Australian Government

Biosecurity Australia

Provisional final import risk analysis report for fresh greenhouse-grown capsicum (paprika) fruit from the Republic of Korea

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Cover image: Fresh greenhouse-grown capsicum fruit from Chollabuk-do Province, the Republic of Korea. Photographed by Biosecurity Australia officer, June 2007.

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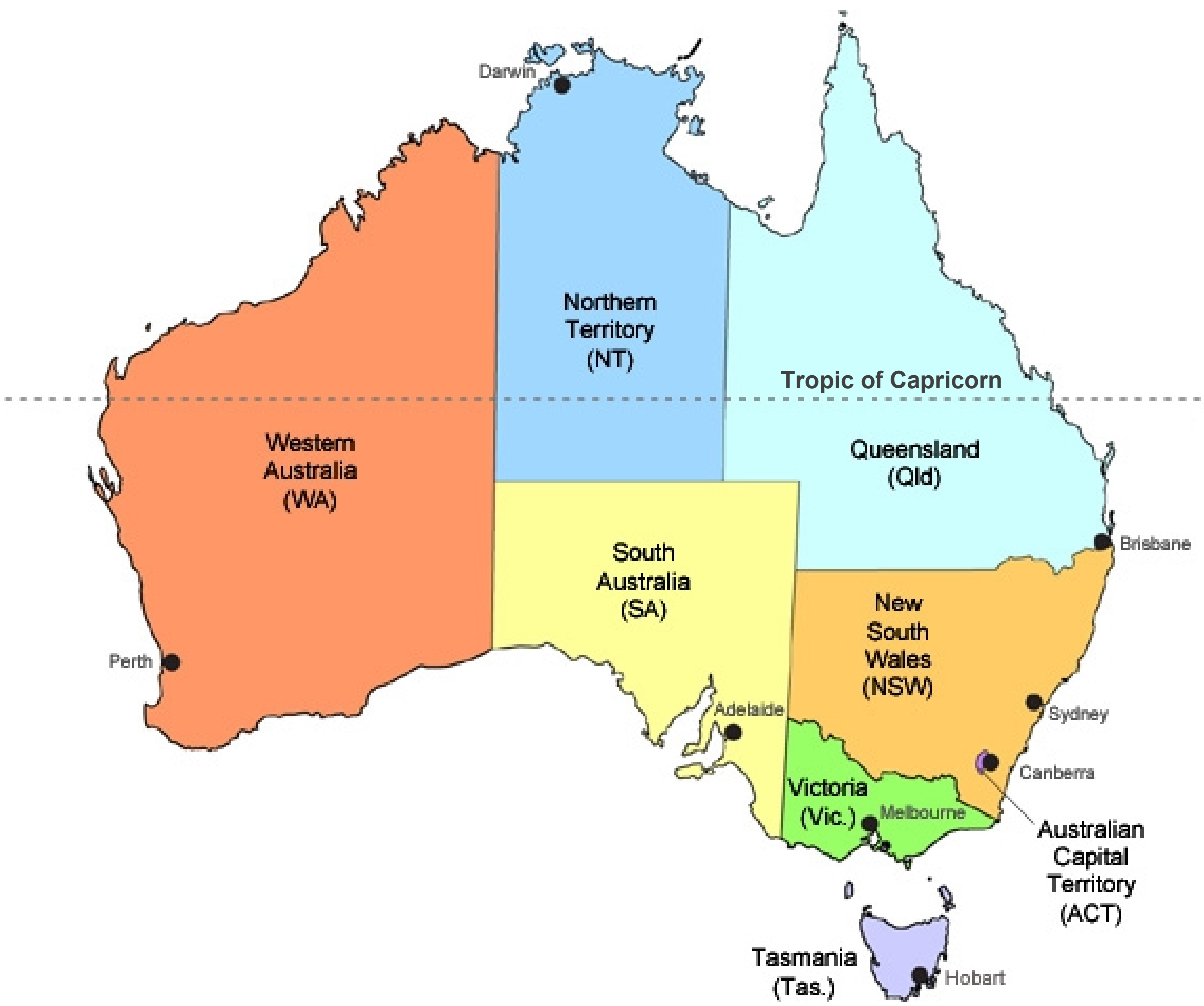

Acronyms and abbreviations

Term or abbreviation	Definition
ALOP	Appropriate level of protection
APPD	Australian Plant Pest Database (Plant Health Australia)
AQIS	Australian Quarantine and Inspection Service
BA	Biosecurity Australia
CABI	CAB International, Wallingford, UK
DAFF	Australian Government Department of Agriculture, Fisheries and Forestry
DAFWA	Department of Agriculture and Food, Western Australia
EPPO	European and Mediterranean Plant Protection Organization
FAO	Food and Agriculture Organization of the United Nations
ICON	AQIS Import Conditions database
IPC	International phytosanitary certificate
IPPC	International Plant Protection Convention
IRA	Import Risk Analysis
IRAAP	Import Risk Analysis Appeals Panel
ISPM	International Standard for Phytosanitary Measures
NPPO	National Plant Protection Organization
NPQS	National Plant Quarantine Service, Republic of Korea
NSW	New South Wales
NT	Northern Territory
pH	The measure of the acidity or alkalinity of a solution
PFA	Pest free area
PRA	Pest risk analysis
Qld	Queensland
SA	South Australia
SPS	Sanitary and phytosanitary
Tas.	Tasmania
Vic.	Victoria
WA	Western Australia
WTO	World Trade Organization

Abbreviations of units

Term or abbreviation	Definition
ºC	degree Celsius
cm	centimetre
g	grams
h	hour
ha	hectare
kg	kilogram
km	kilometre
m	metre
μ	micrometre (one millionth of a metre)
mm	millimetre
nm	nanometre (one billionth of a metre)
t	tonnes

Summary

Biosecurity Australia is undertaking an import risk analysis to assess a proposal from the Republic of Korea for market access to Australia for fresh 'paprika' fruit. In Australia, 'paprika' is known as capsicum.

Australia has existing quarantine policy that allows the importation of fresh capsicum fruit from New Zealand, the United States and Europe, subject to specific quarantine measures. The policy for fresh capsicum from the United States is currently on hold pending review.

This provisional final import risk analysis (IRA) report recommends that the importation of fresh capsicum (*Capsicum annuum*) fruit into Australia from registered export greenhouses in the Republic of Korea be permitted, subject to specific quarantine conditions.

The report identifies three thrips as pests that require risk management measures to manage the quarantine risk to a very low level in order to achieve Australia's appropriate level of protection (ALOP). The thrips are intonsa flower thrips, western flower thrips and melon thrips.

The report recommends a combination of risk management measures and an operational system, including:

- pre-export phytosanitary inspection and certification by the National Plant Quarantine Service of the Republic of Korea and on-arrival inspection by the Australian Quarantine and Inspection Service, and remedial action if any pests are detected
- an operational system to maintain and verify the quarantine status of consignments.

The report takes account of stakeholders' comments on the draft import risk analysis report issued in May 2008.

Western flower thrips has been identified as a quarantine pest for Tasmania and the Northern Territory and melon thrips has been identified as a quarantine pest for Western Australia, South Australia, Tasmania and the Northern Territory. The recommended quarantine measures take account of these regional differences.

This provisional final import risk analysis report is open to appeal for 30 days from publication. Stakeholders who believe there was a significant deviation from the IRA process set out in the *Import Risk Analysis Handbook 2007* that adversely affected their interests may appeal to the Import Risk Analysis Appeals Panel.

1 Introduction

1.1 Australia’s biosecurity policy framework

Australia's biosecurity policies aim to protect Australia against the risks that may arise from exotic pests[1] entering, establishing and spreading in Australia, thereby threatening Australia's unique flora and fauna, as well as those agricultural industries that are relatively free from serious pests.

The import risk analysis (IRA) process is an important part of Australia's biosecurity policies. It enables the Australian Government to formally consider the risks that could be associated with proposals to import new products into Australia. If the risks are found to exceed Australia’s appropriate level of protection (ALOP), risk management measures are proposed to reduce the risks to an acceptable level. However, if it is not possible to reduce the risks to an acceptable level, then no trade will be allowed.

Successive Australian Governments have maintained a conservative, but not a zero-risk, approach to the management of biosecurity risks. This approach is expressed in terms of Australia's ALOP, which reflects community expectations through government policy and is currently described as providing a high level of protection aimed at reducing risk to a very low level, but not to zero.

Australia’s IRAs are undertaken by Biosecurity Australia using teams of technical and scientific experts in relevant fields, and involve consultation with stakeholders at various stages during the process. Biosecurity Australia provides recommendations for animal and plant quarantine policy to Australia’s Director of Animal and Plant Quarantine (the Secretary of the Australian Department of Agriculture, Fisheries and Forestry). The Director, or delegate, is responsible for determining whether or not an importation can be permitted under the *Quarantine Act 1908*, and if so, under what conditions. The Australian Quarantine and Inspection Service (AQIS) is responsible for implementing appropriate risk management measures.

More information about Australia’s biosecurity framework is provided in Appendix C of this report and in the *Import Risk Analysis Handbook 2007* located on the Biosecurity Australia website www.biosecurityaustralia.gov.au.

1.2 This import risk analysis

1.2.1 Background

The National Plant Quarantine Service of the Republic of Korea (NPQS) formally requested market access for fresh greenhouse-grown ‘paprika’ (*Capsicum annuum* L.) fruit to Australia in a technical submission received in June 2006. The 2006 submission provided information on the pests associated with capsicum crops and the commercial production practices for fresh greenhouse-grown capsicum fruit produced in the Republic of Korea.

In Australia, when referring to fresh fruit of *C. annuum*, the word capsicum is commonly used and this term is used in this report.

[1] A pest is any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products (FAO 2009)

In June 2007, an officer from Biosecurity Australia visited production areas in the Republic of Korea to verify the commercial greenhouse production practices, packing house procedures and export processes for greenhouse-grown capsicum fruit for export.

On 18 March 2008 (BAA 2008/07), Biosecurity Australia advised stakeholders that this market access request would be progressed as a standard IRA, using the process described in the *Import Risk Analysis Handbook 2007*.

A draft IRA report (BAA 2008/14) was released in May 2008 for stakeholder comment. Comments received were considered and, where appropriate, the issues raised have been addressed in this provisional final IRA report. Stakeholder submissions on the draft report are available on the Biosecurity Australia website[2].

1.2.2 Scope

This IRA assesses the biosecurity risks associated with the importation into Australia of fresh capsicum fruit produced in greenhouses in the Republic of Korea and recommends quarantine measures for identified risks. The locations of existing capsicum greenhouses are listed in Section 3.2.1 and shown in Figure 3.1. The conclusions of this IRA will apply to current and any future greenhouse production areas in the Republic of Korea.

Fresh capsicum fruit is currently exported from greenhouses in the Republic of Korea to Japan, Canada and Taiwan. Details of the production processes for capsicum fruit grown in greenhouses in the Republic of Korea are set out in Section 3.

The fresh capsicum fruit will be exported with the calyx and a shortened peduncle attached. Pest risk assessments have taken this into account.

Seedborne viruses of capsicum that occur in the Republic of Korea but not in Australia have not been assessed beyond pest categorisation (Appendix A) in this IRA. Capsicum seed for planting is currently permitted entry into Australia from all countries, as described in Condition C11817 in the Australian Quarantine and Inspection Service (AQIS) import conditions (ICON) database[3]. Accordingly, it would be inconsistent with Australia's obligations under the World Trade Organization (WTO) Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) to consider measures for seedborne viruses carried in seed in fresh capsicum fruit imported for consumption when the risk pathway of capsicum seed for planting is currently permitted. The seedborne viruses not assessed further in this IRA are *Peanut stunt virus*, *Pepper mild mottle virus*, *Tobacco rattle virus* and *Tobacco ringspot virus*.

1.2.3 Existing policy

Australia currently permits the importation of fresh capsicum fruit from New Zealand, the United States of America and Europe. The policy for fresh capsicum from the United States is currently on hold pending review.

The conditions under which fresh capsicum fruit is permitted entry into Australia can be viewed on the AQIS import conditions (ICON) database.

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[2] www.biosecurityaustralia.gov.au
[3] http:www.aqis.gov.au/icon

1.2.4 Transition into the regulated process

The Australian Government announced changes to the IRA process on 18 October 2006. The new regulated process applies to all IRAs announced by Biosecurity Australia on or after the commencement of the *Quarantine Amendment Regulations 2007 (No.1)* on 5 September 2007.

On 12 September 2007, Biosecurity Australia announced in Biosecurity Australia Policy Memorandum (BAPM) 2007/20 the transitional arrangements for its current work program for import proposals. In the memorandum, stakeholders were advised that the import proposal for fresh capsicum fruit from the Republic of Korea would be finalised under the regulated IRA process. It also advised that previous work or comparable steps already completed would not be repeated under the regulated process.

On 18 March 2008, Biosecurity Australia announced in Biosecurity Australia Advice (BAA) 2008/07 the formal commencement of an IRA under the regulated process to consider the proposal to import fresh capsicum fruit from the Republic of Korea. It also advised that the analysis would be undertaken as a standard IRA requiring completion within 24 months. The IRA process is described in the *Import Risk Analysis Handbook 2007*.

Stakeholders were also advised that although the regulations allow a timeframe of 24 months to complete a standard IRA, in view of the significant body of work already undertaken, a draft report was expected to be released by 30 May 2008.

1.2.5 Contaminating pests

In addition to the pests of greenhouse-grown capsicum fruit in the Republic of Korea identified in this IRA, there are other organisms that may arrive with the fruit. These organisms could include pests of other crops or predators and parasitoids of other arthropods. Biosecurity Australia considers these organisms to be contaminating pests that could pose sanitary and phytosanitary risks. These risks are addressed by existing standard operational procedures.

1.2.6 Consultation

In May 2008, Biosecurity Australia released a draft IRA report for stakeholder consultation. Comments were received from six stakeholders. These were considered and, where appropriate, the issues raised have been addressed in this provisional final IRA report.

1.2.7 Next steps

This provisional final IRA report is open to appeal for 30 days from publication.

Stakeholders who believe there was a significant deviation from the IRA process set out in the *Import Risk Analysis Handbook 2007* that adversely affected their interests may appeal to the Import Risk Analysis Appeals Panel (IRAAP).

The appeals process is independent of Biosecurity Australia.

At the conclusion of the appeals process and after issues arising from the IRAAP process have been addressed, the Chief Executive of Biosecurity Australia will provide the final IRA report and recommendation for a policy determination to the Director of Animal and Plant Quarantine.

Further details of the appeals process may be found at Annex 6 of the *Import Risk Analysis Handbook 2007*.

The Director of Animal and Plant Quarantine will then make a determination. The determination provides a policy framework for decisions on whether or not to grant an import permit and any conditions that may be attached to a permit. A policy determination represents the completion of the IRA process.

2 Method for pest risk analysis

In accordance with the International Plant Protection Convention, the technical component of a plant IRA is termed a 'pest risk analysis' (PRA). Biosecurity Australia has conducted this PRA in accordance with the International Standards for Phytosanitary Measures (ISPMs), including ISPM 2: *Framework for Pest Risk Analysis* (FAO 2007) and ISPM 11: *Pest Risk Analysis for Quarantine Pests, including analysis of environmental risks and living modified organisms* (FAO 2004).

A PRA is 'the process of evaluating biological or other scientific and economic evidence to determine whether a pest should be regulated and the strength of any phytosanitary measures to be taken against it' (FAO 2009). A pest is 'any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products' (FAO 2009).

Quarantine risk consists of two major components, the probability of a pest entering, establishing and spreading in Australia from imports and the consequences should this happen. These two components are combined to give an overall estimate of the risk.

Unrestricted risk is estimated taking into account the existing commercial production practices of the exporting country and that minimal on-arrival verification procedures will apply. Restricted risk is estimated with phytosanitary measure(s) applied. A phytosanitary measure is 'any legislation, regulation or official procedure having the purpose to prevent the introduction and spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests' (FAO 2009).

A glossary of the terms used is provided at the back of this IRA report.

The PRA was conducted in the following three consecutive stages.

2.1 Stage 1: Initiation

Initiation identifies the pest(s) and pathway(s) that are of quarantine concern and should be considered for risk analysis in relation to the identified PRA area.

The initiation point for this PRA was the receipt of a technical submission from the National Plant Protection Organization (NPPO) for access to the Australian market for the commodity. This submission included information on the pests associated with the production of the commodity, including the plant part affected, and the existing commercial production practices for the commodity.

The pests associated with the crop and the exported commodity were tabulated from information provided by the NPPO of the exporting country, literature and database searches. This information is set out in Appendix A.

For this PRA, the 'PRA area' is defined as Australia for pests that are absent, or of limited distribution and under official control. For areas with regional freedom from a pest, the 'PRA area' may be defined on the basis of a state or territory of Australia or may be defined as a region of Australia consisting of parts of a state or territory or several states or territories.

For pests that have been considered by Biosecurity Australia in other risk assessments and for which import policies already exist, a judgement was made on the likelihood of entry of pests on the commodity and whether existing policy is adequate to manage the risks associated with its import. Where appropriate, the previous policy has been adopted.

2.2 Stage 2: Pest risk assessment

A pest risk assessment (for quarantine pests) is: 'the evaluation of the probability of the introduction and spread of a pest and of the likelihood of associated potential economic consequences' (FAO 2009).

In this PRA, pest risk assessment was divided into the following interrelated processes:

2.2.1 Pest categorisation

Pest categorisation identifies which of the pests identified in Stage 1 require a pest risk assessment. The categorisation process examines, for each pest, whether the criteria in the definition for a quarantine pest are satisfied. A 'quarantine pest' is a pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled, as defined in ISPM 5: *Glossary of phytosanitary terms* (FAO 2009).

The pests identified in Stage 1 were categorised using the following primary elements to identify the quarantine pests for the commodity being assessed:

- identity of the pest
- presence or absence in the PRA area
- regulatory status
- potential for establishment and spread in the PRA area
- potential for economic consequences (including environmental consequences) in the PRA area.

The results of pest categorisation are set out in Appendix A. The quarantine pests identified during pest categorisation were carried forward for pest risk assessment and are listed in Table 4.1.

2.2.2 Assessment of the probability of entry, establishment and spread

Details of how to assess the 'probability of entry', 'probability of establishment' and 'probability of spread' of a pest are given in ISPM 11 (FAO 2004). A summary of this process is given below, followed by a description of the qualitative methodology used in this IRA.

Probability of entry

The probability of entry describes the probability that a quarantine pest will enter Australia as a result of trade in a given commodity, be distributed in a viable state in the PRA area and subsequently be transferred to a host. It is based on pathway scenarios depicting necessary steps in the sourcing of the commodity for export, its processing, transport and storage, its utilisation in Australia and the generation and disposal of waste. In particular, the ability of the pest to survive is considered for each of these various stages.

The probability of entry estimates for the quarantine pests for a commodity are based on the use of the existing commercial production, packaging and shipping practices of the exporting country. Details of the existing commercial production practices for the commodity are set out in Section 3. These practices are taken into consideration by Biosecurity Australia when estimating the probability of entry.

For the purpose of considering the probability of entry, Biosecurity Australia divides this step of this stage of the PRA into two components:

Probability of importation: the probability that a pest will arrive in Australia when a given commodity is imported

Probability of distribution: the probability that the pest will be distributed, as a result of the processing, sale or disposal of the commodity, in the PRA area and subsequently transfer to a susceptible part of a host.

Factors considered in the probability of importation include:

- distribution and incidence of the pest in the source area
- occurrence of the pest in a life-stage that would be associated with the commodity
- volume and frequency of movement of the commodity along each pathway
- seasonal timing of imports
- pest management, cultural and commercial procedures applied at the place of origin
- speed of transport and conditions of storage compared with the duration of the lifecycle of the pest
- vulnerability of the life-stages of the pest during transport or storage
- incidence of the pest likely to be associated with a consignment
- commercial procedures (e.g. refrigeration) applied to consignments during transport and storage in the country of origin, and during transport to Australia.

Factors considered in the probability of distribution include:

- commercial procedures (e.g. refrigeration) applied to consignments during distribution in Australia
- dispersal mechanisms of the pest, including vectors, to allow movement from the pathway to a host
- whether the imported commodity is to be sent to a few or many destination points in the PRA area
- proximity of entry, transit and destination points to hosts
- time of year at which import takes place
- intended use of the commodity (e.g. for planting, processing or consumption)
- risks from by-products and waste.

Probability of establishment

Establishment is defined as the ‘perpetuation for the foreseeable future, of a pest within an area after entry’ (FAO 2009). In order to estimate the probability of establishment of a pest, reliable biological information (lifecycle, host range, epidemiology, survival, etc.) is obtained from the areas where the pest currently occurs. The situation in the PRA area can then be compared with that in the areas where it currently occurs and expert judgement used to assess the probability of establishment.

Factors considered in the probability of establishment in the PRA area include:

- availability of hosts, alternative hosts and vectors
- suitability of the environment
- reproductive strategy and potential for adaptation
- minimum population needed for establishment
- cultural practices and control measures.

Probability of spread

Spread is defined as 'the expansion of the geographical distribution of a pest within an area' (FAO 2009). The probability of spread considers the factors relevant to the movement of the pest, after establishment on a host plant or plants, to other susceptible host plants of the same or different species in other areas. In order to estimate the probability of spread of the pest, reliable biological information is obtained from areas where the pest currently occurs. The situation in the PRA area is then carefully compared with that in the areas where the pest currently occurs and expert judgement used to assess the probability of spread.

Factors considered in the probability of spread include:

- suitability of the natural and/or managed environment for natural spread of the pest
- presence of natural barriers
- the potential for movement with commodities, conveyances or by vectors
- intended use of the commodity
- potential vectors of the pest in the PRA area
- potential natural enemies of the pest in the PRA area.

Assigning qualitative likelihoods for the probability of entry, establishment and spread

In its qualitative PRAs, Biosecurity Australia uses the term 'likelihood' for the descriptors it uses for its estimates of probability of entry, establishment and spread. Qualitative likelihoods are assigned to each step of entry, establishment and spread. Six descriptors are used: high; moderate; low; very low; extremely low; and negligible (Table 2.1). Descriptive definitions for these descriptors and their indicative probability ranges are given in Table 2.1. The indicative probability ranges are only provided to illustrate the boundaries of the descriptors. These indicative probability ranges are not used beyond this purpose in qualitative PRAs. The standardised likelihood descriptors and the associated indicative probability ranges provide guidance to the risk analyst and promote consistency between different risk analyses.

Table 2.1: Nomenclature for qualitative likelihoods

Likelihood	Descriptive definition	Indicative probability (P) range
High	The event would be very likely to occur	$0.7 < P \leq 1$
Moderate	The event would occur with an even probability	$0.3 < P \leq 0.7$
Low	The event would be unlikely to occur	$0.05 < P \leq 0.3$
Very low	The event would be very unlikely to occur	$0.001 < P \leq 0.05$
Extremely low	The event would be extremely unlikely to occur	$0.000001 < P \leq 0.001$
Negligible	The event would almost certainly not occur	$0 \leq P \leq 0.000001$

The likelihood of entry is determined by combining the likelihood that the pest will be imported into the PRA area and the likelihood that the pest will be distributed within the PRA area, using a matrix of rules (Table 2.2). This matrix is then used to combine the likelihood of entry and the likelihood of establishment, and the likelihood of entry and establishment is then combined with the likelihood of spread to determine the overall likelihood of entry, establishment and spread.

For example, if the probability of importation is assigned a likelihood of 'low' and the probability of distribution is assigned a likelihood of 'moderate', then they are combined to give a likelihood of 'low' for the probability of entry. The likelihood for the probability of entry is then combined with the likelihood assigned to the probability of establishment (e.g. 'high') to give a likelihood for the probability of entry and establishment of 'low'. The likelihood for the probability of entry and establishment is then combined with the likelihood assigned to the probability of spread (e.g. 'very low') to give the overall likelihood for the probability of entry, establishment and spread of 'very low'.

Table 2.2: Matrix of rules for combining qualitative likelihoods

	High	**Moderate**	**Low**	**Very low**	**Extremely low**	**Negligible**
High	High	Moderate	Low	Very low	Extremely low	Negligible
Moderate		Low	Low	Very low	Extremely low	Negligible
Low			Very low	Very low	Extremely low	Negligible
Very low				Extremely low	Extremely low	Negligible
Extremely low					Negligible	Negligible
Negligible						Negligible

Time and volume of trade

One factor affecting the likelihood of entry is the volume and duration of trade. If all other conditions remain the same, the overall likelihood of entry will increase as time passes and the overall volume of trade increases.

Biosecurity Australia normally considers the likelihood of entry on the basis of the estimated volume of one year's trade. This is a convenient value for the analysis that is relatively easy to estimate and allows for expert consideration of seasonal variations in pest presence, incidence and behaviour to be taken into account. The consideration of the likelihood of entry, establishment and spread and subsequent consequences takes into account events that might happen over a number of years even though only one year's volume of trade is being considered. This difference reflects biological and ecological facts, for example where a pest or disease may establish in the year of import but spread may take many years.

The use of a one year volume of trade has been taken into account when setting up the matrix that is used to estimate the risk and therefore any policy based on this analysis does not simply apply to one year of trade. Policy decisions that are based on Biosecurity Australia's method that uses the estimated volume of one year's trade are consistent with Australia's policy on appropriate level of protection and meet the Australian Government's requirement for ongoing quarantine protection. Of course, if there are substantial changes in the volume and nature of the trade in specific commodities then Biosecurity Australia has an obligation to review the risk analysis and, if necessary, provide updated policy advice.

In assessing the volume of trade in this PRA, Biosecurity Australia assumed that a substantial volume of trade will occur.

2.2.3 Assessment of potential consequences

The objective of the consequence assessment is to provide a structured and transparent analysis of the likely consequences if the pests or disease agents were to enter, establish and spread in Australia. The assessment considers direct and indirect pest effects and their economic and environmental consequences. The requirements for assessing potential consequences are given in Article 5.3 of the SPS Agreement (WTO 1995), ISPM 5 (FAO 2009) and ISPM 11 (FAO 2004).

Direct pest effects are considered in the context of the effects on:

- plant life or health
- other aspects of the environment.

Indirect pest effects are considered in the context of the effects on:

- eradication, control, etc.
- domestic trade
- international trade
- environment.

For each of these six criteria, the consequences were estimated over four geographic levels, defined as:

Local: an aggregate of households or enterprises (a rural community, a town or a local government area).

District: a geographically or geopolitically associated collection of aggregates (generally a recognised section of a state or territory, such as 'Far North Queensland').

Regional: a geographically or geopolitically associated collection of districts in a geographic area (generally a state or territory, although there may be exceptions with larger states such as Western Australia).

National: Australia wide (Australian mainland states and territories and Tasmania).

For each criterion, the magnitude of the potential consequence at each of these levels was described using four categories, defined as:

Indiscernible: Pest impact unlikely to be noticeable.

Minor significance: Expected to lead to a minor increase in mortality/morbidity of hosts or a minor decrease in production but not expected to threaten the economic viability of production. Expected to decrease the value of non-commercial criteria but not threaten the criterion's intrinsic value. Effects would generally be reversible.

Significant: Expected to threaten the economic viability of production through a moderate increase in mortality/morbidity of hosts, or a moderate decrease in production. Expected to significantly diminish or threaten the intrinsic value of non-commercial criteria. Effects may not be reversible.

Major significance: Expected to threaten the economic viability through a large increase in mortality/morbidity of hosts, or a large decrease in production. Expected to severely or irreversibly damage the intrinsic 'value' of non-commercial criteria.

Values were translated into a qualitative impact score (A–G)[4] using Table 2.3.

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[4] In earlier qualitative IRAs, the scale for the impact scores went from A to F and did not explicitly allow for the rating 'indiscernible' at all four levels. This combination might be applicable for some criteria. In this report, the

Table 2.3: Decision rules for determining the consequence impact score

Impact score	Local	District	Regional	National
G	Major significance	Major significance	Major significance	Major significance
F	Major significance	Major significance	Major significance	Significant
E	Major significance	Major significance	Significant	Minor significance
D	Major significance	Significant	Minor significance	Indiscernible
C	Significant	Minor significance	Indiscernible	Indiscernible
B	Minor significance	Indiscernible	Indiscernible	Indiscernible
A	Indiscernible	Indiscernible	Indiscernible	Indiscernible
	Geographic level			

The overall consequence for each pest is achieved by combining the qualitative impact scores (A–G) for each direct and indirect consequence using a series of decision rules (Table 2.4). These rules are mutually exclusive, and are assessed in numerical order until one applies.

Table 2.4: Decision rules for determining the overall consequence rating for each pest

Rule	The impact scores for consequences of direct and indirect criteria	Overall consequence rating
1	Any criterion has an impact of 'G'; or more than one criterion has an impact of 'F'; or a single criterion has an impact of 'F' and each remaining criterion an 'E'.	Extreme
2	A single criterion has an impact of 'F'; or all criteria have an impact of 'E'.	High
3	One or more criteria have an impact of 'E'; or all criteria have an impact of 'D'.	Moderate
4	One or more criteria have an impact of 'D'; or all criteria have an impact of 'C'.	Low
5	One or more criteria have an impact of 'C'; or all criteria have an impact of 'B'.	Very Low
6	One or more but not all criteria have an impact of 'B', and all remaining criteria have an impact of 'A'.	Negligible

2.2.4 Estimation of the unrestricted risk

Once the above assessments are completed, the unrestricted risk can be determined for each pest or groups of pests. This is determined by using a risk estimation matrix (Table 2.5) to combine the estimates of the probability of entry, establishment and spread and the overall consequences of pest establishment and spread. Therefore, risk is the product of likelihood and consequence.

When interpreting the risk estimation matrix, note the descriptors for each axis are similar (e.g. low, moderate, high) but the vertical axis refers to likelihood and the horizontal axis refers to consequences. Accordingly, a 'low' likelihood combined with 'high' consequences,

impact scale of A-F has changed to become B-G and a new lowest category A ('indiscernible' at all four levels) was added. The rules for combining impacts in Table 2.4 were adjusted accordingly.

is not the same as a 'high' likelihood combined with 'low' consequences – the matrix is not symmetrical. For example, the former combination would give an unrestricted risk rating of 'moderate', whereas, the latter would be rated as a 'low' unrestricted risk.

Table 2.5: Risk estimation matrix

Likelihood of pest entry, establishment and spread						
High	Negligible risk	**Very low risk**	Low risk	Moderate risk	High risk	Extreme risk
Moderate	Negligible risk	**Very low risk**	Low risk	Moderate risk	High risk	Extreme risk
Low	Negligible risk	Negligible risk	**Very low risk**	Low risk	Moderate risk	High risk
Very low	Negligible risk	Negligible risk	Negligible risk	**Very low risk**	Low risk	Moderate risk
Extremely low	Negligible risk	Negligible risk	Negligible risk	Negligible risk	**Very low risk**	Low risk
Negligible	Negligible risk	Negligible risk	Negligible risk	Negligible risk	Negligible risk	**Very low risk**
	Negligible	**Very low**	**Low**	**Moderate**	**High**	**Extreme**
	Consequences of pest entry, establishment and spread					

2.2.5 Australia's appropriate level of protection (ALOP)

The SPS Agreement defines the concept of an 'appropriate level of sanitary or phytosanitary protection (ALOP)' as the level of protection deemed appropriate by the WTO Member establishing a sanitary or phytosanitary measure to protect human, animal or plant life or health within its territory.

Like many other countries, Australia expresses its ALOP in qualitative terms. Australia's ALOP, which reflects community expectations through government policy, is currently expressed as providing a high level of sanitary or phytosanitary protection aimed at reducing risk to a very low level, but not to zero. The band of cells in Table 2.5 marked 'very low risk' represents Australia's ALOP.

2.3 Stage 3: Pest risk management

Pest risk management describes the process of identifying and implementing phytosanitary measures to manage risks to achieve Australia's ALOP, while ensuring that any negative effects on trade are minimised.

The conclusions from pest risk assessment are used to decide whether risk management is required and if so, the appropriate measures to be used. Where the unrestricted risk estimate exceeds Australia's ALOP, risk management measures are required to reduce this risk to a very low level. The guiding principle for risk management is to manage risk to achieve Australia's ALOP. The effectiveness of any proposed phytosanitary measure (or combination of measures) is evaluated, using the same approach as used to evaluate the unrestricted risk, to ensure it reduces the restricted risk for the relevant pest or pests to meet Australia's ALOP.

ISPM 11 (FAO 2004) provides details on the identification and selection of appropriate risk management options and notes that the choice of measures should be based on their effectiveness in reducing the probability of entry of the pest.

Examples given of measures commonly applied to traded commodities include:

- options for consignments – e.g., inspection or testing for freedom from pests, prohibition of parts of the host, a pre-entry or post-entry quarantine system, specified conditions on preparation of the consignment, specified treatment of the consignment, restrictions on end-use, distribution and periods of entry of the commodity
- options preventing or reducing infestation in the crop – e.g., treatment of the crop, restriction on the composition of a consignment so it is composed of plants belonging to resistant or less susceptible species, harvesting of plants at a certain age or specified time of the year, production in a certification scheme
- options ensuring that the area, place or site of production or crop is free from the pest – e.g., pest-free area, pest-free place of production or pest-free production site
- options for other types of pathways – e.g., consider natural spread, measures for human travellers and their baggage, cleaning or disinfestation of contaminated machinery
- options within the importing country – e.g., surveillance and eradication programs
- prohibition of commodities – if no satisfactory measure can be found.

Risk management measures are identified for each quarantine pest where the risk exceeds Australia's ALOP. These are presented in the 'Pest Risk Management' section of this report.

3 The Republic of Korea's commercial production practices for greenhouse-grown capsicum fruit

3.1 Assumptions used to estimate unrestricted risk

In June 2007, an officer from Biosecurity Australia visited the Republic of Korea and verified the information on commercial production practices and post-harvest handling procedures for production of greenhouse-grown capsicum fruit in the Republic of Korea provided by NPQS (2006, 2007a, 2007b, 2008).

Biosecurity Australia considered the existing commercial production practices when it estimated the unrestricted risk of pests likely to be associated with fresh greenhouse-grown capsicum fruit imported from the Republic of Korea. NPQS informed Biosecurity Australia that the procedures observed during this visit are applied to all greenhouse-grown capsicums in the Republic of Korea. This visit clarified Biosecurity Australia's understanding of the cultivation and harvesting methods, pest control, and packing and transport protocols proposed to produce and export capsicum fruit to Australia.

3.2 Commercial production practices

The existing commercial production practices for greenhouse-grown capsicum fruit in the Republic of Korea involve the following steps: planning, seeding, raising of seedlings, planting of seedlings, cultivation, harvesting, transporting, warehousing, sorting, packing, and exporting.

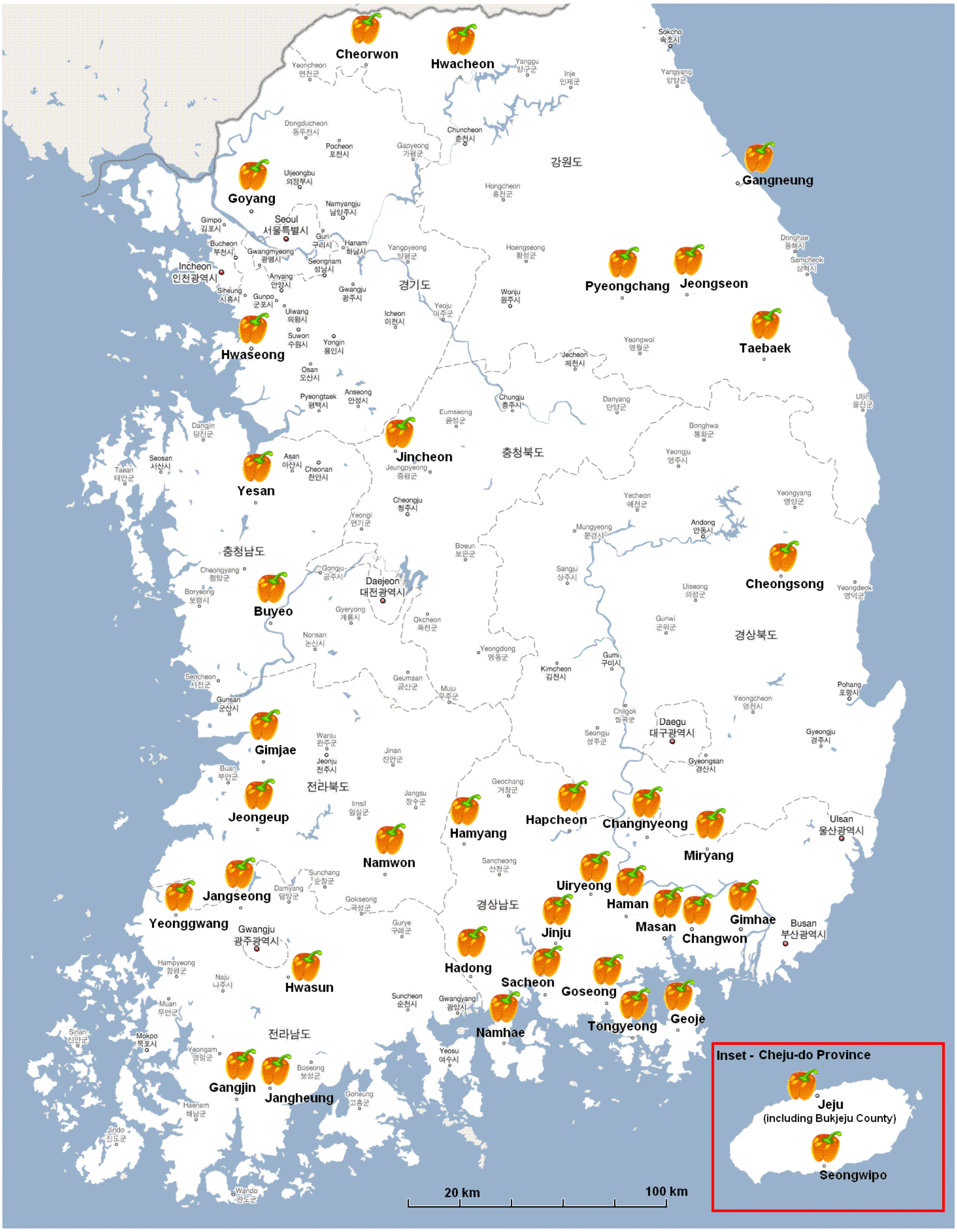
3.2.1 Production

Commercial production of greenhouse-grown capsicums in the Republic of Korea commenced in 1994. The economic returns saw the area of greenhouse production increase rapidly from 6.7 ha in 1997 to 264.8 ha in 2006. NPQS informed Biosecurity Australia that during the 1997 capsicum season, 320 t of fruit was produced, increasing to 7500 t in 2000 and 28 870 t in 2007. The production areas are shown in Figure 3.1.

The locations and areas of the greenhouses proposed to produce capsicum fruit for export to Australia are:

- Kangwon-do Province: Cheorwon, Hwacheon, Jeongseon and Pyeongchang Counties; Gangneung and Taebaek Cities (28.8 ha)
- Kyonggi-do Province: Goyang and Hwaseong Cities (4.6 ha)
- Chungchongbuk-do Province: Jincheon County (2.3 ha)
- Kyongsangbuk-do Province: Cheongsong County (3.7 ha)
- Kyongsangnam-do Province: Changnyeong, Goseong, Hadong, Haman, Hamyang, Hapcheon, Namhae and Uiryeong Counties; Changwon, Geoje, Gimhae, Jinju, Masan, Miryang, Sacheon and Tongyeong Cities (108.9 ha)
- Chollanam-do Province: Gangjin, Hwasun, Jangheung, Jangseong and Yeonggwang Counties (52.7 ha)
- Chollabuk-do Province: Gimjae, Jeongeup and Namwon Cities (52.3 ha)
- Cheju-do Province: Bukjeju County; Jeju and Seogwipo Cities (6.4 ha)
- Chungchongnam-do Province: Buyeo and Yesan Counties (5.1 ha).

Figure 3.1: Provinces, major cities and production areas for greenhouse-grown capsicum in the Republic of Korea



Source: Google™Earth (2009)

NPQS advised that capsicums are grown in greenhouses in the Republic of Korea to protect them from the elements. Monsoonal weather and particulate air pollution, especially airborne sand, would cause extensive damage to capsicums if they were not protected by a barrier.

NPQS also advised that the cultivars of capsicum fruit grown in greenhouses in the Republic of Korea and proposed for export to the Australian market include: red cultivars (‘Spirit’, ‘Special’, ‘Jubilee’, ‘Sprinter’, ‘Express’, ‘Cupra’, ‘Plenty’), yellow cultivars (‘Fiesta’, ‘Romeca’, ‘Maserati’, ‘Derby’, ‘RZ208’) and orange cultivars (‘Nassau’, ‘Emily’, ‘Boogie’, ‘President’, ‘Fellini’).

Capsicum seedlings and plants are cultured and grown in venlo-type greenhouses, single span vinyl houses and multispan vinyl houses (where by multispan vinyl houses consist of joined single span vinyl houses). Some greenhouses are fully automated with machines that monitor and maintain temperature and humidity, others are non-automated. The roofs of all types of greenhouses can be opened or closed to alter the light, temperature and humidity levels. Growing media such as rockwool, cowpeat and pearlite are used to grow capsicum fruit hydroponically. Figure 3.2 shows greenhouse production of capsicums near Gimjae City in Chollabuk-do Province, as observed by a Biosecurity Australia officer in 2007.

Figure 3.2: Venlo-type greenhouse capsicum production

Pest management practices in greenhouses in the Republic of Korea include:

- removing waste material such as dead/dying vegetation and malformed, diseased or pest damaged capsicum fruit
- adjusting environmental conditions (temperature and humidity) to reduce the likelihood of fungal diseases
- spraying relevant pesticides, when required, for arthropod pests
- applying biocontrol agents to target arthropod pests.

Upon entering a greenhouse, staff step on mats soaked in fungicide to reduce the chance of introducing pathogens into the greenhouse. Insects are monitored and controlled around greenhouses by the use of yellow sticky traps to attract some families of Diptera and Hymenoptera and fluorescent light traps that attract some species of Lepidoptera and other flying insects.

Biocontrol agents have been introduced into many greenhouses, for the control of thrips and mites, to supplement pesticide use. Farmers that supply packing houses with capsicum fruit are required to provide records of the pesticides and biocontrol agents used. These records are maintained by the packing houses. Biocontrol agents are reared, delivered to greenhouses and monitored by private companies. Consultants from these companies visit the greenhouses weekly to monitor the use and effectiveness of biocontrol agents. Mite species used as biocontrol agents are deployed using medical tape, with mites attached, stuck to leaves of the capsicum plant. Parasitic wasps are released in small boxes of sawdust attached to the stem of capsicum plants. The predatory mites *Amblyseius swirskii*, *Neoseiulus californicus*, *N. cucumeris* and *Phytoseiulus persimilis*, the pirate bug *Orius laevigatus* and the parasitic wasps *Aphidius colemani*, *A. ervi*, *Encarsia formosa* and *Eretmocerus eremicus* are used in the Republic of Korea as biocontrol agents.

3.2.2 Cultivation practices

In early July, capsicum seed from the Netherlands is germinated in polystyrene trays filled with growing medium in a greenhouse. The growing medium is also imported from the Netherlands. Germination temperatures are 29–30 °C, with relative humidity maintained at approximately 70 %. Once germinated, seedlings are moved into 10 cm^3 units of growing medium. The production beds with the irrigation system and growing medium are prepared for planting (Figure 3.3). When the seedlings are large enough they are moved to the main cultivation area of the greenhouse in early September (Figure 3.4). During the day, the cultivation temperature in greenhouses is maintained with air-conditioners at 21 °C. At night, the temperature is allowed to fall below this. Humidifiers maintain relative humidity at 70 % all year round.

Figure 3.3: Irrigation system and growing medium ready for planting

Figure 3.4: Seedlings being planted in the main cultivation greenhouse

Fruit development begins in October, two to three months after seedlings have established. Fruit is harvested from November until early July of the following year (about 9 months). Capsicums are harvested manually by cutting the peduncle and leaving the calyx on the fruit (Figure 3.5). At the end of the growing season (July/August) the facility is cleaned and disinfected and is ready for planting the next season's capsicum plants in September.

Figure 3.5: Capsicums being harvested at a greenhouse near Namwon City, Chollabuk-do Province

3.2.3. Post-harvest handling

After harvest, capsicums are transported directly to the packing house. Large production areas have their own packing houses (Figure 3.6). Small production areas transport capsicum fruit to the packing house in wing-trucks (which can be loaded from both sides) or covered trucks, which both have cold storage facilities.

Figure 3.6: Packing house for capsicums near Gimjae City in Chollabuk-do Province

3.2.4. Packing house procedures

At the packing house, capsicum fruit is cleaned using brushes and compressed air and sorted by variety and size. During post-harvest handling, chemical treatments are not applied. For export, capsicums are sorted as follows: small (130–150 g), medium (150–170 g), large (170–220 g) and extra large (>220 g). Infested, infected and otherwise damaged capsicums are rejected during the sorting process. Premium capsicums for export are packed into 5 kg boxes (Figure 3.7). Packing boxes have holes to allow the capsicums to breathe (Figure 3.7).

Premium capsicums for the domestic market are bagged in pairs, in breathable polythene bags and placed in plastic trays (Figure 3.8). Standard capsicums for the domestic market are also bagged in pairs and packed into 10 kg boxes. The schematic layout of a packing house processing capsicums for the domestic market and for export is detailed in Figure 3.11.

Figure 3.7: Capsicums boxed for export

Figure 3.8: Premium capsicums for the domestic market

3.2.5. Export

More than 90 % of the Republic of Korea's total capsicum exports are to Japan (99.87 % in 2006). NPQS provided information that between 1996 and 2006, exports to Japan increased from 234 t to 13 881 t, representing a 59-fold increase. A total of 13 899 t were exported from the Republic of Korea in 2006, of which 13 881 t were exported to Japan, 11 t to Canada, 5 t to Taiwan and the remaining 2 t to other countries.

Capsicums are stored at a temperature between 16-18 °C prior to export. Generally, fresh capsicums are transported in containers to export ports. Wing and covered trucks with cold storage facilities are used. For the Japanese market, capsicums are shipped from the Republic of Korea in refrigerated containers; the voyage takes about 5 hours. The Republic of Korea proposes air transport at 12 °C for export of capsicums to Australia.

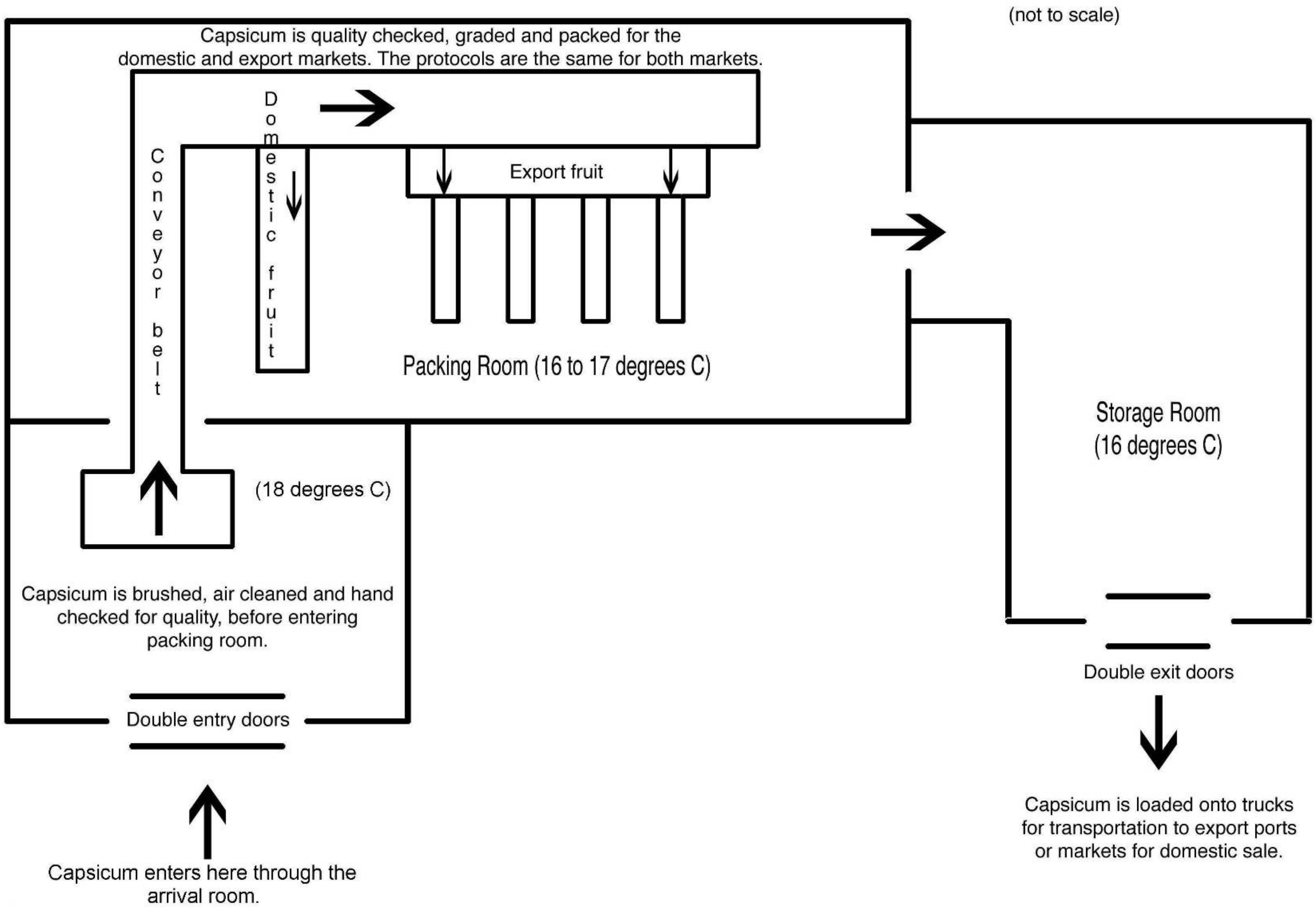
Boxes of capsicum fruit for export are labelled with the packing house identity code, year of production, commodity code, area code and farmer's individual identification code to allow traceback to the source farm.

Capsicum fruit for export is visually inspected for pests and diseases by trained NPQS officers (Figures 3.9, 3.10). Capsicums free from pests are cleared for export. A phytosanitary certificate is issued for cleared consignments.

Figure 3.9: NPQS officer inspecting a capsicum externally for export

Figure 3.10: NPQS officer inspecting a capsicum internally for export

Figure 3.11 Schematic layout of a packing house



4 Pest risk assessments for quarantine pests

4.1 Quarantine pests for pest risk assessment

Pest categorisation (Appendix A) identified eight quarantine pests associated with fresh greenhouse-grown capsicum fruit from the Republic of Korea. These quarantine pests are listed in Table 4.1.

Table 4.1: Quarantine pests for fresh greenhouse-grown capsicum fruit from the Republic of Korea

The relevant state or territory for pests of regional concern are shown in parentheses.

Pest	Common name
Armoured scales [Hemiptera: Diaspididae]	
Pseudaulacaspis pentagona (Targioni Tozzetti, 1886) (WA)	White peach scale
Thrips [Thysanoptera: Thripidae]	
Frankliniella intonsa (Trybom, 1895)	Intonsa flower thrips
Frankliniella occidentalis (Pergande, 1895) (Tas., NT)	Western flower thrips
Thrips palmi Karny, 1925 (WA, SA, Tas., NT)	Melon thrips
Viruses	
Chilli veinal mottle virus	Chilli veinal mottle
Pepper mottle virus	Pepper mottle
Pepper vein chlorosis virus	Pepper vein chlorosis
Pepper vein mosaic virus	Pepper vein mosaic

The estimated likelihoods and consequences of entry, establishment and spread for these quarantine pests are presented in this section. The results are summarised in Table 4.2, together with the overall estimates of unrestricted risk. The rationale for each value of the pest risk assessment, summarised in this table, is described in the relevant sections below.

4.2 White peach scale

Pseudaulacaspis pentagona

(of regional quarantine concern to Western Australia)

4.2.1 Introduction

Pseudaulacaspis pentagona (white peach scale) is an armoured scale. Armoured scales are sessile, small (2–4 mm long), and inconspicuous as their body is covered with a hard, waxy 'armour'. The armour covers adult females and immature males. First instars or crawlers are mobile and are the dispersal stage. The reproductive rates for armoured scales are temperature dependent and more generations are produced in warmer climates.

4.2.2 Probability of entry

Probability of importation

The likelihood that *P. pentagona* will arrive in Western Australia with the importation of fresh greenhouse-grown capsicum fruit from the Republic of Korea is: **MODERATE**.

- *Pseudaulacaspis pentagona* is associated with fresh capsicum fruit in the Republic of Korea (Ben-Dov *et al*. 2009; CABI 2007).
- This species generally infests woody tissue, such as twigs, branches and the trunks of hosts (Hanks and Denno 1993 as cited in Hanks and Denno 1994), but will also feed on fruit (Ben-Dov *et al*. 2009; CABI 2007).
- A high prevalence of *P. pentagona* on the surface of fruit has been reported to cause quarantine problems for Hawaiian papaya (Follett 2006). However, greenhouse production of capsicums provides some protection from armoured scales.
- Armoured scales are small and may be difficult to detect, particularly in low numbers. Adult female *P. pentagona* measure 2–2.5 mm in length; males are 0.7 mm in length (Branscome 2008).
- First instar nymphs (or crawlers) are capable of moving onto fruit where they permanently attach and commence feeding (Mopper and Strauss 1998). Subsequent developmental stages and adult females are sessile (Beardsley and Gonzalez 1975).
- Armoured scales have a relatively hard, impermeable, external covering or 'scale' (Smith *et al.* 1997) that can protect them from physical and chemical damage (Foldi 1990). Therefore, commercial fruit cleaning procedures may not eliminate all viable scales present on the fruit surface (Taverner and Bailey 1995).
- The development threshold for *P. pentagona* is 9.8 °C. At 15 °C this species has a fecundity rate of almost 19 crawlers per female and a generation time of 97.42 days (Abbasipour 2007). Females begin to lay eggs and hatching peaks at 10.5 °C and 10.9 °C, respectively. Capsicum fruit is packed and stored at 16–18 °C and shipped for export at 12 °C. In the event that *P. pentagona* is present on fruit, the scale could survive transport to Australia.

A preference for woody plant parts and the security provided by a greenhouse facility are limiting factors for the importation of *P. pentagona.* However, there is a known association of the pest with the pathway at its origin, the species is likely to survive post-harvest cleaning procedures and transport to Australia, and may escape detection during routine visual inspection due to its small size. Therefore a probability rating of 'moderate' is allocated.

Probability of distribution

The likelihood that *P. pentagona* will be distributed to Western Australia in a viable state and transferred to a susceptible part of a host, as a result of the processing, sale or disposal of fresh greenhouse-grown capsicum fruit from the Republic of Korea is: **LOW**.

- Capsicum would be distributed for sale to various destinations across Western Australia.
- *Pseudaulacaspis pentagona* is likely to survive local storage and transportation because it can tolerate cold temperatures and overwinters at various stages of growth. In temperate countries, adult female *P. pentagona* survive temperatures as low as -20 °C, although there is high mortality at such low temperatures (MacLeod 2007).
- Although the intended use is human consumption, some waste will be generated. Wholesalers, retailers or consumers could discard of infested fruits at multiple locations within the PRA area.
- Disposal of waste is likely to be via commercial or domestic rubbish systems; some fruit waste may be disposed of in the home garden. Therefore, a portion of the pests that enter the PRA area are likely to reach areas of host abundance.
- *Pseudaulacaspis pentagona* is highly polyphagous and has been recorded from hosts belonging to 115 genera across 55 plant families (Watson 2009). Commercially grown hosts include *Malus* spp. (apples), *Prunus* spp. (stonefruit), *Pyrus* spp. (pears) *Ribes* spp. (currants), *Rubus* spp. (blackberry, raspberry), *Vitis* spp. (grape) and *Nerium* spp. (oleander).
- Hosts are widely distributed in Western Australia (FloraBase 2009). Thus, there is a good chance that *P. pentagona* would locate a suitable host to infest.
- There are two principal means by which armoured scales may transfer to a suitable host: active dispersal of crawlers and the action of wind (Malumphy *et al.* 2007). Birds, insects and other animals, including humans, may also act as vectors (Beardsley and Gonzalez 1975).
- The period of crawler mobility is limited by their small energy reserves and need to settle and feed. Crawlers remain active for up to 24 hours and disperse mostly within plants (Hanks and Denno 1994).
- Aerial dispersal of crawlers tends to be laterally and downward with the vast majority of crawlers perishing on the ground. Additionally, wind dispersal of crawlers is initiated from above-ground plant parts and is unlikely to be successful from discarded fruit waste (Mopper and Strauss 1998).
- Dispersal between hosts separated by more than 100 m is negligible (Mopper and Strauss 1998).

The limited mobility of first instar crawlers and disposal of most waste by municipal garbage collection support a risk rating for distribution of ‘Low’.

Probability of entry (importation × distribution)

The likelihood that *P. pentagona* will enter Western Australia and be transferred in a viable state to a susceptible host, as a result of trade in fresh greenhouse-grown capsicum fruit from the Republic of Korea, is: **LOW**.

4.2.3 Probability of establishment

The likelihood that *P. pentagona* will establish in Western Australia, based on a comparison of factors in the source and destination areas considered pertinent to its survival and reproduction, is: **HIGH**.

- *Pseudaulacaspis pentagona* is of East Asian origin and now experiences a cosmopolitan distribution (Watson 2009).
- This species requires temperatures over 9.8 °C for development (Abbasipour 2007). Females are able to overwinter and can survive temperatures as low as -20 °C (MacLeod 2007).
- There are similar climatic regions in Western Australia to parts of the world where *P. pentagona* is present that would be suitable for the establishment of this species (Peel *et al.* 2007).
- *Pseudaulacaspis pentagona* is already established in eastern Australia (Ben-Dov *et al.* 2009), further demonstrating the suitability of the Australian environment for the establishment of this species.
- Furthermore, hosts of *P. pentagona* are widely distributed within these climatic regions in Western Australia (Peel *et al.* 2007; FloraBase 2009).
- Scales feed externally on their hosts and existing pest management practices such as pesticide application may impact the establishment of *P. pentagona* in Western Australia. Scales are often controlled by predators such as small parasitic wasps and beetles (Dreistadt *et al.* 1994).
- Chemical controls in commercial orchards may impact on the establishment of *P. pentagona*, but would not be applied in all the environments where this species would be present, particularly in urban environments (Dreistadt *et al.* 1994).
- Reproduction in *P. pentagona* is sexual—i.e. requiring a male and a female (Brown and Bennett 1957).
- Adult males represent a short-lived reproductive phase; adult male *P. pentagona* live for only one day (Branscome 2008). Adult males lack functional mouthparts and cannot feed (Beardsley and Gonzalez 1975).
- Adult males are winged and capable of weak flight, but this is generally limited to passive downward dispersal (Hanks and Denno 1993 as cited in Hanks and Denno 1994).
- Adult female *P. pentagona* release sex pheromones to attract flying males (Drees and Jackman 1999). This increases the chances of individuals being able to find a suitable mate, even at low densities.
- Females lay approximately 100 eggs beneath their waxy scale cover about two weeks after mating, and continue to oviposit for 8 or 9 more days (Branscome 2008).
- Crawlers emerge from the eggs within 3–5 days (Watson 2009), but observations in Texas suggest that it may take between 30 and 60 days (Drees and Jackman 1999).
- Female *P. pentagona* undergo two moults before reaching maturity (Branscome 2008). The duration of the instar stages are 7–8 days and 12 days respectively (Drees and Jackman 1999).
- Males undergo five moults before becoming adults (Branscome 2008).
- Development time from egg to adult is reportedly 35–40 days (Drees and Jackman 1999). However the generation time is significantly longer (97–98 days) at 15 °C (Abbasipour 2007).

- There may be as many as four generations per year depending on climate (Branscome 2008; Watson 2009).

The large number of host plants, adaptability over a wide climatic range and short lifecycle support a risk rating for establishment of *P. pentagona* of 'high'.

4.2.4 Probability of spread

The likelihood that *P. pentagona* will spread in Western Australia, based on a comparison of those factors in source and destination areas considered pertinent to the expansion of the geographic distribution of the pest, is: **MODERATE**.

- *Pseudaulacaspis pentagona* has been reported from a variety of environments (CABI 2007; Watson 2009). There are similarities in the natural and urban environments of these areas with those in Western Australia, which would be suitable for the spread of this species (Peel *et al.* 2007; FloraBase 2009).
- Host plants that support the spread of *P. pentagona* are widely distributed in commercial orchards, suburban and rural environments in Western Australia (FloraBase 2009). Hosts include some 115 genera across 55 plant families (Watson 2009).
- The spread of *P. pentagona* is strongly influenced by climatic conditions, particularly temperature, humidity and rainfall (Beardsley and Gonzalez 1975). Temperature influences both the initiation and rate of crawling, as well as crawler survival. Low humidity and extreme temperatures limit the establishment and spread of Diaspididae species (Beardsley and Gonzalez 1975).
- The dry conditions towards inland Australia are therefore predicted to limit the spread of *P. pentagona* in Australia.
- *Pseudaulacaspis pentagona* lack active long-range dispersal mechanisms.
- Crawlers are the primary dispersal stage of the lifecycle and can disperse by active movement or by wind (Malumphy *et al.* 2007). Birds, insects and other animals, including humans, may also act as vectors (Beardsley and Gonzalez 1975).
- The period of crawler mobility is limited by their small energy reserves and need to settle and feed. Crawlers remain active for up to 24 hours and disperse mostly within plants (Hanks and Denno 1994).
- Aerial dispersal of crawlers tends to be laterally and downward with the vast majority of crawlers perishing on the ground (Mopper and Strauss 1998).
- Dispersal between hosts separated by more than 100 m is negligible (Mopper and Strauss 1998).
- Dispersal (particularly long distance dispersal) of sessile adults and eggs occurs almost entirely through human transport of infested plant material.
- Adults and nymphs of armoured scales may be moved within and between orchards (or other commercial production sites) with the movement of infested plant material, equipment and personnel (Dreistadt *et al.* 1994).
- Movement of infested planting material or produce is the main cause of armoured scales being introduced to other countries (Beardsley and Gonzalez 1975).
- Across its range, *Pseudaulacaspis pentagona* is attacked by a large number of parasitoids and predators (CABI 2007). Several of these species are present in Australia: *Chilocorus circumdatus* (Gyllenhal), *Exochomus quadripustulatus* (Linnaeus), *Rhyzobius lophanthae* (Blaisdell) (Coleoptera: Coccinellidae); *Aphytis chilensis* Howard, *Aphytis proclia*

(Walker) *Encarsia lounsburyi* (Berlese & Paoli) and *E. citrina* Craw (Hymenoptera: Aphelinidae).

- In the natural environment, these parasitoids and predators reduce the spread of *P. pentagona* by keeping populations numbers down (CABI 2007). However, broad spectrum insecticides applied to control scales and other arthropods in commercial orchards reduce population numbers of natural enemies causing local outbreaks (Dreistadt *et al.* 1994; CABI 2007).
- The efficiency of natural enemies is also reduced in urban areas by pollution. Consequently, *P. pentagona* readily spreads amongst ornamental plants in towns and cities (CABI 2007).

Pseudaulacaspis pentagona has expanded its distribution across numerous climatic zones and has a wide host range to support spread. However, the lack of an active long-range dispersal mechanism and high mortality in the crawler stage are significant limiting factors. Therefore a spread rating of 'moderate' is allocated.

4.2.5 Probability of entry, establishment and spread

The likelihood that *P. pentagona* will be imported as a result of trade in fresh greenhouse-grown capsicum fruit from the Republic of Korea, be distributed in a viable state to a susceptible host, establish and spread within Western Australia, is: **LOW**.

4.2.6 Consequences

Assessment of the potential consequences (direct and indirect) of *P. pentagona* for Western Australia is: **LOW**.

Criterion	Estimate and rationale
Direct	
Plant life or health	**Impact score**: D – significant at the district level *Pseudaulacaspis pentagona* is highly polyphagous, and host plants are common in Western Australia (e.g. *Vitis* and *Acacia* spp.) (Florabase 2009). Hosts of *P. pentagona* include numerous crop plants, garden plants and amenity trees in tropical, subtropical and some temperate regions (Bobb *et al.* 1973; Ball 1980; Yasuda 1983; Kaneko *et al.* 2006; Abbasipour 2007; Malumphy *et al.* 2007). Commercially important *Vitis* spp. are major hosts of this pest (CABI 2007). The highly polyphagous nature of this species means there is potential for many plant genera and species to be attacked, including some rare and threatened species. – For example, several species in the genus *Acacia*, which are minor hosts of this pest (CABI 2007), are considered rare in Western Australia (Florabase 2009). *Pseudaulacaspis pentagona* causes direct damage to fruit, leaves and bark (Branscome 2008). – Fruit is disfigured by the appearance of the scales, and toxins in their saliva cause depressions, discolorations and other distortions of host tissues (Beardsley and Gonzalez 1975; Kosztarab 1990). – Defoliation, splitting of bark, stem dieback and an overall decline in host plant health, sometimes leading to death, may follow if the infestation is heavy (Beardsley and Gonzalez 1975; Smith *et al.* 1997).
Other aspects of the environment	**Impact score**: B – minor significance at the local level There are no known direct consequences of *P. pentagona* on other aspects of the environment. When introduced into a new environment they will undoubtedly compete for resources with the native species.

Indirect	
Eradication, control etc.	**Impact score**: D – significant at the district level Additional programs to eradicate this species from its hosts may be necessary. Existing control programs may be effective for some hosts (e.g. broad spectrum pesticide applications). Existing integrated pest management programs may be disrupted because of the need to re-introduce or increase the use of organophosphate insecticides. This may result in a subsequent increase in the cost of production. Additionally, costs for crop monitoring and consultant's advice to manage this pest may be incurred by the producer. Increased insecticide usage may have non-target affects on the environment. For example, broad spectrum insecticides applied to control scales and other arthropods in commercial orchards are known to reduce population numbers of natural enemies (Dreistadt *et al.* 1994).
Domestic trade	**Impact score**: A – indiscernible at the local level *Pseudaulacaspis pentagona* is present in Australia, except for Western Australia. Hence, the introduction of this pest into commercial production areas in Western Australia would not have a significant effect on interstate trade.
International trade	**Impact score**: C – significant at the local level The presence of *P. pentagona* in commercial production areas of a range of commodities would have a significant effect at the local level due to limitations of accessing international markets where these pests are absent.
Environmental and non-commercial	**Impact score**: B – minor significance at the local level There are no known indirect environmental and non-commercial consequences of *P. pentagona* introduction to Western Australia. There will undoubtedly be a minor impact on the environment arising from reductions in native plant health.

4.2.7 Unrestricted risk estimate

The unrestricted risk for *P. pentagona* is: **VERY LOW**.

Unrestricted risk is the result of combining the probability of entry, establishment and spread with the outcome of overall consequences. Probabilities and consequences are combined using the risk estimation matrix shown in Table 2.5.

The unrestricted risk estimate for *P. pentagona* of 'very low' achieves Australia's ALOP. Therefore, specific risk management measures are not required for this pest.

4.3 Thrips

Frankliniella intonsa; Frankliniella occidentalis; Thrips palmi***

(*of regional quarantine concern to Tasmania and the Northern Territory; **of regional quarantine concern to Western Australia, South Australia, Tasmania and the Northern Territory)

4.3.1 Introduction

Some Thysanoptera (thrips) species are pests of commercial crops, due to the damage they cause feeding on developing flowers, leaves and fruit (CABI 2007). Their mouthparts are used to rupture and imbibe fluids from plant cells, causing scarring that can reduce crop yield, productivity and marketability (CSIRO 1991). They can also transmit tospoviruses while feeding (CABI 2007). Thrips are opportunistic, well adapted to surviving difficult conditions, and capable of tolerating temperatures below freezing over extended periods (McDonald *et al.* 1997).

The thrips considered in this import risk assessment are *Frankliniella intonsa*, *Frankliniella occidentalis* and *Thrips palmi*. These species have been grouped together because of their related biology and taxonomy. They are predicted to pose a similar risk and require similar mitigation measures. In this pest risk assessment, the term 'thrips' is used to refer to these species, unless otherwise specified.

Frankliniella intonsa, *F. occidentalis* and *Thrips palmi* were previously assessed in the *Provisional final import risk analysis report for fresh unshu mandarin fruit from Japan* (Biosecurity Australia 2009). The assessment of thrips presented here builds on the previous assessment.

The probability of importation for thrips was rated as 'high' in the pest risk assessment conducted in the unshu mandarin IRA (Biosecurity Australia 2009).

The distribution of thrips with capsicums, after arrival in Australia, is not considered to be significantly different to their distribution with unshu mandarins. Similarly, once thrips have entered Australia and transferred to a suitable host, the commodity on which they are imported is not likely to affect the probability of establishment, spread, or consequences. Accordingly, there is no need to re-assess these components. However, differences in production practices, climatic conditions and prevalence of the pests in the exporting country make it necessary to re-assess the likelihood of thrips entering Australia with trade in fresh greenhouse-grown capsicum fruit from the Republic of Korea.

4.3.2 Reassessment of probability of importation

Probability of importation

The likelihood that the thrips assessed will arrive in Australia with the importation of fresh greenhouse-grown capsicum fruit from the Republic of Korea is: **HIGH**.

- Thrips are associated with fresh capsicum fruit in Korea (NPQS 2006).
- Thrips are small and inconspicuous, and may escape detection, particularly in low numbers. Adult thrips are only 1.3 mm long (Pernezny *et al.* 2003; QDPIF 2005b). Eggs of *Frankliniella* spp. are small (about 200 μ long) and may be laid on, or under the skin of fruit.

- Damage may appear as scratches, bronzing or silvering of the fruit (CABI 2007), which at low levels would be difficult to detect.
- Thrips are cold tolerant and may survive low temperatures during storage and transport (CABI 2007). For example, *T. palmi* is able to survive temperatures as low as –3–7 °C (Nagai and Tsumuki 1990).
- The lifespan of *F. intonsa* adults is up to 49 days (CABI 2007) which exceeds the packing and transport period (refer to *Export*, Chapter 3).

The cold tolerance, lifespan, small size and cryptic nature of thrips, and their association with fresh capsicum fruit, all support a risk rating for importation of 'high'.

4.3.3 Probability of distribution, of establishment and of spread

As indicated above, the probability of distribution, establishment and of spread for thrips will be the same as those assessed for unshu mandarins from Japan (Biosecurity Australia 2009). The ratings from the previous assessments are presented below:

Probability of distribution:	**MODERATE**
Probability of establishment:	**HIGH**
Probability of spread:	**HIGH**

4.3.4 Overall probability of entry, establishment and spread

The likelihood that thrips will be imported as a result of trade in fresh greenhouse-grown capsicum fruit from the Republic of Korea, be distributed in a viable state to a susceptible host, establish and spread within Australia, is: **MODERATE**.

4.3.5 Consequences

The consequences of the establishment of thrips have been estimated previously for unshu mandarins from Japan (Biosecurity Australia 2009). This estimate of impact scores is provided below:

Plant life or health:	**D** – significant at the district level
Other aspects of the environment:	**B** – minor significance at the local level
Eradication, control, etc.:	**D** – significant at the district level
Domestic trade:	**D** – significant at the district level
International trade:	**D** – significant at the district level
Environment:	**B** – minor significance at the local level

Based on the decision rules described in Table 2.4, that is, where the consequences of a pest with respect to one or more criteria are '**D**', the overall consequences are estimated to be: **LOW**.

4.3.6 Unrestricted risk estimate

The unrestricted risk estimate for *Frankliniella intonsa*, *F. occidentalis and Thrips palmi* is: **LOW**.

Unrestricted risk is the result of combining the probability of entry, establishment and spread with the outcome of overall consequences. Probabilities and consequences are combined using the risk estimation matrix shown in Table 2.5.

The unrestricted risk estimate for thrips of 'low' exceeds Australia's ALOP. Therefore, specific risk management measures are required for these pests. These are outlined in Chapter 5.

4.4 Pepper vein chlorosis and pepper vein mosaic viruses

Pepper vein chlorosis virus, Pepper vein mosaic virus

4.4.1 Introduction

Two viruses detected in *Capsicum annuum* in the Republic of Korea have been partially characterised. Pepper vein chlorosis virus (PepVCV) was isolated from plants with necrotic stems and leaves with chlorotic veins (Kim *et al*. 1990a, 1990b, 1991). Some plants lost leaves, buds died, and stems with necrosis withered. Pepper vein mosaic virus (PepVMV) was isolated from plants with chlorotic veins and mosaic patterns on the leaves (Kim *et al*. 1991). Isolates of both viruses were experimentally transmitted in a non-persistent manner by the aphid *Myzus persicae*. Non-persistent transmission, also known as stylet-borne transmission, is the most common form of transmission by aphid vectors (Powell 2005). Both viruses were found to have isometric particles about 20 to 25 nm in diameter. Neither virus has been classified, but purified virions of PepVMV reacted weakly with antisera from one strain of cucumber mosaic virus, suggesting that PepVMV might be a cucumovirus. Both viruses had a moderately broad experimental host range (Kim *et al*. 1990b, 1991).

It is possible that the two viruses are strains of the same species. PepVCV has been found co-infecting plants with tobacco mosaic virus and cucumber mosaic virus (Kim *et al*. 1990a) and it is possible that the more severe symptoms associated with PepVCV are produced by synergistic interactions with one or both of those viruses. Neither PepVCV nor PepVMV is known to occur outside of the Republic of Korea.

Experiments with a potyvirus species, *Plum pox virus*, suggest some viruses transmitted in a non-persistent manner can be transmitted by aphids from infected fruit (Gildow *et al*. 2004). The possibility that PepVCV and PepVMV could enter Australia in infected capsicum fruit was considered.

4.4.2 Probability of entry

Probability of importation

The likelihood that Pepper vein chlorosis virus or Pepper vein mosaic virus will arrive in Australia with the importation of fresh greenhouse-grown capsicum fruit from the Republic of Korea is: **LOW**.

- Several aphid species associated with capsicum in the Republic of Korea can transmit viruses including *Aphis craccivora*, *Aphis fabae*, *Aphis gossypii*, *Aphis nerii*, *Aphis spiraecola*, *Aulacorthum solani*, *Macrosiphum euphorbiae*, *Myzus persicae* (Kim *et al*. 1986; Choo *et al*. 1987; Kim *et al*. 1991; Blackman and Eastop 1994; Brunt *et al*. 1996; Vuong *et al*. 2001; USDA 2005; CABI 2006; NPQS 2006).
- Viruses are acquired by aphids from field crops and weeds (Gibbs and Harrison 1976). Very large numbers of flying aphids may transmit potyviruses in some seasons (Dixon 1977; Harrington *et al*. 1986). Aphids may enter a greenhouse on staff, or when roofs are open, and may infect capsicum. However, non-persistent transmission of viruses is limited by the period of virus retention in their aphid vectors.
- An outbreak of aphids in a greenhouse crop may not be detected and controlled before they have spread viruses.

- A limited survey done in 1988 found 1.1 % to 26.9 % of greenhouse-grown capsicum plants had symptoms probably caused by PepVCV or PepVMV (Kim *et al.* 1990a).
- PepVCV was not detected in surveys of viruses infecting capsicum in the Republic of Korea from 2001 and 2004 (Choi *et al.* 2004). Viruses could not be identified in some plants with viral disease-like symptoms identified in the surveys.
- PepVMV has not been reported since 1991 (Kim *et al.* 1991).
- Capsicum plants infected with PepVCV have chlorotic veins on the leaves and necrotic stems and plants lose their leaves and suffer shoot necrosis and withered stems (Kim *et al.* 1990a, 1990b, 1991). Capsicum plants infected with PepVMV have chlorotic veins and mosaic patterns on the leaves (Kim *et al.* 1991). Plants infected with the viruses may be culled from greenhouses.
- PepVCV infections of tomato (*Lycopersicon esculentum*) are symptomless (Kim *et al.* 1990b).
- Different cultivars of capsicum were grown in the Republic of Korea when PepVCV and PepVMV were detected (Kim *et al.* 1990a). The new cultivars may carry virus resistant genes (Kerlan and Moury 2008) that reduce PepVCV and PepVMV infection.
- Capsicum plants infected with PepVCV or PepVMV might produce deformed or discoloured fruit. Fruit from infected plants might be removed during the grading and packing processes.
- It is possible that some infected fruit may not show symptoms and would escape detection at harvest, grading and packing and may be exported to Australia.

The low incidence of PepVCV in capsicum in the Republic of Korea in recent years and the absence of reports of PepVMV after 1991 support a risk rating for importation of ‘Low’.

Probability of distribution

The likelihood that Pepper vein chlorosis virus or Pepper vein mosaic virus will be distributed in Australia in a viable state and transferred to a susceptible part of a host, as a result of the processing, sale or disposal of fresh greenhouse-grown capsicum fruit from the Republic of Korea, is: **VERY LOW**.

- Imported capsicum fruit is intended for human consumption. Fruit will be distributed to many localities by wholesale and retail trade and by individual consumers. Virus infected fruit may not be detected prior to distribution of fruit throughout Australia. Therefore, virus infected fruit could be distributed throughout Australia.
- Most capsicum fruit waste will be discarded into managed waste systems and will be disposed of in municipal tips.
- Consumers will discard small quantities of fruit waste in urban, rural and natural localities. Small quantities of fruit waste will be discarded in domestic compost.
- If infected fruit is imported, it may be distributed throughout Australia and infected fruit waste may be discarded near host plants.
- Aphid species that transmit viruses in a non-persistent manner are found on capsicum and are present in all states of Australia. These species include *Aphis craccivora*, *Aphis gossypii, Aphis nerii*, *Aphis spiraecola*, *Aulacorthum solani, Brachycaudus helichrysi*, *Macrosiphum euphorbiae* and *Myzus persicae* (Brunt *et al.* 1996; DEWHA 2009).
- *Myzus persicae* and *Aphis spiraecola* that have fed on peach fruit infected with *Plum pox virus*, a potyvirus, can transmit this virus (Gildow *et al.* 2004). Infected apricot and peach fruit can act as a source of *Plum pox virus* for aphid vectors under field conditions

(Labonne and Quiot 2001). This virus may be able to be transferred to a susceptible host if high numbers of infected fruit, vectors and a susceptible host occur nearby (Labonne and Quiot 2001).

- Virus particles can be acquired and transmitted by an aphid in a few seconds or minutes of feeding (Harris 1977). Aphids typically retain particles of non-persistently transmitted viruses for minutes, and sometimes retain the particles for a few hours (Harris 1977; Matthews 1991).
- Aphids will probe inappropriate plants to test their suitability as a food source, and if a plant is not suitable, winged aphids will fly to search for a suitable plant. This behaviour probably assists virus spread (Matthews 1991; Powell *et al.* 2006; Moorman 2008).
- It is very unlikely that aphid vectors will probe the small amounts of infected discarded fruit waste and transfer the viruses to susceptible hosts in the short time that virus particles are retained by aphids.
- Plants that can be infected by PepVCV and PepVMV grow throughout Australia. Commercial crops of capsicum are grown in every Australian state (HAL 2004), and these plants are grown in domestic gardens. Other solanaceous plants that could be hosts grow throughout Australia. The main solanaceous crops are potato (*Solanum tuberosum* ssp. *tuberosum*) and tomato (*Lycopersicon esculentum*). Solanaceous weeds that could be hosts include *Datura*, *Physalis* and *Solanum* species.

Capsicum fruit will be distributed and some fruit waste may be exposed to aphid vectors, but it is very unlikely that the small amounts of infected fruit waste will be discarded near host plants and it is unlikely aphid vectors will feed on discarded fruit waste, and this combination of factors support a risk rating for distribution of 'Very low'.

Probability of entry (importation × distribution)

The likelihood that Pepper vein chlorosis virus or Pepper vein mosaic virus will enter Australia and be transferred in a viable state to a susceptible host, as a result of trade in fresh greenhouse-grown capsicum from the Republic of Korea, is: **VERY LOW**.

4.4.3 Probability of establishment

The likelihood that Pepper vein chlorosis virus or Pepper vein mosaic virus will establish within Australia, based on a comparison of factors in the source and destination areas considered pertinent to its survival and reproduction, is: **MODERATE**.

- It not known what climatic conditions favour infection by PepVCV and PepVMV following probing by viruliferous aphids.
- The effects on infection of high or low temperatures and light intensities vary greatly depending on the virus species (Bawden 1956; Gibbs and Harrison 1976).
- Fresh capsicum fruit from the Republic of Korea will be imported from November until early July, which is after the springtime growth of herbaceous plants in southern Australia. Bright light and stress may mean that plants are less likely to get infected (Bawden 1956; Gibbs and Harrison 1976). This suggests that drought may reduce the chance of infection.
- In general, young plants that are growing vigorously are more likely to be infected by viruses and more likely to express pronounced symptoms (Bawden 1956; Gibbs and Harrison 1976).

- Climatic conditions that favour the growth of plant hosts may increase the chance of a foreign virus becoming established in Australia. For example, rainfall during the Australian summer may result in the germination and growth of susceptible host plants.
- PepVCV infected capsicum plants may not survive, as some infected plants lost leaves, buds died and necrotic stems withered (Kim *et al.* 1990a, 1990b, 1991). However, infected capsicum plants may survive as PepVMV only produces clorotic veins and mosaic patterns in infected capsicum plants (Kim *et al.* 1991).
- The absence of reports of PepVCV and PepVMV in crop plants outside the Republic of Korea suggests these viruses may not become established easily in new areas.

The possibility that PepVCV and PepVMV will become established in host plants in Australia is moderated by the absence of evidence of newly established populations of the viruses, supporting an establishment risk rating of 'Moderate'.

4.4.4 Probability of spread

The likelihood that Pepper vein chlorosis virus or Pepper vein mosaic virus will spread within Australia, based on a comparison of those factors in the source and destination areas considered pertinent to the expansion of the geographic distribution of the pest, is: **MODERATE**.

- Other viruses that are transmitted in a non-persistent manner by aphids spread widely in Australia (Brunt *et al.* 1996).
- Cucumber mosaic virus, a *Cucumovirus*, is transmitted by more than 60 aphid species. If PepVCV or PepVMV is a *Cucumovirus*, it may also be transmitted by a wide range of aphid species.
- Aphid species that might transmit the viruses and are present in some or all states of Australia include *Acyrthosiphon pisum*, *Aphis craccivora*, *Aphis gossypii*, *Aphis nerii*, *Aphis spiraecola*, *Aulacorthum solani*, *Brachycaudus helichrysi*, *Macrosiphum euphorbiae* and *Myzus persicae* (Brunt *et al.* 1996; DEWHA 2009).
- Host plants that could support the spread of PepVCV and PepVMV grow throughout Australia. Capsicum is grown in every state in commercial crops and in domestic gardens. Other solanaceous plants could be hosts of the viruses. Potato and tomato are grown in every Australian state, and solanaceous weeds, including *Datura*, *Physalis* and *Solanum* species, also grow throughout Australia.
- These viruses may sometimes infect a substantial proportion of a crop (Kim *et al.* 1990a).
- PepVCV and PepVMV appear to have a reduced distribution (Kim *et al.* 1990a), suggesting they may not spread readily.
- PepVCV was not detected in surveys of viruses infecting capsicum in the Republic of Korea from 2001 and 2004 (Choi *et al.* 2004).
- PepVMV has not been reported in the Republic of Korea since 1991 (Kim *et al.* 1991).
- Capsicum plants infected with PepVCV and PepVMV produce visible symptoms, and are likely to be detected and culled to control spread of the virus.
- Infections of weeds or plants in a domestic garden may not be detected.

The possibility that aphids in Australia will spread PepVCV and PepVMV is moderated by an absence of evidence that the viruses have spread in the Republic of Korea or to other countries, supporting a spread risk rating of 'Moderate'.

4.4.5 Probability of entry, establishment and spread

The likelihood that Pepper vein chlorosis virus or Pepper vein mosaic virus will be imported as a result of trade in fresh greenhouse-grown capsicum fruit from the Republic of Korea, be distributed in a viable state to a susceptible host, establish and spread within Australia, is: **VERY LOW**.

4.4.6 Consequences

Assessment of the potential consequences (direct and indirect) of Pepper vein chlorosis virus or Pepper vein mosaic virus is: **LOW**.

Criterion	Estimate and rationale
Direct	
Plant life or health	**Impact score**: D – minor significance at the regional level Capsicum is produced commercially in all Australian states including WA. The Australian capsicum crop of 2002, including the crop of chilli (*Capsicum frutescens*), was estimated to have a gross value of $64.2 million (HAL 2004). Virus diseases in capsicum crops are a major cause of loss, reducing yields and fruit quality (Green and Kim 1991; CABI 2006). Plants infected with PepVCV lose leaves, their buds die, and they develop necrosis, which may be progressive, causing plant death (Kim *et al*. 1990a, 1990b, 1991). These effects are likely to substantially reduce crop yields. Plants infected with PepVMV have chlorotic veins and mosaic patterns on the leaves (Kim *et al*. 1991). Vein chlorosis probably indicates the phloem is affected, and it is likely that infection causes substantial yield losses (Bos 1999). Other plant species might be infected. Both PepVCV and PepVMV have been shown to infect broad bean (*Vicia faba*), yard-long bean (*Vigna sesquipedalis*) and cowpea (*Vigna unguiculata*) (Kim *et al*. 1990b, 1991), all of which are grown in Australia, although none are major commercial crops. PepVCV has been shown in experiments to infect tomato without symptoms (Kim *et al*. 1990b). Latent infections, that produce no characteristic symptoms, may reduce yields by up to 20 % (Bos 1999).
Other aspects of the environment	**Impact score**: B – minor significance at the local level PepVMV has been shown in experiments to infect *Datura metel* (Kim *et al*. 1991). Some *Datura* species are significant weeds in Australia and so the introduction of this virus might reduce the weed burden within some ecosystems.
Indirect	
Eradication, control etc.	**Impact score**: D – significant at the district level If a foreign virus was to become established, virus control measures may be employed. Plants may be culled from crops, crops may be destroyed and resistant cultivars may be sought.
Domestic trade	**Impact score**: D – significant at the district level If a foreign virus became established in Australia, restrictions might be introduced on the interstate trade of capsicum and this may lead to the loss of markets and some industry adjustment.
International trade	**Impact score**: D – significant at the district level Exports of capsicum from Australia are small (HAL 2004). If a damaging foreign virus became established in Australia, restrictions may be introduced in international trade and this may lead to the loss of markets and some industry adjustment.
Environmental and non-commercial	**Impact score**: A – indiscernible at any level No information was found indicating a possible effect.

4.4.7 Unrestricted risk estimate

The unrestricted risk for Pepper vein chlorosis virus or Pepper vein mosaic virus is: **NEGLIGIBLE**.

Unrestricted risk is the result of combining the probability of entry, establishment and spread with the outcome of overall consequences. Probabilities and consequences are combined using the risk estimation matrix shown in Table 2.5.

The unrestricted risk estimate for Pepper vein chlorosis virus and Pepper vein mosaic virus of 'Negligible' achieves Australia's ALOP. Therefore, specific risk management measures are not required for these viruses.

4.5 Potyviruses

Chilli veinal mottle virus, Pepper mottle virus

4.5.1 Introduction

Chilli veinal mottle virus (ChiVMV) and *Pepper mottle virus* (PepMoV) are members of the *Potyvirus* genus that cause significant disease in capsicum crops. The viruses also infect crops of chilli (*Capsicum frutescens*) and PepMoV infects some solanaceous weeds (Brunt *et al*. 1996; Goldberg 2001).

The viruses cause a range of symptoms, mostly on the leaves, and they can stunt plants (Brunt *et al*. 1996; Cerkauskas 2004b, 2004c). Crop yields can be substantially reduced and fruit can be deformed or discoloured (Cerkauskas 2004b, 2004c). They are transmitted by aphids from the Aphidinae family in a non-persistent manner, being retained for short periods after feeding within the aphid's stylet (Harris 1977). Experiments with another potyvirus species, *Plum pox virus*, suggest potyviruses can be transmitted by aphids from infected fruit (Gildow *et al*. 2004). The viruses are not transmitted in seed.

4.5.2 Probability of entry

Probability of importation

The likelihood that *Chilli veinal mottle virus* or *Pepper mottle virus* will arrive in Australia with the importation of fresh greenhouse-grown capsicum fruit from the Republic of Korea is: **MODERATE**.

- PepMoV was detected in 13.4 % of 1056 samples from capsicum crops showing symptoms of disease in a 2001 to 2004 survey in the Republic of Korea (Choi *et al*. 2005). ChiVMV was not reported in the survey, but it is reported to be widespread in Asia (Brunt *et al*. 1996; CABI 2006).
- PepMoV is probably transmitted by aphids from solanaceous weeds, including some *Datura* and *Solanum* spp. (Brunt *et al.* 1996; Goldberg 2001; Cerkauskas 2004c). ChiVMV probably also has hosts, other than *Capsicum* spp., that act as reservoirs for the virus.
- Aphid species that are associated with capsicum in the Republic of Korea, and can transmit the viruses, include *Aphis craccivora*, *Aphis gossypii*, *Aphis spiraecola* and *Myzus persicae* (Kim *et al*. 1986; Choo *et al*. 1987; Kim *et al*. 1991; Brunt *et al*. 1996; Vuong *et al*. 2001; USDA 2005; CABI 2006; NPQS 2006). *Myzus persicae* is probably the most important vector of potyviruses (Nelson *et al*. 1982; Shukla *et al*. 1994; Brunt *et al*. 1996).
- Very large numbers of flying aphids may transmit potyviruses in some seasons (Dixon 1977; Harrington *et al*. 1986). Aphids may enter a greenhouse on staff or when roofs are open, and may infect capsicum plants with viruses. However, non-persistent transmission of viruses is limited by the period that virus particles are retained in the aphid vectors.
- An outbreak of aphids in a greenhouse crop may not be detected and controlled before they have spread viruses.
- Resistant alleles are present in many capsicum cultivars, and some capsicum cultivars cannot be infected by certain potyvirus species or isolates (Moury *et al*. 2004). ChiVMV does not systemically infect capsicum cultivars with the *pvr2*^{2} or *pvr6* alleles, whereas

PepMoV does not infect cultivars with the *pvr4* allele (Dogimont *et al.* 1996; Moury *et al.* 2005). Resistance of some cultivars reduces the likelihood that infected fruit will be exported.

- Potyviruses sometimes induce conspicuous symptoms (Bawden 1956; Shukla *et al*. 1994). ChiVMV causes vein-banding and mottling symptoms on the leaves and streaks on the stems; the leaves of some cultivars are reduced and distorted and plants may be stunted (Brunt *et al*. 1996; Cerkauskas 2004b). Plants with PepMoV become mottled, leaves may be distorted and necrotic lesions may develop. Plants heavily infected with this virus are stunted and some chilli plants die (Green and Kim 1991; Brunt *et al*. 1996; Cerkauskas 2004c).
- Capsicum plants with conspicuous symptoms are likely to be detected and culled from greenhouses. However, virus symptoms vary depending on the light intensity, temperature, and physiological condition of the plant (Bawden 1956), and in some instances it may be difficult to identify infected plants.
- Some capsicum cultivars remain symptomless for several weeks after inoculation with PepMoV (Zitter and Cook 1973; Shukla *et al.* 1994).
- Capsicum plants infected with ChiVMV or PepMoV may produce deformed fruit (Cerkauskas 2004b, 2004c; Lovatt *et al.* 2005). Most capsicum infected with ChiVMV drop their flowers before fruit develop (Cerkauskas 2004b). Plants infected by PepMoV can produce fruit with mottle or mosaic patterns (Cerkauskas 2004c; Green and Kim 1991).
- Fruit from infected plants may be culled during harvesting, grading or packing.
- It is possible that some infected fruit may not show symptoms and so would escape detection, leading to export to Australia.

The resistance of capsicum cultivars reduces the possibility that infected fruit will be exported, as does the likelihood that infected fruit may be culled because they are deformed or discoloured, supporting a risk rating for importation of 'Moderate'.

Probability of distribution

The likelihood that *Chilli veinal mottle virus* or *Pepper mottle virus* will be distributed in Australia in a viable state and transferred to a susceptible part of a host, as a result of the processing, sale or disposal of fresh greenhouse-grown capsicum fruit from the Republic of Korea, is: **VERY LOW**.

- Imported capsicum fruit is intended for human consumption. Fruit will be distributed to many localities by wholesale and retail trade and by individual consumers. Virus infected fruit may not be detected prior to distribution of fruit throughout Australia. Therefore, virus infected fruit could be distributed throughout Australia.
- Most capsicum fruit waste will be discarded into managed waste systems and will be disposed of in municipal tips.
- Consumers will discard small quantities of fruit waste in urban, rural and natural localities. Small amounts of fruit waste will be discarded in domestic compost.
- If infected fruit is imported, it may be distributed throughout Australia and infected fruit waste may be discarded near host plants.
- The aphids *Aphis gossypii* and *Myzus persicae* transmit ChiVMV and PepMoV and are present in all states of Australia (Brunt *et al.* 1996; Kerlan 2006; DEWHA 2009). *Aphis spiraecola* is a vector of ChiVMV that is present in all Australian states, except WA (Brunt *et al.* 1996; DEWHA 2009).

- *Myzus persicae* and *Aphis spiraecola* that have fed on peach fruit infected with *Plum pox virus*, a related potyvirus, can transmit this virus (Gildow *et al.* 2004). Infected apricot and peach fruit can act as a source of *Plum pox virus* for aphid vectors under field conditions (Labonne and Quiot 2001). This virus may be able to be transferred to a susceptible host if high numbers of infected fruit, vectors and a susceptible host occur nearby (Labonne and Quiot 2001).
- Potyvirus particles can be acquired and transmitted by an aphid in a few seconds or minutes of feeding (Harris 1977). Aphids usually retain potyvirus particles for no more than an hour, and many will not transmit the virus after a few minutes (Matthews 1991). However, particles may be retained for longer, possibly up to 24 hours (Shukla *et al.* 1994).
- Aphids will probe inappropriate plants to test their suitability as a food source, and if a plant is not suitable, winged aphids will fly in search of a suitable plant. This behaviour probably assists virus spread (Matthews 1991; Powell *et al*. 2006; Moorman 2008).
- It is very unlikely that aphid vectors will probe the small amounts of infected discarded fruit waste and transfer the viruses to susceptible hosts in the short time that virus particles are retained by aphids.
- Plants that can be infected by ChiVMV and PepMoV grow throughout Australia. Commercial crops of capsicum and chilli are grown in every Australian state (HAL 2004), and these plants are grown in domestic gardens. PepMoV is found in solanaceous weeds, including *Datura* and *Solanum* species, and both ChiVMV and PepMoV have been shown to infect *Physalis floridana*, another solanaceaous plant. Some species of *Datura*, *Physalis* and *Solanum* are widespread weeds in Australia.

Capsicum fruit will be distributed and some fruit waste may be exposed to aphid vectors, but it is very unlikely that the small amounts of infected fruit waste will be discarded near host plants and it is unlikely aphid vectors will feed on discarded fruit waste, and this combination of factors support a risk rating for distribution of 'Very low'.

Probability of entry (importation × distribution)

The likelihood that *Chilli veinal mottle virus* or *Pepper mottle virus* will enter Australia and be transferred in a viable state to a susceptible host, as a result of trade in fresh greenhouse-grown capsicum fruit from the Republic of Korea, is: **VERY LOW**.

4.5.3 Probability of establishment

The likelihood that *Chilli veinal mottle virus* or *Pepper mottle virus* will establish within Australia, based on a comparison of factors in the source and destination areas considered pertinent to its survival and reproduction, is: **HIGH**.

- The geographic distributions of ChiVMV and PepMoV suggest these viruses have become established in regions outside their original ranges, and indicate they can become established under a wide range of climatic conditions.
- ChiVMV is found in China, Korea DPR, the Republic of Korea, Malaysia, Philippines, Sri Lanka, Thailand, Taiwan and Tanzania (Brunt *et al*. 1996; CABI 2006). PepMoV is found in North and Central America, Puerto Rico, India and Japan (Brunt *et al*. 1996; Ogawa *et al*. 2003; CABI 2006).
- The effects on infection of high or low temperatures and light intensities vary greatly depending on the virus species (Bawden 1956).

- Fresh capsicum fruit from the Republic of Korea will be imported between November and July, which is after the springtime growth of herbaceous plants in southern Australia. Bright light and stress may mean that plants are less likely to be infected (Bawden 1956; Gibbs and Harrison 1976). This suggests that drought may reduce the chance of infection.
- In general, young plants that are growing vigorously are more likely to be infected by viruses and more likely to express pronounced symptoms (Bawden 1956; Gibbs and Harrison 1976).
- Climatic conditions that favour the growth of plant hosts may increase the chance of a foreign virus becoming established in Australia. For example, rainfall during the Australian summer may result in germination and the growth of susceptible host plants.
- Potato virus Y, another potyvirus of foreign origin, is found in capsicum crops, and other solanaceous crops, in the eastern and southern states of Australia (Moran and Rodoni 2003; Persley *et al.* 2005; Gibbs *et al*. 2008). Several foreign potyviruses have become established in Australia since European settlement (Gibbs *et al*. 2008).
- If introduced, ChiVMV and PepMoV are likely to become established and this may occur in any state of Australia.

The availability of hosts and capacity of potyviruses to become established in new regions supports an establishment risk rating of 'High'.

4.5.4 Probability of spread

The likelihood that *Chilli veinal mottle virus* or *Pepper mottle virus* will spread within Australia, based on a comparison of those factors in the source and destination areas considered pertinent to the expansion of the geographic distribution of the pest is: **HIGH**.

- The viruses are spread by aphids. *Aphis gossypii* and *Myzus persicae* are probably among the most important vectors and these aphids are present in all the states of Australia (Shukla *et al*. 1994; Brunt *et al*. 1996; Kerlan 2006; DEWHA 2009). *Aphis spiraecola* is a vector of ChiVMV that is present in all Australian states, except WA (Brunt *et al*. 1996; DEWHA 2009).
- Another potyvirus species, potato virus Y, has been reported to infect entire crops of capsicum, potato and tomato (Kerlan and Moury 2008). It is likely that ChiVMV and PepMoV would also spread throughout crops.
- Reports of ChiVMV and PepMoV affecting crops in several locations (Brunt *et al*. 1996; CABI 2006) suggest they spread easily. PepMoV is found in several states in the USA (Brunt *et al*. 1996).
- Host plants that could support the spread of ChiVMV and PepMoV grow throughout Australia. Capsicum is grown in every state, in commercial crops and in domestic gardens. In the USA, PepMoV infects weeds from the *Datura* and *Solanum* genera (Goldberg 2001), and species from those genera grow as weeds throughout Australia. ChiVMV probably also infects solanaceous weeds.
- Crop plants infected with ChiVMV or PepMoV will probably have conspicuous symptoms, and may be detected by visual inspection and culled to control spread of the virus.
- Infections of weeds or plants in a domestic garden may not be detected.
- Potyvirus infections can be controlled by cultivating resistant cultivars. Capsicum cultivars that resist infection by ChiVMV or PepMoV are available (Dogimont *et al.* 1996; Cerkauskas 2004b, 2004c; Moury *et al.* 2005).

The prevalence of aphid vectors in Australia and evidence that potyviruses will spread easily supports a spread risk rating of 'High'.

4.5.5 Probability of entry, establishment and spread

The likelihood that *Chilli veinal mottle virus* or *Pepper mottle virus* will be imported as a result of trade in fresh greenhouse-grown capsicum fruit from the Republic of Korea, be distributed in a viable state to a susceptible host, establish and spread within Australia, is: **VERY LOW**.

4.5.6 Consequences

Assessment of the potential consequences (direct and indirect) of *Chilli veinal mottle virus* or *Pepper mottle virus* is: **MODERATE**.

Criterion	Estimate and rationale
Direct	
Plant life or health	**Impact score**: E – significant at the regional level Capsicums are produced commercially in all Australian states. The Australian capsicum crop of 2002, including the crop of chilli (*Capsicum frutescens*), was estimated to have a gross value of $64.2 million (HAL 2004). Potyvirus diseases in capsicum crops are a common cause of loss (Green and Kim 1991). Capsicum fruit set, size and weight are reduced. Fruit may be malformed and have mosaic symptoms. Capsicum crop losses due to potyviruses vary, with the severity of disease depending on the level of aphid infestation, timing of infection, cultivar and virus genotype (Bos 1999; Kerlan and Moury 2008). Losses are likely to be greater when one of these potyviruses co-infects with one or more other viruses (Beemster and de Bokx 1987). ChiVMV causes disease in chilli across Asia, with estimated yield losses of up to 50% (Ong *et al.* 1980), and it is reported to cause significant losses in *Capsicum chinense* (Wang *et al.* 2006). PepMoV significantly reduces the yields of capsicum crops in New Mexico and kills certain chilli cultivars (Green and Kim 1991; Goldberg 2001). Endangered Solanaceae might be infected by a foreign potyvirus, although this is unlikely, and the size or health of a population might be affected. Endangered Solanaceae are found in Qld, NSW, NT and WA, and include *Anthocercis gracilis, Cyphanthera odgersii* subsp. *occidentalis*, *Solanum armourense*, *S. carduiforme*, *S. celatum*, *S. dunalianum*, *S. karsense*, *S. limitare* and *Symonanthus bancroftii* (DEWHA 2009; DECC 2009).
Other aspects of the environment	**Impact score**: B – minor significance at the local level Solanaceous weeds may be infected by ChiVMV or PepMoV, possibly reducing the weed burden within some ecosystems.
Indirect	
Eradication, control etc.	**Impact score**: D – significant at the district level If a foreign potyvirus were to become established, virus control measures may be required. Potyvirus outbreaks may be prevented or controlled by taking one or more of the following measures: (1) planting resistant varieties of capsicum (Cerkauskas 2004b, 2004c); (2) growing crops or seedlings in insect-proof greenhouses or net houses (Cerkauskas 2004b); (3) inspecting crops and seedlings for aphids or symptoms, and culling affected plants (Brunt *et al*. 1996; Cerkauskas 2004b); (4) avoiding growing crops near established solanaceous crops and when aphid numbers are high; (5) controlling solanaceous weeds; (6) spraying crops with insecticides or mineral oils. Capsicum cultivars that resist ChiVMV and PepMoV are available (Cerkauskas 2004b, 2004c). The use of insecticides to control aphids has proven ineffective in the control of potato virus Y, another potyvirus, and is probably also ineffective for the control of PepMoV (Brunt *et al.* 1996; Cerkauskas 2004c; Kerlan 2006).
Domestic trade	**Impact score**: D – significant at the district level If a damaging foreign potyvirus became established in an Australian state, then restrictions are likely to be introduced on the interstate trade of capsicum, and possibly other solanaceous crops, and this may lead to the loss of markets and some industry adjustment.

International trade	**Impact score**: D – significant at the district level Exports of capsicum from Australia are very small (HAL 2004). If a damaging foreign potyvirus became established in Australia restrictions may be introduced on the international trade of tomatoes or potatoes and this may lead to the loss of markets and some industry adjustment.
Environmental and non-commercial	**Impact score**: A – indiscernible at any level No information was found indicating a possible effect.

4.5.7 Unrestricted risk estimate

The unrestricted risk for *Chilli veinal mottle virus* or *Pepper mottle virus* is: **VERY LOW**.

Unrestricted risk is the result of combining the probability of entry, establishment and spread with the outcome of overall consequences. Probabilities and consequences are combined using the risk estimation matrix shown in Table 2.5.

The unrestricted risk estimate for *Chilli veinal mottle virus* or *Pepper mottle virus* of ‘Very low’ achieves Australia's ALOP. Therefore, specific risk management measures are not required for these viruses.

4.6 Pest risk assessment conclusion

Table 4.2 summarises the pest risk assessments and provides unrestricted risk estimates for the quarantine pests for fresh greenhouse-grown capsicum fruit from the Republic of Korea.

Frankliniella intonsa was assessed to have an unrestricted risk estimate of ‘low’ for Australia, *F. occidentalis* was assessed to have an unrestricted risk estimate of ‘low’ for Tas. and the NT and *T. palmi* was assessed to have an unrestricted risk estimate of ‘low’ for WA, SA, Tas. and the NT.

The unrestricted risk estimates for these pests exceed Australia’s ALOP of very low. Specific pest risk management measures are therefore required for fresh greenhouse-grown capsicum fruit imported from the Republic of Korea into these areas to address the potential quarantine risks. The recommended pest risk management measures are discussed in Section 5.

Table 4.2: Summary of pest risk assessments for quarantine pests of fresh greenhouse-grown capsicum fruit from the Republic of Korea

Pest name	**Probability of**					**Overall probability of entry, establishment and spread**	**Consequences**	**Unrestricted risk**
	Entry			**Establish-ment**	**Spread**			
	Importation	Distribution	Overall (importation x distribution)					
Armoured scales [Hemiptera: Diaspididae]								
Pseudaulacaspis pentagona (WA)	Moderate	Low	Low	High	Moderate	Low	Low	Very Low
Thrips [Thysanoptera: Thripidae]								
Frankliniella intonsa *Frankliniella occidentalis* (NT, Tas.) *Thrips palmi* (NT, WA, SA, Tas.)	High	Moderate	Moderate	High	High	Moderate	Low	Low
Viruses								
Pepper vein chlorosis virus Pepper vein mosaic virus	Low	Very Low	Very Low	Moderate	Moderate	Very Low	Low	Negligible
Chilli veinal mottle virus *Pepper mottle virus*	Moderate	Very Low	Very Low	High	High	Very Low	Moderate	Very Low

The relevant state or territory for pests of regional concern are shown in parentheses.

5 Pest risk management

5.1 Pest risk management measures and phytosanitary procedures

In addition to the standard commercial production practices for fresh greenhouse-grown capsicum fruit from the Republic of Korea, specific pest risk management measures, including an operational system, are recommended to achieve Australia's ALOP. These are:

- pre-export phytosanitary inspection by NPQS for thrips and other quarantine risk material
- on-arrival inspection by AQIS for thrips and other quarantine risk material and
- an operational system for the maintenance and verification of the phytosanitary status of capsicums.

The specific pest risk management measures and operational system recommended for fresh greenhouse-grown capsicum fruit from the Republic of Korea are summarised in Table 5.1.

Table 5.1: Phytosanitary measures recommended for quarantine pests of fresh greenhouse-grown capsicum fruit from the Republic of Korea

Pest	Common name	Measures
Thrips [Thysanoptera: Thripidae]		
Frankliniella intonsa	Intonsa flower thrips	Pre-export and on-arrival visual inspection and remedial action and a supporting operational system
Frankliniella occidentalis (NT, Tas.)	Western flower thrips	
Thrips palmi (NT, SA, Tas., WA)	Melon thrips	

Australian regional quarantine pests are indicated with the region(s) concerned in parentheses.

5.1.1 Pest risk management for thrips

In this report, the thrips *Frankliniella intonsa, F. occidentalis* and *T. palmi* were identified as quarantine pests with an unrestricted risk rating that was above Australia’s ALOP. The pest risk management measures recommended to address the thrips are pre-export and on-arrival inspection of the fresh greenhouse-grown capsicum fruit.

Each consignment[5] is required to be free of quarantine pests, based on finding no live quarantine pests in a sample of 600 units (single capsicum fruit) from each inspection lot[6] from a consignment. No detection of pests resulting from the inspection of 600 units achieves a confidence level of 95 % that not more than 0.5 % of the units in the inspection lot are infested or infected.

[5] A consignment is ‘a quantity of plants, plant products and/or other articles being moved from one country to another and covered, when required, by a single phytosanitary certificate (a consignment may be composed of one or more commodities or lots)’ (FAO 2009).
[6] An inspection lot is defined as ‘the quantity of product from which the NPPO draws its sample of units for inspection from a consignment or part of a consignment’.

If quarantine pests and/or regulated articles[7] are detected during inspections, remedial action is to be taken. Remedial action may include one or more of the following:

- removal of the inspection lot from export to Australia
- re-export of the inspection lot from Australia
- treatment, where an appropriate treatment is available for the quarantine pest detected, and re-inspection of the inspection lot to ensure no viable quarantine pests or other regulated articles are present
- destruction of the inspection lot.

The objective of these measures is to reduce the likelihood of importation of thrips to at least 'moderate'. The restricted risk would then be reduced to at least 'very low', which would achieve Australia's ALOP.

These recommended measures are applicable to all greenhouse-grown capsicum export consignments from the Republic of Korea irrespective of the port of entry in Australia, and are consistent with existing import policy for fresh capsicum fruit.

5.1.2 Operational system for the maintenance and verification of phytosanitary status

A system of operational procedures is necessary to maintain and verify the phytosanitary status of fresh greenhouse-grown capsicum fruit from the Republic of Korea. This is to ensure that the recommended risk management measures have been met and are maintained.

The components of the recommended operational system are described below.

Registration of export greenhouses

The objectives of this recommended procedure are to ensure that:

- capsicum fruit is sourced from greenhouses producing export quality fruit (described in section 3.2) as the pest risk assessments are based on commercial production and harvesting activities
- greenhouses from which capsicum fruit is sourced can be identified so investigation and corrective action can be targeted rather than applying to all contributing export greenhouses to Australia if live pests are regularly intercepted during on-arrival inspection.

Registration of packing houses and auditing of procedures

The objectives of this recommended procedure are to ensure that:

- capsicum fruit is sourced from packing houses processing export quality fruit, as the pest risk assessments are based on commercial packing activities
- packing houses from which capsicum fruit is exported can be identified so investigation and corrective action can be targeted rather than applying to all packing houses exporting to Australia if live pests are intercepted during on-arrival inspection.

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[7] A regulated article is defined as 'any plant, plant product, storage place, packaging, conveyance, container, soil and any other organism, object or material capable of harbouring or spreading pests, deemed to require phytosanitary measures, particularly where international transportation is involved' (FAO 2009).

Approved packaging and labelling

The objectives of this recommended procedure are to ensure that:

- capsicum fruit exported to Australia is not contaminated by quarantine pests or regulated articles (e.g. capsicum foliage, trash, soil and weed seeds)
- unprocessed packing material of plant origin that may act as a vector for pests is not imported with the capsicum fruit
- all wood material used in packaging of the commodity complies with AQIS conditions (see AQIS publication 'Cargo Containers: Quarantine aspects and procedures')
- all boxes are labelled with the greenhouse registration number to enable trace back to registered greenhouses
- secure packaging is used if consignments are not transported directly to Australia.

Specific conditions for storage and transport of produce

The objectives of this recommended procedure are to ensure that:

- product for export to Australia is secure to prevent mixing or cross-contamination with produce destined elsewhere
- the quarantine integrity of the commodity is maintained during storage and movement.

Pre-export phytosanitary inspection and certification by NPQS

The objectives of this recommended procedure are to ensure that:

- all consignments are inspected by NPQS in accordance with official procedures for all visually detectable quarantine pests and other regulated articles (including soil, animal and plant debris) at a standard 600 unit sampling rate per inspection lot whereby one unit is one capsicum fruit
- an international phytosanitary certificate (IPC) is issued for each consignment upon completion of pre-export inspection to verify that the relevant measure has been undertaken
- each IPC includes:
    - a description of the consignment (including grower number and packing house details)

    and

    - an additional declaration that '*The capsicum fruit in this consignment has been produced in greenhouses in the Republic of Korea in accordance with the conditions governing the entry of fresh capsicum fruit to Australia and inspected and found to be free of quarantine pests*'.

On-arrival phytosanitary inspection and clearance by AQIS

The objectives of this recommended procedure are to ensure that:

- consignments undergo appropriate quarantine inspection on arrival in Australia, as outlined in section 5.1.1.

5.1.3 Uncategorised pests

If an organism is detected on capsicum fruit, either in the Republic of Korea or on-arrival in Australia, that has not been categorised, it will require assessment by Biosecurity Australia to determine its quarantine status and if phytosanitary action is required. The detection of any pests of quarantine concern not already identified in the analysis may result in remedial action, as appropriate.

5.2 Review of policy

The adopted policy may be reviewed after substantial trade of fresh greenhouse-grown capsicum fruit from the Republic of Korea to Australia has occurred, or earlier in the event of new outbreaks in the Republic of Korea of pests of concern to Australia.

If product continually fails on-arrival phytosanitary inspection, the export program can be suspended and audited by AQIS. The export program may be reinstated after AQIS is satisfied that appropriate corrective action has been taken.

Appendices

Appendix A: Initiation and pest categorisation for phytosanitary pests

Pest	Associated with Capsicum crop in the Republic of Korea	Present within Australia	Presence on the commodity (Yes/No/Not assessed)	Potential for establishment and spread (Feasible/Not feasible/Not assessed)	Potential for economic consequences (Significant/Not significant/Not assessed)	Consider further in PRA
ARTHROPODA						
ARACHNIDA: ACARINA						
Acaridae						
Tyrophagus putrescentiae (Schrank, 1781) <u>mould mite</u>	Yes (NPQS 2007b)	Yes (Halliday 2003)	Not assessed	Not assessed	Not assessed	No
Laelapidae						
Hypoaspis aculeifer (Canestrini, 1884) <u>laelapid mite</u>	Yes (NPQS 2007b)	Yes (Halliday 2000)	Not assessed	Not assessed	Not assessed	No
Carpoglyphidae						
Carpoglyphus lactis (Linnaeus, 1758) <u>dried fruit mite</u>	Yes (NPQS 2007b)	Yes (Halliday 2003)	Not assessed	Not assessed	Not assessed	No
Tarsonemidae						
Phytonemus pallidus (Banks, 1899) <u>strawberry mite</u>	Yes (USDA 2005; NPQS 2006)	Yes (Halliday 2000)	Not assessed	Not assessed	Not assessed	No
Polyphagotarsonemus latus (Banks, 1904) <u>broad mite</u>	Yes (Lee *et al*. 1992; Cho *et al*. 1996; USDA 2005; NPQS 2006)	Yes (Kessing and Mau 2007)	Not assessed	Not assessed	Not assessed	No
Tetranychidae						
Tetranychus kanzawai Kishida, 1927 <u>Kanzawai spider mite</u>	Yes (USDA 2005)	Yes (Flechtmann and Knihinicki 2002)	Not assessed	Not assessed	Not assessed	No

Pest	Associated with Capsicum crop in the Republic of Korea	Present within Australia	Presence on the commodity (Yes/No/Not assessed)	Potential for establishment and spread (Feasible/Not feasible/Not assessed)	Potential for economic consequences (Significant/Not significant/Not assessed)	Consider further in PRA
Tetranychus urticae Koch, 1836 two-spotted spider mite	Yes (Lee *et al*. 1992; USDA 2005; NPQS 2006)	Yes (Flechtmann and Knihinicki 2002)	Not assessed	Not assessed	Not assessed	No
INSECTA: COLEOPTERA						
Coccinellidae						
Epilachna vigintioctopunctata (Fabricius) hadda beetle	Yes (USDA 2005)	No (CABI 2007)	No Only affects leaves (USDA 2005)	Not assessed	Not assessed	No
Epilachna vigintioctomaculata Motschulsky, 1857 large 28-spotted lady beetle	Yes (USDA 2005)	Yes Not in WA (IHS 2000; DAFWA 2006)	No Only affects leaves (USDA 2005)	Not assessed	Not assessed	No
Curculionidae						
Listroderes costirostris Schönherr, 1826 Australian tomato weevil	Yes (USDA 2005; NPQS 2006)	Yes (Wilson and Wearne 1962; CABI 2006)	Not assessed	Not assessed	Not assessed	No
Tenebrionidae						
Tribolium castaneum (Herbst, 1797) red flour beetle	Yes (USDA 2005; CABI 2006)	Yes (Daglish 2005)	Not assessed	Not assessed	Not assessed	No
INSECTA: DIPTERA						
Agromyzidae						
Liriomyza huidobrensis (Blanchard, 1926) pea leafminer	Yes (CABI 2006)	No (Bjorksten *et al.* 2005; EPPO 1997)	No Only affects leaves (CABI 2006)	Not assessed	Not assessed	No

Pest	Associated with Capsicum crop in the Republic of Korea	Present within Australia	Presence on the commodity (Yes/No/Not assessed)	Potential for establishment and spread (Feasible/Not feasible/Not assessed)	Potential for economic consequences (Significant/Not significant/Not assessed)	Consider further in PRA
Liriomyza trifolii (Burgess, 1880) serpentine leafminer	Yes (USDA 2005; NPQS 2006)	No (Bjorksten *et al.* 2005)	No Only affects leaves (NPQS 2006).	Not assessed	Not assessed	No
Cecidomyiidae						
Aphidoletes aphidimyza (Rondani, 1847) gall midge	Yes (NPQS 2007b)	Yes Cosmopolitan (Gagné 1996)	Not assessed	Not assessed	Not assessed	No
Sciaridae						
Bradysia difformis Frey, 1948 Syn.: *Bradysia agrestis* Sasakawa, 1978 black fungus gnat	Yes (Lee *et al*. 2001)	No (Steffan 1989)	No Damages roots of host seedlings grown in greenhouses in the Republic of Korea, including capsicum (Kim *et al*. 2000).	Not assessed	Not assessed	No
INSECTA: HEMIPTERA						
Aleyrodidae						
Bemisia tabaci (Gennadius, 1889) silver leaf whitefly	Yes B biotype (USDA 2005; NPQS 2006) Q Biotype (Lee *et al.* 2005)	Yes B biotype is present in Australia (Carver and Reid 1996; Gunning *et al.* 1997). Q biotype is present in Australia (IPPC 2009) Species has a restricted distribution in WA and is under official control (DAFWA 2006)	No Damages plants by sucking sap from leaves (CABI 2006; NPQS 2006).	Not assessed	Not assessed	No

Pest	Associated with Capsicum crop in the Republic of Korea	Present within Australia	Presence on the commodity (Yes/No/Not assessed)	Potential for establishment and spread (Feasible/Not feasible/Not assessed)	Potential for economic consequences (Significant/Not significant/Not assessed)	Consider further in PRA
Trialeurodes vaporariorum (Westwood, 1856) tea whitefly	Yes (USDA 2005; NPQS 2006)	Yes (De Barro and Carver 1997; Malipatil and Wainer 2008)	Not assessed	Not assessed	Not assessed	No
Aphididae						
Aphis craccivora Koch, 1854 groundnut aphid	Yes (CABI 2006)	Yes (Gutierrez *et al*. 1974; Behncken and Maleevsky 1977)	Not assessed	Not assessed	Not assessed	No
Aphis fabae Scopoli, 1763 blackbean aphid	Yes (USDA 2005; NPQS 2006)	No (APPD 2006; CABI 2007)	No Attacks the leaves and stem (NPQS 2006). Feeding damage results in a loss of sap and injury to plant tissues. Young plants are most vulnerable. Plants may be stunted or die under heavy attack. Leaves may appear wilted. Seed formation is subsequently reduced (CABI 2006).	Not assessed	Not assessed	No
Aphis gossypii Glover, 1877 cotton aphid	Yes (Kim *et al*. 1986; Choo *et al*. 1987; Vuong *et al*. 2001; USDA 2005; NPQS 2006)	Yes (Smith *et al*. 1997; Wool *et al*. 1995)	Not assessed	Not assessed	Not assessed	No
Aphis nerii Boyer de Fonscolombe, 1841 sweet pepper aphid	Yes (USDA 2005; NPQS 2006)	Yes (Carver 1984)	Not assessed	Not assessed	Not assessed	No

Pest	Associated with Capsicum crop in the Republic of Korea	Present within Australia	Presence on the commodity (Yes/No/Not assessed)	Potential for establishment and spread (Feasible/Not feasible/Not assessed)	Potential for economic consequences (Significant/Not significant/Not assessed)	Consider further in PRA
Aphis spiraecola Patch, 1914 Syn.: *Aphis citricola* (van der Goot, 1912) spiraea aphid	Yes (USDA 2005; NPQS 2006)	Yes (Blackman and Eastop 2000)	Not assessed	Not assessed	Not assessed	No
Aulacorthum solani (Kaltenbach, 1843) foxglove aphid	Yes (Blackman and Eastop 2000)	Yes (Berlandier 1997)	Not assessed	Not assessed	Not assessed	No
Indomegoura indica (van der Goot, 1916) yellow pollen aphid	Yes (Blackman and Eastop 2000; USDA 2005)	No (Blackman and Eastop 1994)	No Inhabits the underside of leaves or the apical section of young stems of *Staphylea* spp. especially *S. bumalda* in the Republic of Korea (Lee 2001)	Not assessed	Not assessed	No
Macrosiphum euphorbiae (Thomas, 1878) potato aphid	Yes (USDA 2005; CABI 2006)	Yes (Cole and Horne 2006)	Not assessed	Not assessed	Not assessed	No
Myzus persicae (Sulzer, 1776) green peach aphid	Yes (Kim *et al*. 1991; Vuong *et al*. 2001; USDA 2005; NPQS 2006)	Yes (Wilson *et al*. 2002)	Not assessed	Not assessed	Not assessed	No
Coccidae						
Coccus hesperidum Linnaeus, 1758 brown soft scale	Yes (Ben-Dov 1993; USDA 2005)	Yes (Ben-Dov *et al*. 2005; Buchan 2008)	Not assessed	Not assessed	Not assessed	No
Saissetia coffeae (Walker, 1852) hemispherical scale	Yes (Ben-Dov 1993; USDA 2005)	Yes (Ben-Dov *et al*. 2005; QDPIF 2005a)	Not assessed	Not assessed	Not assessed	No
Diaspididae						

Pest	Associated with Capsicum crop in the Republic of Korea	Present within Australia	Presence on the commodity (Yes/No/Not assessed)	Potential for establishment and spread (Feasible/Not feasible/Not assessed)	Potential for economic consequences (Significant/Not significant/Not assessed)	Consider further in PRA
Pinnaspis strachani (Cooley, 1899) lesser snow aphid	Yes (Ben-Dov *et al*. 2005; USDA 2005; NPQS 2006)	Yes (Ben-Dov *et al*. 2005; QDPIF 2005a)	Not assessed	Not assessed	Not assessed	No
Pseudaulacaspis pentagona (Targioni Tozzetti, 1886) white peach scale	Yes (Ben-Dov *et al*. 2005; CABI 2006)	Yes (Ben-Dov *et al*. 2005; CABI 2006) Not in WA (DAFWA 2006)	Yes (Ben-Dov *et al*. 2005; CABI 2006)	Feasible Host range spans 115 genera across 55 plant families including capsicum, grape, papaya and peach (Watson 2009). Very limited ability to colonise new hosts (Mopper & Strauss 1998). Can survive extremely low temperatures (MacLeod 2007).	Significant This species can damage a wide range of plant hosts, affecting fruit quality and plant health (Bobb *et al.* 1973; Ball 1980; Yasuda 1983; Kaneko *et al.* 2006; Abbasipour 2007; Malumphy *et al.* 2007).	Yes
Pentatomidae						
Nezara viridula (Linnaeus, 1758) green vegetable bug	Yes (USDA 2005; CABI 2006; NPQS 2006)	Yes (CABI 2006; Knight and Gurr 2007)	Not assessed	Not assessed	Not assessed	No
INSECTA: LEPIDOPTERA						
Gelechiidae						
Phthorimaea operculella (Zeller, 1873) potato tuber moth	Yes (USDA 2004; CABI 2006; NPQS 2006)	Yes (Edwards 1996)	Not assessed	Not assessed	Not assessed	No
Noctuidae						
Agrotis ipsilon (Hufnagel, 1766) black cut worm	Yes (USDA 2004; CABI 2006; NPQS 2006)	Yes (CABI 2006)	Not assessed	Not assessed	Not assessed	No

Pest	Associated with Capsicum crop in the Republic of Korea	Present within Australia	Presence on the commodity (Yes/No/Not assessed)	Potential for establishment and spread (Feasible/Not feasible/Not assessed)	Potential for economic consequences (Significant/Not significant/Not assessed)	Consider further in PRA
Agrotis segetum (Denis & Schiffermüller, 1775) turnip moth	Yes (USDA 2004; CABI 2006; NPQS 2006)	No (CABI 2006)	No Affects leaves, stems and roots of hosts (CABI 2006)	Not assessed	Not assessed	No
Chrysodeixis eriosoma (Doubleday, 1843) green looper caterpillar	Yes (USDA 2004; CABI 2006; NPQS 2006)	Yes (CABI 2006)	Not assessed	Not assessed	Not assessed	No
Eudocima fullonia (Clerck, 1764) fruit piercing moth	Yes (USDA 2004; NPQS 2006)	Yes (CABI 2006)	Not assessed	Not assessed	Not assessed	No
Helicoverpa armigera (Hübner, 1805) cotton boll worm	Yes (USDA 2004; CABI 2006; NPQS 2006)	Yes (EPPO 1997; CABI 2006)	Not assessed	Not assessed	Not assessed	No
Helicoverpa assulta (Guenée, 1852) cape gooseberry budworm	Yes (Yang *et al*. 2004; USDA 2005; NPQS 2006)	Yes (Common 1990; CABI 2006)	Not assessed	Not assessed	Not assessed	No
Mamestra brassicae (Linnaeus, 1758) cabbage moth	Yes (USDA 2005; NPQS 2006)	No (Cassis and Gross 2002)	No Attacks leaves and stems. Capsicum listed as minor host (CABI 2006; NPQS 2006)	Not assessed	Not assessed	No
Spodoptera exigua (Hübner, 1808) lesser armyworm	Yes (USDA 2005; CABI 2006; NPQS 2006)	Yes (Common 1990; CABI 2006)	Not assessed	Not assessed	Not assessed	No
Spodoptera litura (Fabricius, 1775) cluster caterpillar	Yes (USDA 2005; CABI 2006)	Yes (Common 1990; CABI 2006)	Not assessed	Not assessed	Not assessed	No
Trichoplusia ni (Hübner, 1803) cabbage looper	Yes (USDA 2005; NPQS 2006)	No (Cassis and Gross 2002)	No Feeds on leaves, causing dwarfing and dieback of plant (CABI 2006; NPQS 2006).	Not assessed	Not assessed	No
Pyralidae						

Pest	Associated with Capsicum crop in the Republic of Korea	Present within Australia	Presence on the commodity (Yes/No/Not assessed)	Potential for establishment and spread (Feasible/Not feasible/Not assessed)	Potential for economic consequences (Significant/Not significant/Not assessed)	Consider further in PRA
Ostrinia furnacalis (Guenée, 1854) Asian corn borer	Yes (CABI 2006; NPQS 2006)	Yes (Mutuura and Munroe 1970; Common 1990)	Not assessed	Not assessed	Not assessed	No
INSECTA: THYSANOPTERA						
Phlaeothripidae						
Haplothrips chinensis Priesner, 1933 rose thrips	Yes (Woo 1988)	No (Mound 2001)	No Initially recorded in the Republic of Korea on rose, chrysanthemum and other ornamentals (Woo and Paik 1971). Rose is the most common host of this species in Taiwan (Hua *et al*. 1997; Wang 1997). Feeds and oviposits on flowers (Wang 1997). Has been reported on capsicum in the Republic of Korea, but not on the fruit (Woo 1988).	Not assessed	Not assessed	No
Thripidae						

Pest	Associated with Capsicum crop in the Republic of Korea	Present within Australia	Presence on the commodity (Yes/No/Not assessed)	Potential for establishment and spread (Feasible/Not feasible/Not assessed)	Potential for economic consequences (Significant/Not significant/Not assessed)	Consider further in PRA
Frankliniella intonsa (Trybom, 1895) Intonsa flower thrips	Yes (USDA 2005; NPQS 2006)	No (Mound *et al.* 2005)	Yes (NPQS 2006) Oviposits on and feeds on fruit, causing suction injury, of hosts including capsicum (CABI 2006). The damage caused by *F. intonsa* in greenhouse capsicum has been shown to be similar to that caused by *F. occidentalis* (CABI 2006).	Feasible Host range includes capsicum, tomato, cotton, rice and peach (CABI 2006). High reproductive rate - there are up to 22 generations per year, with females each laying up to 76 eggs each (Tang 1976).	Significant Causes a medium level of damage on citrus in the Republic of Korea, and control measures are considered necessary. *Frankliniella intonsa* is associated with economic damage of several crop species: asparagus, chrysanthemum, okra, tomatoes and peas. As part of a pest complex, *F. intonsa* has been associated with economic damage to strawberries in Italy and the UK, lucerne in former Czechoslovakia and nectarines in Greece (CABI 2006).	Yes
Frankliniella occidentalis (Pergande, 1895) western flower thrips	Yes (Han *et al*. 1998; Lee *et al*. 2003; USDA 2005; NPQS 2006)	Yes Not in the NT and under official control in Tas. and the NT (Mound and Teulon 1995; Mound 2001; DPIFM 2007)	Yes Attacks fruit (NPQS 2006). Capsicum plants may be attacked whilst they develop, showing serious distortion as they mature (CABI 2006).	Feasible *Frankliniella occidentalis* has a very broad host range including cucurbits, chrysanthemum, cotton, grapes, citrus and apple (CABI 2006). High reproductive rate (Katayama 1997), with more than one generation per year (McDonald *et al*. 1998). Adults are capable of flight (Pearsall 2002).	Significant *F. occidentalis* is a pest of several economically important crop species (CABI 2006).	Yes (For NT and Tas.)
Heliothrips haemorrhoidalis (Bouché, 1833) greenhouse thrips	Yes (CABI 2006)	Yes (Zabaras *et al.* 1999)	Not assessed	Not assessed	Not assessed	No

Pest	Associated with Capsicum crop in the Republic of Korea	Present within Australia	Presence on the commodity (Yes/No/Not assessed)	Potential for establishment and spread (Feasible/Not feasible/Not assessed)	Potential for economic consequences (Significant/Not significant/Not assessed)	Consider further in PRA
Scirtothrips dorsalis Hood, 1919 chilli thrips	Yes (USDA 2005; CABI 2006)	Yes (Collins *et al.* 2006; Hodges *et al.* 2005)	Not assessed	Not assessed	Not assessed	No
Thrips hawaiiensis (Morgan, 1913) banana flower thrips	Yes (USDA 2005; NPQS 2006)	Yes (Reynaud *et al.* 2008)	Not assessed	Not assessed	Not assessed	No
Thrips palmi Karny, 1925 melon thrips	Yes (USDA 2005; CABI 2006; NPQS 2006)	Yes (EPPO 1997; Mound 2007) Restricted distribution in WA. (DAFWA 2006) WA, SA, Tas., and the NT apply quarantine restrictions for movement of melon thrips hosts (QDPIF 2005b)	Yes High population numbers may cause a silvery or bronzed appearance on plant surfaces, especially on the midrib and veins of leaves and on the surface of fruit (CABI 2006).	Feasible Main hosts are plants in the Cucurbitaceae and Solanaceae families (CABI 2006). Short lifecycle of about 18 days and high fecundity of up to 200 eggs per female (Wang *et al.* 1989).	Significant It is a major pest of cucurbits and solanaceous pests in many tropical regions (CABI 2006).	Yes (For NT, SA, Tas. and WA)
Thrips tabaci Lindeman, 1889 onion thrips	Yes (USDA 2005)	Yes (Herron *et al.* 2006)	Not assessed	Not assessed	Not assessed	No
BACTERIA						
Clavibacter michiganensis subsp. *michiganensis* (Smith 1910) Davis *et al.* 1984 bacterial canker	Yes (USDA 2005; NPQS 2006)	Yes (Bradbury 1986)	Not assessed	Not assessed	Not assessed	No

Pest	Associated with Capsicum crop in the Republic of Korea	Present within Australia	Presence on the commodity (Yes/No/Not assessed)	Potential for establishment and spread (Feasible/Not feasible/Not assessed)	Potential for economic consequences (Significant/Not significant/Not assessed)	Consider further in PRA
Dickeya chrysanthemi (Burkholder *et al*. 1953) Sampson *et al*. 2005 Syn.: *Pectobacterium chrysanthemi* (Burkholder *et al*. 1953) Brenner *et al*. 1973 bacterial soft rot	Yes (USDA 2005; CABI 2006)	Yes (Cother 1979; Peltzer and Sivasithamparam 1985)	Not assessed	Not assessed	Not assessed	No
Pectobacterium carotovor subsp. *atrosepticum* (van Hall 1902) Hauben *et al*. 1999 blackleg	Yes (USDA 2005)	Yes (Bradbury 1986; CABI 2006)	Not assessed	Not assessed	Not assessed	No
Pectobacterium carotovorum subsp. *carotovorum* (Jones 1901) Hauben *et al*. 1999 bacterial stem rot	Yes (USDA 2004; CABI 2006; NPQS 2006)	Yes (Cother 1979)	Not assessed	Not assessed	Not assessed	No
Pseudomonas cichorii (Swingle 1925) Stapp 1928 chicory bacterial blight	Yes (USDA 2005; CABI 2006)	Yes (CABI 2006)	Not assessed	Not assessed	Not assessed	No
Pseudomonas fuscovaginae (ex Tanii *et al*. 1976) Miyajima *et al*. 1983 rice soft rot	Yes (Yi and Seo 2000; NPQS 2006)	No (CABI 2006)	No Causes soft rot of fruit (NPQS 2006). Diseased fruit has soft-rotted sarcocarp and decolorized pericarps. Hypersensitive lesions may appear on leaves (Yi and Seo 2000). Diseased fruit would not be packed for export.	Not assessed	Not assessed	No
Pseudomonas marginalis (Brown 1918) Stevens 1925 lettuce marginal leaf blight	Yes (USDA 2005; CABI 2006)	Yes (CABI 2006) Not in WA (DAFWA 2003)	No Affects fruit, leaf, stem and root. Primarily causes lesions of the leaves of hosts, may cause soft lesions on fruit of hosts (USDA 2005). Diseased fruit would not be packed for export.	Not assessed	Not assessed	No

Pest	Associated with Capsicum crop in the Republic of Korea	Present within Australia	Presence on the commodity (Yes/No/Not assessed)	Potential for establishment and spread (Feasible/Not feasible/Not assessed)	Potential for economic consequences (Significant/Not significant/Not assessed)	Consider further in PRA
Pseudomonas syringae pv. *aptata* (Brown & Jamieson 1913) Young *et al*. 1978 sugarbeet leaf spot	Yes (USDA 2005; CABI 2006)	Yes (CABI 2006) Not in WA (DAFWA 2003)	No Affects leaves (Bradbury 1986).	Not assessed	Not assessed	No
Pseudomonas syringae pv. *tabaci* (Wolf & Foster 1917) Young *et al*. 1978 angular leaf spot	Yes (USDA 2005; CABI 2006)	Yes (CABI 2006)	Not assessed	Not assessed	Not assessed	No
Pseudomonas syringae van Hall 1902 bacterial canker	Yes (USDA 2005; CABI 2006)	Yes (CABI 2006)	Not assessed	Not assessed	Not assessed	No
Pseudomonas viridiflava (Burkholder 1930) Dowson 1939 bean bacterial blight	Yes (USDA 2005; CABI 2006; NPQS 2006)	Yes (CABI 2006)	Not assessed	Not assessed	Not assessed	No
Ralstonia solanacearum (Smith 1896) Yabuuchi *et al*. 1996 bacterial wilt	Yes Phylotype I/biovar 3/race 1 Phylotype I/biovar 4/race 1 (Jeong *et al.* 2007)	Yes (Pitkethley 1981; Cook and Sequeira 1991) Biovar 2/ race 3 under official control in WA (Stansbury *et al.* 2007; DAFWA 2008) Movement of capsicums into WA from eastern states where *Ralstonia solanacearum* occurs is not regulated.	Not assessed	Not assessed	Not assessed	No

Pest	Associated with Capsicum crop in the Republic of Korea	Present within Australia	Presence on the commodity (Yes/No/Not assessed)	Potential for establishment and spread (Feasible/Not feasible/Not assessed)	Potential for economic consequences (Significant/Not significant/Not assessed)	Consider further in PRA
Rhizobium radiobacter (Beijerinck & van Delden 1902) Young *et al*. 2001 crown gall	Yes (USDA 2005; NPQS 2006)	Yes (CABI 2006)	Not assessed	Not assessed	Not assessed	No
Xanthomonas vesicatoria (ex Doidge 1920) Vauterin *et al*. 1995 bacterial spot	Yes (CABI 2006; NPQS 2006)	Yes (CABI 2006)	Not assessed	Not assessed	Not assessed	No
FUNGI						
Alternaria alternata (Fr.: Fr.) Keissl. alternaria leaf spot	Yes (USDA 2005; CABI 2006; Farr *et al*. 2006; NPQS 2006)	Yes (CABI 2006; Taylor *et al*. 1998)	Not assessed	Not assessed	Not assessed	No
Alternaria solani Sorauer early blight	Yes (USDA 2005; NPQS 2006)	Yes (CABI 2006; Vloutoglou and Kalogerakis 2000)	Not assessed	Not assessed	Not assessed	No
Alternaria tenuissima (Kunze) Wiltshire black mould	Yes (Farr *et al*. 2006; NPQS 2006)	Yes (Farr *et al*. 2006; Giles *et al*. 2002)	Not assessed	Not assessed	Not assessed	No
Ascochyta capsici Bond.-Mont. leaf spot	Yes (USDA 2005; NPQS 2006)	No (DAFWA 2003; Farr *et al*. 2006)	No Only affects leaves (USDA 2004; NPQS 2006).	Not assessed	Not assessed	No
Aspergillus niger Tiegh. black mould	Yes (USDA 2005; CABI 2006)	Yes (CABI 2006; Farr *et al*. 2006; Sinclair and Letham 1996)	Not assessed	Not assessed	Not assessed	No
Botrytis cinerea Pers.: Fr. grey mould	Yes (USDA 2005; CABI 2006; USDA 2006)	Yes (CABI 2006; Tomas *et al*. 1995)	Not assessed	Not assessed	Not assessed	No

Pest	Associated with Capsicum crop in the Republic of Korea	Present within Australia	Presence on the commodity (Yes/No/Not assessed)	Potential for establishment and spread (Feasible/Not feasible/Not assessed)	Potential for economic consequences (Significant/Not significant/Not assessed)	Consider further in PRA
Cercospora capsici Heald & F.A. Wolf frog eye leaf spot of pepper	Yes (USDA 2005; NPQS 2006)	Yes (APPD 2006) Not in WA (DAFWA 2003)	No Causes circular, whitish, grey or brown, often brown or reddish brown bordered leaf spots (Kirk 1982). Fruit are not infected (Cerkauskas 2004a).	Not assessed	Not assessed	No
Choanephora cucurbitarum (Berk. & Ravenel) Thaxt. choanephora wet rot	Yes (USDA 2005)	Yes (CABI 2006) Not in WA (DAFWA 2003)	No In Florida on capsicums, this fungus generally originates on declining flowers and then spreads to the leaves and stems, causing a 'wet-rot' and eventually, dieback (Dougherty 1980). Young fruit may become infected, soften and abort with the fungal growth apparent on the fruit (Pernezny and Momol 2006). This species has been recorded as a post-harvest rot of *C. annuum* in markets in Andhra Pradesh, India (Prabhavathy and Reddy 1995). Infected fruit rot quickly and would be discarded during harvesting, grading and packing.	Not assessed	Not assessed	No
Cladosporium herbarum (Pers.:Fr.) Link cladosporium rot	Yes (USDA 2005; CABI 2006; NPQS 2006)	Yes (Farr *et al*. 2006)	Not assessed	Not assessed	Not assessed	No
Colletotrichum acutatum J.H. Simmonds anthracnose	Yes (USDA 2005; CABI 2006; NPQS 2006)	Yes (CABI 2006; Farr *et al*. 2006)	Not assessed	Not assessed	Not assessed	No
Colletotrichum coccodes (Wallr.) S. Hughes anthracnose	Yes (USDA 2005; CABI 2006; Farr *et al*. 2006; NPQS 2006)	Yes (CABI 2006; Farr *et al*. 2006)	Not assessed	Not assessed	Not assessed	No

Pest	Associated with Capsicum crop in the Republic of Korea	Present within Australia	Presence on the commodity (Yes/No/Not assessed)	Potential for establishment and spread (Feasible/Not feasible/Not assessed)	Potential for economic consequences (Significant/Not significant/Not assessed)	Consider further in PRA
Colletotrichum dematium (Pers.: Fr.) Grove Cited as *Colletotrichum dematium* f.sp. *capsicum* by NPQS (2006) anthracnose	Yes (USDA 2005; Farr *et al*. 2006; NPQS 2006)	Yes (Farr *et al*. 2006)	Not assessed	Not assessed	Not assessed	No
Colletotrichum gloesporioides (Penz.) Penz. & Sacc. Teleomorph: *Glomerella cingulata* (Stoneman) Spauld. & H Schrenk anthracnose	Yes (USDA 2005; CABI 2006; Farr *et al*. 2006; NPQS 2006)	Yes (CABI 2006; Farr *et al*. 2006)	Not assessed	Not assessed	Not assessed	No
Corynespora cassiicola (Berk. & M.A. Curtis) C.T. Wei. leaf spot	Yes (Kwon *et al*. 2001; USDA 2005; NPQS 2006)	Yes (CABI 2006; Farr *et al*. 2006) Not in WA (DAFWA 2003)	No Causes leaf spot on *Capsicum annuum* in the Republic of Korea (Kwon *et al*. 2001)	Not assessed	Not assessed	No
Diaporthe phaseolorum (Cooke & Ellis) Sacc. Anamorph: *Phomopsis phaseolin* (Desm.) Sacc. pod blight of soybean	Yes (Punithalingam and Holliday 1972; USDA 2005; NPQS 2006)	Yes (CABI 2006) Not in WA (DAFWA 2003)	No Causes dieback (CABI 2006)	Not assessed	Not assessed	No
Fusarium equiseti (Corda) Sacc. Teleomorph: *Gibberella intricans* Wollenw fruit rot	Yes (USDA 2005)	Yes (CABI 2006)	Not assessed	Not assessed	Not assessed	No
Fusarium oxysporum Schltdl.: Fr. basal rot	Yes (USDA 2005; Farr *et al*. 2006; NPQS 2006)	Yes (CABI 2006; Farr *et al*. 2006)	Not assessed	Not assessed	Not assessed	No

Pest	Associated with Capsicum crop in the Republic of Korea	Present within Australia	Presence on the commodity (Yes/No/Not assessed)	Potential for establishment and spread (Feasible/Not feasible/Not assessed)	Potential for economic consequences (Significant/Not significant/Not assessed)	Consider further in PRA
Haematonectria haematococca (Berk. & Broome) Samuels & Rossman Anamorph: *Fusarium solani* (Mart.) Sacc. potato dry rot	Yes (USDA 2005; CABI 2006; Farr *et al*. 2006)	Yes (CABI 2006; Farr *et al*. 2006)	Not assessed	Not assessed	Not assessed	No
Leveillula taurica (Lév.) G. Arnaud Anamorph: *Oidiopsis sicula* Scalia powdery mildew	Yes (USDA 2005; CABI 2006; Farr *et al*. 2006)	Yes (CABI 2006; Farr *et al*. 2006)	Not assessed	Not assessed	Not assessed	No
Macrophomina phaseolina (Tassi) Goid. charcoal rot	Yes (USDA 2005; CABI 2006; Farr *et al*. 2006)	Yes (CABI 2006; Farr *et al*. 2006)	Not assessed	Not assessed	Not assessed	No
Phoma destructiva Plowr. fruit and stem rot	Yes (USDA 2005; Farr *et al*. 2006; NPQS 2006)	Yes (Farr *et al*. 2006)	Not assessed	Not assessed	Not assessed	No
Rhizoctonia solani J.G. Kühn Teleomorph: *Thanatephorus cucumeri* (A.B. Frank) Donk 1956 soil rot	Yes (Farr *et al*. 2006; NPQS 2006)	Yes (Farr *et al*. 2006)	Not assessed	Not assessed	Not assessed	No
Rhizopus stolonifer (Ehrenb.: Fr.) Vuill. rhizopus rot	Yes (USDA 2005; CABI 2006; Farr *et al*. 2006; NPQS 2006)	Yes (CABI 2006; Farr *et al*. 2006)	Not assessed	Not assessed	Not assessed	No
Sclerotinia sclerotiorum (Lib.) de Bary cottony soft rot	Yes (USDA 2005; CABI 2006; Farr *et al*. 2006; NPQS 2006)	Yes (CABI 2006; Farr *et al*. 2006)	Not assessed	Not assessed	Not assessed	No
Sclerotium rolfsii Sacc. Teleomorph: Athelia rolfsii (Curzi) Tu & Kimbr. sclerotium rot	Yes (USDA 2005; CABI 2006; Farr *et al*. 2006)	Yes (CABI 2006; Farr *et al*. 2006)	Not assessed	Not assessed	Not assessed	No

Pest	Associated with Capsicum crop in the Republic of Korea	Present within Australia	Presence on the commodity (Yes/No/Not assessed)	Potential for establishment and spread (Feasible/Not feasible/Not assessed)	Potential for economic consequences (Significant/Not significant/Not assessed)	Consider further in PRA
Septoria lycopersici Speg. tomato leaf spot	Yes (USDA 2005; CABI 2006; Farr *et al*. 2006; NPQS 2006)	Yes (CABI 2006; Farr *et al*. 2006)	Not assessed	Not assessed	Not assessed	No
Stemphylium lycopersici (Enjoji) W. Yamam. grey leaf spot	Yes (USDA 2005; Farr *et al*. 2006; NPQS 2006)	Yes (DAFWA 2003)	Not assessed	Not assessed	Not assessed	No
Stemphylium solani G.F. Weber grey leaf spot	Yes (USDA 2005; Farr *et al*. 2006; NPQS 2006)	Yes (Farr *et al*. 2006)	Not assessed	Not assessed	Not assessed	No
Verticillium albo-atrum Reinke & Berthier verticillium wilt	Yes (USDA 2005; Farr *et al*. 2006)	Yes (CABI 2006; Farr *et al*. 2006)	Not assessed	Not assessed	Not assessed	No
Verticillium dahliae Kleb. verticillium wilt	Yes (USDA 2005; Farr *et al*. 2006)	Yes (CABI 2006; Farr *et al*. 2006)	Not assessed	Not assessed	Not assessed	No
STRAMINOPILA						
Peronospora hyoscyami (Rabenh.) de Bary tobacco blue mould	Yes (USDA 2005)	Yes (CABI 2006; Farr *et al*. 2006)	Not assessed	Not assessed	Not assessed	No
Phytophthora capsici Leonian capsicum stem and fruit rot	Yes (Choi and Park 1982; Choe 1989; USDA 2005; Farr *et al*. 2006; NPQS 2006)	Yes (Weinert *et al*. 1999; Farr *et al*. 2006)	Not assessed	Not assessed	Not assessed	No
Phytophthora infestans (Mont.) de Bary phytophthora blight	Yes (USDA 2005; CABI 2006; Farr *et al*. 2006)	Yes (CABI 2006; Farr *et al*. 2006)	Not assessed	Not assessed	Not assessed	No

Pest	Associated with Capsicum crop in the Republic of Korea	Present within Australia	Presence on the commodity (Yes/No/Not assessed)	Potential for establishment and spread (Feasible/Not feasible/Not assessed)	Potential for economic consequences (Significant/Not significant/Not assessed)	Consider further in PRA
Phytophthora nicotianae Breda de Haan black shank	Yes (USDA 2005; CABI 2006; Farr *et al*. 2006; NPQS 2006)	Yes (CABI 2006; Farr *et al*. 2006)	Not assessed	Not assessed	Not assessed	No
Pythium aphanidermatum (Edson) Fitzp. damping off	Yes (USDA 2005; Farr *et al*. 2006)	Yes (CABI 2006; Farr *et al*. 2006)	Not assessed	Not assessed	Not assessed	No
Pythium debaryanum auct. non R. Hesse damping off	Yes (USDA 2005; CABI 2006; Farr *et al*. 2006)	Yes (CABI 2006; Farr *et al*. 2006)	Not assessed	Not assessed	Not assessed	No
Pythium myriotylum Drechsler groundnut brown rot	Yes (USDA 2005; CABI 2006; Farr *et al*. 2006)	Yes (CABI 2006; Farr *et al*. 2006)	Not assessed	Not assessed	Not assessed	No
Pythium spinosum Sawada damping off	Yes (USDA 2005; Farr *et al*. 2006)	Yes (Farr *et al*. 2006)	Not assessed	Not assessed	Not assessed	No
Pythium ultimum Trow damping off	Yes (USDA 2005; CABI 2006; Farr *et al*. 2006; NPQS 2006)	Yes (CABI 2006; Farr *et al*. 2006)	Not assessed	Not assessed	Not assessed	No
VIRUSES						
Alfalfa mosaic virus (*Alfamovirus*)	Yes (USDA 2004; CABI 2006; NPQS 2006)	Yes (Coutts and Jones 2002)	Not assessed	Not assessed	Not assessed	No
Beet curly top virus (*Hibriheminivirus*)	Yes (USDA 2004; CABI 2006)	No (Brunt *et al*. 1996; CABI 2006)	Yes Virus causes systemic infections in capsicum plants, causing rigid, dwarfed, yellowed, twisted and malformed leaves and stimulation of axillary buds (Brunt *et al*. 1996).	Not feasible Vectored by the cicadellids *Neoaliturus tenellus* and *N. opacipennis* in a persistent manner (Brunt *et al*. 1996). Vectors not on the pathway and not in Australia.	Not assessed	No

Pest	Associated with Capsicum crop in the Republic of Korea	Present within Australia	Presence on the commodity (Yes/No/Not assessed)	Potential for establishment and spread (Feasible/Not feasible/Not assessed)	Potential for economic consequences (Significant/Not significant/Not assessed)	Consider further in PRA
Broad bean wilt virus (*Fabavirus*)	Yes (Lee *et al*. 2000; USDA 2004; NPQS 2006)	Yes (Brunt *et al*. 1996) Not in WA (DAFWA 2003)	No Causes necrotic spots or streaks on leaves and stems, followed by stunting and death of plants (Lee *et al*. 2000).	Not assessed	Not assessed	No
Chilli veinal mottle virus (*Potyvirus*)	Yes (USDA 2004; CABI 2006)	No (Brunt *et al*. 1996; CABI 2006)	Yes Virus causes systemic infections in capsicum plants, causing dark green mottling adjacent to main leaf veins, reduction in size and distortion of leaves and stunting of plants (Brunt *et al*. 1996).	Feasible Transmitted by the aphid vectors *Aphis craccivora*, *A. gossypii*, *A. spiraecola*, *Myzus persicae*, *Toxoptera citricidus*, *Hysteroneura setarieae* and *Rhopalosiphum maidis* in a non-persistent manner (Brunt *et al*. 1996). Aphids probe plants to test their suitability and fly in search of a suitable plant, probably assisting virus spread (Matthews 1991; Powell *et al*. 2006; Moorman 2008).	Significant This virus infects crops of capsicum and chilli pepper (Brunt *et al*. 1996; Goldberg 2001). Potyvirus diseases in capsicum crops are a common cause of loss (Green and Kim 1991).	Yes
Cucumber mosaic virus (*Cucumovirus*)	Yes (Kim *et al*. 1990a; USDA 2004; NPQS 2006)	Yes *Cucumber mosaic virus* subgroups I and II are recorded on capsicum in Australia (Perry *et al.* 1993)	Not assessed	Not assessed	Not assessed	No

Pest	Associated with Capsicum crop in the Republic of Korea	Present within Australia	Presence on the commodity (Yes/No/Not assessed)	Potential for establishment and spread (Feasible/Not feasible/Not assessed)	Potential for economic consequences (Significant/Not significant/Not assessed)	Consider further in PRA
Peanut stunt virus (*Cucumovirus*)	Yes (USDA 2004)	No (Brunt *et al*. 1996; CABI 2006)	Yes Virus causes systemic infections in plants, causing mottling and mosaic symptoms (Brunt *et al*. 1996).	Not assessed This virus was not assessed, as it may be seedborne in capsicum seed (Brunt *et al*. 1996) for planting that is permitted entry into Australia.	Not assessed	No
Pepper mild mottle virus (*Tobamovirus*)	Yes (NPQS 2006)	Yes (CABI 2006) Not in WA (DAFWA 2003)	Yes Fruits on infected plants are small, malformed, mottled and have necrotic depressions (Brunt *et al*. 1996). Most infected fruit would be discarded during harvesting and grading operations.	Not assessed This virus was not assessed, as it may be seedborne in capsicum seed (Brunt *et al*. 1996) for planting that is permitted entry into Western Australia.	Not assessed	No
Pepper mottle virus (*Potyvirus*)	Yes (NPQS 2006)	No (CABI 2006)	Yes Virus causes systemic infections in capsicum plants, causing mottling and malformation of leaves (Brunt *et al*. 1996).	Feasible Transmitted by the aphid vectors *Aphis craccivora*, *A. gossypii*, *A. spiraecola*, *Myzus persicae*, *Toxoptera citricidus*, *Hysteroneura setarieae* and *Rhopalosiphum maidis* in a non-persistent manner (Brunt *et al*. 1996). Aphids probe plants to test their suitability and fly in search of a suitable plant, probably assisting virus spread (Matthews 1991; Powell *et al*. 2006; Moorman 2008).	Significant Potyvirus diseases in capsicum crops are a common cause of loss (Green and Kim 1991). Infection with this virus may substantially reduce yields and may result in deformed or discoloured fruit or necrotic lesions in tubers (Cerkauskas 2004b, 2004c; Kerlan 2006). Infected plants may lose leaves, their crowns may die, and they may collapse (Green and Kim 1991; Kerlan 2006).	Yes

Pest	Associated with Capsicum crop in the Republic of Korea	Present within Australia	Presence on the commodity (Yes/No/Not assessed)	Potential for establishment and spread (Feasible/Not feasible/Not assessed)	Potential for economic consequences (Significant/Not significant/Not assessed)	Consider further in PRA
Pepper vein chlorosis virus	Yes (Kim *et al*. 1990b; NPQS 2006)	Not known to occur outside of the Republic of Korea (Gildow *et al*. 2004).	Yes Virus causes systemic infections in capsicum plants (Kim *et al*. 1990b).	Feasible Virus transmitted by various aphid vectors present in Australia in a non-persistent manner (Blackman and Eastop 1994; Kim *et al*. 1986; Choo *et al*. 1987; Kim *et al*. 1991; Brunt *et al*. 1996; Vuong *et al*. 2001; USDA 2005; CABI 2006; NPQS 2006).	Significant Infected plants lose leaves, buds die, and necrosis develops, which may be progressive, causing plant death (Kim *et al*. 1990a, 1990b, 1991).	Yes
Pepper vein mosaic virus	Yes (Kim *et al*. 1991)	Not known to occur outside of the Republic of Korea (Gildow *et al*. 2004).	Yes Virus causes systemic infections in capsicum plants (Kim *et al*. 1991).	Feasible Virus transmitted by various aphid vectors present in Australia in a non-persistent manner (Blackman and Eastop 1994; Kim *et al*. 1986; Choo *et al*. 1987; Kim *et al*. 1991; Brunt *et al*. 1996; Vuong *et al*. 2001; USDA 2005; CABI 2006; NPQS 2006).	Significant Infected plants have chlorotic veins and mosaic patterns on the leaves (Kim *et al*. 1991), and it is likely that infection causes substantial yield losses (Bos 1999).	Yes
Potato leafroll virus (*Luteovirus*)	Yes (USDA 2004; CABI 2006)	Yes (Brunt *et al*. 1996; CABI 2006)	Not assessed	Not assessed	Not assessed	No
Potato X virus (*Potexvirus*)	Yes (USDA 2004)	Yes (Brunt *et al*. 1996; CABI 2006)	Not assessed	Not assessed	Not assessed	No

Pest	Associated with Capsicum crop in the Republic of Korea	Present within Australia	Presence on the commodity (Yes/No/Not assessed)	Potential for establishment and spread (Feasible/Not feasible/Not assessed)	Potential for economic consequences (Significant/Not significant/Not assessed)	Consider further in PRA
Potato Y virus (*Potyvirus*)	Yes (USDA 2004; CABI 2006; NPQS 2006)	Yes (Brunt *et al*. 1996; CABI 2006) Not known to be present and under official control in WA (Jones et al. 2003; DAFWA 2008) Movement of capsicums into WA from eastern states where *Potato Y virus* occurs is not regulated.	Not assessed	Not assessed	Not assessed	No
Tobacco mild green mosaic virus (*Tobamovirus*)	Yes (NPQS 2006)	Yes (Fraile *et al*. 1996) Not in WA (DAFWA 2003).	No Virus causes severe necrotic mosaic with infected plants often killed (Brunt *et al*. 1996). Infected fruit would be discarded during harvesting and grading operations.	Not assessed	Not assessed	No
Tobacco mosaic satellite virus (Satellite virus)	Yes (USDA 2004; CABI 2006; NPQS 2006)	No (Brunt *et al*. 1996; CABI 2006)	No This satellite virus is found naturally associated with *tobacco mild green mosaic virus* (Brunt *et al*. 1996). Infected fruit would be discarded during harvesting and grading operations.	Not assessed	Not assessed	No

Pest	Associated with Capsicum crop in the Republic of Korea	Present within Australia	Presence on the commodity (Yes/No/Not assessed)	Potential for establishment and spread (Feasible/Not feasible/Not assessed)	Potential for economic consequences (Significant/Not significant/Not assessed)	Consider further in PRA
Tobacco rattle virus (*Tobravirus*)	Yes (USDA 2004)	Yes (Brunt *et al*. 1996; CABI 2006) Not in WA (DAFWA 2003)	Yes Virus causes systemic infections in *Capsicum annum*, causing ringspots or line patterns (Brunt *et al*. 1996).	Not assessed This virus was not assessed, as it may be seedborne in capsicum seed (Brunt *et al*. 1996) for planting that is permitted entry into Western Australia.	Not assessed	No
Tobacco ringspot virus (*Nepovirus*)	Yes (USDA 2004)	Yes (Brunt *et al*. 1996; CABI 2006) Not in WA (DAFWA 2003)	Yes Virus causes systemic infections in plants, causing necrotic spots, mottling, chlorotic ringspots and vein banding. Symptoms disappear soon after infection. (Brunt *et al*. 1996).	Not assessed This virus was not assessed, as it may be seedborne in capsicum seed (Brunt *et al*. 1996) for planting that is permitted entry into Western Australia.	Not assessed	No
Tomato mosaic virus (*Tobamovirus*)	Yes (USDA 2004; NPQS 2006)	Yes (Brunt *et al*. 1996; CABI 2006)	Not assessed	Not assessed	Not assessed	No
Tomato spotted wilt virus (*Tospovirus*)	Yes (USDA 2004)	Yes (Brunt *et al*. 1996; CABI 2006)	Not assessed	Not assessed	Not assessed	No

Appendix B: Additional data for quarantine pests

Quarantine pest	*Pseudaulacaspis pentagona* (Targioni Tozzetti, 1886) MacGillivray, 1921
Synonyms	*Diaspis pentagona* Targioni Tozzetti, 1886 *Aulacaspis pentagona* (Targioni Tozzetti) Cockerell, 1902 *Diaspis amygdali* Tryon, 1889 *Pseudaulacaspis amygdali* Tryon, 1889 *Sasakiaspis pentagona* (Targioni Tozzetti), Kuwana, 1926 *Diaspis lanatus* Cockerell, 1892 *Diaspis patelliformis* Sasaki, 1894 *Aspidiotus vitiensis* Maskell, 1895 *Diaspis auranticolor* Cockerell, 1899 *Diaspis amygdali var. rubra* Maskell, 1889 *Diaspis geranii* Maskell, 1897 *Chionaspis prunicola* Maskell, 1895 *Diaspis lanata* (Cockerell) Green, 1896 *Howardia prunicola* (Maskell) Kirkaldy, 1902 *Aulacaspis pentagona rubra* (Maskell) Fernald, 1903 *Aulacaspis pentagona auranticolor* (Cockerell) Carnes, 1907 *Epidiaspis vitiensis* (Maskell) Lindinger, 1937 *Aspidiotus lanatus* (Cockerell) Ferris, 1941 *Diaspis rubra* (Maskell) Scott, 1952 *Pseudaulacaspis prunicola*
Common name(s)	white peach scale mulberry scale West Indian peach scale white scale peach scale
Main hosts	*Abelmoschus esculentus* (okra), *Carica papya* (papaw), *Celtis* (nettle tree), *Euonymus* (spindle trees), *Malus* (ornamental species apple), *Nerium* (oleander), *Prunus* (stone fruit), *Prunus armeniaca* (apricot), *Prunus aviam* (sweet cherry), *Prunus persica* (peach), *Pyrus* (pears), *Ribes* (currants), *Rubus* (blackberry, raspberry), *Vitis* (grapes) (CABI 2006)
Distribution	This species is distributed across Africa, Asia, Europe, Central, North and South America, and Oceania (CABI 2006). Not present in Western Australia (DAFWA 2008).
Quarantine pest	*Frankliniella intonsa* (Trybom, 1895)
Synonyms	*Frankliniella intonsa f. norashensis* Yakhontov & Jurbanov, 1957 *Thrips intonsa* Trybom, 1895 *Frankliniella formosae* Moulton, 1928
Common name(s)	Intonsa flower thrips
Main hosts	*Abelmoschus esculentus* (okra), *Arachis hypogaea* (groundnut), *Asparagus officinalis* (asparagus), *Capsicum annuum* (capsicum), *Chrysanthemum indicum* (chrysanthemum), *Fragaria* (strawberry), *Glycine max* (soyabean), *Gossypium* (cotton), *Lycopersicon esculentum* (tomato), *Medicago sativa* (lucerne), *Oryza sativa* (rice), *Phaseolus vulgaris* (common bean), *Pisum sativum* (pea), *Prunus persica* (peach), *Vigna angularis* (adzuki bean) (CABI 2006)
Distribution	This species is distributed across Asia, Europe and North America (CABI 2006).

Quarantine pest	*Frankliniella occidentalis* (Pergande, 1895)
Synonyms	*Euthrips helianthi* Moulton, 1911 *Euthrips tritici californicus* Moulton, 1911 *Frankliniella chrysanthemi* Kurosawa, 1941 *Frankliniella canadensis* Morgan, 1925 *Frankliniella claripennis* Morgan, 1925 *Frankliniella conspicua* Moulton, 1936 *Frankliniella dahliae* Moulton, 1948 *Frankliniella dianthi* Moulton, 1948 *Frankliniella nubila* Treherne, 1924 *Frankliniella occidentalis brunnescens* Priesner, 1932 *Frankliniella occidentalis dubia* Priesner, 1932 *Frankliniella syringae* Moulton, 1948 *Frankliniella trehernei* Morgan, 1925 *Frankliniella tritici maculata* Priesner, 1925 *Frankliniella tritici moultoni* Hood, 1914 *Frankliniella umbrosa* Moulton, 1948 *Frankliniella venusta* Moulton, 1936
Common name(s)	Western flower thrips
Main hosts	*Allium cepa* (onion), *Amaranthus palmeri* (Palmer amaranth), *Arachis hypogaea* (groundnut), *Beta vulgaris* (beetroot), *Beta vulgaris* var. *saccharifera* (sugarbeet), *Brassica oleracea* var. *capitata* (cabbage), *Capsicum annuum* (capsicum), *Carthamus tinctorius* (safflower), *Chrysanthemum morifolium* (chrysanthemum), *Citrus* x *paradisi* (grapefruit), *Cucumis melo* (melon), *Cucumis sativus* (cucumber), *Cucurbita maxima* (giant pumpkin), *Cucurbita pepo* (ornamental gourd), *Cyclamen*, *Dahlia*, *Daucus carota* (carrot), *Dianthus caryophyllus* (carnation), *Euphorbia pulcherrima* (poinsettia), *Ficus carica* (fig), *Fragaria ananassa* (strawberry), *Fuchsia*, *Geranium* (cranesbill), *Gerbera jamesonii* (African daisy), *Gladiolus hybrids* (sword lily), *Gossypium* (cotton), *Gypsophila* (baby's breath), *Hibiscus* (rosemallows), *Impatiens* (balsam), *Kalanchoe*, Lactuca *sativa* (lettuce), *Lathyrus odoratus* (sweet pea), *Leucaena leucocephala* (leucaena), *Limonium* sinuatum (sea pink), *Lisianthus*, *Lycopersicon esculentum* (tomato), *Malus domestica* (apple), *Medicago sativa* (lucerne), Orchidaceae (orchids), *Petroselinum crispum* (parsley), *Phaseolus vulgaris* (common bean), Pisum *sativum* (pea), *Prunus armeniaca* (apricot), *Prunus domestica* (plum), *Prunus persica* (peach), *Prunus persica* var. *nucipersica* (nectarine), *Purshia tridentata* (bitterbrush), *Raphanus raphanistrum* (wild radish), *Rhododendron* (Azalea), *Rosa* (roses), *Saintpaulia ionantha* (African violet), *Salvia* (sage), *Secale cereale* (rye), *Sinapis arvensis* (wild mustard), *Sinningia speciosa* (gloxinia), *Solanum melongena* (aubergine), *Sonchus* (Sowthistle), *Syzygium jambos* (rose apple), *Trifolium* (clovers), *Triticum aestivum* (wheat), *Vitis vinifera* (grapevine) (CABI 2006)
Distribution	Asia, Europe, North Central and South America, New Zealand and Australia (CABI 2006). Under official control in Tasmania and not present in the Northern Territory (DPIFM 2007).
Quarantine pest	*Thrips palmi* Karny, 1925
Synonyms	*Chloethrips aureus Ananthrakrishnan & Jagadish, 1967* *Thrips gossypicola (Priesner, 1939)* *Thrips gracilis Ananthrakrishnan & Jagadish, 1968* *Thrips leucadophilus Priesner, 1936*
Common name(s)	Melon thrips
Main hosts	*Allium cepa* (onion), *Capsicum annum* (capsicum), *Chrysanthemum* (daisy), *Citrus*, *Cucumis melo* (melon), *Cucumis sativus* (cucumber), *Cucurbita pepo* (ornamental gourd), Fabaceae (leguminous plants), *Glycine max* (soyabean), *Gossypium* (cotton), *Helianthus annuus* (sunflower), *Lactuca sativa* (lettuce), *Lycopersicon esculentum* (tomato), *Mangifera indica* (mango), *Nicotiana tabacum* (tobacco), Orchidaceae (orchids), *Oryza sativa* (rice), *Persea americana* (avocado), *Phaseolus* (beans), *Phaseolus vulgaris* (common bean), *Sesamum indicum* (sesame), *Solanum melongena* (aubergine), *Solanum tuberosum* (potato), *Vigna unguiculata* (cowpea) (CABI 2006)

Distribution	Asia, Africa, North Central and South America, Oceania (CABI 2006). In Australia, restricted to parts of southeast Queensland, northwest Western Australia and the Darwin area (Northern Territory) (EPPO 1997; DAFWA 2006; Mound 2007). WA, SA, Tas., and the NT apply quarantine restrictions for movement of melon thrips hosts (QDPIF 2005b; NTRDPIFR 2008).
Quarantine pest	Pepper vein chlorosis virus and Pepper vein mosaic virus
Synonyms	None
Common name(s)	Pepper vein chlorosis Pepper vein mosaic
Main hosts	*Vicia faba* (broad bean), *Vigna sesquipedalis (*yard-long bean), *Vigna unguiculata* (cowpea) (Kim *et al*. 1990b; Kim *et al*. 1991), *Solanum tuberosum* (potato), *Lycopersicon esculentum* (tomato), solanaceous weeds include *Datura*, *Physalis* and *Solanum* species (HAL 2004)
Distribution	The Republic of Korea (Kim *et al*. 1990a, 1990b, 1991)
Quarantine pest	*Chilli veinal mottle virus* and *Pepper mottle virus*
Synonyms	*chilli veinal mottle potyvirus* *chilli vein-banding mottle virus*
Common name(s)	Chilli veinal mottle Pepper mottle
Main hosts	*Capsicum annum* (capsicum), *Capsicum frutescens* (chilli) (CABI 2006)
Distribution	Asia and Africa (CABI 2006)

Appendix C: Biosecurity framework

Australia's biosecurity policies

The objective of Australia's biosecurity policies and risk management measures is the prevention or control of the entry, establishment or spread of pests and diseases that could cause significant harm to people, animals, plants and other aspects of the environment.

Australia has diverse native flora and fauna and a large agricultural sector, and is relatively free from the more significant pests and diseases present in other countries. Therefore, successive Australian Governments have maintained a conservative, but not a zero-risk, approach to the management of biosecurity risks. This approach is consistent with the World Trade Organization's (WTO's) Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement).

The SPS Agreement defines the concept of an 'appropriate level of protection' (ALOP) as the level of protection deemed appropriate by a WTO Member establishing a sanitary or phytosanitary measure to protect human, animal or plant life or health within its territory. Among a number of obligations, a WTO Member should take into account the objective of minimising negative trade effects in setting its ALOP.

Like many other countries, Australia expresses its ALOP in qualitative terms. Australia's ALOP, which reflects community expectations through Australian Government policy, is currently expressed as providing a high level of sanitary and phytosanitary protection, aimed at reducing risk to a very low level, but not to zero.

Consistent with the SPS Agreement, in conducting risk analyses Australia takes into account as relevant economic factors:

- the potential damage in terms of loss of production or sales in the event of the entry, establishment or spread of a pest or disease in the territory of Australia
- the costs of control or eradication of a pest or disease
- and the relative cost-effectiveness of alternative approaches to limiting risks.

Roles and responsibilities within Australia's quarantine system

Australia protects its human[14], animal and plant life or health through a comprehensive quarantine system that covers the quarantine continuum, from pre-border to border and post-border activities.

Pre-border, Australia participates in international standard-setting bodies, undertakes risk analyses, develops offshore quarantine arrangements where appropriate, and engages with our neighbours to counter the spread of exotic pests and diseases.

At the border, Australia screens vessels (including aircraft), people and goods entering the country to detect potential threats to Australian human, animal and plant health.

The Australian Government also undertakes targeted measures at the immediate post-border level within Australia. This includes national co-ordination of emergency responses to pest

[14] The Australian Government Department of Health and Ageing is responsible for human health aspects of quarantine.

and disease incursions. The movement of goods of quarantine concern within Australia's border is the responsibility of relevant state and territory authorities, which undertake inter- and intra-state quarantine operations that reflect regional differences in pest and disease status, as a part of their wider plant and animal health responsibilities.

Roles and responsibilities within the Department

The Australian Government Department of Agriculture, Fisheries and Forestry is responsible for the Australian Government's animal and plant biosecurity policy development and the establishment of risk management measures. The Secretary of the Department is appointed as the Director of Animal and Plant Quarantine under the *Quarantine Act 1908* (the Act).

There are three groups within the Department primarily responsible for biosecurity and quarantine policy development and implementation:

- Biosecurity Australia conducts risk analyses, including IRAs, and develops recommendations for biosecurity policy as well as providing quarantine advice to the Director of Animal and Plant Quarantine and AQIS.
- AQIS develops operational procedures, makes a range of quarantine decisions under the Act (including import permit decisions under delegation from the Director of Animal and Plant Quarantine) and delivers quarantine services.
- Product Integrity, Animal and Plant Health Division (PIAPH) coordinates pest and disease preparedness, emergency responses and liaison on inter- and intra-state quarantine arrangements for the Australian Government, in conjunction with Australia's state and territory governments.

Roles and responsibilities of other government agencies

State and territory governments play a vital role in the quarantine continuum. Biosecurity Australia and PIAPH work in partnership with state and territory governments to address regional differences in pest and disease status and risk within Australia, and develop appropriate sanitary and phytosanitary measures to account for those differences. Australia's partnership approach to quarantine is supported by a formal Memorandum of Understanding that provides for consultation between the Australian Government and the state and territory governments.

Depending on the nature of the good being imported or proposed for importation, Biosecurity Australia may consult other Australian Government authorities or agencies in developing its recommendations and providing advice.

As well as a Director of Animal and Plant Quarantine, the Act provides for a Director of Human Quarantine. The Australian Government Department of Health and Ageing is responsible for human health aspects of quarantine and Australia's Chief Medical Officer within that Department holds the position of Director of Human Quarantine. Biosecurity Australia may, where appropriate, consult with that Department on relevant matters that may have implications for human health.

The Act also requires the Director of Animal and Plant Quarantine, before making certain decisions, to request advice from the Environment Minister and to take the advice into account when making those decisions. The Australian Government Department of the Environment, Water, Heritage and the Arts (DEWHA) is responsible under the *Environment Protection and Biodiversity Conservation Act 1999* for assessing the environmental impact associated with proposals to import live species. Anyone proposing to import such material should contact DEWHA directly for further information.

When undertaking risk analyses, Biosecurity Australia consults with DEWHA about environmental issues and may use or refer to DEWHA's assessment.

Australian quarantine legislation

The Australian quarantine system is supported by Commonwealth, state and territory quarantine laws. Under the Australian Constitution, the Commonwealth Government does not have exclusive power to make laws in relation to quarantine, and as a result, Commonwealth and state quarantine laws can co-exist.

Commonwealth quarantine laws are contained in the *Quarantine Act 1908* and subordinate legislation including the *Quarantine Regulations 2000*, the *Quarantine Proclamation 1998*, the *Quarantine (Cocos Islands) Proclamation 2004* and the *Quarantine (Christmas Island) Proclamation 2004*.

The quarantine proclamations identify goods, which cannot be imported, into Australia, the Cocos Islands and or Christmas Island unless the Director of Animal and Plant Quarantine or delegate grants an import permit or unless they comply with other conditions specified in the proclamations. Section 70 of the *Quarantine Proclamation 1998*, section 34 of the *Quarantine (Cocos Islands) Proclamation 2004* and section 34 of the *Quarantine (Christmas Island) Proclamation 2004* specify the things a Director of Animal and Plant Quarantine must take into account when deciding whether to grant a permit.

In particular, a Director of Animal and Plant Quarantine (or delegate):

- must consider the level of quarantine risk if the permit were granted, and
- must consider whether, if the permit were granted, the imposition of conditions would be necessary to limit the level of quarantine risk to one that is acceptably low, and
- for a permit to import a seed of a plant that was produced by genetic manipulation – must take into account any risk assessment prepared, and any decision made, in relation to the seed under the Gene Technology Act, and
- may take into account anything else that he or she knows is relevant.

The level of quarantine risk is defined in section 5D of the *Quarantine Act 1908*. The definition is as follows:

> reference in this Act to a *level of quarantine risk* is a reference to:
> (a) the probability of:
> (i) a disease or pest being introduced, established or spread in Australia, the Cocos Islands or Christmas Island; and
> (ii) the disease or pest causing harm to human beings, animals, plants, other aspects of the environment, or economic activities; and
> (b) the probable extent of the harm.

The *Quarantine Regulations 2000* were amended in 2007 to regulate keys steps of the import risk analysis process. The Regulations:

- define both a standard and an expanded IRA,
- identify certain steps, which must be included in each type of IRA,
- specify time limits for certain steps and overall timeframes for the completion of IRAs (up to 24 months for a standard IRA and up to 30 months for an expanded IRA),

- specify publication requirements,
- make provision for termination of an IRA, and
- allow for a partially completed risk analysis to be completed as an IRA under the Regulations.

The Regulations are available at www.comlaw.gov.au.

International agreements and standards

The process set out in the *Import Risk Analysis Handbook 2007* is consistent with Australia's international obligations under the SPS Agreement. It also takes into account relevant international standards on risk assessment developed under the International Plant Protection Convention (IPPC) and by the World Organisation for Animal Health (OIE).

Australia bases its national risk management measures on international standards where they exist and when they achieve Australia's ALOP. Otherwise, Australia exercises its right under the SPS Agreement to apply science-based sanitary and phytosanitary measures that are not more trade restrictive than required to achieve Australia's ALOP.

Notification obligations

Under the transparency provisions of the SPS Agreement, WTO Members are required, among other things, to notify other members of proposed sanitary or phytosanitary regulations, or changes to existing regulations, that are not substantially the same as the content of an international standard and that may have a significant effect on trade of other WTO Members.

Risk analysis

Within Australia's quarantine framework, the Australian Government uses risk analyses to assist it in considering the level of quarantine risk that may be associated with the importation or proposed importation of animals, plants or other goods.

In conducting a risk analysis, Biosecurity Australia:

- identifies the pests and diseases of quarantine concern that may be carried by the good
- assesses the likelihood that an identified pest or disease or pest would enter, establish or spread
- assesses the probable extent of the harm that would result.

If the assessed level of quarantine risk exceeds Australia's ALOP, Biosecurity Australia will consider whether there are any risk management measures that will reduce quarantine risk to achieve the ALOP. If there are no risk management measures that reduce the risk to that level, trade will not be allowed.

Risk analyses may be carried out by Biosecurity Australia's specialists, but may also involve relevant experts from state and territory agencies, the Commonwealth Scientific and Industrial Research Organisation (CSIRO), universities and industry to access the technical expertise needed for a particular analysis.

Risk analyses are conducted across a spectrum of scientific complexity and available scientific information. An IRA is a type of risk analysis with key steps regulated under the

Quarantine Regulations 2000. Biosecurity Australia's assessment of risk may also take the form of a non-regulated analysis of existing policy or technical advice to AQIS. Further information on the types of risk analysis is provided in the *Import Risk Analysis Handbook 2007*.

Glossary

Term or abbreviation	Definition
Additional declaration	A statement that is required by an importing country to be entered on a phytosanitary certificate and which provides specific additional information on a consignment in relation to regulated pests (FAO 2009).
Appropriate level of protection (ALOP)	The level of protection deemed appropriate by the Member establishing a sanitary or phytosanitary measure to protect human, animal or plant life or health within its territory (WTO 1995).
Area	An officially defined country, part of a country or all or parts of several countries (FAO 2009).
Area of low pest prevalence	An area, whether all of a country, part of a country, or all parts of several countries, as identified by the competent authorities, in which a specific pest occurs at low levels and which is subject to effective surveillance, control or eradication measures (FAO 2009).
Biosecurity Australia	A prescribed agency within the Australian Government Department of Agriculture, Fisheries and Forestry. Biosecurity Australia provides science-based quarantine assessments and policy advice that protects Australia's favourable pest and disease status and enhances Australia's access to international animal and plant related markets.
Consignment	A quantity of plants, plant products and/or other articles being moved from one country to another and covered, when required, by a single phytosanitary certificate (a consignment may be composed of one or more commodities or lots) (FAO 2009).
Control (of a pest)	Suppression, containment or eradication of a pest population (FAO 2009).
Endangered area	An area where ecological factors favour the establishment of a pest whose presence in the area will result in economically important loss (FAO 2009).
Entry (of a pest)	Movement of a pest into an area where it is not yet present, or present but not widely distributed and being officially controlled (FAO 2009).
Establishment	Perpetuation, for the foreseeable future, of a pest within an area after entry (FAO 2009).
Fresh	Living; not dried, deep-frozen or otherwise conserved (FAO 2009).
Fruits and vegetables	A commodity class for fresh parts of plants intended for consumption or processing and not for planting (FAO 2009).
Host	Species capable, under natural conditions, of sustaining a specific pest or other organism.
Import permit	Official document authorising importation of a commodity in accordance with specified phytosanitary import requirements (FAO 2009).
Import risk analysis	The assessment of the level of risk associated with the importation, or proposed importation, of animal, plants or other goods and, where necessary, the identification of risk management options to limit the level of quarantine risk to one that is acceptably low (*Quarantine Act 1908*).
Infestation (of a commodity)	Presence in a commodity of a living pest of the plant or plant product concerned. Infestation includes infection (FAO 2009).
Inspection	Official visual examination of plants, plant products or other regulated articles to determine if pests are present and/or to determine compliance with phytosanitary regulations (FAO 2009).
Inspection lot	The quantity of product from which the NPPO draws its sample of units for inspection from a consignment or part of a consignment.
Intended use	Declared purpose for which plants, plant products, or other regulated articles are imported, produced, or used (FAO 2009).
Interception (of a pest)	The detection of a pest during inspection or testing of an imported consignment (FAO 2009).

Term or abbreviation	Definition
International Standard for Phytosanitary Measures (ISPM)	An international standard adopted by the Conference of the Food and Agriculture Organization, the Interim Commission on phytosanitary measures or the Commission on phytosanitary measures, established under the IPCC (FAO 2009).
Introduction	The entry of a pest resulting in its establishment (FAO 2009).
Lot	A number of units of a single commodity, identifiable by its homogeneity of composition, origin etc., forming part of a consignment (FAO 2009).
National Plant Protection Organization (NPPO)	Official service established by a government to discharge the functions specified by the International Plant Protection Convention (FAO 2009).
Official control	The active enforcement of mandatory phytosanitary regulations and the application of mandatory phytosanitary procedures with the objective of eradication or containment of quarantine pests or for the management of regulated non-quarantine pests (FAO 2009).
Pathway	Any means that allows the entry or spread of a pest (FAO 2009).
Pest	Any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products (FAO 2009).
Pest categorisation	The process for determining whether a pest has or has not the characteristics of a quarantine pest or those of a regulated non-quarantine pest (FAO 2009).
Pest free area (PFA)	An area in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained (FAO 2009).
Pest free place of production	Place of production in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained for a defined period (FAO 2009).
Pest free production site	A defined portion of a place of production in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this conditions is being officially maintained for a defined period and that is managed as a separate unit in the same way as a pest free place of production (FAO 2009).
Pest risk analysis (PRA)	The process of evaluating biological or other scientific and economic evidence to determine whether an organism is a pest, whether it should be regulated, and the strength of any phytosanitary measures to be taken against it (FAO 2009).
Pest risk assessment (for quarantine pests)	Evaluation of the probability of the introduction and spread of a pest and the magnitude of the associated potential economic consequences (FAO 2009).
Pest risk management (for quarantine pests)	Evaluation and selection of options to reduce the risk of introduction and spread of a pest (FAO 2009).
Phellogen	Plant meristem (growth layer) responsible for secondary growth of a corky protective layer.
Phytosanitary Certificate	Certificate patterned after the model certificates of the IPPC (FAO 2009).
Phytosanitary measure	Any legislation, regulation or official procedure having the purpose to prevent the introduction and/or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests (FAO 2009).
Phytosanitary regulation	Official rule to prevent the introduction and/or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests, including establishment of procedures for phytosanitary certification (FAO 2009).
Polyphagous	Feeding on a relatively large number of hosts from different genera.
PRA area	Area in relation to which a Pest Risk Analysis is conducted (FAO 2009).
Quarantine pest	A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled (FAO 2009).
Regulated article	Any plant, plant product, storage place, packing, conveyance, container, soil and any other organism, object or material capable of harbouring or spreading pests, deemed

Term or abbreviation	Definition
	to require phytosanitary measures, particularly where international transportation is involved (FAO 2009).
Restricted risk	Risk estimate with phytosanitary measure(s) applied.
Spread	Expansion of the geographical distribution of a pest within an area (FAO 2009).
SPS Agreement	WTO Agreement on the Application of Sanitary and Phytosanitary Measures (WTO 1995).
Stakeholders	Government agencies, individuals, community or industry groups or organizations, whether in Australia or overseas, including the proponent/applicant for a specific proposal, who have an interest in the import risk analysis.
Systems approach(es)	The integration of different risk management measures, at least two of which act independently, and which cumulatively achieve the appropriate level of protection against regulated pests (FAO 2009).
Unrestricted risk	Unrestricted risk estimates apply in the absence of risk mitigation measures.

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