Plant Health AUSTRALIA

National Vegetable Industry Biosecurity Plan

Version 1

May 2007

For more information on Plant Health Australia

Location: Suite 5, FECCA House
4 Phipps Close
DEAKIN ACT 2600

Phone: +61 2 6260 4322

Fax: +61 2 6260 4321

E-mail: admin@phau.com.au

Visit our web site: www.planthealthaustralia.com.au

An electronic copy of this plan is available from the web site listed above.

ACKNOWLEDGEMENTS

The *National Vegetable Industry Biosecurity Plan* was coordinated by Plant Health Australia (PHA) and developed through a partnership approach using government and industry resources and expertise.

The following organisations, agencies and/or individuals were involved in the development and finalisation of the plan.

AUSVEG

Horticulture Australia Ltd

Department of Primary Industries and Fisheries, Queensland

Department of Agriculture and Food, Western Australia

Department of Primary Industries and Water, Tasmania

Primary Industries and Resources of South Australia

Victorian Department of Primary Industries

New South Wales Department of Primary Industries

Australian Quarantine and Inspection Service (AQIS)

Department of Agriculture, Fisheries and Forestry

This plan was developed using funding the Australian Government Budget Initiative through the Department of Agriculture, Fisheries and Forestry and from levy funding through Horticulture Australia Ltd.

PHA would like to acknowledge the special contribution Primary Industries and Resources South Australia and the New South Wales Department of Primary Industries made to this IBP through staff exchange programs.

TABLE OF CONTENTS

National Vegetable Industry Biosecurity Plan

INTRODUCTION

For more information on Plant Health Australia

Location: Suite 5, FECCA House
4 Phipps Close
DEAKIN ACT 2600

Phone: +61 2 6260 4322

Fax: +61 2 6260 4321

E-mail: admin@phau.com.au

Visit our web site: www.planthealthaustralia.com.au

An electronic copy of this plan is available from the web site listed above.

TABLE OF CONTENTS

TABLES

FIGURES

Acronyms

ABS	Australian Bureau of Statistics
AUSVEG	Australian Vegetable and Potato Growers Federation Inc.
DAFF	Department of Agriculture, Forestry and Fisheries
DAFWA	Department of Agriculture and Food, Western Australia
DPI	Department of Primary Industries
DPIW	Department of Primary Industries and Water, Tasmania
EPP	Emergency Plant Pest
EPPRD	Emergency Plant Pest Response Deed
GIMP	Generic Incursion Management Plan
HAL	Horticulture Australia Limited
IBG	Industry Biosecurity Group
IBMP	Industry Best Management Practice
IBP	Industry Biosecurity Plan
NSWFA	New South Wales Farmers Association
OCPPO	Office of the Chief Plant Protection Officer
PHA	Plant Health Australia
PIRSA	Primary Industries and Resources of South Australia
TFGA	Tasmanian Farmers and Graziers Association
VGA	Vegetable Growers Association, Victoria
QA	Quality Assurance
QDPI&F	Queensland Department of Primary Industries and Fisheries

Note: The definition of a pest as adopted by the International Plant Protection Convention (any species, strain or biotype of plant, animal, or pathogenic agent, injurious to plants or plant products) is used throughout this plan.

Plant Health Australia

Plant Health Australia (PHA) is a public company, with members including the Australian Government, all state and territory governments, and a range of plant industry organisations. The company was formed to address high 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.

Need for biosecurity plans

Australia's geographic isolation and lack of shared land borders have, in the past, provided a degree of natural protection from exotic threats. Australia's national quarantine system also helps to prevent the introduction of harmful exotic threats to plant industry. Rapid increases in overseas tourism, imports and exports, mail and changing transport procedures (e.g. refrigeration and containerisation of produce), as well as the potential for pests to enter via natural routes, mean that relying on quarantine measures is not enough.

Biosecurity planning provides a mechanism for the vegetable industry, government and other relevant stakeholders to actively determine pests, analyse the risks, and put in place procedures to reduce the chance of pests reaching our borders, and procedures to minimise the threat even if a pest incursion occurs.

Ensuring the vegetable industry has the capacity to minimise the risk of 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, negotiate access to new overseas markets, and reduce the social and economic costs of pest incursions to both growers and the wider community.

Background on the vegetable industry

The vegetable industry is a large and diverse industry, with numerous and widespread locations in Australia, in temperate and tropical climates. Vegetable production, processing, and retailing are important industries in the Australian economy and society. The industry contributes, in economic and societal terms, to all states and is relatively important in regional economies where it is located (Kiri-ganai research, 2005). The Australian Bureau of Statistics (ABS) data indicates that the industry had a gross value of production (GVP) of $2,355.5 million in 2003-04. The GVP has increased 10.8% from $2,125.6 million in 2002-03 and has been steadily rising over the past decade at an average of around 4.7% per annum (ABS in Kiri-ganai research, 2005). The GVP and local value for vegetables in Australia and each state is outlined in Table 1.

Table 1: *Value of vegetable crops in Australia*

	Australia		States: 2003-04							
	2002-03	2003-04	NSW	Vic	Qld	SA	WA	Tas	NT	ACT
Gross Value ($m)	2,125.6	2,355.5*	271.1	552.2	834.4	274.6	240.6	179.5	3.1	-
Local Value ($m)	1,744.8	1,928.4	207.8	485.6	630.5	241.1	188.7	172.1	2.7	-

*AUSVEG believes this underestimates the true value of vegetable production and estimates it to be $3,200 million (AUSVEG, 2004). Source: ABS, Value of Agriculture Commodities Produced Australia, Cat. 7503.0, 2002-03 and 2003-04.

The composition of the Australian vegetable industry and its value of production and farm gate value is outlined in Table 2. Potatoes are the largest crop by value at around 20% of total production, followed by tomatoes, mushrooms and onions.

Table 2: *Gross Value of Australian vegetable production 2003-04*

Commodity	Value of Production ($m)	Farm Gate Value ($m)
Potatoes	480.9	412.7
Tomatoes	280.4	218.3
Mushrooms	219.3	194.1
Onions	153.1	134.9
Carrots	149.7	111.5
Lettuces	115.1	79.6
Asparagus	46.5	44.1
Beans	62.1	58.0
Beetroot	in other	in other
Broccoli	81.4	68.8
Cabbages	in other	in other
Capsicums, chillies and peppers	115.9	92.0
Cauliflower	57.3	39.9
Celery	in other	in other
Cucumbers	in other	in other
Green Peas	14.1	13.9
Marrow, squash and zucchini	in other	in other
Melons	143.6	104.6
Parsnips	in other	in other
Pumpkins	57.2	35.8
Sweet Corn	70.6	53.7
Other	308.3	266.4
Total (Aggregate of ABS Class Data)	**2,355.5**	**1,661.9**

Source: ABS, Agricultural Commodities, 7121.0, 2003-04 in Kiri-ganai research, 2005

In 2003-04, 3,051 million tonnes of the 14 major vegetables were produced (ABS, in AUSVEG, 2004). The 14 major vegetables reflected in this analysis include potatoes, tomatoes, carrots, onions, melons, lettuces, pumpkins, cauliflower, capsicums chillies and peppers, broccoli, mushrooms, beans, green peas and asparagus. Potatoes, tomatoes, carrots, onions and melons dominate production. The 2003-04 production for the 14 major vegetable crops is outlined in Table 3.

Table 3: *2003-04 Production of major vegetable crops in Australia*

Commodity	Production (million tonnes)	Ranking
Potatoes	1310.4	1
Tomatoes	474.2	2
Carrots	302.6	3
Onions	233.4	4
Melons	205.5	5
Lettuces	127.2	6
Pumpkins	94.6	7
Cauliflower	78.3	8
Capsicums, chillies and peppers	56.3	9
Broccoli	51.5	10
Mushrooms	46.3	11
Beans	31.1	12
Green Peas	30.1	13
Asparagus	10.4	14
Total	**3051.0**	

Source: Australian Bureau of Statistics, Cat. 1721. in AUSVEG, 2004.

Gaps in the agricultural census of the total production of vegetables currently exist, however, following a joint effort between AUSVEG and the ABS this problem will be rectified with the 2006 agriculture census (AUSVEG, 2004).

The area planted to the 14 major vegetables in 2003-04 was 104,473 hectares. This is a +0.4% increase from 2002-03 where the area planted was 104,067 hectares (AUSVEG, 2005). The area of the 14 major vegetables planted in 2003-04 and 2002-03 is outlined in Table 4.

Table 4: *Area planted, in Australia, to the 14 major vegetables in 2003-04*

Plantings of Vegetables	2002-03	2003-04	Annual % change in area planted
Asparagus	2,286	2,245	+1.8
Beans	6,951	7,097	+2.1
Broccoli	7,285	6,966	-4.4
Capsicums, chillies and peppers	2,485	2,838	+14.2
Carrots	7,367	7,195	-2.3
Cauliflower	3,879	3,516	-9.4
Green Peas	5,527	5,731	+3.7
Lettuces	6,134	6,121	0.2
Melons	6,970	6,572	-5.7
Mushrooms	128	153	+19.5
Onions	5,263	5,558	+5.6
Potatoes	35,899	36,120	+0.6
Pumpkins	6,584	5,901	-10.4
Tomatoes	7,309	8,460	+15.7
Total	104,067	104,473	+0.4

Source: ABS Catalogue 7121.0, various years in AUSVEG, 2005

The largest acreage of vegetable production occurs in Queensland, New South Wales and Victoria (AUSVEG, 2004). Queensland also has the largest number of growers and currently accounts for 29 percent of vegetable farms (AUSVEG, 2004). ABS statistics

indicate the total number of commercial vegetable farms in 2003-04 was 4,297 (ABS, 2003-04). AUSVEG and HAL believe the number of vegetable farms is between 6,500 and 8,000 based on the calculations of levy receipts (Kiri-ganai research, 2005). The production of certain vegetables is prominent in some states and is depicted in Table 5.

Table 5: *Main growing states in Australia for key vegetable crops, 2004*

Product	Main growing states, 2004
Potatoes (total)	Vic, SA, Tas
Tomatoes (total)	Vic, Qld
Carrots	WA, Vic, SA, Tas
Mushrooms	NSW, Vic, Qld
Onions white and brown	SA, Tas
Lettuce	Qld, Vic
Asparagus	Vic
Capsicum, chillies and peppers	Qld
Cauliflowers	Qld, WA, Vic, NSW
Broccoli	Vic, Qld
Pumpkins	Qld
French and runner beans (total)	Qld, Tas
Sweet corn	NSW, Qld
Peas (processing)	Tas
Peas (pod)	Qld, NSW

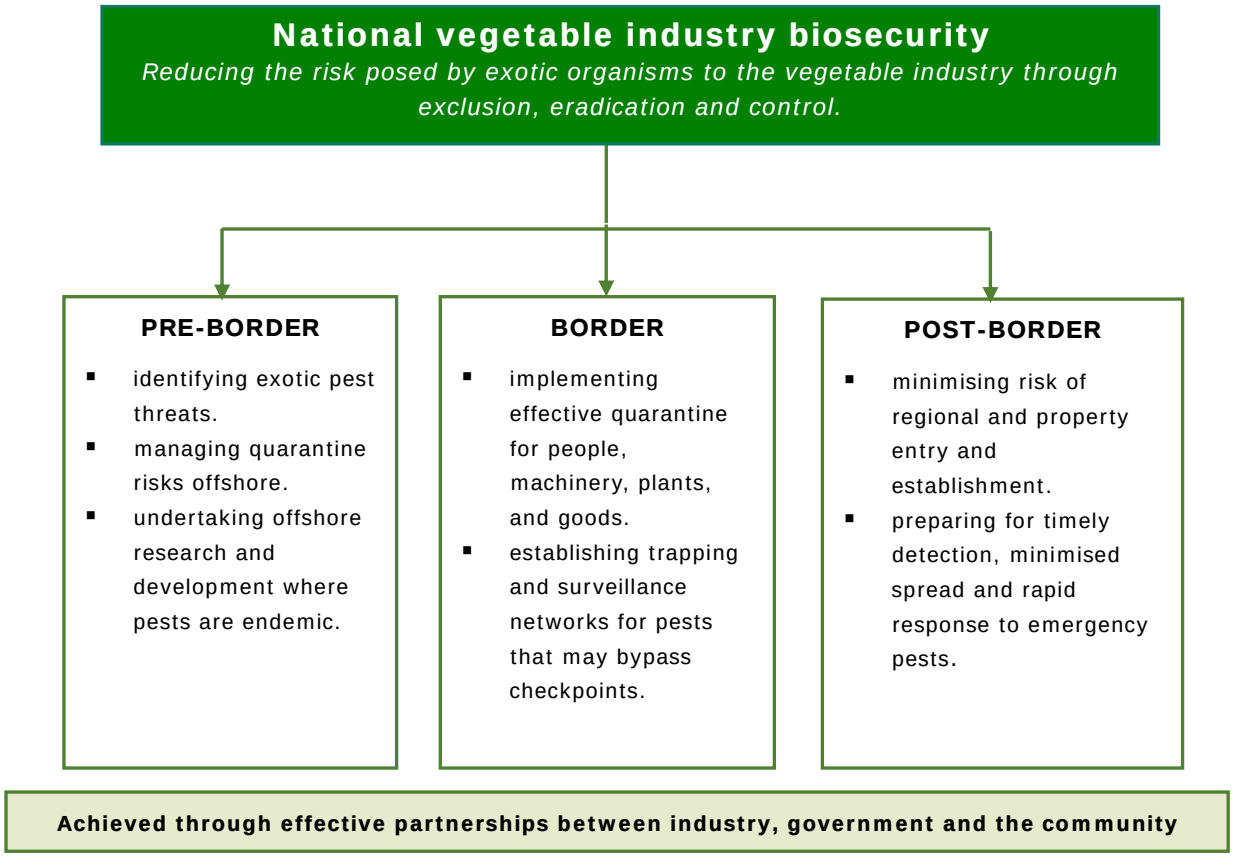
Source: ABS, Agricultural Commodities, 7121.0, 2003-04 in Kiri-ganai research, 2005

The Australian vegetable industry set strategic areas for action in November 2005 based on a stock take of its performance which was undertaken by the Australian vegetable industry in partnership with the Commonwealth Department of Agriculture, Fisheries and Forestry (DAFF). Strategic area one 'Competitiveness' includes expansion of the domestic market and export market development (Kiri-ganai research, 2005). Obtaining outcomes in this strategic area is partly reliant on the pest and disease status of the area of production.

What is industry biosecurity planning?

Industry biosecurity is the minimisation of risks posed by exotic organisms through actions such as exclusion, eradication, and control. Effective industry biosecurity relies on all stakeholders, including government agencies, industry, and the public (Figure 1). A number of authors have identified the components of a plant industry biosecurity continuum, and Lloyd (1996) summarised them in the Generic Incursion Management Plan (GIMP) for the plant industries (Figure 2).

Figure 1: *Industry biosecurity: a shared responsibility*



With the assistance of AUSVEG, an Industry Biosecurity Group (IBG), coordinated by PHA, was formed to work on the development of a national biosecurity plan for the vegetable industry. The IBG includes representatives from vegetable industry associations in each relevant state/territory, as well as representatives from relevant state/territory agriculture agencies, the Australian Government, and PHA. Members of the IBG are shown in Table 6. A Vegetable Working Group also contributed to the development of the National Vegetable IBP. Members of this group are shown in Table 7.

Vegetables included in the National Vegetable IBP include:

- **Solanaceous** – potato, tomato, capsicum, chilli and pepper
- **Brassicas and Leafy Vegetables** – cabbage, brussel sprouts, broccoli, cauliflower, lettuce and celery
- **Root crops** – beetroot, carrot, parsnip, white and brown onions and asparagus
- **Cucurbits** – cucumber, marrow, squash, zucchini and pumpkin
- **Grains and leguminous plants** – French and runner beans, green peas, sweet corn.

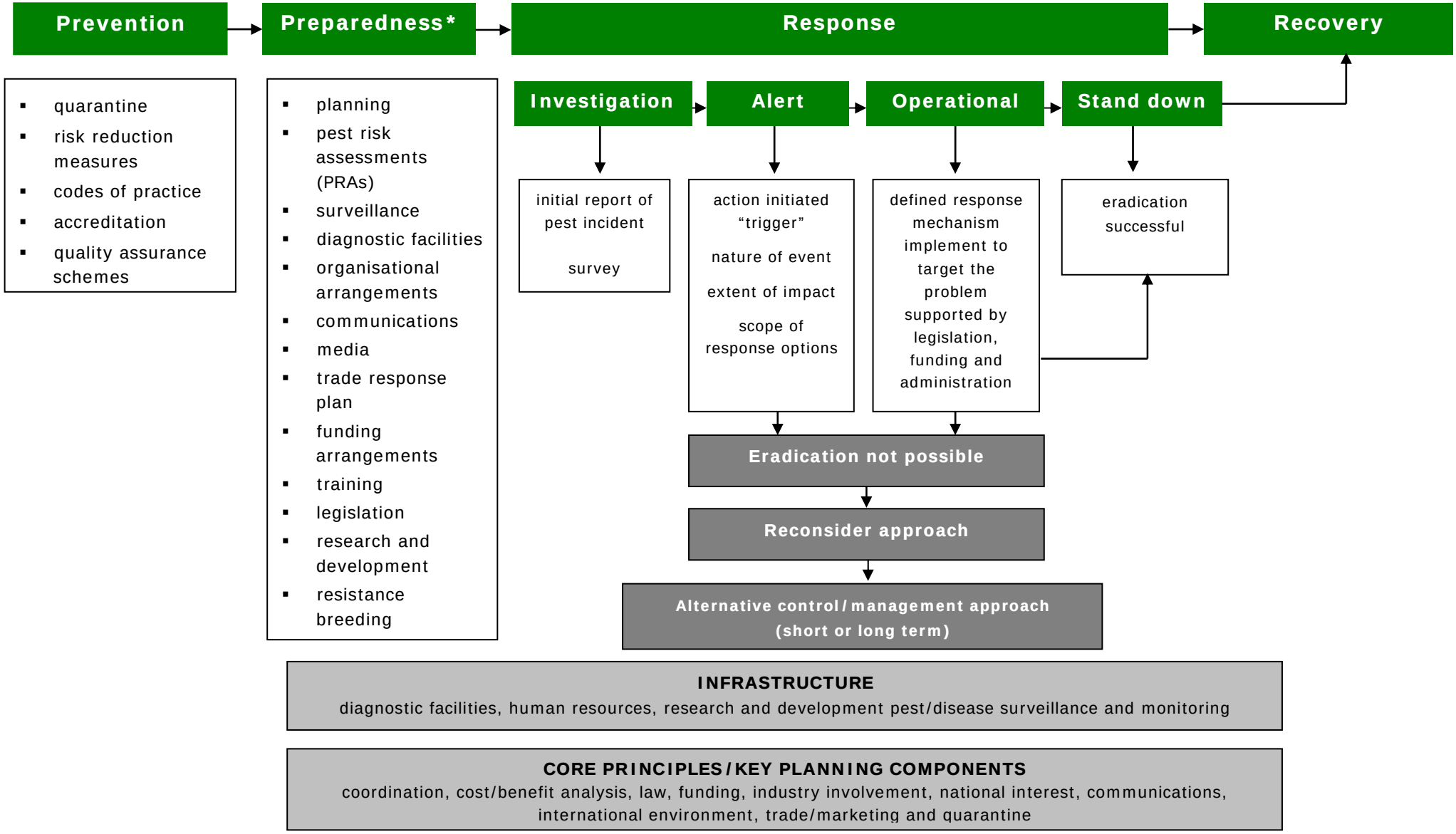
Table 6: *Members of the Industry Biosecurity Group*

Name	Organisation
Ms Alison Anderson	New South Wales Farmers Association (NSWFA)
Mr Mike Ashton	Queensland Department of Primary Industries and Fisheries (QDPI&F)
Mr Michael Badcock	AUSVEG
Mr Phillip Beswick	AUSVEG
Mr Jim Collings	Growcom
Mr Dom Della Vedova	AUSVEG
Mr Simon Drum	Horticulture Australia Limited (HAL)
Mr John Duff	Queensland Department of Primary Industries and Fisheries (QDPI&F)
Mr Rodney Dunn	Industry Representative
Mr Jonathan Eccles	AUSVEG
Mr David Ellement	AUSVEG
Mr Craig Feutrill	ARRIS
Mr Paul Gazzola	AUSVEG
Mr Michael Horne	Tasmanian Farmers and Graziers Association
Mr Tony Imeson	Vegetable Growers Association, Victoria (VGA)
Ms Gisele Irvine	Biosecurity Victoria, Department of Primary Industries, Vic
Mr Kim James	Horticulture Australia Limited (HAL)
Mr Luke Jewell	New South Wales Farmers Association (NSWFA)
Mr Kon Koroneos	Industry Representative
Mr Denis Leonard	Tasmanian Farmers and Graziers Association (TFGA)
Mr Matthew Dent	Growcom
Mr John McPhee	Department of Primary Industries and Water, Tasmania (DPIW)
Mr Jeff McSpedden	AUSVEG
Mr John Mundy	Industry Representative
Mr Figaro Natoli	Industry Representative
Mr John Newman	Industry Representative
Mr Neil Perry	AUSVEG
Mr Denis Persley	Queensland Department of Primary Industries and Fisheries (QDPI&F)
Mr Barry Philp	Primary Industries and Resources of South Australia (PIRSA)
Dr Brendon Rodoni	PIRVic, Department of Primary Industries, Vic
Mr John Roach	AUSVEG
Mr Tom Schreurs	Industry Representative
Mr Rob Schwartz	Department of Agriculture Fisheries & Forestry (DAFF)
Dr Shashi Sharma	Department of Agriculture and Food, Western Australia (DAFWA)
Mr George Smith	Industry Advisory Committee, HAL
Mr Clive Stevens	AUSVEG
Mr Eli Szandala	Office of Chief Plant Protection Officer (OCPPO)
Mr Jim Turley	Western Australian Potato Growers Association
Mr Patrick Ulloa	AUSVEG
Mr Stephen Welsh	Tasmanian Farmers and Graziers Association
Mr Kent West	Industry Representative
Dr Phil Wright	New South Wales Department of Primary Industries (NSW DPI)
Mr Ian Young	AUSVEG

Table 7: *Members of the Vegetable Working Group*

Name	Organisation
Mr André Mayne	Office of the Chief Plant Protection Officer (OCPPO)
Mr Denis Persley	Queensland Department of Primary Industries and Fisheries (QDPI&F)
Dr Shashi Sharma	Department of Agriculture and Food, Western Australia (DAFWA)
Ms Kimberly Green	Primary Industries and Resources of South Australia (PIRSA)
Mr John Roach	AUSVEG
Mr Jonathan Eccles	AUSVEG
Mr Kim James	Horticulture Australia Limited (HAL)
Mr Simon Drum	Horticulture Australia Limited (HAL)

Figure 2: *Generic Incursion Management Plan (GIMP) for the plant industries*

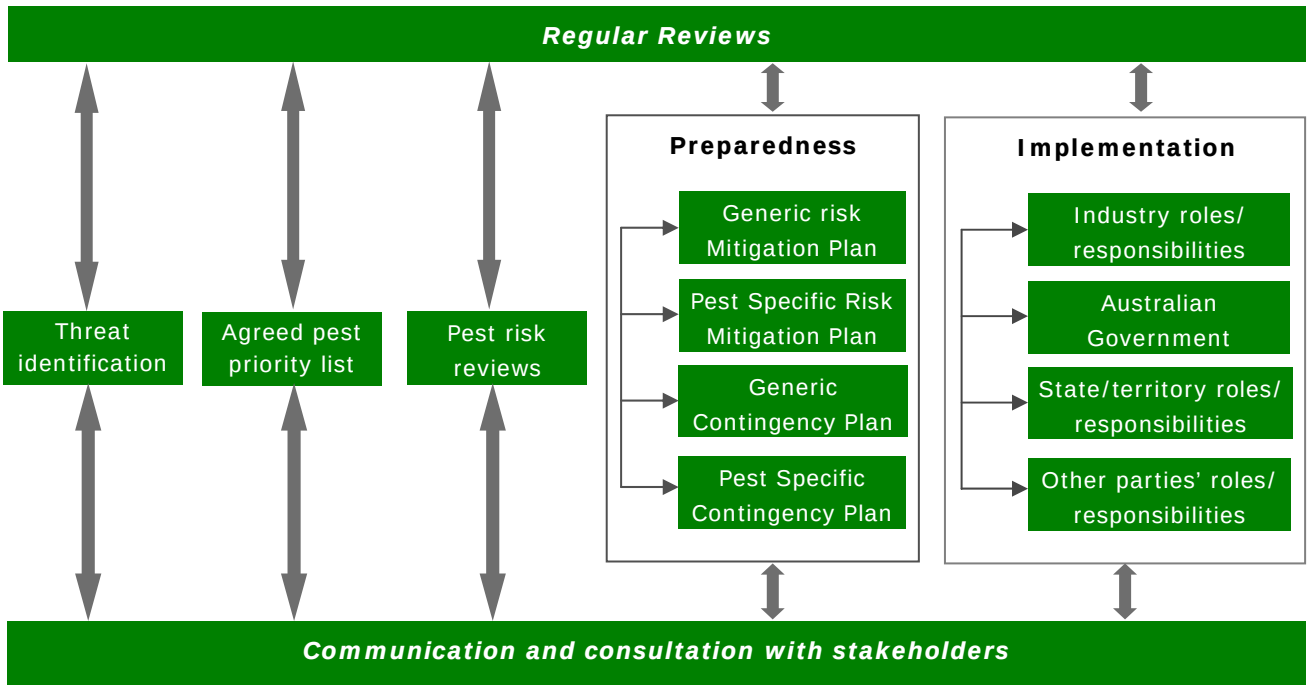


* stages of 'all hazards' approach adopted by Emergency Management Australia

Key steps in the development of the *National Vegetable Industry Biosecurity Plan* are shown in Figure 3, and included:

- identifying and documenting key threats to the vegetable industry
- developing an agreed emergency plant pest priority list
- undertaking and documenting appropriate pest risk reviews
- developing an industry risk mitigation plan
- developing a generic incursion response plan
- agreeing on, and documenting the roles and responsibilities of stakeholder groups
- developing appropriate communication and consultation strategies
- developing a review strategy.

Figure 3: *Steps involved in the development of an Industry Biosecurity Plan*



Document overview

The biosecurity package developed for the Australian vegetable industry focuses on a number of key areas.

Threat identification, pest risk reviews and incursion management funding arrangements

Guidelines are provided for the identification and categorisation of biosecurity threats through a process of qualitative risk assessment. The primary goal is to coordinate identification of exotic pest threats that could impact on productivity, sustainability, and marketability and to assess their potential impacts. This plan strengthens risk assessment work already being done both interstate and overseas. Pest Risk Reviews have been included for individual pests where available. Key vegetable biosecurity threats are detailed

in Threat Summary Tables, along with the emergency plant pest priority list (the top ranked threats to the vegetable industry).

An Emergency Plant Pest Response Deed (EPPRD) has been negotiated between the government and industry members of PHA. As at May 2006, fifteen plant industries had formally ratified the EPPRD. Once formally ratified by all relevant parties, the Deed will provide a formal mechanism for industry and governments to raise funds for the eradication of emergency pest incursions in a timely and efficient manner. The following key outcomes have been endorsed by PHA members:

- cost minimisation for all parties
- early detection and response
- ensuring rapid responses to emergency plant pests – excluding weeds in the first instance
- ensuring decisions to eradicate are based on appropriate criteria (must be technically feasible and cost beneficial)
- an agreed list of potential emergency plant pests
- a commitment of all signatories to biosecurity and risk mitigation
- cost sharing/payment of eligible costs
- a cap on contributions (based on local value of production)
- an effective industry/government decision-making process
- a limit in scope (to only cover emergency pest threats relevant to PHA member industries).

Risk mitigation plan

This section provides a summary of activities to mitigate the impact of pest threats on the Australian vegetable 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. These include:

- surveillance, awareness and training activities
- exclusion activities (e.g. restricting movement of planting material and machinery and barrier quarantine)
- selection of appropriate planting materials and cultivars
- destruction of crop residues
- control of vectors
- control of alternative hosts and weeds
- tillage practices
- post-harvest handling and produce transport procedures
- use of warning and information signs
- use of dedicated equipment when working in high risk areas
- restricting the use of high risk vehicles during high risk times
- reporting suspect pests to appropriate authorities
- including farm biosecurity in Industry Best Management Practice (IBMP) and Quality Assurance (QA) schemes.

Contingency plans and response management arrangements

This section describes arrangements for incursion responses, including reference to other emergency plans, contact details for key people and pest specific response information where available.

The overarching incursion response plan for Australia's plant industries is PLANTPLAN, the generic emergency response plan developed by PHA and endorsed by PHA members. This plan details the relevant procedures and the organisations responsible in the event of an incursion of a high priority plant pest.

This section also includes pest specific emergency response plans or documentation where available. This includes pest specific contingency plans and diagnostic standards for key pests. PHA has developed guidelines to assist the consistent development of pest specific contingency plans.

This section also contains key contacts and communications procedures for use in the event of an incursion affecting the vegetable industry.

Awareness material

Information on where to find further information on key identified threats to the Australian vegetable industry is provided. Information on high priority vegetable pests will help increase industry awareness and promote rapid detection and eradication.

Review processes

With the support of PHA, the IBG is responsible for reviewing this plan on an annual basis. The review process will be used to determine:

- strategies to maximise the adoption of recommended practices
- where further improvements can be made
- revisions/updates to the plan
- where resources should be allocated to improve biosecurity of the industry.

References

Australian Bureau of Statistics, 2002-03, Value of Agricultural Commodities Produced Australia 7503.0, Australian Bureau of Statistics, Canberra

Australian Bureau of Statistics, 2003-04, Agricultural Commodities 7121.0, Australian Bureau of Statistics, Canberra

Australian Bureau of Statistics, 2003-04, Value of Agricultural Commodities Produced Australia 7503.0, Australian Bureau of Statistics, Canberra

AUSVEG, 2004, Domestic Vegetable Industry Snapshot, AUSVEG R&D Meeting, November 13, 2004

AUSVEG, 2005, Plantings of Vegetables – current data, AUSVEG, Clayton North

Lloyd, H. L. (1996). *Incursion management in Australian plant industries: a report by the Plant Industries Sub-Committee of the SCARM Task Force on Incursion Management*. Department of Primary Industries and Energy, Canberra, ACT.

Kiri-ganai Research Pty Ltd., November 2005, *The Australian Vegetable Industry: taking stock and setting directions,* Kiri-ganai Research Pty. Ltd., Canberra

Kiri-ganai Research Pty Ltd., November 2005, *Setting Directions for the Future of the Vegetable Industry,* Kiri-ganai Research Pty. Ltd., Canberra

National Vegetable Industry Biosecurity Plan

THREAT IDENTIFICATION, PEST RISK REVIEWS AND INCURSION MANAGEMENT FUNDING ARRANGEMENTS

For more information on Plant Health Australia

Location: Suite 5, FECCA House
4 Phipps Close
DEAKIN ACT 2600

Phone: +61 2 6260 4322

Fax: +61 2 6260 4321

E-mail: admin@phau.com.au

Visit our web site: www.planthealthaustralia.com.au

An electronic copy of this plan is available from the web site listed above.

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

Acronyms

AS/NZS	Australian Standard/New Zealand Standard
AQIS	Australian Quarantine and Inspection Service
DTQ	Disease Threat Questionnaire
EPP	Emergency Plant Pest
EPPRD	Emergency Plant Pest Response Deed
IBP	Industry Biosecurity Plan
IBG	Industry Biosecurity Group
PHA	Plant Health Australia
PTQ	Pest Threat Questionnaire
TST	Threat Summary Table

Note: The definition of a pest as adopted by the International Plant Protection Convention (any species, strain or biotype of plant, animal, or pathogenic agent, injurious to plants or plant products) is used throughout this plan.

Introduction

This section is designed to help identify high risk pest threats to the vegetable industry, and to present a framework for assessing the potential economic, social, and environmental impacts associated with each threat. A consistent approach to threat identification and risk assessment will provide a strong base for future risk management activities by facilitating a more coordinated and efficient approach.

Emergency plant pests are defined as those that meet one or more of the following criteria:

a) It is a known exotic plant pest, the economic consequences of an incident of which would be economically or otherwise harmful for Australia, and for which it is considered to be in the regional or national interest to be free of the plant pest.

b) It is a variant form of an established plant pest which can be distinguished by appropriate investigative and diagnostic methods, and which if established in Australia, would have a regional or national impact.

c) It is a serious plant pest of unknown or uncertain origin which may, on the evidence available at the time, be an entirely new plant pest, and which if established in Australia would have an adverse economic impact regionally and or nationally.

d) It is a plant pest of potential economic importance to the area endangered thereby and not yet present there or widely distributed and being officially controlled, but is occurring in such a fulminant outbreak form, that an emergency response is required to ensure that there is not either a large scale epidemic of regional or national significance or serious loss of market access.

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 Emergency Plant Pest Response Deed (EPPRD) that has been negotiated between PHA's government and industry members. Once finalised, the Deed will ensure reliable and agreed funding arrangements are in place in advance of emergency plant pest incursions, and assist in the response to emergency plant pest incursions, particularly those identified as key threats.

Identification of high risk 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.

Threat identification

Information on biosecurity threats to the vegetable industry described in this document came from a combination of:

- past records
- existing industry protection plans

- relevant experience
- industry practice and experience
- relevant published literature
- local industry and overseas research
- economic models
- specialist and expert judgment.

At this time, only invertebrate pests (insects/mites) and pathogens (disease causing organisms) have been identified, although the issue of weeds may be revisited through reviews of this plan.

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 organism to identify and control and/or eradicate?

The Threat Summary Tables (TSTs) presented at Appendix 1 list potential exotic pest threats to the vegetable industry and provide summarised information on entry, establishment and spread potential, consequences of establishment, and eradication potential (where available).

The most serious threats from the TSTs were identified through a process of qualitative risk assessment and are listed in Table 1. Threats listed in Table 1 are exotic pests, not currently found in Australia. Specific contingency plans are being developed for these threats, and will be made available from PHA.

Pest and Disease Threat Questionnaire scores

The Pest Threat Questionnaire (PTQ) system was developed by the Department of Agriculture and Food, Western Australia (DAFWA) to rank the relative importance of quarantine threats for that state.

In conjunction with the DAFWA, PHA has developed a web based PTQ and Disease Threat Questionnaire (DTQ) system for ranking the relative importance of threats at a national level.

The PTQ can be found at www.planthealthaustralia.com.au/PTQ
The DTQ can be found at www.planthealthaustralia.com.au/DTQ

Generation of a PTQ or DTQ score involves a number of experts answering multiple choice questions on particular pests. The DTQ or PTQ score is calculated based on combined questionnaire responses (which carry different numerical weightings). Through this process, high priority pests are identified and targeted for further in-depth risk assessment and the development of specific risk management strategies (as required).

Emergency plant pest priority list

Table 1: *Emergency plant pest priority list*

This table provides the top ranked pest threats to the vegetable industry (see end of Table 1 for legend). Additional pest-specific information is provided in the Threat Summary Tables at Appendix 1. Assessments may change given more detailed research, and the priority list will be reviewed at least annually.

Insects

Common name	Life form	Scientific name	Vegetable Group	Relevant host/s	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
Melon fly	Fly	*Bactrocera cucurbitae*	Cucurbitaceae	Cucumber, giant pumpkin, ornamental gourd	**HIGH**	**HIGH**	**HIGH**	**HIGH**	**HIGH**
Tomato leaf miner	Fly	*Liriomyza bryoniae* Diptera: Agromyzidae	Multiple Vegetable Groups	Cabbages, cucumbers, lettuces and tomatoes.	**HIGH**	**MEDIUM**	**HIGH**	**HIGH**	**HIGH**
Serpentine leaf miner	Fly	*Liriomyza huidobrensis* Diptera: Agromyzidae	Multiple Vegetable Groups	Potatoes, eggplant, beets, capsicum, celery, cucumbers, beans, garlic, lettuces, onions, peas, spinach and tomatoes.	**HIGH**	**HIGH**	**MEDIUM**	**HIGH**	**HIGH**
Vegetable leaf miner	Fly	*Liriomyza sativae* Diptera: Agromyzidae	Multiple Vegetable Groups	Eggplants, capsicums, celery, cucumbers, peas and tomatoes.	**HIGH**	**HIGH**	**MEDIUM**	**HIGH**	**HIGH**

Common name	Life form	Scientific name	Vegetable Group	Relevant host/s	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
American serpentine leaf miner or chrysan-themum leaf miner	Fly	*Liriomyza trifolii* Diptera: Agromyzidae	Multiple Vegetable Groups	Highly polyphagous. Beetroot, Chinese cabbage, capsicum, celery, cucumber, garlic, lettuce, onion, peas, spinach and tomato	**MEDIUM**	**HIGH**	**HIGH**	**HIGH**	**HIGH**
Carrot (rust) fly	Fly	*Psila rosae* Diptera: Psilidae	Multiple Vegetable Groups	Carrot, parsnip, celery, parsley, as well as other members of Apiaceae	**HIGH**	**HIGH**	**MEDIUM-HIGH**	**EXTREME**	**EXTREME**

Pathogens

Common name	Life form	Scientific name	Vegetable Group	Relevant host/s	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
Carrot cyst nematode	Nem	*Heterodera carotae* Tylenchida : Heteroderidae	Multiple Vegetable Groups	Carrot, other *Daucus* spp. and *Torilis* spp.	**MEDIUM**	**HIGH**	**HIGH**	**HIGH**	**HIGH**
Rust	Fun	*Uromyces scirpi* Uredinales: Pucciniaceae	Root crops	Carrot	**UNKNOWN**	**MEDIUM**	**HIGH**	**HIGH**	**HIGH-UNKNOWN**

Common name	Life form	Scientific name	Vegetable Group	Relevant host/s	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
Zucchini lethal chlorosis tospovirus	Vir	*Zucchini Lethal Chlorosis Virus* Bunyaviridae: Tospovirus	Cucurbitaceae	Zucchini	**UNKNOWN**	**UNKNOWN**	**UNKNOWN**	**HIGH**	**HIGH-UNKNOWN**
Watermelon silver mottle virus group (serogroup iv group)	Vir	*Watermelon silver mottle, Groundnut bud necrosis, watermelon bud necrosis*	Multiple Vegetable Groups	Watermelon, melon, squash, pumpkin, pepper, eggplant, capsicum, cucumber,	**HIGH**	**HIGH**	**HIGH**	**HIGH**	**HIGH**

Note: See end of table for legend

Life Form Legend

BAC	Bacteria	FLY	Flies and Midges (DIPTERA)
BTLE	Beetles (weevils etc.) (COLEOPTERA)	SLUG	Slugs (GASTROPODA)
BUG	Stink bugs, aphids, mealybugs, scale, whiteflies and hoppers (HEMIPTERA)	SNAI	Snails (GASTROPODA)
BUT	Butterflies (LEPIDOPTERA)	THRI	Thrips (THYSANOPTERA)
FUN	Fungus	MITE	Mites e.g. spider and gall mites (ACARI)
NEM	Nematode	EWIG	Earwigs (DERMAPTERA)
PLO	Phytoplasma like organism	MOTH	Butterflies and moths (LEPIDOPTERA)
VIR	Virus	LOCU	Locusts and grasshoppers (ORTHOPTERA)

Entry Potential

Negligible	probability of entry is extremely low given the combination of factors including the distribution of the pest source, management practices applied, low probability of pest survival in transit.
Low	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 or certain given the combination of factors described above.
Unknown	pest entry potential is unknown or very little of value is known.

Establishment Potential

Negligible	the pest has no potential to survive and become established.
Low	the pest has the potential to survive and become established in approximately one third or less of the range of hosts. 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 no potential for natural spread.
Low	the pest has potential for natural spread locally.
Medium	the pest has potential for natural spread throughout a physiographic region.
High	the pest has potential for natural spread to all production areas.
Unknown	spread potential is unknown or very little of value is known.

Economic Impact

Negligible	there is no impact on yield, host longevity, production costs or storage.
Low	there is minor impact on standing crop and little effect on stored product.
Medium	there is moderate impact on crops, but host mortality is rare, storage losses may occur.
High	there is severe impact on standing crop, with significant host mortality and/or storage losses.
Extreme	there is extreme impact on standing crop, with extreme host mortality and/or storage losses.
Unknown	the economic potential of the pest is unknown or very little of value is known.

Pest Risk Reviews

The objective of risk analysis is to clearly identify and classify biosecurity risks and to provide data to assist in the evaluation and treatment of these risks. Risk analysis 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 analysis may be undertaken to various degrees of refinement, depending on the risk information and data available. Analysis may be qualitative, semi-quantitative, quantitative, or a combination of these. The complexity and cost of analyses 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 analysis, and if necessary, undertake more specific quantitative analysis later (AS/NZS-4360, 1999).

When a risk analysis is performed, it is important to document the type of analysis used, the level of confidence in the analysis, and any areas where assumptions have been made or where information is limited or unavailable. The steps listed below, which follow Biosecurity Australia's *Draft Guidelines for Import Risk Analysis* (2001), provide an outline of the qualitative pest risk assessment process. Refer to Biosecurity Australia (2001) for further detail if required.

Appendix 2 contains Pest Risk Reviews for key threats to the vegetable industry.

Step 1 - Clearly identify the pest

It is important to clearly define the identity of the pest for which the risk assessment is being performed, so that it is not confused with other pests. The generally accepted unit for defining the pest is its scientific name. A broader grouping than species may be used in some circumstances, for example when carrying out a risk assessment for a group of closely related species. Alternatively, in some cases the unit for defining a pest may be more narrowly defined, for example a sub-type within a species (e.g. subspecies, race, pathovar). In such cases there must be evidence that factors, such as differences in host range, pathogenicity or vector

relationship, make that sub-type distinct from others in terms of biosecurity significance (Biosecurity Australia, 2001).

Step 2 – Assess the likelihood of entry, establishment and spread

It is likely that a combination of qualitative and quantitative data will be used to assess the likelihood or potential of an exotic incursion and its establishment. The likelihoods of entry, establishment and spread should be rated separately, noting any limitations or comments that may help in further refinement of the rating given. Table 2 defines the different risk level ratings that may be allocated (Biosecurity Australia, 2001).

After each risk area has been rated individually, a combined risk rating should be determined using the qualitative risk analysis matrix presented in Table 3. Again any important assumptions or limitations should be noted (Biosecurity Australia, 2001).

Table 2: *Factors used to rate the likelihood or potential of a pest incursion*

Likelihood or potential	Qualitative ratings	Statistical probability of occurrence
Entry potential, establishment potential and spread potential	High	Range = 0.7 to 1
	Medium	Range = 0.3 to 0.7
	Low	Range = 0.05 to 0.3
	Very low	Range = 0.001 to 0.05
	Extremely low	Range = 10^{-6} to 0.001
	Negligible	Range = 0 to 10^{-6}
	Unknown	n/a

From Biosecurity Australia (2001)

Table 3: *Combining qualitative risk ratings*

	Likelihood					
Likelihood	**Negligible (N)**	**Extremely low (EL)**	**Very low (VL)**	**Low (L)**	**Moderate (M)**	**High (H)**
High	N	EL	VL	L	M	H
Moderate	N	EL	VL	L	L	M
Low	N	EL	VL	VL	L	L
Very low	N	EL	EL	VL	VL	VL
Extremely low	N	N	EL	EL	EL	EL
Negligible	N	N	N	N	N	N

From Biosecurity Australia (2001)

Step 3 – Assess the likely consequences

The most obvious consequence of a pest introduction is the economic impact it may have on an industry and local communities. Environmental and social impact ratings are also important to consider, as they help to determine the level of responsibility and the cost-sharing arrangements that may be involved in managing the risk. Whilst economic impacts may sometimes be expressed numerically, qualitative impact ratings can be used in place of numerical data if necessary.

Table 4 defines the categories for rating economic, environmental, and social impacts (Biosecurity Australia, 2001).

Table 4: *Factors used to rate the consequences of a pest incursion*

Impact rating	Definition
Unlikely to be discernible	Not usually distinguishable from normal variation in the criterion.
Minor	Not expected to threaten economic viability, but would cause a minor increase in mortality/morbidity or a minor decrease in production. For non-commercial factors, impact not expected to threaten the intrinsic 'value' of the criterion, but the value would be considered as 'disturbed'. These effects would generally be reversible.
Significant	Would threaten economic viability through a moderate increase in mortality/morbidity or moderate decrease in production. For non-commercial factors, the intrinsic 'value' of the criterion would be significantly diminished or threatened. Effects may not be reversible.
Highly significant	Would threaten economic viability through a large increase in mortality/morbidity, or a large decrease in production. For non-commercial factors, the intrinsic 'value' of the criterion would be considered as severely or irreversibly damaged.

From Biosecurity Australia (2001)

Economic, environmental, and social impacts should be assessed individually, and should be calculated for each of four geographic and/or geopolitical scales: local areas (i.e. rural communities, towns, or local government areas); districts (i.e. recognised sections of states, such as 'North West Slopes and Plains' and 'Far North Queensland'); regions (i.e. collections of districts – generally states), and; Australia as a whole (Biosecurity Australia, 2001).

These values are then translated to an 'impact score' (range A-F) according to the guidelines in Table 5.

Table 5: *Assessing consequences for pest incursions at local, district, regional, and national levels*

Scale	Consequence ratings					
National	Unlikely to be discernible	Unlikely to be discernible	Unlikely to be discernible	Minor	Significant	Highly significant
Regional	Unlikely to be discernible	Unlikely to be discernible	Minor	Significant	Highly significant	Highly significant
District	Unlikely to be discernible	Minor	Significant	Highly significant	Highly significant	Highly significant
Local	Minor	Significant	Highly significant	Highly significant	Highly significant	Highly significant
Impact score	**A**	**B**	**C**	**D**	**E**	**F**

From Biosecurity Australia (2001)

Combine individual consequence ratings to produce an overall consequence rating for a specific pest

Where numerical data are used in risk assessment, the overall consequences for a particular pest can be calculated by simply summing the values. However if, as is more often the case, a qualitative evaluation has been used to rate economic, social or environmental impacts, it is not possible to simply sum the outcomes to determine the overall impact of a pest across these categories. The following rules have been developed by (Biosecurity Australia, 2001) to perform a similar function and should instead be used to obtain an approximate impact evaluation. These rules are mutually exclusive and should be addressed in order, until one is found to apply.

1. Where the consequence of a pest for any direct or indirect criterion is rated as 'F', the overall consequences are considered to be 'extreme'.
2. Where the consequences of a pest are rated as 'E' for more than one criterion, the overall consequences are considered to be 'extreme'.
3. Where one consequence is rated 'E' and all others are rated 'D', the overall consequences are considered to be 'high'.
4. Where one consequence is rated 'E' and all others are not unanimously rated 'D', the overall consequences are considered to be 'high'.
5. Where all consequences are rated 'D', the overall consequences are considered to be 'high'.
6. When the consequences of at least one criterion are rated 'D', the overall consequences are considered to be 'moderate'.
7. Where all consequences are rated 'C', the overall consequences are considered to be 'moderate'.
8. Where the consequences of a pest are rated as 'C' for one or more criteria, the overall consequences are considered to be 'low'.
9. Where the consequences for all criteria are rated as 'B', the overall consequences are considered to be 'low'.

10. Where the consequences for one or more criteria are considered 'B', the overall consequences are considered to be 'very low'.

11. Where the consequences for all criteria are rated 'A', the overall consequences are considered to be 'negligible'.

Step 4 – Derive an overall risk estimate by combining the likelihood and consequence ratings

Once the probabilities of entry, establishment and spread have been calculated for the pest, and an assessment of the likely consequences has been made, this information can be combined to achieve a risk estimate. This may be done mathematically for numerical data, however a set of 'decision rules' are required in order to combine qualitative rankings (Biosecurity Australia, 2001). Table 6 summarises decision rules for combining the qualitative likelihood and consequence ratings described in this document.

Table 6: Risk estimation matrix

Likelihoods of entry, establishment and spread	Consequences of entry, establishment and spread					
	Negligible impact	**Very low impact**	**Low impact**	**Moderate impact**	**High impact**	**Extreme impact**
High likelihood	**Negligible risk**	**Very low risk**	**Low risk**	**Moderate risk**	**High risk**	**Extreme risk**
Moderate likelihood	**Negligible risk**	**Very low risk**	**Low risk**	**Moderate risk**	**High risk**	**Extreme risk**
Low likelihood	**Negligible risk**	**Negligible risk**	**Very low risk**	**Low risk**	**Moderate risk**	**High risk**
Very low likelihood	**Negligible risk**	**Negligible risk**	**Negligible risk**	**Very low risk**	**Low risk**	**Moderate risk**
Extremely low likelihood	**Negligible risk**	**Negligible risk**	**Negligible risk**	**Negligible risk**	**Very low risk**	**Low risk**
Negligible likelihood	**Negligible risk**	**Negligible risk**	**Negligible risk**	**Negligible risk**	**Negligible risk**	**Very low risk**

From Biosecurity Australia (2001)

Definition of risk categories with respect to risk management

- **Extreme risk** – specific action is required immediately to reduce risk.
- **High risk** – specific action is required. Generic risk mitigation plans should be adopted as soon as possible in the interim to increase the level of protection.

- **Moderate risk** – the current level of risk protection is insufficient. Appropriate risk reduction measures need to be identified and applied.
- **Low risk** – the current level of risk protection is insufficient. Appropriate risk reduction measures need to be identified and applied.
- **Very low risk** – an acceptable level of risk protection is in place. Additional risk management measures are not required.
- **Negligible risk** – an acceptable level of risk protection is in place for this threat. Risk management measures should be reviewed to ensure that they are justifiable.

Step 5 – Review the risks

Risks will change over time and may become more or less important based on changing technology, practices, legislation and policy. A process to identify new threats and to reassess the risk of existing threats facing the industry will be undertaken regularly as part of the review process of this plan. This will help ensure all threats have been identified and appropriately prioritised, with suitable risk mitigation strategies in place. It is recommended that these reviews be undertaken at least annually.

Formal categorisation of pests for inclusion in the industry/government Emergency Plant Pest Response Deed

The following section outlines the Emergency Plant Pest Response Deed between government and industry members of PHA that was formally ratified on the 26 October 2005. As of the 19 February 2007 members representing the Vegetable industry have not signed the Deed. The Deed aims to minimise the impact of emergency plant pests by establishing an industry/government agreement to cover eradication of emergency pests, reducing delays in securing funding, providing industry with greater involvement in eradication efforts, and removing disincentives to report emergency pests.

Only the response to emergency pests will be covered by the Deed. Industry and government will share the total cost of an approved emergency plant pest response based on pre-agreed funding categories. These categories determine the contributions that each party will pay, based on the relative public and private benefits to be obtained from eradication. Four funding categories are included in the Deed.

Table 7: *Cost sharing categories*

Category	Description	Funding share
Category 1: Very high public benefits	Pest which if not eradicated would: ▪ cause major environmental damage to natural ecosystems; and/or ▪ potentially affect human health or cause a major nuisance to humans; and/or ▪ cause significant damage to amenity flora; and ▪ have relatively little impact on commercial crops. This category also covers situations where the pest has a very wide range of hosts including native flora and there is considerable uncertainty as to the relative impacts on the different crops. In short, it is almost impossible to properly determine which industries benefit from eradication and to what extent, and in any case, the incursion primarily affects native flora and/or amenity plants, and/or is a major nuisance if not a health risk to humans.	100 per cent public funding
Category 2: High public benefits	Pest which if not eradicated would: ▪ cause significant public losses either directly through serious loss of amenity, and/or environmental values and/or effects on households, or indirectly through very severe economic impacts on regions and the national economy, through large trade losses with flow on effects through the economy; and ▪ also impose major costs on the industries concerned so that these industries would significantly benefit from eradication.	80 per cent public funding, 20 per cent private funding
Category 3: Moderate public benefits	Pest which if not eradicated would: ▪ primarily harm the industries concerned but there would also be some significant public costs as well (that is, moderate public benefits from eradication). In this case the pest could adversely affect public amenities, households or the environment, and/or could have significant, though moderate trade implications and/or national and regional economic implications.	50 per cent public, 50 per cent private funding

Category	Description	Funding share
Category 4: Mostly if not wholly private benefits	Pest which if not eradicated would: ▪ have little or no public cost implications and little or no impacts on natural ecosystems. The affected commercial industries would be adversely affected primarily through additional costs of production, through extra control costs or nuisance costs; and ▪ generally there would be no significant trade issues that would affect national and regional economies.	80 per cent private funding, 20 per cent public funding

Pest categorisation

Exotic organisms listed in the emergency plant pest priority list may be put forward for categorisation and inclusion in the schedules to the Deed. Other organisms identified in TSTs or identified via other means as being priority pests, may also be categorised if required.

Organisms that enter Australia, but which have not been formally categorised will be treated as belonging to Category 3 until formally categorised.

A Categorisation Group determines the category that applies to high priority pests. Only emergency plant pests that have a high impact or establishment potential are considered for categorisation. Taking into account relevant scientific and other knowledge and experience the Categorisation Group will consider requests for pest categorisation, undertake reviews of pest categorisation, or remove pests from priority lists.

When more than one industry is affected by an emergency plant pest, the Categorisation Group will also determine, and where requested review, the funding weight for determining industry cost shares. Funding weights provide a means for calculating each industry's contributions if a pest affects multiple industry parties.

Figure 1 outlines the decision-making process for pest categorisation.

Composition of the categorisation group

Membership of the Categorisation Group will comprise (at a minimum):

- an independent chair from PHA
- a standing representative of industry parties
- three technical experts [people with specific expertise in the areas of plant pathology or entomology], one nominated by the Australian Government, one nominated by the states/territories and one nominated by plant industry(s)
- a person with relevant economic expertise including social, trade and regional impact assessment
- a nominee from each plant industry or industries affected by the emergency plant pest being categorised.

The Categorisation Group may also seek advice from:

- a person with human health expertise, if a public health risk may exist
- a conservation representative or

- other relevant members determined by the independent chair.

Advisers who have specific expertise may accompany members, but will not be part of the decision-making process

PHA commenced the pest categorisation process in March 2004 with a preliminary round of pest categorisation for each plant industry. Membership of the Vegetable Categorisation Group was:

- an independent chair from PHA - Mr Neil Fisher
- a standing representative of industry parties - Dr Simon McKirdy
- three technical experts [people with specific expertise in the areas of plant pathology or entomology], one nominated by the Australian Government, one nominated by the states/territories and one nominated by plant industry(s) – Dr Graeme Hamilton (Australian Government), Mr Michael Grimm (State Government) and Dr Peter Merriman (Industry)
- a person with relevant economic expertise including social, trade and regional impact assessment – Dr John Brennan and Ms Lisa Elliston
- a nominee from each plant industry or industries affected by the emergency plant pest being categorised – Mr Michael Badcock.

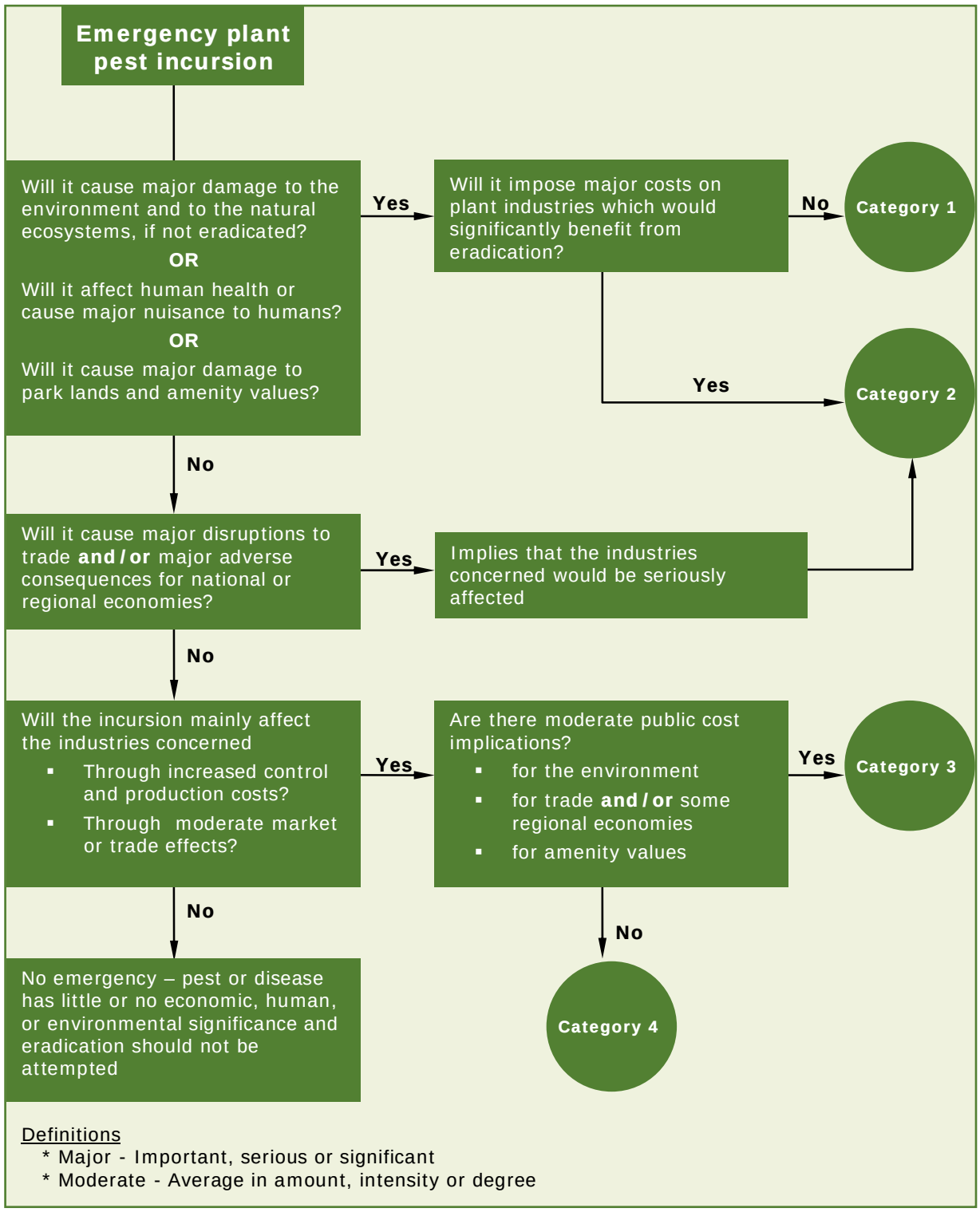
Formal vegetable industry EPP categories and Funding Weights are shown in Table 8. Funding Weights are applicable where pests affect multiple industries. Full details and calculations of Cost Sharing for EPP Responses where more than on Industry Party is affected are shown in Schedule 6, Section 2.2 if the EPPRD. Now that the EPPRD has been ratified, PHA will re-establish the Categorisation Group to categorise the remaining pests in the priority pest list, identified through this industry biosecurity planning process.

Table 8: *Formal Vegetable Industry EPP categories.*

Scientific name	Common name	Formal Category	Funding Weights (%)
Bactrocera dorsalis	Oriental fruit fly	**2**	**16.7**
Bactrocera papayae	Papaya fruit fly	**2**	**16.7**
Bactrocera philippinensis	Philippine fruit fly	**2**	**16.7**
Cryptophlebia leucotreta	False codling moth	**2**	**5.3**
Globodera rostochiensis	Potato cyst nematode	**3**	**N/A**
Leptinotarsa decemlineata	Colorado potato beetle	**3**	**N/A**
Potato spindle tuber viroid	Potato spindle tuber viroid	**3**	**N/A**
Mythimna unipuncta	Armyworm	**4**	**31.3**
Nasonovia ribisnigri	Currant lettuce aphid	**2**	**N/A**
Peridroma saucia	Variegated cutworm	**4**	**97.1**
Phymatotrichopsis omnivorum	Cotton root rot, Texas root rot	**2**	**11.1**

Scientific name	Common name	Formal Category	Funding Weights (%)
Puccinia asparagi	Asparagus rust	**4**	**N/A**
Tetranychus piercei	Spider mite	**4**	**18.1**
Verticillium dahliae	Verticillium wilt (defoliating strain)	**3**	**N/A**

Figure 1: *Pest categorisation decision tree*



References

AS/NZS-4360. (1999). Risk Management Standards Association of Australia, Strathfield, NSW.

Biosecurity Australia. (2001) *Guidelines for Import Risk Analysis: Draft September 2001*. Department of Agriculture, Fisheries and Forestry – Australia, Barton, ACT.

Appendix 1: Threat Summary Tables (DRAFT)

Solanaceae (Insects)

Details of exotic insect threats to the Solanaceae family can be found in the National Potato Industry Biosecurity Plan, Threat Summary Table.

Solanaceae (Pathogens)

Details of exotic pathogen threats to the Solanaceae family can be found in the National Potato Industry Biosecurity Plan, Threat Summary Table.

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
Tomato apical stunt viroid	Vir									
Yellow mosaic, pepper new begomovirus										

Brassicaceae [Crucifers] and Leafy Vegetables (Insects)

Information provided below is a basic overview and may change given further research or if new information comes to hand.

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
Brassica pod midge	Fly	*Dasineura brassicae* Diptera : Cecidomyiidae	Cabbages, cauliflowers	Gall forming fly	Distribution: Europe, Africa. Targeted Survey Option: Yes	**MEDIUM**	**MEDIUM**	**MEDIUM**	**MEDIUM**	**LOW**
Cabbage Root fly	Fly	*Delia radicum* Diptera : Anthomyiidae	Cabbages, cauliflowers, and broccoli		Distribution: Asia, Europe, Africa and North America. Targeted Survey Options: Yes	**LOW**	**MEDIUM**	**MEDIUM**	**LOW**	**EXTREMELY LOW**
Crucifer, caterpillar	But	*Evergestis forficalis* Lepidoptera: Crambidae	Cabbages, cauliflowers, brussel sprouts.	Whole plant. Stunted growth if infected as seedlings, discoloured leaves which wilt and roots black and rotten.	Distribution: India, Japan and Europe	**UNKNOWN**	**UNKNOWN**	**UNKNOWN**	**LOW**	**LOW - UNKNOWN**
Cabbage caterpillar	Moth	*Pieris brassicae* Lepidoptera: Pieridae	Cabbages, cauliflowers, broccoli, brussel sprouts,	Leaves. Pupae are likely to settle in curds/heads.	Distribution: Asia, Europe, Africa and Chile. Targeted Survey Options: Yes	**MEDIUM**	**MEDIUM**	**MEDIUM**	**LOW**	**EXTREMELY LOW**

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
Flea beetles	Btle	*Phyllotreta spp.* Coleoptera: Chrysomelidae Including *Phyllotreta albionica, Phyllotreta atra, Phyllotreta striolata, Phyllotreta flexuosa, Phyllotreta nemorum*	Brassicas: Cauliflowers, brussel sprouts and cabbage.	Larvae feeding on underground may result in decreased vigour or damage to underground crops. Adults mainly feed on leaves.	Distribution: Widespread. Targeted Survey Options: Unknown	**MEDIUM**	**MEDIUM**	**MEDIUM**	**LOW**	**EXTREMLEY LOW**

Brassicaceae [Crucifers] and Leafy Vegetables (Pathogens)

Information provided below is a basic overview and may change given further research or if new information comes to hand.

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
Cercospora leafspot	Fun	*Cercospora longissima*	Lettuce	Leaves: Infection normally appears in the older, lower leaves. When infections are numerous, extensive areas of leaf tissue may be killed.	Distribution: found in many parts of the world but is rarely destructive. Common in tropics and sub-tropics.	LOW Not seed-borne	HIGH Many weeds are also hosts eg. Dandelion, wild lettuce	MED Wind borne. Disease may be controlled using foliar fungicides, or cultural practices.	LOW Yield loss approx 5%	
Celery brown spot	Fun	*Acremonium apii*	Celery	Leaves, stem						
Fusarium wilt of lettuce	Fun	*Fusarium oxysporum f.sp. lactucum* Hypocreales	Lettuce			Seedbourne				

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
	Fun	*Hyaloperonospora brassicae* f.sp. *brassicae*	Brassica	Foliage						
	Fun	*Hyaloperonospora brassicae* f.sp. *raphani*	Raphanus	Foliage						
	Fun	*Hyaloperonospora cochleariae*	Armoracia	Foliage						

Root Crops (Insects)

Information provided below is a basic overview and may change given further research or if new information comes to hand.

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
Carrot beetle	Btle	*Ligyrus gibbosus* Coleoptera: Scarabaeidae	Carrot and a number of weeds	Roots	Distribution: Widespread in USA and Canada. Targeted survey optons: UNKNOWN	**NEGLIGIBLE**	**MEDIUM**	**MEDIUM**	**LOW**	**NEG**
Onion maggot or Onion fly	Fly	*Delia antiqua* Diptera: Anthomyiidae	Onion and garlic.	Bulb	Distribution: Widespread. Asia, Middle East, Europe, Africa, North, South and Central America	**See Onions IBP**	**See Onions IBP**	**See Onions IBP**	**See Onions IBP**	**See Onions IBP**

Root Crops (Pathogens)

Information provided below is a basic overview and may change given further research or if new information comes to hand.

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
Sweet Potato Leaf Curl Virus	Vir	*Begomovirus Sweet Potato Leaf Curl Virus (SPLCV)*	Sweet potato	Leaves	Vector is white flies. Distribution: Peru					
Sweet potato rust	Fun	*Coleosporium ipomoeae*	Sweet potato		Distibution: Americas, Southern Africa, Indonesia					
Carrot mosaic virus	Vir	Carrot Mosaic Virus Potyviridae: Potyvirus	Carrot	Leaves and petioles	Distribution: former Czechoslovakia	**NEGLIGIBLE**	**UNKNOWN**	**UNKNOWN**	**UNKNOWN**	**NEG-UNKNOWN**
Carrot thin leaf virus	Vir	Carrot Thin Leaf Virus Potyviridae: Potyvirus	Carrot	Leaves Generally does not affect carrot yield or quality.	Distribution: USA Virus transmitted by a vector, *Cavariella aegopodii, Myzus persicae*; Aphididae. Not transmitted by seed. Can be a problem when it occurs with other diseases.	**NEGLIGIBLE**	**UNKNOWN**	**UNKNOWN**	**UNKNOWN**	**NEG-UNKNOWN**
Phoma complanata	Fun	*Phoma complanata*	Parsnip		Distribution: India, Canada					
Phoma root rot / Brown rot	Fun	*Phoma rostrupi* Pleosporales: Leptosphaeriaceae	Carrot	Roots	Distribution: Spain and Ukraine. Disease is seedborne.	**UNKNOWN**	**UNKNOWN**	**HIGH** If seed not tested free of pathogen.	**NEGLIGIBLE**	**LOW – UNKNOWN**

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
Umbel rot	Fun	*Phomopsis dauci* Diaporthales: Valsaceae	Carrot		Distribution: Netherlands	**UNKNOWN**	**UNKNOWN**	**UNKNOWN**	**UNKNOWN**	**UNKNOWN**
Streptomycete soil rot	Fun	*Streptomyces ipomoeae*	Sweet potato	Roots	Distribution: Japan, Vietnam, USA					
Leaf rot, snow mold	Fun	*Typhula variabilis*	Carrot	Leaves	Distribution: UK	**LOW**	**LOW**	**LOW**	**NEGLIGIBLE**	**NEGLIBIBLE**
Rust	Fun	*Uromyces scirpi* Uredinales: Pucciniaceae	Carrot		Distribution: USA	**UNKNOWN**	**MEDIUM** May need an alternate host (Cyperaceae) to complete life cycle.	**HIGH**	**HIGH**	**HIGH-UNKNOWN**

Cucurbitaceae (Insects)

Information provided below is a basic overview and may change given further research or if new information comes to hand.

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
Cucurbit fly	Fly	*Dacus ciliatus* Diptera: Tephritidae	Cucurbits Minor host: tomato	Fruit	Distribution: Africa and Asia. Mode of spread: in host fruits. Fruit will show signs of oviposition punctures.					
Melon fly	Fly	*Bactrocera cucurbitae*	Cucumber, giant pumpkin, ornamental gourd	Larvae tunnel in fruit; the associated bacteria cause it to rot. Oviposition puncture marks often visible. Flowers, stems and roots may also be attacked	Distribution: Iran and Pakistan to southern China and Taiwan and throughout SE Asia. Introduced to PNG, Solomon Is, East Africa, Egypt, Hawaii, Marianas and Nauru. Occasional detections in Torres Strait and WA. Males respond to cue lure.	**HIGH** Natural dispersal, carried in infested fruit or wind-borne from PNG	**HIGH**	**HIGH** Known to disperse long distances.	**HIGH**	**HIGH**

Cucurbitaceae (Pathogens)

Information provided below is a basic overview and may change given further research or if new information comes to hand.

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
Acremonium hypocotyl rot	Fun	*Acremonium cucurbitacearum*	Seedling melon, cucumber and watermelon	Seedlings	Distribution: USA and Spain.	**LOW**	**HIGH** Infection can occur over a wide range of temps.	**MEDIUM** Survives in and spreads via soil.	**LOW** Controlled with fungicides and cultural practices.	**EXTREMELY LOW**
Scab of cucurbits	Fun	*Cladosporium cucumerinum*	Primary host: cucumber. Secondary hosts: watermelon, melon, cantaloupe, pumpkin, squash and ornamental gourd.	Whole plant, above ground	Distribution: Europe, Asia, Africa, North, South and Central America, French Polynesia.	**HIGH**	**MEDIUM** Favourable environ. Conditions for development are wet weather (valley fogs, heavy dews and light rains) and temperatures < 21°C.	**HIGH** Survives in soil, cracks found in greenhouse structures and on seed. Disseminated on insects, clothing and equipment. Can survive long-distance transport in moist air. Fungus may also be seedborne	**MEDIUM** Impact reduced by using resistant varieties. Disease can still affect some cucurbits. Yields of susceptible cucumber cultivars can be greatly reduced.	**MEDIUM**

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
Cucurbit yellow stunting disorder virus	Vir	Cucurbit Yellow Stunting Disorder Virus (CYSDV)	Cucurbits	Whole plant, mainly leaves	Distribution: Europe, North America, Middle East. Vector = white fly (*Bemisia tabaci*)	**UNKNOWN**	**UNKNOWN**	**UNKNOWN**	**UNKNOWN**	**UNKNOWN**
Cucurbit bacterial wilt	Bac	*Erwinia tracheiphila* Enterobacteriales: Enterobacteriaceae	Cucumber, melon, watermelon, ornamental gourd and pumpkin.	Leaves, stems	Distribution: Europe, Asia, Africa and North America. Targeted Survey Options: UNKNOWN	**LOW**	**MEDIUM** Has no specialized survival structures. Desiccates easily and killed by temp. extremes.	**MEDIUM** Completely dependent on cucumber beetles of the Chrysomelidae for dispersal.	**HIGH** Caused near complete crop failures, esp in cucumber and musk melon. Some crops are more tolerant.	**MEDIUM**
Cucurbit Aphid-borne yellow virus	Vir	Cucurbit Aphid-borne yellow virus (CABYV)		Leaves	Distribution: Tunisia					
Net spot	Fun	*Leandria momordicae*	Cucumber	Whole plant	Distribution: USA. Targeted Survey Options: UNKNOWN	**UNKNOWN**	**UNKNOWN**	**UNKNOWN**	**UNKNOWN** Causes severe defoliation	**UNKNOWN**

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
Melon yellow spot virus	Vir	*Melon yellow spot virus*	Curcubits and capsicums	Whole plant	Distribution: Thailand, Taiwan, Japan	**UNKNOWN**	**HIGH –** Wide range of species	**HIGH –** Transmitted by thrips species present in Australia	**UNKNOWN**	
Monosporascus root rot and vine decline	Fun	*Monosporascus cannonballus* : Sordariales	Watermelon, melon, bottle gourd.	Whole plant	Distribution: Spain, Japan, Taiwan, Tunisia, Mexico and USA. Targeted Survey Options: UNKNOWN		**MEDIUM** Optimum growth temp. 30 to 35 C not below 15 C. Tolerant of high pH and salt.	**MEDIUM** Spread in infected soil, irrigation runoff and plant material	**LOW** Controlled using cultural practices.	**EXTREMELY LOW-UNKNOWN**
Phomopsis black rot and purple stem	Fun	*Phomopsis cucurbitae* Diaporthales: Valsaceae	Watermelon, melon and cucumber.	Fruit	Distribution: Canada, India, Japan and USA. Targeted Survey Options: UNKNOWN		**UNKNOWN**	**MEDIUM – HIGH** Can be seedborne in melon.	**UNKNOWN**	**MEDIUM-UNKNOWN**
Black root rot of cucumber	Fun	*Phomopsis sclerotioides* Diaporthales: Valsaceae	Cucumber	Roots	Distribution: Europe, Asia, Canada. Targeted Survey Options: UNKNOWN		**UNKNOWN**	**UNKNOWN**	**LOW** Problem in greenhouse production. Controlled through steam sterilisation of soil.	**LOW-UNKNOWN**

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
Ulocladium leaf spot	Fun	*Ulocladium cucurbitae*	Cucumber	Leaves	Distribution: Europe and USA. Targeted Survey Options: UNKNOWN		**HIGH** Temperatures from 9 to 36 C	**MEDIUM** Survives between crops on infected debris in the soil.	**LOW** Fungicides and resistant var. available.	**LOW-UNKNOWN**
Watermelon silver mottle virus group (serogroup iv group)	Vir	*Watermelon silver mottle, Groundnut bud necrosis, watermelon bud necrosis*	Watermelon, melon, squash, pumpkin, pepper, eggplant, capsicum, cucumber,	Whole plant	Viruses within this group are found throughout south east Asia.	**High –** close proximity to south east Asia.	**High –** Capsicum chlorosis viruses have already shown ability of tospoviruses to establish in Australia.	**High** – both Thrips palmi and Frankliniella schultzei, major vectors of this group, are present in Australia**.**	**HIGH**	
Whitefly transmitted begomoviruses	Vir									
Zucchini lethal chlorosis tospovirus	Vir	*Zucchini Lethal Chlorosis Virus* Bunyaviridae: Tospovirus	Zucchini	Whole plant: plants may be stunted, die, or do not yield marketable fruit. Leaves may show yellowing or mottling.	Targeted Survey Options: UNKNOWN		**UNKNOWN**	**UNKNOWN**	**HIGH**	**HIGH-UNKNOWN**

Grains and Leguminous Plants (Insects)

Details of exotic insect threats to grains and leguminous plants can be found in the National Grains Industry Biosecurity Plan Threat Summary Table.

Grains and Leguminous Plants (Pathogens)

Details of additional exotic pathogen threats to grains and leguminous plants can be found in the National Grains Industry Biosecurity Plan Threat Summary Table.

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
golden mosaic of beans	Vir	*Bean golden mosaic virus* Geminiviridae: Begomovirus{GEM2 }	Beans		Distribution: North, Central and South America and Nigeria					
Pea cyst nematode	Nem	*Heterodera goettingiana*	Peas, beans							

Multiple Vegetable Groups (Insects)

Information provided below is a basic overview and may change given further research or if new information comes to hand.

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
Striped cucumber beetle	Btle	*Acalymma vittatum* or *Diabrotica melanocephala* Coleoptera: Chrysomelidae	Primary hosts include cucumber, cantaloupe, winter squash, pumpkin, gourd, summer squash, watermelon, and many other species of cucurbits. May also feed on beans, corn, peanuts, potatoes, and other crops.	Seedlings, roots, leaves, stems, flowers and fruit.	Distribution: USA, southern Canada and northern Mexico.	**MEDIUM**	**MEDIUM**	**MEDIUM**	**HIGH** Kills small plants and feeds on stems, leaves, roots and outer rind of fruit. Also a vector of bacterial wilt	**MEDIUM**
Wireworm	Btle	*Agriotes lineatus* Coleoptera: Elateridae	Highly polyphagous in more than 5 families.	Roots, leaves	Distribution: Europe, Middle East, USA, Canada. Targeted Survey Options: UNKNOWN	**MEDIUM**	**MEDIUM**	**MEDIUM**	**LOW**	**EXTREMELY LOW**
Turnip moth	Moth	*Agrotis segetum* Lepidoptera: Noctuidae	Maize, potato, sugarbeet, cabbage, turnip	Whole plant	Distribution: Europe. Targeted Survey Options: Yes	**MEDIUM**	**MEDIUM**	**HIGH**	**MEDIUM**	**LOW**

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
Beet worm	Moth	*Autographa nigrisigna* Lepidoptera: Noctuidae	Cabbages, potato, cowpea	Leaves, stems, flowers, fruit	Distribution: Russia, China, India, Japan, Korea, Nepal and Pakistan. Targeted Survey Options: UNKNOWN	**NEGLIGIBLE**	**MEDIUM**	**HIGH**	**VERY LOW**	**NEG**
Oriental fruit fly	Fly	*Bactrocera dorsalis* Diptera: Tephritidae	Polyphagous. Affects all fruit (except pineapples and strawberries)	Fruit	Distribution: South-East Asia. Fruit with “stings” (oviposition marks) and rot (maggots feeding). Targeted Survey Options: Yes.	**HIGH**	**HIGH**	**HIGH**	**HIGH**	**HIGH**
pea leaf miner	Fly	*Chromatomyia horticola* Diptera: Agromyzidae	Tomato, leguminous plants, lettuce, pea, onion, garlic, crucifers. Highly poloyphagous		Distribution: Widespread in Africa, Europe and Asia.					
Saltmarsh caterpillar	Moth	*Estigmene acrea* Lepidoptera: Arctiidae	Brassicaceae and beans	Leaves, may be at levels to cause yield loss	Distribution: South America, USA, Central America, Canada. Targeted Survey Options: UNKNOWN	**NEGLIGIBLE**	**LOW**	**MEDIUM**	**LOW**	**NEG**
Jar worm, mole cricket	Locu	*Gryllotalpa gryllotalpa* Orthoptera: Gryllotalpidae	Cucumber, *Fragaria, Gladiolus* hybrids, cotton, turf grasses, sugarbeet, cucumber, carrot, tobacco, potato, maize, lettuce	Young roots	Distribution: Europe, USA, Africa and India. Protected species in the UK and may be close to extinction. Targeted Survey Options: UNKNOWN	**NEGLIGIBLE**	**MEDIUM**	**MEDIUM**	**LOW**	**NEG**

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
American cotton bollworm	Moth	*Helicoverpa zea* Lepidoptera: Noctuidae	Maize, cotton, sorghum, tomato, bell pepper, eggplant.		Distribution: North, Central and South America, UK and Switzerland,					
Tomato leaf miner	Fly	*Liriomyza bryoniae* Diptera: Agromyzidae	Cabbages, cucumbers, courgettes, watermelons, other melons, lettuces, tomatoes	Leaves	Distribution: Europe, Israel, Egypt, Morocco, USA, Japan, Taiwan. Abundant in Vietnam Mode of spread: plants or cuttings intended for propagation.	**HIGH** Most likely route will be by cut flowers where eggs could be present.	**HIGH**	**MEDIUM**	**HIGH**	**HIGH**
Serpentine leaf miner	Fly	*Liriomyza huidobrensis* Diptera: Agromyzidae	Potatoes, eggplant, beets, capsicum, celery, cucumbers, beans, garlic, lettuces, melons, onions, peas, radishes, spinach, tomatoes.	Leaves	Distribution: Indonesia, Vietnam, Thailand, Europe, Israel, India, Mauritius, Reunion. Mode of spread: plants or cuttings intended for propagation, and cut flowers	**HIGH** Most likely route will be by cut flowers where eggs could be present.	**HIGH**	**MEDIUM**	**HIGH**	**HIGH**

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
Vegetable leaf miner	Fly	*Liriomyza sativae* Diptera: Agromyzidae	Eggplants, capsicums, celery, cucumbers, melons, peas, tomatoes.	Leaves	Distribution: Very important in Indonesia and Vientnam. Present in numerous countries in Asia, Africa, North America, Central America, South America and the Pacific. Mode of spread: plants or cuttings intended for propagation, and cut flowers.	**HIGH** It has now been found in East Timor suggesting that wind dispersal is possible to Australia.	**HIGH** The leaf miner best suited to horticultural crops grown around Darwin.	**MEDIUM**	**HIGH**	**HIGH**
American serpentine leafminer or chrysanthemum leaf miner	Fly	*Liriomyza trifolii* Diptera: Agromyzidae	Highly polyphagous. Beetroot, Chinese cabbage, capsicum, celery, cucumber, garlic, leek, lettuce, melon, marrow, onion, peas, spinach, tomato, watermelon.	Leaves	Widely distributed. Europe, Asia, Africa, North America, Central America, South America and the Pacific. Targeted Survey Options: UNKNOWN Mode of spread: plants or cuttings intended for propagation, and cut flowers. Low numbers in Vietnam.	**MEDIUM**	**HIGH**	**HIGH**	**HIGH**	**HIGH**

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
Carrot weevil	Btle	*Listronotus oregonensis and L. texanus* Coleoptera: Curculionidae	Carrot, parsnip, celery, parsley	Roots, crowns and petioles.	Distribution: Canada and USA. Targeted Survey Options: UNKNOWN	**MEDIUM**	**HIGH** Occurs in regions with similar climate.	**MEDIUM** Pupae have the potential to be spread in soil on machinery.	**MEDIUM** Some losses in the stand from damage to the young plants. Also reduced carrot quality.	**LOW**

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
Beet webworm	Moth	*Loxostege sticticalis* Lepidoptera: Pyralidae	Highly polyphagous. Hosts mostly in the Fabaceae, Solanaceae, Asteraceae, Convolvulaceae, Polygonaceae, Poaceae, Chenopodiaceae, Brassicaceae, Liliaceae, Malvaceae, Apiaceae, Cyperaceae, Rosaceae, Papaveracae, Plantaginaceae, Cucurbitaceae and Cannabaceae.	Leaves, stems, growing points, flowers, fruits	Distribution: found in the northern part of the Northern Hemisphere, mostly north of 30°N. Targeted Survey Options: Yes.	**LOW**	**MEDIUM**	**MEDIUM**	**LOW**	**EXTREMELY LOW**
Aster leafhopper	Bug	*Macrosteles quadrilineatus* Hemiptera: Cicadellidae	Polyphagous. Primary hosts include celery, endive, carrot, barley, lettuce, lucerne, flax and parsley.	Leaves, flowers, fruits	Distribution: widespread in the USA. Targeted Survey Options: UNKNOWN	**UNKNOWN**	**NEGLIGIBLE**	**MEDIUM**	**MEDIUM**	**NEG-UNKNOWN**

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
Cabbage moth	Moth	*Mamestra brassicae* Lepidoptera: Noctuidae	Onions, garlic, leek, sugarbeet, cabbages, cauliflowers, brussel sprouts, lettuce, tomato, common bean, potato and maize.	Feed on leaves. Frass accumulate in central part of plant.	Distribution: Asia, Europe and Libya.					-
Bertha armyworm	Moth	*Mamestra configurata* Lepidoptera: Noctuidae	Highlyt Polyphagous. Rape, turnip rape, common bean, pea, cauliflowers, cabbages, potato, maize, turnip and more	Leaves and pods.	Distribution: Canada, USA and Mexico. Targeted Survey Options: Yes	**LOW**	**LOW**	**MEDIUM**	**LOW**	**NEGLIGIBLE**

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
Armyworm	Moth	*Mythimna unipuncta* Lepidoptera: Noctuidae	Mainly a pest of small grains (maize and other cereals). Secondary hosts include onion, garlic, leek, tomato, beans and potato.	Leaves, stems and seeds.	Distribution: Europe, Asia, Africa, North America, Central America, and South America. Eggs extremely difficult to detect. Early instar larvae feed gregariously on young leaves during the day. Older instars feed in protected sites e.g. leaf axils, or are found under dense vegetation or on the ground during the day.	**LOW –** Larvae overwinter and could be transported in straw	**HIGH –** Could establish in most areas of Australia	**HIGH** – Wide host range a climate tolerance	**MEDIUM** – Impact difficult to estimate, relative to native species	**Extremely low risks**
beet leafhopper	Bug	*Neoaliturus tenellus* Hemiptera: Cicadellidae	Sugarbeet, tomato.	Leaves, direct damage minor. Vector for Beet Curly Top Virus (BCTV) which affects a number of vegetables	Distribution: Asia, Europe, North and Central America, aFricua					

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
Old world swallowtail	Moth	*Papilio machaon* Lepidoptera: Papilionidae	Angelica, common rue, bullwort, carrot, parsley, fennel	Adult food: flower nectar	Distribution: Europe, Asia, USA and Canada. Targeted Survey Options: UNKNOWN	**NEGLIGIBLE**	**LOW**	**MEDIUM**	**VERY LOW**	**NEG**
Pearly underwing moth or Varieagated Cutworm	Moth	*Peridroma saucia* Lepidoptera: Noctuidae	Beetroot, cauliflowers, cabbages, bell pepper, lettuce, tomato, tobacco and potato.	Leaves. Young plants may be cut off at the base. May feed within cabbage head.	Distribution: Asia, Europe, Africa, North, Central and South America. Targeted Survey Options: Yes	**MEDIUM**	**MEDIUM**	**MEDIUM**	**LOW**	**EXTREMELY LOW**
Striped flea beetle	Btle	*Phyllotretachota chotanica* Coleoptera: Chrysomelidae	Brassica, Chinese cabbage, cabbage and beans	Whole plant.	Distribution: Widespread throughout Asia.	**MEDIUM**	**MEDIUM**	**MEDIUM**	**LOW**	**EXTREMELY LOW**
Lesser snow scale	Bug	*Pinnaspis strachani* Hemiptera: Diaspididae	Asparagus, eggplant, pepper, tomatoe, common bean. Highly polyphagous		Distribution: Wide distribution including PNG					
Scarlet mealybug	Bug	*Pseudococcus calceolariae* Hemiptera: Pseudococcidae	Highly polyphagous with hosts from 40 different plant families.	Leaves, stems, flowers, fruits	Distribution: present in NSW, QLD, Tas and VIC. Not present in WA. Targeted Survey Options: UNKNOWN	**LOW**	**MEDIUM**	**MEDIUM**	**LOW**	**EXTREMELY LOW**

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
Carrot (rust) fly	Fly	*Psila rosae* Diptera: Psilidae	Carrot, parsnip, celery, parsley, lovage, celeriac, as well as other members of the Apiaceae	Roots and leaves	Distribution: Europe, Asia (Japan, Mongolia, Turkey), South Africa, Canada, USA and New Zealand. Appears to be limited by the -10^0C and 25^0C isotherms. Targeted Survey Options: UNKNOWN	**HIGH**	**HIGH** Once introduced may survive on Apiaceous weeds eg fennel. May also be able to survive on native Apiaceae.	**MEDIUM-HIGH** HIGH in the SW of WA and other temperate regions. May be spread in carrots being shipped interstate.	**EXTREME** Causes seedling mortality, root forking, reduces carrot quality.	**EXTREME**
Brown gourd-shaped weevil	Btle	*Scepticus uniformis* Coleoptera: Curculionidae	Carrot and burdock		Distribution: Asia. Targeted Survey Options: UNKNOWN	**NEGLIGIBLE**	**MEDIUM**	**MEDIUM**	**LOW**	**NEG**
Southern army worm	Moth	*Spodoptera eridania* Lepidoptera: Noctuidae	Polyphagous: brassicas, legumes, maize and other Poaceae, cassava, capsicum, eggplant, potato, sweet potato, tobacco, tomato and many other vegetables and ornamentals.	Leaves and fruits	Distribution: southern USA, Central America and South America. Targeted Survey Options: UNKNOWN	**NEGLIGIBLE**	**MEDIUM**	**HIGH**	**LOW**	**NEG**

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
Fall armyworm	Moth	*Spodoptera frugiperda* Lepidoptera: Noctuidae	Maize, sorghum, crucifers, cucurbits, potato, cabbages, bell pepper and cauliflowers	Foliage, larvae also burrow into growing points.	Distribution: North, Central and South America	Identified in Deed as high priority				-
Lateral lined army worm	Moth	*Spodoptera latifascia* Lepidoptera: Noctuidae	Polyphagous: Including brassicas, peanut, capsicum, carrot, sweet potato, tomato, tobacco, beans and maize	Leaves and fruits	Distribution: Central and South America. Targeted Survey Options: UNKNOWN	**NEGLIGIBLE**	**MEDIUM**	**HIGH**	**LOW**	**NEG**
Cotton leafworm	Moth	*Spodoptera littoralis* Lepidoptera: Noctuidae	Tomato, onion, cabbages, cauliflowers, ornamental gourd, broad bean, maize, potato,		Distribution: Asia, Europe and Africa.					
Spider mite	Mite	*Tetranychus 25ransmiss* Acarina: Tetranychidae	Polyphagous: castor-oil plant, cassava, maize, eggplant, melon, carrots, cassava, African oil palm, mora, and beans.	Leaves	Distribution: China and South-East Asia. Targeted Survey Options: UNKNOWN.	**LOW**	**MEDIUM**	**MEDIUM**	**LOW**	**EXTREMELY LOW**

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
Cabbage looper	Moth	*Trichoplusia ni* Lepidoptera: Noctuidae	Cabbage, turnip, spinach, crucifers and cucurbits	Leaves	Distribution: Asia, Europe, Africa, North, South and Central America. Targeted Survey Options: Yes.	**LOW**	**HIGH**	**HIGH**	**LOW**	**EXTREMELY LOW**
Spotted cutworm		*Xestia c-nigrum* Lepidoptera: Noctuidae	Onion, celery, beetroot, grape, oats, cabbages, cauliflowers, tomato, lettuce, maize and potato.		Distribution: Asia, Europe, Morocco, North America and El Salvador.					

Multiple Vegetable Groups (Pathogens)

Information provided below is a basic overview and may change given further research or if new information comes to hand.

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
Aster yellows	Plo	Aster yellows phytoplasma Acholeplasmatales: Acholeplasmataceae	Numerous plant hosts from many families, including many vegetables	Whole plant	Distribution: Europe and Japan. WA does have Hairy root, which shows very similar symptoms.		**HIGH**	**HIGH** Spread by Gray aster leafhopper plus other 27ransmissi spp. Not seed 27ransmissible.	**MEDIUM** Insecticides for leafhoppers. General reduction in quantity and quality of yield.	**MED-UNKNOWN**
Curly top	Vir	*Beet curly top virus* Geminiviridae: Curtovirus{CURR }	Sugar beet, peppers, cucurbits, tomato and common bean	Leaf and fruit	Distribution: Asia, Europe, North, Central and South America.					
bacterial wilt of maize	Bac	*Pantoea stewartii* Enterobacteriales: Enterobacteriaceae	Sweet corn and cucumber		Distribution: India, North, Central and South America. Vector = Corn flea beetle. Details of vector can be found in the National Grains IBP.					

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
Powdery mildew of carrot	Fun	*Erysiphe heraclei* *Synonym* = *E. polygoni DC* Erysiphales: Erysiphaceae	Dill, coriander, fennel, carrot and parsley.	Leaves	Has been recorded on parsnip in Australia, however not on carrots. Possibility of specific strains. Distribution: Europe and USA	**LOW**	**MEDIUM** It occurs in areas with a similar climate. Climate possibly too dry in WA.	**MEDIUM-HIGH** Spores are wind-dispersed	**MEDIUM** Yield reductions in Mediterranean climatic regions. Spray program required.	**LOW**
Fusarium dry rot	Fun	*Exotic* Fusarium spp. Hypocreales:	Potato, beans	Tubers (seed decay), roots. Plants become stunted	Some species do occur in Australia.		**UNKNOWN**	**UNKNOWN**	**LOW** Controlled by storage temps below 34 deg F.	**LOW-UNKNOWN**

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
Tomato black ring virus (TBRV) (sub group)	Vir	Tomato black ring nepovirus	Host range includes Allium, celery, sugarbeet, Brassica, Capsicum, cucumber, Fragaria, lettuce, tomato, Narcissus, Phaseolus vulgaris peach, Ribes, Rubus, eggplant, potato, grapevine	Whole plant, leaves, and fruits/pods		**HIGH** Movement in bulbs may be an issue. Seed transmission occurs for some.	**HIGH**	**LOW** Longidorus attenuatus is a vector of the potato bouquet strain; L. elongatus (exotic to Australia) is a vector of the beet ringspot strain	**LOW**	**LOW**
Raspberry ringspot virus (RpRSV)	Vir	Raspberry ringspot nepovirus	RpRSV occurs in a very wide range of monocotyledonous and dicotyledonous species	Whole plant, leaves, and fruits/pods.		**HIGH** Movement in bulbs may be an issue. Seed transmission occurs for some.	**HIGH**	**LOW** Longidorus elongatus and L. macrosoma (both exotic to Australia) are vectors	**LOW**	**LOW**
Storage rot	Fun	*Gliocladium aureum*	Beans, peas, eggplant	Post-harvest disease of stored product.	Distribution: Europe, Asia, Canada, USA and South America.		**LOW**	**LOW**	**NEGLIGIBLE**	**NEG-UNKNOWN**

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
Carrot cyst nematode	Nem	*Heterodera carotae* : Heteroderidae	Carrot other *Daucus* spp. and *Torilis* spp. And Olives.	Underground plant parts.	Distribution: Europe, USA, India	**MEDIUM**	**HIGH** Occurs in regions with Mediterranean climate.	**HIGH** Can persist as cysts in soil for 10 years. May be spread via soil on machinery and on carrots being shipped interstate.	**HIGH** Causes seedling mortality and root forking so reduces carrot quality.	**HIGH**
Lettuce infectious yellows	Vir	Lettuce Infectious Yellows Virus (LIYV) Closteroviridae: Crinivirus	Wide host range including beet, carrot, all cucurbits, lettuce, spinach. Also present in many weed species.	Whole plant	Distribution: Mexico and USA. Targeted Survey Options: UNKNOWN		**MEDIUM**	**MEDIUM** Transmitted by whitefly – *Bemisia tabaci*.	**LOW** Controlled through elimination of the whitefly vector, allowing a host free period and removing host weed spp.	**EXTREMELY LOW-UNKNOWN**

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
False root knot	Nem	*Nacobbus batatiformis* : Pratylenchidae	Wide host range including potato, tomato, sugarbeet, cabbages, broccoli, turnip, lettuce, cucumber, peas, carrot, eggplant and capsicum.	Underground plant parts.	Distribution: Europe, USA, Central and South America.	**UNKNOWN**	**UNKNOWN**	**UNKNOWN**	**UNKNOWN**	**UNKNOWN**

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
Texas root rot	Fun	*Phymatotrichum omnivorum*	Over 200 spp of plants, including, members of the families Anacardiaceae, Berberidaceae, Bignoniaceae, Brassicaceae, Celastraceae, Chenopodiaceae, Convolvulaceae, Ebenaceae, Elaeagnaceae, Euphorbiaceae, Ginkgoaceae, Grossulariaceae, Lauraceae, Loganiaceae, Meliaceae, Moraceae, Nyctaginaceae, Oleaceae, Papaveraceae, Passifloraceae, Poaceae, Polygonaceae, Protaceae, Rhamnaceae, Rutaceae, Salicaceae, Scrophulariaceae, Simaroubaceae, Solanaceae, and Ulmaceae.	Roots	Distribution: USA		**UNKNOWN**	**MEDIUM** Soil borne fungi.	**LOW**	**LOW-UNKNOWN**

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
Downy mildew	Fun	*Plasmopara nivea (= P. crustosa, P. umbelliferum)* Peronosporales: Peronosporaceae	Carrot, celery, parsley and other Apiaceae.	Leaves and seed.	Distribution: Europe. Strains affecting other Apiaceae occur in America and Asia.	**MEDIUM**	**LOW** May establish in Tas. and other areas with cool, moist climates.	**LOW-MEDIUM**	**MEDIUM**	**LOW**
Crater rot	Fun	*Rhizoctonia carotae* Ceratobasidiales: Ceratobasidiaceae	Numerous plant hosts including carrot	Whole plant	Distribution: USA, Denmark, and Norway.		**MEDIUM**	**MEDIUM** Infected plant debris or infested soil. Space plants widely.	**LOW** Losses of 4-10% recorded in USA.	**EXTREMELY LOW-UNKNOWN**
Squash leaf curl	Vir	Squash Leaf Curl Virus (SLCV) Geminiviridae: Begomovirus	Cucumber, melon, watermelon, squash, pumpkin, ornamental gourd and beans	Leaves, growing points	Distribution: Saudi Arabia, South America, Mexico and USA. Targeted Survey Options: UNKNOWN		**UNKNOWN**	**MEDIUM** Transmitted by whitefly – *Bemisia tabaci*	**UNKNOWN**	**MEDIUM-UNKOWN**
Seedling blight	Fun	*Stemphylium ramulosum*	Numerous hosts.		Distribution: USA, Denmark and Netherlands	**UNKNOWN**	**UNKNOWN**	**UNKNOWN**	**UNKNOWN**	**UNKNOWN**
Bacterial stalk rot	Bac	*Erwinia dissolvens*	Maize, sweet corn and tobacco		Distribution: USA, Canada, Europe and India	**UNKNOWN** Seed transmission unknown	**UNKNOWN**	**UNKNOWN**	**UNKNOWN**	**UNKNOWN**

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
Awl nematode	Nem	*Dolichodorus heterocephalus*	Celery, sweet corn and water chestnut	Roots, plant become stunted.	Distribution: USA	**LOW**	**UNKNOWN**	**UNKNOWN** Generally limited to moist habitats.	**LOW** Although *Dolichodorus heterocephalus* can be devastating where it occurs (USA), outbreaks are localised	**EXTREMELY LOW - UNKNOWN**
Lance nematode	Nem	*Hoplolaimus columbus*	Wide host range including maize	Leaves, roots.	Distribution: USA and Africa	**LOW**	**UNKNOWN**	**UNKNOWN**	**LOW**	**EXTREMELY LOW - UNKNOWN**
False root-knot nematode	Nem	*Nacobbus dorsalis*	Wide host range, Brassicaceae, Cucurbitaceae and Solanaceae	Whole plant		**UNKNOWN**	**UNKNOWN**	**UNKNOWN**	**UNKNOWN**	**UNKNOWN**
Lesion nematode	Nem	*Pratylenchus delattrei*			Distribution: Reported in USA	**LOW** Not likely to enter on seed; could enter with soil or roots as it is endoparasitic	**UNKNOWN**	**UNKNOWN**	**MEDIUM** Significant yield losses reported in US, India and Korea.	**LOW-UNKNOWN**

Common name	Life form	Scientific name	Relevant host/s	Plant part affected	Comments (quarantine risk) and targeted survey options?	Entry potential	Establishment potential	Spread potential	Economic impact	Risk
Stubby-root nematode	Nem	*Quinisulcius acutus*	Maize, sweet corn and potato			**UNKNOWN**	**UNKNOWN**	**UNKNOWN**	**UNKNOWN**	**UNKNOWN**
Root-knot nematode	Nem	*Meloidogyne chitwoodi*	Maize, sweet corn, carrot, tomato, common bean and potato	Tubers and roots	Distribution: South America, Central America, USA and South Africa.	**LOW** Endoparasite so could enter on plant roots or in soil	**HIGH** Wide host range and suitable climatic regions throughout Australia	**UNKNOWN**	**MEDIUM** A major parasite of many vegetables	**LOW-UNKNOWN**

Life Form Legend

NEM	Nematode	**EWIG**	Earwigs (DERMAPTERA)
BAC	Bacteria	**FLY**	Flies and Midges (DIPTERA)
VIR	Virus	**LOCU**	Locusts and grasshoppers (ORTHOPTERA)
FUN	Fungus	**MITE**	Mites e.g. spider and gall mites (ACARI)
PLO	Phytoplasma like organism	**MOTH**	Butterflies and moths (LEPIDOPTERA)
BTLE	Beetles (weevils etc.) (COLEOPTERA)	**SLUG**	Slugs (GASTROPODA)
BUG	Stink bugs, aphids, mealybugs, scale, whiteflies and hoppers (HEMIPTERA)	**SNAI**	Snails (GASTROPODA)
BUT	Butterflies (LEPIDOPTERA)	**THRI**	Thrips (THYSANOPTERA)

Entry Potential

Negligible	probability of entry is extremely low given the combination of factors including the distribution of the pest source, management practices applied, low probability of pest survival in transit.
Low	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 or certain given the combination of factors described above.
Unknown	pest entry potential is unknown or very little of value is known.

Establishment Potential

Negligible	the pest has no potential to survive and become established.
Low	the pest has the potential to survive and become established in approximately one third or less of the range of hosts. 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 no potential for natural spread.
Low	the pest has potential for natural spread locally.
Medium	the pest has potential for natural spread throughout a physiographic region.
High	the pest has potential for natural spread to all production areas.
Unknown	spread potential is unknown or very little of value is known.

Economic Impact

Negligible	there is no impact on yield, host longevity, production costs or storage.
Low	there is minor impact on standing crop and little effect on stored product.
Medium	there is moderate impact on crops, but host mortality is rare, storage losses may occur.
High	there is severe impact on standing crop, with significant host mortality and/or storage losses.
Extreme	there is extreme impact on standing crop, with extreme host mortality and/or storage losses.
Unknown	the economic potential of the pest is unknown or very little of value is known.

Appendix 2: Pest Risk Reviews

1. **Leafminers** *(Liriomyza spp.)*
2. **Carrot rust** *(Uromyces lineolatus)*
3. **Carrot cyst nematode** *(Heterodera carotae)*
4. **Carrot fly** *(Psila rosae)*
5. **Zucchini lethal chlorosis virus** *(Zucchini lethal chlorosis virus)*

VEGETABLE INDUSTRY BIOSECURITY PLAN

Pest Risk Review

COMMON NAME: **Leafminers**

SCIENTIFIC NAME:
Liriomyza bryoniae Kaltenbach Diptera: Agromyzidae
Liriomyza huidobrensis (Blanchard)
Liriomyza sativae Blanchard
Liriomyza trifolii Burgess

SYNONYMS: See Taxonomic Appendix

The scientific and technical content of this document is current to the date published and all efforts were made to obtain relevant and published information on the threat. New information will be included as it comes to light, or when the document is reviewed.

Prepared by Kathy Gott

Contact: Debra Eaton, Plant Health Australia.

PRR (ADAPTED FROM HORTGUARD™ AND BIOSECURITY AUSTRALIA) – MAY 2006

Background

The *Liriomyza* species are leafmining flies. Leaf damage is caused by adult female flies puncturing the leaf surface to lay eggs and feed on the leaf tissue and by larvae tunnelling within the leaf tissue forming destructive and disfiguring mines. Over 300 species of *Liriomyza* have been identified. The majority are not considered pests because they have a restricted host range and do not feed on plant species that are economically important (DEFRA 2001). Six polyphagous *Liriomyza* species are ranked as serious agricultural pests worldwide. Four of these pest species (*L. huidobrensis, L. trifolii, L. sativae, L. brassicae*), the Americas group, originated in Central and South America; two (*L. bryoniae, L.strigata*), the Europe group, originated in Europe (CAB International 2005c).

Part of plant/commodity affected

Leaves.
Plants can be affected during all stages of growth: seedlings, vegetative growth, flowering and fruiting.

Biology

Symptoms

Foliage becomes stippled as cells on the upper leaf surfaces are punctured and destroyed by female flies during feeding and oviposition. Removal of mesophyll cells between the leaf surfaces by feeding larvae appears as white or greenish-white mines or blotches on leaves (University of Florida 2005). Larvae may move through the petiole to a second leaf but are unable to externally penetrate the leaf surface (CAB International 2005a). The surface of pea pods can be affected by larvae of *L. huidobrensis* and *L. sativae* (CAB International 2005b,c). Damage reduces the photosynthetic capacity of plants and may cause stunting (CAB International 2005a).

Fungal destruction of leaves and plants may occur as damage by agromyzid flies increases susceptibility to infections. Leaves may colour abnormally or fall prematurely; plants may wilt (CAB International 2005c,d). *Liriomyza bryoniae* has been reported as transmitting tobacco mosaic tobamovirus (CAB International 2005a).

Identification

Liriomyza species are small flies, yellow and black in colour. The yellow spot on the scutellum is characteristic of the genus (DEFRA 2001). Variations in colour patterning, colour intensity and wing lengths can be used to differentiate species (University of Florida 2005) but laboratory analysis by a specialist taxonomist is necessary to confirm identification (DEFRA 2001). *Liriomyza sativae* has been differentiated from *L. bryoniae, L. huidobrensis* and *L. trifolii* using allozyme variation patterns on gel electrophoresis (CAB International 2005c).

Different species of *Liriomyza* produce mines of a characteristic shape but this feature can be used only as a general guide to identification as host type and leaf size influence mine shapes. Quarantine *Liriomyza* leafminers generally leave a dark trail of frass within the mine (DEFRA 2001).

Life history

Each life-stage of *Liriomyza* leafminers is temperature dependant. In warm climates or temperature-controlled facilities reproduction is almost continuous and 10-14 generations per annum may occur (CAB International 2005a,b,c,d; University of Florida 2005).

Liriomyza eggs are inserted just beneath the leaf surface. Three larval instars develop as the larvae feed rapidly within the leaf. Larvae are 2-3mm long and become yellowish by the third instar (University of Florida 2005). Prior to pupation, the larva cuts a semicircular exit slit from the mine, drops from the leaf and burrows into the soil. Pupation takes place in the sclerotised skin of the third larval instar (CAB International 2005b). Adults emerge after one to three weeks although in colder climates, pupae can undergo winter diapause (CAB International 2005a). Peak emergence of adult flies is usually in the early morning. Mating occurs within 24 hours. Females are normally larger and more robust than males (University of Florida 2005) and cause the feeding and oviposition damage to leaf surfaces.

Dispersal

Pathways are human assisted movement of infected plants or parts of plants (pathway for eggs, larvae), soil or potting media (pathways for pupae) or packaging. *L. sativae* was probably introduced to Europe via imports for glasshouse cultivation (CAB International 2005c). *Liriomyza huidobrensis* was first detected in glasshouses in Netherlands in 1987 and has now spread through Europe and the Mediterranean region (CAB International 2005b).

Liriomyza species are not known to be transported on bulbs, fruits (other than peas), flowers, roots, seeds or wood (CAB International 2005 a,b,c,d).

Host range and distribution

Host range

Quarantine *Liriomyza* species are polyphagous and have extensive host ranges. *Liriomyza huidobrensis* has been recorded affecting 15 families of plants with no clear preference for any family although in South America *L. huidobrensis* is a key pest of potato (CAB International 2005b). *Liriomyza sativae* has been reported on 40 hosts from 10 plant families, favouring Cucurbitaceae, Fabaceae and Solanaceae (University of Florida 2005). *Liriomyza bryoniae* also affects multiple vegetable groups and is established in the United Kingdom as an important pest of tomatoes (DEFRA 2001). *Liriomyza trifolii* causes considerable damage on hosts in 28 families and is a major pest of Asteraceae worldwide (CAB International 2005d).

Distribution

Quarantine *Liriomyza* species are absent from Australia and New Zealand. *Liriomyza huidobrensis* and *L. trifolii* have been intercepted in Australia but have not established (CAB International 2005b,d).

Liriomyza bryoniae probably originated in southern Europe but has now spread across Europe and the Mediterranean region, especially through glasshouse horticulture. This species is present in North Africa, Japan and Taiwan, with unconfirmed reports from India and Nepal. *Liriomyza bryoniae* is not established in USA (CAB International 2005a).

Liriomyza huidobrensis originated in Central and South America and is present in North America. This species was detected in glasshouses in the Netherlands in 1987 and has subsequently

spread throughout Europe and the Mediterranean region (CAB International 2005b). *Liriomyza sativae* was considered the most important agromyzid pest in North America until this status was claimed by *L. trifolii* (University of Florida 2005). *Liriomyza sativae* was originally described in Argentina. The species has been found throughout the Americas and the Caribbean Islands and is reported from Africa, some Pacific Islands and Asian countries as well as Europe (CAB International 2005c). *Liriomyza trifolii,* which originated in the Carribbean Islands or Florida, is now widespread on all continents except Australia (CAB International 2005d).

Potential distribution in Australia

Quarantine *Liriomyza* species have rapidly colonised most habitats to which they have been introduced (CAB International 2005c). Introduced species could potentially establish in all cropping areas. The extensive host ranges of the *Liriomyza* pests which include significant families of Australian native plants such as Fabaceae, Solanaceae and Asteraceae increase the risk of widespread distribution. The prevalence of potential weed hosts would also encourage pest survival, establishment and spread.

Pest risk analysis

The following risk analysis for Liriomyza species *is based on the methodology in Biosecurity Australia's guidelines on Import Risk Analysis for Plants and Plant Products (2001).*

Entry potential

Entry potential: Rating = High

The number of *Liriomyza* species being identified as quarantine pests is increasing, partly as an outcome of taxonomic work on the Agromyzidae but also due to increased international commerce in fresh plant material, creating opportunities for establishment of flies across continents (CAB International 2005c).

Establishment potential

Establishment potential: Rating = High

Quarantine *Liriomyza* species have colonised most habitats to which they have been introduced. Reproduction can be almost continuous in warm temperature-controlled environments such as glasshouse horticulture. Monocultures of primary hosts particularly favour establishment (CAB International 2005c). The success of eradication programs which have been conducted cannot be confirmed (CAB International 2005d)

Spread potential following establishment

Spread potential following establishment: Rating = High

Quarantine *Liriomyza* species are pervasive pests in many areas and have expanded rapidly due to their extensive host range. Even so, *Liriomyza* species are not active fliers. In crops showing active leafminer damage by *L. trifolii* and *L sativae*, adults can be observed walking rapidly over

the leaves and making only short, jerky flights to adjacent leaves (CAB International 2005c,d). Transporting eggs, larvae and pupae in produce or soil is the principal means by which *Liriomyza* flies have been widely dispersed.

Economic impact

Economic impact: Rating = High

The host range affected by quarantine *Liriomyza* species is extensive. Damage in severe infestations from both adult-puncturing and larval-mining can lead to total crop losses. Control on edible crops is difficult due to the limited availability of effective treatments and the potential for rapid and explosive development of the pest population (DEFRA 2001). Some pyrethroid insecticides and insect growth regulators are effective but resistance can make control difficult (CAB International 2005b). Chemical insecticides are incompatible with the increasing trend to biological control in glasshouses (CAB International 2005a). Larvae are susceptible to cold storage but pupae may remain viable in soil at cold temperatures (DEFRA 2001). *Liriomyza* species have been reported to vector plant viruses (CAB International 2005d).

Environmental impact

Environmental impact: Rating = High

In endemic environments, populations of *Liriomyza* species are balanced by natural predators such as small parasitic wasps, entomorphagous nematodes and fungal pathogens (CAB International 2005d). However, natural predators seem more susceptible than *Liriomyza* pests to the oil-based insecticides and chlorinated chemicals that have been extensively used in agriculture over the last 50 years. The survival of resistant strains of Agromyzidae in the absence of natural predators has resulted in very large and damaging populations of *Liriomyza* pest species (CAB International 2005c).

Conclusions

Overall risk: Rating = High

Liriomyza pest species have been documented as readily establishing after introduction and rapidly spreading. Control is difficult. Economic impacts could be highly significant in most crops and across most cropping areas. Environmental impacts both directly and as reservoirs for crop infection are also likely to be significant. Excluding entry of *Liriomyza* pest species is the preferred scenario.

References

CAB International (2005a) Crop Protection Compendium: *Liriomyza bryoniae*. www.cabicompendium.org/cpc Accessed 23 May 2006.

CAB International (2005b) Crop Protection Compendium: *Liriomyza huidobrensis*. www.cabicompendium.org/cpc Accessed 23 May 2006.

CAB International (2005c) Crop Protection Compendium: *Liriomyza sativae*. www.cabicompendium.org/cpc Accessed 23 May 2006.

CAB International (2005d) Crop Protection Compendium: *Liriomyza trifolii*. www.cabicompendium.org/cpc Accessed 23 May 2006.

DEFRA (2001) Plant Health: *Liriomyza* leafminers. http://www.defra.gov.uk/plant/pestnote/liriomyz.htm Accessed 22 May 2006.

University of Florida (2005) Featured creatures: Vegetable leafminer. http://creatures.ifas.ufl.edu/veg/leaf/vegetable_leafminer.htm Accessed 22 May 2006

Taxonomic Appendix

Scientific name	Synonyms	Common name
Liriomyza bryoniae Kaltenbach	*Agromyza bryoniae* Kaltenbach *Liriomyza citrulla* Rohdendorf *Liriomyza solani* Hering *Liriomyza mercurialis* Hering	Tomato leafminer
Liriomyza huidobrensis (Blanchard)	*Liriomyza cucumifoliae* Blanchard *Agromyza huidobrensis* Blanchard *Liriomyza dianthi* Frick *Liriomyza langei* Frick *Liriomyza decora* Blanchard	South American leafminer Serpentine leafminer Pea leafminer
Liriomyza sativae Blanchard	*Liriomyza pullata* Frick *Liriomyza canomarginis* Frick *Liriomyza minutiseta* Frick *Liriomyza munda* Frick *Liriomyza guytona* Freeman *Liriomyza propepusilla* Frost *Agromyza subpusilla* *Lemurimyza lycopersicae* Pla. & de la Cruz *Liriomyza subpusilla* *Liriomyza verbenicola*	Vegetable leafminer Serpentine vegetable leafminer Cabbage leafminer Melon leafminer Tomato leafminer South American leafminer
Liriomyza trifolii Burgess	*Liriomyza alliiovora* Frick *Agromyza phaseolunata* Frost *Liriomyza phaseolunta* (Frost) *Oscinis trifolii* Burgess	American serpentine leafminer Serpentine leafminer Chrysanthemum leafminer

VEGETABLE INDUSTRY BIOSECURITY PLAN

Pest Risk Review

COMMON NAME: **Carrot rust**

SCIENTIFIC NAME: *Uromyces lineolatus* (Desm.)J.Schröt Uredinales: Pucciniaceae

SYNONYMS:
Aecidium glaucis Dozy &Molk.
Puccinia lineolate Desm.
Uromyces lineolatus f.sp. *glaucis-scirpi* Jaap
Uromyces lineolatus f.sp. *scirpi-oenanthi-crocati* Maire
Uromyces maritimae Plowr.
Uromyces scirpi Burrill

The scientific and technical content of this document is current to the date published and all efforts were made to obtain relevant and published information on the threat. New information will be included as it comes to light, or when the document is reviewed.

Prepared by Kathy Gott

Contact: Debra Eaton, Plant Health Australia.

PRR (ADAPTED FROM HORTGUARD™ AND BIOSECURITY AUSTRALIA) – MAY 2006

Background

Rusts on umbelliferous crops are not important relative to other diseases. The major crop affected is carrot, but rust is rarely seen (Davis & Raid 2002).

Part of plant/commodity affected

Leaves, stems

Biology

Symptoms

Initial symptoms include light green discolouration around infection sites. The upper surface of the leaf becomes chlorotic around the lesion and yellow-orange pustules of spores often form on the underside of the leaf. Infected stems bend or arch and appear distorted or swollen. Severe infections may stunt plants (Davis & Raid 2002).

Identification

Symptom expression and location of reproductive structures on host plants are diagnostic tools.

Microscopic examination of teliospores differentiate rusts which occur on umbelliferous hosts. The three main genera are *Puccinia spp.* which possess pedicellate, generally two-celled teliospores, *Uromyces spp.* which possess pedicellate one-celled teliospores and *Nyssopsora spp.* which possess pedicellate, three-celled, spiny teliospores (Davis & Raid 2002).

Life history

Rusts are obligate parasites. Disease development depends on inoculum from alternate crops (if heteroecious), wild hosts and volunteer host plants.

Uromyces lineolatus (syn. *U.scirpi* Index Fungorum Partnership 2004) is a heteroecious macrocyclic rust. Aecidia occur on umbelliferous species and uredinia and telia occur on *Scirpus spp.* (club-rushes) in the family Cyperaceae (Davis & Raid 2002). Each spore stage develops from a specialised reproductive structure.

Dispersal

Urediospores and teliospores are commonly wind dispersed.

Host range and distribution

Host range

Carrot is the major crop affected by rust. Minor crops include anise, fennel and parsley. In the United States a number of wild umbelliferous plants are hosts to numerous rusts (Davis & Raid 2002).

Distribution

Uromyces lineolatus occurs on carrot in Bermuda, Canada, Europe and the United States (Davis & Raid 2002). This species is not listed as present in fungal databases from the United Kingdom (British Mycological Society 2004) and New Zealand (Landcare Research 2004).

Potential distribution in Australia

Rust spores require high humidity for germination and appressorial penetration of the leaf. Carrot cropping areas with high humidity or where in-crop humidity is retained at high levels would be susceptible to the disease.

Pest risk analysis

The following risk analysis for Uromyces lineolatus is based on the methodology in Biosecurity Australia's guidelines on Import Risk Analysis for Plants and Plant Products (2001).

Entry potential

Entry potential: Rating = Extremely low

Cereal rusts have spread internationally in global air currents but cereal cropping areas are much more extensive than carrot production areas. Carrots are not imported into Australia from areas where carrot rust occurs and the root vegetable is unaffected by the disease.

Establishment potential

Establishment potential: Rating = Extremely low

Cereal rusts have spread internationally in global air currents but cereal cropping areas are much more extensive than carrot production areas. Carrots are not imported into Australia from areas where carrot rust occurs and the root vegetable is unaffected by the disease. Distribution of *Scirpus sp.*, a genus noted as the alternate host for *Uromyces lineolatus*, may overlap with some carrot production areas (Botanic Gardens Trust 2006, Horticulture Australia Limited 2004).

Spread potential following establishment

Spread potential following establishment: Rating = Very low

Rusts are readily dispersed and are often difficult to control, however, carrot production areas are spatially separated. The movement of machinery and other equipment between production areas can dramatically increase the chance of spreading the rust.

Economic impact

Economic impact: Rating = Negligible

Rusts on umbelliferous crops are not important relative to other diseases (Davis & Raid 2002). Carrots account for 8% of Australia's total vegetable production. Carrot production, per capita consumption and exporting has remained relatively stable over recent years although in real terms, gross value declined by 1% annually between 1997 and 2003 (AUSVEG 2005)

Environmental impact

Environmental impact: Rating = Extremely low

Umbelliferous natives and members of the alternate host genus, *Scipus spp*. may be affected, but the extent of that impact is unknown.

Conclusions

Overall risk: Rating = Negligible

Rusts on umbelliferous crops are not important relative to other diseases (Davis & Raid 2002).

References

AUSVEG (2004) January 2005: Commodity spotlight – carrots. http://www.ausveg.com.au/assets/1537/Carrots.pdf Accessed 15 May 2006.

Botanic Gardens Trust (2006) New South Wales Flora Online. http://plantnet.rbgsyd.nsw.gov.au Accessed 23 May 2006.

British Mycological Society (2004) Fungi of the British Isles checklist. http://194.203.77.76/fieldmycology/GBCHKLST/gbsyns.asp?intGBNum=4605 Accessed 18 May 2006.

Davis, R.M. and Raid R.N. Eds (2002) *Compendium of Umbelliferous Crop Diseases.* The American Phytopathological Society Press.

Horticulture Australia Limited (2004) *The Australian Horticulture Statistics Handbook 2004*. Horticulture Australia Limited.

Index Fungorum Partnership (2004) Species Fungorum: *Uromyces.* http://www.indexfungorum.org/Names/NamesRecord.asp?RecordID=161084 Accessed 18 May 2006.

Landcare Research (2004) NZFungi – New Zealand Fungi (and Bacteria). http://nzfungi.landcareresearch.co.nz/html Accessed 18 May 2006.

VEGETABLE INDUSTRY BIOSECURITY PLAN

Pest Risk Review

COMMON NAME: **Carrot nematode**
Carrot cyst nematode
Carrot cyst eelworm
Carrot root nematode

SCIENTIFIC NAME: *Heterodera carotae* (Jones) Heteroderidae

SYNONYMS: n/a

The scientific and technical content of this document is current to the date published and all efforts were made to obtain relevant and published information on the threat. New information will be included as it comes to light, or when the document is reviewed.

Prepared by Kathy Gott

Contact: Debra Eaton, Plant Health Australia.

PRR (ADAPTED FROM HORTGUARD™ AND BIOSECURITY AUSTRALIA) - NAY 2006

Background

Carrot cyst nematodes inject toxins into carrot root cells while feeding which severely decreases the quality, size and yield of the crop. Yield reductions of 20-80% have been reported. United States Society of Nematologists advocates regulatory control to prevent spread of carrot cyst nematode within USA and to minimise risk of introduction from other countries (Society of Nematologists 2003).

Part of plant/commodity affected

Tap roots become distorted, rendering commercial carrots unmarketable

Biology

Symptoms

Cleared patches of irregular plant growth are noticeable in the crop. These patches enlarge from one season to the next. Leaves are yellowish or reddened and stunted and may appear moisture stressed. Carrots are small, abnormally developed and have a characteristic bearded appearance referred to as “hairy root” because of a proliferation of rootlets (HYPP Zoology1998).

Identification

Heterodera carotae is a cyst-forming nematode. The cysts are persistent sacs derived from the body of the female and contain eggs. In the presence of susceptible hosts, male and female threadlike juveniles 1.5mm long emerge from the cysts, penetrate host roots and commence feeding. Males then migrate from the root while females remain attached. After fertilisation, females become white then later brown lemon-shaped cysts engorged with 200-600 eggs. The cysts rupture the carrot root epidermis and are visible as protrusions on the surface (Stanbury *et al* 2001).

Life history

Cysts can survive in soil in the absence of host material for up to 10 years. Cysts are dispersed in soil and on plants, machinery or other materials contaminated with soil. Multiplication in the presence of susceptible hosts is rapid, up to ten-fold per crop (HYPP Zoology 1998).

Dispersal

Cysts can survive in soil in the absence of host material for up to 10 years. Cysts are dispersed in soil and on plants, machinery or other materials contaminated with soil. Multiplication in the presence of susceptible hosts is rapid, up to ten-fold per crop (HYPP Zoology 1998).

Host range and distribution

Host range

Carrot cyst nematode has a restricted host range. Carrots (*Daucus carotae*) and other *Daucus* species are hosts. Some species of hedge parsleys in the related genus *Torilis* may act as reservoirs for cyst survival. Susceptibility of olives (*Olea europaea* subsp *europaea*) has been suggested but not confirmed (Society of Nematologists 2003).

Distribution

Carrot cyst nematode is currently limited to parts of Europe, India and USA (Michigan) (Society of Nematologists 2003).

Potential distribution in Australia

All carrot production areas would be potentially affected by carrot cyst nematode. *Torilis nodosa* is present as an introduced weed of roadsides and pastures in eastern Australia. Cultivated olives have spread widely as weeds and are recognised as naturalised in Western Australia, South Australia, Victoria and NSW (Botanic Gardens Trust 2006).

Pest risk analysis

The following risk analysis for Heterodera carotae is based on the methodology in Biosecurity Australia's guidelines on Import Risk Analysis for Plants and Plant Products (2001).

Entry potential

Entry potential: Rating = High

Principal potential pathways for entry into non-infested areas are the movement of infested carrots, soil and machinery or materials containing contaminated soil. Unrestricted entry into Australia from infested areas is prohibited. Import conditions such as absence of soil and other debris and phytosanitary certification and inspection should ensure freedom from pests and diseases. Seeds do not carry the pest.

Establishment potential

Establishment potential: Rating = High

Cysts are small, inconspicuous and capable of long-term survival in the absence of host material. Each cyst may contain 200-600 eggs. Any infested carrots that may enter fresh vegetable market supply chains are likely to be discarded as waste by retailers or consumers.

Spread potential following establishment

Spread potential following establishment: Rating = High

Spread following establishment could occur through the movement of infested carrots, soil and machinery or materials containing contaminated soil. Cysts are small, inconspicuous and capable of long-term survival in the absence of host material. Each cyst may contain 200-600 eggs.

Economic impact

Economic impact: Rating = High

Australia produces 320-330,000 tonnes carrots annually with an approximate gross market value of $200 million (Horticulture Australia 2004). Carrots infested with carrot cyst nematode are unmarketable. Application of nematicides, though effective, is not economically feasible. Farming systems management practices such as crop rotation could be adversely affected due to the long term latency of cysts in soil in the absence of susceptible hosts. Carrots sourced from NSW and Queensland are prohibited entry into Taiwan on account of the root burrowing nematode (*Radopholus similis*) (AQIS 2001).

Environmental impact

Environmental impact: Rating = Negligible

That the confirmed host range is restricted to commercial carrots minimises environmental impacts.

Conclusions

Overall risk: Rating = High

Carrot cyst nematode has been rated as high risk due to the survival and reproductive potential of cysts in soil and infected product and in recognition of marketing impacts and management costs that would be incurred due to the pest.

References

AQIS (2001) Phyto alert 2004/09 Quarantine security of potato and carrot consignments for export to Taiwan. http://www.aqis.gov.au/phyto/asp/ex_ALERTS.asp?Type=2&ID=165 Accessed 17 May 2006.

Botanic Gardens Trust (2006) New South Wales Flora Online. http://plantnet.rbgsyd.nsw.gov.au Accessed 17 May 2006.

Horticulture Australia Limited (2004) *The Australian Horticulture Statistics Handbook 2004*. Horticulture Australia Limited.

HYPP Zoology (1998) Carrot root nematode, Carrot cyst nematode. http://www.inra.fr/Internet/Produits/HYPPZ/RAVAGEUR6hetcar.htm Accessed 16 May 2006.

Stanbury, C.; McKirdy, S.; Davidson, E.; Mackie, A. and Power, G. (2001) Carrot cyst nematode: *Heterodera carotae*: Exotic threat to Western Australia. *Western Australia Department of Agriculture Factsheet No19/2001.* http://agspsrv38.agric.wa.gov.au/pls/portal30/docs/folder/ikmp/pw/ph/par/fs01901.PDF Accessed 16 May 2006.

Society of Nematologists (2003) Exotic nematode plant pests of agricultural and environmental significance to the United States: *Heterodera carotae.* http://nematode.unl.edu/pest8.htm Accessed 16 May 2006.

VEGETABLE INDUSTRY BIOSECURITY PLAN

Pest Risk Review

COMMON NAME: **Carrot fly**
Carrot rust fly

SCIENTIFIC NAME: *Psila rosae* (Fabricius) Diptera: Psilidae

SYNONYMS:
Chamaepsila rosae (Fabricius)
Musca rosae Fabricius
Chamaspsila hennigi Thompson & Pont

The scientific and technical content of this document is current to the date published and all efforts were made to obtain relevant and published information on the threat. New information will be included as it comes to light, or when the document is reviewed.

Prepared by Kathy Gott

Contact: Debra Eaton, Plant Health Australia.

PRR (ADAPTED FROM HORTGUARD™ AND BIOSECURITY AUSTRALIA) - MAY 2006

Background

Control of the pest carrot fly is difficult due to the wide host range of species affected. Even though economic damage occurs to carrot, parsnip, celery and parsley crops, larvae can feed on cabbage, endive, chicory, lettuce and potato if Apiaceae hosts have been removed. Waste ground containing weeds of the carrot family can act as a reservoir for flies. Some beetles and wasps act as natural enemies and parasitise *P.rosea* eggs, larvae and pupae; carabid ground beetles predate *P. rosea* eggs (CAB International 2005).

Part of plant/commodity affected

Carrot fly affects the whole plant during the vegetative growing stage of host plants. Larvae (maggots) damage and destroy roots.

Biology

Symptoms

Throughout the growing season, pest impacts on carrots and parsnips can be severe. Seedlings can be killed or damaged as larvae feed on apices of tap roots. Symptoms are gaps in the crop or reddening of the foliage. If attacked when larger, carrots become distorted in shape and size. Sub-surface irregular reddish-brown feeding channels or mines on the surface render carrots unsaleable. Damage from feeding channels and mines allows colonisation by secondary rots (CAB International 2005).

Larvae bore into the roots, crowns and petioles of celery causing yellowing of the leaves, reduced growth and death of young plants. Roots of parsley are attacked.

Identification

Include details of how the pest/disease may be detected wither in the field or via diagnostic tests.

Life history

The adult carrot fly is 8mm long, shiny black with a reddish head, yellow-orange legs and transparent wings (Miles *et al* 2004). Larvae are 8-10mm long and creamy white or yellowish.

The length of the life-cycle is temperature dependant. One, two or three generations per year are possible. Adults can be found on foliage around host plants. Each female lays between 5 and 167 eggs into cracks in the soil. Larvae emerge after 7 days and can move up to 60cm through soil, feeding on roots. Second generation larvae burrow into the tap root and produce a mine. When mature, the larva forms a puparium in soil. Overwintering can occur in puparia or as larvae in host roots (CAB International 2005).

Dispersal

Larvae can be transported in underground plant parts such as bulbs, tubers, corms and rhizomes. Eggs, larvae and pupae can be transported in infected soil. Flowers, fruits, seeds, leaves and stems are not known to carry the pest (CAB International 2005).

Host range and distribution

Host range

The wide host range includes all cultivated and wild species of the carrot family. Economic damage occurs to carrot (*Daucus*), parsnip (*Pastinaca*), celery (*Apium*) and parsley (*Petroselinum*). Many of the Apiaceae herbs and spices such as caraway and coriander are minor hosts (CAB International 2005).

Distribution

Carrot fly probably originated in Europe where it is widely distributed. From Europe, it has spread across the northern hemisphere, including Canada and USA and has also been introduced to New Zealand (CAB International 2005).

Potential distribution in Australia

Carrot fly is not known to occur in Australia. Distribution of the fly is reported to be limited by cold winter temperatures (<-10^{o}C) and hot summer temperatures (>25^{o}C) (CAB International 2005). Most of southern Australia and coastal Queensland could potentially be affected (BOM 2006).

Pest risk analysis

The following risk analysis for Psila rosae is based on the methodology in Biosecurity Australia's guidelines on Import Risk Analysis for Plants and Plant Products (2001).

Entry potential

Entry potential: Rating = High

Principal potential pathways for entry into non-infested areas are the movement of soil and machinery or materials containing contaminated soil and root vegetables containing larvae, pupae or eggs of carrot fly. The unrestricted entry potential is high. Unrestricted entry into Australia from infested areas is prohibited. Australia imports fresh carrots from New Zealand. Import conditions such as absence of soil and other debris and phytosanitary certification and inspection have been imposed to mitigate against the entry of carrot fly (AQIS 2006). Entry of adult flies is unlikely. Seeds are not known to carry the pest.

Establishment potential

Establishment potential: Rating = High

Carrot fly has a large host range that includes cultivated, native and weed species of Apiaceae. Soil types are not limiting. Average maximum temperatures across most of southern Australia and coastal Queensland would not exclude establishment of the pest in root-crop production areas. Some native or introduced beetles and wasps may act as natural enemies but the effectiveness of Australian fauna against carrot fly as an exotic pest is unknown. Any infested carrots that may enter fresh vegetable market supply chains are likely to be discarded as waste by retailers or consumers.

Spread potential following establishment

Spread potential following establishment: Rating = High

Spread following establishment could occur through the movement of infested soil and root vegetables and machinery or materials containing contaminated soil. Adult flies are not a principal means of dispersal as they are weak fliers. Growing crops in windswept sites has been recommended as a control in the United Kingdom, although the chance of incidental wind dispersal of the flies was not addressed. Carrot flies are attracted to the scent released by bruised foliage. Growers are advised to avoid sowing and in-crop management activities during periods when the flies are most active (Garden Organic 2005).

Economic impact

Economic impact: Rating = High

Carrot crop losses in untreated, non-resistant varieties can reach 60%. The difficulty with chemical control is ensuring a lethal dose reaches larvae in root mines. *P. rosae* has become resistant to some chemicals (CAB International 2005). Intercropping with medics or *Allium spp* is being trialled (Miles *et al* 2004). Low fencing or fleece matting to exclude adult flies has been used in smaller field contexts but is impractical in large scale horticulture. Research into breeding for resistance is being undertaken (Garden Organic 2005).

Environmental impact

Environmental impact: Rating = Low

Although the host range is broad, the potential impact on natural flora is unknown. Ecological species composition may be modified depending on the severity of infection as susceptible natives are killed or weakened and seed set reduced. Waste ground weed reservoirs may also be affected, although these sites could act as nurseries for subsequent crop infestation.

Conclusions

Overall risk: Rating = High

Carrot fly has been rated as a moderate risk due to the wide host range able to be infected, the severity of the economic losses that may be incurred and the high potential for establishment and spread that could occur if the pest were introduced.

References

AQIS (2006) Import Conditions Database. http://www.aqis.gov.au/icon32/asp/homecontent.asp Accessed 15 May 2006.

Bureau of Meteorology (2006) Temperature Percentile Maps: Annual maximum temperatures – 10th percentile. http://www.bom.gov.au/cgi-bin/climate/cgi_bin_scripts/tmp_percent.cgi Accessed 15 May 2006.

CAB International (2005) Crop Protection Compendium: Carrot fly. www.cabicompendium.org/cpc Accessed 15 May 2006.

Garden Organic (2005) Factsheet PC17: Carrot fly. http://www.organicgardening.org.uk/factsheets/pc17.php Accessed 15 May 2006.

Horticulture Australia Limited (2004) *The Australian Horticulture Statistics Handbook 2004*. Horticulture Australia Limited.

Miles, C.; Zenz, L.; DeWreede, B. and Puhichs, J. (2004) Carrot rust fly control: Intercropping in carrots for rust fly control. http://agsyst.wsu.edu/carrot.htm Accessed 15 May 2006.

VEGETABLE INDUSTRY BIOSECURITY PLAN

Pest Risk Review

COMMON NAME: **Zucchini lethal chlorosis virus**

SCIENTIFIC NAME: Zucchini lethal chlorosis virus Bunyaviridae: Tospovirus

SYNONYMS: n/a

The scientific and technical content of this document is current to the date published and all efforts were made to obtain relevant and published information on the threat. New information will be included as it comes to light, or when the document is reviewed.

Prepared by Kathy Gott

Contact: Debra Eaton, Plant Health Australia.

PRR (ADAPTED FROM HORTGUARD™ AND BIOSECURITY AUSTRALIA) – MAY 2006

Background

Zucchini lethal chlorosis virus was initially observed in 1991 in Brazil in experimental fields of courgette (zucchini). *Frankliniella zucchini* was subsequently identified as a new thrips species and the vector of zucchini lethal chlorosis virus (EPPO Quarantine Alert 1999).

Part of plant/commodity affected

Whole plant; fruit

Biology

Symptoms

Symptom expression on zucchini is severe. Plants which are infected prior to flowering die within a few days. Plants infected after flowering do not die but are stunted and do not produce marketable fruits. High yield losses occur (EPPO Quarantine Alert 1999).

Affected cucumbers show yellowing, mottling and vein banding on leaves. Mortality has not been reported when cucumbers are infected with zucchini lethal chlorosis virus (EPPO Quarantine Alert 1999).

Identification

The 'tomato spotted wilt virus group' or tospoviruses, which includes zucchini lethal chlorosis virus, can be detected by electron microscopy and identified by virus-specific antibody tests such as ELISA. However, newly detected tospoviruses have failed to react with the standard panel of ELISA antibodies and are designated new species (ProMED-mail 2005). Symptoms, host range and vector identification are used as corroborating tools.

The vector, *Frankliniella zucchini*, is a new thrips species. Zucchini lethal chlorosis tospovirus is not transmitted by the common thrips pests *Frankliniella occidentalis* (western flower thrips), *F. schultzei* (tomato thrips) and *Thrips tabaci* (onion thrips) (EPPO Quarantine Alert 1999).

Life history

Thysanoptera insects of the Order Thripidae (thrips) are vectors of tospoviruses. Virulification can only be acquired by larvae feeding on infected plants. Acquisition of virus may occur within 10 minutes and may continue while the larvae feed on the infected plant. Virus is passed transtadially in thrips through moulting, pupation and emergence to the adult stage. Adults cannot acquire the virus but infected adults remain viruliferous throughout life (20-40 days depending on environmental conditions) (Wageringen University Research Centre 2002).

Dispersal

Primary transmission of tospoviruses is by adult thrips when they move from plant to plant. Adults are winged and able to fly small distances at low wind speed and are dispersed over large distances at higher wind speed. Second instar viruliferous larvae can be significant in closed canopy transfer of the virus as they crawl from plant to plant (Wageringen University Research Centre 2002). Seed transmission of tospoviruses has never been proven (Maryland Cooperative Extension 2002).

Host range and distribution

Host range

Zucchini lethal chlorosis virus was initially isolated from zucchini (*Cucurbita pepo*) and cucumber (*Cucumis sativus*) in Brazil. The disease was subsequently isolated from pumpkin, squash, watermelon, choko, bur gherkin and a native Brazilian species of Cucurbitaceae (EPPO Quarantine Alert 1999).

Distribution

Tospoviruses are generally widespread in tropical and subtropical zones and in greenhouse conditions in temperate zones (Kormelink, Peters & Goldbach 1998). Zucchini lethal chlorosis virus was initially observed in experimental fields of zucchini in Sao Paulo State in Brazil in 1991 and has spread to large areas of central Brazil (Food Safety Network 2000).

Potential distribution in Australia

All zucchini production areas would be potentially affected by zucchini lethal chlorosis virus if the thrips vector were introduced into Australia or an established thrips species was found to vector the disease. Zucchinis are grown in all mainland states. Production is non-seasonal.

Pest risk analysis

The following risk analysis for zucchini lethal chlorosis virus is based on the methodology in Biosecurity Australia's guidelines on Import Risk Analysis for Plants and Plant Products (2001).

Entry potential

Entry potential: Rating = Very Low

Entry of infected cucurbit plants from Brazil has been identified as the principal importation pathway (EPPO Quarantine Alert 1999). Infected zucchinis do not produce marketable fruits (EPPO Quarantine Alert 1999) although cucumbers, which are less severely affected, might produce infected fruits. Australia does not import fresh cucurbits from South or Central America. Entry of fresh zucchini from USA requires an entry permit and phytosanitary certificate verifying freedom from live insects, disease symptoms, contaminants and debris and inspection and treatment if necessary (AQIS 2006).

Establishment potential

Establishment potential: Rating = Very Low

Establishment of zucchini lethal chlorosis virus would require distribution of the virus in a viable state from the point of entry and subsequent transfer to a suitable host. The presence of the thrips vector would be required.

Spread potential following establishment

Spread potential following establishment: Rating = Low

Spread is contingent upon the vector, *Frankliniella zucchini*, and would not occur in its absence. If the vector were present, dispersal could be rapid as trips are difficult to control and have short life cycles. Viruliferous thrips can transmit viruses as second instar crawlers or as adults capable of flight or wind-assisted dispersal (Maryland Cooperative Extension 2002). *Frankliniella zucchini* was isolated in association with zucchini lethal chlorosis virus and may have a narrow host range.

Economic impact

Economic impact: Rating = Low

Zucchini lethal chlorosis virus causes mortality of zucchini plants or total loss of marketable product. Australia produces 15-16,000 tonnes zucchini annually with an approximate gross market value of $22.6 million (Horticulture Australia Limited 2004). The immediate local impact of zucchini lethal chlorosis virus would be highly significant. However, thrips management and the narrow host range of the vector may present other cropping options for affected producers.

Environmental impact

Environmental impact: Rating = Low

The Cucurbitaceae family is represented in habitats ranging from coastal rainforests to arid woodlands. Many are naturalised weeds but at least one is an endangered native species (Botanic Gardens Trust 2006). Zucchini lethal chlorosis virus seems to have a narrow host range and a host-specific vector. Infection of one native species in Brazil has been reported (EPPO Quarantine Alert 1999).

Conclusions

Overall risk: Rating = Negligible

Zucchini lethal chlorosis virus is restricted to Brazil. Spread is dependant upon the host-specific vector, *Frankliniella zucchini.* Importation into Australia of fresh zucchini or other cucurbits is regulated by certification, inspection and treatment conditions. Neither zucchini not cucumber is imported from Central and South America.

References

AQIS (2006) Import Conditions Database. http://www.aqis.gov.au/icon32/asp/homecontent.asp Accessed 22 May 2006.

Botanic Gardens Trust (2006) New South Wales Flora Online. http://plantnet.rbgsyd.nsw.gov.au Accessed 22 May 2006.

EPPO Quarantine Alert (1999) Zucchini lethal chlorosis tospovirus (a new tospovirus of courgette and cucumber). http://www.eppo..org/QUARANTINE/Alert_List/deleted%files/virus/Zucchini_letha_chlorosis_tospovirus.doc Accessed 19 May 2006.

Food Safety Network (2000) Tospovirus, zucchini, courgette and cucumber – Brazil. http://archives.foodsafetynetwork.ca/agnet/2000/1-2000/ag-01-30-00-01.txt Accessed 19 May 2006.

Horticulture Australia Limited (2004) *The Australian Horticulture Statistics Handbook 2004*. Horticulture Australia Limited.

Kormelink, R.; Peters, D. and Goldbach, R. (1998) Descriptions of Plant Viruses: 363 Tospovirus genus. http://www.dpvweb.net Accessed 22 May 2006.

Maryland Cooperative Extension (2002) Tospovirus. http://www.agnr.umd.edu/tospo/ Accessed 19 May 2006.

ProMED-mail (2005) Tomato Fruit Yellow Ring Virus, new tospovirus – Iran. http://www.agnic/pmp/2005/tfy050905.HTML Accessed 19 May 2006.

Wageringen University Research Centre (2002) Molecular and biological aspects of Tospoviruses. http://dpw.wageringen-us.nl/viro/research/t_1_5.html Accessed 19 May 2006.

National Vegetable Industry Biosecurity Plan

RISK MITIGATION PLAN

Plant Health Australia is a peak national coordinating body for plant health in Australia. We commission projects and work with members to coordinate the development of national policy and capability to enhance the ability of Australian agriculture to respond effectively to plant pests, weeds and diseases.

For more information on Plant Health Australia

Location:	Suite 5, FECCA House 4 Phipps Close DEAKIN ACT 2600
Phone:	+61 2 6260 4322
Fax:	+61 2 6260 4321
E-mail:	admin@phau.com.au
Visit our web site:	www.planthealthaustralia.com.au

An electronic copy of this plan is available from the web site listed above.

TABLE OF CONTENTS

TABLES

Acronyms

APVMA	Australian Pesticides and Veterinary Medicines Authority
AQIS	Australian Quarantine and Inspection Service
BA	Biosecurity Australia
DAFF	Department of Agriculture, Fisheries and Forestry
DQMAWG	Domestic Quarantine and Market Access Working Group
EPP	Emergency Plant Pest
EPPRD	Emergency Plant Pest Response Deed
GIMP	Generic Incursion Management Plan
IBG	Industry Biosecurity Group
IBP	Industry Biosecurity Plan
IBMP	Industry Best Management Practice
IPM	Integrated Pest Management
IRA	Import Risk Analysis
NAQS	Northern Australian Quarantine Strategy
OCPPO	Office of the Chief Plant Protection Officer
ORIA	Ord River Irrigation Area
PCN	Potato Cyst Nematode
PHA	Plant Health Australia
QA	Quality Assurance
SPS	Sanitary and Phytosanitary
WTO	World Trade Organization

Note: The definition of a pest as adopted by the International Plant Protection Convention (any species, strain or biotype of plant, animal, or pathogenic agent, injurious to plants or plant products) is used throughout this plan.

Introduction

There are a number of strategies that can be adopted to help protect and minimise the risks of exotic and emergency pests to the Australian vegetable industry.

Many pre-emptive practices can be adopted to reduce the risk of exotic pest movement for the vegetable industry. Such risk mitigation practices 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 vegetable industry members. Risk mitigation activities include:

- surveillance, awareness and training activities
- exclusion activities (e.g. restricting movement of planting material and machinery, and barrier quarantine)
- selection and preparation of appropriate planting materials
- destruction of crop residues
- control of vectors
- control of alternative hosts and weeds
- tillage practices
- produce transport procedures
- use of warning and information signs
- use of dedicated equipment when working in high risk areas
- restricting the use of high risk vehicles during high risk times
- reporting suspect pests to appropriate authorities
- including farm biosecurity in Industry Best Management Practice (IBMP) and Quality Assurance (QA) schemes.

Barrier quarantine

Barrier quarantine should be implemented at all levels of the vegetable industry including at the national, state, regional, and farm levels.

National level – importation restrictions

Responsibility	▪	Australian Government

The Department of Agriculture, Fisheries and Forestry (DAFF) is the Australian Government Department responsible for maintaining and improving international trade and market access opportunities for agriculture, fisheries, forestry, and food industries. DAFF 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 and collaboration with portfolio industries and exporters. DAFF also undertakes research to improve policies and procedures for protecting Australia's animal and plant health and natural environment, and provides technical assistance to further Australia's export market access program.

Biosecurity Australia (BA) is a part of DAFF and plays a key role in import regulation. BA undertakes Import Risk Analyses (IRAs) to determine which products may enter Australia, and under what quarantine conditions. BA also consults with industry and the community, conducting research and developing policy and procedures to protect Australia's technical market access program by negotiating quarantine conditions to meet other countries' import requirements for Australian animals and plants.

Administrative authority for national quarantine is vested in the Australian Quarantine and Inspection Service (AQIS) under the *Quarantine Act 1908*. Quarantine policies are developed on the basis of an IRA process outlined in the report of the Australian Quarantine Review Committee (Nairn *et al*., 1996). The management of quarantine policy, as it relates to the introduction into Australia of fruit, seed, or other plant material, including any vegetables material, is the responsibility of AQIS Operations.

AQIS Operations maintains barrier quarantine services at all international ports and in the Torres Strait region.

A range of import conditions apply to vegetables and other plant based material being imported into Australia. For details on specific commodities refer to the AQIS Import Conditions Database (ICON) available at www.aqis.gov.au. ICON 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. If there is any uncertainty, contact AQIS on (02) 6272 3933 or 1800 020 504.

Most vegetable seed is imported into Australia and many vegetable seeds may be imported unrestricted. These seeds may not have proof of disease free status; for example, tomato and cucumber seed can be imported in non-commercial and commercial quantities with no import permit and only visually inspected on arrival in Australia. Samples are only taken for further examination if suspected of being contaminated with a pest or disease (Irvine, 2005). Due to Tastobacco blue mould seed being released in Tasmania requires production documentation and/or barrier treatment.

The Australian Government is responsible for the inspection of machinery and equipment being imported into Australia. Administrative authority for national quarantine is vested in AQIS under the *Quarantine Act 1908*. Any machinery or equipment being imported into Australia must meet quarantine requirements.

For more details, including the most up-to-date conditions, refer to the ICON and PHYTO (export requirements) and/or contact AQIS directly on (02) 6272 3933 or 1800 020 504.

State level – movement restrictions

Responsibility	▪ state and territory governments

Each state has quarantine legislation in place to control the importation of plant and other host materials and to manage agreed pests if an incursion occurs (refer to Table 1).

There are a number of interstate restrictions on the movement of vegetables, depending on where they are from, what state they are being sent to, and the intended use. Before moving vegetable products, machinery or equipment interstate, a permit may need to be obtained from the appropriate authority (refer to Table 1).

Further regulations have been put in place in response to specific pest threats and these are regularly reviewed and updated by the Domestic Quarantine and Market Access Working Group (DQMAWG). Through DQMAWG, Queensland Department of Primary Industries and Fisheries (QDPI&F) have made a commitment to maintain a national list of contacts and details on the interstate movement of plant material (http://www.dpi.qld.gov.au/health/4058.html).

Most State government departments have a manual on quarantine of plant material, which can be accessed from this QDPI&F site, or alternatively from the websites listed in Table 2.

Table 1: Controls on interstate and interregional movement of vegetables

State	Legislation	Administering authority
ACT	*Plant Diseases Act 2002*	Environment ACT www.environment.act.gov.au
NSW	*Plant Diseases Act 1924*	New South Wales Department of Primary Industries www.dpi.nsw.gov.au
NT	*Plant Diseases Control Act*	Department of Primary Industry, Fisheries and Mines www.nt.gov.au/dpifm
Qld	*Plant Protection Act 1989*	Queensland Department of Primary Industries and Fisheries www.dpi.qld.gov.au
SA	*Fruit and Plant Protection Act 1992*	Primary Industries and Resources of South Australia www.pir.sa.gov.au

State	Legislation	Administering authority
Tas	*Plant Quarantine Act 1997*	Department of Primary Industries and Water, Tasmania www.dpiw.tas.gov.au
Vic	*Plant Health and Plant Products Act 1995*	Victorian Department of Primary Industries www.dpi.vic.gov.au
WA	*Plant Diseases Act 1914 and Regulations 1989, Agriculture and Related Resources Protection Act 1976*	Department of Agriculture and Food, Western Australia www.agric.wa.gov.au

Table 2: *State quarantine manuals for interstate and interregional movement of plant material*

State	Administering authority	Links to quarantine manual*
ACT	Environment ACT	See NSW conditions.
NSW	New South Wales Department of Primary Industries	http://www.agric.nsw.gov.au/reader/pe-plantquarantine
NT	Department of Primary Industry, Fisheries and Mines	See the quarantine section at http://www.primaryindustry.nt.gov.au/
Qld	Queensland Department of Primary Industries and Fisheries	http://www2.dpi.qld.gov.au/health/4058.html
SA	Primary Industries and Resources of South Australia	http://www.pir.sa.gov.au/pages/agriculture/horticulture/fruitfly/plant_quarant_stand.pdf
Tas	Department of Primary Industries and Water, Tasmania	Go to DPIW home page at http://www.dpiw.tas.gov.au/biosecurity Or go to: http://www.dpiw.tas.gov.au/inter.nsf/Publications/RPIO-52B3FX?open
Vic	Victorian Department of Primary Industries	Go to Plant Standards Branch at http://www.dpi.vic.gov.au Or: http://www.dpi.vic.gov.au/psb
WA	Department of Agriculture and Food, Western Australia	See quarantine section of http://www.agric.wa.gov.au/

* If the link does not work, the relevant documents can be found by going to the department home page and using links to find the quarantine section of the website.

Further advice can be obtained by contacting your local state or territory agriculture agency directly (details below), or by telephoning the Quarantine Domestic Hotline on 1800 084 881.

New South Wales/Australian Capital Territory

Information on pre-importation certification and treatment requirements may be obtained from the NSW Department of Primary Industries Regulatory Services office, phone (02) 9764 3311 or fax (02) 9746 3409.

Northern Territory

Information on pre-importation treatments and/or certification requirements for moving plant produce into the Northern Territory may be obtained from the NT Quarantine Inspection Branch, phone (08) 8999 2138 or fax (08) 8999 2111.

Queensland

Information on pre-importation treatments and/or certification requirments for movement of plant produce into Queensland may be obtained from the QDPI&F Animal and Plant Health Service, phone (07) 3404 6999 or fax (07) 3211 3293.

South Australia

Information on pre-importation treatments and/or certification requirements for movement of plant produce into SA may be obtained from the PIRSA Plant Health Operations, phone 1300 666 010 or fax (08) 8344 6033.

Tasmania

For domestic quarantine enquiries phone: 03 6233 3352 or 1800 084 881 or fax 03 6234 6785.

Victoria

Information on disinfestation treatments and area freedom certification requirements for movement of plant produce into Victoria may be obtained from the DPI Plant Standards Centre, phone (03) 8371 3500 or 136 186 (free call).

Western Australia

Information on pre-importation treatments and/or certification requirements for moving plant material into Western Australia may be obtained from the Western Australian Quarantine and Inspection Service, phone (08) 9311 5333, fax (08) 9455 3052.

Restriction of movement for specific vegetables

The movement of vegetables that are Queensland fruit fly hosts into the Tri-state Fruit Fly Exclusion Zone (includes parts of South Australia, New South Wales and Victoria) is prohibited unless certified. Vegetables included in the National Vegetable IBP that are fruit fly hosts include: capsicum, chilli, and tomato. Further details on the Tri-state Fruit Fly Exclusion Zone are included in the 'Regional level – movement restrictions' section.

Regional level – movement restrictions

Responsibility	▪ state and territory governments

Quarantine legislation currently in place provides a basis for regulating the movement of vegetables between regions within states. Before moving vegetables intrastate, a plant health certificate may be required from the appropriate authority (see Table 1). Advice can be obtained by contacting your local state or territory agriculture agency directly, or by telephoning the Quarantine Domestic Hotline on 1800 084 881.

New South Wales / Australian Capital Territory

Fruit Fly Host Produce
A Fruit Fly Exclusion Zone (Tri-State FFEZ) is in operation, encompassing certain fruit-growing areas of New South Wales Victoria and South Australia, including the Murrumbidgee Irrigation Area, Murray Valley, Goulburn Valley, Sunraysia and the Riverland (for quarantine zone maps refer to the National Citrus Industry Biosecurity Plan). It is illegal to take uncertified fruit fly host produce into the FFEZ, and those who fail to dispose of uncertified host produce before entering this area face minimum $200 on-the-spot fines. Roadside signs are in place to warn motorists of the FFEZ entry requirements. Random roadblocks are also used to enforce the FFEZ requirements.

Further information on the FFEZ can be found at http://www. agric.nsw.gov.au/fruitfly and http://www.pir.sa.gov.au/fruitfly.

Potatoes - Associated equipment and containers
A seed potato protected area in New South Wales has quarantine requirements for the introduction of potatoes and associated equipment. For further information refer to the 'National Potato Industry Biosecurity Plan'.

For current information and further advice on requirements residents should contact their local NSW Agriculture office or NSW Department of Primary Industries Regulatory Services office, phone (02) 9764 3311 or fax (02) 9746 3409.

Northern Territory

Melon Thrips Host Produce
Declared hosts of the pest melon thrips, (*Thrips palmi)* should not be transported south of the Adelaide River township, without treatment or certification from the Northern Territory Quarantine Service. Vegetables included in the National Vegetable IBP that are hosts of melon thrips include: cucurbits, leguminous plants, Solanaceae, onions and lettuce.

Fruit Fly Host Produce
Ti Tree (north of Alice Springs) is a declared fruit fly free zone. No fruit fly host produce should enter this zone, unless treated in an appropriate manner. Certification must also accompany the fruit/vegetables.

For current information and further advice on requirements, residents should contact the Northern Territory Quarantine Inspection Branch on phone (08) 8999 2138 or fax (08) 8999 2111.

Queensland

Papaya Ringspot Virus – cucurbit plants
A curburbit plant (excluding fruit or seed) must not be moved from a papaya ringspot quarantine area without an inspector's approval. The quarantine area for papaya ringspot can be viewed on the QDPI&F website:
http://www2.dpi.qld.gov.au/extra/pdf/aphs/cond_issue.pdf

Plants from Cape York Peninsula (including parts of plants)
A targeted pest or a plant infested with a targeted pest must not be moved within or out of the Cape York Peninsula quarantine area without an inspector's approval. A map of the Cape York Peninsula quarantine area and a listing of the targeted pests are located on the Queensland Department of Primary Industries and Fisheries website:
http://www2.dpi.qld.gov.au/extra/pdf/aphs/cond_issue.pdf

For current information and further advice on requirements within Queensland, residents should contact their regional QDPI&F office or phone the QDPI&F Call Centre on 13 25 23 (Queensland residents only, local call charge within Queensland). Outside Queensland phone (07) 3404 6999 or e-mail callweb@dpi.qld.gov.au.

South Australia

Fruit Fly Host Produce
A Fruit Fly Exclusion Zone (Tri-State FFEZ) is in operation, encompassing certain areas of South Australia, New South Wales and Victoria, including 'the Riverland' (for quarantine zone maps refer to the National Citrus Industry Biosecurity Plan). Fruit fly host produce commercially grown in South Australia must not be introduced into 'the Riverland' if it was produced within an area declared to be a fruit fly quarantine area, unless certified by a Plant Health Inspector. Fruit fly host produce that was purchased in South Australia must not be introduced into the Riverland unless accompanied by the retail purchase docket applicable to that produce.

Potato Tubers - Associated Machinery and Containers
The Kangaroo Island Protected Production Area has quarantine requirements on the introduction of seed potatoes, ware potatoes (consumption), machinery and associated containers.

The introduction of seed potatoes onto the Kangaroo Island Protected Production Area is prohibited unless they are minitubers or plantlets grown by accredited laboratories using micro-propagation techniques. The sowing of potatoes within the Kangaroo Island Protected Production Area is prohibited unless they are minitubers or plantlets grown by accredited laboratories using micro-propagation techniques or generation 1 (G1), generation 2 (G2) or generation 3 (G3) potato seed which has been grown within the Protected Production Area.

The introduction of ware potatoes for consumption is prohibited unless they are washed or brushed and in new packaging.

The introduction of machinery which has been used in the production or manipulation of potatoes is prohibited unless it has been thoroughly cleaned and disinfected, inspected and certified by an inspector. Containers used in the storage and/or manipulation of potatoes are prohibited unless they are new, or, they have been cleaned, disinfected, inspected and certified. For further information refer to the 'National Potato Industry Biosecurity Plan'.

For current information and further advice on requirements within South Australia residents should contact Plant Health Operations on phone 1300 666010 or fax (08) 8344 6033.

Tasmania

There are no regional movement restrictions, for vegetables, in Tasmania.

Victoria

Fruit Fly Host Produce

As with New South Wales and South Australia, a Fruit Fly Exclusion Zone (Tri-State FFEZ) is in operation, encompassing certain areas of Victoria, including Sunraysia (for quarantine zone maps refer to the National Citrus Industry Biosecurity Plan). The Victorian portion of the FFEZ is protected from the entry of the pest by placing restrictions, prohibitions and requirements on the movement of fruit fly host product into the area.

Queensland fruit fly is considered to be endemic in far eastern Victoria. This area has been declared as a Restricted Area for the control of QFF. Prohibitions, restrictions and conditions apply to the movement of host produce out of this area.

Leafy Vegetables and Potato Tubers

The Toolangi Plant Protection District has restrictions on the introduction of consignments of leafy vegetables and potato tubers. These products must be free from certain plant pests and diseases, or treated to control certain pests.

All consignments entering the Toolangi Plant Protection District must be accompanied by certification and be verified by an accredited business.

Potato Tubers - Associated Equipment, used bins, bulk bags and bulk handlers

There are a number of regions within Victoria which have restrictions relating to the movement of commercial potato tubers, associated equipment, used bins, bulk bags and bulk handlers. These regions include Portland and Colac-Otway protection districts, Koo WeeRup and Toolangi. Declaration forms are available from Portland Potato Growers or DPI Plant Standards Branch. Retail potatoes for consumption are exempt from the conditional requirements. For further information refer to the Potato IBP or contact the Victorian DPI Plant Standards Branch on phone 136 186 (free call) or email plant.standards@dpi.vic.gov.au.

Western Australia

Potato Tubers

Potato tubers grown within the Perth Statistical Division are prohibited entry to all potato growing areas in Western Australia. Exceptions to the restrictions only occur where special permission is obtained from Western Australian Quarantine Inspection Service and relevant conditions are met. For further information refer to the 'National Potato Industry Biosecurity Plan'.

For current information, maps of potato growing areas and further advice on requirements residents should contact the Western Australian Quarantine and Inspection Service on phone (08) 9334 1800 or fax (08) 9334 1888

Table 3 Notifiable *vegetable* pests for each state/territory

State	Notifiable pests
ACT	Nil
NSW	Green snail (*Helix aperta*), Mediterranean fruit fly (*Ceratitis capitata*), Onion smut (*Urocystis cepulae*), Powdery scab (*Spongospora subterranean*), Spiraling whitefly (*Aleurodieus disperses*), White blister of Brassica (*Albugo candida)*, Asparagus rust (*Puccinia asparagi*), Armywom (*Mythimna unipuncta*), Colorado potato beetle (*Leptinotarsa decemlineata)*, Lettuce Aphid *(Nasonovia ribisnigri*), Oriental fruit fly (*Bactrocera dorsalis*), Potato Cyst Nematode (*Globodera rostochiensis*), Potato spindle tuber viroid (*Potato spindle tuber viroid*), Ring Rot (*Clavibacter michiganensis subsp.sepedonicus*), Spider mite (*Tetranychus piercei*), Texas root rot (*Phymatotrichum ominivorum*), Variegated cutworm (*Peridroma saucia*).
NT	Mediterranean fruit fly (*Ceratitis capitata*), Cucumber fly (*Bactrocera cucumis*), Western flower thrips (*Frankliniella occidentalis*), Silver leaf white fly (*Bemesia argentifolii or Bermisia tabaci*), Spiralling white fly (*Aleurodicus dispersus*), Potato cyst nematode (*Globodera rostochiensis* and *Globodera pallida*), Red imported fire ant (*Solenopsis invicta*), Boil smut of maize (*Ustilago maydis*), Peanut mottle virus (Bunyaviridae: Potyvirus), Silver leaf whitefly or poinsettia whitefly (*Bemisia tabaci*).
Qld	Khapra beetle (*Trogoderma granarium*), Melon fly (*Bactrocera cucurbitae*), Oriental fruit fly (*Bactrocera dorsalis*), Papaya fruit fly (*Bactrocera papayae*), Red imported fire ant (*Solenopsis invicta*), Sugarcane borer (*Sesamia* spp.), Tropical fire ant (*Solenopsis germinata*), Potato cyst nematodes (*Globodera pallida* and *Globodera rostochiensis*), Potato ring rot or Blight of potato plants (*Clavibacter michiganensis* subsp. *sepedonicus*), Bacterial wilt of potato (*Pseudomonas solanacearum* and *Ralstonia solanacearum*), Sugarcane downy mildew (*Peronosclerospora sacchari*).
SA	Bacterial wilt of potato (*Pseudomonas solanacearum*), Boil smut of maize (*Ustilago maydis*), Fruit flies (pest species of Tephritidae family), Garlic rust (*Puccinia allii*), Green snail (*Helix aperta*), Java downy mildew of maize (*Peronospora maydis*), Melon thrips (*Thrips palmi*), Onion smut (*Urocystis cepulae*), Potato cyst nematodes (*Globodera pallida* and *Globodera rostochiensis*), Purple round scale (*Chrysomphalus ficus*), Warehouse beetle (*Trogoderma variabile*), Western flower thrips (*Frankliniella occidentalis*), White louse scale (*Unaspis citri*), Fusarium wilt of tomato (*Fusarium oxysporum* Race 3), Currant lettuce aphid (*Nasonovia ribis nigri*).
Tas	Bacterial wilt of potato (*Pseudomonas solanacearum*), Papaya fruit fly (*Bactrocera papayae*), Ash whitefly (*Siphoninus phillyreae*), Boil smut (*Ustilago maydis*), Chickpea blight (*Didymella raiei*), Queensland fruit fly (*Bastrocera tryoni*), Mediterranean fruit fly (*Ceratitis capitata*), Green snail (*Helix aperta*), Potato cyst nematodes (*Globodera pallida* and *Globodera rostochiensis*), Pea weevil (*Bruchus pisorum*), Red imported fire ant (*Solenopsis invicta*), Onion smut (*Urocystis cepulae*), San Jose scale (*Diaspidiotus perniciosus*), Spindle tuber viroid, Spiralling white fly (*Aleurodicus dispersus*), Tobacco blue mould (*Peronospora hyoscyami f.sp. tabacina*), Melon thrips (*Thrips palmi*), White blister of cauliflower (*Albugo candida*), Western flower thrips (*Frankliniella occidentalis*), Silverleaf whitefly (*Bemisia tabaci).*

State	Notifiable pests
Vic	Asparagus stem blight (*Phomopsis asparagi*), Red imported fire ant (*Solenopsis invicta*), Green snail (*Helix aperta*), Mediterranean fruit fly (*Ceratitis capitata*), Onion smut (*Urocystis cepulae*), Potato cyst nematode (*Globodera rostochiensis*) – outside of PCN restricted areas, Queensland fruit fly (*Bactrocera tryoni*), Spiralling white fly (*Aleurodicus dispersus*), Western flower thrips (*Frankliniella occidentalis*), Lettuce leaf blight (*Pythium tracheiphilum)*
WA	Boil smut of maize (*Ustilago maydis*), Verticillium wilt (*Verticillium dahliae* and *Verticillium alboatrum*), Tan spot (*Curtobacterium flaccumfaciens*), Warehouse beetle (*Trogoderma variabile*), Ergot (*Claviceps spp.*), Rust of grasses (*Puccinia purpurea*), Head smut of maize (*Sporisorium reilianum*), Codling moth (*Cydia pomonella*), Potato cyst nematode (*Globodera rostochiensis*), Melon thrips (*Thrips palmi*), Onion rust (*Puccinia allii*), White rot (*Sclerotium cepivorum*), Onion smut (*Urocystis cepulae*), Silver leaf white fly (*Bemesia argentifolii*), Spiraling white fly (*Aleurodicus dispersus*), Red imported fire ant (*Solenopsis invicta*).

Farm level – exclusion activities

Responsibility	▪ state/territory governments ▪ Industry/growers

The greatest risk of spreading pests between properties is when propagation material, people, machinery and equipment move from farm to farm and from region to region. It is the responsibility of the owner/manager of each property to ensure these risks are minimised.

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

Surveillance, awareness and training

Surveys enhance prospects for early detection, minimise costs of eradication and are necessary to meet the treaty obligations of the World Trade Organization's (WTO) SPS Agreement with respect to the area freedom status of the Australian mainland.

The SPS agreement gives WTO members the right to impose SPS measures to protect human, animal and plant life and health provided such measures do not serve as technical barriers to trade. In simple terms, for countries such as Australia that have signed the SPS Agreement, imports of food, including fresh fruit and vegetables, can only be prohibited on proper, science based quarantine grounds. The agreement also stipulates that appropriate surveillance and monitoring are necessary to support claims of area freedom.

There are currently no international standards for structured pest surveys. Their 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, and if so, where these occur.

Industry personnel can provide very effective general surveillance as part of their normal management procedures, provided individuals are aware of what to look for and of reporting procedures. Producers, non commercial growers, staff, and consultants can provide valuable information as they are regularly in the field, and hence can observe any unusual pest activity or symptoms on plants.

Suitable awareness programs are required to support and encourage surveillance activities. These awareness programs can range from general information posters and sheets for tractor drivers, through to field day activities and professional courses. Awareness programs should also outline procedures (i.e. who to contact, where and how) so that industry personnel are able to have unusual plant symptoms or insects identified quickly. Promoting community awareness and reporting should be encouraged. Industry personnel need to be kept informed of areas within the local area where pest incursions exist so that they can take precautionary measures when working in or receiving produce from those areas.

National surveillance programs

Responsibility	▪	Australian Government
	▪	industry (national associations)

AQIS maintains barrier quarantine services at all international ports and in the Torres Strait region. AQIS 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 Australian Quarantine Strategy (NAQS).

Surveillance is undertaken on a variety of vegetable crops grown for seed production to enable international market access. Vegetable varieties surveyed include carrots, lettuce, celery.

State surveillance programs

Responsibility	▪	state and territory governments
	▪	Industry/growers

State level surveillance in the vegetable industry depends on the participation of all stakeholder groups, particularly state/territory agriculture departments, industry representative groups, agribusiness and growers.

Relevant state/territory agriculture departments are responsible for:

- planning and auditing surveillance systems
- coordinating surveillance activities with those of industry and interstate groups
- provision of diagnostic services
- providing field diagnosticians for special field surveillance
- surveillance of non commercial sites
- liaising with industry members
- developing communication, training and extension strategies with industry
- carrying out training
- reporting to all interested parties (e.g. AQIS, national bodies, trading partners and industry).

Various pest surveillance programs are managed by AQIS, and the state/territory agriculture departments.

New South Wales / Australian Capital Territory

NSW Department of Primary Industries carries out surveillance targeting fruit flies in and around the Tri-State FFEZ in south western New South Wales. Surveys in all three member states of the Tri-State FFEZ follow national codes of practice for the management of Queensland fruit fly (*Bactrocera tryoni*) and Mediterranean fruit fly (*Ceratitis capitata*). Random roadblocks are also used within the FFEZ to ensure travellers do not carry host material into the area.

Targeted surveillance is undertaken on a number of vegetable varieties to quantify pest and disease status. The New South Wales Department of Primary Industries surveys for currant lettuce aphid (*Nasonovia ribis nigri)* and garlic rust (*Puccinia allii*).

The New South Wales Department of Primary Industries also produces, and makes available, public awareness materials on pests of concern to the New South Wales vegetable industry including fruit flies and encourages the reporting of such pests. Quarantine information road signs are in place at the boundaries of the FFEZ. For quarantine zone maps refer to the National Citrus Industry Biosecurity Plan.

Northern Territory

AQIS, through the NAQS program, carries out general exotic pest and disease surveillance along the far northern coastal region. Community awareness materials identifying target pests, including those that may affect vegetables, are provided through the NAQS “Top Watch” awareness campaign.

Targeted surveillance is undertaken on a number of vegetable varieties to quantify pest and disease status. The Northern Territory Quarantine Inspection Branch surveys for melon thrips (*Thrips palmi*).

Queensland

As in the Northern Territory and Western Australia, AQIS carries out general exotic pest and disease surveillance in the far northern coastal regions Queensland. Community awareness materials identifying target pests, including those that may affect vegetables, are provided through the NAQS "Top Watch" awareness campaign.

Targeted surveillance is undertaken on a number of vegetable varieties to quantify pest and disease status. The Queensland Department of Primary Industries and Fisheries surveys for melon thrips (*Thrips palmi*), garlic rust (*Puccinia allii*), western flower thrips (*Frankliniella occidentalis)*, spiraling white fly (*Aleurodicus dispersus*), tomato yellow leaf curl virus (TYLCV), asparagus stem blight (*Phomopsis asparagi)* and Japanese bayberry whitefly (*Parabemisia myricae*), Silverleaf whitefly (*Bemisia tabaci*), Potato spindle tuber viroid.

The Queensland Department of Primary Industries and Fisheries also produces and makes available public awareness materials on pests of concern to the Queensland vegetable industry and encourages reporting of such pests.

South Australia

Primary Industries and Resources of South Australia (PIRSA) undertake surveillance and monitoring for fruit fly, in accordance with the national codes of practice for the management of both Queensland fruit fly (*Bactrocera tryoni*) and Mediterranean fruit fly (*Ceratitis capitata*). Fruit Fly surveillance and monitoring is undertaken in the South Australian portion of the Tri-State FFEZ, metropolitan Adelaide, Adelaide Hills, Northern Adelaide Plains, the 'Iron Triangle' (including Port Pirie, Whyalla, Port Augusta and Stirling North), Ceduna/ Thevenard and Port Lincoln. PIRSA also audit privately funded fruit fly surveillance work carried out to maintain area freedom in the Mypolonga district.

Targeted surveillance is undertaken on a number of vegetable varieties to quantify pest and disease status. PIRSA currently surveys for currant lettuce aphid (*Nasonovia ribis nigri)*, bacterial wilt of potato (*Pseudomonas solanacearum*), potato cyst nematodes (*Globodera pallida* and *Globodera rostochiensis)*, onion smut (*Urocystis cepulae)*, Western flowers thrips (*Frankliniella occidentalis)*, Burrowing nematode (*Radopholus sirnilis*), Dieback (*Phytopthora cinnamomi)* and silver leaf whitefly (*Bemisia tabaci)*.

PIRSA also produces and makes available public awareness materials on pests of concern to the South Australian vegetable industry including fruit flies and encourages reporting of such pests. Quarantine information road signs are in place at the boundaries of the FFEZ (for quarantine zone maps refer to the National Citrus Industry Biosecurity Plan).

Tasmania

The Department of Primary Industries and Water (DPI&W) undertakes surveillance and monitoring for fruit flies, in accordance with the national codes of practice for the management of Queensland fruit fly (*Bactrocera tryoni*) and Mediterranean fruit fly (*Ceratitis capitata*). Surveillance and monitoring is also undertaken for Melon fruit fly (*Bactrocera cucurbitae*) and Papaya fruit fly (*Bactrocera papayae*).

Targeted surveillance is undertaken on a number of vegetable varieties to quantify pest and disease status. DPI&W currently surveys for Western Flower Thrips (*Frankliniella occidentalis)*, Melon Thrips (*Thrips palmi*), Potato Cyst Nematodes (*Globodera pallida* and *Globodera rostochiensis)*, *Ditylenchus* spp., Burrowing Nematode (*Radopholus sirnilis*), silver leaf whitefly (*Bemisia tabaci)*, Tobacco blue mould (Peronospora tabacina), pea

weevil (*Bruchus pisorum*), bacterial wilt of potato (*Pseudomonas solanacearum*), Silverleaf whitefly (*Bemisia tabaci).*

DPI&W also produces and makes available public awareness materials on pests of concern to the Tasmanian vegetable industry including fruit fly and encourages reporting of such pests.

Victoria

The Victorian Department of Primary Industries (DPI) carries out surveillance targeting fruit flies in the Victorian area of the Tri-State FFEZ in accordance with the national codes of practice for management of Queensland fruit fly (*Bactrocera tryoni*) and Mediterranean fruit fly (*Ceratitis capitata*). For quarantine zone maps refer to the National Citrus Industry Biosecurity Plan.

Targeted surveillance is undertaken on a number of vegetable varieties to quantify pest and disease status. The Victorian DPI currently surveys for Western flower thrips (*Frankliniella occidentalis*), Potato Cyst Nematodes (*Globodera pallida* and *Globodera rostochiensis*), Melon thrips (*Thrips palmi*), various whitefly species, tomato yellow leaf curl virus (TYLCV), asparagus stem blight (*Phomopsis asparagi*).

The Victorian DPI also produces and distributes public awareness material for fruit fly and other pests of concern to the Victorian vegetable industry. As for New South Wales and South Australia, quarantine information road signs are in place at the boundaries of the Tri-State FFEZ.

Western Australia

As in the Northern Territory and Queensland, AQIS carries out general exotic pest and disease surveillance in the far northern coastal regions of Western Australia, between the Broome area and the Northern Territory border. Community awareness materials identifying target pests, including those that may affect vegetables, are provided through the NAQS “Top Watch” awareness campaign.

In Western Australia, surveillance and monitoring of Queensland fruit fly (*Bactrocera tryoni*) and associated pest species is undertaken. Also, a surveillance and monitoring system is conducted for Mediterranean fruit fly (*Ceratitis capitata*) and other exotic species in the Ord River Irrigation Area (ORIA).

Targeted surveillance is undertaken on a number of vegetable varieties to quantify pest and disease status. The Western Australian Quarantine and Inspection Service (WAQIS) surveys for currant lettuce aphid (*Nasonovia ribis nigri)*, Potato Cyst Nematodes (*Globodera pallida* and *Globodera rostochiensis)*, green snail (*Helix aperta*), melon thrips (*Thrips palmi*) and western flower thrips (*Frankliniella occidentalis).*

The Western Australian Department of Agriculture and Food has a community surveillance program to increase public awareness and engagement of the community in surveillance. The Pest and Disease Information Service (PaDIS) offers a free service to identify specimens and handle any unusual sightings.

Farm surveillance activities

Responsibility	▪ industry/growers

Industry representative groups may contribute toward the provision of effective surveillance through a range of activities. Examples include:

- carrying out surveillance on commercial properties
- liaising with agriculture departments
- reporting suspect pests
- provision of farm surveillance records
- coordination of grower surveillance
- funding commercial surveillance activities
- working with agriculture departments to develop awareness, training and extension programs
- carrying out training.

Agribusinesses participate in surveillance by increasing general pest awareness and providing diagnostic services. Specific actions that contribute to surveillance include:

- distribution of extension materials
- assistance with training
- receiving suspect samples
- supplying surveillance equipment (e.g. traps and diagnostic kits)
- providing diagnostic services to growers.

Grower roles and responsibilities include:

- implementation of surveillance on properties (where possible)
- reporting suspect pests
- provision of records of farm surveillance
- attending training providing awareness and training to staff
- meeting state/territory agriculture department and industry surveillance requirements
- ensuring identification material and sampling kits are available for staff.

Vegetable growers undertake different levels and types of inspection. The inspections are undertaken by industry representative groups, consultants, crop monitors and growers. A survey, completed by the OCPPO in 2002/03, of surveillance undertaken in Australia by industry includes: asparagus rust (*Puccinia asparagi*), asparagus stem blight (*Phomopsis asparagi*), Tomato yellow leaf curl virus (TYLCV), bacterial wilt of potatoes (*Pseudomonas solanacearum*), burrowing nematode (*Radopholus sirnilis*), cabbage leafminer (Liriomyza brassicae), cabbage looper (*Chrysodeixis subsidens)*, celery Mosaic Virus (CeMV), Colorado potato beetle (*Leptinotarsa decemlineata*), false rust wart (*Synchytrium phaseolin*), fruit flies (Tephritidae family), giant African snail (*Achatina fulica)*, golden mystery snail (*Pomacea bridgesi*), leaf beetle (Paropsines spp.), lesion nematode (*Pratylenchus spp*.), lesser snow scale (*Pinnaspis aspidistrae*), Mediterranean fruit fly (*Ceratitis capitata*), onion smut (*Urocystis cepulae*) , pea leaf miner (*Liriomyza huidobrensis*), pea weevil (*Bruchus pisorum*), potato cyst nematodes (*Globodera pallida* and *Globodera rostochiensis)*, potato late blight (*Phytophthora infestans*), potato spindle tuber viroid (PSTVd), Potato virus Y (PVY), red spider mite (*Tetranychus urticae*), root-knot nematode (Meloidogyne sp.), silver leaf whitefly (*Bemisia tabaci)*, spiraling whitefly (*Aleurodicus dispersus*), stem nematode (*Ditylenchus dipsaci*), Tetranychus spp., turnip moth (*Agrotis segetum*), white blister (*Albugo candida*) and whiteflies.

Farm biosecurity / farm hygiene

The following sections of this document deal specifically with guidelines for farm biosecurity. Specific focus areas include:

- avoidance of pest spread by selecting appropriate planting materials;
- removing or reporting volunteer or neglected vegetables;
- control of pest vectors;
- control of alternative hosts;
- destruction of crop residues;
- integration of biosecurity awareness into post-harvest handling and transport procedures;
- use of warning and information signs for biosecurity awareness;
- use of dedicated equipment in high risk areas;
- restriction of people and vehicle movement in high risk areas;
- reporting suspect pests to appropriate authorities; and
- including farm biosecurity in Industry Best Management Practice (IBMP) and Quality Assurance (QA) schemes.

Selection and preparation of appropriate planting materials

Obtaining pest and pathogen free planting material for crop production

Responsibility	▪ national border control (Australian Government) ▪ intra- and interstate border controls (state and territory governments) ▪ industry/growers

Vegetables and propagation material should not be distributed without screening for pests and diseases. Infected planting material can be the main source of spread for some serious diseases. Material from infected plants may appear healthy, so the outward appearance of planting material cannot be regarded as a reliable indicator of disease status. Soil carried on plants can harbour pathogens or pests, such as fungal spores or nematodes.

Planting material that has been certified as being free of pests and pathogens provides a useful safeguard for growers. Growers should seek out certified propagation material wherever possible. The value of certified planting material is enhanced if the parent crops have been grown in pest free areas.

Seed potato certification is conducted under the *National Standard for Certification of Seed Potatoes* (©HAL). The Standard ensures that buyers will receive seed potatoes, which have met, or exceeded, an agreed standard. A number of laboratories in Australia are accredited to produce stock material for the schemes. Refer to the National Potato Industry Biosecurity Plan for further information.

The Organisation for Economic Collaboration and Development (OECD) Agricultural seed scheme is a globally recognised framework for the certification of agricultural (including

vegetable) seed moving through international trade. The scheme facilitates international trade through the simplification and harmonisation of documentary, inspection and testing procedures for seeds by encouraging the production and use of seeds or plants of consistently high quality for which trueness to name or source is guaranteed (OECD). This scheme does not include the testing or inspection for pest or disease.

Use of chemical control measures

Responsibility	▪	industry – drawing on advice from government and non government research agencies

Agriculture departments and the vegetable industry should identify and list suitable chemical control measures for high priority exotic pests, and put into place procedures for the emergency registration of necessary chemicals that may be unavailable.

The Australian Pesticides and Veterinary Medicines Authority (APVMA) is the national authority responsible for registration and deregistration of chemicals and can be contacted by phone on (02) 6272 5852. The APVMA Permit Section deals specifically with emergency registrations for chemicals. Further information can be obtained from the APVMA web site at www.apvma.gov.au

Control of vectors

Responsibility	▪	industry – drawing on advice from government and non government research agencies

Many viruses and some bacteria require a vector to provide a means of dispersal. Vectors are commonly invertebrates such as insects and mites. Nematodes, fungi, birds, people and machinery can also serve as vectors of plant pathogens. The activity and mobility of the vector determines the rate and distance of dispersal.

Inspection and cleaning of vehicles, machinery and equipment helps to prevent pest spread, as does cleaning of footwear and restricting unnecessary people movements around the farm. Consideration should also be given to the control of known vectors of plant pathogens when new disease outbreaks are likely.

Control of alternative hosts

Responsibility	▪	industry – drawing on advice from government and non government research agencies

Some weed species can act as alternative hosts of crop pests. Where this is so, weed control practices can significantly contribute to limiting the survival of pests and reducing the potential for outbreaks. Details of any alternative hosts will be included in pest specific contingency plans and awareness materials for high priority vegetable pests. Contingency plans and awareness materials are listed in later sections of this Industry Biosecurity Plan.

Destruction of crop residues

Responsibility	▪	industry – drawing on advice from government and non government research agencies

Protocols for the destruction or treatment of affected crop material should be developed for high risk pests and pathogens.

As many crop pests and pathogens are able to survive on crop residues and by-products these should be treated responsibly. Burying, burning or removing crop residues, and cleaning equipment and machinery are effective cultural practices that may be adopted if necessary. When developing protocols some issues that will determine the effectiveness of crop residue treatment will include:

- the extent of the cropping area
- the survival mechanism, dispersal ability, and host range of the pathogen
- environmental constraints.

Neglected crops and volunteer plants

Responsibility	▪	government
	▪	industry

Neglected crops and volunteer plants potentially pose a high biosecurity risk to the vegetable industry, as they may allow pests to multiply, become established and spread. Suspected neglected crops or volunteer crops should be reported to one of the following authorities.

Table 4. Authorities responsible for dealing with neglected/feral/volunteer plants

State	Authority
ACT	Environment ACT
NSW	New South Wales Department of Primary Industries
NT	Department of Primary Industry, Fisheries and Mines
Qld	Department of Primary Industries and Fisheries, Queensland
SA	Primary Industries and Resources of South Australia
Tas	Department of Primary Industries and Water, Tasmania
Vic	Victorian Department of Primary Industries
WA	Department of Agriculture and Food, Western Australia

After reporting, appropriate steps may be taken by the relevant authority to ensure that neglected plants do not carry pests or pose a risk to any nearby or adjacent farms. Table 5 summarises the actions that may be carried out in each state under relevant legislation.

Table 5. State/territory legislation governing control of neglected crops

State	Legislation	Actions enabled
ACT	*Plant Diseases Act 2002*	The minister may direct, in writing, the owner or person in charge of premises to destroy or treat a stated plant, fruit or another stated thing at the premises.
NSW	*Plant Diseases Act 1924*	The Plant Diseases Act 1924 provides powers to require the owner to destroy neglected plants.
NT	*Plant Diseases Control Act*	Notification can be made to owners of neglected plants, requiring them to rectify the situation within a reasonable period with failure to do so making them liable to prosecution. Under a notice from the Chief Inspector, neglected plants may be destroyed and any costs incurred recovered.
Qld	*Plant Protection Act 1989* and associated regulations	The Queensland Department of Primary Industries and Fisheries has no particular powers on neglected plants, unless they are infested with a declared pest.
SA	*Fruit and Plant Protection Act 1992*	If a declared pest or disease has been detected in the vicinity, a Ministerial notice may be issued requiring specific control or eradication actions to be carried out.
Tas	*Plant Quarantine Act 1997*	Neglected plants should be reported to the Department of Primary Industries and Water. Neglected plants may be removed if they present a risk to adjacent plants by harbouring populations of pests or diseases on the "Annual List of List A and List B Declared Pests and Diseases". Copies of these lists are available on request from Quarantine Services, Tasmania.
Vic	*Plant Health and Plant Products Act 1995*	If an inspector knows or reasonably suspects that land is affected by any plant pest or disease, this may be reported to the Secretary of the Department of Primary Industries. A notice may be issued requiring the owner or occupier to control or eradicate the pest or disease, or to destroy the affected plants and/or produce.
WA	*Plant Diseases Act 1914*	Neglected production plants in Western Australia can be removed or destroyed if required, under order by the Minister.

Growers wishing to remain anonymous when reporting suspected neglected or feral crops may report through their local or national grower association (for contact details refer to section 4 – contingency plans and response management arrangements).

Post-harvest handling and produce transport procedures

Responsibility	▪	industry – drawing on advice from government and non government research agencies

Vehicles that are used to harvest or to transport vegetables, particularly if moving between farms, should be cleaned to remove soil and plant matter. This will help to minimise the risk of pest spread. For this purpose, all farms should have access to a high pressure wash down facility that is associated with a concrete or tarmac pad.

It is preferable that wash down facilities are located on the property, or failing this, close to the property. At a minimum, wash down facilities should be located within the same region as the property. Detergent based disinfectants should be considered. Water draining from the wash down facility should not be directed back into fields or the farm irrigation water supply.

Growers should maintain effective pest and disease monitoring and management programs. This includes keeping record of pest/disease outbreaks and the control measures used. Receivers should be informed of the source of the produce, and whether the material has come from an area experiencing a pest or disease outbreak.

Restrictions may be placed on the introduction or movement of vegetables by individual states or territories, for example, specifying the use of certain transport routes, container types or consignment management procedures. If proposing to move vegetables within or between quarantine areas or between states, transporters first should check with state authorities to find out which regulations apply (see Barrier Quarantine section). Vegetables should be transported securely to prevent spillage.

Identification and tracing systems will assist in tracing produce consignments to their source if they are found to be contaminated with an exotic pest. Consignments should be clearly marked with the name of the grower, and a batch identification mark (date or other code). Growers should maintain a record of the source and destination of each batch, and identify separate growing areas on a property map.

Post-harvest handling and produce transport procedures that minimise the risk of pest movement should be developed further and promoted within the industry.

Use of warning and information signs

Responsibility	▪	industry

Placing warning and information signs on the entrances and gates of properties can help inform visitors of the biosecurity practices in place, and reminds industry personnel that farm biosecurity is a priority. Signs should also include up-to-date contact details for people to gain further information, as visitors to the area may not be aware of relevant biosecurity protocols.

All people entering the property should have a clear view of any information signs. Signs should contain clear and simple messages (e.g. do not enter the farm without prior approval, use wash down facilities for cleaning vehicles and machinery).

Use of dedicated equipment when working in high risk areas

Responsibility	▪ industry ▪ state and territory governments

It may be practical to assign equipment (including clothing, tools and footwear) to be used in pest infected/infested areas only. This means that the equipment used in infected/infested farms or areas is not reused in clean areas – and *vice versa*.

Restricting the movement of vehicles, equipment and people

A high risk of spreading pests comes from movements of people, machinery and equipment between regions and farms. This risk can be reduced by ensuring plant material and soil that may harbour pests is not moved to other properties or regions.

National controls

Responsibility	▪ Australian Government

The Australian Government is responsible for the inspection of machinery and equipment being imported into Australia. Administrative authority for national quarantine is vested in AQIS under the Quarantine Act 1908. Any machinery or equipment being imported into Australia must meet quarantine requirements. If there is any uncertainty, contact AQIS on (02) 6272 3933 or 1800 020 504.

State controls

Responsibility	▪ state and territory governments

Enquiries regarding interstate movements of plant material should be directed to your local state or territory agriculture agency, or by telephoning the Quarantine Domestic Hotline on 1800 084 881.

A seed potato protected area in NSW has quarantine requirements for the introduction of potatoes and associated equipment.

Table 6. State/territory restrictions on movement of machinery and equipment

State	Legislation	Administering authority	Control procedures

State	Legislation	Administering authority	Control procedures
ACT	Plant Diseases Act 2002	Environment ACT	
NSW	Plant Diseases Act 1924	New South Wales Department of Primary Industries	Potato machinery & equipment prohibited if been within 20km radius of PCN.
NT	Plant Diseases Control Act	Department of Primary Industry, Fisheries and Mines	
Qld	Plant Protection Act 1989	Department of Primary Industries and Fisheries, Queensland	Prohibited if been within 20km of PCN or Golden Nematode,or, subject to conditions.
SA	Fruit and Plant Protection Act 1992	Primary Industries and Resources South Australia	Clean, Inspected and Certified. Prohibited if originated within 20km of PCN or subject to conditions.
Tas	Plant Quarantine Act 1997	Department of Primary Industries and Water, Tasmania	Free from soil, plant trash, plants, declared weed seeds and declared diseases and organisms. Disinfestation is required if used in certain areas.
Vic	Plant Health and Plant Products Act 1995	Victorian Department of Primary Industries	Free of Soil and organic material in relation to certain pests. Entry to Protection Districts requires certification. Disinfection and certification required for certain areas.
WA	Plant Diseases Act 1914 and Regulations, 1989	Department of Agriculture and Food, Western Australia	Used potato machinery and agricultural containers are subject to conditions and inspection upon arrival. Free of soil applies to all other machinery and equipment.

Farm / regional activities

Responsibility	▪	industry/growers

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

Suggested practices for minimising pest spread at the farm level include:

- ensuring that all visitors to the farm report directly to the office on arrival
- checking that machinery, vehicles, and equipment (e.g. trailers, crates, bins) entering or leaving properties are free of soil and crop debris
- visually inspecting machinery and equipment before it comes onto the property and denying access to any equipment that does not meet biosecurity standards

- restricting movements of vehicles and people (if possible) during high risk periods. This may include avoiding moving vehicles and machinery, particularly when roads are wet and muddy
- ensuring all visitors and employees are aware of the importance of keeping footwear and clothing free from loose dirt and vegetable matter before entering or leaving the property
- providing wash down facilities for both machinery and people (e.g. high pressure hose with a concrete or tarmac pad, scrubbing brushes and footbaths)
- providing a designated parking area and transporting visitors, contractors, employees and government officials using vehicles based permanently on the property
- minimising unnecessary entry of vehicles from outside the farm and movements of vehicles around the farm (especially when the soil is wet)
- reporting all suspected exotic pests to your relevant agriculture department.

Including farm biosecurity in IBMP and QA schemes

Responsibility	▪ industry

For farm level protection from pests, the following farm biosecurity (farm hygiene) measures are recommended:

- using pest- and disease-free propagating material and planting resistant cultivars where applicable
- inspecting all incoming vehicles and equipment for signs of contaminated soil or plant material and enforcing biosecurity standards
- using high pressure wash down facilities associated with a concrete or tarmac pad for cleaning vehicles and equipment, with disposal of effluent away from plants and irrigation sources
- undertaking a biosecurity/quarantine education and training program for employees and related personnel
- having a planned, effective monitoring and pest management program
- erecting informative signs at the entrance of the property which outline the basic biosecurity requirements for all visitors
- reporting all suspect diseased plants and pests to the local state/territory agriculture department, for identification
- minimising vehicle movement around the farm (particularly when muddy)
- training staff in effective use of relevant chemicals
- disposing of unwanted plants and reporting neglected crops and volunteer plants to the local state/territory agriculture department
- managing visitor movement around the farm by using vehicles which remain on the property, and supplying footwear or footbaths
- minimising or keeping public sales and tourist activities separate from the farm area.

Including these measures in IBMP and QA schemes will strengthen the ability to rapidly detect, control and eradicate exotic pest outbreaks in the vegetable industry before extensive damage occurs.

Reporting suspect pests

Any unusual plant pest should be reported immediately to the relevant state/territory agriculture agency. Early reporting enhances the chance of effective control and eradication.

Some vegetable pests are notifiable. Landowners and consultants have a legal obligation to notify the relevant state/territory agriculture department of the presence of those pests within 24 hours of detection.

Early reporting enhances the chance of effective pest control and/or eradication.

Reporting an exotic plant pest carries serious implications and should be done via the relevant state/territory agriculture department. Careless use of information, particularly if a pest has not been confirmed, can result in extreme stress for individuals and communities, and possibly damaging and unwarranted trade restrictions.

If you suspect a new pest, please call the Exotic Plant Pest Hotline on 1800 084 881 or contact one of the following state/territory authorities directly.

Suspect material should not generally be moved or collected without seeking advice from the relevant state/territory department, as incorrect handling of samples could spread the pest or render the samples unsuitable for diagnostic purposes. State/territory agriculture department officers will usually be responsible for sampling and identification of pests.

Table 7. Contacts for reporting suspected exotic pests

State	Relevant authority	Contact
ACT	Environment ACT	**13 22 81**
NSW	New South Wales Department of Primary Industries	Phone **(02) 6394 3174** and ask for the Manager, Plant Biosecurity Risk Management
NT	Department of Primary Industry, Fisheries and Mines	Phone **(08) 8999 2337** and ask for the Manager of Plant Health
Qld	Department of Primary Industries and Fisheries, Queensland	DPI&F Call Centre on **(07) 3404 6999** or the Call Centre on **13 25 23.**
SA	Primary Industries and Resources of South Australia	**1300 666 010**
Tas	Department of Primary Industries and Water, Tasmania	**(03) 6233 3352**
Vic	Victorian Department of Primary Industries	**136 186** or **(03) 8371 3500**
WA	Department of Agriculture and Food, Western Australia	Phone **(08) 9368 3333** and ask for the Manager of Plant Health

References

Irvine, G. (2005). *Seed as a pathway for exotic diseases of vegetables in Victoria*. (Review). Primary Industries Research Victoria, Knoxfield, Victoria.

OECD, OECD Agricultural Codes and Schemes for International Trade, OECD

Nairn, M.E., Allen, P.G., Inglis, A.R. and Tanner, C. (1996). *Australian Quarantine; a shared responsibility. Report of the Australian Quarantine Review Committee.* Department of Primary Industries and Energy, Canberra, ACT.

National Vegetable Industry Biosecurity Plan

CONTINGENCY PLANS AND RESPONSE MANAGEMENT ARRANGEMENTS

Plant Health Australia is a peak national coordinating body for plant health in Australia. We commission projects and work with members to coordinate the development of national policy and capability to enhance the ability of Australian agriculture to respond effectively to plant pests, weeds and diseases.

For more information on Plant Health Australia

Location:	Suite 5, FECCA House 4 Phipps Close DEAKIN ACT 2600
Phone:	+61 2 6260 4322
Fax:	+61 2 6260 4321
E-mail:	admin@phau.com.au
Visit our web site:	www.planthealthaustralia.com.au

An electronic copy of this plan is available from the web site listed above.

TABLE OF CONTENTS

TABLES

FIGURES

Acronyms

DAFF	Department of Agriculture, Fisheries and Forestry
EPP	Emergency Plant Pest
EPPRD	Emergency Plant Pest Response Deed
IBG	Industry Biosecurity Group
IBP	Industry Biosecurity Plan
PHA	Plant Health Australia
OCPPO	Office of the Chief Plant Protection Officer

Note: The definition of a pest as adopted by the International Plant Protection Convention (any species, strain or biotype of plant, animal, or pathogenic agent, injurious to plants or plant products) is used throughout this plan.

Introduction

Gathering information, developing procedures, and defining roles and responsibilities during an emergency can be extremely difficult. To address this area, Plant Health Australia (PHA) has developed PLANTPLAN, a national set of incursion response guidelines for the plant sector, detailing procedures required and the roles and responsibilities of all parties involved in an incursion response.

In the future pest contingency plans may be developed for key pests of the vegetable industry. These documents would be used in conjunction with PLANTPLAN and would provide the pest specific responses information needed in an eradication effort for that particular pest.

PLANTPLAN

PLANTPLAN provides a description of the general procedures, management structure and information flow system for the handling of a plant pest emergency at national, state/territory and district levels. This includes the operations of the control centres, principles for the chain of responsibility, functions of sections and role descriptions. PLANTPLAN is a general manual for use by all jurisdictions for all plant pest emergencies.

PLANTPLAN is regularly reviewed and updated to ensure it provides the best possible guidance to plant industries and governments in responding to serious plant pests. Accordingly, please check the web site (www.planthealthaustralia.com.au/plantplan) to ensure you have the most up to date version.

Current response management procedures

On finding a pest, or after a pest is reported, the relevant state/territory agriculture agency may collect samples of a suspect organism and seek a positive identification. If the pest is suspected to be an exotic pest (not yet present in Australia), within 24 hours the agency will inform the Office of the Chief Plant Protection Officer (OCPPO) which will notify other relevant Australian Government Departments and relevant state agencies and industry representatives. After consultation, appropriate response measures will be decided.

If the pest is considered potentially serious, then the relevant state/territory agriculture department may adopt precautionary measures. These measures, depending on the pest, may include:

- restriction of operations in the area
- withdrawal of people, vehicles and machinery from the area and disinfection
- restricted access to the area
- interim control or containment measures.

If an exotic plant pest is confirmed, technical and economic considerations are reviewed, and a decision made on whether to eradicate, contain or do nothing about the incursion (depending on the likely costs and impacts of the pest). Under the Emergency Plant Pest Response Deed (EPPRD) all decisions are made by committees with government and industry representation.

During this investigation/alert period, the affected area will be placed under quarantine until a decision is made on whether to eradicate or control the pest. Once a decision has been made on a suitable response, efforts enter the operational phase. Eradication or control methods used will vary according to the nature of the pest involved and infested material will be destroyed where necessary. All on ground response operations are undertaken by the relevant state department(s) in accord with relevant state/territory legislation.

In the stand down phase, all operations are wound down. Where a plant pest emergency was not confirmed, those involved will be advised that the threat no longer exists. Where an eradication or management/control campaign has taken place, quarantine measures will be reviewed.

Figure 1 *General decision making and communication chain for a plant pest emergency response*

Investigation	Alert	Operational	Stand Down
Detection of new pest Report forwarded to state agriculture department Investigation by state agency – samples collected/identified	Chief Plant Protection Officer (Department of Agriculture, Fisheries and Forestry - DAFF) and other state agencies and industry notified Quarantine restrictions imposed if appropriate Likely impacts of pest evaluated and decision made on response	State agencies manage operational response under relevant legislation State and/or Local Pest Control Centre established (if appropriate) Lead agency, DAFF and industry cooperate regarding communication/media relations	Response successful or decision made to move to contain and live with the pest

The figure and information provided above is a general guide. For more detailed information on how pest responses are managed, please refer to PLANTPLAN.

State Plans

Various States have Emergency response plans.

Primary Industries and Resources of South Australia have the "Plant Health - Emergency Plant Pests Response Plan".

Tasmania has the Biosecurity Emergency Preparedness Program (BEPP).

Industry specific response procedures

Industry communication

In the event of a pest incursion affecting the vegetable industry, AUSVEG will be the key industry contact point and will have responsibility for industry communication and media relations.

Close cooperation is required between relevant government bodies and industry in regards to the effective management of a pest response and media/communication issues. Readers should refer to PLANTPLAN for further information.

Regional or state based industry organisations will be informed of the incident through the national industry contact.

Table 1 *Key vegetable industry contacts*

Name	Organisation	Position	Contact details
National			
John Roach	Australian Vegetable and Potato Growers Federation (AUSVEG)	CEO	Suite 9, 756 Blackburn Rd, Clayton North, VIC 3168. Phone: (03) 9544 8098 Fax: (03) 9558 6199 Email: john.roach@ausveg.com.au or info@ausveg.com.au Web: www.ausveg.com.au
Lisa Maguire	AUSVEG	Communications Manager	As above Email: lisa.maguire@ausveg.com.au
The Australian Chamber of Fruit and Vegetable Industries Ltd	Australian Chamber of Fruit and Vegetable Industries Ltd		Suite 24B Market Plaza Building Sydney Markets NSW 2129 Phone: 02 9764 3244 Fax: 02 9764 2776 Email: thechamber@freshmarkets.com.au Web: www.freshmarkets.com.au
National – R & D organisations			
Horticulture Australia Ltd (HAL)	Horticulture Australia Ltd		Level 1, 50 Carrington Street Sydney, 2000 Phone: 02 8295 2300 Fax: 02 8295 2399 Web: www.horticulture.com.au

Name	Organisation	Position	Contact details
Kim James	HAL	Portfolio Manager, Postharvest and biosecurity	Phone: 08 9284 7711 Fax: 08 9284 7722 Email: kim.james@horticulture.com.au
National – Retailers and distributors			
Coles	Coles	National Produce Manager	Customer relations - 1800 061 562 Web: www.coles.com.au
Woolworths	Woolworths	National Produce Manager	National Supermarkets Head Office Corner Fairfield and Dursley Roads Yennora NSW 2165 Phone: 02 9892 7111 Fax: 02 9892 7171 Web: www.woolworths.com.au
Foodland Associated Llimited (FAL)	Foodland Associated Limited	National Produce Manager	218 Bannister Road Canning Vale Western Australia 6155 Phone: 08 9311 6000 Fax: 08 9311 6013 Web: www.fal.com.au
Foodland South Australia	Foodland South Australia	State Produce Manager	292 Grange Rd Flinders Park South Australia, 5025 Phone : 08 8351 9233 Fax: 08 8351 9235 Web: www.foodlandsa.com.au
Independent Grocers of Australia (IGA)	Independent Grocers of Australia (IGA)	National Produce Manager	628 Kingston Rd Loganlea QLD 4131 Phone: 07 3804 4000 Web: www.iga.net.au
Aldi Australia	Aldi Australia	National Produce Manager	1 Sargents Road Minchinbury NSW 2770 Phone: 02 9675 9000 Web: www.aldi.com.au

Name	Organisation	Position	Contact details
Metcash Trading Limited	Metcash Trading Limited	National Produce Manager	4 Newington Road Silverwater NSW 2128 Phone: 02 9741 3000 Web: www.metcash.com (Includes IGA Distribution & FAL)
National – Related industry associations			
Avcare	Avcare		Level 2, AMP Building 1 Hobart Place Canberra ACT 2601 Phone: 02 6230-6399 Fax: 02 6230-6355 Email: info@avcare.org.au Web: www.avcare.org.au
Claude Gauchat	Avcare	Executive Director	As above.
Jane Adams	Australian Farmers' Markets Association (AFMA)	Interim Chairperson	Telephone: 02 9360 9380 Fax: 02 9360 3568 Web: www.farmersmarkets.org.au
Jenny Lambert	Nursery and Garden Industry Australia	Chief Executive Officer	PO Box 907 EPPING NSW 1710 Telephone: (02) 9876-5200 Fax: (02) 9876-6360 jenny.lambert@ngia.com.au
Australian Melon Association	Australian Melon Association		25 Whaddon Road Wallaville QLD 4671 Australia Telephone: (07) 4157 6238 Fax: (07) 4157 6228 Web: www.melonsaustralia.org.au
Australian Garlic Industry Association	Australian Garlic Industry Association		Tel/Fax (+61) 3 9578 2306 Email: GarlicAssocAust@aol.com
Biological Farmers of Australia	Biological Farmers of Australia		Head Office PO Box 530 - L1/766 Gympie Rd CHERMSIDE QLD 4032 Ph: (07) 3350 5716 Fax: (07) 3350 5996 info@bfa.com.au Web: www.bfa.com.au
Bedding Plants Australia			Web: www.beddingplants.com.au

Name	Organisation	Position	Contact details
New South Wales and Australian Capital Territory			
NSW Farmers Association	NSW Farmers Association		Level 10, 255 Elizabeth St Sydney NSW 2001 Phone: 02 8251 1700 Fax: 02 8251 1750 Email: emailus@nswfarmers.org.au Web: www.nswfarmers.org.au
Luke Jewell	NSW Farmers Association	Senior Analyst	See above
New South Wales Chamber of Fruit and Vegetable Industries Ltd	New South Wales Chamber of Fruit and Vegetable Industries Ltd		PO Box 6, Sydney Markets NSW 2129 Phone: 02 9764 3244 Fax: 02 9764 2776 Email: nswchamber@freshmarkets.com.au
FreeGrowers Council of NSW			
Northern Territory			
Northern Territory Horticulture Association			PO Box 2207 PALMERSTON NT 0831 Phone: (08) 8983 3233 Fax: (08) 8983 3244 Email: ntha@octa4.net.au Web: www.ntha.com.au
Queensland			
Growcom	Growcom		385 St Pauls Terrace Fortitude Valley 4006 Phone: 07 3620 3844 Fax: 07 3620 3880 Email: info@growcom.com.au Web: www.growcom.com.au
Jan Davis	Growcom	CEO	As above Email: jdavis@growcom.com.au
Bundaberg Fruit & Vegetable Growers Association	Bundaberg Fruit & Vegetable Growers Association		27 Barolin Street Bundaberg QLD 4670 Phone: 07 4153 3007 Fax: 07 4053 1322 Email: bfvg@interworx.com.au
Bowen Group			
South Australia			

Name	Organisation	Position	Contact details
South Australian Farmers Federation (SAFF)	SAFF		3rd Floor, 122 Frome Street Adelaide SA 5000 Phone: 08 8232 5555 Fax: 08 8232 1311 Email: info@saff.com.au Web: www.saff.com.au
Carol Vincent	SAFF	CEO	See above
Mike Redmond	Virginia Horticulture Centre	CEO	Old Port Wakefield Road Virginia SA 5120 Phone: 08 8282 9200 Fax: 08 8380 8950 Email: virghc@chariot.com.au Web: www.virginiahc.com.au
South Australian Chamber of Fruit and Vegetables			
Tasmania			
Tasmanian Farmers and Graziers Association (TFGA)	TFGA		Cnr Charles & Cimitiere Streets Launceston Tasmania 7250 Phone: 03 6332 1800 Fax: 03 6331 4344 Web: www.tfga.com.au
Bruce Williams	TFGA	CEO	As above.
Denis Leonard	TFGA	Executive Officer	As above
Stephen Welsh	TFGA	Vegetable IDO (including potatoes)	As above
Victoria			
Vegetable Grower's Association Victoria	VGA		Mail Box 111 Melbourne Markets 542 Footscray Rd West Melbourne Vic 3003 Phone: 03 9687 4707 Fax: 03 9687 4723 Email: contact@vgavic.org.au Web: www.agos.org.au
Asparagus Growers of Sunraysia East Gippsland??			
Victorian Chamber of Fruit and Vegetable Industries	Victorian Chamber of Fruit and Vegetable Industries		Mail Box 113 542 Footscray Road West Melbourne Victoria 3003 Phone: 03 9689 3233 Fax: 03 6989 9223 Email: vicchamber@freshstate.com.au
Western Australia			

Name	Organisation	Position	Contact details
Western Australia Vegetable Growers Association Carnarvon Kununurra Industry Growers Association	WAVGA		PO Box 498 West Perth WA 6872 Phone: 08 9226 0244 Fax: 08 9226 0344
Western Australian Farmer's Federation Inc.	WAFF		Ground Floor 28 Thorogood Street, Burswood WA 6100 PO Box 6291, EAST PERTH WA 6892 Ph: (08) 9486 2100 Fax: (08) 9361 3544 Email: WAFarmers@waff.org.au Web: www.waff.org.au
The Chamber of Fruit and Vegetable Industries in Western Australia Inc.	The Chamber of Fruit and Vegetable Industries in Western Australia Inc.		Phone: 08 9455 2742 Fax: 08 94554923

Counselling services

Provision for counselling will be made through the various grower organisations and government agencies. Details are provided below.

Table 2 *Counselling services*

State	Organisation	Contact
National	Australian Government Agriculture Advancing Australia information line	Phone **1800 686 175** for referral to your nearest service provider.
National	Relationships Australia	Phone **1300 364 277** or see http://www.relationships.com.au/ for regional contacts and services
NSW	NSW Rural Assistance Authority	Phone **1800 678 593** or visit http://www.raa.nsw.gov.au
NT	Employee Assistance Service NT Inc	Phone **1800 193 123**
Qld	QDPI&F	Phone **13 25 23** or visit http://www.dpi.qld.gov.au/health/4085.html
SA	Counselling services SA: Department for families and communities	Phone: **08 8226 8800** Facsimile: **08 8124 4099** Crisis Care: **13 1611** (All Hours)
Tas	Free advice and support: Rural Support Tasmania	North: Ph **0419 138 963** or **(03) 6334 2768** South: Ph **0407 519 245** or **(03) 6272 5992** Email: rurals@southcom.com.au
Tas	DPIWE fee for service counsellors: Newport & Wildman	Ph **(03) 6334 2333**
Vic	Department of Primary Industries maintains a list of various relevant counselling providers	DPI Customer Service Centre - phone **136 186,** e-mail customer.service@nre.vic.gov.au or visit http://www.dpi.vic.gov.au
WA	DAFWA	Rita Rosman Rural Counselling Liaison Officer Ph **(08) 9368 3160** or fax **(08) 9367 4265** rrosman@agric.wa.gov.au

Advice on financial support for affected growers can be obtained from the following organisations free of charge.

Table 3 *Financial counselling services*

State	Organisation	Contact
All states	Rural Financial Counselling Service	Phone **1800 686 175** for referral to your nearest service provider.
NSW	NSW Rural Assistance Authority	Phone **1800 678 593** or visit http://www.raa.nsw.gov.au
NT	Territory Business Centres, Department of Business, Industry and Resource Development	Phone **1800 193 111**
Qld	QDPI&F Farm Financial Counselling Service.	Phone **13 25 23** (within Queensland) or **(07) 3404 6999** (outside Queensland) or fax (07) 3404 6900 to locate your nearest Farm Financial Counselling Service office.
SA	Central Riverland Financial Counselling Service Inc	Rural Financial Counsellor PIRSA Loxton Office Bookpurnong Road, Loxton Phone **(08) 8595 9146** or fax **(08) 8595 9199**
SA	SA Association of Rural Counselling Services	Visit http://www.ruralcounsellingsa.com or contact PIRSA on **(08) 8226 0222** for information on your nearest service provider
Tas	Rural Support Tasmania	Hobart Phone **(03) 6272 5992** or fax **(03) 6272 3195** Mobile **0407 519 245** Email: rurals@southcom.com.au. P.O. Box 627, Glenorchy 7010 Launceston Phone **(03) 6334 2768** Fax **(03) 6334 0979** 62 York Street, Launceston 7250.
Vic	The DPI maintains a list of various relevant counselling providers	DPI Customer Service Centre - phone **136 186,** e-mail customer.service@nre.vic.gov.au or visit http://www.dpi.vic.gov.au
WA	DAFWA	Rural Counselling Liaison Officer Phone **(08) 9325 0013** or fax **(08) 9225 4970**

Pest Contingency Plans

Over time, pest-specific Contingency Plans will be completed for priority exotic threats of the industry. Updated plans will be made available in electronic format.

Currently, a number of Pest- and Industry-specific Contingency Plans exist. These are detailed below.

Industry-Specific Contingency Plans

Horticulture 2000 Group., July 1999, *Horticulture Emergency Plan – A National Emergency Plan for the Horticulture Industries of Australia*, Funding/ Support by Supermarket to Asia Ltd., AFFA

Power. G., November 1998, *HortGuard*, Funding/ Support by Department of Agriculture and Food, Western Australia.

Pest-Specific Contingency Plans

Berg. G., Merriman, P. and Sully, R.. In preparation, *National PCN (Potato Cyst Nematode) Management Plan*, Funding / Support by Horticultural Research and Development Corporation (HRDC); Australian Potato Industry Council.

Queensland Department of Primary Industries and Fisheries (QDPI&F), September 1999, *National Contingency Plan for Response to an Incursion of Melon Fly (Bactrocera cucurbitae) and its Allies (Diptera: Tephritidae) in Australia*, Funded / Supported by HRDC; AFFA.

Department of Health, 1980, *Guidelines for the Eradication of Some Exotic Plant Pests and Diseases,* Plant Quarantine Branch, Department of Health, Canberra.

Primary Industries and Resources of South Australia, Revised Annually, *Fruit Fly Contingency Plan – Riverland,* South Australia

National Diagnostic Standards for Emergency Plant Pests

Plant Health Australia has commissioned a number of diagnostic standards that would be used to identify an exotic/emergency plant pest. This is to avoid use of multiple protocols and so that time does not have to be spent developing a protocol.

Currently, a system is being set up so that these protocols are formally nationally endorsed, through the Subcommittee on Plant Health Diagnostic Standards (SPHDS). The most up to date version will be available on the website of SPHDS in the future, or by contacting PHA in the interim.

A number of diagnostic standards of relevance to the vegetable industry have been commissioned by PHA and others, and are either currently available or being developed. Diagnostic standards which have been developed for pests that affect potatoes are contained in the National Potato Industry Biosecurity Plan. PHA has also developed diagnostic standards for other pests that affect the vegetable industry. These include: *Liriomyza* spp., Pepino Mosaic Virus, Thrips and Spider mites. For details of these diagnostic standards please contact the PHA office.

National Vegetable Industry Biosecurity Plan

AWARENESS MATERIAL

Plant Health Australia is a peak national coordinating body for plant health in Australia. We commission projects and work with members to coordinate the development of national policy and capability to enhance the ability of Australian agriculture to respond effectively to plant pests, weeds and diseases.

For more information on Plant Health Australia

Location:	Suite 5, FECCA House 4 Phipps Close DEAKIN ACT 2600
Phone:	+61 2 6260 4322
Fax:	+61 2 6260 4321
E-mail:	admin@phau.com.au
Visit our web site:	www.planthealthaustralia.com.au

An electronic copy of this plan is available from the web site listed above.

TABLE OF CONTENTS

Priority pests

The following pests have been identified by members of the vegetable industry, government agencies and relevant research bodies as being high priority threats to the industry. They have been assessed as having a high entry and/or high impact potential.

Fact sheets

This section will ultimately list fact sheets for the pests identified in the emergency plant pest priority list and the list of exotic pests currently under active control (refer to section 2 – threat identification, pest risk reviews and incursion management funding arrangements).

Exotic threat	Information available from
Oriental fruit fly *Bactrocera dorsalis*	Plant Health Australia – Vegetable Industry Biosecurity Plan
Tomato leaf miner *Liriomyza bryoniae*	Department of Primary Industries, Victoria
Serpentine leaf miner *Liriomyza huidobrensis*	Department of Primary Industries, Victoria
Vegetable leaf miner *Liriomyza sativae*	Plant Health Australia – Vegetable Industry Biosecurity Plan
American serpentine leaf miner or chrysan-themum leaf miner *Liriomyza trifolii*	Department of Primary Industries, Victoria
Carrot (rust) fly *Psila rosae*	
Carrot cyst nematode *Heterodera carotae*	
Rust *Uromyces scirpi*	
Zucchini lethal chlorosis tospovirus *Zucchini Lethal Chlorosis Virus*	
Watermelon silver mottle virus group (serogroup iv group)	

Pests under active control	Information available from
Currant Lettuce Aphid *Nasonovia ribisnigri*	Department of Primary Industries, Victoria
Potato cyst nematode *Globodera rostochiensis*	Refer to National Potato Industry Biosecurity Plan
Carrot virus y *Carrot Virus Y*	
Asparagus rust *Puccinia asparagi*	

Pests under active control	Information available from
Bacterial brown spot *Erwinia ananas*	
Cucurbit bacterial wilt *Erwinia tracheiphila*	
Fusarium wilt of cucumber *Fusarium oxysporum* .fsp *cucumerinum*	
Fusarium wilt of melon *Fusarium oxysporum* f.sp *melonis*	
Crater rot *Myrothecium roridum*	
Bacterial fruit blotch *Pseudomonas* *pseudoalcaligenes subsp.* *citrulli*	
Ear rot *Botryosphaeria rhodina* (syn. *Physalospora* *rhodina*)	
Maize dwarf mosaic *Maize Dwarf Mosaic Virus*	
Scarlet mealybug *Pseudococcus calceolariae*	
Hop bare-bine *Arabis Mosaic Virus*	Refer to National Strawberry Industry Biosecurity Plan
Citrus scaly butt *Citrus Exocortis Viroid*	
Target spot *Corynespora cassiicola*	
Potato eelworm *Ditylenchus destructor*	
Fusarium dry rot *Exotic Fusarium spp.*	
Licorice rot *Mycocentrospora acerina*	
Papaya ringspot virus – W *Papaya Ring Spot Virus -* *W*	
Lettuce marginal leaf blight *Pseudomonas marginalis* *pv. marginalis*?	
Foliage blight *Rhizoctonia microsclerotia*	
Downy mildew of sorghum *Peronosclerospora sorghi*	
Maize bushy stunt *Ustilaginoidea virens*	

Pests under active control	Information available from
False smut *Ustilaginoidea virens*	
Boil smut *Bactrocera cucurbitae*	
Scarlet mealybug *Pseudococcus calceolariae*	
Tobacco necrosis virus *Tobacco Necrosis Virus*	
Tomato ringspot virus *Tomato Ringspot Virus* *(TmRSV)*	
Verticillium wilt *Verticillium albo-atrum*	
Verticillium wilt *Verticillium dahliae*	
Watermelon mosaic virus 2 *Watermelon Mosaic Virus 2*	
Bacterial blight of carrot *Xanthomonas hortorum* *pv. carotae*	
Brassica White Blister *Albugo candida*	

Further information / relevant web sites

Details of relevant government agencies, research organisations and grower groups are provided below for persons seeking further information on biosecurity for the vegetable industry.

The Department of Primary Industries and Water biosecurity website (www.dpiw.tas.gov.au/biosecurity) provides information on State biosecurity and quarantine requirements as well as access to relevant manuals and publications related to plant health.

Fact sheet

Exotic threat to vegetables: Oriental fruit fly

Oriental Fruit Fly
Source: PADIL

What is it?

The oriental fruit fly, *Bactrocera dorsalis,* has been recorded on more than 150 kinds of fruit and vegetables, including citrus, mango, papaya, avocado, banana, tomato, apple, passionfruit, pineapple, peach, pear and apricot. Avocado, mango, and papaya are the most commonly attacked. The fly can damage up to 100% of unprotected fruit.

What to look for

The adult oriental fruit fly is approximately 6 to 8 mm long, or slightly larger than the common housefly, with a narrow brown band along the front edge of its wings.

The thorax (middle body part) is dark with two prominent, yellow stripes on top and yellow marks on each side. The abdomen is yellowish with a black T-shaped mark.

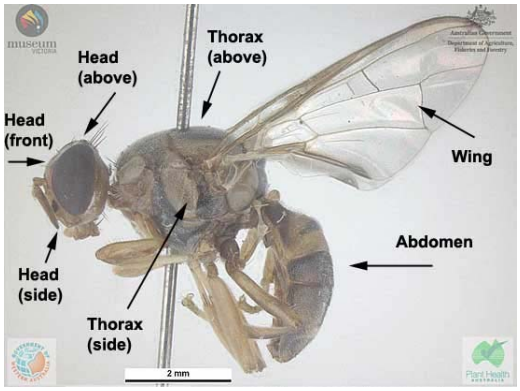
The female has a serrated-tip ovipositor (tube extending from the back end or underneath), which penetrates the host fruit or vegetable and deposits eggs inside.

Damage

Larval feeding in fruits causes breakdown of tissues and internal rotting. Infested young fruit becomes distorted, callused and usually drop; mature attacked fruits develop a water soaked appearance.

The larval tunnels provide entry points for bacteria and fungi that cause the fruit to rot.

When only a few larvae develop, damage consists of an unsightly appearance and reduced marketability



Oriental Fruit Fly
Source: PADIL

because of the egg laying punctures or tissue break down due to the decay

Where is it found?

The oriental fruit fly is widespread throughout much of Asia and the Hawaiian Islands.

Reporting

Growers can report suspect exotic pests or diseases to the Exotic Plant Pest Hotline (**1800 084 881**) or contact their local department of agriculture.

If suspect symptoms or pests are found, you should report this immediately. To minimise the risk of spread, samples should not be moved from your property.

This fact sheet is part of the National Vegetable Industry Biosecurity Plan. For more information about the Biosecurity Plan, please contact Plant Health Australia.

Plant Health AUSTRALIA

FOR MORE INFORMATION
Contact
Plant Health Australia

Phone: +61 2 6260 4322
Fax: +61 2 6260 4321
www.planthealthaustralia.com.au

ABN 97 092 607 997

Fact sheet

Exotic threats to vegetables: *Liriomyza sativae* – Vegetable leaf miner

Adult *Liriomyza sativae* (dorsal view)
Image Amy Carmichael, Queensland University of Technology, Pests and Disease Image Library (PaDIL), www.padil.gov.au.

What is it?

Liriomyza sativae is a major international insect pest, mining leaves of many crop and ornamental plants. It can be found hosted on most *Allium* species, including onions and garlic, as well as a diverse and large range of common horticultural crops.

Foliage punctures caused by females during the acts of oviposition or feeding may cause a stippled appearance on foliage, but this damage is slight compared to the leaf mining activity of larvae. Multiple mines on individual leaves, during infestations, can seriously injure and even destroy both seedlings and older plants.

Liriomyza sativae larval leaf mining damage to green onion.
Image Whitney Cranshaw, Colorado State University, www.insectimages.org

What do I look for?

Adult: small, greyish-black, compact bodied fly, 1.3-2.3mm in body length, 1.3-2.3mm in wing length, females slightly larger than males. The scutellum, face, 3rd antennal segment and femora are bright yellow, whilst the mesonotum is shiny black.

Egg: white, elliptical and measure about 0.23 mm in length and 0.13 mm in width. Eggs are inserted into plant tissue just beneath the leaf surface and hatch in about three days. Flies feed on the plant secretions caused by oviposition, and also on natural exudates.

Larvae: attain a length of about 2.25 mm. Initially the larvae are nearly colourless, becoming greenish and then yellowish as they mature.

The mines can vary in form with the host-plant but when adequate leaf area is available they are usually U-shaped, long, linear, and narrow but widening towards the end; they are usually white. In very small leaves the limited area for feeding often results in the

formation of a secondary blotch. The frass (larval excrement) is deposited in conspicuous black strips alternately at either side to the end of the mine.

Adult *Liriomyza sativae* (lateral view) Image Amy Carmichael, Queensland University of Technology, Pests and Disease Image Library (PaDIL), www.padil.gov.au.

Where is it found?

Originally described from South America, it has spread across the world into North and Central America, parts of Africa (Cameroon, Sudan, Zimbabwe), Asia (China, India, Oman, Thailand, Yemen), the Pacific Islands, and has been found in shipments in Europe. It is probably more widespread, but unreported, and may have been mistaken for other *Lyriomyza* species.

Reporting

Growers may report suspected exotic pests to the Exotic Plant Pest Hotline (1800 084 881) or can directly contact their relevant state agriculture or primary industries department.

To minimise the risk of pest spread, samples should not be moved until they have been checked by an expert.

This fact sheet is part of the National Onion Industry Biosecurity Plan. For more information about the Biosecurity Plan, please contact Plant Health Australia.

Plant Health AUSTRALIA

FOR MORE INFORMATION
Contact
Plant Health Australia

Phone: +61 2 6260 4322
Fax: +61 2 6260 4321
www.planthealthaustralia.com.au

ABN 97 092 607 997