This should in turn reduce the likelihood of a costly incident response, thereby reducing costs to industry, government and the community.

One major way this can be achieved is through management of industry biosecurity at the farm level using exclusion practices. Further detail on potential strategies is included in the Farm Biosecurity section (page 83). The potato industry is already a strong supporter of farm biosecurity with its ‘Come clean. Go clean’ message; but should continue to further extend this message of promoting good farm hygiene in a wide range of ways.

Surveillance

Surveys enhance prospects for early detection, minimise costs of eradication and are necessary to meet the treaty obligations of the WTO SPS Agreement with respect to the area freedom status of Australia’s states, territories and regions.

The SPS Agreement gives WTO members the right to impose SPS measures to protect human, animal and plant life health provided such measures do not serve as technical barriers to trade. In other words, for countries (such as Australia) that have signed the SPS

Agreement, imports of food, including fresh fruit and vegetables, can only be restricted on proper, science-based quarantine grounds. Where quarantine conditions are imposed, these will be the least trade restrictive measures available that meet Australia's appropriate level of quarantine protection. The Agreement also stipulates that claims of area freedom must be supported by appropriate information, including evidence from surveillance and monitoring activities. This is termed "evidence of absence" data and is used to provide support that we have actively looked for pests and not found them.

ISPM 6 (**www.ippc.int/sites/default/files/documents/20140528/spec_61_revispm6_2014-05-28_201405281352--150.18%20KB.pdf**) provides international guidelines for structured pest surveys. Structured pest survey planning and implementation depends on the risk involved, the resources available, and the requirements of trading partners (particularly when Australia wishes to access overseas markets). The intensity and timing of surveys also depend on the spread characteristics of the pest and the costs of eradication.

Early detection of an exotic incursion can significantly increase the likelihood of a successful eradication campaign, and reduce the associated costs. Effective surveillance plays a critical role in working toward this goal. Surveillance can be either targeted toward specific pests, or general in nature. General non-targeted surveillance is based on recognising normal versus suspect plant material. Targeted surveillance is important for establishing whether particular pests are present in each state or region, and if so, where these occur.

Industry personnel can provide very effective early detection of new or unusual symptoms through their normal management practices (i.e. 'passive surveillance'), provided individuals are aware of what to look for and of reporting procedures. Consultants and crop scouts can provide valuable information as they are regularly in the field, and hence can observe any unusual pest activity or symptoms on plants.

National surveillance programs

The Department of Agriculture and Water Resources (DAWR) maintains barrier quarantine services at all international ports and in the Torres Strait region. DAWR also surveys the northern coast of Australia, offshore islands and neighbouring countries for exotic pests that may have reached the country through other channels (e.g. illegal vessel landings in remote areas, bird migrations, wind currents) as part of the Northern Australia Quarantine Strategy (NAQS). NAQS surveillance programs relevant to the potato industry are listed in Table 11.

State surveillance programs

State level surveillance depends on the participation of all stakeholder groups, particularly state/territory agriculture departments, industry representative groups, agri-business and growers.

The state/territory agriculture department can provide:

- planning and auditing surveillance systems
- coordination of surveillance activities between industry and interstate groups
- diagnostic services
- field diagnosticians for special field surveillance
- surveillance on non-commercial sites
- liaison services with industry members
- communication, training and extension strategies with industry
- biosecurity training
- reporting services to all interested parties (Department of Agriculture and Water Resources, national bodies, trading partners and industry).

Various pest surveillance programs are managed by the Department of Agriculture and Water Resources and the state/territory agriculture departments. Many state/territory departments run general surveillance programs whereby suspect samples can be forwarded and diagnosed for the presence of exotic pests free of charge. Official surveillance programs that target pests of the potato industry (exotic or those under official control in a region or state/territory) are shown in Table 11.

Table 11. *Official surveillance programs that target pests of the potato industry (as at September 2017)*[37]

Surveillance program	Pests targeted	Hosts targeted
National		
National Plant Health Surveillance Program	Multiple including tomato-potato psyllid (*Bactericera cockerelli*) and zebra chip (*Candidatus* Liberibacter solanacearum), Potato leafminer (*Liriomyza huidobrensis*), cabbage leaf miner (*Liriomyza sativae),*	Multiple
Northern Australia Quarantine Strategy	Multiple including potato late blight (*Phytophthora infestans*), Peach fruit fly (*Bactrocera zonata*)	Multiple
New South Wales		
Candidatus Liberibacter solanacearum	Zebra chip (*Candidatus* Liberibacter solanacearum)	Solanaceae

[37] Information presented has been taken from the National Plant Health Status Report 2016 and confirmed or updated in December 2016 by the Subcommittee on National Plant Health Surveillance (sub-committee of the Plant Health Committee)

Surveillance program	Pests targeted	Hosts targeted
Onion seed crop surveillance	Varies but may include *Burkholderia gladioli* pv. *alliicola, Erwinia chrysanthemi, Alternaria porri, Pyrenochaeta trrestris, Urocystis cepulae, Ceratitis spp. Helix aspersa, Liriomyza trifolii, Naupactus leucoloma, Aphelenchoides fragariae, Ditylenchus destructor, D. dipsaci, Longidorus, Meloidogyne goeldi, Paratrichodorus, Pratylenchus filipjev*	Onions
Northern Territory		
National Plant Health Surveillance Program	Potato leafminer (*Liriomyza huidobrensis*), pea leafminer (*Liriomyza huidobrensis*), serpentine leafminer (*Liriomyza huidobrensis*)	Solanaceae
National Plant Health Surveillance Program	Vegetable leafminer (*Liriomyza sativae*)	Solanaceae, Cucurbitaceae, Fabaceae
National Plant Health Surveillance Program	American leafminer (*Liriomyza trifolii*)	Solanaceae, Asteraceae
National Plant Health Surveillance Program	*Bactericera cockerelli, Candidatus* Liberibacter solanacearum	Solanaceae
Queensland		
Grow Help Australia diagnostic service project	All pests and pathogens that can affect horticultural crops, national parks, gardens, hobby growers and home gardeners. Commonly encountered pathogens include *Phytophthora* spp., *Fusarium* spp., *Colletotrichum* spp., *Alternaria* spp., *Rhizoctonia* spp., *Pythium* spp., *Ralstonia* spp., *Erwinia* spp. and viruses	Fruit, vegetable and ornamental
South Australia		
Potato spindle tuber viroid	*Potato spindle tuber viroid*	Solanaceae

Farm surveillance activities

Farm level surveillance involves the participation and interaction of growers, agribusiness and industry representative groups. Examples of the surveillance activities that can be carried out by each of these groups are outlined in Figure 3. Conducting regular surveys of farms and nurseries provides the best chance of spotting new pests early and implementing eradication or management responses.

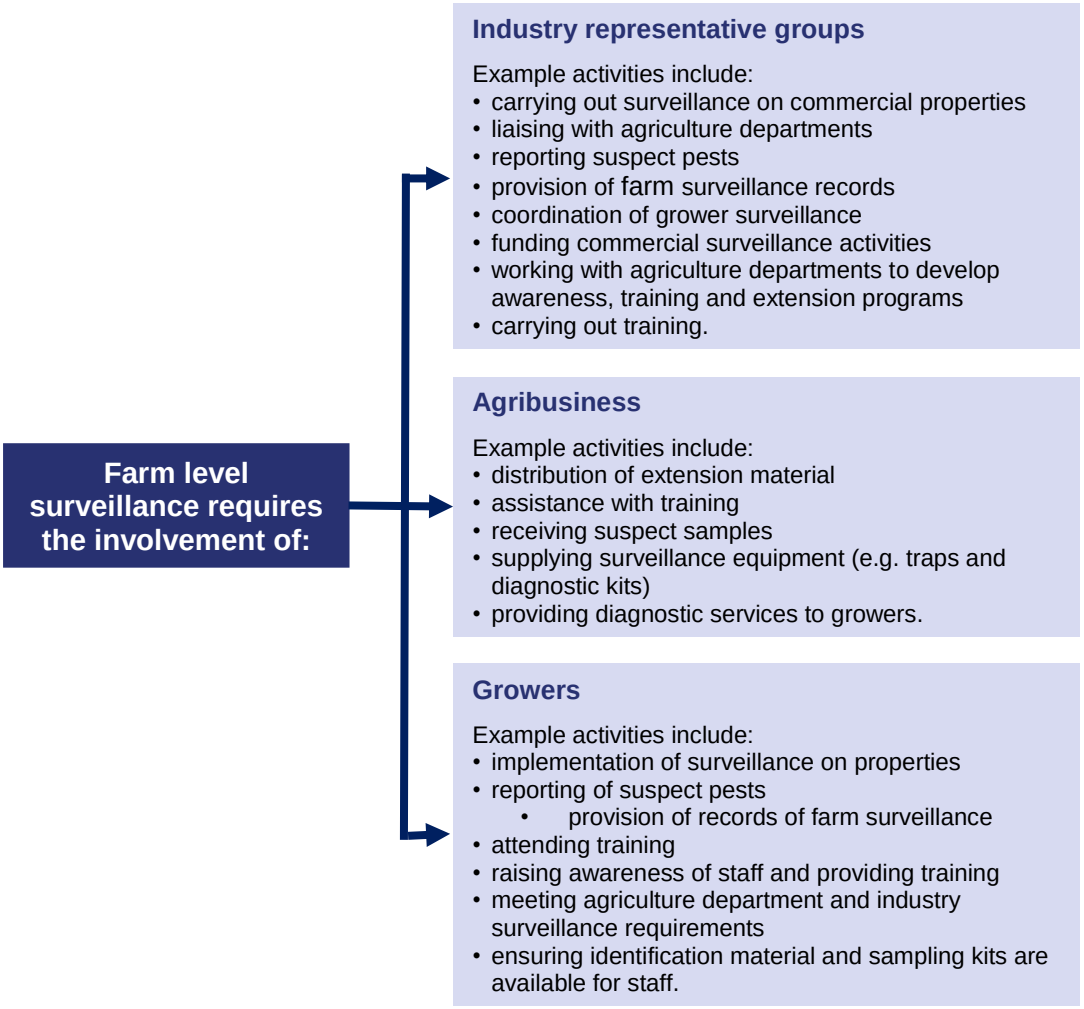


Figure 3. **Examples of farm level surveillance activities**

Training

A key component of biosecurity preparedness is ensuring personnel engaged are suitable and effectively trained for their designated roles in a response. Biosecurity preparedness training is the responsibility of all governments and industries involved in the biosecurity system.

National EPP Training Program

PHA supports its members in training personnel through the delivery of the National EPP Training Program. This program is focussed on ensuring personnel from the governments and peak industry bodies that will be involved in responding to EPPs have the skills and

knowledge to effectively fulfil the roles and responsibilities, as signatories to the EPPRD. This covers a range of areas, from representatives on the national decision making committees (i.e. the Consultative Committee on Emergency Plant Pests and the National Management Group) through to industry liaison personnel in the State Coordination or Local Control Centres.

In addition to face to face training delivered to members and the provision of simulation exercises, PHA also offers biosecurity training through the Biosecurity OnLine Training (BOLT) platform which houses a variety of eLearning courses relevant to plant biosecurity. Access to BOLT is free and open to any stakeholder interested in biosecurity, and is available through **www.planthealthaustralia.com.au/bolt**.

For more information on the National EPP Training program, refer to **www.planthealthaustralia.com.au/training**.

Awareness

Early reporting enhances the chance of effective control and eradication. Awareness activities raise the profile of biosecurity and exotic pest threats to the potato industry, which increases the chance of early detection and reporting of suspect pests. Responsibility for awareness material lies with industry and government, with assistance from PHA as appropriate. Any unusual plant pest should be reported immediately to the relevant state/territory agriculture department through the Exotic Plant Pest Hotline (1800 084 881).

High priority plant pest threat-related documents

Pests listed in Table 1 have been identified as high priority threats to the potato industry by members of the TEG. They have been assessed as having high entry, establishment and spread potentials and/or a high economic impact. This list should provide the basis for the development of awareness material for the industry.

Further information on high priority pests

The websites listed below (Table 12) contain information on pests across most plant industries, including the potato industry.

Table 12. *Sources of information on high priority pest threats for the potato industry*

Source	Website
Department of Agriculture and Water Resources	**www.agriculture.gov.au**
Pest and Disease Image Library (PaDIL)	**www.padil.gov.au**
DAF Queensland A-Z list of significant plant pests and diseases	**www.daf.qld.gov.au/plants/health-pests-diseases/a-z-significant**
University of California Statewide Integrated Pest Management (IPM) Program	**www.ipm.ucdavis.edu/EXOTIC/exoticpestsmenu.html**
European and Mediterranean Plant Protection Organization (EPPO)	**www.eppo.int/DATABASES/pqr/pqr.htm**

Further information/relevant web sites

A range of government and grower organisation details and websites are provided below (Table 13) for persons seeking further information on potato industry biosecurity.

Table 13. *Relevant sources of further biosecurity information for the potato industry*

Agency	Website/email	Phone	Address
National			
AUSVEG	**www.ausveg.com.au** **info@ausveg.com.au**	(03) 9822 0388	PO BOX 138 Camberwell VIC 3124
Department of Agriculture and Water Resources	**www.agriculture.gov.au**	(02) 6272 3933 1800 020 504	GPO Box 858 Canberra, ACT 2601
Plant Health Australia	**www.planthealthaustralia.com.au** **biosecurity@phau.com.au**	(02) 6215 7700	Level 1, 1 Phipps Cl Deakin, ACT 2600
New South Wales			
Department of Primary Industries	**www.dpi.nsw.gov.au/biosecurity/plant**	(02) 6391 3535	Locked Bag 21 Orange, NSW 2800
Queensland			
Biosecurity Queensland, a part of the Department of Agriculture and Fisheries, Queensland	**www.daf.qld.gov.au** **callweb@daf.qld.gov.au**	13 25 23[38] (07) 3404 6999[39]	80 Ann Street Brisbane, QLD 4000

[38] Within Qld
[39] Interstate

Agency	Website/email	Phone	Address
Northern Territory			
Department of Primary Industry and Resources	**www.nt.gov.au/d/Primary_Industry** **info.DPIF@nt.gov.au**	(08) 8999 5511	Berrimah Farm, Makagon Road, Berrimah, NT 0828
South Australia			
Primary Industries and Regions SA	**www.pir.sa.gov.au**	(08) 8226 0900	GPO Box 1671, Adelaide, SA 5001
Biosecurity SA-Plant Health	**www.pir.sa.gov.au/biosecuritysa/planthealth** **PIRSA.planthealth@sa.gov.au**	(08) 8207 7820	33 Flemington Street, Glenside, SA 5065
Biosecurity SA-Plant Health Market access and Interstate Certification Assurance	**PIRSA.planthealthmarketaccess@sa.gov.au**	(08) 8207 7814	
Biosecurity SA-Plant Health Transport manifest lodgement	**pirsa.planthealthmanifest@sa.gov.au**	Fax (08) 8124 1467	
South Australian Research and Development Institute	**www.sardi.sa.gov.au** **sardi@sa.gov.au**	(08) 8303 9400	2b Hartley Grove Urrbrae, SA 5064
Tasmania			
Department of Primary Industries, Parks, Water and Environment	**www.dpipwe.tas.gov.au** **BPI.Enquiries@dpipwe.tas.gov.au**	1300 368 550	GPO Box 44, Hobart, TAS 7001
Victoria			
Department of Economic Development, Jobs, Transport and Resources	**http://economicdevelopment.vic.gov.au/**	136 186	Biosecurity-Regulation and Compliance, Private bag 15, Ferntree Gully Delivery Centre, Vic 3156

Agency	Website/email	Phone	Address
Western Australia			
Department of Primary Industries, Resources and Development	**www.agric.wa.gov.au** **enquiries@agric.wa.gov.au**	(08) 9368 3333	DAFWA 3 Baron-Hay Court, South Perth, WA 6151

Farm biosecurity

Introduction

Plant pests can have a major impact on production if not managed effectively. This includes pests already present in Australia and a number of serious pests of potato that Australia does not have.

Farm biosecurity measures can be used to minimise the spread of such pests before their presence is known or after they are identified, and therefore can greatly increase the likelihood that they could be eradicated. This section of the document outlines farm biosecurity and hygiene measures to help reduce the impact of pests on the industry.

The biosecurity and hygiene measures outlined here can be considered as options for each farm's risk management. Many of these measures can be adopted in a way that suits a given farm so that each can have an appropriate level of biosecurity.

Farm biosecurity reporting procedures and hygiene strategies to reduce threats covered in this document are:

- selection and preparation of appropriate plant material
- chemical control measures
- control of vectors
- control of alternative hosts
- neglected farms and volunteer plants
- post-harvest handling and produce transport procedures
- use of warning and information signs
- managing the movement of vehicles and farm equipment
- movement of people
- visiting overseas farms/orchards – what to watch out for when you return
- including farm biosecurity in Industry best management practice and quality assurance schemes
- farm biosecurity checklist

Development of an on farm biosecurity plan tailored to the needs of an individual operation is a good way to integrate best practice biosecurity with day to day operations (**www.farmbiosecurity.com.au/planner/**). Further information on farm biosecurity can be found at **www.farmbiosecurity.com.au** or by contacting AUSVEG**.**

Reporting suspect exotic plant pests

Rapid reporting of exotic plant pests is critical: early detection gives Australia the best chance to effectively control and eradicate pests. If you find something you believe could be an exotic plant pest, call the Exotic Plant Pest Hotline immediately to report it to your local state or territory government.

The one phone number – 1800 084 881 – will connect to an automated system that allows the caller to choose the state or territory that the report relates to. The caller will then be connected to the relevant authority for that jurisdiction. Most lines are only monitored during business hours. Messages can be left outside of those hours and calls will be returned as soon as an officer is available. A summary of the opening hours for each state and territory is provided in Table 14. Each jurisdiction also has an alternative contact to ensure no report is missed. It does not matter which of these methods is used to report a suspect exotic plant pest. The important thing is to report it.

Calls to the Exotic Plant Pest Hotline will be answered by an experienced person, who will ask some questions to help understand the situation, such as:

- What was seen (describe the pest or send a photo)
- Where it was found
- What it was found on
- How many pests are present/how infected is the crop
- How widely distributed it is
- When it was first noticed

It is important not to touch or move the suspect material as this may spread the exotic pest or render samples unsuitable for diagnostic purposes. A biosecurity officer may attend the location to inspect and collect a sample. In some cases, the biosecurity officer will explain how to send a sample for testing. In this circumstance they will explain how to do this without risk of spreading the pest and allowing it to arrive at the laboratory in a suitable condition to be identified.

Every report will be taken seriously, will be followed up and treated with confidentiality.

Table 14. *Exotic Plant Pest Hotline hours of operation and alternate contact information for reporting per jurisdiction*

State/ territory	Hotline hours	Alternative contact
NSW	Operates 0830 – 1630 Monday to Friday. After hours answering machine service with messages followed up the next business day.	**biosecurity@dpi.nsw.gov.au**
NT	Operates 0800 – 1630 Monday to Friday. After hours answering machine service with messages followed up the next business day.	**quarantine.NT@nt.gov.au**
QLD	Operates 0800-1700 Monday to Friday (0900-1700 Thursday). Calls outside these hours answered by a third party who will take the message and depending on the urgency of the report, organise a response from a biosecurity officer as soon as possible.	Biosecurity Queensland on 13 25 23
SA	Operates 24 hrs/ 7 days	**Online plant pest report form**[40]
TAS	Operates 24 hrs/ 7 days	Biosecurity Tasmania 03 6165 3777
VIC	Operates 0800 – 1800 Monday to Friday. After hours answering machine service with messages followed up the next business day. Option also to forward to the 24 hr Emergency Animal Disease Watch Hotline.	**plant.protection@ecodev.vic.gov.au**
WA	Operates 0830 – 1630 Monday to Friday. After hours answering machine service with messages followed up the next business day.	**info@agric.wa.gov.au**

Recent changes to legislation in some states includes timeframes for reporting and have implications for those who do not report. It is important that individuals know the obligations for their jurisdiction.

Some potato pests are notifiable under each state or territory's quarantine legislation. Each state or territory's list of notifiable pests are subject to change over time so contacting your local state/territory agricultural agency (details in Table 10) will ensure information is up to date. Landowners and consultants have a legal obligation to notify the relevant state/territory agriculture agency of the presence of those pests within a defined timeframe (Table 14).

[40] Available from **https://form.jotform.co/70732909804864**

Preparedness

Pest-specific preparedness and response information documents

To help prepare for an incursion response a list of pest-specific preparedness and response information documents are provided in Table 5 that may support a response. Over time, as more resources are produced for pests of the potato industry they will be included in this document and made available through the PHA website. Resources include the development of pest-specific information and emergency response documents, such as fact sheets, contingency plans, diagnostic protocols and a summary of surveillance programs currently in operating for these high priority pests (see **www.planthealthaustralia.com.au/pidd**). These documents and programs should be developed over time for all medium to high risk pests listed in the TSTs (Appendix 2).

Fact sheets

Fact sheets or information sheets are a key activity of biosecurity extension and education with growers. Fact sheets provide summary information about the pest, its biology, what it looks like and what symptoms it may cause. They also contain detailed images. For a list of current fact sheets available from PHA for olive producers see (Table 13).

Contingency Plans

Contingency Plans provide background information on the pest biology and available control measures to assist with preparedness for incursions of a specific pest into Australia. The contingency plan provides guidelines for steps to be undertaken and considered when developing a response plan for the eradication of that pest. Any response plan developed using information in whole or in part from a contingency plan must follow procedures as set out in PLANTPLAN and be endorsed by the National Management Group prior to implementation.

As a part of contingency planning, biological and chemical control options are considered as are options for breeding for pest resistance. Through the planning process, it may be discovered that there are gaps in knowledge. Such gaps should be identified and consequently be considered as RD&E needs to be met within the implementation table.

For a list of current contingency plans see **www.planthealthaustralia.com.au/pidd**.

***Table 15**. Pest-specific information documents for the potato industry*[41]

Scientific name	Common name	Fact sheet	Contingency plan
INVERTEBRATES			
DIPTERA (Flies and midges)			
Liriomyza huidobrensis	Serpentine pea leaf miner	Yes	Yes
Liriomyza sativae	Vegetable leaf miner	Yes[42]	Yes
Liriomyza trifolii	American serpentine leaf miner	Yes	Yes
COLEOPTERA (Beetles and weevils)			
Diabrotica undecimpunctata	Spotted cucumber beetle southern corn rootworm	Yes	No
Leptinotarsa decemlineata	Colorado potato beetle	Yes	No
HEMIPTERA (Stink bugs, aphids, mealybugs, scale, whiteflies and hoppers)			
Aphis fabae	Black bean aphid	No	Yes
Aphis gossypii (exotic strains)	Cotton aphid, melon aphid	Yes	No
Lygus lineolaris	Tarnished plant bug	Yes	Yes
Paracoccus marginatus	Papaya mealy bug	Yes	Yes
LEPIDOPTERA (Butterflies and moths)			
Agrotis segetum	Turnip moth, cutworm	No	Yes
Tuta absoluta	South American tomato moth, tomato leaf miner	Yes	No
TYSANOPTERA (Thrips)			
Frankliniella bispinosa	Florida flower thrips	Yes	No
PATHOGENS			
BACTERIA			
Candidatus Liberibacter solanacearum (with known vector) (syn. *Candidatus Liberibacter psyllaurous*)	Zebra chip	Yes	Yes
Clavibacter michiganensis sepedonicus	Bacterial ring rot, potato ring rot	Yes	No
FUNGI			
Verticillum dahliae (exotic defoliating strains)	Verticillium wilt	Yes	No
NEMATODES			
Meloidogyne enterolobii (syn. Meloidogyne mayaguensis)	Root knot nematode	Yes[43]	No

[41] Copies of these documents are available from www.planthealthaustralia.com.au/pidd or by contacting the relevant state/territory agriculture agency.
[42] http://keys.lucidcentral.org/keys/v3/leafminers/key/Polyphagous%20Agromyzid%20Leafminers/Media/Html/Liriomyza_sativae.htm ; www.planthealthaustralia.com.au/sci_name/liriomyza-sativae/
[43] www.plantwise.org/KnowledgeBank/Datasheet.aspx?dsid=33248 ; www.pestnet.org/fact_sheets/root_knot_nematodes_127.htm

Scientific name	Common name	Fact sheet	Contingency plan
VIRUSES			
Impatiens necrotic spot virus (Tospovirus)	Impatiens necrotic spot virus	No	Yes
Potato spindle tuber viroid (Pospiviroid)	Potato spindle tuber viroid (PSTVd)	Yes	No
Tomato black ring virus (Nepovirus)	Tomato black ring virus	Yes	No

National Diagnostic Protocols

Diagnostic protocols are documents that contain information about a specific plant pest, or related group of pests, relevant to its diagnosis. National Diagnostic Protocols (NDPs) are diagnostic protocols for the unambiguous taxonomic identification of a pest in a manner consistent with ISPM No. 27 – Diagnostic Protocols for Regulated Pests. NDPs include diagnostic procedures and data on the pest, its hosts, taxonomic information, detection and identification.

Australia has a coherent and effective system for the development of NDPs for plant pests managed by the Subcommittee on Plant Health Diagnostics (SPHD). NDPs are peer reviewed and verified before being endorsed by Plant Health Committee (PHC).
Endorsed NDPs are available on the National Plant Biosecurity Diagnostic Network (NPBDN) website (**www.plantbiosecuritydiagnostics.net.au**), together with additional information regarding their development and endorsement.

Diagnostic information for some potato pests is also available through the PHA website **www.planthealthaustralia.com.au/pidd**. For diagnostic information on fruit flies, refer to the Australian Handbook for the Identification of Fruit Flies, available from the PHA website.

Table 16. Potato pests for which draft diagnostic protocols or diagnostic information exists[44]

Scientific name	Common name	Document link
Leptinotarsa decemlineata	Colorado potato beetle	NDP22
Liriomyza huidobrensis	Serpentine leaf miner	Draft NDP
Liriomyza trifolii	American serpentine leaf miner	NDP27
Candidatus Liberibacter solanacearum (with known vector) (syn. *Candidatus* Liberibacter psyllaurous)	Zebra chip	NDP18
Clavibacter michiganensis subsp. sepedonicus	Bacterial ring rot, potato ring rot	NDP8

[44] Diagnostic protocols are available at **http://plantbiosecuritydiagnostics.net.au/resource-hub/priority-pest-diagnostic-resources/**

Scientific name	Common name	Document link
Synchytrium endobioticum	Potato wart, potato blackwart	NDP16
Verticillum dahliae (exotic defoliating strains)	Verticillium wilt	Draft NDP
Globodera pallida	Pale potato cyst nematode	Draft NDP
Globodera rostsochiensis (Pathotypes RO2, RO3, RO4 and RO5)	Golden potato cyst nematode	Draft NDP
Phytophthora infestans (A2 mating type)	Late blight	Draft NDP
Pepino mosaic virus (Potexvirus) (with known vector)	Pepino mosaic virus	Draft NDP
Potato mop-top virus (Pomovirus)	Potato mop-top virus	NDP15
Potato spindle tuber viroid (Pospiviroid)	Potato spindle tuber viroid (PSTVd)	NDP7

Research Development and Extension

Research, Development and Extension – Linking Biosecurity Outcomes to Priorities

Through the biosecurity planning process, gaps in knowledge or extension of knowledge will have been identified and need to be documented in the implementation table. Some of these gaps will require further research and development (e.g. understanding risk pathways, developing surveillance programs or diagnostic protocols, developing tools to facilitate preparedness and response, developing IPM or resistance breeding strategies), other gaps will require communication or extension of that knowledge to various target audiences (developing awareness raising materials, undertaking training exercises, running workshops, consideration of broader target audiences).

It is important that the RD&E gaps identified through this plan feed directly into the normal annual RD&E priority setting and strategic planning activities that an industry undertakes. This is fundamental if an industry is to progress biosecurity preparedness and response throughout the life of the biosecurity plan.

RESPONSE MANAGEMENT

Introduction

No matter how many preparedness activities are undertaken or how much surveillance is done at the border, a small amount of plant pests will inevitably make their way into Australia. This section outlines the national agreements and processes in place to effectively respond to such incursions.

The Emergency Plant Pest Response Deed

A fundamental component of the Australian plant biosecurity system is the Emergency Plant Pest Response Deed (EPPRD), which is an agreement between the Australian government, the state/territory governments, 33 plant industries (including AUSVEG) and PHA (collectively known as the signatories), that allows the rapid and efficient response to Emergency Plant Pests (EPPs)[45]. The EPPRD is a legally binding document that outlines the basic operating principles and guidelines for eradication responses of EPPs.

The EPPRD provides:

- A national response management structure that enables all governments and plant industry signatories affected by the EPP to contribute to the decisions made about the response.
- An agreed structure for the sharing of costs to deliver eradication responses to EPPs detected in Australia. Costs are divided between signatories affected by the EPP in an equitable manner.
- A mechanism to encourage reporting of EPP detections and the implementation of risk mitigation activities.
- A mechanism to reimburse growers whose crops or property are directly damaged or destroyed as a result of implementing a Response Plan.

For further information on the EPPRD and frequently asked questions, visit **www.planthealthaustralia.com.au/epprd** or **www.planthealthaustralia.com.au/epprd-qa**.

[45] Refer to the PHA website for details of what an EPP is **http://www.planthealthaustralia.com.au/biosecurity/emergency-plant-pests/**

PLANTPLAN

PLANTPLAN outlines the generic approach to response management under the EPPRD and introduces the key roles and positions held by industry and government during a response. The document is supported by a number of operating guidelines, job cards and standard operating procedures that provide further detail on specific topics.

PLANTPLAN underpins the EPPRD and is endorsed by all EPPRD signatories.
The current version of PLANTPLAN and supporting documents are available on the PHA website (**http://www.planthealthaustralia.com.au/biosecurity/incursion-management/plantplan/**).

Funding a response under the EPPRD

This section outlines how eradication responses are nationally cost shared between affected industries and governments.

Cost sharing a response

Affected industries and governments invest in the eradication of EPPs and share the costs of an agreed response plan, this is referred to as 'cost sharing'. Not all activities in a response are eligible to be cost shared, with some activities considered as normal commitments[46] for signatories.

The cost shared costs of a response are divided between affected industries and governments in an equitable manner directly relating to the public versus private benefit of eradicating the EPP. These relative benefits are represented by the category of the pest, with the overall view that 'the higher the benefit, the greater the investment'.

There are four categories for EPPs, as shown in Table 17. The category indicates how the funding will be split between government and industries; with the governments funding the share of public benefit and industry funding the share of private benefit. The category does not indicate the likelihood of eradication or the overall importance of the EPP.

[46] Further information can be found in the guideline document for Normal Commitments for Parties to the Emergency Plant Pest Response Deed available from **http://www.planthealthaustralia.com.au/biosecurity/incursion-management/plantplan/**

Table 17. *The categories and funding allocations to government and industry parties to the EPPRD*

Category	Government allocation	Industry allocation
Category 1	100%	0%
Category 2	80%	20%
Category 3	50%	50%
Category 4	20%	80%

Pest categorisation

The list of categorised EPPs can be found in *schedule 13 of the EPPRD*. In the event that a response plan is endorsed for an uncategorised EPP, cost sharing will commence using the default category (category 3), and may be revised later.

Any signatory to the EPPRD can request for additional pests to be categorised and added to *schedule 13 of the EPPRD*. Contact **EPPRD@phau.com.au** for more information and guidance on this process.

Once a substantiated request has been received by PHA a group of independent scientific technical experts (known as the categorisation group) will be convened to assess all known information about the EPP to identify the public and private benefits. Full details can be found in *clause 7 and schedule 3 of the EPPRD*.

Categorised Potato EPPs

The EPPs for the potato industry that are categorised and listed on *schedule 13 of the EPPRD*[47] are listed in Table 18.

Table 18. *Categorised EPPs for potato industry (as at 30 September, 2017)*[48]

Formal Category	Scientific name	Common name
2	*Candidatus* Liberibacter solanacearum (syn. *Candidatus* Liberibacter psyllaurous)	Zebra chip
3	*Clavibacter michiganensis subsp. sepedonicus*	Bacterial ring rot, potato ring rot

[47] For the latest version of *schedule 13*, refer to the EPPRD version found at **www.planthealthaustralia.com.au/epprd**.

[48] Note scientific and common names are listed as they appear in the EPPRD

Formal Category	Scientific name	Common name
3	*Globodera rostsochiensis* (exotic pathotypes)	Golden potato cyst nematode
3	*Leptinotarsa decemlineata*	Colorado potato beetle
3	*Liriomyza sativae*	Vegetable leafminer
3	*Potato spindle tuber viroid* (Pospiviroid)	Potato spindle tuber viroid (PSTVd)
3	*Verticillum dahliae* (exotic defoliating strains)	Verticillium wilt
4	*Mythimna unipuncta*	Rice armyworm
4	*Peridroma saucia*	Pearly underwing moth, variegated cutworm

How to respond to a suspect EPP

Following the detection of a suspect EPP, the relevant state or territory agricultural agency will be notified either directly or through the Exotic Plant Pest Hotline. Within 24 hours of the state agency having a reasonable suspicion that they are dealing with an EPP the, Chief Plant Health Manager (CPHM) of the state or territory, will inform the Australian Chief Plant Protection Officer (ACPPO) within the Federal Department of Agriculture and Water Resources. All signatories affected by the EPP (both government and industry) will be notified immediately, and the Consultative Committee on Emergency Plant Pests (CCEPP) convened (this process is outlined in Figure 4). Only the industry signatories affected by the EPP are engaged in the response process and are determined based on the known hosts of the EPP.

Figure 4. *Reporting suspect EPPs and notification process*

Once a pest is notified to the CCEPP, all signatories that are affected by the EPP play a part in the national management of the incursion. This is primarily through the two national decision making committees, both of which AUSVEG have a representative on:

- The Consultative Committee on Emergency Plant Pests (CCEPP) which provide technical expertise on the response
- The National Management Group (NMG) which acts on recommendations from the CCEPP and make the final decisions about EPP responses and funding.

Technical and economic considerations are reviewed, and a decision made on whether to eradicate using the cost sharing mechanisms under the EPP (i.e. develop a response plan) or take another course of action (potentially to contain or stand down the response to the incursion, which will mean long term management of the pest).

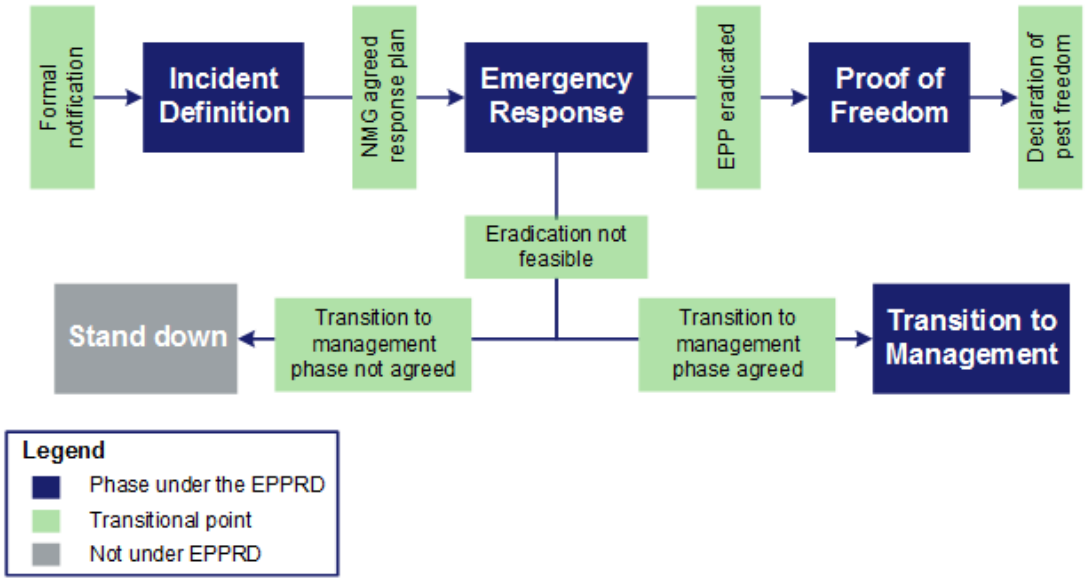
The relevant state/territory agriculture department is responsible for the on ground response to EPPs and will adopt precautionary emergency containment measures if appropriate. Depending on the nature of the EPP, measures could include:

- Restriction of operations in the area

- Disinfection and withdrawal of people, vehicles and machinery from the area
- Restricted access to the area
- Control or containment measures

Each response to an EPP is applied differently due to the nature of the incursion, however each follows the defined phases of a response as summarised in Figure 5 and in the text below.

Figure 5. *EPPRD response phases*



Incident definition phase

The aim of the incident definition phase is to investigate the nature and extent of the incursion. The phase commences following formal notification to the CCEPP and continues until the NMG endorses a response plan or determines that the EPP is not eradicable.

Emergency response phase

The aim of the emergency response phase is to implement the response plan to eradicate the EPP. This phase commences once a response plan is endorsed by the NMG and continues until the CCEPP declares that the EPP has been eradicated or it is deemed by the NMG that the EPP is no longer eradicable.

Proof of freedom phase

The aim of the proof of freedom phase is to undertake activities to confirm whether the EPP has been eradicated. This phase begins once the CCEPP determines that the emergency response activities have been successfully completed and continues until the NMG declares freedom from the EPP or that the proof of freedom phase should come to an end.

Transition to management phase

The aim of the transition to management phase is to undertake activities seeking eradication of the EPP during an emergency response to management of the EPP outside of the EPPRD. If during the course of the emergency response phase the CCEPP and NMG agree it is no longer feasible to eradicate the EPP, a transition to management phase may be agreed. This phase will begin if determined by the NMG as appropriate and transition to management activities are achievable within a defined and reasonable timeframe not exceeding 12 months.. This phase continues until the NMG determines that transition to management has been completed or that the transition to management phase should come to an end.

Further information about the response processes under the EPPRD can be found in the PHA Foundation Course and National EPP Response Management BOLT courses[49].

Owner Reimbursement Costs

Owner Reimbursement Costs (ORCs) were developed to encourage early reporting and increase the chance of successful eradication. ORCs are included in the shared costs of a response and are available to eligible growers to alleviate the financial impacts of crops or property that are directed to be destroyed under an agreed response plan.

ORCs are paid to the owner and may cover direct costs associated with implementing a response plan, including:

- Value of crops destroyed
- Replacement of destroyed capital items
- Fallow periods
- Extra treatments directed under the response plan

[49] All of PHA's BOLT courses are feely available at **https://pha.canopihr.com.au**

ORCs are only available when there is an approved response plan under the EPPRD, and only to industries that are signatories to the EPPRD, such as the potato industry. The value of ORCs is directed by the **ORC Evidence Framework** and is based on an agreed valuation approach developed for each industry.

Further information about ORCs is available from **www.planthealthaustralia.com.au/biosecurity/incursion-management/owner-reimbursement-costs/**

Industry involvement in a response

AUSVEG are the peak industry body for the potato industry, i.e. signatory to the EPPRD, and for the purposes of the EPPRD, represent the crops listed in *schedule 7 of the EPPRD*. AUSVEG is the key industry contact point if a plant pest affecting the potato industry is detected and responded to using the EPPRD (Table 19). AUSVEG representatives will sit on the CCEPP and the NMG and make decisions on behalf of the potato industry. It is important that all signatories to the EPPRD ensure their contacts for these committees are nominated to PHA[50] and updated swiftly when personnel change.

Table 19. *Contact details for AUSVEG .*

Website	**www.ausveg.com.au**
Postal address	PO BOX 138 Camberwell VIC 3124
Email	info@ausveg.com.au
Phone	(03) 9882 0277
Fax	(03) 9882 6722

Cooperation is required between relevant government and industry bodies to ensure the effective development and implementation of a response to an EPP, and the management of media, communications and trade issues. As such, there is also the opportunity for AUSVEG to appoint an Industry Liaison Coordinator in the State Coordination Centre for the response and Industry Liaison Officers in Local Control Centres at the heart of the response activities to allow industry input in all levels of the response activities. In addition to the state or territory agricultural agency leading the response, AUSVEG have the responsibility for delivering relevant industry communication and media regarding the incursion (refer to PLANTPLAN and the supporting documents for information on approved communications during a response).

[50] Contact **EPPRD@phau.com.au** for more information.

Readers should refer to PLANTPLAN or undertake the relevant BOLT courses[49] for further information.

References

Plant Health Australia Ltd (2017) Government and Plant Industry Cost Sharing Deed in respect of Emergency Plant Pest Responses (2017) Plant Health Australia, Canberra, ACT.

PLANTPLAN (2016) PLANTPLAN Australian Emergency Plant Pest Response Plan. Version 3. (**www.planthealthaustralia.com.au/plantplan**).

APPENDIX 1: PROFILE OF THE AUSTRALIAN POTATO INDUSTRY

Potato industry background

AUSVEG

AUSVEG is the national peak industry body, representing Australian vegetable and potato growers. Their members include Growcom, NSW Farmers Association, NT Farmers Association, Potato Growers Association of WA, Tasmanian Farmers & Graziers Association, AUSVEG Vic, Vegetables WA and AUSVEG SA.

This association is involved in a number of projects to improve the productivity and sustainability of the vegetable industry. The vegetable industry is multifaceted, combining approximately 6000 growers across 3259-5832 farms (Horticulture Innovation Australia Limited, 2017b) and spanning numerous types of vegetable crops, including potatoes, across the various growing regions within Australia.

Crop production profile

The potato was domesticated in southern modern-day Peru (Spooner et al., 2005). A single domestication event is estimated to have occurred between 8,000 BCE and 5,000 BCE (Brown and Henfling, 2014, Hawkes, 1994a), however, it is known that the potato was domesticated once (Spooner et al., 2005). Andean societies had developed highly organised agricultural systems based on potatoes and maize by the time the Spanish arrived in South America (Brown and Henfling, 2014). There were multiple introductions of the potato into Europe, with the first introduction by the Spanish in the late 1500s (Hawkes, 1994a).

Potatoes were first produced in Europe for animal feed, however production increased rapidly following the introduction of new varieties, and the discovery that they could produce high yields when grain crops failed. (Horton and Anderson, 1994, Cooke and Andersson, 2013). Potato production replaced other staple food crops such as buckwheat and oats in Europe and peaked in 1850 as it was the second cheapest stable crop after wheat (Horton and Anderson, 1994). A cold wet, summer and the introduction of the pathogen *Phytophthora infestans* in 1845 resulted in the failure of the potato crop across Europe in 1845 (Cooke and Andersson, 2013). Due to the reliance on potato and social structures at the time, Ireland was particularly affected by the failure of the crop resulting in mass famine (Cooke and Andersson, 2013, Agrios, 2005). The Irish potato famine resulted in the deaths of approximately 1 million people and the emigration of a further million which reduced Ireland's population by between a quarter and a fifth (Ross, 2002, Kinealy, 1994).

Seven of the 230 potato species are cultivated, however, one species, *Solanum tuberosum,* is the main species that is grown worldwide (van de Berg and Groendijk-Wilders, 2014, Hawkes, 1994b). The distinction between the different potato species is poorly defined due to hybridization events that have occurred throughout the history of potato cultivation (van de Berg and Groendijk-Wilders, 2014). Potatoes are in the nightshade family (Solanaceae) along with a number of other important horticultural plants such as eggplant (*Solanum melongena*), tomato (*Solanum lycopersicum*) and capsicum (*Capsicum annuum*) as well as a number of important weeds species such as apple of Sodom (*Solanum linnaeanum*).

Potato is grown in over 100 countries and is the fourth largest food crop, behind maize, wheat, and rice (Stevenson et al., 2001). They can be grown in temperate, subtropical and tropical conditions, however, tuber formation is inhibited by temperatures above 30°C and below 10°C (Food and Agriculture Organization, 2008).

Potatoes are considered to be a perennial herbaceous dicot, however, in commercial production they are grown as annuals. They are generally propagated from tubers, known as seed potatoes, rather than from true seed, except in potato breeding programs (Stevenson et al., 2001). Potatoes are produced across Australia except in the NT and the ACT (Horticulture Innovation Australia Limited, 2017). There are major production regions in each of the states is outlined in Table 20. In the 2015-16 growing season Tasmania was the largest producer of potatoes closely followed by South Australia (Horticulture Innovation Australia Limited, 2017). In Australia potatoes are produced year round with the lowest production in December (Horticulture Innovation Australia Limited, 2017). Australia exported 37,212t of potatoes in 2015-16 representing approximately three per cent of production (Horticulture Innovation Australia Limited, 2017). The majority of the Australian crop, approximately 64 per cent, went to the processing market in 2015-16, while the remaining 34 per cent was sold as fresh potatoes (Horticulture Innovation Australia Limited, 2017).

Table 20. *Major growing regions of potato and production by state (Horticulture Innovation Australia Limited, 2017).*

State	2015/16 Production by state (t)	Major growing region
New South Wales	88,033	Riverina
Queensland	47,374	Atherton, Bundaberg and Lockyer Valley
South Australia	441,323	Murray region and Riverland
Tasmania	469,459	North West Tasmania
Victoria	257,107	Gippsland
Western Australia	39,723	Manjimup and Perth region

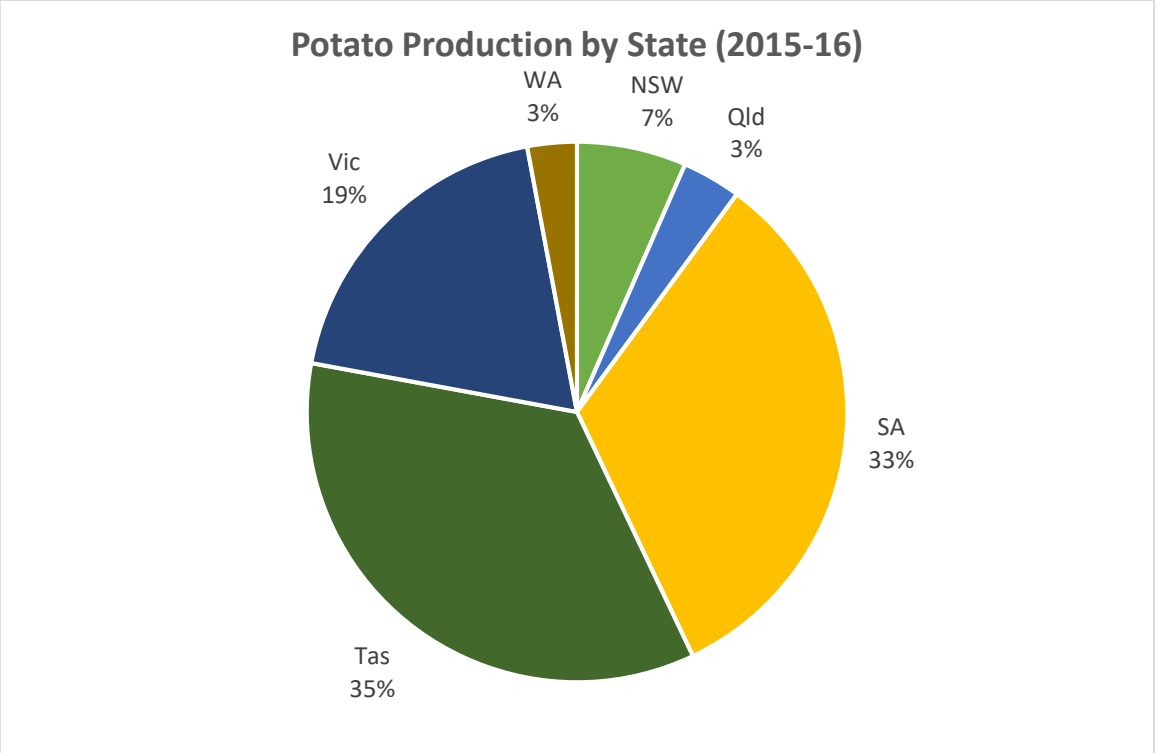


Figure 6. *Production of potatoes by state (Horticulture Innovation Australia Limited, 2017).*

References

Agrios, G.N. (2005) Plant Pathology 5th Ed. Elsevier-Academic Press. San Diego, USA.

Brown, C.R. and Henfling, J.-W. (2014) A history of the potato. In: Navarre, R., Pavek, M.J. (eds) The Potato: Botany, Production and Uses. CAB International, Wallingford, UK, pp 1-11.

Cooke, D.E.L. and Andersson, B (1993) *Phytophthora infestans* and Potato Late Blight in Europe. In

Food and Agriculture Organisation (2009) *"International Year of the Potato 2008 – The potato"* Available from **ftp://ftp.fao.org/docrep/fao/011/i0500e/i0500e02.pdf**

Lamour, K. (ed) *Phytophthora*: A Global Perspective. CAB International, Wallingford, UK, pp. 59-67.

Hawkes, J.G. (1994a) History of the Potato. In: Harris, P.M. (ed) The Potato Crop: Scientific Basis for Improvement. Chapman and Hall, London, UK, pp. 1-12

Hawkes, J.G. (1994b) Biosystematics of the Potato. In: Harris, P.M. (ed) The Potato Crop: Scientific Basis for Improvement. Chapman and Hall, London, UK, pp. 1-12

Horton, D.E. and Anderson, J.L. (1994) Potato Production in the Context of the World and Farm Economy. In: Harris, P.M. (ed) The Potato Crop: Scientific Basis for Improvement. Chapman and Hall, London, UK, pp. 794-96. pp. 794-815.

Horticulture Innovation Australia Limited (2017) 2014/15 Australian Horticulture Statistics Handbook. Available from: **http://horticulture.com.au/wp-content/uploads/2016/10/Australian-Horticulture-Statistics-Handbook-Vegetables.pdf**

Kinealy, C. (1994) This Great Calamity: The Irish Famine 1845-52, Gill & Macmillan, Dublin, Ireland.

Ross, D. (2002) Ireland: History of a Nation, Geddes & Grosset Ltd, New Lanark UK.

Spooner, D.M., McLean, K., Ramsay, G., Waugh, R. and Bryan, G.J. (2005). A single domestication for potato based on multilocus amplified fragment length polymorphism genotyping. PNAS. 102 (41): 14694–99.

Van den Berg, R.G. and Groendijk-Wilders, N. (2014) A history of the potato. In: Navarre, R., Pavek, M.J. (eds) The Potato: Botany, Production and Uses. CAB International, Wallingford, UK, pp 12-28..

APPENDIX 2: THREAT SUMMARY TABLES

Potato industry threat summary tables

The information provided in the threat summary is an overview of exotic plant pest threats to the potato industry. More than 200 exotic plant pests were identified. Summarised information on entry, establishment and spread potentials and economic consequences of establishment are provided where available. Pests under official control[51] or eradication may be included in these tables where appropriate. However, potato pests that are established but regionalised within Australia are not covered by TSTs, but may be assessed in state biosecurity plans. Assessments may change given more detailed research, and will be reviewed with the biosecurity plan.

Full descriptions of the risk rating terms can be found on page 62. An explanation of the method used for calculating the overall risk can be found on the PHA website[52]. Additional information on a number of the pests listed in the TSTs can be found in pest-specific information document (Table 5).

[51] Official control defined in ISPM No. 5 as the active enforcement of mandatory phytosanitary regulations and the application of mandatory phytosanitary procedures with the objective of eradication or containment of quarantine pests or for the management of regulated non-quarantine pests

[52] Available from **www.planthealthaustralia.com.au/biosecurity/risk-mitigation**

Invertebrates

***Table 21**. Potato invertebrate threat summary table*

'Unknown' indicates insufficient information available to make an assessment of risk

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
ACARI (Mites e.g. spider and gall mites)										
Tetranychus canadensis	Four-spotted spider mite, Canadian spider mite	Potato, sweet potato, rye, wheat, grapevine, maize, peanut	Leaves	Infested plant material, machinery, personal effects. Wind dispersed.	North America	LOW	HIGH	HIGH	LOW	**VERY LOW**
Tetranychus cinnabarinus	Carmine spider mite	Potato, sweet potato, okra, peanut, apple, papaya, watermelon, citrus, cucurbits, strawberry, cotton, tomato, cassava, banana, beans, peach	Leaves	Infested plant material, machinery, personal effects. Wind dispersed.	Worldwide except Australia and New Zealand	HIGH	HIGH	HIGH	LOW	**LOW**
COLEOPTERA (Beetles and weevils)										
Agriotes lineatus	Common click beetle, wireworm	Polyphagous including potato, *Allium* spp., corn, carrot, tomato	Whole plant	Larvae and pupae are soil borne	Widespread in Europe, present in North America	MEDIUM	HIGH	MEDIUM	MEDIUM[53]	**LOW**
Agriotes mancus	Wheat wireworm	Polyphagous including potato, tomato, wheat, turnip, beans, maize	Seeds, leaves, roots, stems	Larvae and pupae are soil borne	United States and Canada	MEDIUM	HIGH	MEDIUM	MEDIUM	**LOW**

[53] Adults are carnivorous but sometimes attack leaves of cereals. Majority of damage is caused by larvae, which attack roots (CABI).

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Agriotes obscurus (syn. *A. hirtellus*)	Dusky wireworm, click beetle, dark click beetle	Potato, sugarbeet, cereals	Tubers, roots	Adults capable of flight	Europe, North America	MEDIUM	HIGH	MEDIUM	MEDIUM	**LOW**
Anomala cupripes	Large green chafer beetle	Potato, soybean, clove, cowpea, maize	Leaves	Adults capable of flight, wind dispersal	China, Malaysia, Singapore, Thailand, Vietnam	LOW	LOW	LOW	LOW	**NEGLIGIBLE**
Cerotoma ruficornis	Red horned leaf beetle	Potato, soybean, common bean, cowpea and other legumes, sweet potato	Above ground plant parts; larvae affect roots	Adults capable of flight. Larvae may be transported in soil	Central and South America	LOW	UNKNOWN	UNKNOWN	UNKNOWN	**UNKNOWN**
Cleonis punctiventris		Potato, tobacco, maize, sugarbeet	Leaves	Larvae and pupae are soil borne	Europe, the Middle East and Asia	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	**UNKNOWN**
Conoderus falli	Southern potato wireworm	Potato, peanut, maize, soybean, cotton, sweet potato, tomato, cowpea, tobacco	Tubers and roots	Possibly spread via contaminated soil. Adults capable of flight	North America	LOW	LOW	MEDIUM	MEDIUM[54]	**VERY LOW**
Conoderus spp. **(including *C. rudis* and *C. amplicollis*)**	Wireworm	Polyphagous including potato, rockmelon, beetroot, cabbage, carrot, celery, corn, turnip, cowpea, mustard, sweet potato, tomato, peanut, strawberry, tobacco	Tubers and roots	Possibly spread via contaminated soil. Adults capable of flight	North and South America	LOW	MEDIUM	MEDIUM[55]	MEDIUM	**LOW**

[54] Eggs laid in soil. Larvae are highly polyphagous and adults are nocturnal and feed on nectar and pollen (Norris Jr, 1953).
[55] Appears to have spread through much of the southern United States from South America (Stone, 1975).

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Diabrotica balteata	Banded cucumber beetle	Polyphagous including potato, beans, cucurbits, sweet potato, tomato, rice, brassicas, maize, wheat, sorghum	Leaves, roots, flowers, fruit	Larvae and pupae are soil borne	North, Central and South America	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN[56]	**UNKNOWN**
Diabrotica speciosa	Cucurbit beetle, Chrysanthemum beetle, San Antonio beetle	Polyphagous including potato, pumpkin, cucurbits, maize, wheat, peanut, soybean, common bean, dahlia, chrysanthemum	Flowers and leaves (adults), roots (larvae)	Larvae and pupae are soil borne	Central and South America	LOW	MEDIUM	MEDIUM	MEDIUM[57]	**LOW**
Diabrotica undecimpunctata	Spotted cucumber beetle, southern corn rootworm	Potato, melons, cucumber, peanut, sweet potato, soybean, maize	Leaves, roots, flowers	Adults capable of flight over long distances	United States, Canada and Mexico	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	**UNKNOWN**
Diaprepes abbreviatus	Citrus weevil, West Indian weevil, sugarcane rootstalk borer	Polyphagous including potato, citrus, sugarcane, corn, sorghum, sweet potato	Flowers, leaves, roots	Larvae and pupae are soil borne, adults transported on tractors and vehicles	The Caribbean, North, Central and South America	MEDIUM[58]	HIGH	MEDIUM	HIGH[59]	**MEDIUM**
Epicaerus cognatus	Mexican potato weevil	Potato	Below-ground plant parts	Adults capable of flight, larvae are soil borne	Mexico	UNKNOWN	LOW	LOW	LOW	**NEGLIGIBLE**

[56] *D. balteata* does not appear to primarily attack potatoes, however, the polyphagous and sporadic nature of its feeding makes it an ideal vector of many plant diseases (Gergerich et al 1986).
[57] Larvae feed on roots causing stunting and occasionally plant death; adults cause defoliation and general leaf damage (CABI).
[58] Has been intercepted in the Netherlands (EPPO 2014).
[59] Larvae can severely damage plants through feeding on roots, which, may increase the potential of *Phytophthora* infection, when *Phytophthora* is present in the soil (CABI 2015).

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Epicauta vittata	Striped blister beetle	Potato, tomato, alfalfa, soybean, sugarbeet, cotton, lucerne	Leaves	Adults capable of flight, larvae and pupae are soil borne	Central Africa, North and South America	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN[60]	**UNKNOWN**
Epilachna dregei	Potato ladybird	Potato, tomato, cucurbits	Leaves	Infested plant parts	Southern Africa	LOW	MEDIUM	MEDIUM	LOW	**VERY LOW**
Epilachna ocellata		Potato, eggplant, capsicum, bean, cucumber, tomato, radish, mung bean	Leaves	Infested plant parts	India	LOW	MEDIUM	MEDIUM	LOW	**VERY LOW**
Epilachna pusillanima	Potato epilachna	Potato, cowpea, wax gourd, watermelon, cucumber, cucurbits, loofah	Leaves	Infested pant parts	Bangladesh, India, Myanmar, Indonesia, Japan[61]	LOW	MEDIUM	MEDIUM	LOW	**VERY LOW**
Epilachna vigintioctomaculata	Large 28-spotted lady beetle	Potato, eggplant, panax	Leaves	Infested plant parts	India	LOW	MEDIUM	MEDIUM	LOW	**VERY LOW**
Epitrix cucumeris	Potato flea beetle	Potato, tomato, tobacco, eggplant, cucurbits	Leaves and roots (not tubers)	Pupae and diapausing adults are soil borne[62]	North, Central and South America and southern Europe[63]	LOW	LOW	MEDIUM	MEDIUM	**VERY LOW**

[60] Is a known vector of plant viruses (Patel and Pitre 1971, Adams and Selander 1979).

[61] Widespread in southeast Asia and Taiwan and its occurrence in Ishigaki Island in southern Japan, suggests that it may be able to disperse long distances overseas (Nakano and Katakura 1999). It is not known whether the long distance dispersal of this pest occurs through natural movement of human assisted movement (Nakano and Katakura 1999).

[62] Adults potentially carried in plant parts but this rarely occurs in practice.

[63] Native to the Americas and has been recorded in Italy, Russia, Tahiti, Fiji and Hawaii (Orlova-Bienkowskaja 2014).

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Epitrix hirtipennis	Tobacco flea beetle	Potato, tomato, tobacco, eggplant, sweet potato, citrus	Leaves	Infested plant material and eggs, larvae, pupae and overwintering adults are soil borne. Adults are capable of flight.	Guyana, Mexico, Central America, Italy	MEDIUM	MEDIUM	MEDIUM	UNKNOWN	**UNKNOWN**
Epitrix papa[64]		Potato	Tubers	Adults capable of flight	Southern Europe	LOW	LOW	MEDIUM	UNKNOWN	**UNKNOWN**
Epitrix tuberis	Tuber flea beetle	Polyphagous including potato, tomato, eggplant, capsicum, chilli, beetroot, cucumber, spinach, lettuce, lucerne, tobacco	Leaves, roots, tubers, flowers, fruit	Infested plant material, adults capable of flight and pupae are soil borne.	United States and Canada	LOW	LOW	MEDIUM	UNKNOWN[65]	**UNKNOWN**
Holotrichia javana		Potato	Leaves	Larvae and pupae are soil borne	Indonesia	MEDIUM	LOW	MEDIUM	UNKNOWN	**UNKNOWN**
Holotrichia serrata	White grub, chafer beetle, cock chafer, leaf chafer, May beetle, June beetle	Polyphagous including potato, peanut, sorghum, sugarcane, riche, chilli, tobacco, soybean, coconut	Roots and tubers	Eggs, larvae and pupae are soil borne	India, Bangladesh and throughout the Pacific	MEDIUM	HIGH	HIGH	MEDIUM[66]	**MEDIUM**

[64] Only recently classified as an individual species and is often misidentified as *E. similaris* (Orlova-Bienkowskaja 2015).

[65] Is a known vector of several pathogens including *Phytophthora infestans*, *Ralstonia solanaceaurm*, *Streptomyces scabiei* and *Potato spindle tuber viroid* (CABI).

[66] Larvae are subterranean and therefore can be difficult to control as there are few control options available. However, a chlorpyriphos soil drench has been shown to effectively control the pest in some crops (Patil et al 1991).

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Hypera postica	Lucerne weevil	Polyphagous including potato, chickpea, lettuce, alfalfa, lucerne, clover, stone fruit, rubus, wheat, faba bean	Above-ground plant parts	Adults capable of flight	Asia including Indonesia, Europe, Africa, North America and restricted distribution in the South Pacific	MEDIUM	MEDIUM	MEDIUM	LOW	**VERY LOW**
Leptinotarsa decemlineata	Colorado potato beetle	Solanaceae including tomato, potato and eggplant	Above-ground plant parts	Infested plant material. Adults capable of flight over long distances[67]	Widespread in Asia and Europe, present in North and Central America.	MEDIUM	MEDIUM	HIGH	EXTREME[68]	**HIGH**
Limonius californicus	Sugarbeet wireworm	Polyphagous including potato, watermelon, wheat, lucerne, sugarbeet, beetroot, beans	Seeds, roots, tubers, stems	Infested plant material (tubers). Adults capable of flight. Eggs, larvae and pupae are soil borne	Canada and the United States	LOW	MEDIUM	MEDIUM	MEDIUM[69]	**LOW**
Melanotus communis	Common wireworm	Potato, sugarcane	Seeds, seedlings, tubers, roots	Adults capable of flight. Larvae are soil borne	North America	UNKNOWN	MEDIUM	MEDIUM	HIGH[70]	**UNKNOWN**

[67] This includes flight over large bodies of water. They can survive several days in sea water before being washed ashore. Adults can contaminate bulk material moved in trade, while larvae can be readily transported on plant parts (CABI).
[68] *L. decemlineata* is one of the most economically damaging pests of potato worldwide (Hare 1990) as it has developed resistance insecticides from a number of different chemical classes (CABI).
[69] Larvae can burrow into tubers, rendering them unmarketable (CABI).
[70] Larvae damage developing tubers, and can cause up to 45% of potatoes to be downgraded due to damage from wireworms (Jansson and Lecrone 1989).

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Melolontha melolontha	White grub cock chafer, common cock chafer, June bug, May bug	Polyphagous including potato, beetroot, hazel, strawberry, apple, pastures, oak, raspberry, dandelion, turf grass, grape	Roots	Adults capable of flight. Larvae are soil borne	Northern Europe, India and China and United States	LOW	MEDIUM	MEDIUM[71]	LOW	**VERY LOW**
Metapocyurtus spp. (syn. *Trachycyrtus spp.*)	Weevil borer, pineapple weevil, broad-nosed weevil	Polyphagous including potato, pineapple, citrus	Leaves, stems	Larvae and pupae are soil borne	Philippines	UNKNOWN	UNKNOWN[72]	UNKNOWN	UNKNOWN	**UNKNOWN**
Monolepta signata	White-spotted flea beetle	Potato, beans, peanut tobacco, sunflower, soybean, chickpea	Leaves	Adults capable of flight	Laos, Vietnam, Malaysia, Cambodia	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	**UNKNOWN**
Myllocerus subfasciatus	Ash weevil	Potato, eggplant	Leaves, roots	Larvae and pupae are soil borne	India	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	**UNKNOWN**
Naupactus xanthographus	South American fruit tree weevil	Polyphagous including potato, citrus, apple, lucerne, grapevine	Whole plant	Infested plant material, larvae and pupae are soil borne	South America, Indonesia	MEDIUM	LOW	LOW	MEDIUM[73]	**VERY LOW**
Phyllophaga smithi	White grub	Potato, citrus, yam, sweet potato, banana, bean, pea, sugarcane, maize	Roots	Infested plant material (adults and larvae). All life stages are soil borne.	Caribbean, Madagascar	LOW	UNKNOWN	UNKNOWN	UNKNOWN	**UNKNOWN**

[71] Broad host range allows it to spread readily (CABI).

[72] Usually found between 500-2000m above sea level. Habitat typically consists of tropical vegetation or mixed forests with dense undergrowth along rivers and ravines or on ridges and mountains. However, habitat destruction has led to them being observed at lower elevations where they can destroy potato crops (Yap 2007).

[73] Adults borne externally on fruit (CABI). Primary symptom is foliage wilt because of larvae feeding on roots. Adults cause superficial damage to foliage and fruit (Caballero 1972).

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
***Premnotrypes spp.* (including *P. solani*)**	Andean potato weevil	Potato	Whole plant[74]	Larvae and pupae are soil borne	Peru	LOW	LOW	LOW	MEDIUM[75]	**VERY LOW**
Rhigopsidius tucumanus	Potato weevil	Potato	Tubers	Adults capable of flight	Argentina, Bolivia, Chile	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	**UNKNOWN**
Systena basalis	S-lettered leaf beetle	Potato, sweet potato, beans, tomato, sugarcane	Leaves, roots	Larvae are soil borne	Cuba, Germany	LOW	UNKNOWN	UNKNOWN	UNKNOWN	**UNKNOWN**
Systena s-littera	S-lettered leaf beetle	Potato, sugarbeet, pigeon pea, carrot, soybean, cucurbits, sweet potato, beans, tomato, cassava, sugarcane, eggplant	Leaves, roots	Larvae are soil borne	Central and South America	LOW	UNKNOWN	UNKNOWN	UNKNOWN	**UNKNOWN**
DIPTERA (Flies and midges)										
Bactrocera zonata	Peach fruit fly	Polyphagous including potato, tropical fruit crops, tomato, peach, fig	Fruit	Adults capable of flight. Larvae transported by movement of infested fruit	Vietnam and Sri Lanka, North Africa	MEDIUM	HIGH	HIGH	LOW[76]	**LOW**
***Contarinia spp.* (including *C. maculipennis*, *C. lycipersici* and *C. solani*)**		Polyphagous including potato, orchid, hibiscus, tomato, eggplant, pepper, bitter melon, other vegetable and ornamental species	Flowers, fruit, leaves	Adults capable of flight. Larvae transported by movement of infested fruit	Europe, Asia, North America	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	**UNKNOWN**

[74] Adults feed on above ground plant parts, while larvae on roots and tubers.

[75] Appears to only affect potatoes grown at altitudes higher than 2500m, however, severe infestations can cause total loss of marketable yields when gone untreated, and there are no known natural enemies (Vreugdenhil et al 2007).

[76] The processing sector does not currently operate in Northern Australia. If a processing sector was to develop in northern Australia, the economic rating would be low or medium.

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Delia florilega	Bean fly, turnip maggot	Polyphagous including potato, tomato, onion, leek, cauliflower, cabbage, cruciferous crops, bean, maize, garlic, flowering bulbs	Bulb, seedlings	Infested plant material. Adults capable of flight	North America, Norway	HIGH	MEDIUM[77]	HIGH	LOW	**LOW**
Liriomyza huidobrensis	Serpentine leaf miner	Polyphagous including potato, beets, spinach, lupin, faba bean, field pea, cow pea, common bean	Leaves	Infested plant material.[78] Adults capable of flight.	Worldwide[79] excluding Australia and New Zealand	HIGH[80]	HIGH	HIGH	HIGH	**HIGH**
Liriomyza sativae	American leaf miner, vegetable leaf miner	Wide host range including potato, *Allium* spp., bean, pea, eggplant, pumpkin, cucumber, beets, lettuce, celery	Leaves	Infested plant material. Adults capable of flight.[78]	Worldwide[81] excluding Australia[82] and New Zealand	HIGH[83]	HIGH	HIGH	HIGH	**HIGH**

[77] Mean fecundity is lower and fewer larvae reach pupation at temperatures above 40°C (Kim and Eckenrode 2014).
[78] Eggs and larvae may be carried internationally in above-ground plant parts.
[79] Found in Indonesia
[80] Has been intercepted coming at the Australian border.
[81] Present in New Calendonia, PNG, Vanuatu therefore a natural dispersal risk
[82] Detected in Queensland Cape York Peninsula (Far Northern Biosecuirty zone 1). Eradication is not considered feasible but measures are being undertaken to prevent further spread.
[83] Is established in the Torres Strait and phytosanitary measures are in place to ensure it does not spread to the Australian mainland and Tasmania (IPPC 2014).

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Liriomyza trifolii	American serpentine leaf miner	Broad host range including Alliaceae, Cucurbitaceae, Fabaceae and Solanaceae (including potato)[84]	Leaves	Infested plant material (eggs and larvae). Adults capable of flight. Infested machinery and personal effects.	Worldwide excluding Australia and New Zealand.[85]	HIGH	HIGH	HIGH	HIGH[86]	**HIGH**
Tipula paludosa	European crane fly, leatherjacket	Potato, celery, sugarbeet, carrot, legumes, lettuce, lucerne, tobacco, pea, wheat, maize	Leaves, stems, roots	Adults capable of flight, larvae and pupae are soil borne	Europe, the United States and Canada	LOW	UNKNOWN	UNKNOWN	UNKNOWN	**UNKNOWN**
GASTROPODA (Slugs and snails)										
Arion vulgaris	Spanish slug, invasive arion	Polyphagous including potato, sunflower, Persian clover, canola, lupin, lucerne, wheat, faba bean, maize, field pea, common bean	Above ground plant parts	Infested plant material	Europe	MEDIUM	MEDIUM	MEDIUM[87]	UNKNOWN	**UNKNOWN**
Helix pomatia	French escargot	Polyphagous including potato, tomato, carrot, hawthorn	Above ground plant parts	Infested plant material	Europe	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	**UNKNOWN**

[84] Wide host range over 400 species of plants in 28 families.
[85] This pest has a worldwide distribution inclusing the South Pacific. It has been intercepted at the Australian border.
[86] Is known to vector plant viruses (Zitter et al 1980).
[87] Had been considered highly invasive in Central Europe, but new research suggests that it did not spread from south-west Europe as previously thought but was native to Central Europe all along (Pfenninger et al 2014).

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
HEMIPTERA (Stink bugs, aphids, mealybugs, scale, whiteflies and hoppers)										
Adelphocoris lineolatus	Lucerne bug	Polyphagous including potato, tomato, asparagus, cucumber, wheat, strawberry, soybean, sunflower, lettuce, lucerne, tobacco, cut flowers, pea, apricot, peach, pears, vetch sesame	Leaves, buds, flowers, stems, seeds	Adults capable of flight, but not over long distances	Europe, in China, Japan, Canada and the United States	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	**UNKNOWN**
Amrasca devastans (syn. *Amrasca biguttula biguttula*)	Indian cotton jassid	Polyphagous including potato, cotton	Leaves	Infested plant material	China, India, Japan, Laos, Taiwan, Indonesia, Myanmar, the Philippines, Thailand, Vietnam	LOW	HIGH	HIGH	LOW	**VERY LOW**
Aphis fabae	Black bean aphid	Very broad host range with over hosts including cabbage, cauliflower, radish, celery, chilli, capsicum, eggplant, cucumber, beets, broad bean, bean, pea, cucurbits, grain, potato, legumes	Whole plant	Infested plant material. Adults capable of flight and can be spread long distances on strong wind currents.	Widespread distribution across Asia, Africa, Europe, North and South America	HIGH	HIGH	HIGH	HIGH[88]	**HIGH**

[88] This species can multiply rapidly under warm spring temperatures (CABI). Primary impact comes from direct feeding damage, but can also vector viruses (CABI).

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
***Aphis gossypii* (exotic strains)**	Cotton aphid, melon aphid	Highly polyphagous including potato, lettuce, papaya, citrus, capsicum, melon, cucumber, pumpkin, carnation, sunflower, jasmine, apple, lychee, macadamia, cotton, passionfruit, maize, avocado, tomato	Leaves, flowers, stems	Infested plant material. Adults capable of flight and can be spread long distances on strong wind currents.	Worldwide	HIGH	HIGH	HIGH	HIGH[89]	**HIGH**
Coccidophystrix insolita	Eggplant mealybug, brinjal mealybug	Potato, tomato, eggplant	Whole plant	Infested plant material	Central and southern Africa, Asia and southeast Asia, Guam and Samoa	LOW	MEDIUM	MEDIUM	MEDIUM	**LOW**
Edessa meditabunda	Green and brown stinkbug	Polyphagous including potato, okra, pigeon pea, citrus, beans, cassava, cotton, cocoa, soybean, eggplant, tomato	Leaves, stems	Infested plant material	Central and South America, Indonesia, Pacific Islands	MEDIUM	MEDIUM	MEDIUM	LOW[90]	**VERY LOW**
Edessa rufomarginata		Potato, eggplant, soybean	Leaves, stems	Infested plant material	South America	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	**UNKNOWN**

[89] Due to its extreme polyphagy it can transmit a wide variety of viruses (including potato leafroll virus and potato virus Y, making it an environmental as well as economic concern (CABI).

[90] Applications of *Bacillus thuringiensis* and the insecticides carbaryl, diflubenzurion, dimethoate endosulfan and trichlorophon have been used to control *E. meditabunda* without affecting its natural enemies (Lorenzato and Corseuil 1982).

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Empoasca citrusa (syn. *E. distinguenda*)	Green citrus leafhopper	Polyphagous including potato, faba bean, citrus, cotton, tomato, castor bean, cowpea	Leaves, fruit	Infested plant material. Adults capable of flight and strong wind currents.	South Africa	LOW	UNKNOWN	UNKNOWN	UNKNOWN	**UNKNOWN**
Empoasca fabae	Potato leafhopper	Polyphagous including potato, tomato, alfalfa, green bean, apple, soybean, peanut	Leaves	Infested plant material. Adults capable of flight and strong wind currents.	North America, India	LOW	MEDIUM	MEDIUM	MEDIUM[91]	**LOW**
Empoasca kerri	Cicadellid	Polyphagous including legumes, potato, brinjal, chilli, cowpea, tomato	Leaves	Infested plant material. Adults capable of flight and strong wind currents.	India	MEDIUM	MEDIUM	MEDIUM	LOW	**VERY LOW**
Empoasca vitis	Small green leafhopper	Polyphagous including potato, grape, beans, tomato	Leaves	Infested plant material. Adults capable of flight and strong wind currents.	Europe, North Africa, Asia (Indonesia)	MEDIUM	MEDIUM	MEDIUM	UNKNOWN	**UNKNOWN**
Insignorthezia insignis	Greenhouse orthezia	Polyphagous including potato, tomato, eggplant, capsicum, coffee, lantana, eucalyptus, jacaranda, citrus, sugarcane	Leaves, stems	Infested plant material	Present on every continent except Australia[92]	MEDIUM	HIGH	HIGH	UNKNOWN[93]	**UNKNOWN**

[91] Loss of up to 10% of production value of potato crops has been reported in the United States (Noetzl et al 1985).
[92] Present in New Caledonia and Indonesia.
[93] Usually not a serious pest; its sap-sucking behaviour leads to build-up of sugary deposits on stems which can attract ants or other pests, and can also lead to mould infections or cause leaf-fouling (CABI).

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Jacobiasca lybica	Cotton jassid	Potato, eggplant, tomato, pigeon pea, cotton	Leaves	Infested plant material	India, the Middle East, Africa, Europe, Argentina	LOW	HIGH	HIGH	MEDIUM	**LOW**
Lygus lineolaris	Tarnished plant bug	Polyphagous including potato, rubus, pear, cotton, brassicas, lucerne, strawberry, bean, peach	Whole plant	Infested plant material	North and Central America, Republic of Georgia	MEDIUM	HIGH	HIGH	LOW[94]	**LOW**
Nipaecoccus nipae	Spiked mealybug	Polyphagous including breadfruit, potato, pigeon pea, papaya, coconut, citrus, fig, rubber plant, sweet potato, mango, cassava, mulberry, banana, olive, orchids, grape, avocado, guava, cocoa, ginger	Fruit, leaves, stem	Infested plant material	The Americas, Africa, Europe, Asia, South Pacific	HIGH	MEDIUM	MEDIUM	LOW[95]	**VERY LOW**

[94] This species feeds on above-ground plant parts and while it does not directly impact the tubers it can affect overall health of the plant (CABI).
[95] Damage to foliage and fruit can cause crops to lose their market value (CABI).

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Paracoccus marginatus	Papaya mealy bug	Polyphagous including potato, papaya, citrus, sweet potato, cherry, bean, avocado, mango, hibiscus, cotton, pea, tomato, eggplant, capsicum, pomegranate	Fruit, leaves, stems	Infested plant material (ornamentals)	Asia, Africa, North and Central America	HIGH[96]	MEDIUM	MEDIUM	LOW	**VERY LOW**
Phenacoccus madeirensis	Madeira mealybug, cassava mealybug	Potato, oats, cotton, capsicum, hibiscus, lantana, cassava, eggplant	Whole plant	Infested plant parts	Worldwide except Australia and New Zealand	MEDIUM	MEDIUM[97]	MEDIUM	MEDIUM	**LOW**
Philaenus spumarius	Meadow froghopper	Polyphagous including potato, tomato, beetroot, eucalyptus, lucerne, strawberry, lavender, tobacco, stonefruit, almond, peach, grape, rubus	Stems	Adults capable of flight[98]	Canada and United States, Europe, North Africa, South Asia, the Middle East, China, Japan, New Zealand	HIGH	MEDIUM	MEDIUM	UNKNOWN[99]	**UNKNOWN**

[96] The range of this pest has expended consistently since it was first recorded outside the Caribbean in 1994, reaching as far as Micronesia (CABI).

[97] This species can reproduce parthenogenetically and overwinters as a first or second nymphal instar. Overseas there are several natural enemies which keep population levels low, it but can be a serious pest of crops in areas where natural enemies are not present. The vast majority of the natural enemies of *P. madeirensis* are not present in Australia (CABI).

[98] Adults capable of limited flight but can disperse further when aided by wind. Not known to cross large bodies of water unaided.

[99] Is an effective vector of many diseases including *Xylella fastidiosa* (Genite and Radzyavichyus 1983). While *X. fastidiosa* does not affect potatoes, the potato industry is aware of the risk posed to other industries by this disease.

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Pseudococcus jackbeardsleyi	Jack Beardsley mealybug	Highly polyphagous including potato, tomato, eggplant, pineapple, celery, pigeon pea, mint, capsicum, papaya, citrus, coffee, melon, pumpkin, cotton, sweet potato, cut flowers, lantana, lychee, mango, cassava, grape, banana, sage, rambutan, avocado, guava, ginger, pomegranate, cocoa, tamarind, maize	Leaves	Infested plant parts (leaves and fruit)	North, Central and South America, Africa, South Asia, Southeast Asia (including Papua New Guinea) South Pacific	HIGH	HIGH	HIGH	LOW[100]	**LOW**
Scaphytopius nitridus		Polyphagous including potato, citrus, rice, barley, corn, sugarcane, wheat, sorghum, apple, pear, carrot, grapevine, tomato, papaya, peach, strawberry, *Rubus*, ornamentals	Leaves	Infested plant parts (leaves and fruit)	North America	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	**UNKNOWN**

[100] Not yet considered a serious pest, but given its wide geographic range and polyphagous nature it could become a more serious pest in the future, particularly in the absence of natural enemies (CABI).

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Trialeurodes ricini	Castor bean whitefly	Polyphagous including potato, tomato, eggplant, cucumber, sweet potato, cassava, beans, guava, castor bean, roses, sesame	Leaves	Infested plant parts. Adults capable of flight over short distances.	Sub-Saharan Africa, the Middle East, South Asia, Southeast Asia[101]	HIGH	HIGH	HIGH	MEDIUM[102]	**MEDIUM**
HYMENOPTERA (Ants, bees and wasps)										
Dorylus orientalis	Oriental army ant	Polyphagous including potato, peanut, soybean, cow pea, bean, Chinese cabbage	Roots, tubers	Soil borne	South and Southeast Asia	MEDIUM	MEDIUM	MEDIUM	UNKNOWN[103]	**UNKNOWN**
Pheidologeton diversus	East Indian harvesting ant	Potato, capsicum	Roots	Soil borne	South Asia	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	**UNKNOWN**
ISOPTERA (Termites)										
Microtermes mycophagus		Potato, chickpea, cotton, sugarcane, cowpea	Stems, tubers	Infested plant material. Soil borne	South Asia (India and Pakistan)	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	**UNKNOWN**
LEPIDOPTERA (Butterflies and moths)										
Acherontia atropos	Death's head hawkmoth	Potato, sugarbeet, lantana, tomato, privet, oleander, tobacco, olive, eggplant, honey bees[104]	Leaves	Infested plant material. Adults capable of flight	South Asia and the Middle East, Europe	MEDIUM	MEDIUM	MEDIUM	LOW	**VERY LOW**

[101] There is a localised population in France.
[102] Commonly intercepted in northern Australia. Is a known vector of tomato yellow leaf curl virus and likely other plant viruses (Idriss et al 1997).
[103] Reported to damage 70-90% of potato crops at harvest in India by creating small holes on the surface of tubers (Kishore et al 1990).
[104] The death's head hawkmoth feed on honey in beehives (Pittaway 2017).

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Agrotis biconica	Cutworm	Potato, *Phaseolus*, chickpea, pea	Above ground plant parts	Infested plant material. Adults capable of flight	South Asia	LOW	MEDIUM	MEDIUM	LOW	**VERY LOW**
Agrotis exclamationis	Heart and dart moth	Polyphagous including potato, tomato, tobacco, cabbage, maize	Whole plant	Infested plant material. Adults capable of flight	Europe	LOW	MEDIUM	MEDIUM	LOW	**VERY LOW**
Agrotis malefida	Pale-sided cutworm	Polyphagous including potato, corn, lucerne, barley, bean, beet, cabbage, cauliflower, clover, coffee, collard, oat, cotton, cowpea, rye, cucumber, flax, pea, garlic, lettuce, rice, melon, onion, chard, capsicum, sorghum, soybean, squash, strawberry, wheat, sunflower, tobacco, tomato	Seedlings	Infested plant material. Adults capable of flight	North, Central and South America	LOW[105]	MEDIUM	MEDIUM	MEDIUM	**LOW**
Agrotis repleta (syn. *Feltia repleta*)	Cutworm	Polyphagous including potato, peanut, brassicas, pigeon pea, sweet potato, cucurbits, beans, sugarcane, tomato	Leaves, stems	Infested plant material. Adults capable of flight	Central and South America	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	**UNKNOWN**

[105] Unlikely to be a hitchhiker on plant material as it is subterranean during the day (CABI).

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Agrotis segetum	Turnip moth, cutworm	Polyphagous including potato, brassicas, capsicum, daisy, chickpea, pine, melon, carrot, carnation, freesia, cotton, sunflower, barley, sweet potato, lettuce, lucerne, spruce, blackcurrant, tomato, clovers, wheat, grapevine, corn, gladioli	Leaves, roots	Infested plant material. Adults capable of flight over long distances.	Indonesia, Malaysia, Philippines, Africa, Europe	HIGH	HIGH	HIGH	MEDIUM[106]	**MEDIUM**
Agrotis tokionis	Cutworm	Potato, tobacco, onion, wheat, corn	Leaves	Infested plant material. Adults capable of flight	Asia	LOW	MEDIUM	MEDIUM	LOW	**VERY LOW**
Amorbia emigratella	Mexican leaf roller	Polyphagous including potato, corn, avocado, citrus, sweet potato, beans, tomato, blackberry, broccoli, cocoa, eggplant, peanut, guava, macadamia, papaya	Leaves, fruit	Infested plant material. Adults capable of flight	North America	LOW	UNKNOWN	UNKNOWN	UNKNOWN	**UNKNOWN**

[106] Extent of damage to crops is variable but can be extensive if the larval period coincides with dry, warm weather (Esbjerg 1985).

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Autographa gamma	Silver-Y moth	Polyphagous including potato, cotton, lucerne, field pea, chickpea, corn, cowpea, bean, wheat, soybean, sunflower	Leaves	Infested plant material. Adults capable of flight over long distances	Europe, Asia, North Africa	MEDIUM	HIGH[107]	MEDIUM	UNKNOWN	**UNKNOWN**
Autographa nigrisigna	Beet worm	Potato, cabbage, cowpea	Leaves, stems, flowers, fruit	Infested plant material. Adults capable of flight	East Asia, South Asia, Indonesia	HIGH	HIGH	MEDIUM	LOW[108]	**LOW**
Cacoecimorpha pronubana	Carnation tortrix	Highly polyphagous including potato, faba bean, tomato, avocado, carrots, strawberries, stone fruit, carnation	Leaves, flowers	Infested plant material. Adults capable of flight	Europe and North Africa[109]	LOW	MEDIUM	MEDIUM	LOW	**VERY LOW**
Chrysodeixis chalcites	Tomato looper, green garden looper	Potato, maize, beans, cabbage, tomato	Leaves	Infested plant material. Adults capable of flight	Asia, Africa, Europe	HIGH	HIGH	HIGH	LOW	**LOW**

[107] Egg mortality is lowest at high humidity and periods of wet weather can lead to mass outbreaks (Maceljski and Balarin 1974).
[108] Numbers can be controlled by pheromonal disruption to mating (Koyama et al 1995).
[109] Occurrences in North America, Asia and southern Africa.

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Chrysodeixis includens	Soybean looper	Highly polyphagous including potato, okra, garlic, celery, maize, peanut, asparagus, cabbage, broccoli, pea, pigeon pea, cut flowers, capsicum, lantana, watermelon, tomato, cucurbits, carrot, mint, soybean, beans, sweet potato, cotton, sorghum, lettuce, lucerne, watercress, tobacco, cowpea, avocado, sugarcane, eggplant, passionfruit	Leaves, flowers, fruit	Infested plant material (larvae pupae). Adults capable of flight	North, Central and South America	LOW	MEDIUM	HIGH	UNKNOWN	**UNKNOWN**
Euzophera osseatella	Eggplant stem borer	Eggplant, potato	Stems	Infested plant material (larvae). Adults capable of flight	North Africa	LOW	UNKNOWN[110]	UNKNOWN	UNKNOWN	**UNKNOWN**
Feltia subterranea	Granulate cutworm	Polyphagous including potato, tomato, sugarcane, spinach, capsicum, tobacco, cotton	Leaves, stems	Adults capable of flight	North and South America, Central America and the Caribbean	LOW	UNKNOWN	UNKNOWN[111]	UNKNOWN	**UNKNOWN**

[110] Developmental time is faster at temperatures above 30°C, but females lay fewer eggs at these temperatures (Ali et al 2011).
[111] Is evolving broad spectrum resistance to *Bt* toxins (Gould et al 1992).

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Heliothis virescens (syn. *Helicoverpa viriscens*)	Tomato budworm	Polyphagous including potato, cotton, pigeon pea, chickpea, maize, sunflower, flax, pea, sweetpotato, tomato, bean, tobacco, peanut, soybean, sorghum, common vetch	Above ground plant parts	Adults capable of flight	North, Central and South America	LOW	HIGH	HIGH	MEDIUM	**LOW**
Hepialus humuli	Ghost swift moth	Potato, raspberry, strawberry, lettuce, carrot, hops, grasses	Roots	Adults capable of flight	Europe	LOW	UNKNOWN	UNKNOWN	UNKNOWN	**UNKNOWN**
Hydraecia micacea	Potato skin borer	Potato, tomato, wheat, maize, sugarbeet, *Allium*	Whole plant	Adults capable of flight	North America, eastern and northern Europe	LOW	HIGH[112]	HIGH	HIGH	**MEDIUM**
Keiferia lycopersicella	Tomato pinworm	Potato, tomato, eggplant, horse nettle	Leaves, flowers, fruit	Adults capable of flight. Infested plant material (larvae). Soil borne pupae	North, Central and South America	LOW	UNKNOWN	UNKNOWN	LOW[113]	**UNKNOWN**
Leucinodes orbonalis	Eggplant fruit borer	Potato, sweetpotato, tomato, eggplant, pea	Flowers, young leaves, stems, fruit	Infested plant material. Adults capable of flight. Soil borne pupae[114]	sub-Saharan Africa, the Middle East, Asia[115]	MEDIUM	UNKNOWN	HIGH	UNKNOWN	**UNKNOWN**

[112] It is highly adaptable and its host range has expanded along with its geographic range in North America; this is likely to also be the case if it spreads to more countries (CABI).
[113] Primarily a tomato pest as the larvae damage fruit. This is less of an issue for potatoes.
[114] Last instar larvae can bore into fruit so potentially could be spread by transported fruit.
[115] Including Indonesia and the Philippines.

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Loxostege sticticalis	Beet webworm	Polyphagous including potato, peanut, faba bean, wheat, maize, beets, sunflower, soybean, canola, cucumber, cotton, onion, carrot, flax, lucerne	Leaves	Adults capable of flight over long distances	Asia and Europe, some occurrences in North America	MEDIUM	MEDIUM[116]	HIGH	LOW	**VERY LOW**
Mamestra brassicae	Cabbage armyworm, cabbage moth	Highly polyphagous including potato, onion, leek, garlic, sugarbeet, lettuce, maize, bean, pea, tomato, grapevine, brassicas	Above ground plant parts	Adults capable of flight	Europe, Asia, North Africa	LOW	MEDIUM	MEDIUM[117]	LOW	**VERY LOW**
Mamestra configurata	Bertha armyworm	Polyphagous including potato, sugarbeet, lucerne, brassicas, tobacco, pea, clover, maize	Leaves, seeds, flowers	Adults capable of flight	Canada, United States, Mexico	LOW	MEDIUM	MEDIUM	LOW	**VERY LOW**
Manduca quinquemaculata	Tomato hornworm	Potato, tomato, capsicum, tobacco, eggplant	Whole plant	Infested plant material (eggs and larvae). Adults capable of flight.	North America	LOW	MEDIUM	MEDIUM	UNKNOWN[118]	**UNKNOWN**

[116] Larvae that have stopped feeding in preparation for pupation can undergo diapause, allowing them to survive unfavourable conditions and emerge suddenly in large numbers in a given area (CABI). Diapause may be shorter in warmer conditions (Luo et al 2009).
[117] Egg deposition is delayed or inhibited at temperatures higher than 30°C (CABI).
[118] Has many natural enemies, both parasites and predators, and severe outbreaks of *M. quinquemaculata* are rare when high numbers of these enemies are present (CABI).

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Manduca sexta	Tobacco hornworm	Potato, capsicum, tomato, tobacco, sesame	Whole plant	Adults capable of flight	North, Central and South America[119]	MEDIUM	MEDIUM	MEDIUM	LOW[120]	**VERY LOW**
Mythimna unipuncta	Rice armyworm	Polyphagous including potato, oat, tomato, *Allium*, corn, brassicas, quinoa, lucerne, rice, bean, sugarcane, clover, wheat, maize	Leaves, stems, seeds	Infested plant material (larvae). Adults capable of flight over long distances and via wind currents. Soil borne pupae	North, Central and South America, North Africa, Europe, Asia (including China)	MEDIUM	HIGH	HIGH	MEDIUM	**MEDIUM**
Noctua pronuba	Common yellow underwing moth	Polyphagous including potato, allium, beetroot, cut flowers, carrot, dock, strawberry, lettuce, plantain, grapevine	Whole plant	Adults capable of migratory flight	North America, North Africa and Europe	MEDIUM	MEDIUM	HIGH[121]	UNKNOWN	**UNKNOWN**
Ostrinia nubilalis	European maize borer	Polyphagous including potato, tomato, sweet corn, amaranth, oats, hops, capsicum, peach, cut flowers, soybean, cotton, wheat, maize, sunflower, barley, apple, bean, sorghum	Leaves, stems	Adults capable of flight	Canada, the United States, Europe, North Africa, South Asia, the Middle East, northern China	LOW	MEDIUM	HIGH	MEDIUM[122]	**LOW**

[119] This pest has been recorded in Papua New Guinea (CABI).

[120] Larvae are severe defoliators, with one or two larvae capable of defoliating entire plants (CABI).

[121] Due to its ability to fly long distances and feed on a wide range of hosts, it is likely to be able to spread if introduced as was the case in Canada (Copley and Cannings 2005).

[122] Tunnelling larvae cause wilting and damage and occasionally plant death. Studies in the US reported no yield loss attributed to *O. nubilalis*, but damage caused by the larvae increased susceptibility to disease and reduced marketability (Kennedy 1983).

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Peridroma saucia	Pearly underwing moth, variegated cutworm	Potato, vetch, sweet pea, lucerne	Leaves	Adults capable of flight over long distances	North, Central and South America, Europe and North Africa	LOW	MEDIUM	MEDIUM	UNKNOWN[123]	**UNKNOWN**
Spodoptera eridania	Southern armyworm	Polyphagous including potato, tomato, faba bean, eggplant, cowpea, maize, cotton, avocado, tobacco, beans, carrot, sweet potato, soybean, cut flowers, banana, onion, rice, pumpkin, celery, capsicum, watermelon	Leaves	Infested plant material (larvae). Adults capable of flight over short distances	North, Central and South America	LOW	HIGH	HIGH	LOW[124]	**VERY LOW**
Spodoptera frugiperda	Fall armyworm	Highly polyphagous including quinoa, Solanaceae, maize, sorghum, cowpea, grape, rice, ginger, bean, onion, banana, peach, cotton, pea, soybean, chickpea, cabbage, peanut, asparagus, citrus, amaranth, sugarbeet	Leaves, buds, flowers, stems	Infested plant material (eggs and larvae). Adults capable of flight over short distances	North, Central and South America, Central Africa[125]	LOW[126]	HIGH	HIGH	MEDIUM	**LOW**

[123] Intensive weed control can reduce the need for an amount of control measures taken (Machuca et al 1990).
[124] Is usually only a minor pest of most crops, but severe local infestations can sometimes occur (CABI).
[125] An outbreak of this pest in Nigeria occurred in 2016 from which it spread rapidly to numerous other African countries. There are occasional occurrences of this pest in Germany.
[126] Often intercepted in air-freight on vegetables or fruit being imported into Europe from the New World (EPPO).

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Spodoptera littoralis	Cotton leafworm	Highly polyphagous including potato, tea, plum, tomato, carrot, rice eggplant, okra, onion, amaranth, pea, celery, beans, cowpea, asparagus, beetroot, sugarbeet, cabbage, cauliflower, capsicum, citrus, cut flowers, watermelon, pumpkin, maize, pepper, eucalyptus, cocoa, cotton, sweet potato, lantana, banana, lettuce, tobacco, legumes, soybean, avocado	Leaves	Infested plant material (eggs and larvae). Adults capable of flight	Throughout Europe, the Middle East and Africa	LOW	HIGH	HIGH	MEDIUM[127]	**LOW**
Spodoptera ornithogalli	Yellow striped armyworm	Polyphagous including potato, tomato, allium, capsicum, cucurbits, cotton, soybean, sweet potato, cassava, rice, beans, pea, maize	Leaves	Infested plant material (eggs and larvae). Adults capable of flight	North America	LOW	HIGH	HIGH	MEDIUM	**LOW**
Strymon megarus (syn. *Tecia basilides*)	Pineapple fruit borer	Polyphagous including potato, pineapple, capsicum, hibiscus, mango, eggplant, ornamental bromeliads	Fruit, leaves, flowers	Adults capable of flight	Mexico to Brazil	LOW	MEDIUM	MEDIUM	UNKNOWN	**UNKNOWN**

[127] Considered a pest of quarantine significance by the EPPO due to its broad host range and ability to cause serious destruction to crops in the subtropical and tropical range (EPPO).

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Tecia solanivora (syn. *Scrobipalpopsis solanivora*)	Central American potato tuber moth	Potato	Vegetative organs, tubers	Infested plant material.[128] Adults capable of flight. Soil borne eggs	North, Central and South America	LOW	MEDIUM	LOW	MEDIUM[129]	**VERY LOW**
Trichoplusia ni	Cabbage looper	Highly polyphagous including potato, onion, tomato, eggplant, amaranth, celery, peanut, asparagus, cotton, citrus, mint, beetroot, brassicas, capsicum, okra, cut flowers, cucurbits, carrot, strawberry, soybean, sunflower, sweet potato, bean, lettuce, sweet pea, lucerne, tobacco, parsley, clover, vetch, mung bean, cowpea, maize, horseradish	Leaves	Infested plant material. Adults capable of flight and wind dispersal.	Worldwide except Australia and New Zealand, closest occurrence is in Indonesia	HIGH	HIGH	MEDIUM	LOW	**LOW**
Tuta absoluta	South American tomato moth, tomato leaf miner	Tomato, potato, eggplant, other Solanaceae	Whole plant	Adults capable of flight. Pupae can be soil borne	Asia, Africa, Europe, Central and South America	LOW	HIGH	HIGH[130]	HIGH	**MEDIUM**

[128] Eggs and pupae may be transported on potato plants, seed and ware potatoes, reused potato bags or infested soil.
[129] Larvae feed on tubers both in the field and in storage, rendering them unfit for human or animal consumption, with damage to up to 95% of the crop commonly reported in America (EPPO 2005).
[130] Is highly invasive and has spread rapidly in Europe since being introduced from South America (Desneux et al 2010).

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Xestia c-nigrum (syn. *Amathes c-nigrum*)	Spotted cutworm	Potato, onion, celery, beetroot, grape, oats, cabbage, cauliflower, tomato, lettuce, maize	Leaves, stems, fruit	Adults capable of flight	Asia, North and Central America, Europe, North Africa	LOW	HIGH	HIGH	LOW	**VERY LOW**
ORTHOPTERA (Locusts, grasshoppers and katydids)										
Chrotogonus trachypterus	Surface grasshopper	Polyphagous including potato, capsicum, chickpea, cotton, sunflower, cowpea, wheat, oats, tomato chickpeas, spinach, millet, Egyptian clover, mustard, lucerne	Above ground plant parts	Adults capable of flight	South Asia	UNKNOWN	UNKNOWN	UNKNOWN	UNKNOWN	**UNKNOWN**
Dichroplus elongatus	South American grasshopper	Polyphagous including potato, tomato, watermelon, grasses, lucerne, maize	Above ground plant parts	Adults capable of flight	Indonesia, Western Pacific, South America	HIGH	MEDIUM	MEDIUM	MEDIUM	**LOW**
Gryllotalpa gryllotalpa	European mole cricket	Polyphagous including potato, tomato, *Allium*, cucurbits, tobacco, cut flowers	Young roots and tubers	Infested plant material	Europe, the Middle East, North Africa, North America, Vietnam and the Philippines	MEDIUM	MEDIUM	MEDIUM	MEDIUM	**LOW**
Melanoplus bivittatus	Two-striped grasshopper	Polyphagous including potato, maize, vetch, wheat, turf grass, rye, lucerne, barley, oats, beetroot, onion	Leaves	Adults capable of flight	Canada, the United States	LOW	MEDIUM	MEDIUM	UNKNOWN	**UNKNOWN**

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Melanoplus sanguinipes	Lesser migratory grasshopper	Polyphagous including potato, tomato, onion, celery, oats, cereals, carrot, barley, lucerne, pea, rye, wheat, maize	Above ground plant parts	Adults capable of flight[131]	Canada and the United States	LOW	HIGH	HIGH	MEDIUM	**LOW**
THYSANOPTERA (Thrips)										
Frankliniella bispinosa	Florida flower thrips	Polyphagous including potato, tomato, baby's breath pepper, bean, eggplant, tomatillo, sweet corn, citrus, rye, strawberry, rose, tobacco, wheat, wild radish, cucumber, squash, watermelon, chrysanthemum	Leaves, flowers	Adults capable of flight, wind dispersal	North America, Asia, Georgia (Europe), New Zealand	HIGH	MEDIUM	MEDIUM	HIGH[132]	**MEDIUM**
Haplothrips chinensis	Chinese thrips	Polyphagous including potato, capsicum, carrot, cotton, wheat, dandelion, kiwi, cut flowers, mandarin, tea, orange, mango, onion, stonefruit, hibiscus, spinach, pomegranate, chrysanthemum	Leaves, flowers	Adults capable of flight	East Asia, South Asia	HIGH	HIGH	HIGH	LOW	**LOW**

[131] This species can migrate over long distances in swarms.
[132] Is a vector of *Tomato spotted wilt Tospovirus* (CABI).

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Thrips angusticeps	Field thrips, cabbage thrips	Potato, onion, garlic, leek, oats, cabbage, sugarbeet, broccoli, cut flowers, lucerne, pea, tobacco, beans, rye, peach, wheat	Whole plant	Adults capable of flight. Overwinters in soil	Europe North Africa and the Middle East	HIGH	HIGH	MEDIUM	MEDIUM[133]	**MEDIUM**

[133] In Europe, the most affected crops are flax and linseed; other crops become vulnerable if they are grown following flax or linseed (CABI).

Pathogens and nematodes

***Table 22**. Potato pathogen and nematode threat summary table*

'Unknown' indicates insufficient information available to make an assessment of risk

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
BACTERIA (including phytoplasmas)										
Bacillus pumilus	Potato rot, soft rot	Potato, sweet potato, cabbage, garlic, ginger, strawberry, cotton, bean	Tubers	Infected plant material and mechanical inoculation	Asia, Africa, Europe	LOW	HIGH	MEDIUM	LOW[134]	**VERY LOW**
***Candidatus Liberibacter solanacearum* (with known vector)** (syn. *Candidatus Liberibacter psyllaurous*)	Zebra chip	Solanaceae and Apiaceae[135]	Whole plant	Vectored by tomato potato psyllid (*Bactericera cockerelli*)[136]	Africa, Europe Oceania, North and Central America	HIGH	HIGH	HIGH	EXTREME	**EXTREME**
***Candidatus Phytoplasma solani* (with vector)**	Stolbur phytoplasma[137]	Asteraceae, Convolvulaceae, Fabaceae, Solanaceae (including potato, tomato, eggplant, capsicum)	Whole plant	Vectored by planthoppers[138]	Asia, Europe, the Middle East, North America	MEDIUM	MEDIUM	HIGH[139]	MEDIUM	**LOW**

[134] While it can cause rot in potato tubers, it is also used as a natural enemy in some Integrated Pest Management Programs to control fungal pests (University of California IPM).

[135] Haplotypes A and B affect Solanaceae (potato, tomato, tobacco, capsicum etc). Haplotypes C, D and E affect Apiaceae (carrots and celery).

[136] Tomato-potato psyllid is established in Western Australia.

[137] Strains including Eggplant little leaf phytoplasma, Potato stolbur phytoplasma, Potato round leaf phytoplasma, Potato witches' broom phytoplasma, Iranian potato purple top phytoplasma, Russian potato purple top phytoplasma, Turkish potato stolbur phytoplasma.

[138] Stolbur phytoplasma is vectored by *Hyalesthes obsoletus, H. phytoplasmakosiewiczi, Aphrodes bicintus, Euscelis plebeja, Ligus pratensis, L. rugulipennis, L. gemellatus* and *Macrosteles quadripunctualatus*.

[139] Spread potential is high with known vector.

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Clavibacter michiganensis subsp. sepedonicus	Bacterial ring rot, potato ring rot	Potato, tomato, currant tomato, eggplant	Whole plant	Soil borne. Transmitted through infected plant material and contaminated machinery.	Asia, North Africa, Middle East, North and South America[140]	LOW	HIGH	HIGH	HIGH	**MEDIUM**
Dickeya paradisiaca	Rhizome rot, tip over	Potato, pineapple, begonia, canna lily, capsicum, poinsettia, banana, plantain, maize	Tubers	Soil borne. Transmitted through infected plant material and contaminated machinery.	Asia, Central America, Caribbean, South America, Oceania	LOW	HIGH	IGH	MEDIUM	**LOW**
Dickeya solani	Blackleg disease of potato	Potato, hyacinth	Tubers, stems, leaves	Soil borne. Transmitted through infected plant material and contaminated machinery.	Europe and the Middle East	LOW	HIGH	HIGH	HIGH	**MEDIUM**
Pectobacterium betavasculorum	Sugarbeet rot, bacterial stem rot	Potato, sugarbeet	Stems	Soil borne. Transmitted through infected plant material and contaminated machinery.	The Middle East	LOW	HIGH	HIGH	MEDIUM	**LOW**
Pectobacterium wasabiae	Blackleg, soft rot, bacterial soft rot	Potato, tomato, eggplant, cabbage, wasabi, sweet potato	Stems, tubers, leaves	Mechanical inoculation	Canada, the United States, South Africa Japan, Malaysia	LOW[141]	HIGH	HIGH	MEDIUM	**LOW**

[140] Unconfirmed reports from Central America.
[141] New genetic evidence indicates that *P. wasabiae* may be found in potato fields worldwide (Nykyri et al 2012).

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Potato witches' broom phytoplasma	Yellows-type disease, witches' broom phytoplasma	Potato, lucerne, tobacco, cut flowers	Above ground plant parts	Infected plant material (tubers) and insect vectors	Asia, North America, Europe	LOW	LOW	LOW	LOW	**NEGLIGIBLE**
***Pseudomonas marginalis* (pv. Pastinaceae)**	Brown rot	Potato, lettuce, parsnip	Leaves, tubers	Infected plant material	North America	LOW	MEDIUM	MEDIUM	LOW	**VERY LOW**
***Pseudomonas syringae* pv. garcae**	Bacterial blight	Potato, coffee, bean, tomato	Whole plant	Infected plant material and rain splash	Africa, South America	LOW	MEDIUM	MEDIUM	LOW	**VERY LOW**
***Ralstonia syzigii* (syn. *Ralstonia solanacearum* Race 4, *Pseudomonas solanacearum*)**[142]	Bacterial wilt, brown rot	Over 450 species affected including potato, tomato, ginger, banana	Roots and rhizome leading to whole plant wilting	Soil borne. Transmitted through infected plant material and contaminated machinery.	Worldwide[143]	HIGH	HIGH	HIGH	HIGH	**HIGH**
***Streptomyces* (including *S. acidiscabies, S. stelliscabiei* and *S. turgidiscabiei*)**	Potato scab	Potato	Tubers	Soil borne. Transmitted through infected plant material and contaminated machinery.	North and South America, Asia, Europe	LOW	HIGH	MEDIUM	MEDIUM	**LOW**
Potato marginal flavescence agent[144]		Potato	Tubers	Infected plant material (tubers)	India	MEDIUM	MEDIUM	LOW	MEDIUM[145]	**VERY LOW**

[142] One isolate of *R. solanacearum* phylotype IV has been found on tomato in Darwin in 1979. It has not been isolated since and it is not known if this isolate is considered to be *R. syzygii*.
[143] Present in NZ, PNG, New Calendonia, Vanuatu and therefore a natural dispersal risk
[144] All information about this disease comes from a single study carried out in India in the 1970s (Nagaich 1979). Very little further information is available.
[145] Economic impact is medium if leafhopper vectors are present.

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Purple top roll agent[146]	Purple top roll disease	Potato	Leaves	Infected plant material and leafhopper vectors	India	MEDIUM	MEDIUM	LOW	MEDIUM[147]	**VERY LOW**
FUNGI										
Aecidium cantense	Deforming potato rust, Peruvian rust	*Solanum* spp. including potato, tomato	Leaves, stems	Infected plant material and machinery. Spores are wind and rain splash borne	Western Africa, Central and South America	LOW	LOW	MEDIUM	MEDIUM	**VERY LOW**
Alternaria grandis	Early blight	Potato, tomato	Leaves, tubers	Wind and rain splash borne spores	Brazil, Nigeria United States, Europe, Algeria	LOW	HIGH	HIGH	MEDIUM	**LOW**
Didymella lycopersici	Canker of tomato	Potato, capsicum, tomato, eggplant	Leaves, stems, fruit	Infested plant material and machinery. Soil borne spores.	Worldwide apart from Australia[148]	LOW	LOW	MEDIUM	MEDIUM[149]	**VERY LOW**
Ozonium texanum* var. *parasiticum	Collar rot, ozonium wilt, root rot	Potato, legumes, cotton, barley, tomato	Whole plant	Infected plant material and machinery. Soil borne spores.	North America, South America	NEGLIGIBLE	LOW	MEDIUM	LOW	**NEGLIGIBLE**

[146] Application of chloramphenica, tetracycline and antiamoebin causes remission of symptoms and suggests an association of a phytoplasma-like organism (Nagaich and Giri 1973). Nagaich and Giri's (1973) study was carried out in India; the geographic distribution of this organism beyond India is unknown. Nagaich and Giri (1973) reported severe yield losses of 40 to 70%.

[147] Economic impact is medium if vector is present.

[148] Nearest occurrences are in Papua New Guinea, New Zealand, New Caledonia and Tonga (CABI).

[149] Has very rarely been recorded on non-tomato hosts (CABI) and so is not likely to pose a serious threat to the potato industry.

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Passalora concors (syn. *Mycovellosiella concors, Cercospora concors*)	Cercospora leaf blotch, potato leaf blotch, yellow leaf blotch	Potato, eggplant, tomato	Leaves, stems	Infected plant material and machinery. Airborne spores	Asia, Europe, North America, Eastern Africa	LOW	HIGH	HIGH	LOW	**VERY LOW**
Phoma andina (syn. *P. andigena*)	Phoma leaf spot, Black blight of potato	Tomato, potato	Above ground plant parts	Wind and rain splash borne spores	North, Central and South America	LOW	LOW	LOW	LOW	**NEGLIGIBLE**
Polyscytalum pustulans	Skin spot of potato	Potato	Roots, stems, tubers	Infected plant material (seed tubers). Soil borne spores	North and South America, South Africa, Iran, Europe, New Zealand	LOW	MEDIUM	MEDIUM	LOW	**VERY LOW**
Puccinia pitteriana	Potato rust, common rust	Potato, tomato, other Solanaceae	Above ground plant parts	Infected plant material and machinery. Wind and soil borne spores	North America, Central America and the Caribbean, South America	LOW	LOW	LOW	LOW	**NEGLIGIBLE**
Rosellinia bunodes	Black root rot	Wide host range including potato, citrus, yam, cassava, coffee, banana, tea, avocado, ginger, pea, beetroot, bean, carrot, lettuce, maize, quinine, rubber, cocoa	Roots	Infected plant material and machinery. Soil borne spores	Asia, Central and South America, West Africa, the Caribbean[150]	LOW	LOW	LOW	LOW[151]	**NEGLIGIBLE**

[150] Known only from the tropics.

[151] In Andean potato enterprises, losses due to *Rosellinia spp.* can be as high as 80% and in prolonged monoculture can reach 100% (Orellana 1978).

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Synchytrium endobioticum	Potato wart, potato blackwart	*Solanum* spp. including potato and native Mexican *Solanum* species	Whole plant	Infected plant material and machinery. Soil borne spores	Asia, Africa, Europe, Oceania, the Americas	LOW	HIGH	MEDIUM	HIGH[152]	**MEDIUM**
Thecaphora solani (syn. *Angiosorus solani*)	Potato smut	*Solanum* spp. including potato, tomato, jimsonweed	Tubers	Infected plant material and machinery. Soil borne spores	North, Central and South America	LOW	LOW	LOW	MEDIUM	**VERY LOW**
***Verticillum dahliae* (exotic defoliating strains)**	Verticillium wilt	Broad host range including potato, cotton, olive, tomato, eggplant, sycamore, silk tree, canola, capsicum, pecan, strawberry	Leaves	Infected plant material and soil borne spores	Asia, the Middle East, Africa, Europe and the Americas	LOW[153]	MEDIUM	MEDIUM	LOW	**VERY LOW**
Septoria lycopersici* var. *malagutii	Foliar leaf spot of potato, Septoria leaf spot, annular leaf spot	White potato (*Solanum tuberosum tuberosum*) and Andean potato (*S. tuberosum andigena*)	Above ground plant parts	Infected plant material and machinery. Soil and rain splash borne spores	South America	LOW	MEDIUM	MEDIUM	MEDIUM	**LOW**
NEMATODE										
Belonolaimus longicaudatus	Sting nematode	Polyphagous including potato, blueberry, peanuts, watermelon, onion, pea, bean, grape, citrus, melon, carrot, strawberry, cotton, corn, tomato, turf grass	Roots	Infected plant material, soil, machinery and tools	Pakistan, Saudi Arabia, Turkey, United States, Mexico, Costa Rica, Puerto Rico, Bahamas	MEDIUM	MEDIUM	MEDIUM	MEDIUM	**LOW**

[152] Can vector potato virus X (CABI).
[153] *V. dahliae* has been found in Australia but defoliating symptoms have not been observed.

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Ditylenchus africanus	Peanut pod nematode	Polyphagous including potato, peanut, pea, soybean, sunflower, tobacco, lucerne, bean, wheat	Roots, tubers, seeds	Infected plant material, soil, machinery and tools. Seed borne	South Africa, Mozambique	MEDIUM	HIGH	MEDIUM	LOW[154]	**VERY LOW**
***Ditylenchus dipsaci* and *D. destructor* (exotic strains)**	Stem and bulb nematode, potato tuber nematode	Polyphagous including potato, wheat, beans, peas, cut flowers parsley, onion, leek, celery, oats, turnip, hemp, cucurbits, sweet potato, strawberry, sunflower, lucerne	Below ground plant parts	Infected plant material, soil, machinery and tools. Seed borne	Worldwide	MEDIUM	HIGH	HIGH	MEDIUM[155]	**MEDIUM**
Globodera pallida	Pale potato cyst nematode	Potato, tomato, eggplant	Roots	Infected plant material. Soil borne[156]	Worldwide, including New Zealand	HIGH	MEDIUM	HIGH[157]	HIGH	**HIGH**
***Globodera rostochiensis* (Pathotypes RO2, RO3, RO4 and RO5)**	Golden potato cyst nematode	Potato, tomato, eggplant	Roots	Infected plant material. Soil borne[156]	Worldwide, including New Zealand	HIGH[158]	MEDIUM	HIGH	HIGH	**HIGH**

[154] Infection is asymptomatic in potato.

[155] *D. destructor* causes trade issues and is currently listed as absent from Australia (IPPC 2008).

[156] Pale potato cyst nematode, golden potato cyst nematode and tobacco cyst nematode can pass through the gut of grazing animals and may be transported into new areas in this manner.

[157] Cysts are very difficult to detect and are resistant to mot disinfestation methods (M. Hodda, pers. comm.).

[158] There are five known pathotypes of *G. rostochiensis* (RO1, RO2, RO3, RO4, RO5) and only RO1 is present in Australia (restricted in Victoria). The strain has been eradicated from Western Australia. Cysts are very difficult to detect and are resistant to most disinfestation methods (M. Hodda pers. comm.).

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Globodera tabacum	Tobacco cyst nematode	Potato, tobacco, tomato, eggplant	Roots	Infected plant material. Soil borne[156]	Africa, China, Korea, Japan, Pakistan, Canada, Argentina, Colombia, southern and eastern Europe	LOW	MEDIUM	HIGH	MEDIUM	**LOW**
Hoplolaimus indicus	Lance nematode	Wide host range including Solanaceae, Poaceae, Rutaceae, Myrtaceae, Convolvulaceae, Cucurbitaceae, Brassicaceae	Whole plant	Infected plant material, soil, machinery and tools	Bangladesh, Pakistan, Iran	NEGLIGIBLE	HIGH	LOW	MEDIUM	**NEGLIGIBLE**
Longidorus attenuatus	Tomato black ring nematode, needle nematode	Polyphagous including potato, tomato, barley, cabbage clover, ryegrass, strawberry, wheat, field peas	Roots	Infected plant material, soil, machinery and tools	Europe	LOW	MEDIUM	MEDIUM	LOW	**VERY LOW**
Longidorus breviannulatus	Needle nematode	Potato, maize	Roots	Infected plant material, soil, machinery and tools	North America	LOW	MEDIUM	MEDIUM	LOW	**VERY LOW**
Meloidogyne acronea (syn. *Hypsoperine acronea*)	African cotton root nematode	Polyphagous including potato, tomato, bean sorghum, peanut, pigeon pea, millet, cotton, sunflower	Roots	Infected plant material, soil, machinery and tools	Malawi, South Africa	LOW	MEDIUM	MEDIUM	MEDIUM	**LOW**

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Meloidogyne ethiopica	Root knot nematode	Polyphagous including potato, oat, carrot, bean, sweet corn, grasses, wheat barley, lucerne, pea, maize, quinoa, tomato	Roots	Infected plant material, soil, machinery and tools	Sub-Saharan Africa, Brazil, Turkey	LOW	HIGH	MEDIUM	HIGH	**MEDIUM**
Meloidogyne chitwoodi	Columbia root knot nematode	Polyphagous including potato, tomato, carrot, lucerne	Whole plant	Infected plant material, soil, machinery and tools	United States, Argentina, western Europe, southern Africa	MEDIUM	HIGH	MEDIUM[159]	HIGH	**MEDIUM**
Meloidogyne enterolobii (syn. *Meloidogyne mayaguensis*)	Root knot nematode	Wide host range including potato, tomato, onion, corn, tobacco, cabbage, wheat, eggplant, capsicum, coffee, cucumber, soybean, lettuce, guava	Roots	Infected plant material, soil, machinery and tools	China, Vietnam, sub-Saharan Africa, the Americas, Europe	MEDIUM	HIGH	HIGH	HIGH	**HIGH[160]**
Meloidogyne minor	Root knot nematode	Potato, tomato, turf grass	Roots	Infected plant material, soil, machinery and tools	Belgium, Ireland, Netherlands, UK	HIGH	HIGH	HIGH	MEDIUM[161]	**MEDIUM**

[159] There are several root-knot nematodes already present in Australia and control measures in place for these species are likely to be effective against *M. chitwoodi* as well.

[160] *M. mayaguensis* is not a well-known pest in Australia but should be given much higher priority as it has a broad host range, very severe effects on crops, breaks all known resistance sources and has severe trade implications if found (M. Hodda pers. comm.).

[161] Reduces market value of potato crops by causing skin blemishes (M. Hodda pers. comm.).

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Nacobbus aberrans (syn. *Nacobbus batatiformis*)	False root knot nematode	Polyphagous including potato, Swede, beetroot, cabbage, cauliflower, brussels sprouts, broccoli, capsicum, carrot, lettuce, pea, eggplant, tomato, brassicas, carrot, pumpkin, zucchini	Roots	Infected plant material, soil, machinery and tools	North America, South America	LOW	MEDIUM	MEDIUM	MEDIUM	**LOW**
Paratrichodorus teres	Stubby root knot nematode	Polyphagous including potato, field pea, grasses	Roots	Infected plant material, soil, machinery and tools	North America, Iran	LOW	MEDIUM	LOW	UNKNOWN	**UNKNOWN**
Pratylenchus spp. **(including *P. flakkensis* and *P. andinus*)**	Root lesion nematodes	Highly polyphagous including potato, oats, tomato, okra, eggplant, onion, pineapple, coffee, peanut, pigeon pea, cut flowers, citrus, coconut, cucurbits, sweet potato, tea, mango, stonefruit, avocado, tobacco, melon, macadamia	Roots	Infected plant material, soil, machinery and tools	Worldwide	MEDIUM	HIGH	MEDIUM	HIGH	**MEDIUM**
Quinisculcius acutus	Stubby-root nematode	Potato, sorghum, maize, soybean, sweet potato, wheat	Roots	Infected plant material, soil, machinery and tools	India, Pakistan, Turkey, United States, Venezuela, Cuba	LOW	UNKNOWN	MEDIUM	UNKNOWN	**UNKNOWN**

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Rotylenchus parvus	Reniform nematode	Potato, maize, sunflower, sorghum, sugarcane, grasses	Roots	Infected plant material, soil, machinery and tools	India, Iran, Pakistan, sub-Saharan Africa, United States, Caribbean	MEDIUM	LOW	MEDIUM	LOW	**VERY LOW**
Scutellonema calthricaudatum		Polyphagous including potato, aloe, tomato, rice, eggplant, wheat, mung bean, cowpea, grapevine, peanut, maize, okra, onion, carrot, brassicas, cucurbits, cassava, tobacco	Roots, whole plant	Infected plant material, soil, machinery and tools	Throughout sub-Saharan Africa, also present in Asia (India, Thailand) and Cuba	NEGLIGIBLE	HIGH	LOW	LOW	**NEGLIGIBLE**
Trichodorus viruliferus	Stubby root nematode	Polyphagous including potato, pea, beet, barely, rye, wheat, maize, apple	Roots	Infected plant material, soil, machinery and tools	Throughout Europe	LOW	MEDIUM	LOW	MEDIUM	**VERY LOW**
Trichodorus primitivus	Stubby root nematode	Potato, pea, sugarbeet, cabbage, corn, oats, wheat	Roots	Infected plant material, soil, machinery and tools	Temperate Europe, occurrences in the United States	LOW	MEDIUM	LOW	MEDIUM	**VERY LOW**
Xiphinema bakeri	Dagger nematode	Polyphagous including potato, tomato, raspberry, strawberry, eucalyptus	Roots	Infected plant material, soil, machinery and tools	Worldwide	LOW	MEDIUM	LOW	LOW	**NEGLIGIBLE**

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Zygotylenchus guevarai		Wide host range including potato, pea, faba bean, oats, tomato, onion, hemp, vetch, corn, melon, chickpea, lily, carrot, lucerne, parsley, almond, grapevine	Roots	Infected plant material, soil, machinery and tools	Europe, Iran, Jordan, Syria, Pakistan, Tajikistan, Turkey, Uzbekistan, United States, New Zealand	MEDIUM	MEDIUM	MEDIUM	MEDIUM	**LOW**
OOMYCETES										
Phytophthora infestans (A2 mating type and exotic strains of the A1)	Late blight	Solanaceous species including potato, tomato, eggplant, tobacco	Whole plant	Infected plant material and machinery, wind, rain splash dispersed spores and soil borne mycelia	Both A1 and A2 mating types of *P. infestans* have spread worldwide. All A2 strains are exotic to Australia. Australia only has one A1 strain. [162]	MEDIUM	HIGH	HIGH	HIGH	**HIGH**
Pythium hydnosporum (syn. *P. artotrogus*, *Artotrogus hydnosporus*)	Pythium rot	Wide host range including potato, pineapple, bean, sugarcane, pigeon pea, sweet potato, cowpea, tomato	Roots, tubers	Infected plant material and machinery. Soil borne mycelia and spores[163]	Asia, Europe, North, Central and South America	LOW	MEDIUM	MEDIUM	LOW	**VERY LOW**

[162] *P. infestans* is found in all potato-growing regions. Metalaxyl resistant strains (A2 mating type) are found in Europe, the Middle East, Africa, South Asia, North and Central America.
[163] Requires wounding for infection to occur.

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
VIRUSES AND VIROIDS										
Andean potato mottle virus **(Comovirus)**	Andean mottle of potato	Potato, chilli, eggplant, peppers, tobacco	Leaves, whole plant (dwarfing)	Contact with infected plant material, insect vectors	Central and South America, India[164]	LOW	MEDIUM	LOW	UNKNOWN[165]	**UNKNOWN**
Arracacha virus B **(Nepovirus)**	Arracacha virus B – Oca strain	Potato, arracacha, oca	Whole plant[166]	Mechanical inoculation, grafting, seed borne, pollen to the seed	South America	LOW	HIGH	MEDIUM	LOW[167]	**VERY LOW**
Beet curly top virus **(Curtovirus) (with known vector)[168]**	Curly top virus, potato green dwarf disease	Wide host range including potato, tobacco, tomato, bean, beetroot, chilli, celery, cowpea, flax, cucurbits, pepper, melon, spinach, sugarbeet, weed species	Whole plant	Infected plant material. Vectored by exotic phloem-feeding leafhoppers	Asia, Africa, North America, South America, Europe	LOW	MEDIUM	LOW	LOW	**NEGLIGIBLE**

[164] Including Costa Rica, Honduras, Nicaragua, Argentina, Brazil, Chile, Colombia, Bolivia, Peru, Ecuador,

[165] Several wild potato species are susceptible and may act as reservoirs from which vectors could carry the virus to potato fields. Control depends on the use of high-quality seed potatoes produced from virus-free nuclear stocks, which are initially obtained by meristem-tip culture and in vitro clonal propagation. The virus causes damaging symptoms in potato and is widespread in its area of occurrence (CABI).

[166] Infection is asymptomatic.

[167] Best control option is to ensure seed potatoes are procured from virus-free nuclear stocks.

[168] Considered to be of minor importance in Europe due to its slow spread (EPPO). However, virus particles are resistant to many common disinfectants and can remain viable for many months in dried tissue. Use of resistant varieties and chemicals are options for control.

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Eggplant mottled dwarf virus **(Comovirus)**	Eggplant mottled dwarf virus, tomato vein yellowing virus	Potato, cucumber, eggplant, peppers, tobacco, tomato	Fruit, leaves, stems, whole plant (dwarfing)	Infected plant material, mechanical inoculation, and likely insect vectors[169]	Afghanistan, Iran, Israel, Japan, Libya, Algeria, Tunisia, Morocco, Europe[170]	LOW	LOW	LOW	UNKNOWN[171]	**UNKNOWN**
Impatiens necrotic spot virus **(Tospovirus)**	Impatiens necrotic spot virus	Wide host range including potato, peppers, cucumber, tobacco, lettuce, basil, blackberry, raspberry, capsicum, tomato, spinach, ornamentals	Leaves, stems, flowers	Infected plant material, mechanical inoculation, insect vectors[172]	Europe, United States, Canada, Mexico, Central and South America, New Zealand	MEDIUM	HIGH	HIGH	MEDIUM	**MEDIUM**
Peanut bud necrosis virus **(Tospovirus)**	Peanut bud necrosis virus	Potato, tomato, peanut, carrot, chilli, cotton, pea, sunflower, many wild hosts	Whole plant	Mechanical inoculation, infected plant material, thrips vectors[173]	Bangladesh, India, Nepal, Pakistan, Sri Lanka, Thailand, Vietnam, China, Iran	LOW	MEDIUM	MEDIUM	LOW[174]	**VERY LOW**

[169] Distribution pattern of infected plants in the field suggests an insect vector, however this vector has yet to be identified (CABI).

[170] Including Spain, Italy, Greece, Albania, Bulgaria, Croatia, Portugal, Slovenia

[171] Dissemination though infected propagative material of ornamentals is likely to occur, but whether this will allow spread to vegetable crops is unknown. The virus has no impact on ornamental crops, but can have a severe impact on vegetable crops. However economic impacts are minimal has infections rarely exceed 1% of crops (CABI).

[172] Can be transmitted by the thrips *Frankliniella occidentalis* which is present in Australia.

[173] Can be transmitted by the thrips *Frankliniella occidentalis* and other thrips which are present in Australia.

[174] Potato plants infected at an early stage often collapse and die (CABI).

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Pepino mosaic virus **(Potexvirus) (with known vector)**	Pepino mosaic virus	Potato, tomato, eggplant, other Solanaceae, basil, amaranth, many weeds	Leaves, fruit	Infected plant material and machinery, insect vectors[175]	Asia, Africa, North America, South America, Europe	MEDIUM	HIGH	HIGH[176]	HIGH	**MEDIUM**
Potato aucuba mosaic virus **(Potexvirus)**	Potato aucuba mosaic virus	Potato, tomato	Leaves, stems, tubers	Infected material, mechanical inoculation, insect vectors	Worldwide, including New Zealand	LOW	LOW	MEDIUM[177]	LOW	**NEGLIGIBLE**
Potato black ringspot virus **(Nepovirus)**	Potato black ringspot virus, potato calico strain of tobacco ringspot virus	Potato	Whole plant[178]	Infected plant material , contact between plants and possibly nematode vectors	Peru	LOW	HIGH	MEDIUM	MEDIUM[179]	**LOW**
Potato deforming mosaic virus **(Begomovirus)** (syn. *Tomato yellow vein streak virus*)	Potato deforming mosaic virus (PDMV)	Potato, tomato	Leaves and tubers	Infected plant material and vectors(*Bemisia tabaci*)	Argentina and Brazil	LOW	HIGH	HIGH	LOW[180]	**VERY LOW**

[175] *Bombus terrestris* vectors this virus and is present in Tasmania.

[176] Crates and packaging materials are likely to be contaminated by infected material and should be thoroughly cleaned and disinfected. The virus spreads rapidly through normal cultural practices so hands, tools clothing and machinery should be thorough cleaned and disinfected to reduce transmission (CABI).

[177] *Myzus persicae* is a vector and is present in Australia.

[178] Infection is usually asymptomatic.

[179] Export markets would be severely affected if this virus reached Australia as it would be much more difficult to obtain phytosanitary certification for potato material (CABI).

[180] Vectored by *Bemisia tabaci* which is present in Australia. Up to 35% yield reduction has been reported in some cultivars (CABI).

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
***Potato latent virus* (Carlavirus)**	Potato latent virus, Red LaSoda virus	Potato	Whole plant[181]	Mechanical inoculation, insect vectors	Canada, the United States	LOW	MEDIUM	UNKNOWN	LOW	**UNKNOWN**
***Potato mop-top virus* (Pomovirus)**	Potato mop-top virus	Potato	Whole plant	Vectored by fungus *Spongospora subterranea subterranea*[182]	Asia, North, Central and South America, the Caribbean, Europe	HIGH[183]	HIGH	HIGH	MEDIUM	**MEDIUM**
***Potato rough dwarf virus* (Carlavirus)**	Potato rough dwarf virus, potato virus P	Potato	Whole plant	Infected plant material (tubers)	Argentina and Brazil	LOW	HIGH	MEDIUM	LOW	**VERY LOW**
***Potato spindle tuber viroid* (Pospiviroid)**	Potato spindle tuber viroid (PSTVd)	Solanaceae (including potato, tomato)	Whole plant	Infected plant material (tubers and seed), mechanical transmission	Worldwide	HIGH	HIGH	HIGH	HIGH	**HIGH**
***Potato virus A* (Potyvirus) (exotic strains)**	Potato virus A (PVA), potato mild mosaic	Potato, capsicum, other Solanaceae	Whole plant	Infected plant material (tubers)	Asia, Africa, North and South America, Europe, Oceania	MEDIUM	MEDIUM	MEDIUM	LOW	**VERY LOW**

[181] Infection is symptomless.
[182] Vector is present in Australia.
[183] Potato mop top virus was detected in New Zealand in 2018.

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
***Potato virus M virus* (Carlavirus)**	Potato virus M (PVM)	Potato, tomato, eggplant, tobacco	Whole plant	Contact with infected plant material (including tubers)	Every continent except Australia and New Zealand[184]	LOW	MEDIUM	HIGH	MEDIUM[185]	**LOW**
Potato virus S* (Strain A) (*Carlavirus) (syn. *Pepino latent virus*)	Potato virus S (PVS) Andean strain (strain A)	Potato, pepino, tamarillo	Whole plant	Insect vectors, mechanical transmission	Worldwide except Australia	LOW	HIGH	HIGH	MEDIUM[186]	**LOW**
***Potato virus T* (Tepovirus)**	Potato virus T	Potato	Leaves	Infected plant material, infected tubers	South America	LOW	MEDIUM	MEDIUM	VERY LOW	**NEGLIGIBLE**
***Potato virus U* (Nepovirus)**	Potato virus U	Potato	Whole plant	Potential nematode vectors	South America	LOW	LOW	LOW	MEDIUM	**VERY LOW**
***Potato virus V* (Potyvirus)**	Potato virus V	Potato, tomato	Whole plant[187]	Aphid vectors[188]	North and South America	LOW	HIGH	HIGH	LOW	**VERY LOW**
***Potato yellow dwarf virus* (Nucleorhabdo-virus)**	Potato yellow dwarf virus (PYDV)	Potato	Whole plant	Infected plant material and leafhopper vectors[189]	Asia, North America	LOW	MEDIUM	LOW	LOW	**NEGLIGIBLE**

[184] Not present in southeast Asia.
[185] Even isolates with mild symptoms can cause yield losses of 10-18% (CABI).
[186] Insect vectors include *Myzus persicae* which is present in Australia.
[187] In some potato varieties infection is symptomless.
[188] It is possible that aphids present in Australia could spread the virus.
[189] Leafhopper vectors of this species are not present in Australia.

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
***Potato yellow mosaic virus* (Begomovirus)**	Potato yellow mosaic virus	Potato, tomato, other Solanaceae	Leaves	Infected plant material and *Bemisia tabaci*	Central and South America, the Caribbean	MEDIUM	MEDIUM	MEDIUM	MEDIUM[190]	**LOW**
***Potato yellow mosaic Panama virus* (Begomovirus)**	Potato yellow mosaic Panama virus	Potato, tomato, other Solanaceae	Leaves	Infected plant material and *Bemisia tabaci*	Central and South America, the Caribbean	MEDIUM	MEDIUM	MEDIUM	MEDIUM[191]	**LOW**
***Potato yellowing virus* (Alfamovirus)**	Potato yellowing virus	Potato, capsicums, other Solanaceae	Leaves[192]	Infected plant material (tubers and seed), Insect vectors[193],	Bolivia, Chile, Ecuador, Peru	LOW	HIGH	MEDIUM	LOW[194]	**VERY LOW**
***Potato yellow vein virus* (Crinivirus)**	Potato yellow vein virus	Potato	Leaves	Infected plant material (tubers), insect vectors[195]	South America, Europe	LOW	HIGH	MEDIUM	MEDIUM	**LOW**
***Southern potato latent virus* (Carlavirus)**	Southern potato latent virus (SoPLV)	Potato	Whole plant	Infected plant material (tubers), mechanical inoculation	South America, reported in Japan	LOW	HIGH	MEDIUM	LOW	**VERY LOW**
***Tobacco necrosis virus* (Necrovirus)**	Tobacco necrosis virus (TNV)	Potato, tobacco, other Solanaceae, carrots, ornamentals	Whole plant[196]	Infected plant material (seed), transmitted by fungal vectors	Europe, India, China, Brazil, South Africa	LOW	HIGH	HIGH	LOW	**VERY LOW**

[190] Vectored by *Bemisia tabaci* which is present in Australia.
[191] Vectored by *Bemisia tabaci* which is present in Australia.
[192] In some cultivars infection is asymptomatic.
[193] Can be transmitted by *Myzus persicae* which is present in Australia.
[194] As for all potato viruses, the best option for control is production of high-quality seed potatoes from virus-free nuclear stocks (EPPO).
[195] Can be transmitted by *Trialeurodes vaporariorum* which is present in Australia.
[196] The roots are especially affected by this virus.

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
***Tomato infectious chlorosis virus* (Closterovirus)**	Tomato infectious chlorosis virus	Potato, tomato, other Solanaceae	Whole plant (stunting)	Insect vectors[197]	North America, Europe, Asia [198]	LOW[199]	MEDIUM	HIGH	UNKNOWN	**UNKNOWN**
***Tobacco rattle virus* (Tobravirus) (exotic strains)**	Tobacco rattle virus	Wide host range including potato, iris, tobacco, beetroot, artichoke, capsicum, peas, beans, broad bean, weed species	Whole plant	Nematode vectors[200]	Asia, Africa, North, Central and South America, the Caribbean, Europe, Oceania	MEDIUM	HIGH	MEDIUM	MEDIUM	**LOW**
***Tomato black ring virus* (Nepovirus)**	Ringspot of beet, tomato black ring virus	Wide host range including potato, pea, tomato, onion, zucchini, cucumber, capsicum, tomato, grape, bean, lettuce, artichoke, turnip, strawberry, swede, sugarbeet, daffodil, raspberry, eggplant	Above ground plant parts	Nematode vectors[201], seed borne	Asia, Africa, North and South America, Europe	LOW	HIGH	HIGH	MEDIUM	**MEDIUM**
***Tomato leaf curl Mali virus* (Begomovirus)**	Tomato leaf curl Mali virus	Potato, tomato	Leaves	Vector transmission by *Bemisia tabaci*[202]	Africa	LOW	MEDIUM	MEDIUM	UNKNOWN	**UNKNOWN**

[197] Insect vectors include *Trialeurodes vaporariorum* which is present in Australia.

[198] Including Japan and Indonesia.

[199] The pathogen is not transmitted by seed and currently there is no entry pathway into Australia of live host tomato material. Post-entry quarantine requirements are imposed on other potential ornamental hosts. For the most up-to-date measures please refer to BICON (**www.agriculture.gov.au/import/online-services/bicon**).

[200] Nematodes present in Australia could transmit the virus.

[201] Can be transmitted by *Longidorus sp.* nematodes which are present in Australia (Brown et al 1996).

[202] Vectored by *Bemisia tabaci* which is present in Australia.

Scientific name	Common name	Host(s)	Affected plant part	Means of movement and dispersal	Geographic distribution	Entry potential	Establishment potential	Spread potential	Economic impact	Overall risk
Tomato leaf curl New Delhi virus **(Begomovirus)**	Tomato leaf curl New Delhi virus	Potato, tomato, capsicum, pumpkin, marrow, carrot, gourd	Leaves	Vector transmission by *Bemisia tabaci*[203]	Asia, Africa, Europe	LOW	MEDIUM	MEDIUM	UNKNOWN[204]	**UNKNOWN**
Tomato yellow mosaic virus **(Begomovirus)**	Tomato yellow mosaic virus	Potato, tomato, wild tomato, currant tomato, naranjillo	Leaves	Vector transmission by *Bemisia tabaci*[205]	Central and South America, the Caribbean	MEDIUM	MEDIUM	MEDIUM	MEDIUM[206]	**LOW**
Tomato zonate spot virus **(Tospovirus)**	Tomato zonate spot virus	Potato, tomato, capsicum, iris, lettuce, tobacco	Leaves	Vector transmission by thrips[207]	Asia	LOW	LOW	MEDIUM	MEDIUM	**VERY LOW**

[203] Vectored by *Bemisia tabaci* which is present in Australia.
[204] Vectored by *Bemisia tabaci* which is present in Australia.
[205] Vectored by *Bemisia tabaci* which is present in Australia.
[206] Vectored by *Bemisia tabaci* which is present in Australia.
[207] Can be transmitted by the thrips *Frankliniella occidentalis* and other thrips which are present in Australia.

References

Adams CA and Selander RB. 1979. 'The biology of blister beetles of the Vittata group of the genus *Epicauta*'. *Bulletin of the American Museum of Natural History* **162**, 137-266

Ali MA, Essa AES, Abd El-Wahib HA and Ooda M. 2011. 'Thermal constant and degree-day requirements for the development of the eggplant stem borer, *Euzophera osseatella* Triet (Lepidoptera: Pyralidae). *Egypt Journal of Agricultural Resources* **89**, 899-906

Brown DJF, Trudgill DL and Robertson WM. 1996. 'Nepoviruses: transmission by nematodes'. In: Harrison BD, Murant AF (Eds) *The Plat Viruses: Polyhedral Virions and Bipartite Genomes*. New York, USA

Caballero VC. 1972. 'Some aspects of the biology and control of *Naupactus xanthographus* Gemar (Coleoptera: Curculionidae) on peach trees in Chile'. *Revista Peruana de Entomologia* **15**, 190-194

Copley CR and Cannings RA. 2005. 'Notes on the status of the Eurasian moths *Noctua pronuba* and *Noctua comes* (Lepidoptera: Noctuidae) on Vancouver Island, British Columbia'. *Journal of the Entomological Society of British Columbia* **102**, 83-84

Desneux N, Wajnberg E, Wyckhuys KAG, Burgio G, Arpaia S, Narvaez-Vasquez CA, Gonzales-Cabrera J, Catalan Ruescas D, Tabone E, Frandon J, Pizzol J, Poncet C, Cabello T and Urbaneja A. 2010. 'Biological invasion of European tomato crops by *Tuta absoluta*: ecology, geographic expansion and prospects for biological control'. *Journal of Pest Science* **83**, 197-215

Esbjerg P. 1985. 'Cutworms (*Agrotis segetum*) – forecasting and damages in 1983 and 1984'. *Second Danish Plant Protection Conference*, 249-260

Genite LP and Radzyavichyus BB. 1983. 'The development of froghoppers'. *Zaschita Rasteni* **11**, 27-27

Gergerich RC, Scott HA and Fulton JP. 1986. 'Evaluations of *Diabrotica* beetles as vectors of plant viruses'. In: Krysan JL, Miller TA (eds) *Methods for the Study of the pest* Diabrotica'. Springer-Verlag, New York

Gould F, Martinez-Ramirez A, Anderson A, Ferre J, Silva FJ and Moar WJ. 1992. 'Broad-spectrum resistance to *Bacillus thuringiensis* toxins in *Heliothis virescens*'. *Proceedings of the National Academy of Sciences* **89**, 7986-7990

Hare JD. 1990. 'Ecology and management of the Colorado potato beetle'. *Annual Review of Entomology* **35**, 81-100

Idriss M, Abdallah N, Aref N, Haridy G and Madkour M. 1997. 'Biotypes of the castor bean whitefly *Trialeurodes ricini* (Misra) (Hom., Aleyrodidae) in Egypt: biochemical characterisation and efficiency of geminivirus transmission'. *Journal of Applied Entomology* **121**, 501-509

IPPC. 2014. '*Liriomyza sativae* in Torres Strait'. International Plant Protection Convention Official Pest Report, No. AUS-61/1. Available from: **http://www.ippc.int/en/countries/Australia/pestreports/2014/10/liriomyza-sativae-in-torres-strait-/**

Jansson RK and Lecrone SH. 1989. 'Evaluation of food baits for pre-plant sampling of wireworms (Coleoptera: Elateridae) in potato fields in southern Florida'. *Florida Entomologist* **72**, 503-510

Kennedy GG. 1983. 'Effects of European corn borer (Lepidoptera: Pyralidae) damage on yields of spring-grown potatoes'. *Journal of Economic Entomology* **76**, 115-118

Kim TH and Eckenrode CJ. 2014. 'Bionomics of bean seed maggot, *Delia florilega* (Diptera: Anthomyiidae), under controlled conditions. *Environmental Entomology* **16**, 881-886

Kishore R, Ram G and Misra SS. 1990. 'Red ant, *Dorylus orientalis* Westwood – an insect peset of potatoes in Bihar'. *Journal of Entomological Research* **14**, 87-88

Koyama S, Sebongi I and Iwata N. 1995. 'Control of *Autographa nigrisigna* (Walker) by the confusion method using sex pheromone'. *Proceedings of the Kanto-Tosan Plant Protection Society* **42**, 221-222

Lorenzato D and Corseuil E. 1982. 'Effects of different control measures on the main pests of soyabean (*Glycine max* (L.) Merrill) and its predators. *Agronomia Sulriograndense* **18**, 61-84

Luo L, Huang S, Jiang X and Zhang L. 2009. 'Characteristics and causes for the outbreaks of beet webworm, *Loxostege stricticalis* in northern China during 2008'. *Plant Protection* **1**, 9-9

Macelski M and Balarin I. 1974. 'Factors influencing the population density of the looper *Autographa gamma* L. in Yugoslavia'. *Acta Entomologica Jugoslavica* **10**, 63-76

Machuca JR, Araya JE, Arretz PV and Larrain PI. 1990. 'Evaluation of chemical and cultural control for noctuid larvae in Chilean artichokes produced for foreign markets'. *Crop Protection* **9**, 115-118

Nagaich BB. 1979. 'The yellows diseases of potatoes'. *Journal of the Indian Potato Association* **6**, 1-11

Nagaich BB and Giri BK. 1973. 'Purple top roll disease of potato'. *American Potato Journal* **50**, 79-85

Nakano S and Katakura H. 1999. 'Morphology and biology of a phytophagous ladybird beetle, *Epilachna pusillanima* (Coleoptera: Coccinellidae) newly recorded on Ishigaki Island, the Ryukyus'. *Applied Entomology and Zoology* **34**, 189-194

Noetzl DK, Cutkomp LK and Harein PK. 1985. 'Estimated annual losses due to insects in Minnesota'. *University of Minnesota Agriculture Experimental Research Station Bulletin*, 2541

Norris Jr DM. 1953. 'Bionomics of the southern potato wireworm, *Conoderus falli* Lane'. *Florida Agricultural Station Journal Series* **660**, 109-111

Nykyri J, Niemi O, Koskinen P, Nokso-Koivisto J, Pasanen M, Broberg M, Plyusnin I, Toronen P, Holm L, Pirhonen M and Tapio Palva E. 2012. 'Revised phylogeny and novel horizontally acquired virulence determinants of the model soft rot phytopathogen *Pectobacterium wasabiae* SCC3193'. *PLoS Pathogens* **8**, e1002013

Orellana H. 1978. 'Estudio de la 'Lanosa' de la papa en Ecuador'. *Fitopatologia* **13**, 61-66

Orlova-Bienkowskaja MJ. 2014. 'First record of the potato flea beetle *Epitrix hirtipennis* Melsheimer Coleoptera: Chrysomelidae: Alticinae) in Russia. *Bulletin OEPP/EPPO Bulletin* 44, 44-46

Orlova-Bienkowskaja MJ. 2015. '*Epitrix papa* sp. n. (Coleoptera: Chrysomelidae: Galerucinae: Altinici), previously misidentified as *Epitrix similaris*, is a threat to potato production in Europe'. *European Journal of Entomology* **112**, 824-830

Patil SM, Adsule VM and Khaire VM. 1991. 'Efficacy of some insecticides against white grub infesting chillies'. *Journal of Maharashtra Agricultural Universities* **16**, 276-277

Patel VC and Pitre HN. 1971. 'Transmission of bean pod mottle virus to soybean via the striped blister beetle *Epicauta vittata*'. *Plant Disease Reporter*

Pfenninger M, Weigand A, Baling M and Klussman-Kolb A. 2014. 'Misperceived invasion: the Lusitanian slug (*Arion lusitanicus* auct. Non-Mabillle or *Arion vulgaris* Moquin-Tandon 1855) is native to Central Europe'. *Evolutionary Applications* **7**, 702-713

Pittaway, A.R. (2017). *Sphingidae of the Western Palaearctic (including Europe, North Africa, the Middle East, western Siberia and western Central Asia)*. http://tpittaway.tripod.com/sphinx/list.htm. [Site accessed: 21 September, 2017]

Stone MW. 1975. 'Distributioin of four introduced *Conoderus* species in California (Coleoptera: Elateridae)'. *The Coleopterists' Bulletin*, 163-165

Vreugdenhil D (Ed), with Bradshaw J, Gebhardt C, Govers F, MacKerron DKL, Taylor MA and Ross HA. 2007. *Potato Biology and Biotechnology Advances and Pespectives*. Elsevier, Amsterdam

Yap AS. 2007. 'From forests to farms: emergency of genus *Metapocyrtus* (Coleoptera: Curculionidae: Entiminae: Pachyrrhynchini) as potential agricultural pests'. *Philippine Journal of Crop Science*

Zitter TA, Tsai JH and Harris KF. 1980. *Flies*. In: Harris KF and Maramorosch K. 1980. *Vectors of Plant Pathogens*. Academic Press, New York

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