Australian Government

Biosecurity Australia

# Draft Import Risk Analysis Report for Fresh Capsicum (Paprika) Fruit from the Republic of Korea

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

## Submissions

This draft import risk analysis (IRA) report has been issued to give all interested parties an opportunity to comment and draw attention to any scientific, technical, or other gaps in the data, misinterpretations and errors. Any comments should be submitted to Biosecurity Australia within the comment period stated in the related Biosecurity Australia Advice on the Biosecurity Australia website. The draft IRA report will then be revised as necessary to take account of the comments received and a provisional final IRA report will be released at a later date.

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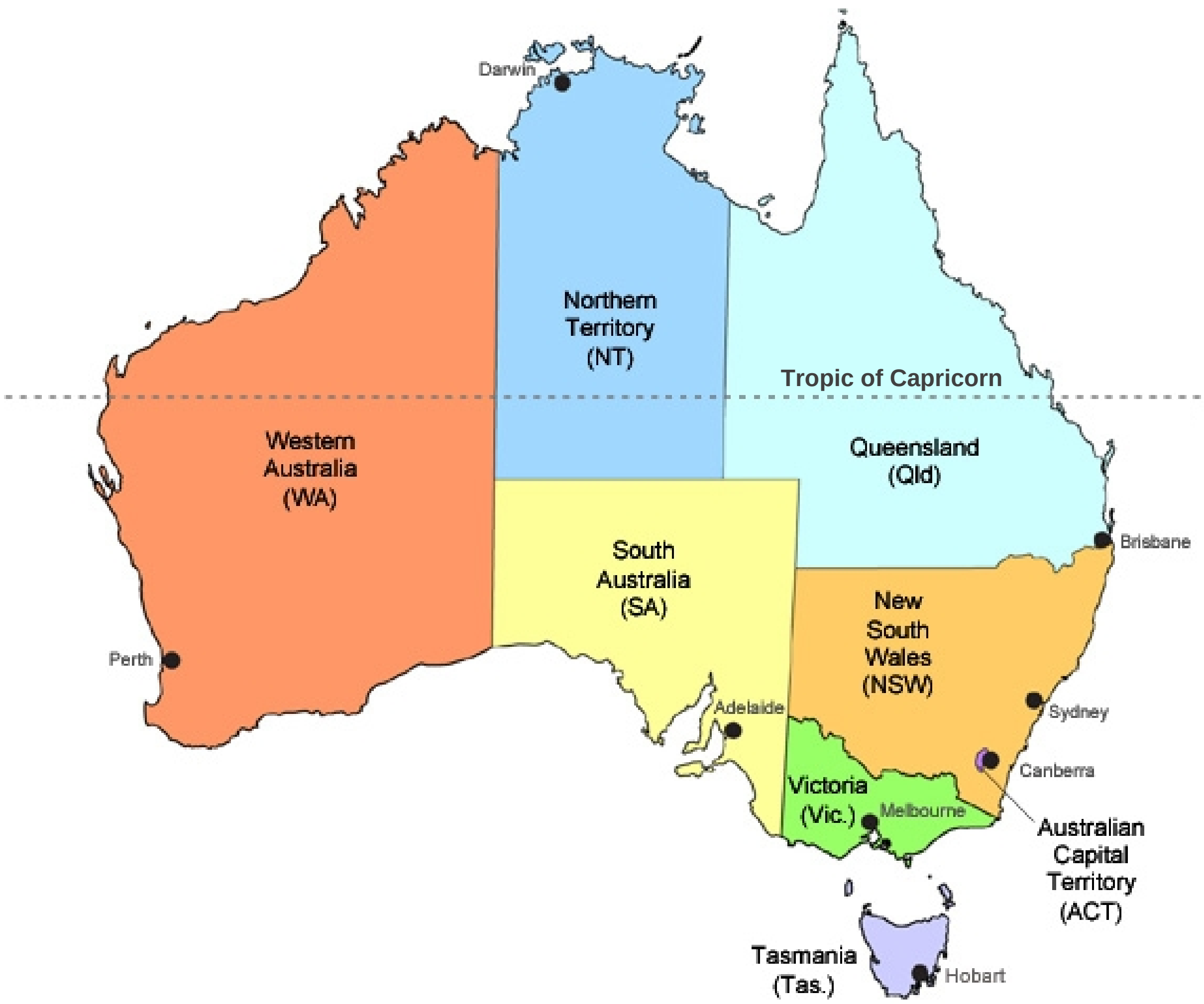

# Acronyms and abbreviations

| Term or abbreviation | Definition |
|---|---|
| **ALOP** | Appropriate level of protection |
| **AQIS** | Australian Quarantine and Inspection Service |
| **DAFF** | Australian Government Department of Agriculture, Fisheries and Forestry |
| **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 |
| **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 |
| **PFA** | Pest Free Area |
| **PRA** | Pest Risk Analysis |
| **Qld** | Queensland |
| **SA** | South Australia |
| **SPS Agreement** | WTO Agreement on the Application of Sanitary and Phytosanitary Measures (WTO 1995) |
| **Tas.** | Tasmania |
| **Vic.** | Victoria |
| **WA** | Western Australia |
| **WTO** | World Trade Organization |

# Summary

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

The draft report proposes that the importation of capsicum fruit to Australia from Korea be permitted, subject to specific quarantine measures.

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

Australia already has existing quarantine policy that allows the importation of capsicum fruit from New Zealand, the United States of America and Europe, subject to specific quarantine measures.

The draft report proposes pre-export and on-arrival inspections. If any quarantine pests are detected, remedial action, such as fumigation, will be taken. This will be supported by an operational system to maintain and verify the quarantine status of consignments.

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

This draft report contains details of the risk assessments for the quarantine pests and the proposed quarantine measures in order to allow interested parties to provide comments and submissions to Biosecurity Australia within the consultation period.

# 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 consider formally the risks that could be associated with proposals to import new products into Australia. If the risks are found to be above Australia’s appropriate level of protection (ALOP), risk management measures are proposed to reduce the risks to an acceptable level. But, 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 involves consultation with stakeholders at various stages during the process. The recommendations from Biosecurity Australia are provided to the Director of Animal and Plant Quarantine (the Secretary of the Australian Department of Agriculture, Fisheries and Forestry), who 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 the import protocol, including any 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 (NPQS) Republic of Korea formally requested market access for fresh ‘paprika’ (*Capsicum annuum* L.) fruit to Australia in a technical submission received in June 2006 (NPQS 2006). In Australia, capsicum is used when referring to fresh fruit of *C. annuum* and this term is used in this report. This submission included information on the pests associated with capsicum crops in Korea, including the plant part affected, and the standard commercial production practices for fresh capsicum fruit in Korea (NPQS 2006; 2007a; 2007b; 2007c).

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[1] A pest is any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products (FAO 2007b)

On 18 March 2008, 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*.

### 1.2.2. Scope

This IRA assesses the biosecurity risks associated with the importation of fresh capsicum fruit produced in greenhouses in Korea and proposes quarantine measures for identified risks. Details of the production processes for this fruit in Korea are set out in Section 3.

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

Capsicum seed for planting is permitted entry into Australia from all countries, as described in Condition C11817 in the Australian Quarantine and Inspection Service (AQIS) import conditions (ICON) database. It would be inconsistent with Australia's obligations under the SPS Agreement to consider measures for the seed-borne viruses of capsicum for seed that is internal in capsicum fruit for consumption when the risk pathway of seed for planting is permitted. For this reason, the potentials for the seed-borne viruses of capsicum that occur in Korea but not in Australia to establish and spread in Australia or regions of Australia from fresh capsicum fruit from Korea are not considered in this IRA. These viruses are *peanut stunt virus*, *pepper mild mottle virus*, *tobacco rattle virus* and *tobacco ringspot virus*.

The Chief Executive of Biosecurity Australia decided that this analysis would be undertaken as a standard IRA.

### 1.2.3. Contaminating pests

In addition to the pests of capsicum in 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.

### 1.2.4. Existing policy

Australia currently permits the importation of fresh capsicum fruit from New Zealand, the United States of America and Europe.

The conditions under which fresh capsicum fruit is permitted entry into Australia can be viewed on the AQIS import conditions (ICON) database at http:www.aqis.gov.au/icon.

# 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 2007a) 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 2007b). A pest is ‘any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products’ (FAO 2007b).

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 2007b).

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 Organisation (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 and 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 had been considered by Biosecurity Australia in other risk assessments and for which import policies already exist, the need for new pest risk assessments was investigated to determine if a new pest risk assessment was required.

## 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 2007b).

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 of 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 2007b).

The pests identified in Stage 1 were categorised using the following criteria 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; and
- 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 suitable 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; and

**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 life cycle 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; and
- 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 suitable 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 suitable hosts;
- Time of year at which import takes place;
- Intended use of the commodity (e.g. for planting, processing or consumption); and
- 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 2007b). In order to estimate the probability of establishment of a pest, reliable biological information (life cycle, host range, epidemiology, survival, etc.) should be 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 suitable hosts, alternative hosts and vectors;

- Suitability of the environment;
- Reproductive strategy and potential for adaptation;
- Minimum population needed for establishment; and
- 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 2007b). 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; and
- 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 illustrate the boundaries of the descriptors. The standardised likelihood descriptors and the associated indicative probability ranges provide guidance to the risk analyst and promote consistency between different risk analyses. However, these indicative probability ranges are not used beyond this purpose in qualitative PRAs.

**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 BA 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 2007b) and ISPM 11 (FAO 2004).

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

- Plant life or health; and
- Other aspects of the environment.

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

- Eradication, control, etc.;
- Domestic trade;
- International trade; and
- 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)[2] using Table 2.3.

**Table 2.3: Decision rules for determining the consequence impact score based on the magnitude of consequences at four geographic levels**

| 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<br>more than one criterion has an impact of 'F'; or<br>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<br>all criteria have an impact of 'E'. | High |
| 3 | One or more criteria have an impact of 'E'; or<br>all criteria have an impact of 'D'. | Moderate |
| 4 | One or more criteria have an impact of 'D'; or<br>all criteria have an impact of 'C'. | Low |
| 5 | One or more criteria have an impact of 'C'; or<br>all criteria have an impact of 'B'. | Very Low |
| 6 | One or more but not all criteria have an impact of 'B', and<br>all remaining criteria have an impact of 'A'. | Negligible |

[2] 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 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.

### 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.

**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** | | | | | |

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, 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.

### 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. These risk management measures will form the basis for the consideration of the quarantine measures in the ‘Import Conditions’ section of the final IRA report.

# 3. Korea's commercial production practices for capsicum fruit

## 3.1. Assumptions used to estimate unrestricted risk

Biosecurity Australia took the following information on the existing commercial production practices into consideration when estimating the unrestricted risk of pests likely to be associated with fresh capsicum fruit imported from Korea. The information was verified by officers from Biosecurity Australia, who observed the existing commercial production practices for capsicum fruit in Korea in June 2007. The existing commercial production procedures observed by Biosecurity Australia in June 2007 are applied to all the growing areas (NPQS 2007b). 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 capsicum fruit in Korea involve the following steps: planning, seeding, raising of seedlings, planting of seedlings, cultivation, fruit setting, harvesting, transportation, warehousing, sorting, packing, and exporting (NPQS 2007a).

### 3.2.1. Production

During the 2002 Korean capsicum season, 381 000 tonnes of fruit were produced and in 2003 350 000 tonnes were produced. The following year 410 280 tonnes of capsicum were produced from 68 000 ha for domestic and export markets (FAO 2007c). The production areas are shown in Figure 3.1.

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

- Kangwon-do Province: Gangneung and Taebaek Cities; Jeongseon, Cheorwon, Pyeongchang, and Hwacheon Counties (28.8 ha)
- Chungchongnam-do Province: Geoje, Gimhae, Masan, Miryang, Sacheon, Jinju, Changwon, and Tongyeong Cities; Goseong, Namhae, Uiryeong, Hadong, Haman, Hamyang, and Hapcheon Counties (105.2 ha)
- Chungchongbuk-do Province: Cheongsong County (3.7 ha)
- Chollanam-do Province: Yeonggwang, Jangseong and Jangheung Counties (21.8 ha)
- Chollabuk-do Province: Namwon and Jeongeup Cities (12.0 ha)
- Cheju-do Province: Seogwipo and Jeju Cities, Bukjeju Counties (6.4 ha)
- Kyongsangnam-do Province: Buyeo, Yesan, and Jincheon Counties (7.4 ha) (See Fig. 3.1).

The total growing area of the production locations mentioned above is approximately 185 ha (NPQS 2006; 2007a; 2007b).

Capsicums and many other plant products are grown in greenhouses in Korea to protect them from the elements. Monsoonal weather and particulate air pollution, particularly airborne sand, would cause extensive damage to plant products if they were not protected by a barrier (NPQS 2007a).

The cultivars of capsicum fruit grown in greenhouses in 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') (NPQS 2006).

**Figure 3.1: Provinces, major cities and production regions for capsicum and other horticultural commodities in Korea**

Capsicum seedlings and plants are grown and cultured in venlo-type glasshouses, single span vinyl houses and multispan vinyl houses (multispan vinyl houses are made up of single span vinyl houses connected together). Some greenhouses are fully automated with machines that monitor and maintain temperature and humidity, others are non-automated. The roofs of all types of greenhouse can be opened or closed to alter the light, temperature and humidity levels. Artificial growing media such as rockwool, cowpeat and pearlite are used to grow capsicum hydroponically (NPQS 2007a). Figure 3.2 shows glasshouse production of capsicums, near Gimjae City in Chollabuk-do Province.

**Figure 3.2: Venlo-type glasshouse capsicum production**

Pest management practices in greenhouses include:

- removal of 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, before harvest for arthropod pests; and
- applying natural enemies to attack target arthropod pests (NPQS 2007a).

Upon entering a greenhouse, staff walk on mats soaked in fungicide to reduce the chance of walking live fungal spores into the greenhouse. Insect control and monitoring techniques used include yellow sticky traps deployed around the greenhouse to attract some families of Diptera and Hymenoptera, and fluorescent light traps which attract some 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 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 Korea as biocontrol agents.

### 3.2.2. Cultivation practices

In early July, capsicum seed originating from the Netherlands is germinated in polystyrene trays filled with artificial growing media in a greenhouse. The growing media is also imported from the Netherlands. Germination temperatures are 29 to 30°C, with humidity maintained at approximately 70%. Once germinated, seedlings are moved into 10 $cm^3$ units of artificial growing media before they reach a large enough size to be moved to the main cultivation area of the greenhouse in early September. In summer and winter, the cultivation temperature during the day is maintained at 21°C with air-conditioners and humidifiers. At night, the temperature is allowed to fall below this. Humidity is maintained at 70% all year round.

Fruiting begins in early November, two to three months after seedlings are established. Harvesting starts when fruiting begins and continues through until early July (approximately 9 months). Capsicums are harvested manually using cutting knives. The pedicel is cut, leaving the calyx on the fruit (Fig. 3.3). After harvest, the growing facility is cleaned and disinfected until August to be ready for planting again in September (NPQS 2006).

**Figure 3.3: Capsicum being harvested at a greenhouse near Namwon City, Chollabuk-do Province**

### 3.2.3. Post-harvest handling

To maintain freshness after harvesting, capsicum is directly transported to the packing house (NPQS 2007a). Large production areas have their own packing houses (Figure 3.4). Small production areas use wing-trucks (which can be loaded from both sides) and covered trucks, with cold storage facilities, to transport the capsicum to the packing house (NPQS 2007b).

**Figure 3.4: 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 before being 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/or otherwise damaged capsicums are rejected during the sorting process. Premium capsicums for export are freely packed into boxes in 5 kg lots (Figure 3.5). The boxes have uncovered holes to the outside to allow the capsicums to breathe (NPQS 2007b). Premium capsicums for the domestic market are bagged in pairs, in breathable polythene bags; then placed in plastic trays (Figure 3.6). Standard capsicums for the domestic market are bagged in pairs and packed into boxes of 10 kg lots. See Figure 3.8 for a schematic of a packing house used to pack domestic product and product for export.

**Figure 3.5: Capsicums boxed for export**

**Figure 3.6: Premium capsicums for the domestic market**

### 3.1.5. Export

In 2006, Korea exported 13 899 tonnes of capsicum from 296 hectares of greenhouse production, with Japan the major market (NPQS 2007a).

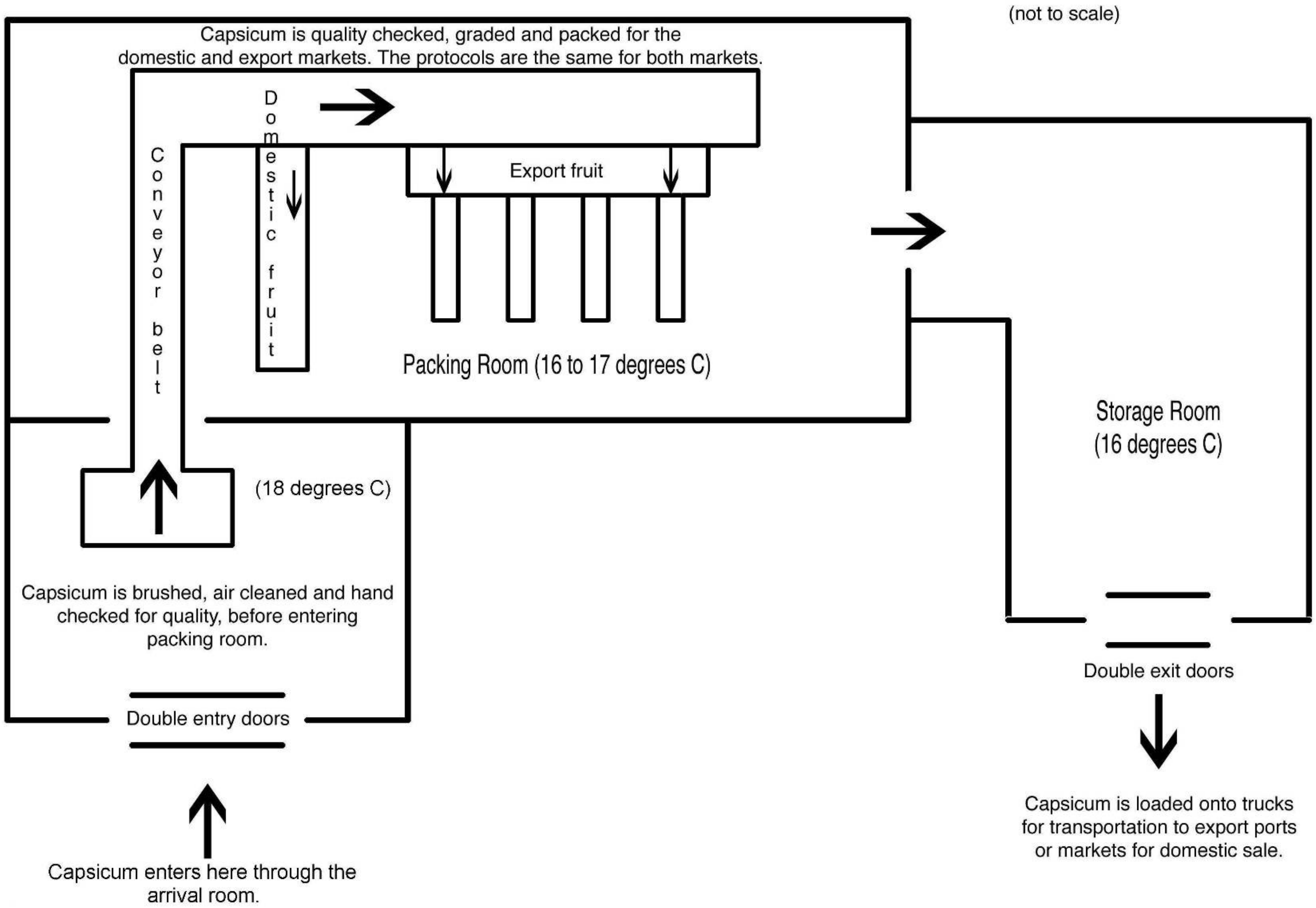
Capsicums are stored under low temperature conditions ready for export. Generally, containers are used to transport fresh capsicums to export ports. Sometimes wing and covered trucks with cold storage facilities are used (NPQS 2007b). For the Japanese market, capsicums are shipped from Korea in refrigerated containers; the voyage takes approximately 5 h (NPQS 2007a). To maintain freshness, air cargo is proposed to transport capsicums from Korea to Australia.

A requirement of the packing house companies is that boxes of capsicum fruit for export are labelled with the identity code, the year of production, the commodities code, the area code and the farmer's individual identification code to allow them to trace to the source farm if required. This allows the packing companies to control the quality of produce that leaves their houses.

Capsicum fruit for export are visually inspected for pests and diseases by trained quarantine officers (Figure 3.7). If the capsicums are free from pests, the consignment is cleared for export. A phytosanitary certificate is issued for cleared consignments (NPQS 2007a).

**Figure 3.7: NPQS quarantine officer inspecting capsicums for export**

**Figure 3.8 Schematic of a packing house**



# 4. Pest risk assessments for quarantine pests

## 4.1. Quarantine pests for pest risk assessment

Pest categorisation (Appendix A) identified three pests (all thrips) from the list of pests identified as being on fresh capsicum fruit from Korea in this PRA. These quarantine pests are listed in Table 4.1.

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

### Table 4.1: Quarantine pests for capsicum fruit from Korea

| **Pest** | **Common name** |
|---|---|
| Thrips [Thysanoptera: Thripidae] | |
| *Frankliniella intonsa* (Trybom, 1895) | European flower thrips |
| *Frankliniella occidentalis* (Pergande, 1895) | Western flower thrips |
| *Thrips palmi* Karny, 1925 | Melon thrips |

## 4.2. *Frankliniella intonsa* [Thysanoptera: Thripidae]

*Frankliniella intonsa* (European flower thrips) is known to attack the flowers, fruit and foliage of a range of crops and weeds, causing damage through its feeding activities (CABI 2006). Its mouthparts are used to rupture and suck fluids from plant cells, causing scarring that can reduce crop yield, productivity and marketability (CSIRO 1991). European flower thrips can also transmit four tospoviruses while feeding (CABI 2006). Thrips are easily overlooked because of their small size, especially eggs that are usually laid within host plant tissues. Larval, pupal and adult thrips are mobile and easily dispersed on clothing and packing materials. Adult thrips are winged and can travel on the wind (CABI 2006). *Frankliniella intonsa* and allied species are opportunistic, well adapted to surviving difficult conditions, and capable of tolerating temperatures below freezing over extended periods (McDonald *et al.* 1997).

### 4.2.1. Probability of entry

*Probability of importation*

The likelihood that *F. intonsa* will arrive in Australia with the importation of fresh capsicum fruit from Korea is: **HIGH**

- *Frankliniella intonsa* is associated with fresh capsicum fruit in Korea (USDA 2005; NPQS 2006).
- Thrips species are cold tolerant and may survive cold temperatures during storage and transport (CABI 2006).
- The lifespan of an adult is up to 49 days (CABI 2006), exceeding the packing/transport period.
- Eggs of *Frankliniella* spp. are very small (about 200 µm long) and may be laid on or under the skin of fruit. Damage may appear as scratches, bronzing or silvering to the fruit (CABI 2006). Adult infestations of thrips commonly occur around and under the calyx of capsicum, as well as on the pedicel (fruit stalk) (Pernezny *et al.* 2003).

The cold tolerance, long lifespan, small size and cryptic nature of this thrips and its association with capsicum fruit all support a risk rating for importation of 'High'.

*Probability of distribution*

The likelihood that *F. intonsa* will be distributed within Australia in a viable state, as a result of the processing, sale or disposal of fresh capsicum fruit from Korea, is: **MODERATE**

- Adult thrips may hide and feed under the calyx, and eggs may be laid under the skin of fruit (Pernezny *et al.* 2003). Adults can survive for up to 49 days (CABI 2006). Although adults will most likely move off the fruit when disturbed, eggs may remain with the fruit during distribution via wholesale or retail trade.
- Thrips are among the weakest flying insects but their finely fringed wings enable them to remain airborne and easily dispersed by wind (Lewis 1973) and on clothing, hair, contaminated equipment and containers (EPPO 1997). Adult thrips are able to run and jump within an orchard or glasshouse (Jenser 1973; EPPO 1997; Pearsall 2002), further increasing their mobility.
- *Frankliniella intonsa* has a wide host range including capsicum, tomato, asparagus, strawberry, peach, nectarine, chrysanthemum, pea, soybean, lucerne, rice and cotton

(CABI 2006). All of these hosts are present in Australia. A food source distributed across the country is more likely to support the establishment of pest populations.

- Distribution of the commodity in the PRA area would be for retail sale, as the intended use of the commodity is human consumption. This would assist the potential distribution of this species.
- It is likely that *F. intonsa* would be discarded with fruit scraps or damaged fruit, but damaged capsicum fruit collapses and rots very quickly and may not persist sufficiently long for the thrips to complete their development.

The cryptic nature, long lifespan, polyphagy and high mobility of this thrips, moderated by its weak directional flying ability and the rapid breakdown of discarded capsicum waste, support a risk rating for distribution of 'Moderate'.

*Probability of entry (importation × distribution)*

The likelihood that *F. intonsa* will enter Australia and be transferred in a viable state to a susceptible host, as a result of trade in fresh capsicum fruit from Korea, is: **MODERATE**

### 4.2.2. Probability of establishment

The likelihood that *F. intonsa* 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**

- Adult thrips can reproduce rapidly. Laboratory experiments showed that up to 22 generations of *F. intonsa* can be produced in one year and the egg, larval stage and pupal stage each lasted only 1–3 days. The generation time ranged from 7 to 16 days, and adult female lifespan from 17.7 to 49 days (Tang 1976; Pernezny *et al.* 2003; CABI 2006).
- Abiotic factors have a large influence on the abundance of thrips. *Frankliniella intonsa* develops at a faster rate with warmer temperatures, and adults are more mobile when the maximum temperature reaches 20°C or above, with mass flights occurring in these conditions (Jenser 1973; CABI 2006). Laboratory methods have found success in high reproductive rates when rearing *F. intonsa* at 20°C and the optimum temperature for oviposition is 28°C (Tang 1976). Much of Australia is subject to temperatures between 15°C and 30°C, providing excellent opportunity for establishment.
- Natural enemies and pesticides have controlled populations of thrips with some success (CABI 2006). However, whilst insecticides have been widely used to suppress *F. intonsa* populations on plants such as cotton, they are not capable of keeping population levels low (Atakan and Özgür 2001). In addition, use of biological controls such as thrips parasitoids have been shown to have very limited prospects for control for thrips in greenhouse production of capsicum, cucumber and ornamentals such as roses and potted plants (Loomans 2003).

The high reproductive rate, preadaptation to temperature ranges found in the Australia and limited success of control measures for this thrips all support an establishment risk rating of 'High'.

### 4.2.3. Probability of spread

The likelihood that *F. intonsa* will spread within Australia, based on a comparison of those factors in the source and destination considered pertinent to the expansion of the geographic distribution of the pest, is: **HIGH**

- *Frankliniella intonsa* originated in South-East Asia. It is now found throughout Europe and Asia, where it has established itself as an economically significant pest (CABI 2006).
- *Frankliniella intonsa* has a wide host range, including capsicum, tomato, asparagus, strawberry, peach, nectarine, chrysanthemum, pea, soybean, lucerne, rice and cotton (CABI 2006).
- Hosts are widely distributed in Australia.
- The outer flesh of capsicum may contain eggs of thrips at the time of sale. The pest may be spread further when the calyx and other parts of the capsicum are disposed of after the rest of the fruit has been consumed.
- Thrips are small and light enough to be spread by wind currents.

Experience elsewhere has shown that this thrips can readily spread in new areas. This, plus its polyphagy, ready availability of hosts, and cyptic nature support a risk rating for spread for this thrips of 'High'.

### 4.2.4. Probability of entry, establishment and spread

The likelihood that *F. intonsa* will be imported as a result of trade in fresh capsicum fruit from Korea, be distributed in a viable state to a suitable host, establish and spread within Australia, is: **MODERATE**

### 4.2.5. Consequences

Assessment of the potential consequences (direct and indirect) of *F. intonsa* for Australia is: **LOW**

| Criterion | Estimate and rationale |
|---|---|
| **Direct** | |
| Plant life or health | **D** – significant at the district level<br>*Frankliniella intonsa* causes direct harm to a wide range of plant hosts, both crop and ornamental species, including capsicum, tomato, asparagus, strawberry, peach, nectarine, chrysanthemum, pea, soybean, lucerne, rice and cotton (CABI 2006). All of these hosts are present in Australia. The damage caused by *F. intonsa* in capsicum has been shown to be similar to that caused by *F. occidentalis* (CABI 2006). Light infestations are usually not harmful to plants. However more severe infestations can result in holes in fruit, skin 'russeting', the occurrence of white swellings and spots caused by oviposition, fruit drop, stunting of shoot growth, delay in production of flowers and fruit, diminished fruit set, distorted fruits and a general decline in plant vigour (CABI 2006).<br>*Frankliniella intonsa* also causes harm through acting as a vector of tospoviruses (Pernezney *et al.* 2003). At least four different tospoviruses are known to be transmitted, including *tomato spotted wilt virus* (TSWV), *impatiens necrotic spot virus*, *groundnut ringspot virus* and *tomato chlorotic spot virus* (Campbell *et al*. 2008). *Frankliniella intonsa* has been found to transmit TSWV with a high efficiency in green capsicum (Okazaki and Sakurai 2005). Viral symptoms vary considerably in different plants, ranging from wilting and collapse of lettuce plants, leaf mottling and distortions, to ring-spotting on tomato fruits. These viral infections can lead to the total loss of certain crops (CABI 2006). |
| Other aspects of the environment | **B** – minor significance at the local level<br>Thrips introduced into a new environment may compete for resources with the native species. There are no known consequences on other aspects of the environment. |
| **Indirect** | |

| | |
|---|---|
| Eradication, control etc. | **C** – significant at the local level<br>Existing control programs using pesticides may be effective, though it is difficult to determine the specific damage caused by *F. intonsa.* Programs would have to be adjusted for this. Control programs with broad spectrum pesticide applications could be effective for some hosts. Control treatments would need to be supplemented by other methods shown to be effective, such as hygiene measures in glasshouses. |
| Domestic trade | **D** – significance at the district level<br>The introduction of this species, which is not present within Australia, is likely to have a significant impact on interstate trade in capsicum and other crops, with potential loss of markets and significant industry adjustment. |
| International trade | **D** – significant at the district level<br>Presence of this species in commercial production areas of a wide range of commodities (e.g. species of Fabaceae, Solanaceae, Rosaceae and Malvaceae) may limit access to overseas markets which lack this pest. |
| Environmental and non-commercial | **B** – minor significance at the local level<br>Although additional pesticide applications would be required to control this pest on susceptible crops, this is not considered to have significant consequences for the environment. |

### 4.2.6. Unrestricted risk estimate

The unrestricted risk estimate for *F. intonsa* 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 *F. intonsa* of 'low' is above Australia's ALOP. Therefore, specific risk management measures are required for this pest.

## *4.3. Frankliniella occidentalis* [Thysanoptera: Thripidae]

*Frankliniella occidentalis* (western flower thrips) is a serious agricultural pest, damaging flowers, leaves and fruit through its feeding activities (CABI 2006). Its mouthparts are used to rupture and imbibe fluids from plant cells, causing scarring that can reduce crop yield, productivity and marketability (CSIRO 1991). Western flower thrips are also vectors of at least four tospoviruses (Nagata *et al.* 2002; CABI 2006). Thrips are easily overlooked because of their small size, especially eggs that are usually laid within host plant tissue. Larval, pupal and adult thrips are mobile and easily dispersed on clothing and packing materials. Adult thrips are winged and can travel considerable distances on the wind (CABI 2006). *Frankliniella occidentalis* is an opportunistic species well adapted to surviving harsh climatic conditions and is known to survive temperatures below freezing over extended periods (McDonald *et al.* 1997).

*Frankliniella occidentalis* is absent from the NT (DPIFM 2007), and interstate restrictions on the movement of host material exist in Australia (DPIWE 2003; DPIFM 2006; DPI 2007). In Tas., it is an 'A List Pest' under the *Plant Quarantine Act 1997*. There are controls on host produce entering Tas. and there are active monitoring and control practices in the state.

### 4.3.1. Probability of entry

#### *Probability of importation*

The likelihood that *F. occidentalis* will arrive in NT and Tas. with the importation of fresh capsicum fruit from Korea is: **HIGH**

- *Frankliniella occidentalis* is associated with fresh capsicum fruit in Korea (Han *et al.* 1998; Cho *et al.* 1999; Lee *et al.* 2003; NPQS 2006).
- Thrips species are cold tolerant and may survive cold temperatures during storage and transport (CABI 2006).
- Eggs of *Frankliniella* spp. are very small (about 200 µm long) and may be laid on or under the skin of fruit. Damage may appear as scratches, bronzing or silvering to the fruit (CABI 2006). Adult infestations of thrips commonly occur around and under the calyx of capsicum, as well as on the pedicel (fruit stalk) (Pernezny *et al.* 2003).

The cold tolerance, small size and cryptic nature of this thrips and its association with capsicum fruit all support a risk rating for importation of 'High'.

#### *Probability of distribution*

The likelihood that *F. occidentalis* will be distributed to NT and Tas. in a viable state, as a result of the processing, sale or disposal of fresh capsicum fruit from Korea, is: **MODERATE**

- Adult thrips may hide and feed under the calyx of fruit and eggs may be laid under the skin of fruit (Pernezny *et al.* 2003). Adults will most likely move off the fruit when disturbed, but immature forms may remain with the fruit during distribution for wholesale or retail trade.
- *Frankliniella occidentalis* has a very wide host range of crop plants and ornamental species including chrysanthemums, cucurbits, cotton, grapes, citrus and apple (CABI 2006). All of these host species are present in Australia. A food source distributed across the country is more likely to support the establishment of pest populations.

- Thrips are among the weakest flying insects but their finely fringed wings enable them to remain airborne and easily dispersed by wind (Lewis 1973) and on clothing, hair, contaminated equipment and containers (EPPO 1997). Adult thrips are able to run and jump within an orchard or glasshouse (Jenser 1973; EPPO 1997; Pearsall 2002), further increasing their mobility.
- Distribution of the commodity in the PRA area would be for retail sale, as the intended use of the commodity is human consumption. This would assist the potential distribution of this species.
- It is likely that the pest would be discarded with fruit scraps or damaged fruit, but damaged capsicum fruit collapses and rots very quickly and may not persist sufficiently long for the thrips to complete their development.
- In Tas., *F. occidentalis* is an 'A List Pest' under the *Plant Quarantine Act 1997*. There are controls on host produce entering Tas. and there are active monitoring and control practices in the state. It is absent from the NT (DPIFM 2007), and interstate restrictions on the movement of host material exist in Australia (DPIWE 2003; DPIFM 2006; DPI 2007).

The cryptic nature, polyphagy, ready availability of hosts and high mobility of this thrips, moderated by its weak directional flying ability and the rapid breakdown of discarded capsicum waste, support a risk rating for distribution of 'Moderate'.

### *Probability of entry (importation × distribution)*

The likelihood that *F. occidentalis* will enter NT and Tas. and be transferred in a viable state to a susceptible host, as a result of trade in capsicum fruit from Korea, is: **MODERATE**

## 4.3.2. Probability of establishment

The likelihood that *F. occidentalis* will establish in NT and Tas., based on a comparison of factors in the source and destination areas considered pertinent to its survival and reproduction, is: **HIGH**

- *Frankliniella occidentalis* is already established in Australia, in Queensland (Mound 2005), New South Wales (Bright *et al.* 2006), South Australia and Western Australia (DPIFM 2007).
- *Frankliniella occidentalis* may reproduce continuously under favourable conditions. Laboratory experiments show that up to 15 generations of *F. occidentalis* may occur per year (Katayama 1997; McDonald *et al.* 1998; CABI 2006).
- Temperature is the main factor controlling development of this species and development time decreases as temperatures increase. The total life cycle of *F. occidentalis* takes between 15 days (at 30°C) and 45 days (at 15°C) (CABI 2006). Much of Australia is subject to temperatures between 15°C and 30°C, providing opportunity for establishment.
- Natural enemies and pesticides have controlled populations of thrips with some success. However, control for long periods is difficult, because of their secretive habit, and because populations develop resistance quickly (Herron *et al.* 1996; Datta *et al.* 1999; Herron and Cook 2002; CABI 2006).

The history of establishment of this pest in other parts of Australia, its high reproductive rate, preadaptation to temperatures in the PRA areas and difficulty of control all support a risk rating for establishment of 'High'.

### 4.3.3. Probability of spread

The likelihood that *F. occidentalis* will spread within NT and Tas., 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: **HIGH**

- *Frankliniella occidentalis* is native to western North America, but since 1960 this species has spread rapidly and now occupies much of North America, Europe, northern and southern Africa, parts of South America and Asia, Australia, and New Zealand (Kirk and Terry 2003). The species therefore poses a significant threat to countries still free of the pest (EPPO 1997). In Europe, the spread of this pest has been estimated at approximately 229 km/year (Kirk and Terry 2003).
- Already present within parts of Australia, *F. occidentalis* is able to spread extremely quickly. *Frankliniella occidentalis* was first recorded in Western Australia in 1993 (Malipatil *et al.* 1993), and within two years it had become a major pest in most states (Seaton *et al.* 1997; Latham and Jones 1998; Steiner and Goodwin 2002; Ullio 2002). *Frankliniella occidentalis* became established south-east of Brisbane by the end of 1993, and spread to reach Mackay (central Queensland) in 1995, and the Atherton Tablelands (north Queensland) in 1999 (Kirk and Terry 2003).
- *Frankliniella occidentalis* has a very wide host range including chrysanthemum, cucurbits, cotton, grapes, citrus and apple (CABI 2006). All of these host species are present in Australia, and most are in NT and Tas.
- The NT is characterised by natural physical barriers (e.g. deserts/arid areas) that can significantly slow the spread of some insect pests. Adult thrips would not be capable of traversing these areas unassisted. However, adults and immature forms may be carried undetected over such distances, via the movement of fruit as it is transported for retail sale.
- The outer flesh of capsicum may contain eggs of thrips at the time of sale. The pest may be spread when the calyx and other parts of the capsicums are disposed of after the rest of the fruit has been consumed.

Experience overseas and in other parts of Australia has shown that this pest can readily spread in new areas. This, plus its polyphagy, ready availability of hosts and cryptic nature all support a risk rating for spread of 'High'.

### 4.3.4. Probability of entry, establishment and spread

The overall likelihood that *F. occidentalis* will be imported as a result of trade in fresh capsicum fruit from Korea, be distributed in a viable state to a susceptible host, establish and spread within Northern Territory and Tasmania, is: **MODERATE**

### 4.3.5. Consequences

The assessment of the potential consequences (direct and indirect) for NT and Tas. is: **LOW**

| Criterion | Estimate and rationale |
|---|---|
| **Direct,** | |
| Plant life or health | **D** –significant at the district level<br>*Frankliniella occidentalis* causes direct harm on an internationally significant level to a very wide range of plant hosts, including chrysanthemums, cucurbits, cotton, grapes, citrus and apple (CABI 2006). All of these host species are present in Australia (CABI 2006). The major symptoms of feeding include discolouration, deformity or scarring of the upper leaf surface, distortion of fruit, and discolouration and scarring of open blooms and petals (EPPO 1997; CABI 2006). Light infestations are usually not harmful to plants, but more severe infestations will most likely result in holes in fruit, fruit drop, stunting of shoot growth, and delay in production of flowers and fruit, as well as a general decline in plant vigour.<br>*Frankliniella occidentalis* is a vector of tospoviruses (Pernezney *et al*. 2003). At least four different tospoviruses are known to be transmitted, including *tomato spotted wilt virus*, *impatiens necrotic spot virus*, *groundnut ringspot virus* and *tomato chlorotic spot virus* (Campbell *et al*. 2008). Viral symptoms vary considerably in different plants, ranging from wilting and collapse of lettuce plants, leaf mottling and distortions, to ring-spotting on tomato fruits. These viral attacks can lead to the total loss of certain crops. |
| Other aspects of the environment | **B** – minor significance at the local level<br>Thrips introduced into a new environment may compete for resources with the native species. There are no known consequences on other aspects of the environment. |
| **Indirect** | |
| Eradication, control etc. | **C** –significant at the local level<br>Existing control programs may be effective, but new programs will need to be devised, based on how quickly thrips can establish and spread. Control treatments would also need to be supplemented by other methods shown to be effective, such as hygiene measures in glasshouses, and use of alarm pheromones (Cook *et al.* 2002; Herron and Cook 2002). |
| Domestic trade | **D** – significant at the district level<br>The introduction of this species, which is under official control in some parts of Australia, is likely to have a significant impact on domestic trade, with potential loss of markets and significant industry adjustment. |
| International trade | **D** – significant at the district level<br>Presence of this species in commercial production areas of a wide range of commodities (e.g. cucurbits, *Prunus* spp. and *Citrus* spp.) may limit access to overseas markets that lack this pest. |
| Environmental and non-commercial | **B** – minor significance at the local level<br>Although additional pesticide applications would be required to control this pest on susceptible crops, this is not considered to have significant consequences for the environment. |

### 4.3.6. Unrestricted risk estimate

The unrestricted risk estimate for *F. occidentalis* 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 *F. occidentalis* of ‘low’ is above Australia's ALOP. Therefore, specific risk management measures are required for this pest.

## 4.4. *Thrips palmi* [Thysanoptera: Thripidae]

*Thrips palmi* (melon thrips) is known to attack the flowers, fruits and foliage of a range of crops and weeds, causing damage through its feeding activities (Murai 2002; CABI 2006). Its mouthparts are used to rupture and imbibe fluids from plant cells, causing scarring that can reduce crop yield, productivity and marketability. Melon thrips can also transmit a range of tospoviruses while feeding (Nagata *et al.* 2002; CABI 2006). Thrips are easily overlooked because of their small size, especially eggs that are usually laid within host plant tissue. Larval, pupal and adult thrips are mobile and easily dispersed on clothing and packing materials. Adult thrips are winged and can travel considerable distances on the wind (CABI 2006). *Thrips palmi* is an opportunistic species, well adapted to invading new territory and establishing on a range of host plants, to become a pest of economic significance (Young and Zhang 1998; Murai 2002; CABI 2006).

*Thrips palmi* is established in the Darwin area (NT), southeast Qld, NSW and Vic., with no permanent populations established elsewhere. Interstate quarantine restricts movement of plant material from affected areas to all other states, including parts of NT south of the Adelaide River (Young and Zhang 1998; QDPIF 2005b).

### 4.4.1. Probability of entry

#### *Probability of importation*

The likelihood that *T. palmi* will arrive in NT, SA, Tas. and WA with the importation of fresh capsicum fruit from Korea is: **HIGH**

- *Thrips palmi* is associated with fresh capsicum fruit in Korea (CABI 2006; NPQS 2006).
- *Thrips palmi* is able to survive in temperatures as low as -3°C to -7°C (Nagai and Tsumuki 1990).
- Eggs of thrips may be laid on or under the skin of fruit. Adult infestations of thrips on capsicum commonly occur around and under the calyx of the fruit, as well as the pedicel (fruit stalks). Adult thrips are only 1.3 mm long (Pernezny *et al*. 2003; QDPIF 2005b).

Its cold tolerance, cryptic nature and association with capsicum fruit all support a risk rating for importation of this thrips of 'High'.

#### *Probability of distribution*

The likelihood that *T. palmi* will be distributed within NT, SA, Tas. and WA in a viable state, as a result of the processing, sale or disposal of fresh capsicum fruit from Korea, is: **MODERATE**

- Adult thrips may hide and feed under the calyx of fruit and eggs may be laid under the skin of fruit (Pernezny *et al.* 2003). Adults will most likely move off the fruit when disturbed, but immature forms may remain with the fruit during distribution for wholesale or retail trade.
- *Thrips palmi* has a wide host range, including plants in the families Curcurbitaceae and Solanaceae (Young and Zhang 1998; QDPIF 2005b; CABI 2006). Many host species are present throughout Australia.
- Thrips are among the weakest flying insects but their finely fringed wings enable them to remain airborne and easily dispersed by wind (Lewis 1973) and on clothing, hair,

contaminated equipment and containers (EPPO 1997). Adult thrips are also mobile, unaided, within an orchard or glasshouse (Jenser 1973; EPPO 1997).

- Distribution of the commodity in the PRA area would be for retail sale, as the intended use of the commodity is human consumption. This would assist the potential distribution of this species.
- It is likely that the pest would be discarded with fruit scraps or damaged fruit, but damaged capsicum fruit collapses and rots very quickly and may not persist sufficiently long for the thrips to complete their development.

The cryptic nature, polyphagy, ready availability of hosts and mobility of this thrips, moderated by its weak directional flying ability and the rapid breakdown of discarded capsicum waste, support a risk rating for distribution of 'Moderate'.

*Probability of entry (importation $\times$ distribution)*

The likelihood that *T. palmi* will enter NT, SA, Tas. and WA in a viable state, as a result of processing, sale or disposal of capsicums from Korea, is: **MODERATE**

### 4.4.2. Probability of establishment

The likelihood that *T. palmi* will establish within NT, SA, Tas. and WA, based on a comparison of factors in the source and destination areas considered pertinent to its survival and reproduction, is: **HIGH**

- *Thrips palmi* is already established in Australia (in parts of NT and southeast Qld) with control measures in place on interstate transport of known host commodities (Young and Zhang 1998; QDIPF 2005b; NTDPIFM 2006).
- *Thrips palmi* has a wide host range, including plants in the Curcurbitaceae and Solanaceae families (Young and Zhang 1998; QDPIF 2005b; CABI 2006; NTDPIFM 2006). Many host species are present in Australia. A food source distributed across the country is more likely to support the spread of pest populations.
- Adult thrips can reproduce very rapidly. *Thrips palmi* are capable of producing 25–26 generations per year (Huang and Chen 2004) with the entire egg to adult stage taking 10–19 days. Adult females can lay up to 200 eggs during their lifespan (Wang *et al.* 1989).
- Temperature is the main factor controlling development of *T. palmi*; the rate of development increases with increasing temperature (EPPO 1997; CABI 2006). Temperatures in the range of 25–30°C are optimum for population growth of *T. palmi* (Huang and Chen 2004). Much of Australia is subject to temperatures between 15°C and 30°C, providing excellent opportunity for establishment.
- Natural enemies and pesticides have controlled populations of thrips with some success. However, control for long periods is difficult because of their secretive habit, and because populations develop resistance quickly (Datta *et al.* 1999; CABI 2006).

The wide host range of this pest, its high reproductive potential, its preadaptation to temperatures in the PRA areas and the difficulty of control, all support a risk rating for establishment of 'High'.

### 4.4.3. Probability of spread

The likelihood that *T. palmi* will spread within the NT, SA, Tas. and WA, based on a comparison of factors in the source and destination areas considered pertinent to the expansion of the geographic distribution of the pest, is: **HIGH**

- Already present within parts of Australia*, T. palmi* is able to spread very quickly (Young and Zhang 1998; CABI 2006). This species has rapidly become a major pest of cucurbits and solanaceous plants, and has established significant footholds in many tropical regions of the world, including isolated and controlled populations in Australia (Qld and NT) (Young and Zhang 1998; QDIPF 2005b; CABI 2006).
- *Thrips palmi* has a wide host range, including plants in the Curcurbitaceae and Solanaceae families (Young and Zhang, 1998; QDIPF 2005b; CABI 2006). Many host species are present throughout Australia. A food source distributed across the country is more likely to support the spread of pest populations.
- Australia is characterised by natural physical barriers (e.g. deserts/arid areas) which can significantly slow the spread of some insect pests. Adult thrips would not be capable of traversing these areas. However, adults and immature forms may be carried undetected over such distances via the movement of fruit as it is transported for retail sale.
- The outer flesh of capsicum may contain eggs of thrips at the time of sale. The pest may be spread further when the calyx and other parts of the capsicum are disposed of after the rest of the fruit has been consumed.

Experience elsewhere has shown that this pest is capable of rapid spread in new areas. This, plus its wide host range, ready availability of hosts in the PRA areas, and cryptic nature, support a risk rating for spread of 'High'.

### 4.4.4. Probability of entry, establishment and spread

The likelihood that *T. palmi* will be imported as a result of trade in fresh capsicum fruit from Korea, be distributed in a viable state to a suitable host, establish and spread within NT, SA, Tas and WA, is: **MODERATE**

### 4.4.5. Consequences

Assessment of the potential consequences (direct and indirect) of *T. palmi* for NT, SA, Tas. and WA is: **LOW**

| Criterion | Consequence impact score and rationale |
|---|---|
| **Direct** | |
| Plant life or health | **D** –significant at the district level<br>*Thrips palmi* causes direct harm to a wide range of plant hosts. Thrips generally feed on pollen grains and cell sap of other flower tissues and developing fruit, and on the parenchyma cells of young leaves (CABI 2006). The major symptoms of feeding by *Thrips* spp. include discolouration, deformity or scarring of the upper leaf surface, distortion of fruit, and discolouration and scarring of open blooms and petals (EPPO 1997; CABI 2006). Larvae feed on fruit, reducing the ability of plants to reproduce. Light infestations are usually not harmful to plants, but more severe infestations will most likely result in holes in fruit, fruit drop, stunting of shoot growth, and delay in production of flowers and fruit, as well as a general decline in plant vigour (QDPIF 2005b).<br>*Thrips palmi* acts as a vector of the tospovirus *tomato spotted wilt virus* (Campbell *et al*. 2008). Viral symptoms vary considerably in different plants, ranging from wilting and collapse of lettuce plants to ring-spotting on tomato fruits. These viral attacks can lead to serious losses in a wide range of crops. |
| Other aspects of the environment | **B** – minor significance at the local level<br>Thrips introduced into a new environment may compete for resources with the native species. There are no known consequences on other aspects of the environment. |
| **Indirect** | |
| Eradication, control etc. | **C** –significant at the local level<br>Existing control programs may be effective, but new programs will need to be devised, depending on how quickly thrips can establish and spread. Control treatments would also need to be supplemented by other methods shown to be effective, such as hygiene measures in glasshouses. |
| Domestic trade | **D** – significant at the district level<br>The introduction of this species, which is under official control in some areas of Australia, is likely to significantly impact domestic trade with potential loss of markets, and result in significant industry adjustment. |
| International trade | **D** – significant at the district level<br>Presence of this species in commercial production areas of a range of commodities (e.g. cucurbit and solanaceous species) may limit access to overseas markets that lack this pest. |
| Environmental and non-commercial | **B** – minor significance at the local level<br>Although additional pesticide applications would be required to control this pest on susceptible crops, this is not considered to have significant consequences for the environment. |

### 4.4.6. Unrestricted risk estimate

The unrestricted risk estimate for *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 *T. palmi* of 'low' is above Australia's ALOP. Therefore, specific risk management measures are required for this pest.

## 4.5. Pest risk assessment conclusions

Table 4.2 summarises the detailed pest risk assessments and provides unrestricted risk estimates for the quarantine pests for fresh capsicum fruit from 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 the NT and Tas. and *T. palmi* was assessed to have an unrestricted risk estimate of ‘low’ for the NT, SA, Tas. and WA. The unrestricted risk estimates for these pests exceed Australia’s ALOP of very low. Specific pest risk management measures are therefore required for fresh capsicum fruit imported from Korea into these areas to address the potential quarantine risks. The proposed pest risk management measures are discussed in Section 5.

### Table 4.2: Summary of pest risk assessments for quarantine pests for fresh capsicum fruit from Korea

| **Pest name** | **Probability of** | | | | | **Overall probability of entry, establishment and spread** | **Consequences** | **Unrestricted risk** |
|---|---|---|---|---|---|---|---|---|
| | **Entry** | | | **Establishment** | **Spread** | | | |
| | Importation | Distribution | Overall (importation x distribution) | | | | | |
| Thrips [Thysanoptera: Thripidae] | | | | | | | | |
| *Frankliniella intonsa* | High | Moderate | Moderate | High | High | Moderate | Low | Low |
| *Frankliniella occidentalis* (NT, Tas.) | High | Moderate | Moderate | High | High | Moderate | Low | Low |
| *Thrips palmi* (NT, SA, Tas., WA) | High | Moderate | Moderate | High | High | Moderate | Low | Low |
| Regional quarantine pests have the endangered area identified in parentheses. | | | | | | | | |

# 5. Pest risk management

## 5.1. Pest risk management measures and phytosanitary procedures

In addition to Korea's standard commercial production practices for fresh capsicum fruit, and minimum border procedures in Australia, specific pest risk management measures, including operational systems, are proposed to achieve Australia's ALOP. These are:

- pre-export phytosanitary inspection and on-arrival inspection for thrips; and
- an operational system for the maintenance and verification of the phytosanitary status of fresh capsicum fruit from Korea.

The specific pest risk management measures and operational system proposed for fresh capsicum fruit from Korea are summarised in Table 5.1.

**Table 5.1: Phytosanitary measures proposed for quarantine pests for fresh capsicum fruit from Korea**

| Pest | Common name | Measures |
|---|---|---|
| Thrips [Thysanoptera: Thripidae] | | |
| *Frankliniella intonsa* | European flower thrips | Pre-export phytosanitary certification and on-arrival inspection |
| *Frankliniella occidentalis* (NT, Tas.) | Western flower thrips | |
| *Thrips palmi* (NT, SA, Tas., WA) | Melon thrips | |
| If applicable, Australian regional quarantine pests are indicated with the region(s) concerned in parentheses | | |

### 5.1.1. Pest risk management for thrips

The pest risk management measures proposed for fresh capsicum fruit are pre-export and on-arrival inspections for the thrips identified as quarantine pests that were above Australia's ALOP in this draft IRA report, *F. intonsa, F. occidentalis* and *T. palmi*.

The requirement is that the consignment be free of quarantine pests based on finding no quarantine pests in a sample of 600 units (single capsicum fruit) from each consignment. No detection of pests by inspection of 600 units achieves a confidence level of 95% that not more than 0.5% of the units in the consignment are infested or infected.

If quarantine pests and/or regulated articles[3] are detected during inspections, remedial action is to be taken. Remedial action may include one or more of the following:

- re-export of the consignment from Australia;
- treatment and re-inspection of the consignment to ensure no viable quarantine pests or other regulated articles are present; or
- destruction of the consignment.

[3] 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 2007b).

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

These proposed measures are consistent with the import policy for capsicum fruit from New Zealand, the United States of America and Europe.

### 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 capsicum fruit from Korea. This is to ensure that the proposed risk management measures have been met and are maintained.

The components of the proposed operational system are described below.

**Registration of export greenhouses**

The objectives of this procedure are to ensure that:

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

**Registration of packing houses and auditing of procedures**

The objectives of this procedure are to ensure that;

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

**Packaging and labelling**

The objectives of this procedure are to ensure that:

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

### Specific conditions for storage and transport of produce

The objectives of this procedure are to ensure that:

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

### Pre-export phytosanitary inspection and certification by NPQS

The objectives of this procedure are to ensure that:

- all consignments[4] are inspected by NPQS in accordance with official procedures for all visually detectable quarantine pests and other regulated articles at a sample rate that achieves a confidence level of 95% that not more than 0.5% of the units are infested in the consignment (this equates to a level of zero units infested by quarantine pests in a sample of 600 units selected randomly from each homogenous inspection lot from a consignment, where a unit is one capsicum fruit); and
- detection of live quarantine pests will result in failure of the consignment;
- records of the interceptions of live quarantine pests and regulated articles made during these inspections are to be maintained by NPQS and made available on request to AQIS, to assist in future reviews of this import pathway and consideration of the appropriateness of the phytosanitary measures that have been applied;
- an international phytosanitary certificate (IPC) is issued by NPQS for each consignment that has been found free of pests of quarantine concern to Australia during its phytosanitary inspection, consistent with ISPM No. 12 *Guidelines for Phytosanitary Certificates* (FAO 2006b), to provide formal documentation to AQIS verifying that the relevant measures have been undertaken offshore; and
- 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 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 procedure are to ensure that:

- on arrival in Australia, each consignment as defined by a single phytosanitary certificate is inspected by AQIS at the first port of entry for quarantine pests and regulated articles;
- inspection lots are inspected using the standard AQIS inspection protocol, which includes optical enhancement where necessary;

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[4] 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 2007b).

- a sample size for capsicum fruit of 600 units (single capsicum fruit) is inspected from each consignment ( if a consignment has less than 1000 units, then 450 units are to be inspected and if a consignment has less than 450 units, all units must be inspected);
- if no live quarantine pests or other regulated articles are detected in the inspection lot, the consignment will be released from quarantine;
- inspection lots will fail if quarantine pests and/or regulated articles are detected by AQIS during on-arrival inspections and remedial action is to be taken when this occurs; and
- if product continually fails inspection, the export program may be suspended and audited by AQIS with reinstatement after it is satisfied that appropriate corrective action has been taken.

### 5.1.3. Uncategorised pests

If an organism is detected on capsicum fruit, either in 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 and/or suspension of trade while a review is conducted to ensure that existing measures continue to provide the appropriate level of phytosanitary protection for Australia.

## 5.2. Review of policy

The adopted policy may be reviewed after substantial trade of capsicum fruit from Korea to Australia, or earlier in the event of new outbreaks in Korea of pests of concern to Australia.

# 6. Conclusion

The findings of this draft IRA report are based on a comprehensive analysis of relevant scientific literature and existing import requirements for fresh capsicum fruit from New Zealand, the United States of Amercia and Europe.

Biosecurity Australia considers that the risk management measures proposed in this draft IRA report will provide an appropriate level of protection against the pests identified in this risk analysis. Various risk management measures may be suitable to manage the risks associated with fresh capsicum fruit from Korea. Biosecurity Australia will consider any other measures suggested by stakeholders that provide an equivalent level of phytosanitary protection.

# Appendices

# Appendix A: Initiation and pest categorisation for phytosanitary pests

| Pest | Associated with Capsicum crop in 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 2000) | 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 2000) | 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 (Halliday 2000) | Not assessed | Not assessed | Not assessed | No |

| Pest | Associated with Capsicum crop in 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 |
|---|---|---|---|---|---|---|
| Tetranychidae | | | | | | |
| *Tetranychus kanzawai* Kishida, 1927<br>Kanzawai spider mite | Yes<br>(USDA 2005) | Yes<br>(Halliday 2000) | Not assessed | Not assessed | Not assessed | No |
| *Tetranychus urticae* Koch, 1836<br>two-spotted spider mite | Yes<br>(Lee *et al*. 1992; USDA 2005; NPQS 2006) | Yes<br>(Halliday 2000) | Not assessed | Not assessed | Not assessed | No |
| INSECTA: COLEOPTERA | | | | | | |
| Coccinellidae | | | | | | |
| *Epilachna vigintioctomaculata* Motschulsky, 1857<br>large 28-spotted lady beetle | Yes<br>(USDA 2005) | Yes<br>Not in WA (IHS 2000; DAFWA 2006) | No<br>Only affects leaves (USDA 2005) | Not assessed | Not assessed | No |
| Curculionidae | | | | | | |
| *Listroderes costirostris* Schönherr, 1826<br>Australian tomato weevil | Yes<br>(USDA 2005; NPQS 2006) | Yes<br>(Wilson and Wearne 1962; CABI 2006) | Not assessed | Not assessed | Not assessed | No |
| Tenebrionidae | | | | | | |
| *Tribolium castaneum* (Herbst, 1797)<br>red flour beetle | Yes<br>(USDA 2005; CABI 2006) | Yes<br>(Daglish 2005) | Not assessed | Not assessed | Not assessed | No |
| INSECTA: DIPTERA | | | | | | |
| Agromyzidae | | | | | | |
| *Liriomyza huidobrensis* (Blanchard, 1926)<br>pea leafminer | Yes<br>(CABI 2006) | No<br>(Elliot 2006) | No<br>Only affects leaves (CABI 2006) | Not assessed | Not assessed | No |

| Pest | Associated with Capsicum crop in 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)<br>serpentine leafminer | Yes<br>(USDA 2005; NPQS 2006) | No<br>(Elliot 2006) | No<br>Only affects leaves (NPQS 2006). | Not assessed | Not assessed | No |
| Cecidomyiidae | | | | | | |
| *Aphidoletes aphidimyza* (Rondani, 1847)<br>gall midge | Yes<br>(NPQS 2007b) | Yes<br>Cosmopolitan (Gagné 1996) | Not assessed | Not assessed | Not assessed | No |
| Sciaridae | | | | | | |
| *Bradysia difformis* Frey, 1948<br>Syn.: *Bradysia agrestis* Sasakawa, 1978<br>black fungus gnat | Yes<br>(Lee *et al*. 2001) | No<br>(Steffan 1989) | No<br>Damages roots of host seedlings grown in greenhouses in Korea, including capsicum (Kim *et al*. 2000). | Not assessed | Not assessed | No |
| INSECTA: HEMIPTERA | | | | | | |
| Aleyrodidae | | | | | | |
| *Bemisia tabaci* (B biotype) (Gennadius, 1889)<br>silver leaf whitefly | Yes<br>(USDA 2005; NPQS 2006) | Yes<br>(Carver and Reid 1996; Gunning *et al.* 1997).<br>Species has a restricted distribution in WA and is under official control (DAFWA 2006) | No<br>Damages plants by sucking sap from leaves (CABI 2006; NPQS 2006). | Not assessed | Not assessed | No |
| *Trialeurodes vaporariorum* (Westwood, 1856)<br>tea whitefly | Yes<br>(USDA 2005; NPQS 2006) | Yes<br>(Martin and Gillespie 2001) | Not assessed | Not assessed | Not assessed | No |

| Pest | Associated with Capsicum crop in 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 |
|---|---|---|---|---|---|---|
| Aphididae | | | | | | |
| *Aphis craccivora* Koch, 1854<br>groundnut aphid | Yes<br>(CABI 2006) | Yes<br>(Gutierrez *et al*. 1974; Behncken and Maleevsky 1977) | Not assessed | Not assessed | Not assessed | No |
| *Aphis fabae* Scopoli, 1763<br>blackbean aphid | Yes<br>(USDA 2005; NPQS 2006) | No<br>(Hollis and Eastop 2005) | No<br>Attacks the leaves and stem (NPQS 2006).<br>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<br>cotton aphid | Yes<br>(Kim *et al*. 1986; Choo *et al*. 1987; Vuong *et al*. 2001; USDA 2005; NPQS 2006) | Yes<br>(Smith *et al*. 1997) | Not assessed | Not assessed | Not assessed | No |
| *Aphis nerii* Boyer de Fonscolombe, 1841<br>sweet pepper aphid | Yes<br>(USDA 2005; NPQS 2006) | Yes<br>(Carver 1984; ICDb 2004) | Not assessed | Not assessed | Not assessed | No |
| *Aphis spiraecola* Patch, 1914<br>Syn.: *Aphis citricola* (van der Goot, 1912)<br>spiraea aphid | Yes<br>(USDA 2005; NPQS 2006) | Yes<br>(Blackman and Eastop 2000) | Not assessed | Not assessed | Not assessed | No |

| Pest | Associated with Capsicum crop in 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 |
|---|---|---|---|---|---|---|
| *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 1985) | No Inhabits the underside of leaves or the apical section of young stems of *Staphylea* spp. especially *S. bumalda* in Korea (Lee 2001) | Not assessed | Not assessed | No |
| *Macrosiphum euphorbiae* (Thomas, 1878) potato aphid | Yes (USDA 2005; CABI 2006) | Yes (Hollis and Eastop 2005) | 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) | 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 | | | | | | |
| *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 |

| Pest | Associated with Capsicum crop in 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 |
|---|---|---|---|---|---|---|
| *Pseudaulacaspis pentagona* (Targioni Tozzetti, 1886)<br>white peach scale | Yes<br>(Ben-Dov *et al*. 2005; CABI 2006) | Yes<br>(Ben-Dov *et al*. 2005; CABI 2006)<br>Not in WA (DAFWA 2006) | No<br>Capsicum is a minor host. Young plants are the most susceptible. Heavy infestations often occur as thick crusts on tree trunks and older branches of hosts, roots are rarely affected. Leaves and fruits are not usually infested (CABI 2006) | Not assessed | Not assessed | No |
| Pentatomidae | | | | | | |
| *Nezara viridula* (Linnaeus, 1758)<br>green vegetable bug | Yes<br>(USDA 2005; CABI 2006; NPQS 2006) | Yes<br>(CABI 2006; Knight and Gurr 2007) | Not assessed | Not assessed | Not assessed | No |
| INSECTA: LEPIDOPTERA | | | | | | |
| Gelechiidae | | | | | | |
| *Phthorimaea operculella* (Zeller, 1873)<br>potato tuber moth | Yes<br>(USDA 2004; CABI 2006; NPQS 2006) | Yes<br>(Edwards 1996) | Not assessed | Not assessed | Not assessed | No |
| Noctuidae | | | | | | |
| *Agrotis ipsilon* (Hufnagel, 1766)<br>black cut worm | Yes<br>(USDA 2004; CABI 2006; NPQS 2006) | Yes<br>(CABI 2006) | Not assessed | Not assessed | Not assessed | No |
| *Agrotis segetum* (Denis & Schiffermüller, 1775)<br>turnip moth | Yes<br>(USDA 2004; CABI 2006; NPQS 2006) | No<br>(CABI 2006) | No<br>Affects leaves, stems and roots of hosts (CABI 2006) | Not assessed | Not assessed | No |
| *Chrysodeixis eriosoma* (Doubleday, 1843)<br>green looper caterpillar | Yes<br>(USDA 2004; CABI 2006; NPQS 2006) | Yes<br>(CABI 2006) | Not assessed | Not assessed | Not assessed | No |

| Pest | Associated with Capsicum crop in 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 |
|---|---|---|---|---|---|---|
| *Eudocima fullonia* (Clerck, 1764)<br>fruit piercing moth | Yes<br>(USDA 2004; NPQS 2006) | Yes<br>(CABI 2006) | Not assessed | Not assessed | Not assessed | No |
| *Helicoverpa armigera* (Hübner, 1805)<br>cotton boll worm | Yes<br>(USDA 2004; CABI 2006; NPQS 2006) | Yes<br>(EPPO 1997; CABI 2006) | Not assessed | Not assessed | Not assessed | No |
| *Helicoverpa assulta* (Guenée, 1852)<br>cape gooseberry budworm | Yes<br>(Yang *et al*. 2004; USDA 2005; NPQS 2006) | Yes<br>(Common 1990; CABI 2006) | Not assessed | Not assessed | Not assessed | No |
| *Mamestra brassicae* (Linnaeus, 1758)<br>cabbage moth | Yes<br>(USDA 2005; NPQS 2006) | No<br>(Cassis and Gross 2002) | No<br>Attacks leaves and stems. Capsicum listed as minor host (CABI 2006; NPQS 2006) | Not assessed | Not assessed | No |
| *Spodoptera exigua* (Hübner, 1808)<br>lesser armyworm | Yes<br>(USDA 2005; CABI 2006; NPQS 2006) | Yes<br>(Common 1990; CABI 2006) | Not assessed | Not assessed | Not assessed | No |
| *Spodoptera litura* (Fabricius, 1775)<br>cluster caterpillar | Yes<br>(USDA 2005; CABI 2006) | Yes<br>(Common 1990; CABI 2006) | Not assessed | Not assessed | Not assessed | No |
| *Trichoplusia ni* (Hübner, 1803)<br>cabbage looper | Yes<br>(USDA 2005; NPQS 2006) | No<br>(Cassis and Gross 2002) | No<br>Feeds on leaves, causing dwarfing and dieback of plant (CABI 2006; NPQS 2006). | Not assessed | Not assessed | No |
| Pyralidae | | | | | | |
| *Ostrinia furnacalis* (Guenée, 1854)<br>Asian corn borer | Yes<br>(CABI 2006; NPQS 2006) | Yes<br>(Mutuura and Munroe 1970; Common 1990) | Not assessed | Not assessed | Not assessed | No |

| Pest | Associated with Capsicum crop in 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 |
|---|---|---|---|---|---|---|
| INSECTA: THYSANOPTERA | | | | | | |
| Phlaeothripidae | | | | | | |
| *Haplothrips chinensis* Priesner, 1933<br>rose thrips | Yes<br>(Woo 1988) | No<br>(Mound 2001) | No<br>Initially recorded in 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 Korea, but not on the fruit (Woo 1988). | Not assessed | Not assessed | No |
| Thripidae | | | | | | |
| *Frankliniella intonsa* (Trybom, 1895)<br>European flower thrips | Yes<br>(USDA 2005; NPQS 2006) | No<br>(Mound 2001) | Yes<br>(NPQS 2006)<br>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<br>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<br>Causes a medium level of damage on citrus in 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 |

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|---|---|---|---|---|---|---|
| *Frankliniella occidentalis* (Pergande, 1895)<br>western flower thrips | Yes<br>(Han *et al*. 1998; Lee *et al*. 2003; USDA 2005; NPQS 2006) | Yes<br>Not in the NT and under official control in NT and Tas. (Mound and Teulon 1995; Mound 2001; DPIFM 2007) | Yes<br>Attacks fruit (NPQS 2006). Capsicum plants may be attacked whilst they develop, showing serious distortion as they mature (CABI 2006). | Feasible<br>*F. occidentalis* has a very broad host range including cucurbits, chrysanthemum, cotton, grapes, citrus and apple (CABI 2006).<br>High reproductive rate (Katayama 1997), with more than one generation per year (McDonald *et al*. 1998). Adults are capable of flight (Pearsall 2002). | Significant<br>*F. occidentalis* is a pest of several economically important crop species (CABI 2006). | Yes<br>(For NT and Tas.) |
| *Heliothrips haemorrhoidalis* (Bouché, 1833)<br>greenhouse thrips | Yes<br>(CABI 2006) | Yes<br>(Mound 2001) | Not assessed | Not assessed | Not assessed | No |
| *Scirtothrips dorsalis* Hood, 1919<br>chilli thrips | Yes<br>(USDA 2005; CABI 2006) | Yes<br>(Mound 2001) | Not assessed | Not assessed | Not assessed | No |
| *Thrips hawaiiensis* (Morgan, 1913)<br>banana flower thrips | Yes<br>(USDA 2005; NPQS 2006) | Yes<br>(Mound 2001) | Not assessed | Not assessed | Not assessed | No |

| Pest | Associated with Capsicum crop in 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 |
|---|---|---|---|---|---|---|
| *Thrips palmi* Karny, 1925<br>melon thrips | Yes<br>(USDA 2005; CABI 2006; NPQS 2006) | Yes<br>(EPPO 1997; Mound 2007)<br>But a restricted distribution in WA. (DAFWA 2006)<br>SA, Tas., NT and WA apply quarantine restrictions for movement of melon thrips hosts (QDPIF 2005b) | Yes<br>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<br>Main hosts are plants in the Cucurbitaceae and Solanaceae families (CABI 2006). Short life cycle of about 18 days and high fecundity of up to 200 eggs per female (Wang *et al*. 1989). | Significant<br>It is a major pest of cucurbits and solanaceous pests in many tropical regions (CABI 2006). | Yes<br>(For NT, SA, Tas. and WA) |
| *Thrips tabaci* Lindeman, 1889<br>onion thrips | Yes<br>(USDA 2005) | Yes<br>(Herron *et al*. 2006) | Not assessed | Not assessed | Not assessed | No |
| BACTERIA | | | | | | |
| *Clavibacter michiganensis* subsp. *michiganensis* (Smith 1910) Davis *et al*. 1984<br>bacterial canker | Yes<br>(USDA 2005; NPQS 2006) | Yes<br>(Bradbury 1986) | Not assessed | Not assessed | Not assessed | No |
| *Dickeya chrysanthemi* (Burkholder *et al*. 1953) Sampson *et al*. 2005<br>Syn.: *Pectobacterium chrysanthemi* (Burkholder *et al*. 1953) Brenner *et al*. 1973<br>bacterial soft rot | Yes<br>(USDA 2005; CABI 2006) | Yes<br>(Cother 1980; Peltzer and Sivasithamparam 1985) | Not assessed | Not assessed | Not assessed | No |
| *Pectobacterium carotovor* subsp. *atrosepticum* (van Hall 1902) Hauben *et al*. 1999<br>blackleg | Yes<br>(USDA 2005) | Yes<br>(Bradbury 1986; CABI 2006) | Not assessed | Not assessed | Not assessed | No |

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|---|---|---|---|---|---|---|
| *Pectobacterium carotovorum* subsp. *carotovorum* (Jones 1901) Hauben *et al*. 1999<br>bacterial stem rot | Yes<br>(USDA 2004; CABI 2006; NPQS 2006) | Yes<br>(Cother 1980) | Not assessed | Not assessed | Not assessed | No |
| *Pseudomonas cichorii* (Swingle 1925) Stapp 1928<br>chicory bacterial blight | Yes<br>(USDA 2005; CABI 2006) | Yes<br>(CABI 2006) | Not assessed | Not assessed | Not assessed | No |
| *Pseudomonas fuscovaginae* (ex Tanii *et al*. 1976) Miyajima *et al*. 1983<br>rice soft rot | Yes<br>(Yi and Seo 2000; NPQS 2006) | No<br>(CABI 2006) | No<br>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<br>lettuce marginal leaf blight | Yes<br>(USDA 2005; CABI 2006) | Yes<br>(CABI 2006)<br>Not in WA<br>(DAFWA 2003) | No<br>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 |
| *Pseudomonas syringae* pv. *aptata* (Brown & Jamieson 1913) Young *et al*. 1978<br>sugarbeet leaf spot | Yes<br>(USDA 2005; CABI 2006) | Yes<br>(CABI 2006)<br>Not in WA<br>(DAFWA 2003) | No<br>Affects leaves (Bradbury 1986). | Not assessed | Not assessed | No |
| *Pseudomonas syringae* pv. *tabaci* (Wolf & Foster 1917) Young *et al*. 1978<br>angular leaf spot | Yes<br>(USDA 2005; CABI 2006) | Yes<br>(CABI 2006) | Not assessed | Not assessed | Not assessed | No |

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|---|---|---|---|---|---|---|
| *Pseudomonas syringae* van Hall 1902<br>bacterial canker | Yes<br>(USDA 2005; CABI 2006) | Yes<br>(CABI 2006) | Not assessed | Not assessed | Not assessed | No |
| *Pseudomonas viridiflava* (Burkholder 1930) Dowson 1939<br>bean bacterial blight | Yes<br>(USDA 2005; CABI 2006; NPQS 2006) | Yes<br>(CABI 2006) | Not assessed | Not assessed | Not assessed | No |
| *Ralstonia solanacearum* (Smith 1896) Yabuuchi *et al*. 1996<br>bacterial wilt | Yes<br>(CABI 2006; NPQS 2006) | Yes<br>(CABI 2006) | Not assessed | Not assessed | Not assessed | No |
| *Ralstonia solanacearum* race 3 (Smith 1896) Yabuuchi *et al*. 1996<br>bacterial wilt | Yes<br>(USDA 2005) | Yes<br>(CABI 2006) | Not assessed | Not assessed | Not assessed | No |
| *Ralstonia solanacearum* race 1 (Smith 1896) Yabuuchi *et al*. 1996<br>bacterial wilt | Yes<br>(USDA 2005; CABI 2006) | Yes<br>(CABI 2006) | Not assessed | Not assessed | Not assessed | No |
| *Rhizobium radiobacter* (Beijerinck & van Delden 1902) Young *et al*. 2001<br>crown gall | Yes<br>(USDA 2005; NPQS 2006) | Yes<br>(CABI 2006) | Not assessed | Not assessed | Not assessed | No |
| *Xanthomonas vesicatoria* (ex Doidge 1920) Vauterin *et al*. 1995<br>bacterial spot | Yes<br>(CABI 2006; NPQS 2006) | Yes<br>(CABI 2006) | Not assessed | Not assessed | Not assessed | No |
| FUNGI | | | | | | |
| *Alternaria alternata* (Fr.: Fr.) Keissl.<br>alternaria leaf spot | Yes<br>(USDA 2005; CABI 2006; Farr *et al*. 2006; NPQS 2006) | Yes<br>(CABI 2006; Farr *et al*. 2006) | Not assessed | Not assessed | Not assessed | No |
| *Alternaria solani* Sorauer<br>early blight | Yes<br>(USDA 2005; NPQS 2006) | Yes<br>(CABI 2006) | Not assessed | Not assessed | Not assessed | No |

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|---|---|---|---|---|---|---|
| *Alternaria tenuissima* (Kunze) Wiltshire<br>black mould | Yes<br>(Farr *et al*. 2006; NPQS 2006) | Yes<br>(Farr *et al*. 2006) | Not assessed | Not assessed | Not assessed | No |
| *Ascochyta capsici* Bond.-Mont.<br>leaf spot | Yes<br>(USDA 2005; NPQS 2006) | No<br>(DAFWA 2003; Farr *et al*. 2006) | No<br>Only affects leaves (USDA 2004; NPQS 2006). | Not assessed | Not assessed | No |
| *Aspergillus niger* Tiegh.<br>black mould | Yes<br>(USDA 2005; CABI 2006) | Yes<br>(CABI 2006; Farr *et al*. 2006) | Not assessed | Not assessed | Not assessed | No |
| *Botrytis cinerea* Pers.: Fr.<br>grey mould | Yes<br>(USDA 2005; CABI 2006; USDA 2006) | Yes<br>(CABI 2006) | Not assessed | Not assessed | Not assessed | No |
| *Cercospora capsici* Heald & F.A. Wolf<br>frog eye leaf spot of pepper | Yes<br>(USDA 2005; NPQS 2006) | Yes (APPD 2006)<br>Not in WA<br>(DAFWA 2003) | No<br>Causes circular, whitish, grey or brown, often brown or reddish brown bordered leaf spots (Kirk 1982). Fruit are not infected (Cerkauskas 2004). | Not assessed | Not assessed | No |

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|---|---|---|---|---|---|---|
| *Choanephora cucurbitarum* (Berk. & Ravenel) Thaxt.<br>choanephora wet rot | Yes<br>(USDA 2005) | Yes<br>(CABI 2006)<br>Not in WA<br>(DAFWA 2003) | No<br>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<br>cladosporium rot | Yes<br>(USDA 2005; CABI 2006; NPQS 2006) | Yes<br>(Farr *et al*. 2006) | Not assessed | Not assessed | Not assessed | No |
| *Colletotrichum acutatum* J.H. Simmonds<br>anthracnose | Yes<br>(USDA 2005; CABI 2006; NPQS 2006) | Yes<br>(CABI 2006; Farr *et al*. 2006) | Not assessed | Not assessed | Not assessed | No |
| *Colletotrichum coccodes* (Wallr.) S. Hughes<br>anthracnose | Yes<br>(USDA 2005; CABI 2006; Farr *et al*. 2006; NPQS 2006) | Yes<br>(CABI 2006; Farr *et al*. 2006) | Not assessed | Not assessed | Not assessed | No |
| *Colletotrichum dematium* (Pers.: Fr.) Grove<br>Cited as *Colletotrichum dematium* f.sp. *capsicum* by NPQS (2006)<br>anthracnose | Yes<br>(USDA 2005; Farr *et al*. 2006; NPQS 2006) | Yes<br>(Farr *et al*. 2006) | Not assessed | Not assessed | Not assessed | No |

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|---|---|---|---|---|---|---|
| *Colletotrichum gloesporioides* (Penz.) Penz. & Sacc.<br>Teleomorph: *Glomerella cingulata* (Stoneman) Spauld. & H Schrenk<br>anthracnose | Yes<br>(USDA 2005; CABI 2006; Farr *et al*. 2006; NPQS 2006) | Yes<br>(CABI 2006; Farr *et al*. 2006) | Not assessed | Not assessed | Not assessed | No |
| *Corynespora cassiicola* (Berk. & M.A. Curtis) C.T. Wei.<br>leaf spot | Yes<br>(Kwon *et al*. 2001; USDA 2005; NPQS 2006) | Yes<br>(CABI 2006; Farr *et al*. 2006)<br>Not in WA<br>(DAFWA 2003) | No<br>Causes leaf spot on *Capsicum annuum* in Korea (Kwon *et al*. 2001) | Not assessed | Not assessed | No |
| *Diaporthe phaseolorum* (Cooke & Ellis) Sacc.<br>Anamorph: *Phomopsis phaseolin* (Desm.) Sacc.<br>pod blight of soybean | Yes<br>(Punithalingam and Holliday 1972; USDA 2005; NPQS 2006) | Yes<br>(CABI 2006)<br>Not in WA<br>(DAFWA 2003) | No<br>Causes dieback (CABI 2006) | Not assessed | Not assessed | No |
| *Fusarium equiseti* (Corda) Sacc.<br>Teleomorph: *Gibberella intricans* Wollenw<br>fruit rot | Yes<br>(USDA 2005) | Yes<br>(CABI 2006) | Not assessed | Not assessed | Not assessed | No |
| *Fusarium oxysporum* Schltdl.: Fr.<br>basal rot | Yes<br>(USDA 2005; Farr *et al*. 2006; NPQS 2006) | Yes<br>(CABI 2006; Farr *et al*. 2006) | Not assessed | Not assessed | Not assessed | No |
| *Haematonectria haematococca* (Berk. & Broome) Samuels & Rossman<br>Anamorph: *Fusarium solani* (Mart.) Sacc.<br>potato dry rot | Yes<br>(USDA 2005; CABI 2006; Farr *et al*. 2006) | Yes<br>(CABI 2006; Farr *et al*. 2006) | Not assessed | Not assessed | Not assessed | No |

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|---|---|---|---|---|---|---|
| *Leveillula taurica* (Lév.) G. Arnaud<br>Anamorph: *Oidiopsis sicula* Scalia<br>powdery mildew | Yes<br>(USDA 2005; CABI 2006; Farr *et al*. 2006) | Yes<br>(CABI 2006; Farr *et al*. 2006) | Not assessed | Not assessed | Not assessed | No |
| *Macrophomina phaseolina* (Tassi) Goid.<br>charcoal rot | Yes<br>(USDA 2005; CABI 2006; Farr *et al*. 2006) | Yes<br>(CABI 2006; Farr *et al*. 2006) | Not assessed | Not assessed | Not assessed | No |
| *Phoma destructiva* Plowr.<br>fruit and stem rot | Yes<br>(USDA 2005; Farr *et al*. 2006; NPQS 2006) | Yes<br>(Farr *et al*. 2006) | Not assessed | Not assessed | Not assessed | No |
| *Rhizoctonia solani* J.G. Kühn<br>Teleomorph: *Thanatephorus cucumeri* (A.B. Frank) Donk 1956<br>soil rot | Yes<br>(Farr *et al*. 2006; NPQS 2006) | Yes<br>(Farr *et al*. 2006) | Not assessed | Not assessed | Not assessed | No |
| *Rhizopus stolonifer* (Ehrenb.: Fr.) Vuill.<br>rhizopus rot | Yes<br>(USDA 2005; CABI 2006; Farr *et al*. 2006; NPQS 2006) | Yes<br>(CABI 2006; Farr *et al*. 2006) | Not assessed | Not assessed | Not assessed | No |
| *Sclerotinia sclerotiorum* (Lib.) de Bary<br>cottony soft rot | Yes<br>(USDA 2005; CABI 2006; Farr *et al*. 2006; NPQS 2006) | Yes<br>(CABI 2006; Farr *et al*. 2006) | Not assessed | Not assessed | Not assessed | No |
| *Sclerotium rolfsii* Sacc.<br>Teleomorph: Athelia rolfsii (Curzi) Tu & Kimbr.<br>sclerotium rot | Yes<br>(USDA 2005; CABI 2006; Farr *et al*. 2006) | Yes<br>(CABI 2006; Farr *et al*. 2006) | Not assessed | Not assessed | Not assessed | No |
| *Septoria lycopersici* Speg.<br>tomato leaf spot | Yes<br>(USDA 2005; CABI 2006; Farr *et al*. 2006; NPQS 2006) | Yes<br>(CABI 2006; Farr *et al*. 2006) | Not assessed | Not assessed | Not assessed | No |

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|---|---|---|---|---|---|---|
| *Stemphylium lycopersici* (Enjoji) W. Yamam. <br> grey leaf spot | Yes <br> (USDA 2005; Farr *et al*. 2006; NPQS 2006) | Yes <br> (DAFWA 2003) | Not assessed | Not assessed | Not assessed | No |
| *Stemphylium solani* G.F. Weber <br> grey leaf spot | Yes <br> (USDA 2005; Farr *et al*. 2006; NPQS 2006) | Yes <br> (Farr *et al*. 2006) | Not assessed | Not assessed | Not assessed | No |
| *Verticillium albo-atrum* Reinke & Berthier <br> verticillium wilt | Yes <br> (USDA 2005; Farr *et al*. 2006) | Yes <br> (CABI 2006; Farr *et al*. 2006) | Not assessed | Not assessed | Not assessed | No |
| *Verticillium dahliae* Kleb. <br> verticillium wilt | Yes <br> (USDA 2005; Farr *et al*. 2006) | Yes <br> (CABI 2006; Farr *et al*. 2006) | Not assessed | Not assessed | Not assessed | No |
| STRAMINOPILA | | | | | | |
| *Peronospora hyoscyami* (Rabenh.) de Bary <br> tobacco blue mould | Yes <br> (USDA 2005) | Yes <br> (CABI 2006; Farr *et al*. 2006) | Not assessed | Not assessed | Not assessed | No |
| *Phytophthora capsici* Leonian <br> capsicum stem and fruit rot | Yes <br> (Choi and Park 1982; Choe 1989; USDA 2005; Farr *et al*. 2006; NPQS 2006) | Yes <br> (Weinert *et al*. 1999; Farr *et al*. 2006) | Not assessed | Not assessed | Not assessed | No |
| *Phytophthora infestans* (Mont.) de Bary <br> phytophthora blight | Yes <br> (USDA 2005; CABI 2006; Farr *et al*. 2006) | Yes <br> (CABI 2006; Farr *et al*. 2006) | Not assessed | Not assessed | Not assessed | No |
| *Phytophthora nicotianae* Breda de Haan <br> black shank | Yes <br> (USDA 2005; CABI 2006; Farr *et al*. 2006; NPQS 2006) | Yes <br> (CABI 2006; Farr *et al*. 2006) | Not assessed | Not assessed | Not assessed | No |

| Pest | Associated with Capsicum crop in 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 |
|---|---|---|---|---|---|---|
| *Pythium aphanidermatum* (Edson) Fitzp.<br>damping off | Yes<br>(USDA 2005; Farr *et al*. 2006) | Yes<br>(CABI 2006; Farr *et al*. 2006) | Not assessed | Not assessed | Not assessed | No |
| *Pythium debaryanum* auct. non R. Hesse<br>damping off | Yes<br>(USDA 2005; CABI 2006; Farr *et al*. 2006) | Yes<br>(CABI 2006; Farr *et al*. 2006) | Not assessed | Not assessed | Not assessed | No |
| *Pythium myriotylum* Drechsler<br>groundnut brown rot | Yes<br>(USDA 2005; CABI 2006; Farr *et al*. 2006) | Yes<br>(CABI 2006; Farr *et al*. 2006) | Not assessed | Not assessed | Not assessed | No |
| *Pythium spinosum* Sawada<br>damping off | Yes<br>(USDA 2005; Farr *et al*. 2006) | Yes<br>(Farr *et al*. 2006) | Not assessed | Not assessed | Not assessed | No |
| *Pythium ultimum* Trow<br>damping off | Yes<br>(USDA 2005; CABI 2006; Farr *et al*. 2006; NPQS 2006) | Yes<br>(CABI 2006; Farr *et al*. 2006) | Not assessed | Not assessed | Not assessed | No |
| VIRUSES | | | | | | |
| *Alfalfa mosaic virus* (*Alfamovirus*) | Yes<br>(USDA 2004; CABI 2006; NPQS 2006) | Yes<br>(Coutts and Jones 2002) | Not assessed | Not assessed | Not assessed | No |
| *Beet curly top virus* (*Hibriheminivirus*) | Yes<br>(USDA 2004; CABI 2006) | No<br>(Brunt *et al*. 1996; CABI 2006) | Yes<br>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<br>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 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<br>(Lee *et al*. 2000; USDA 2004; NPQS 2006) | Yes<br>(Brunt *et al*. 1996)<br>Not in WA (DAFWA 2003) | No<br>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<br>(USDA 2004; CABI 2006) | No<br>(Brunt *et al*. 1996; CABI 2006) | Yes<br>Virus causes systemic infections in capsicum plants, causing dark green mottling adjacent to main leaf veins, reduction in size and distortion of leaves a and stunting of plants (Brunt *et al*. 1996). | Not feasible<br>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). There is no evidence that aphids can acquire this virus by feeding on capsicum fruit during its distribution, sale and consumption and spread the virus to host plants. Vectors not on the pathway. | Not assessed | No |
| *Cucumber mosaic virus* (*Cucumovirus*) | Yes<br>(Kim *et al*. 1990; USDA 2004; NPQS 2006) | Yes<br>*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 Korea | Present within Australia | Presence on the commodity (Yes/No/Not assessed) | Potential for establishment and spread<br>(Feasible/Not feasible/Not assessed) | Potential for economic consequences<br>(Significant/Not significant/Not assessed) | Consider further in PRA |
|---|---|---|---|---|---|---|
| *Peanut stunt virus* (*Cucumovirus*) | Yes<br>(USDA 2004) | No<br>(Brunt *et al*. 1996; CABI 2006) | Yes<br>Virus causes systemic infections in plants, causing mottling and mosaic symptoms (Brunt *et al*. 1996). | Not assessed<br>This virus was not assessed, as it may be seed-borne in capsicum seed (Brunt *et al*. 1996) for planting that is permitted entry into Australia. | Not assessed | No |
| *Pepper mild mottle virus* (*Tobamovirus*) | Yes<br>(NPQS 2006) | Yes<br>(CABI 2006)<br>Not in WA<br>(DAFWA 2003) | Yes<br>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<br>This virus was not assessed, as it may be seed-borne in capsicum seed (Brunt *et al*. 1996) for planting that is permitted entry into Western Australia. | Not assessed | No |
| *Pepper mottle virus* (*Potyvirus*) | Yes<br>(NPQS 2006) | No<br>(CABI 2006) | Yes<br>Virus causes systemic infections in capsicum plants, causing mottling and malformation of leaves (Brunt *et al*. 1996). | Not feasible<br>Transmitted by the aphid vectors *Aphis gossypii*, *A. craccivora* and *Myzus persicae* in a non-persistent manner (Brunt *et al*. 1996). There is no evidence that aphids can acquire this virus by feeding on capsicum fruit during its distribution, sale and consumption and spread the virus to host plants. Vectors not on the pathway. | Not assessed | No |

| Pest | Associated with Capsicum crop in 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<br>(Kim *et al*. 1990; NPQS 2006) | No records found | Yes<br>Virus causes systemic infections in capsicum plants (Kim *et al*. 1990). | Not feasible<br>Virus transmitted by *Myzus persicae* in a non-persistent manner (Kim *et al*. 1991). There is no evidence that aphids can acquire this virus by feeding on capsicum fruit during its distribution, sale and consumption and spread the virus to host plants. Vectors not on the pathway. | Not assessed | No |
| Pepper vein mosaic virus | Yes<br>(Kim *et al*. 1991) | No records found | Yes<br>Virus causes systemic infections in capsicum plants (Kim *et al*. 1991). | Not feasible<br>Virus transmitted by *Myzus persicae* in a non-persistent manner (Kim *et al*. 1991). There is no evidence that aphids can acquire this virus by feeding on capsicum fruit during its distribution, sale and consumption and spread the virus to host plants. Vectors not on the pathway. | Not assessed | No |
| *Potato leafroll virus* (*Luteovirus*) | Yes<br>(USDA 2004; CABI 2006) | Yes<br>(Brunt *et al*. 1996; CABI 2006) | Not assessed | Not assessed | Not assessed | No |
| *Potato X virus* (*Potexvirus*) | Yes<br>(USDA 2004) | Yes<br>(Brunt *et al*. 1996; CABI 2006) | Not assessed | Not assessed | Not assessed | No |

| Pest | Associated with Capsicum crop in 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 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 |
| *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 seed-borne 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 seed-borne in capsicum seed (Brunt *et al*. 1996) for planting that is permitted entry into Western Australia. | Not assessed | No |

| Pest | Associated with Capsicum crop in 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 |
|---|---|---|---|---|---|---|
| *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** | *Frankliniella intonsa* (Trybom, 1895) |
| **Synonyms** | *Frankliniella intonsa f. norashensis* Yakhontov & Jurbanov, 1957<br>*Thrips intonsa* Trybom, 1895<br>*Frankliniella formosae* Moulton, 1928 |
| **Common name(s)** | 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<br>*Euthrips tritici californicus* Moulton, 1911<br>*Frankliniella chrysanthemi* Kurosawa, 1941<br>*Frankliniella canadensis* Morgan, 1925<br>*Frankliniella claripennis* Morgan, 1925<br>*Frankliniella conspicua* Moulton, 1936<br>*Frankliniella dahliae* Moulton, 1948<br>*Frankliniella dianthi* Moulton, 1948<br>*Frankliniella nubila* Treherne, 1924<br>*Frankliniella occidentalis brunnescens* Priesner, 1932<br>*Frankliniella occidentalis dubia* Priesner, 1932<br>*Frankliniella syringae* Moulton, 1948<br>*Frankliniella trehernei* Morgan, 1925<br>*Frankliniella tritici maculata* Priesner, 1925<br>*Frankliniella tritici moultoni* Hood, 1914<br>*Frankliniella umbrosa* Moulton, 1948<br>*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). Not present in Northern Territory and under official control in Tasmania (DPIFM 2007) |
| **Quarantine pest** | *Thrips palmi* Karny, 1925 |
| **Synonyms** | *Chloethrips aureus Ananthrakrishnan & Jagadish, 1967*<br>*Thrips gossypicola (Priesner, 1939)*<br>*Thrips gracilis Ananthrakrishnan & Jagadish, 1968*<br>*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).<br>In Australia, restricted to parts of southeast Queensland, northwest Western Australia and the Darwin area (Northern Territory) (EPPO 1997; DAFWA 2006; Mound 2007). SA, Tas., NT and WA apply quarantine restrictions for movement of melon thrips hosts (QDPIF 2005b; NTDPIFM 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[5], 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.

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

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 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, and
- 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, and
- 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 pertinent to the phytosanitary condition of a consignment (FAO 2007b) |
| **Appropriate level of protection** | 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 2007b) |
| **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 2007b) |
| **Biosecurity** | The exclusion, eradication, or management of risks posed by pests to the economy, environment and human health |
| **Biosecurity Australia** | A prescribed agency, within the Australian Government Department of Agriculture, Fisheries and Forestry, responsible for recommendations for the development of Australia's biosecurity policy |
| **Certificate** | An official document which attests to the phytosanitary status of any consignment affected by phytosanitary regulations (FAO 2007b) |
| **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 2007b) |
| **Contaminating pest** | A pest that is carried by a commodity and, in the case of plants and plant products, does not infest those plants or plant products (FAO 2007b) |
| **Control (of a pest)** | Suppression, containment or eradication of a pest population (FAO 2007b) |
| **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 2007b) |
| **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 2007b) |
| **Establishment** | Perpetuation, for the foreseeable future, of a pest within an area after entry (FAO 2007b) |
| **Fresh** | Living; not dried, deep-frozen or otherwise conserved (FAO 2007b) |
| **Fruits and vegetables** | A commodity class for fresh parts of plants intended for consumption or processing and not for planting (FAO 2007b) |
| **Host range** | Species of plants capable, under natural conditions, of sustaining a specific pest (FAO 2007b) |
| **Import permit** | An official document authorising importation of a commodity in accordance with specified phytosanitary requirements (FAO 2007b) |
| **Import Risk Analysis** | An administrative process through which quarantine policy is developed or reviewed, incorporating risk assessment, risk management and risk communication |
| **Infestation (of a commodity)** | Presence in a commodity of a living pest of the plant or plant product concerned. Infestation includes infection (FAO 2007b) |
| **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 2007b) |
| **Intended use** | Declared purpose for which plants, plant products, or other regulated articles are imported, produced, or used (FAO 2007b) |
| **Interception (of a pest)** | The detection of a pest during inspection or testing of an imported consignment (FAO 2007b) |
| **Introduction** | The entry of a pest resulting in its establishment (FAO 2007b) |

| Term or abbreviation | Definition |
|---|---|
| **International Standard for Phytosanitary Measures** | 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 2007b) |
| **Lot** | A number of units of a single commodity, identifiable by its homogeneity of composition, origin etc., forming part of a consignment (FAO 2007b) |
| **National Plant Protection Organisation** | Official service established by a government to discharge the functions specified by the IPPC (FAO 2007b) |
| **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 2007b) |
| **Parasitoid** | An insect parasitic only in its immature stages, killing its host in the process of its development , and free living as an adult (FAO 2007b) |
| **Pathway** | Any means that allows the entry or spread of a pest (FAO 2007b) |
| **Pest** | Any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products (FAO 2007b) |
| **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 2007b) |
| **Pest free area** | 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 2007b) |
| **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 2007b) |
| **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 begin officially maintained (FAO 2007b) |
| **Pest Risk Analysis** | 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 2007b) |
| **PRA area** | Area in relation to which a Pest Risk Analysis is conducted (FAO 2007b) |
| **Pest risk assessment (for quarantine pests)** | Evaluation of the probability of the introduction and spread of a pest and of the associated potential economic consequences (FAO 2007a) |
| **Pest risk management (for quarantine pests)** | Evaluation and selection of options to reduce the risk of introduction and spread of a pest (FAO 2007b) |
| **Phytosanitary Certificate** | Certificate patterned after the model certificates of the IPPC (FAO 2007b) |
| **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 2007b) |
| **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 2007b) |
| **Polyphagous** | Feeding on a relatively large number of host plants from different plant families |
| **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 2007b) |
| **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 to require phytosanitary measures, particularly where international transportation is involved (FAO 2007b) |
| **Restricted risk** | Risk estimate with phytosanitary measure(s) applied |
| **Spread** | Expansion of the geographical distribution of a pest within an area (FAO 2007b) |
| **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 policy issues |

| Term or abbreviation | Definition |
|---|---|
| **Systems approach(es)** | The integration of different pest risk management measures, at least two of which act independently, and which cumulatively achieve the appropriate level of phytosanitary protection (FAO 2007b) |
| **Unrestricted risk** | An estimation of the risk of a pest or pathogen entering an endangered area considering only the existing cultural techniques, i.e. minimum border procedures, of the exporting country |

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