Australian Government

Biosecurity Australia

Draft non-regulated risk analysis report for table grapes from the Republic of Korea

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Cover image: Campbell Early grape cultivar (Courtesy: NPQS 2011)

Submissions

This draft non-regulated import risk analysis 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 risk analysis report will then be revised as necessary to take account of the comments received and a final risk analysis report will be released at a later date.

Comments on the draft risk analysis report should be submitted to:

Office of the Chief Executive
Biosecurity Australia
GPO Box 858
CANBERRA ACT 2601
AUSTRALIA

Telephone: +61 2 6272 5094
Facsimile: +61 2 6272 4333
Email: plant@biosecurity.gov.au
Internet: www.biosecurityaustralia.gov.au

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Figure 1 Map of Australia

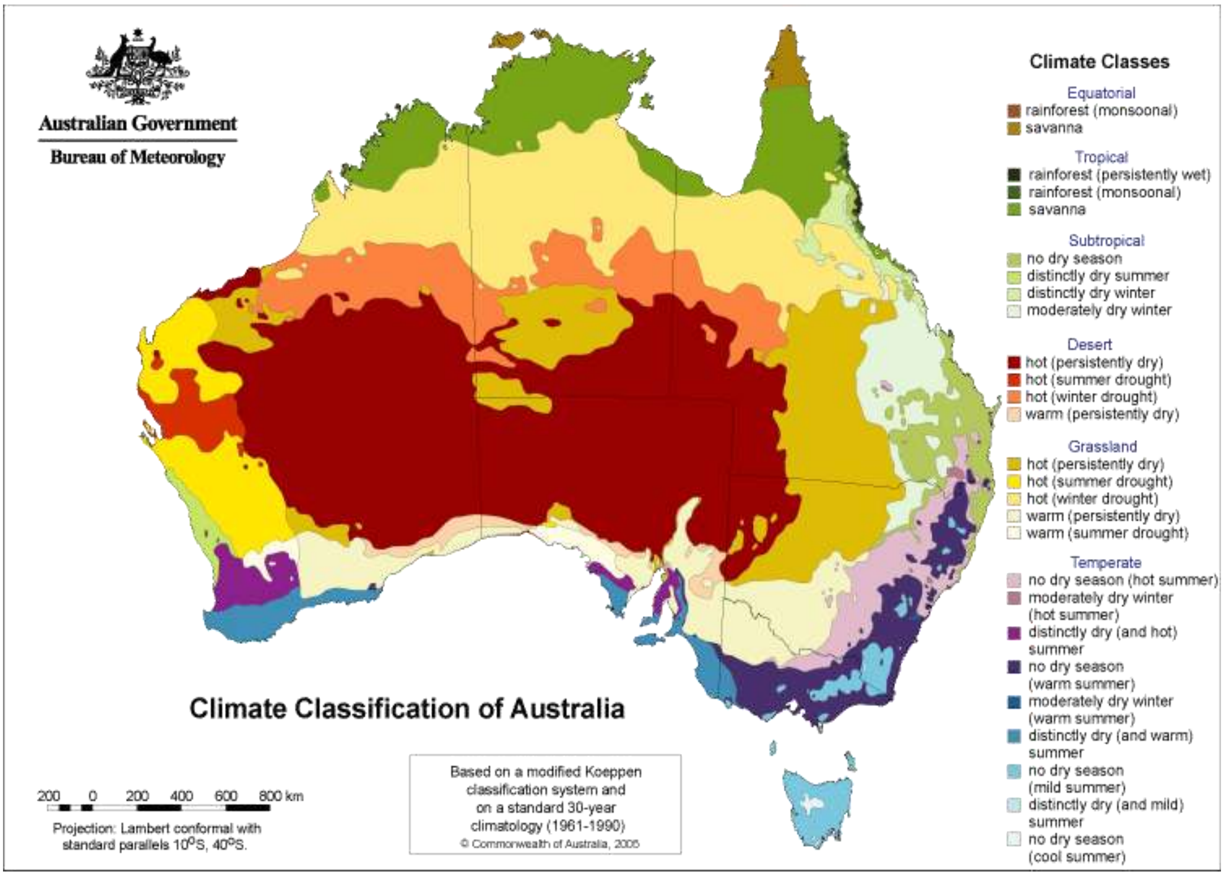


Figure 2 A guide to Australia's bio-climate zones

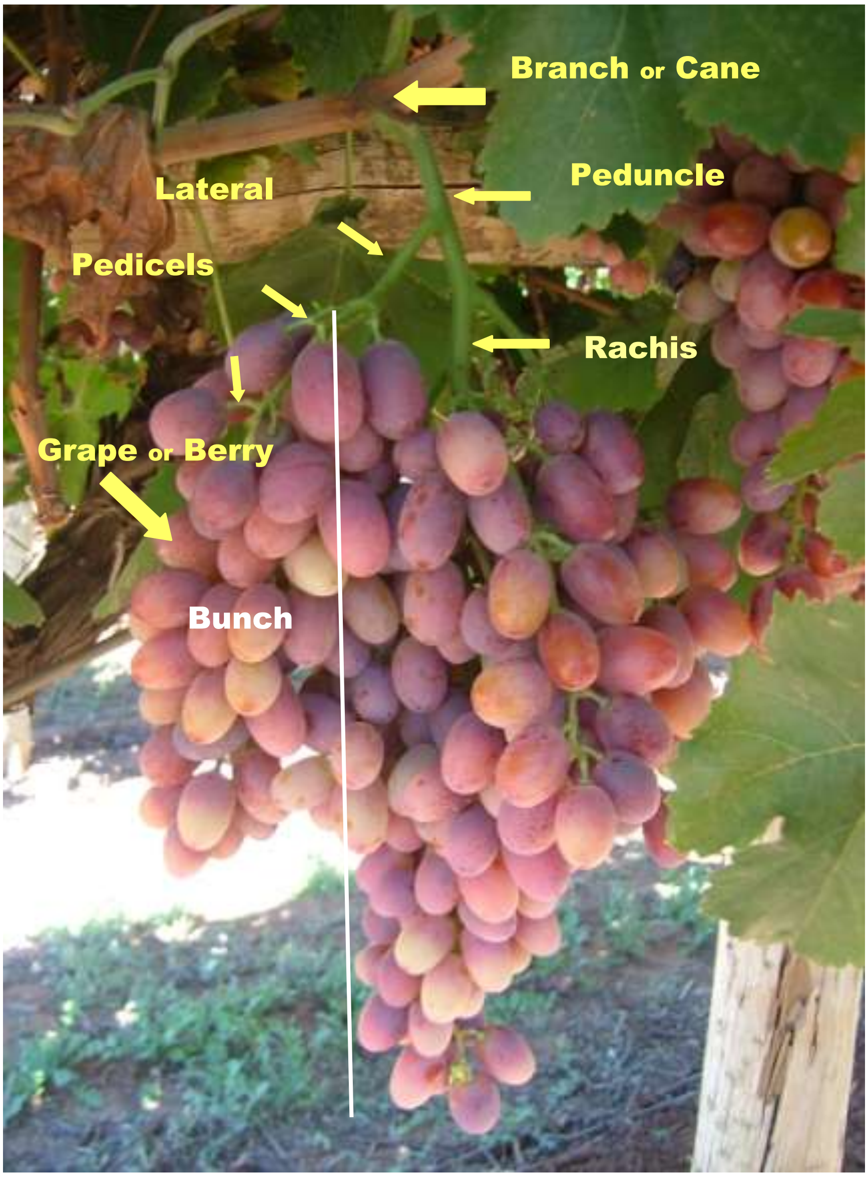


Figure 3 **Structure of grape bunch**

Acronyms and abbreviations

Term or abbreviation	Definition
ALOP	Appropriate level of protection
APPD	Australian Plant Pest Database (Plant Health Australia)
AQIS	Australian Quarantine and Inspection Service
ATGA	Australian Table Grape Association Inc.
BAA	Biosecurity Australia Advice
BSG	Biosecurity Services Group
CABI	CAB International, Wallingford, UK
CMI	Commonwealth Mycological Institute
DAFF	Australian Government Department of Agriculture, Fisheries and Forestry
FAO	Food and Agriculture Organization of the United Nations
IDM	Integrated Disease Management
IPC	International Phytosanitary Certificate
IPM	Integrated Pest Management
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
Qld	Queensland
SPS	Sanitary and Phytosanitary
Tas.	Tasmania
USA	United States of America
Vic.	Victoria
WA	Western Australia
WTO	World Trade Organisation

Abbreviations of units

Term or abbreviation	Definition
cm	centimetre
ºC	degree Celsius
ºF	degree Fahrenheit
g	gram
ha	hectare
kg	kilogram
km	kilometre
m	metre
μ	micrometre (one millionth of a metre)
ml	millilitre
mm	millimetre
ppm	parts per million
s	second
t	tonnes

Summary

This non-regulated import risk analysis assesses a proposal from the Republic of Korea (hereafter referred to as Korea) for market access to Australia for table grapes.

The draft report proposes that the importation of table grapes to Australia from all commercial production areas of Korea be permitted, subject to a range of quarantine conditions.

Australia permits the importation of table grapes for human consumption from Chile, the United States of America (California) and New Zealand, provided they meet Australian quarantine requirements. An import risk assessment for table grapes from China is also nearing finalisation.

This draft report identifies pests that require quarantine measures to manage risks to a very low level in order to achieve Australia's appropriate level of protection (ALOP). The pests requiring measures are: arthropods – Kanzawa spider mite, harlequin ladybird, scarab beetles (two species), spotted winged drosophila, grapevine phylloxera, mealybugs (two species), leafroller moths (two species), the apple heliodinid, and western flower thrips; and pathogens – grape cluster black rot and grapevine leaf rust.

The recommended quarantine measures take account of regional differences. Kanzawa spider mite has been identified as a quarantine pest for Western Australia, and western flower thrips for the Northern Territory. Western Australia's state legislation currently prohibits the importation of table grapes from any source, including other parts of Australia, due to the absence of grape phylloxera, grapevine fanleaf virus and phomopsis cane and leaf spot in this state. The state legislation would need to be modified before the importation of table grapes into Western Australia can occur.

This draft report recommends a combination of risk management measures and operational systems that will reduce the risk associated with the importation of table grapes from Korea into Australia to achieve Australia's ALOP, specifically:

- area freedom, systems approach or fruit treatment for spotted winged drosophila
- a systems approach (vineyard control and surveillance, fruit bagging, and visual inspection and remedial action) for Kanzawa spider mite, mealybugs, leafroller moths, the apple heliodinid and western flower thrips
- a systems approach (vineyard and packing management, and visual inspection and remedial action) for harlequin ladybird and scarab beetles
- area freedom or sulphur pad treatment for grape phylloxera
- area freedom for grape cluster black rot
- area freedom or a systems approach for grapevine leaf rust
- a supporting operational system to maintain and verify the phytosanitary status of consignments. The Australian Quarantine and Inspection Service (AQIS) will verify that the proposed phytosanitary measures have occurred. An AQIS officer will be present

under a pre-clearance arrangement to inspect and verify pest freedom prior to export in the first year of trade. Pre-clearance will then only occur as required.

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 60 day 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 formally consider the risks that could be associated with proposals to import new products into Australia. If the risks are found to exceed Australia's appropriate level of protection (ALOP), risk management measures are proposed to reduce the risks to an acceptable level. 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. Biosecurity Australia provides recommendations for animal and plant quarantine policy to Australia's Director of Animal and Plant Quarantine (the Secretary of the Australian Department of Agriculture, Fisheries and Forestry). The Director, or delegate, is responsible for determining whether or not an importation can be permitted under the *Quarantine Act 1908*, and if so, under what conditions. The Australian Quarantine and Inspection Service (AQIS) is responsible for implementing appropriate risk management measures.

More information about Australia's biosecurity framework is provided in Appendix C of this report and in the *Import Risk Analysis Handbook 2007 (update 2009)* located on the Biosecurity Australia website www.biosecurityaustralia.gov.au.

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

1.2 This non-regulated import risk analysis

1.2.1 Background

The National Plant and Quarantine Service of the Republic of Korea (NPQS) requested market access to Australia for table grapes in 1990. An import proposal was provided in 2007. In December 2009, Korea advised that its top priority was market access for table grapes. Preliminary work was conducted by Biosecurity Australia in 2010 on pests of Korean table grapes and the commencement of the non-regulated risk analysis was announced in November 2010.

1.2.2 Scope

The scope of this non-regulated risk analysis is to consider the quarantine risk that may be associated with the importation of commercially produced fresh table grapes (*Vitis vinifera* L.) and hybrids (henceforth these will be referred to as table grapes), from the Republic of Korea for human consumption in Australia.

In this risk analysis table grapes are defined as table grape bunches or clusters, which include peduncles, rachises, laterals, pedicels and berries (Pratt 1988) but not other plant parts (see Fig. 3). This risk analysis covers all commercially produced table grapes, *Vitis vinifera* and hybrid cultivars and the provinces or regions of Korea in which they are grown for export.

1.2.3 Existing policy

Import policies exist for table grapes imported from Chile (Biosecurity Australia 2005a), the United States of America (California) (AQIS 2000) and New Zealand (ICON 2011). The import policy for table grapes from China is nearing finalisation (Biosecurity Australia 2010c).

The import requirements for these commodities can be found at the Australian Quarantine and Inspection Service (AQIS) Import Conditions database http://www.aqis.gov.au/icon.

Domestic arrangements

The Commonwealth Government is responsible for regulating the movement of plants and plant products in and out of Australia. However, the state and territory governments are responsible for plant health controls within Australia. Legislation relating to resource management or plant health may be used by state or territory government agencies to control interstate movement of plants or their products.

Currently importation of fresh table grapes, seed, plants and used machinery into Western Australia from any source is prohibited due to the absence of grape phylloxera (*Daktulosphaira vitifoliae*), grapevine fanleaf virus and phomopsis cane and leaf spot (*Phomopsis viticola*) in this state (DAFWA 2009).

1.2.4 Contaminating pests

In addition to the pests of table grapes from Korea that are identified in this analysis, there are other organisms that may arrive with table grapes. 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 operational procedures.

The risk of contaminating weed seeds is also addressed by the procedures delineated in section 5.4.

1.2.5 Consultation

On 12 November 2010, Biosecurity Australia notified stakeholders in Biosecurity Australia Advice (BAA) 2010/34 of the formal commencement of a non-regulated import risk analysis under the IRA process to consider a proposal to import table grapes from Korea.

Biosecurity Australia provided a draft pest categorisation table for table grapes from Korea to the state and territory departments of primary industry/agriculture on 4 March 2011 for their advance consideration.

1.2.6 Next steps

This draft non-regulated risk analysis report gives stakeholders the opportunity to comment and draw attention to any scientific, technical, or other gaps in the data, misinterpretations and errors. Stakeholders will be given 60 days to comment and provide submissions.

Biosecurity Australia will consider submissions received on the draft report and may consult informally with stakeholders. Biosecurity Australia will revise the draft risk analysis report as appropriate.

Biosecurity Australia will then prepare a final report, taking into account stakeholder comments. The report will be published on the DAFF website and stakeholders notified by a Biosecurity Australia Announcement (BAA).

Publishing of the final report represents the end of the process. The conditions proposed in the final report will be the basis of any import permits issued to AQIS.

2 Method for pest risk analysis

In accordance with the International Plant Protection Convention, the technical component of a plant import risk analysis (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 2007b) and ISPM 11: *Pest Risk Analysis for Quarantine Pests, including analysis of environmental risks and living modified organisms* (FAO 2004).

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

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

When estimating the unrestricted risk, Biosecurity Australia considered the existing commercial production practices of the exporting country and took into account the on-arrival quarantine procedures, conducted by AQIS, that include verifying the consignment received is as described on the commercial documents and that the consignment's integrity has been maintained. Restricted risk is estimated with phytosanitary measure(s) applied. A phytosanitary measure is 'any legislation, regulation or official procedure having the purpose to prevent the introduction and spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests' (FAO 2009).

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

PRAs are conducted in 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, a judgement was made on the likelihood of entry of pests on the commodity and whether existing policy is adequate to manage the risks associated with its import. Where appropriate, the previous policy has been adopted.

2.2 Stage 2: Pest risk assessment

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

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

2.2.1 Pest categorisation

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

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

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

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

2.2.2 Assessment of the probability of entry, establishment and spread

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

Probability of entry

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

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

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

- **Probability of importation**: the probability that a pest will arrive in Australia when a given commodity is imported.
- **Probability of distribution**: the probability that the pest will be distributed, as a result of the processing, sale or disposal of the commodity, in the PRA area and subsequently transfer to a susceptible part of a host.

Factors considered in the probability of importation include:

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

Factors considered in the probability of distribution include:

- commercial procedures (e.g. refrigeration) applied to consignments during distribution in Australia
- dispersal mechanisms of the pest, including vectors, to allow movement from the pathway to a host

- whether the imported commodity is to be sent to a few or many destination points in the PRA area
- proximity of entry, transit and destination points to hosts
- time of year at which import takes place
- intended use of the commodity (e.g. for planting, processing or consumption)
- risks from by-products and waste.

Probability of establishment

Establishment is defined as the ‘perpetuation for the foreseeable future, of a pest within an area after entry’ (FAO 2004). In order to estimate the probability of establishment of a pest, reliable biological information (lifecycle, host range, epidemiology, survival, etc.) is obtained from the areas where the pest currently occurs. The situation in the PRA area can then be compared with that in the areas where it currently occurs and expert judgement used to assess the probability of establishment.

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

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

Probability of spread

Spread is defined as ‘the expansion of the geographical distribution of a pest within an area’ (FAO 2004). 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
- potential for movement with commodities, conveyances or by vectors
- intended use of the commodity
- potential vectors of the pest in the PRA area
- potential natural enemies of the pest in the PRA area.

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

In its qualitative PRAs, Biosecurity Australia uses the term 'likelihood' for the descriptors it uses for its estimates of probability of entry, establishment and spread. Qualitative likelihoods are assigned to each step of entry, establishment and spread. Six descriptors are used: high; moderate; low; very low; extremely low; and negligible (Table 2.1). Descriptive definitions for these descriptors and their indicative probability ranges are given in Table 2.1. The standardised likelihood descriptors provide guidance to the risk analyst and promote consistency between different risk analyses.

Table 2.1 Nomenclature for qualitative likelihoods

Likelihood	Descriptive definition
High	The event would be very likely to occur
Moderate	The event would occur with an even probability
Low	The event would be unlikely to occur
Very low	The event would be very unlikely to occur
Extremely low	The event would be extremely unlikely to occur
Negligible	The event would almost certainly not occur

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

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

Table 2.2 Matrix of rules for combining qualitative likelihoods

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

Time and volume of trade

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

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

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

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

2.2.3 Assessment of potential consequences

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

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

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

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

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

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

- **Local**: an aggregate of households or enterprises (a rural community, a town or a local government area).
- **District**: a geographically or geopolitically associated collection of aggregates (generally a recognised section of a state or territory, such as 'Far North Queensland').
- **Regional**: a geographically or geopolitically associated collection of districts in a geographic area (generally a state or territory, although there may be exceptions with larger states such as Western Australia).
- **National**: Australia wide (Australian mainland states and territories and Tasmania).

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

- **Indiscernible**: pest impact unlikely to be noticeable.
- **Minor significance**: expected to lead to a minor increase in mortality/morbidity of hosts or a minor decrease in production but not expected to threaten the economic viability of production. Expected to decrease the value of non-commercial criteria but not threaten the criterion's intrinsic value. Effects would generally be reversible.
- **Significant**: expected to threaten the economic viability of production through a moderate increase in mortality/morbidity of hosts, or a moderate decrease in production. Expected to significantly diminish or threaten the intrinsic value of non-commercial criteria. Effects may not be reversible.
- **Major significance**: expected to threaten the economic viability through a large increase in mortality/morbidity of hosts, or a large decrease in production. Expected to severely or irreversibly damage the intrinsic 'value' of non-commercial criteria.

Values were translated into a qualitative impact score (A–G)[2] using Table 2.3.

[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 4 were adjusted accordingly.

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

		Geographic scale			
		Local	District	Region	Nation
Magnitude	Indiscernible	A	A	A	A
	Minor significance	B	C	D	E
	Significant	C	D	E	F
	Major significance	D	E	F	G

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

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

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

2.2.4 Estimation of the unrestricted risk

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

When interpreting the risk estimation matrix, note the descriptors for each axis are similar (e.g. low, moderate, high) but the vertical axis refers to likelihood and the horizontal axis refers to consequences. Accordingly, a 'low' likelihood combined with 'high' consequences, is not the same as a 'high' likelihood combined with 'low' consequences – the matrix is not symmetrical. For example, the former combination would give an unrestricted risk rating of 'moderate', whereas, the latter would be rated as a 'low' unrestricted risk.

Table 2.5 Risk estimation matrix

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

2.2.5 Australia's appropriate level of protection (ALOP)

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

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

2.3 Stage 3: Pest risk management

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

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

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

Examples given of measures commonly applied to traded commodities include:

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

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

3 Korea's commercial production practices for table grapes

This chapter provides information on the pre-harvest, harvest and post-harvest commercial production practices for Korean table grapes for export. The export capability of Korea is also outlined.

3.1 Assumptions used in estimating unrestricted risk

Korea provided Biosecurity Australia with information on the standard commercial practices adopted in the production of table grapes in the different provinces/regions and for all the commercially produced table grape cultivars in Korea. This information was complemented with data from other sources and taken into account when estimating the unrestricted risk of pests that may be associated with the import of this commodity.

Prior to finalisation of this analysis, Biosecurity Australia will visit table grape production areas in Korea in 2011 to verify pest status and vineyard pest management, and observe the harvest, processing and packing procedures for export of table grapes. Biosecurity Australia's observations and additional information provided during the visit will confirm if the production and processing procedures described in this chapter are standard commercial production practices for table grapes for export.

In estimating the likelihood of pest introduction it was assumed that the pre-harvest, harvest and post-harvest production practices for table grapes, as described in this chapter, are implemented for all regions and for all grape cultivars within the scope of this analysis. Where a specific practice described in this chapter is not taken into account to estimate the unrestricted risk, it is clearly identified and explained in Chapter 4.

3.2 Climate in production areas

The main commercial table grape growing regions of the Korea are located in the Cheonan, Gimcheon, Hwaseong, Jeonju, Okcheon, Sangju, Yeongdong, Yeongwol and Yoongcheon provinces, as shown in Figure 3.1.

As a whole, Korea has a temperate climate. Winters in Korea are typically characterised by snow and low temperatures; spring is mild, dry and clear; summers are dry, warm, humid with heavy rainfall and typhoons; autumn is dry and clear, with some heavy rainfall through September (Korea Meteorological Administration 2011).

Figure 3.2 shows the yearly normal mean temperatures in the grape growing provinces of Republic of Korea. Average winter temperatures are considerably lower in the table grape producing regions of Korea than in the commercial table grape-producing regions of Australia.

The grape growing provinces of Korea experience similar average rainfall. The rainfall ranges for each season are: winter 4 to 45 mm per month; spring 13 to 133 mm per month; summer 48 to 766 mm per month; and autumn 14 to 68 mm per month (Korea Meteorological Administration 2011).

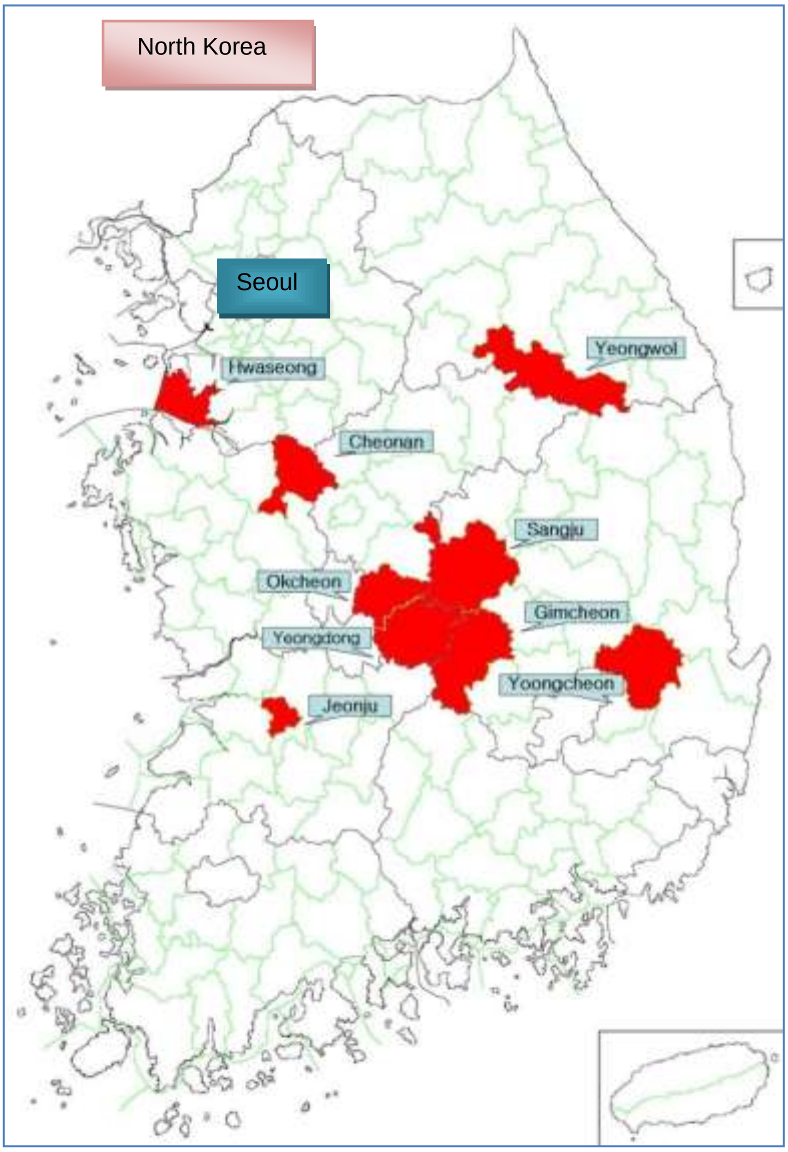
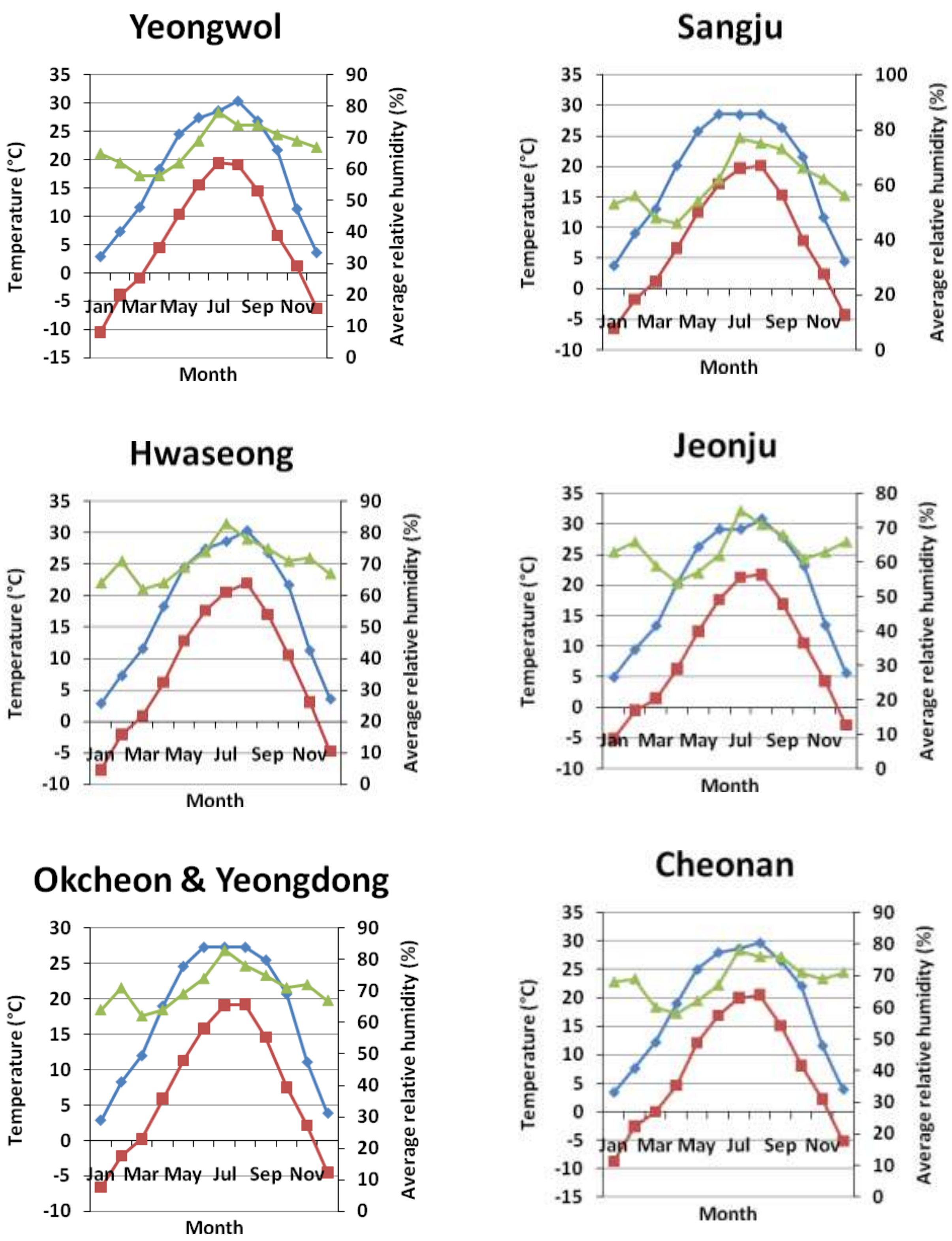


Figure 3.1 Map of the Republic of Korea showing the main grape-producing provinces and regions (NPQS 2011)



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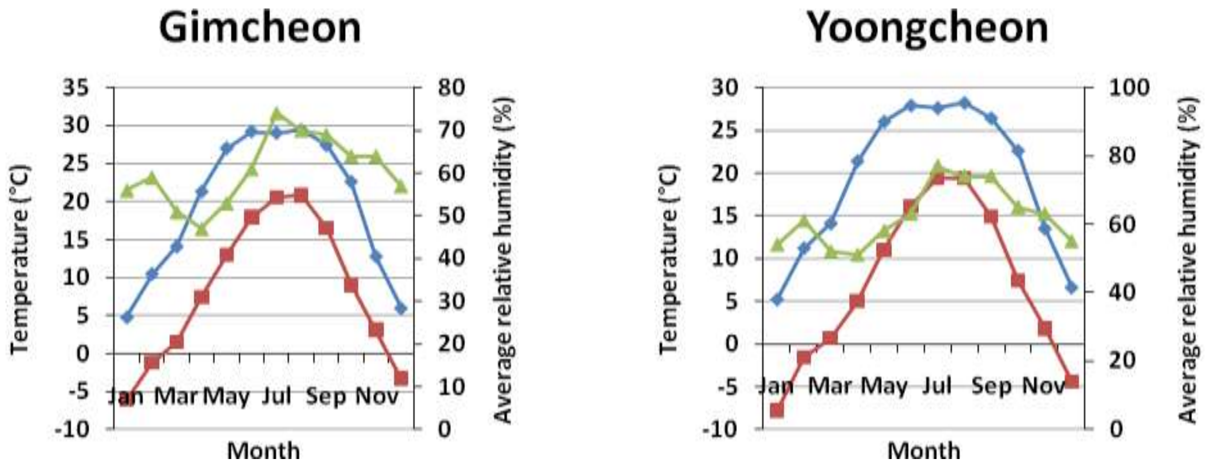


Figure 3.2 Mean maximum (—◆—) and minimum (—■—) temperatures and mean relative humidity (—▲—) in table grape-producing provinces of Gimcheon, Yoongcheon, Hwaseong, Yongwol, Okcheon, Yeongdong, Sangju, Yeonju and Cheonan in Korea.

3.3 Pre-harvest

3.3.1 Cultivars

Grapes (*Vitis vinifera* L. and other *Vitis* spp.) have been grown in Korea for more than 1000 years. Grapes are grown for fresh consumption, wine production, canning, juice, fruit drinks, jams, vinegars and other products (Song 2010). Commercial production of table grapes has dramatically increased since the early 1900's with the introduction of major wine cultivars into Korea (Song 2010). The table grape variety 'Campbell Early' is the principal cultivar grown and accounts for 73% of grapes produced in Korea. This is followed by 'Kyoho' and 'Muscat Bailey A' which account for 12% and 11% of production respectively. Assorted other cultivars make up the remaining 4% of production. Table 3.1 lists the cultivars produced in Korea and the proportions of land used for each.

The cultivars produced in Korean export orchards are European varieties or a hybridisation of American and European cultivars (Song 2010). Campbell Early is the principal cultivar exported (NPQS 2011).

Table 3.1 Amount of land used (ha) for each grape cultivar in proportion to others (%) in Korea across 2002, 2007 and 2009 (NPQS 2011)

Year	Variable	Campbell	Kyoho	Muscat Bailey A	Sheridan	Delaware	Others	Total
2002	**Land used (ha)**	18 884	4 089	599	3 338	97	1 283	**28 290**
	Amount of cultivar produced in comparison to others (%)	66.8	14.5	2.1	11.8	0.3	4.5	**100.0**
2007	**Land used (ha)**	13 491	2 557	1 364	524	115	792	**18 843**
	Amount of cultivar produced in comparison to others (%)	71.6	13.6	7.2	2.8	0.6	4.2	**100.0**
2009	**Land used (ha)**	12 618	2 710	1 315	473	120	760	**17 996**
	Amount of cultivar produced in comparison to others (%)	70.1	15.1	7.3	2.6	0.7	4.2	**100.0**

Campbell Early (Figure 3.3) is an early-season cultivar, maturing in late August to early September. Fruit clusters weigh approximately 350 g. Berries are dark purple, round, tightly filled and thick-skinned. They are low in acidity and very juicy. Campbell Early has a sugar content of over 14 Brix and matures 75–80 days after full bloom (NPQS 2011).

Figure 3.3 Campbell Early cultivar (NPQS 2011)

Figure 3.4 Kyoho cultivar (NPQS 2011)

Kyoho (Figure 3.4) is a mid-season cultivar, maturing in mid-September. Fruit clusters weigh approximately 350 g. Berries are dark purple, egg-shaped and large with soft flesh. They are low in acidity and very juicy. Kyoho has a sugar content of 17 Brix and matures 90–95 days after full bloom (NPQS 2011).

Muscat Bailey A is a late-ripening cultivar, maturing early October. Fruit clusters weigh approximately 400 g. Berries are dark purple, round and medium-sized with tender flesh. Muscat Bailey A has a sugar content of 19 Brix and matures 110–120 days after full bloom (NPQS 2011).

Delaware (Figure 3.5) is a mid-season cultivar, maturing late August to early September. Fruit clusters weigh approximately 120 g. Berries are small and juicy with tender pulp. Delaware has a sugar content of 17 Brix and matures 60–65 days after full bloom (NPQS 2011).

Figure 3.5 Delaware cultivar (NPQS 2011)

3.3.2 Cultivation practices

Planting

Thorough preparation of the land is essential for the successful establishment of the vines. Grapevines are generally planted during spring to avoid winter injury (Song 2010). Due to the cold conditions of winter, farmers are recommended to plant American cultivars when temperatures are not less than -25 °C and European cultivars when temperatures are not less than -15 °C (Song 2010). Grapevines are ideally planted in sandy loam soils and cover crops are sometimes used to limit soil erosion.

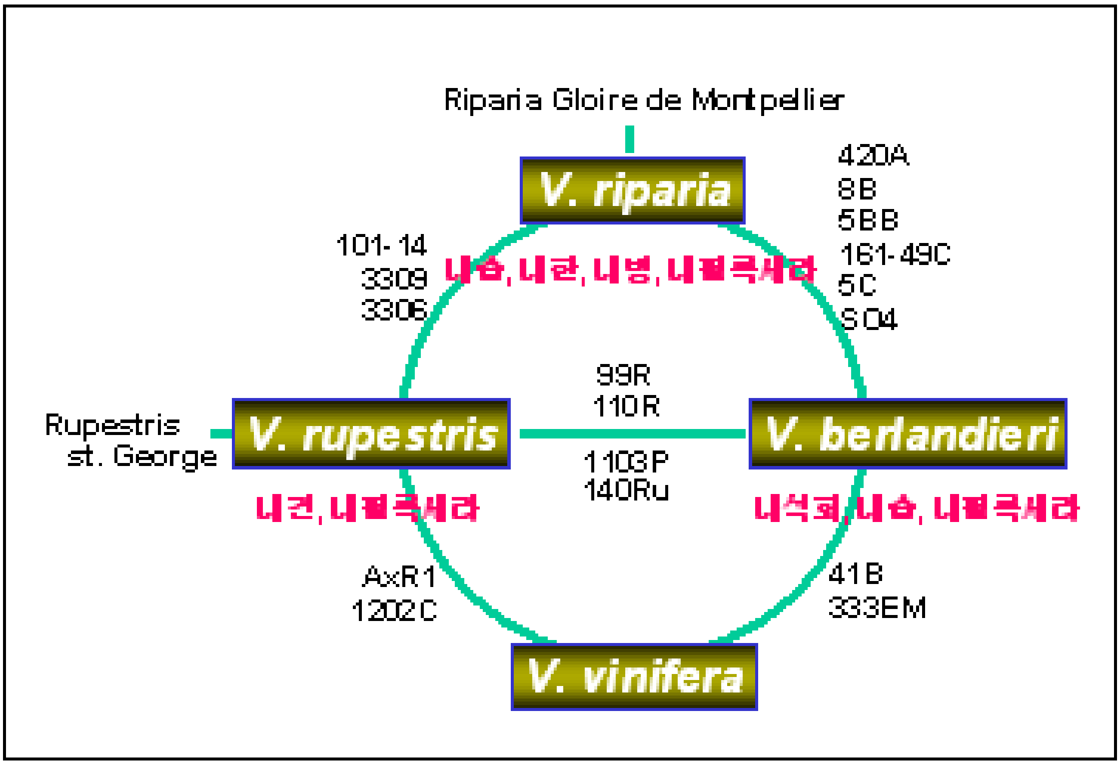


Figure 3.6 Diagram of rootstock hybridisation for cultivars used in Korea (NPQS 2011)

Rootstocks for grape cultivation in Korea are generally phylloxera resistant. Resistant strains include *Vitis riparia*, *V. rupestris*, *V. berlandieri* and rootstocks developed through hybridization, including SO4, 8B, 5BB, 5C, 3306, 3309, 101-14 and 188-08 (Figure 3.6). Specific cultivars are selected depending upon scion variety and soil conditions (NPQS 2011).

Trellis systems

Table grapes are grown in a number of different ways using different trellis systems. Campbell Early is trained in a mutated parallel system (Figure 3.7), as the distances between rows and spacing within rows are important to ensure the right growing length of new shoots. A spacing of 2.7 m between rows is generally appropriate (NPQS 2011). Vines are planted 2.7–3.6 m apart within a row depending upon soil fertility. Spacing in rows should be expanded through thinning as plants mature, with an appropriate final spacing of 5.4–7.2 m depending upon soil fertility (NPQS 2011).

Figure 3.7 Campbell Early planting system demonstrating final spacing between mature plants (5.4 m) (NPQS 2011).

Figure 3.8 Kyoho planting system demonstrating final spacing between mature plants (11.5 m) (NPQS 2011).

Kyoho are planted in rows with an average planting distance of 3.6 m x 1.8 m (Figure 3.8). Spacing in rows should be expanded using a central leader as plants mature, with an appropriate final spacing of 10.8–12.6 m depending upon soil fertility (NPQS 2011).

Vineyards in Korea use a number of different trellis systems to raise the plants. Each system has its advantages and disadvantages. The trellis systems used include the 'Wakeman's training system' (Figure 3.9), the 'T-type Wakeman's training system' (Figure 3.10), the 'mutated parallel training system' (Figure 3.11) and the 'Pyeongdeok training system', which has three variations. These variations include the Pyeongdeok type (Figure 3.12), the mutated Pyeongkeok type (Figure 3.13) and the neutral parallel type (Figure 3.14). The height of the first wire that guides the main branch is always above 90 cm to prevent risk of disease infection by rain water splashing from the ground (NPQS 2011).

Pruning

The pruning method 'pinching' is used to improve berry setting. Pinching restricts the nutrient growth of new shoots and moves it to the flowers. The growing point of the new shoot with unfoliated leaves is cut 5 days prior to flowering. The second cluster of 9–10 leaves on the shoot is secured to prevent physiological disorder. It is a good practice not to pinch side shoots. Pinching is conducted 2–3 times (including before flowering) and is a labour-heavy process. Pruning is labour intensive and can be minimised by allowing adequate spacing within rows to encourage vine vigor (NPQS 2011).

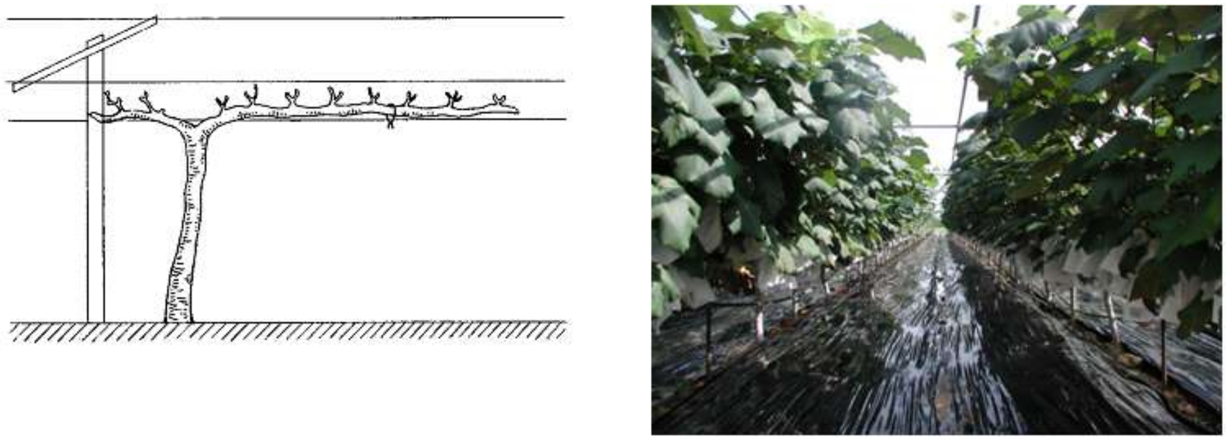


Figure 3.9 Wakeman's training system diagram (left) and use in field (right) (NPQS 2011).

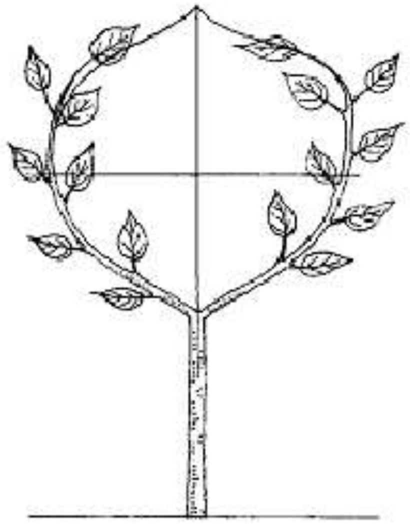
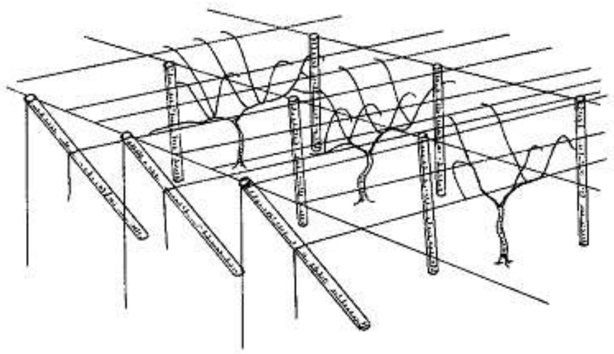


Figure 3.10 T-type Wakeman's training system diagram (left) and use in field (right) (NPQS 2011).



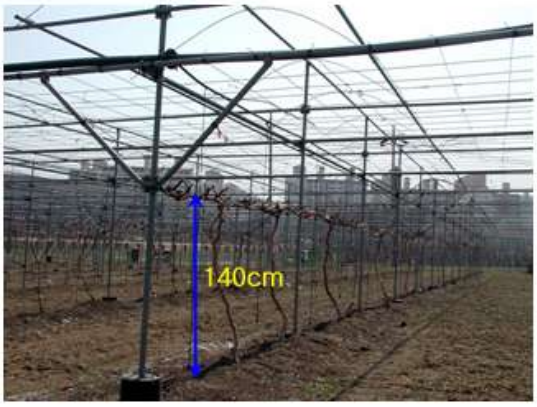


Figure 3.11 Mutated parallel training system diagram (left) and use in field (right), demonstrating a height of 140 cm from ground to first wire (NPQS 2011).

Figure 3.12 Pyeongdeok type training system (NPQS 2011).

Figure 3.13 Mutated Pyeongdeok type training system, demonstrating a height of 150 cm from ground to first wire (NPQS 2011).

Figure 3.14 Neutral parallel type training system (NPQS 2011).

Bagging

Prior to bagging, pest control is thoroughly carried out and bunches are cluster pruned to protect the fruit skin and help manage pests. Grape bunches are bagged prior to July (Figure 3.15). Farms with rainproof cultivation, such as sheltered greenhouses, may bag fruit at a later time (NPQS 2010b). Bag openings are tightly closed to exclude rain and pests. Larger bags are preferred to prevent waxy bloom from being removed. All grapes for export are bagged and bags are not removed until harvest (NPQS 2011). If bags are ruined, the fruit is not brought into the packing house (NPQS 2010b).

Figure 3.15 Grape bagging process (left), large bags used (middle) and a bagged orchard (right) (NPQS 2011).

Irrigation

The method of irrigation is selected depending upon soil type, topography, the supply and quality of water available and the scale and technology of farms. There are two main methods of irrigation; sprinkler systems and drip watering (NPQS 2011).

Sprinkler systems can be fixed or travelling, spraying pressurized water as raindrops or mist. There are under-vine and overhead sprinkler systems. Overhead sprinklers have a much wider dispersal range than under-vine sprinklers, however this method of delivery increases humidity in the air and leaves water drops on plants which can encourage pests. Sprinklers are effective on sloping farms, where the water produced is less than that of surface irrigation and can prevent the formation of surface water. Pressure devices should be installed with sprinkler systems and filters installed where water quality is poor, but this is very costly (NPQS 2011).

Drip watering is a recent development in irrigation. Thin pipes of approximately 2 mm diameter are connected to larger pipes that run under the vines. Water is supplied to the pipes at a constant rate, ensuring that the soil remains moist for optimum growing conditions (NPQS 2011).

3.3.3 Pest management

The following information on pest management was provided by Korea (NPQS 2010b; NPQS 2011). All vineyards producing grapes for export to Australia will be registered with NPQS and receive their own registration number. Only vineyards that pass monthly inspection and are confirmed pest free will be registered for export. Each registered vineyard complies with requirements covering pest monitoring, pest prevention and control including bagging and use of chemical sprays.

Korea has strict guidelines for the use of agricultural pesticides for pest control. Vineyards are responsible for spraying chemicals at appropriate times and in accordance with guidelines, under the supervision of the Korean Agricultural Technology Centre. Table 3.2 details the chemicals used, the timing of application and the pests targeted. As previously stated pest control is conducted prior to bagging.

Table 3.2 Guidelines for pest control in Korean grape orchards. Table details which chemicals are used on particular pests, their magnification and timing of application (NPQS 2011).

Timing	Chemical used and magnification	Targeted pests
Early April	Lime-sulphur mixture & Benomyl (500X)	Blackhead, brown spot, scale
Early May	Z Dithane (600X) & Diazinon (1000X)	Downy mildew, powdery mildew, insects
Early June	Orthocide (1000X), Iprodione (1500X) & Achepate (1000X)	Downy mildew, gray mould, thrips, clear-wing moth
Early July	Sanipa (1000X) & Othathan	Powdery mildew, downy mildew, gray mould, mites,
Early August	4 8 type Bordeaux mixture & Adion (1000X)	Downy mildew, thrips, mites
Late August	4 8 type Bordeaux mixture, Adion (1000X) & Nithoran (2000X)	Downy mildew, thrips, mites
Early September	4 8 type Bordeaux mixture & Fenitrothion (1000X)	Downy mildew, mites

Soil covering, including plastic or felt, is used as a pest control method in vineyards in Korea (Figure 3.16). This helps prevent insects with life stages based in the soil from moving up into the vines.

Figure 3.16 Soil covering in Korean grapevine orchards (NPQS 2011).

NPQS conducts training for farmers and packing house officials at the beginning of each year to comply with the requirements of export partners (Figure 3.17). These training sessions are used to educate these staff members on the export requirements, key quarantine pests and sorting processes (NPQS 2010b; NPQS 2011).

Figure 3.17 Training sessions carried out by NPQS for farmers and packing house officials (NPQS 2011).

3.4 Harvesting and handling procedures

The timing of harvest is largely determined by status of the fruit with colour, gloss, size and sugar-acid ratio used as indicators. A lower sugar ratio may be used as the harvest index depending on the cultivar (Table 3.3).

Table 3.3 Sugar ratio and maturation period harvest index (NPQS 2011).

Cultivar	Sugar content (Brix)	Time taken to reach maturity after full bloom (days)
Campbell Early	14	75–80
Delaware	17	60–65
Kyoho	17	90–95
Muscat Bailey A	19	110–120

Fruit is harvested in the morning if the weather is sunny. Grape bunches are cut from the plant with pruning scissors and stored in a harvest box. Fruit is not packed too tightly to prevent berries from dropping or clusters becoming damaged, and is generally piled 2–3 levels high (Figure 3.18). Harvested fruit is stored under shade to keep it cool until it is transferred to the packhouse (NPQS 2011).


Figure 3.18 Plastic harvest boxes (left) and fruit piling method (right) (NPQS 2011).

3.5 Post-harvest

3.5.1 Packing house

Pre-cooling and sorting

Fruit is pre-cooled following harvest. Using pre-cooling boxes, fruit temperatures are dropped from 30 °C to 4–5 °C by forced air cooling for 4–6 hours, or by static pressure air cooling for 1–2 hours (NPQS 2011).

Trained sorting experts supervise the sorting process (NPQS 2010b). Any unripe, small or dehiscent berries are removed during sorting. Grapes are manually sorted by quality and the size of berries (Figure 3.19).


Figure 3.19 Grape sorting process in packing house (left and right), sorting by quality and size of berries and removing unsuitable fruits (NPQS 2011).

Packing and storage

Packing is carried out to minimise damage to fruit while being convenient for transport and sale. Grapes are packaged in corrugated cardboard boxes holding 4–10 kg (Figure 3.20) (NPQS 2011). These boxes are designed to prevent pest entrance and those with vent holes are covered with vinyl after packing to prevent pest entrance (NPQS 2010b). Grapes are placed in cold storage prior to export at 0 °C to -5 °C ± 0.5 °C and 80–90% humidity (NPQS 2011).

Figure 3.20 Grape packing for export (left). Packaging consists of corrugated cardboard box with paper inner packaging (right) (NPQS 2011).

Figure 3.21 summarises the post-harvest packing house, storage and distribution steps for Korean table grapes produced for export.

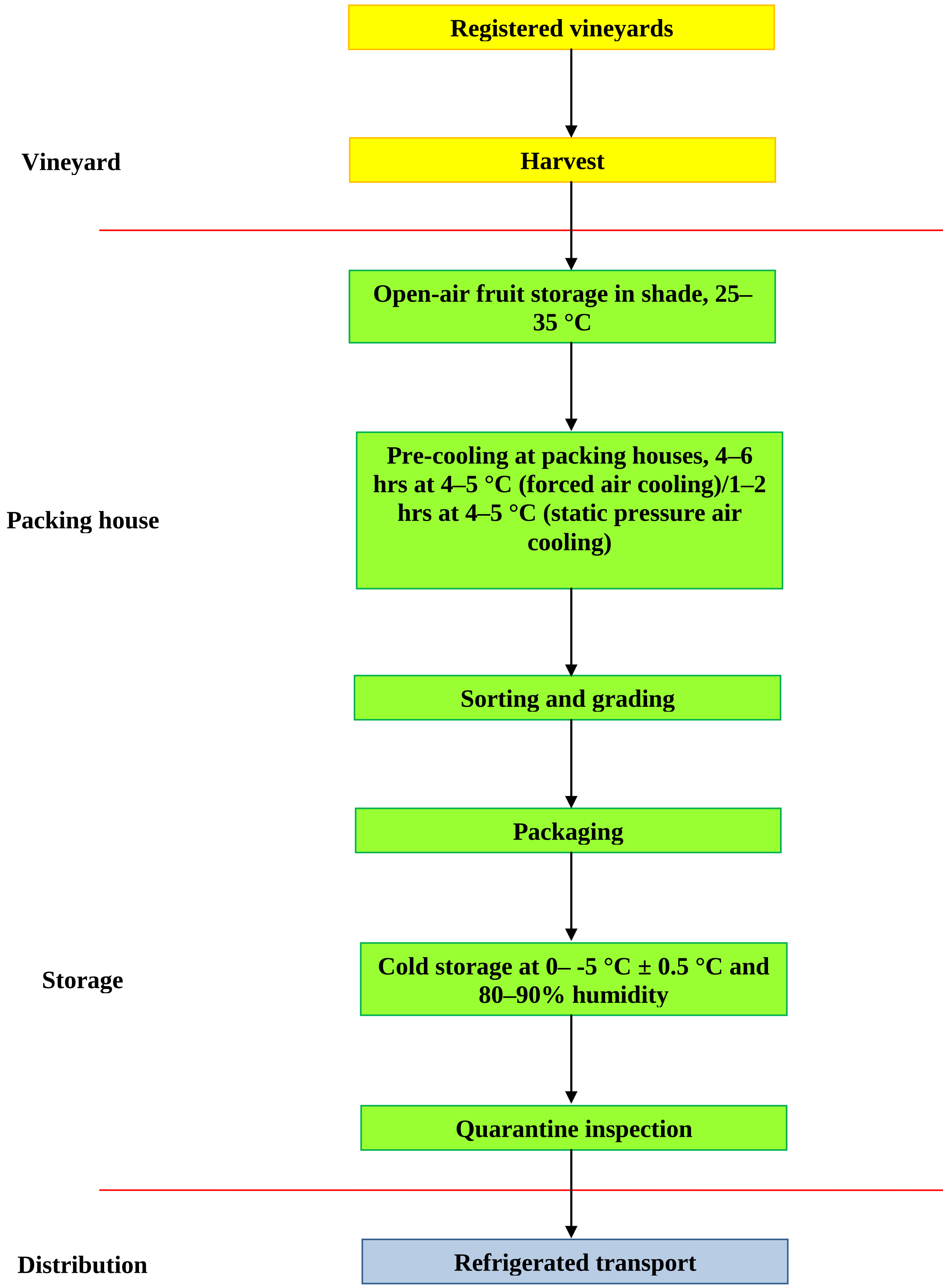


Figure 3.21 Summary of vineyard and post-harvest packing house, storage and distribution steps for table grapes grown in Korea for export (NPQS 2011).

3.5.2 Export procedures

Upon receipt of application for an export inspection, a plant quarantine inspector will visit the site where the consignment is located. The inspector samples 2% of the total consignment and inspect for pests with a magnifying glass (Figure 3.22) in accordance with the official export inspection procedures of Korea (NPQS 2010b; NPQS 2011). If any pests are detected during this process then remedial action will be taken. This may vary depending on the pest and may inlcude treatment, shipment to an alternative market or suspension of the vineyard from the export program for an appropriate period (NPQS 2010b; NPQS 2011). If no pests are detected, the consignment will be issued with a phytosanitary certificate.

Figure 3.22 Plant quarantine inspectors undertaking visual inspections for pests on grapes (NPQS 2011).

3.5.3 Transport

Grapes will be transported to Australia using air and sea freight.

3.6 Export capability

3.6.1 Production statistics

Exports account for approximately 0.1% of total grape production in Korea. Each year there is a gradual increase in the number of countries importing Korean grapes and an increase in export volume. Exports increased from 68 tonnes in 2004 to 340 tonnes in 2008 (Table 3.4). Figure 3.23 displays production ratios in the Korea by region (NPQS 2011).

Table 3.4 Production statistics for grapes in Korea detailing changes in growing area (ha) and production and export volumes (t) from 2004 to 2008 (NPQS 2011).

Variable	2004	2005	2006	2007	2008
Growing area (ha)	22 909	22 057	19 248	19 000	18 000
Production volume (t)	367 894	381 436	330 049	329 000	334 000
Export volume (t)	68	176	180	226	340

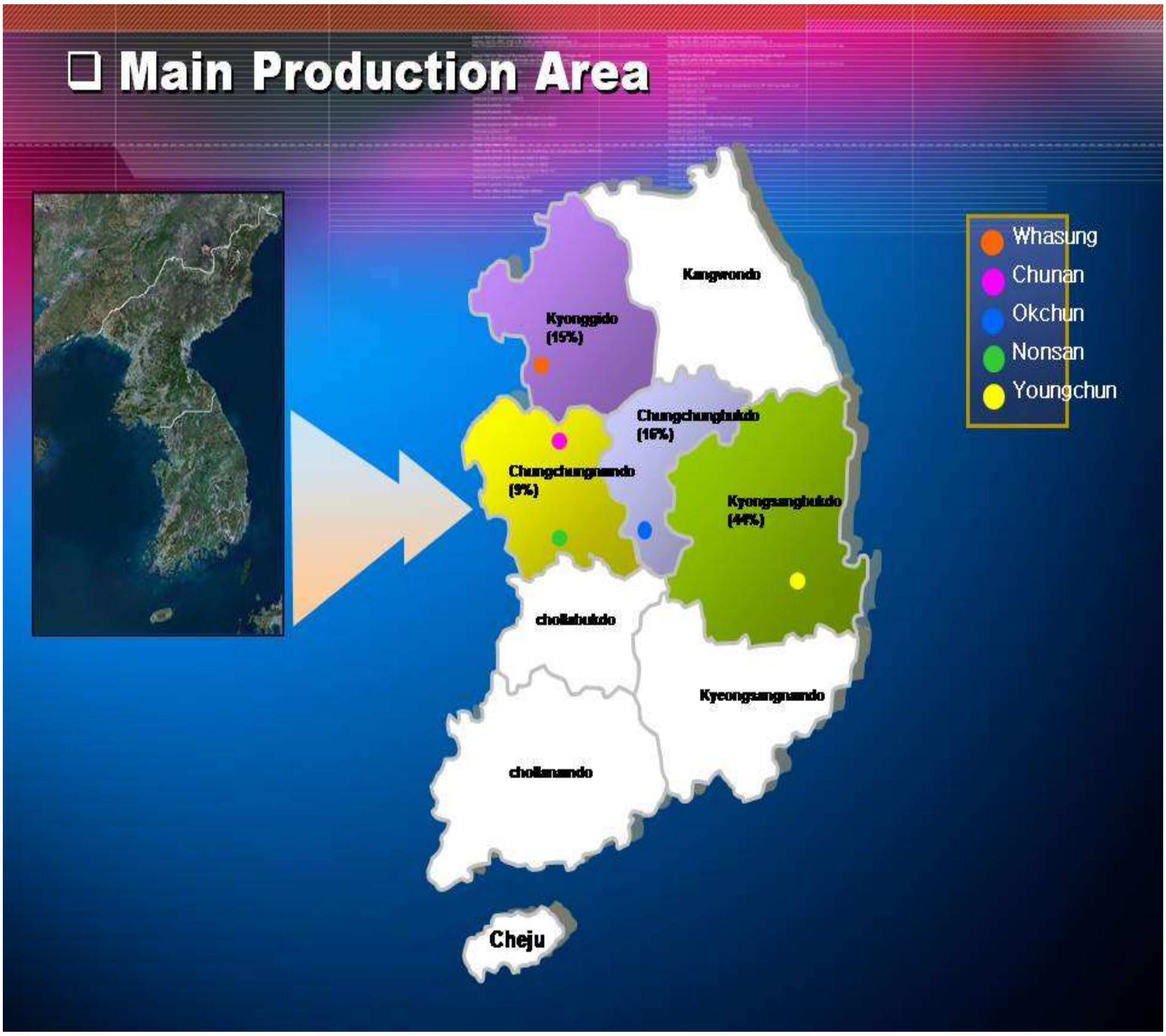


Figure 3.23 Map of the Republic of Korea showing the ratio (%) of grape production by region. Chungch'ong region produces 9%, Kyonggi-do region produces 15%, Ch'ungch'ong bukto region produces 16% and the Kyongsang-bukto region produces 44% (NPQS 2011).

3.6.2 Export statistics

Korea currently exports grapes to the USA (including Guam and Saipan), Japan, Indonesia, Malaysia, Hong Kong and Singapore. Major export markets and volumes are summarised in Table 3.5. The USA is the largest export market with approximately 310 tonnes of grapes exported in 2009.

At present, the volume of table grapes likely to be exported to Australia from Korea cannot be accurately forecast, but preliminary advice from NPQS suggest it is likely to be around 50 tonnes per year (NPQS 2011).

Table 3.5 Main export markets for table grapes from Korea (NPQS 2011).

Country	2002		2004		2006		2008		2009	
	Amount (US$,000)	Volume (t)	Amount (US$,000)	Volume (t)	Amount (US$,000)	Volume (t)	Amount (US$,000)	Volume (t)	Amount (US$,000)	Volume (t)
USA	6	3	0	0	496	121	867	228	1 020	310
Singapore	-	-	21	8	103	27	248	67	374	85
Hong Kong	7	2	68	23	156	38	110	34	245	89
Malaysia	21	11	36	15	47	13	64	17	132	38
Indonesia	38	18	55	20	107	33	123	44	131	37
Total	**233**	**79**	**211**	**74**	**954**	**243**	**1 588**	**430**	**1 991**	**590**

3.6.3 Export season

Table grapes for export from Korea are usually harvested and exported between August and October each year. Specific timing is dependant on the cultivar and growing area (NPQS 2011).

4 Pest risk assessments for quarantine pests

Quarantine pests associated with table grapes from Korea are identified in the pest categorisation process (Appendix A). This chapter assesses the probability of the entry, establishment and spread of these pests and the likelihood of associated potential economic consequences.

Pest categorisation identified 19 quarantine pests associated with table grapes from Korea. Of these, 15 pests are of national concern and 4 are of regional concern. Table 4.1 identifies these quarantine pests and full details of the pest categorisation are given in Appendix A. Additional quarantine pest data are given in Appendix B. Assessments of risks associated with these pests are presented in this chapter. Pests are listed or grouped according to their taxonomic classification, consistent with Appendix A and Appendix B.

Table 4.1 Quarantine pests for table grapes from Korea

Pest	Common name
Spider mite (Acari: Tetranychidae)	
Tetranychus kanzawai [WA, EP]	Kanzawa spider mite
Ladybird (Coleoptera: Coccinellidae)	
Harmonia axyridis [EP]	harlequin ladybird
Beetles (Coleoptera: Scarabaeidae)	
Popillia mutans [EP]	scarab beetle
Popillia quadriguttata [EP]	Chinese rose beetle
Fruit fly (Diptera: Drosophilidae)	
Drosophila suzukii [EP]	spotted winged drosophila
Phylloxera (Hemiptera: Phylloxeridae)	
Daktulosphaira vitifoliae [EP]	grape phylloxera
Soft scales (Hemiptera: Coccidae)	
Parthenolecanium corni [WA, EP]	European fruit lecanium scale
Mealybugs (Hemiptera: Pseudococcidae)	
Planococcus kraunhiae [EP]	Japanese mealybug
Pseudococcus comstocki [EP]	Comstock's mealybug
Leafroller moths (Lepidoptera: Tortricidae)	
Eupoecilia ambiguella [EP]	European grape berry moth
Sparganothis pilleriana [EP]	leaf rolling tortrix
Moth (Lepidoptera: Pterophoridae)	
Nippoptilia vitis [EP]	grape plume moth
Moth (Lepidoptera: Oecophoridae)	
Stathmopoda auriferella [EP]	apple heliodinid
Thrips (Thysanoptera: Thripidae)	
Frankliniella occidentalis [NT, EP]	western flower thrips

Pest	Common name
Fungi	
Physalospora baccae [EP]	grape cluster black rot
Phakopsora euvitis [EP]	grapevine leaf rust
Phomopsis viticola [WA, EP]	phomopsis cane and leaf spot
Viruses	
Tomato ringspot virus [EP]	

[WA]. Regional pest for the state of Western Australia.
[NT]. Regional pest for the Northern Territory.
[EP]: Species has been assessed previously and import policy already exists.

Pest risk assessments were completed to determine whether the risk posed by each pest exceeds Australia’s ALOP and thus whether phytosanitary measures are required to manage the risk. Pest risk assessments already existed for all of the pests considered here as they have been assessed previously by Biosecurity Australia. The pest risk assessments considered in this report assess the change to the likelihood of entry (importation) from previous assessments due to differences in the country assessed. This type of assessment is reflected in the introduction and layout of the risk assessments that follow. In this import risk analysis the superscript ‘**EP**’ is used for pests that have previously been assessed and a policy already exists.

Some pests identified in this assessment have been recorded in some regions of Australia, and due to interstate quarantine regulations are considered pests of regional concern. These organisms are identified with a superscript, such as ‘**NT**’, or ‘**WA**’, for the state for which the regional pest status is considered.

The unrestricted risk estimate (URE) for each quarantine pest is based on the assumption that table grapes are produced for export without fruit bagging. Biosecurity Australia considers there may be situations either currently or in the future where the practice of bagging may not be consistent, feasible or commercially viable. This approach is consistent with that taken on previous IRAs on apples and pears from China and other countries where fruit bagging is used. This approach also ensures consistency in the assessment of similar pests on table grapes between IRAs in countries where bagging is not used.

Grapes harvested, packed, stored and transported for export to Australia may need to travel variable distances to ports. Depending on the port of departure and arrival it could take several weeks for general sea freight from Korea to Australia. Grapes could potentially be air freighted from Korea to Australia within about a week from harvest. While the unrestricted risk assessments undertaken in this risk analysis do not impose any mandatory measures during storage and transport, common commercial practices may impact on the survival of some pests. If these conditions are applied to all consignments for a minimum period of time, then those conditions can be considered as part of the unrestricted risk assessment. As the minimum period in storage and transport after harvest is likely to be around one week, with an optimal cool chain temperature of 0–2 ºC, the impact of these conditions on pests has been broadly but conservatively considered.

4.1 Kanzawa spider mite

Tetranychus kanzawai EP, WA

Tetranychus kanzawai is not present in the state of Western Australia and is a pest of regional quarantine concern for that state (DAWA 2006).

Tetranychus kanzawai, the Kanzawa spider mite, or tea red spider mite, belongs to the spider mite family Tetranychidae (Migeon and Dorkeld 2006; CABI 2010). Spider mites are given this name as they often spin characteristic protective silk webs (Zhang 2008). *Tetranychus kanzawai* is one of the most common spider mites in the entire East Asia region and is a serious pest on a variety of agricultural crops (Zhang 2003; Takafuji *et al.* 2007; Takafuji and Hinomoto 2008).

There are five stages in the life cycle of spider mites: egg, larva, two nymphal stages (protonymph and deutonymph) and adult (Zhang 2008). Adult females of *Tetranychus kanzawai* are dark red with bodies 0.51 mm long and 0.31 mm wide (CABI 2010). Unfertilised eggs develop into males, while fertilised eggs develop into females (Takafuji and Ishii 1989). Four-day-old females produce only females, while 15-day-old females produce only males (Shih 1979; Takafuji and Ishii 1989). Some overwintering populations consist of 100% females (Takafuji *et al.* 2007).

In Fuzhou, China, populations of *T. kanzawai* on strawberries peaked in late December and mid-February and reached outbreak proportions at the end of the growing season (Zhang *et al.* 1996; CABI 2010). Females tended to oviposit on the underside of leaves, with most of the eggs produced during a peak period of a few days (Shih *et al.* 1978; Zhang 2003).

Shih *et al.* (1978) found that the average generation time was 15 days at 27 °C and 65% relative humidity (RH). The preoviposition period was around 1 day. The net reproductive rate was 45 females/female/generation (Shih *et al.* 1978). At 35 °C and 60% RH, the generation time was 6 days. The average number of eggs laid was 7 per day, while the oviposition period was 9 days. At 15 °C and 80% RH, the mites have a generation time of around 27 days with an average of 2 eggs laid per day, while the oviposition period was around 28 days.

The optimal developmental temperature is considered to be between 25 °C and 30 °C (Cao *et al.* 1998). The developmental threshold temperatures for the egg, protonymphal and deutonymphal stages were 14, 13 and 13 °C, respectively (Tsai *et al*. 1989). A preliminary study on mature, *T. kanzawai* showed they could survive up to 10 days at -1 °C to -5 °C (Yang *et al.* 1991).

On hydrangea (*Hydrangea macrophylla*) in Japan two different seasonal population trends occur: one with a single peak occurrence between May and June, and the other with a spring peak in June and an autumn peak in September–October. Each year the populations declined abruptly just after the spring peak, possibly due to the change in secondary compounds in plants (CABI 2010). Studies on strawberry gardens in China showed that eggs and active stages are aggregated (Zhang *et al.* 1996). The incidence of plant infestation may be as high as 90–100%, with the number of mites on each leaf reaching 2000–3000 (Zhang *et al.* 1996).

T. kanzawai constructs complicated webs over the surface of a leaf and usually lives under these. In addition to predator avoidance *T. kanzawai* uses the webs as a place for refuge (Oku 2008). In the presence of a predator, a significantly greater proportion of *T. kanzawai* females entered the quiescent stage (inactive adult) on webs than on leaves (Oku *et al.* 2003). The positive correlation between leaf hair traits (hair height and hair density) and host plant acceptance by *T. kanzawai* suggests that leaf hairs provide a refuge from predators for the females (Oku *et al.* 2006). Life history parameters of grape-adapted and bean-adapted populations of *T. kanzawai* were studied on grape and bean leaves and have found that beans are a better host than grapes, but the intrinsic rate of natural increase of grape-adapted population was higher than that of the bean-adapted population on grape (Kondo *et al*. 1987).

In Taiwan, *T. kanzawai* was found in very low numbers in vineyards, with *T. urticae* Koch being the main spider mite found (Ho and Chen 1994). *T. kanzawai* were found on grape clusters in eight out of 10 surveyed vineyards. Ten percent of grape clusters were infested, but the density was low, with only 0.63 mites per cluster. The percentage of grape berries infested with mites was 0.4% (Ho and Chen 1994). Experimental inoculation of unripe berries with *T. kanzawai* resulted in the mites either dying before development into the next instars or running away. Inoculating ripe berries led to mites being able to feed, develop and reproduce (Ho and Chen 1994). The population density varied considerably between grape cultivars (Ashihara 1996). High developmental success was observed on Muscat Bailey A (*Vitis labrusca* x *V. vinifera* x *V. linsecumii*) and Delaware (*V. labrusca* x *V. vinifera* x *V. aestivalis*) cultivars. On Kychou (*V. vinifera* x *V. labrusca*) 25% of larvae developed to adults, on Muscat of Alexandria (*V. vinifera*) only 2%, while none were observed on Neo Muscat (*V. vinifera*) and Campbell Early (*V. labrusca x V. vinifera*) (Ashihara 1996).

The risk scenario of concern for *T. kanzawai* is the presence of eggs, nymphs or adults on the peduncle, pedicel, or grape berry in the grape cluster.

T. kanzawai was included in the provisional final import policy for table grapes from China (Biosecurity Australia 2010c). The assessment of *T. kanzawai* presented here builds upon this previous assessment. However, differences in horticultural practices, climatic conditions and the prevalence of the pest between Korea and China make it necessary to re-assess the likelihood that *T. kanzawai* will be imported into Western Australia with table grapes from Korea. The probability of distribution for *T. kanzawai* after arrival in Western Australia with table grapes from Korea would be similar to that for table grapes from China. The probability of establishment and of spread in Western Australia, and the consequences the pest may cause will be the same for any commodity or country from which the species is imported into Western Australia, as these probabilities relate specifically to events that occur in Western Australia and are principally independent of the importation pathway. Accordingly, there is no need to re-assess these components, and the likelihood estimates for distribution, establishment, spread, and consequences as set out for *T. kanzawai* in the China table grape IRA (Biosecurity Australia 2010c) will be adopted for this assessment.

4.1.1 Reassessment of probability of importation

The likelihood that *Tetranychus kanzawai* will arrive in Western Australia with the importation of table grapes from Korea is: **MODERATE**.

Supporting information for this assessment is provided below:

- *T. kanzawai* is a polyphagous pest in Korea and other east Asian countries (Takafuji *et al.* 2005). It is mainly a pest of tea in Korea and is also found on fruit trees such as apple, pear, persimmon (Lee *et al*. 1995 in NPQS 2010b).
- There are no reports of damage in grape berries by *T. kanzawai* in Korea (Grape Research Institute 2007 in NPQS 2010b).
- *T. kanzawai* can feed, develop and reproduce when inoculated on ripe grape berries (Ho and Chen 1994).
- *T. kanzawai* is a serious pest of greenhouse grapevines in Japan (Ashihara 1995).
- In contrast, in a survey of vineyards in Taiwan, *T. kanzawai* was rarely found. *T. kanzawai* were found on 10% of grape clusters, but the density was low, with only 0.63 mites per cluster (Ho and Chen 1994).
- On strawberries in China, the incidence of plant infestation may be as high as 90–100%, with the number of mites on each leaf reaching 2000–3000 (Zhang *et al.* 1996).
- The small size (0.52 mm by 0.31 mm) (CABI 2010) of the organism and the possibility of low levels of infestation make it possible that they will be missed by a standard grading and packing process.
- The population density can vary considerably between grape cultivars, with mites on some cultivars showing high developmental success (Ashihara 1996).
- A preliminary study on mature *T. kanzawai* showed they could survive up to 10 days at -1 °C to -5 °C (Yang *et al.* 1991). This suggests that adults and nymphs may be able to survive under cold storage and transport.
- *Tetranychus* species are regularly intercepted on horticultural commodities at the border in Australia, New Zealand and other countries (Brake *et al.* 2003; MAF New Zealand 2009).

T. kanzawai's ability to feed, develop and reproduce on ripe grape berries and their small size, moderated by them not being known as a pest of grapes in Korea, support a likelihood estimate for importation into Western Australia of 'moderate'.

4.1.2 Probability of distribution, of establishment and of spread

As indicated, the probability of distribution, of establishment and of spread for *T. kanzawai* will be the same as those assessed for table grapes from China (Biosecurity Australia 2010c). The likelihood estimates from the previous assessments are presented below:

Probability of distribution: **MODERATE**

Probability of establishment: **HIGH**

Probability of spread: **MODERATE**

4.1.3 Overall probability of entry, establishment and spread

The overall probability of entry, establishment and spread is determined by combining the probabilities of entry, of establishment and of spread using the matrix of rules for combining qualitative likelihood shown in Table 2.2.

The likelihood that *T. kanzawai* will enter Western Australia as a result of trade in table grapes from Korea, be distributed in a viable state to a susceptible host, establish in Western Australia and subsequently spread within Western Australia: **LOW**.

4.1.4 Consequences

The consequences of the establishment of *T. kanzawai* in Western Australia have been estimated previously for table grapes from China (Biosecurity Australia 2010c). This estimate of impact scores is provided below.

Plant life or health	**E**
Any other aspects of the environment	**B**
Eradication, control, etc.	**D**
Domestic trade	**C**
International trade	**D**
Environment	**B**

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

4.1.5 Unrestricted risk estimate

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

Unrestricted risk estimate for *Tetranychus kanzawai*	
Overall probability of entry, establishment and spread	**Low**
Consequences	**Moderate**
Unrestricted risk	**Low**

As indicated, the unrestricted risk estimate for *T. kanzawai* of 'low' exceeds Australia's ALOP. Therefore, specific risk management measures are required for this pest.

4.2 Harlequin ladybird

Harmonia axyridis EP

Harmonia axyridis, known as the harlequin ladybird, is a relatively large lady beetle (5-8mm) with a characteristic convex oval shape. Patterning is highly variable, the elytra can be light orange, red to black and marked with 0 to 19 spots (Koch 2003). The pronotum of the adult is often marked with a black 'W" or 'M' (Ker and Carter 2004).

The natural range of *Harmonia axyridis* includes Korea, China from the northeast to the Himalayas, Japan and eastern Russia (Siberia) (Komai and Chino 1969; Koch 2003; Su *et al*. 2009). *H. axyridis* is associated with a wide range of arboreal (e.g. broadleaf and conifer) and herbaceous habitats (Ker and Carter 2004; Koch *et al*. 2006).

Harmonia axyridis is a voracious predator of plant pests, especially aphids and other soft bodied insects, and has been released as a classical bio-control agent in North America (Koch 2003) and Europe (Brown *et al*. 2008a). It has become established in many countries indicating its potential as an invasive species. This includes the USA, Canada and Mexico (Koch *et al*. 2006), Argentina and Brazil in South America (de Almeida and da Silva 2002), Austria, Belgium, France, the Netherlands, Germany, Greece, Italy, Luxemburg, Switzerland and the United Kingdom in Europe (Brown *et al*. 2008b; Roy and Roy 2008). It is also now present in Poland, Serbia, Hungary, Romania, Slovakia and the Ukraine (EPPO 2009). It is thought by some that founders of the established populations of *H. axyridis* in North America came on a ship from Japan (Potter *et al*. 2005).

The life history of *H. axyridis* is typical of coccinelids. It consists of the egg stage, four larval instars, pupae and adult. Eggs are oval, 1.2 mm long, yellow and are laid in clusters on leaves or stems of host plants (Koch 2003; Potter *et al.* 2005; Roy and Roy 2008). A female can lay 1000–4000 eggs in a lifetime at a rate of about 25 a day (Roy and Roy 2008). Eggs hatch in 3 days at 26 °C, larvae are initially black, and as they grow the dorsal-lateral areas of the segments become more marked with orange. Larvae are 1.9–2.1 mm long at hatching and 7.5 to 10.7 mm long when fully grown (Koch 2003). At 26 °C, the larval stage lasts about 14 days. Larvae pupate exposed on a leaf or stem (Koch 2003; Potter *et al.* 2005). Adults can live for up to 3 years (Koch 2003). In much of Asia, Europe and America, *H. axyridis* has two generations a year, but four or five are possible (Koch 2003).

H. axyridis overwinters as an adult. In response to temperature, day-length and food availability, adults migrate to hibernation sites, which include natural sites such as cracks in rock faces and man-made sites such as buildings (Koch 2003; Potter *et al*. 2005; Huelsman *et al*. 2010). In the autumn, buildings can be invaded by large numbers of beetles, causing distress and inconvenience to human occupants (Potter *et al*. 2005). Exposure to these beetles can cause a range of allergenic responses (Sharma *et al*. 2006; Goetz 2009). In spring, beetles mate and disperse to feeding sites in search of prey (Koch 2003).

In autumn in the USA, *H. axyridis* adults are reported to congregate in large numbers on late season fruit (e.g. apples, peaches, grapes, raspberries) to feed, especially on damaged fruit when invertebrate prey are scarce (Kovach 2004; Galvan *et al*. 2006; Roy and Roy 2008). They can move deep into bunches of grapes and burrow into individual grapes, from which they are difficult to remove (Koch 2003; Roy and Roy 2008). This is a particular concern in vineyards for producing wine grapes as beetles may be crushed along with grapes during processing. The contamination produces an undesirable taint known as 'ladybug taint', which is bottle stable and resistant to common wine fining agents (Pickering *et al*. 2006; Pickering *et al*. 2008).

The risk scenario of concern for *H. axyridis* is the transportation of adult and possibly larvae and pupae in bunches of table grapes.

H. axyridis was included in the provisional final import policy for table grapes from China (Biosecurity Australia 2010c). The assessment of *H. axyridis* presented here builds upon this previous assessment. However, differences in horticultural practices, climatic conditions and the prevalence of the pest between Korea and China make it necessary to re-assess the likelihood that *H. axyridis* will be imported into Australia with table grapes from Korea. The probability of distribution for *H. axyridis* after arrival in Australia with table grapes from Korea would be similar to that for table grapes from China. The probability of establishment and of spread in Australia, and the consequences the pest may cause will be the same for any commodity or country from which the species is imported into Australia, as these probabilities relate specifically to events that occur in Australia and are principally independent of the importation pathway. Accordingly, there is no need to re-assess these components, and the likelihood estimates for distribution, establishment, spread, and consequences as set out for *H. axyridis* in the China table grape IRA (Biosecurity Australia 2010c) will be adopted for this assessment.

4.2.1 Reassessment of probability of importation

The likelihood that *Harmonia axyridis* will arrive in Australia with the importation of table grapes from Korea is: **MODERATE**.

Supporting information for this assessment is provided below:

- *H. axyridis* is present in Korea (Coderre *et al.* 1995; Koch 2003; Brown *et al.* 2008a). *H. axyridis* is known to aggregate on, and in some cases, feed on grapes (Koch 2003).
- Adult *H. axyridis* can live up to 3 years (Koch 2003; Weeden *et al*. 2009), so are likely to survive transport from Korea.
- *H. axyridis* overwinters as adults and is able to survive severe winters of northeast Asia and northeast North America. In Japan, hibernating beetles are known to survive temperatures as low as -16 °C (Koch 2003). Cool conditions used in the storage and transportation of grapes will reduce beetle activity and are likely to extend the lifespan of beetles.
- Adults and larvae of *H. axyridis* will range over a grapevine in search of prey. Adults are attracted to ripe fruit and will feed on damaged grape berries in autumn as invertebrate food becomes scarce (Roy and Roy 2008). Large numbers may be present on crops at harvest and they may also be attracted to bins of picked grapes (Kovach 2004; Galvan *et al*. 2006). Surveys of grape growers in Ohio indicated that 50% of growers had problems with *H. axyridis* feeding on grapes prior to harvest (Kovach 2004). Laboratory tests

indicated that the beetle preferred to feed at sites of previous damage on the fruit, though this is not always the case (Kovach 2004).

- Obvious insects such as *H. axydris* may be removed during commercial harvest and processing procedures. However, there is a risk that individual beetles may remain within bunches, especially where berries are tightly packed. *H. axyridis* have been reported as being difficult to remove from bunches of grapes (Koch 2003; Kovach 2004). Recommendations to harvest grapes at cool times of day and processing and packing grapes under cool conditions are likely to reduce activity of individual beetles and decrease the likelihood that they are detected.
- *H. axyridis* has been recorded arriving live in New Zealand in ya pears imported from China (MAF New Zealand 2009) demonstrating that it is can be shipped with other horticultural products.

The presence of *H. axyridis* in Korea, its preference for grapes and its ability to survive cold storage and transport moderated by the lack of reports of it being a pest of grapes in Korea support a likelihood estimate for importation of 'moderate'.

4.2.2 Probability of distribution, of establishment and of spread

As indicated, the probability of distribution, of establishment and of spread for *H. axyridis* will be the same as that assessed for table grapes from China (Biosecurity Australia 2010c). The likelihood estimates from the previous assessment are presented below:

Probability of distribution: **HIGH**

Probability of establishment: **HIGH**

Probability of spread: **HIGH**

4.2.3 Overall probability of entry, establishment and spread

The overall probability of entry, establishment and spread is determined by combining the probabilities of entry, of establishment and of spread using the matrix of rules for combining qualitative likelihood shown in Table 2.2.

The likelihood that *H. axyridis* will enter Australia as a result of trade in table grapes from Korea, be distributed in a viable state to a susceptible host, establish in Australia and subsequently spread within Australia: **MODERATE**.

4.2.4 Consequences

The consequences of the establishment of *H. axyridis* in Australia have been estimated previously for table grapes from China (Biosecurity Australia 2010c). This estimate of impact scores is provided below.

Plant life or health	**C**
Any other aspects of the environment	**D**
Eradication, control, etc.	**D**

Domestic trade	**E**
International trade	**D**
Environment	**E**

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

4.2.5 Unrestricted risk estimate

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

Unrestricted risk estimate for *Harmonia axyridis*	
Overall probability of entry, establishment and spread	**Moderate**
Consequences	**Moderate**
Unrestricted risk	**Moderate**

As indicated, the unrestricted risk estimate for *H. axyridis* of 'moderate' exceeds Australia's ALOP. Therefore, specific risk management measures are required for this pest.

4.3 Scarab beetles

Popillia mutans [EP] and *Popillia quadriguttata* [EP]

Popillia mutans and *Popillia quadriguttata* (Chinese rose beetle) are scarab beetles (family Scarabaeidae). *Popillia mutans* is reported from Korea, India and China (Li 2004). *Popillia quadriguttata* is found in Korea (previously reported as *P. japonica* until 1990 (Ku *et al.* 1999; Lee *et al.* 2007), China, Russia, Taiwan and Vietnam (Lee *et al.* 2007; Lobl and Smetana 2006).

While little is known of the biology of *Popillia mutans*, it has been recorded damaging grapes (Li 2004) as well as flowers and calyxes of sweet persimmon in Korea (Lee *et al.* 2002c), and lychee and longan (Tan *et al.* 1998). The biology and behaviour of *Popillia quadriguttata* is thought to be similar to that of *P. japonica*, as *P. quadriguttata* was misidentified as *P. japonica* for many years (Ku *et al.* 1999). *P. quadriguttata* differs in having a smaller adult host range (Lee *et al.* 2007). In the absence of detailed biology for *P. quadriguttata* or *P. mutans*, information on *P. japonica* is outlined below.

Popillia japonica has four life history stages: egg, larva, pupa and adult (Fleming 1972; Lawrence and Britton 1991). Adult beetles are attracted to chemicals released from damaged leaves and fruit and form feeding aggregations, which can consist of thousands of beetles (Hammons *et al.* 2009). Beetles exhibit polyandry and polygamy (Potter and Held 2002). Females use a sex pheromone to attract a mate for the first mating. All subsequent matings rely on high densities of both sexes present in feeding aggregations (Potter and Held 2002). After mating, females disperse to find suitable hosts. Eggs are laid individually in soil associated with roots of suitable grass hosts. Females lay between 40–60 eggs during their 4–6 week lifespan, which hatch in approximately two weeks. Larvae take 2–3 weeks and 3–4 weeks to pass through the first and second instars, respectively, with third instar larvae then overwintering. Development resumes in the spring once soil temperatures rise above 10 °C, with larvae taking a further 4–8 weeks to mature. After constructing a pupal chamber in the soil, larvae enter a pre-pupal stage lasting approximately 10 days. Adults emerge after spending 7–17 days as a pupa, but remain in the pupal chamber for between 2–14 days after emergence (Potter and Held 2002).

Adult *P. japonica* feed as generalists on flowers, leaves, fruits and foliage of a wide range of plants, while the larvae feed on the roots of grasses and other plants present in pastures, lawns and sports fields (Fleming 1972). Home gardens are badly affected by this species, as they provide a large range of adult and larval hosts growing in a small area (Fleming 1972). Adult *P. japonica* have sharp mandibles and are capable of biting into skins of ripe fruit including grape berries. Grapes are especially favoured and may be heavily infested with feeding beetles, with adults opportunistically exploiting fruits as a high energy source (Hammons *et al.* 2009).

The risk scenario of concern for *P. mutans* and *P. quadriguttata* is the transportation of adults in bunches of table grapes.

P. mutans and *P. quadriguttata* were included in the provisional final import policy for table grapes from China (where they were assessed with *P. japonica*) (Biosecurity Australia

2010c). As *P. quadriguttata* was mistaken for *P. japonica* for many years, the assessment of *P. mutans* and *P. quadriguttata* presented here builds upon this previous assessment. However, differences in horticultural practices, climatic conditions and the prevalence of the pest between Korea and China make it necessary to re-assess the likelihood that *P. mutans* and *P. quadriguttata* will be imported into Australia with table grapes from Korea. The probability of distribution for *P. mutans* and *P. quadriguttata* after arrival in Australia with table grapes from Korea would be similar to that for table grapes from China. The probability of establishment and of spread in Australia, and the consequences the pest may cause will be the same for any commodity or country from which the species is imported into Australia. These probabilities relate specifically to events that occur in Australia and are independent of the importation pathway. Accordingly, there is no need to re-assess these components, and the likelihood estimates for distribution, establishment, spread and consequences as set out for *P. mutans* and *P. quadriguttata* in the China table grape IRA (Biosecurity Australia 2010c) will be adopted for this assessment.

4.3.1 Reassessment of probability of importation

The likelihood that *Popillia mutans* and *Popillia quadriguttata* will arrive in Australia with the importation of table grapes from Korea is: **LOW**.

Supporting information for this assessment is provided below:

- *P. quadriguttata* is found in grape-growing provinces in Korea (Lee *et al.* 2007). *P. mutans* occurs in Korea (Lee *et al.* 2002c).
- *P. mutans* and *P. quadriguttata* attack the leaves and fruits of *Vitis vinifera* and other hosts (AQSIQ 2006; NPQS 2007). Sugar-rich fruit is opportunistically exploited, as adult ruteline beetles use them as a high calorie fuel for flight (Hammons *et al.* 2009).
- Adults of both *Popillia* species are likely to be present at harvest time (August–October) in Korea. *P. quadriguttata* are most active in June and July in Korea (Lee *et al.* 2007). Adults are likely to live for 30–45 days, as this is the case with *P. japonica* (CFIA 2009).
- Larvae are unlikely to be imported because they (*P. japonica*) feed on the roots of grasses (Potter and Held 2002). The biology and behaviour of *P. quadriguttata* larvae is similar to that of *P. japonica* (Lee *et al.* 2007).
- *P. quadriguttata* adults are attracted to plant-based lures designed for *P. japonica* in South Korea (Lee *et al.* 2007). This suggests that *P. quadriguttata*, like *P. japonica*, responds to volatiles released from leaves and fruit damaged by other beetles. This adaptation may assist large numbers of beetles to readily find food resources (Fleming 1972; Hammons *et al.* 2009) such as grapes.
- *P. japonica* is able to significantly reduce harvestable crops (Hammons *et al.* 2009). As *P. quadriguttata* was confused for *P. japonica* for many years it is possible that *P. quadriguttata* may cause the same damage.
- An adult *P. japonica* has been found in Australia in a blueberry baked in a muffin (Gillespie 2006). This demonstrates that adult beetles can remain on fruit through harvest and post-harvest processing activities and burrow into fruit.

- Beetles are likely to be removed from grape bunches by picking, grading and packing operations because of their size (8–11 mm) and colour. *P. mutans* is black (GNSE 2007) and *P. quadriguttata* is iridescent copper and green (NARIS 2011).
- No reports were found indicating the tolerance of either *P. mutans* or *P. quadriguttata* to cold temperatures. However *P. japonica* can survive temperatures as low as –20 °C without prior cold conditioning (Payne 1928). Temperatures used in Korea for pre-cooling of grapes (4–5 °C) and cold storage (0 °C to -0.5 °C) (NPQS 2011) are unlikely to kill *P. japonica* adults, and may not kill either *P. mutans* or *P. quadriguttata*. Cold conditions may improve the ability of *Popillia* spp. to survive transport to Australia by reducing their metabolic rate and increasing their lifespan.

The presence of *P. mutans* and *P. quadriguttata* in Korea and the likelihood that they will feed on grapes and survive cold storage, moderated by the likely removal of beetles from grape bunches during packing because of their size and colour, support a likelihood estimate for importation of 'low'.

4.3.2 Probability of distribution, of establishment and of spread

As indicated, the probability of distribution, of establishment and of spread for *P. mutans* and *P. quadriguttata* will be the same as for *P. japonica*, *P. mutans* and *P. quadriguttata* for table grapes from China (Biosecurity Australia 2010c). The likelihood estimates from the previous assessment are presented below:

Probability of distribution: **HIGH**

Probability of establishment: **HIGH**

Probability of spread: **HIGH**

4.3.3 Overall probability of entry, establishment and spread

The overall probability of entry, establishment and of spread is determined by combining the probabilities of entry, of establishment and of spread using the matrix of rules shown in Table 2.2.

The likelihood that *P. mutans* and *P. quadriguttata* will enter Australia as a result of trade in table grapes from Korea, be distributed in a viable state to a susceptible host, establish in Australia and subsequently spread within Australia: **LOW**.

4.3.4 Consequences

The consequences of the establishment of *P. mutans* and *P. quadriguttata* in Australia have been estimated previously for table grapes from China (Biosecurity Australia 2010c). This estimate of impact scores is provided below.

Plant life or health	**E**
Other aspects of the environment	**E**
Eradication, control etc.	**E**
Domestic trade	**D**

International trade	**C**
Environment	**D**

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

4.3.5 Unrestricted risk estimate

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

Unrestricted risk estimate for *Popillia mutans and Popillia quadriguttata*	
Overall probability of entry, establishment and spread	**Low**
Consequences	**Moderate**
Unrestricted risk	**Low**

As indicated, the unrestricted risk estimate for *P. mutans* and *P. quadriguttata* of 'low' exceeds Australia's ALOP. Therefore, specific risk management measures are required for these pests.

4.4 Spotted wing drosophila

Drosophila suzukii EP

Biosecurity Australia has undertaken a pest risk analysis to assess the quarantine risks posed by *Drosophila suzukii* from all countries and for all commodities (Biosecurity Australia 2010a). This pest attacks a range of soft fruits including grapes, strawberries, cherries, blueberries, caneberries and stone fruit. This draft pest risk analysis report identified fresh fruit and fresh flower imports as potential pathways for the introduction of *D. suzukii* with an unrestricted risk that exceeds Australia's acceptable level of protection (ALOP). A summary of background information and biology of this pest, as detailed in the Final pest risk analysis report for *Drosophila suzukii* (Biosecurity Australia 2010a), is outlined below.

An unidentified species of *Drosophila* was first recorded attacking a range of soft fruits in California in 2008 (Hauser *et al.* 2009). *Drosophila* are known to be attracted to fermenting, over-ripe and rotting fruit and are well known nuisance pests in restaurants, grocery stores, fruit markets and homes (Jacobs 2010). When damage continued in 2009 samples were submitted for further identification and were determined to be *D. suzukii*, a species which causes damage to fruit in Japan (Hauser *et al.* 2009). *D. suzukii* has subsequently been confirmed to be present in Canada (NAPPO 2010a), several states in the USA (NAPPO 2010b), Italy (EPPO 2010), Spain and France (Calabria *et al.* in press). *D. suzukii* is native to several Asian countries including Korea, Japan and China (Hauser *et al.* 2009).

The potential for the introduction of *D. suzukii* into Australia, via imports of currently traded host fruit, resulted in Australia introducing emergency quarantine measures prior to the re-commencement of trade. The emergency measures were announced on 7 April 2010 for table grapes (*Vitis* spp.), cherries, strawberries and stone fruit and for human consumption from all countries.

The total development time of *D. suzukii* (egg to adult) ranges from 8–28 days. The duration is dependent on seasons, with shorter lifecycles in summer. Typically eggs hatch in 1 day, with larval development taking 3–10 days, and pupation taking 4–14 days. Adults become sexually mature in 1–2 days and live for 21–66 days. Females can lay an average of 380 eggs in their life (Kanzawa 1939).

The larval feeding of early instars causes the fruit to collapse around the oviposition scar and if attack rates are high the entire fruit can collapse. The oviposition scar exposes the fruit to secondary attack by pathogens and other insects (Hauser and Damus 2009). The damage caused by *D. suzukii* larvae renders the fruit unsuitable for sale (Bolda *et al.* 2010).

D. suzukii preferentially oviposit on ripe fruit but will also lay eggs in unripe and over-ripe fruit (Kanzawa 1939). Larvae feeding in fruit that is very acidic fail to complete development (Kanzawa 1935). Oviposition trials on wine and table grapes have shown that fully ripe table grapes are attacked at high levels but that oviposition does not occur on undamaged grapes with low sugar levels. Damaged fruit with low sugar levels will be oviposited in but larvae develop poorly and fail to pupate (Malguashca *et al.* 2010).

During the 1930s in Japan, *D. suzukii* was trapped in vineyards at high levels and there are reports of damage as high as 80% (Kanzawa 1939). More recently there have been reports of outbreaks of *D. suzukii* on grapes in Hokkaido (CFIA 2010). In the USA, *D. suzukii* has been recorded from grapes though infestation rates remained low last season (OSU 2010).

In its native and introduced range, *D. suzukii* has been recorded to cause damage to a range of fruits including grapes, cherry, blueberry and red bayberry, mulberries, peaches, plums, strawberries and various caneberries. Studies in Japan have shown severe crop losses of 80% for grapes and 26–100% for cherries (Kanzawa 1939).

The risk scenario of concern for *D. suzukii* is the presence of the larvae in mature bunches of grapes.

As *D. suzukii* on table grape imports was covered in the *Draft Pest Risk Analysis for Drosophila suzukii* (Biosecurity Australia 2010a) the likelihood estimates from that report are outlined here.

4.4.1 Probability of entry, of establishment and of spread

Probability of importation on table grapes:	**HIGH**
Probability of distribution:	**HIGH**
Overall probability of entry:	**HIGH**
Probability of establishment:	**HIGH**
Probability of spread:	**HIGH**

4.4.2 Overall probability of entry, establishment and spread

The overall probability of entry, establishment and spread is determined by combining the probabilities of entry, of establishment and of spread using the matrix of rules shown in Table 2.2.

The likelihood that *D. suzukii* will enter Australia as a result of trade in table grapes from Korea, be distributed in a viable state to a susceptible host, establish in Australia and subsequently spread within Australia: **HIGH**.

4.4.3 Consequences

The consequences of the establishment of *D. suzukii* in Australia were estimated previously for all commodities for the *Draft pest risk analysis report for Drosophila suzukii* (Biosecurity Australia 2010a). This estimate of impact scores is provided below.

Plant life or health	**F**
Other aspects of the environment	**B**
Eradication, control etc.	**E**
Domestic trade	**E**
International trade	**E**
Environment	**D**

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

4.4.4 Unrestricted risk estimate

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

Unrestricted risk estimate for *Drosophila suzukii*	
Overall probability of entry, establishment and spread	**High**
Consequences	**High**
Unrestricted risk	**High**

As indicated, the unrestricted risk estimate for *D. suzukii* of 'high' exceeds Australia's ALOP. Therefore, specific risk management measures are required for this pest.

4.5 Grape phylloxera

Daktulosphaira vitifoliae EP

Daktulosphaira vitifoliae, commonly known as grape phylloxera or phylloxera, is an aphid related pest in family Phylloxeridae, superfamily Aphidoidea. *Daktulosphaira vitifoliae* attacks the roots and/or leaves of some species of *Vitis* including commercial grapevines depending on the genetic strain of the insect. Its feeding on roots of the vine will lead to death of the plant (Corrie *et al.* 2003). This pest causes considerable losses in both quality and yield of grapevines throughout many grape producing areas around the world. The only proven method for control of phylloxera is the use of grapevines grafted onto phylloxera resistant rootstock developed from American grapevine species (PGIBSA 2003; INRA 2009).

Until recently in Korea many farmers grew grapevines without using phylloxera resistant rootstocks as there were few reports of infestation by grape phylloxera owing to the hot and rainy weather in summer and cold conditions in winter. There were reports that grape phylloxera was present in some regions in 1912–1913 but no notable outbreaks until recently (Song 2010). In 1998, phylloxera emerged in Cheonan and Anseong areas where mostly the Kyoho cultivar is grown, but its spread is now under control (Song 2010). To protect grapevines from phylloxera many farmers in South Korea began to use grafted grapevines. In some important regions like Cheonan, Anseong, Naju, Youngdong, and Kimchoen, farmers largely mass produce grafted nursery plants using phylloxera resistant rootstocks (Song 2010).

Daktulosphaira vitifoliae is also present in Australia, where it is also a domestic quarantine pest and strict quarantine restrictions have been in place since 1917 (Umina *et al.* 2007). It is under official control and restricted to parts of New South Wales and Victoria (Loch and Slack 2007).

The roots of European grapevine, *Vitis vinifera*, are extremely susceptible to attack by *Daktulosphaira vitifoliae* but the leaves are resistant to phylloxera present in Australia; leaf attacking phylloxera have been reported overseas (Botton and Walker 2009; Molnár *et al.* 2009). Populations of *D. vitifoliae* in Australia mostly feed on roots. Leaf gall formation is rare, occurring in humid conditions in late summer on leaves of American *Vitis* species or their hybrids (Loch and Slack 2007). The roots of American species *Vitis berlandieri, V. rupestris* and *V. riparia* are resistant to attack (Skinkis *et al.* 2009), but their resistance to leaf attack appears to vary depending on the *D. vitifoliae* genotype and *Vitis* sp. (Downie *et al.* 2000; Granett *et al.* 2001). The use of resistant American species as rootstock is advised for establishing new grapevines in Australia (PGIBSA 2003). However, the cost of grafted rootstocks can be a limitation for some growers (Powell 2008).

Umina *et al.* (2007) surveyed roots and leaves in phylloxera infested areas of Australia and reported 83 genotypes of *D. vitifoliae,* of which 11 occur both on leaves and roots, 23 on leaves and the remaining 49 on roots. Those that occur on leaves in Australia are mainly restricted to areas in north-eastern Victoria and are found on leaves from rootstocks other than *V. vinifera* (Thomas 2010).

The life cycle of *D. vitifoliae* has recently been reviewed by Forneck and Huber (2009) and in common with other members of the superfamily Aphidoidea, the life cycle is complex (Downie 2006). During spring and summer *D. vitifoliae* reproduces parthenogenetically on the roots and/or on the leaves of susceptible plants. Wingless females 0.8–1.5 mm long (Forneck and Huber 2009) produce up to 400 eggs (Skinkis *et al.* 2009). These eggs hatch into the first instar crawler stage which can move between leaves and roots (Forneck and Huber 2009). Three typically sedentary instars develop before the adult is produced (Granett *et al.* 2001). If disturbed these later instars can relocate to another feeding site (Kingston *et al.* 2009). For populations living on roots the first instar is considered to be the overwintering stage (Granett *et al.* 2001). Three to ten parthenogenetic generations that can be produced (Granett *et al.* 2001; Forneck and Huber 2009).

During summer and autumn the wingless females living on roots produce alate 'sexupara'. Sexupara are females that give birth to male and female sexuals (Forneck and Huber 2009). Sexupara move to the leaves and may fly to disperse (Granett *et al.* 2001). Crowding and resource deterioration may induce the formation of sexupara as much as cooler weather (Downie 2006). Sexupara produce 4–8 eggs which hatch to produce male and female sexuals (Forneck and Huber 2009). After mating of these sexuals, the female lays a single egg under bark. This is an overwintering stage which hatches into a fundatrix next spring. The fundatrix is a colony/clone foundress that produces the next round of wingless females (Forneck and Huber 2009).

On leaves, during summer to late autumn, the wingless females do not produce alates and instead produce wingless sexupara and the life cycle continues as described above except that these wingless sexupara produce 1–63 sexual eggs or 1–90 asexual eggs (Downie and Granett 1998).

The life cycle described above is not the only mode of reproduction available to *D. vitifoliae*. Forneck and Huber (2009) describe reports in earlier literature that found that wingless females on roots can also produce wingless sexupara that produce sexuals, which produce eggs that hatch into a fundatrix that can feed on roots and produce wingless females.

The risk scenario of concern for *D. vitifoliae* is that winged adults or crawlers may be imported in table grapes. *D. vitifoliae* may become established outside of its existing limited distribution in eastern Australia. It may then spread throughout the wine, table grape and dried fruit growing regions of Australia, with potential serious consequences for these grape based industries.

D. vitifoliae was included in the provisional final import policy for table grapes from China (Biosecurity Australia 2010c). The assessment of *D. vitifoliae* presented here builds upon this previous assessment. However, differences in horticultural practices, climatic conditions and the prevalence of the pest between Korea and China make it necessary to re-assess the likelihood that *D. vitifoliae* will be imported into Australia with table grapes from Korea. The probability of distribution for *D. vitifoliae* after arrival in Australia with table grapes from Korea would be similar to that for table grapes from China. The probability of establishment and of spread in Australia, and the consequences the pest may cause will be the same for any commodity or country from which the species is imported into Australia, as these probabilities relate specifically to events that occur in Australia and are principally independent of the importation pathway. Accordingly, there is no need to re-assess these components, and the likelihood estimates for distribution, establishment, spread, and consequences as set out for *D. vitifoliae* in the China table grape IRA (Biosecurity Australia 2010c) will be adopted for this assessment.

4.5.1 Reassessment of probability of importation

The likelihood that *Daktulosphaira vitifoliae* will arrive in Australia with the importation of table grapes from Korea is: **MODERATE**.

Supporting information for this assessment is provided below:

- In 1998, *D. vitifoliae* emerged in Cheonan and Anseong areas where mostly the Kyoho cultivar is grown, but its spread has now been brought under control (Song 2010). It is, therefore, assumed that *D. vitifoliae* has limited potential to establish and spread throughout other grape growing areas of Korea.
- Many farmers in Korea use grafted grapevines to protect from phylloxera. In some important grape growing regions like Cheonan, Youngdong, Kimchoen, Anseong and Naju farmers largely mass produce grafted nursery plants using phylloxera resistant rootstocks (Song 2010). Grapes are not exported from Anseong or Naju (NPQS 2011).
- Phylloxera-resistant rootstocks are used for *Vitis riparia*, *V. rupestris* and *V. berlanderi* in Korea and those developed through hybridisation with these varieties including SO4, 8B, 5C, 5BB, 3309, 3306, 188-08 and 101-14 (NPQS 2011). The foliar form of phylloxera, which causes dispersal of the pest, is usually only found on the foliage of susceptible vines (Pearson and Goheen 1988).
- *D. vitifoliae* is also controlled in Korea by disinfection of roots when planting seedlings and spraying chemicals during cultivation (Grape Research Institute 2007 in NPQS 2010b).
- The NPQS (2010b) reports that there have been no occurrences of this pest on the fruit other than in roots and leaves.
- In Korea, grapes are harvested between August and October (NPQS 2011). During this time, winged *D. vitifoliae* and crawlers may be associated with harvested grapes destined for export to Australia. The first instar crawlers are less than 1 mm long (Forneck and Huber 2009). Owing to their small size, it is unlikely that *D. vitifoliae* on bunches will be observed during routine field and packing house procedures. Winged adults are larger than crawlers (about 2 mm long (Forneck and Huber 2009)), but they may still be too small to be observed during routine field and packing procedures particularly if they are in the bunch.
- Packed grapes for export from Korea are transported in cold humidified storage to ensure grape quality is maintained. NPQS (2011) report storage and transport conditions for grapes as 0 to -0.5 °C +/- 0.5 °C and 80–90% relative humidity. It is unknown if *D. vitifoliae* will survive in table grapes under routine commercial conditions during cold storage, transportation and export. The crawlers have been reported to survive under water at 5 °C for seven days (Korosi *et al.* 2009) and without food for seven days at 25 °C (Kingston *et al.* 2009). For populations living on roots, the first instar is considered to be

the overwintering stage (Granett *et al.* 2001). The first instar may survive temperatures associated with cold storage and transport.

The possibility of association of winged and crawler dispersal stages of *D. vitifoliae* with grape bunches, its limited capacity to be detected in normal picking and packing procedures, moderated by its limited distribution in grape growing regions of Korea and the uncertainty about survival of storage and transport conditions, support a likelihood estimate for importation of 'moderate'.

4.5.2 Probability of distribution, of establishment and of spread

As indicated, the probability of distribution, of establishment and of spread for *D. vitifoliae* will be the same as that assessed for table grapes from China (Biosecurity Australia 2010c). The likelihood estimates from the previous assessment are presented below:

Probability of distribution: **MODERATE**

Probability of establishment: **HIGH**

Probability of spread: **MODERATE**

4.5.3 Overall probability of entry, establishment and spread

The overall probability of entry, establishment and spread is determined by combining the probabilities of entry, of establishment and of spread using the matrix of rules for combining qualitative likelihood shown in Table 2.2.

The likelihood that *D. vitifoliae* will enter Australia as a result of trade in table grapes from Korea, be distributed in a viable state to a susceptible host, establish in Australia and subsequently spread within Australia: **LOW**.

4.5.4 Consequences

The consequences of the establishment of *D. vitifoliae* in Australia have been estimated previously for table grapes from China (Biosecurity Australia 2010c). This estimate of impact scores is provided below.

Plant life or health	**E**
Any other aspects of the environment	**A**
Eradication, control, etc.	**E**
Domestic trade	**D**
International trade	**C**
Environment	**B**

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

4.5.5 Unrestricted risk estimate

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

Unrestricted risk estimate for *Daktulosphaira vitifoliae*	
Overall probability of entry, establishment and spread	**Low**
Consequences	**Moderate**
Unrestricted risk	**Low**

As indicated, the unrestricted risk estimate for *D. vitifoliae* of ‘low’ exceeds Australia’s ALOP. Therefore, specific risk management measures are required for this pest.

4.6 Soft scale

Parthenolecanium corni [EP, WA]

Parthenolecanium corni is not present in the state of Western Australia and is a pest of regional quarantine concern for that state.

Parthenolecanium corni belongs to the soft scale insect family Coccidae. Soft scales are sessile, small and often inconspicuous and are covered with a wax secretion that covers adult females and immature males. There are three life stages; eggs, nymphs and adults. The life cycle of the female scale includes an egg stage, two nymphal stages and an adult stage. The male scale has one egg stage, four nymphal or instar stages and an adult stage which is winged (David'yan 2009). The first nymphal stage or instar is called a 'crawler' and has functional legs (David'yan 2009) and is the main dispersal stage. Crawlers may be dispersed by wind, animals and by human transport of infested material. Apart from the winged male, the other stages are mostly sedentary but once the crawlers settle and feed on leaf undersides, later instars may migrate to stems and branches on the host plant (CABI 2010).

Scales cause major problems in agricultural and ornamental ecosystems and are commonly transported on plant materials (CABI 2010). Due to their small size and habit of feeding in concealed areas, they are frequent invasive species causing billions of dollars in damage annually in the USA (Miller *et al.* 2007). In the USA there are 42 introduced species of soft scales and 41 of them are pests (Miller *et al.* 2007). *Parthenolecanium* spp. produce honeydew as they feed. Sooty mould may grow on the honeydew, causing blackened areas on leaves and fruit. Ants may also be observed feeding on honeydew. When soft scales occur in abundance, they may stunt vine growth (David'yan 2009). The main economic damage caused by soft scales is from the downgrading of fruit quality caused by sooty mould fungi growing on the honeydew produced by these insects.

Parthenolecanium corni is highly polyphagous, attacking some 350 plant species in 40 families (Ben-Dov *et al.* 2010). *P. corni* occurs in Korea (NPQS 2007; CABI 2010).

In spring, overwintering second instar *P. corni* nymphs emerge from grapevine leaves and cracks in grapevine branches and move to branches where they feed, producing large amounts of honeydew. They remain there for the rest of their life cycle. These nymphs pass through the third instar stage and mature into adults. Adult males are very small (1.7 mm long) winged, and are rare (David'yan 2009). Adult females are small (3–6.5 mm long, 2.0–4.0 mm in width and 4.0 mm in height) and covered in a shiny brown leathery domed shell (University of California 2003). They are sessile and reproduce primarily parthenogenetically (without mating), laying 1000–3000 eggs at the end of spring beneath the female's body under her shell. The female then dies, leaving the eggs protected by her shell (University of California 2003). Crawlers emerge from the eggs during early summer, which migrate to leaves to feed, followed by a return to branches (David'yan 2009). The number of *P. corni* generations per year is dependent upon host species (David'yan 2009).

The risk scenario of concern is that imported bunches of table grapes from Korea may contain feeding *P. corni* adult females and nymphs.

P. corni was included in the provisional final import policy for table grapes from China (Biosecurity Australia 2010c) which built upon the import policy for table grapes from Chile (Biosecurity Australia 2005a) and cherries from New Zealand (DAFF 2003a). The assessment of *P. corni* presented here builds upon the previous assessment for table grapes from China (Biosecurity Australia 2010c). However, differences in horticultural practices, climatic conditions and the prevalence of the pest between China and Korea make it necessary to re-assess the likelihood that *P. corni* will be imported into Western Australia with table grapes from Korea. The probability of distribution for *P. corni* after arrival in Western Australia with table grapes from Korea would be similar to that for table grapes from China. The probability of establishment and of spread in Western Australia, and the consequences the pest may cause will be the same for any commodity or country from which the species is imported into Western Australia, as these probabilities relate specifically to events that occur in Western Australia and are independent of the importation pathway. Accordingly, there is no need to re-assess these components, and the likelihood estimates for distribution, establishment, spread and consequences as set out for *P. corni* in the China table grape IRA (Biosecurity Australia 2010c) will be adopted for this assessment.

4.6.1 Reassessment of probability of importation

The likelihood that *Parthenolecanium corni* will arrive in Western Australia with the importation of table grapes from Korea is: **HIGH**.

Supporting information for this assessment is provided below:

- *P. corni* is found within Korea on grapevines (NPQS 2007; CABI 2010).
- Once the first instars or crawlers settle on a suitable host such as grapevine, subsequent nymphs and adults inside the scale covers remain sessile and attached to their host. The small size of *P. corni* adult females and nymphs may make them difficult to detect, especially at low population levels. Therefore, table grape sorting, grading and packing processes may not remove them effectively from the export pathway.
- Nymphs initially feed on the undersides of leaves and new branches before moving to branches to overwinter in September. Nymphs and adults feed on grapevine leaves, bark of branches and sometimes fruit (Li 2004; Zhang 2005; AQSIQ 2007; David'yan 2009). Nymphs and possibly adults are likely to be on table grapes during harvest time (Li 2004; Zhang 2005).
- *P. corni* overwinter on grape branches as second instar nymphs (Li 2004; Zhang 2005; AQSIQ 2007) and this may demonstrate an ability to tolerate cold storage.
- In Korea, agricultural chemicals registered with the Korean government are used to control pests, providing they meet the standards for residues of chemicals from Australia (NPQS 2007). Grapevines are treated in April in Korea for scale (NPQS 2011). Pesticide treatments would likely reduce the number of surviving nymphs and adults on the fruit.

The small size, sessile nature of most life stages and cold tolerance, all support a likelihood estimate for importation of 'high'.

4.6.2 Probability of distribution, of establishment and of spread

As indicated above, the probability of distribution, of establishment and of spread for *P. corni* will be the same as that assessed for table grapes from Chile (Biosecurity Australia 2005a), which were adopted for table grapes from China (Biosecurity Australia 2010c). The likelihood estimates from the previous assessment are presented below:

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

4.6.3 Overall probability of entry, establishment and spread

The overall probability of entry, establishment and spread is determined by combining the probabilities of entry, of establishment and of spread using the matrix of rules shown in Table 2.2.

The likelihood that *P. corni* will enter Western Australia as a result of trade in table grapes from Korea, be distributed in a viable state to a susceptible host, establish in Western Australia and subsequently spread within Western Australia: **LOW**.

4.6.4 Consequences

The consequences of the establishment of *P. corni* in Western Australia have been estimated previously for table grapes from Chile (Biosecurity Australia 2005a) and adopted for table grapes from China (Biosecurity Australia 2010c). This estimate of impact scores is provided below.

Plant life or health	**D**
Other aspects of the environment	**B**
Eradication, control etc.	**D**
Domestic trade	**C**
International trade	**C**
Environment	**B**

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

4.6.5 Unrestricted risk estimate

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

Unrestricted risk estimate for *Parthenolecanium corni* [WA]	
Overall probability of entry, establishment and spread	**Low**
Consequences	**Low**
Unrestricted risk	**Very low**

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

4.7 Mealybugs

Pseudococcus comstocki EP and *Planococcus kraunhiae* EP

The biology and taxonomy of these species is considered sufficiently similar to justify combining them into a single assessment. In this assessment, the term 'mealybug' is used to refer to these two species unless otherwise specified.

Pseudococcus comstocki (Comstock's mealybug) and *Planococcus kraunhiae* (Japanese mealybug) belong to the Pseudococcidae or mealybug family. Mealybugs are small, oval, soft-bodied insects that are covered with a white, cottony or mealy wax secretion that is moisture repellent and protects them against desiccation (University of Minnesota 2007). Mealybugs are sucking insects that injure plants by extracting large quantities of sap. This weakens and stunts plants, causing leaf distortion, premature leaf drop, dieback and even plant death (University of Minnesota 2007). They may also cause indirect damage by injecting toxins or plant pathogens into host plants (e.g. grapevine leafroll virus, mealybug pineapple wilt (Rohrbach *et al.* 1988; Charles *et al.* 2006). Mealybugs detract from the appearance of the plant by contaminating bunches with egg sacs, nymphs and adults (Spangler and Agnello 1991). They may also deposit a waste product, 'honeydew' on the leaves and fruit as they feed. Honeydew may act as a substrate for sooty mould to grow (Spangler and Agnello 1991).

Pseudococcus comstocki female and male mealybugs have different life cycles and life stages. Female mealybugs have three life stages: adult, egg and nymph. They develop from an egg through three nymphal (immature instar) stages before undergoing a final moult into the adult form (CABI 2011). Adult females are 3–4 mm long, slow-moving and oval-shaped. Male mealybugs have four life stages: egg, nymph, cocoon and adult. They develop from eggs through first and second feeding instars, and third and fourth non-feeding instars in a cocoon, before moulting into tiny winged adults, which possess a pair of long wax terminal filaments (University of Minnesota 2007).

Mealybugs generally prefer warm, humid, sheltered sites away from adverse environmental conditions and natural enemies. Mealybug nymphs and adult females are very small and are often not detected as they hide in crevices and in protected spaces in grape bunches. This makes them a potentially serious pest problem in grape-growing areas. Many mealybug species pose particularly serious problems to agriculture when introduced into new areas of the world where natural enemies are not present (Miller *et al.* 2002).

Pseudococcus comstocki has various numbers of generations per year, dependent upon geographic location (CABI 2011). In China, *Ps. comstocki* has three generations a year in grapes. Eggs overwinter in cracks in grapevine trunks and branches. Nymphs of each generation appear in mid and late May, mid and late July and late August, respectively. Adults and nymphs feed on young parts of host plants (AQSIQ 2007).

There are records of *Planococcus kraunhiae* in Korea affecting the fruit, leaves and branches of table grapes (NPQS 2007). *Pl. kraunhiae* has four life stages: adult, egg, nymphs and pupa (Narai and Murai 2002). No record of the life cycle on grapes could be found but in general the biology and taxonomy of mealybugs are similar. Due to the recognised biological and economic importance of *Ps. comstocki*, it was used as the basis for this risk assessment.

The risk scenario of concern is that *Ps. comstocki* and *Pl. kraunhiae* eggs, nymphs or adult females may be present in sheltered areas on imported bunches of Korean grapes.

Ps. comstocki was included in the provisional final import policy for table grapes from China (Biosecurity Australia 2010c) which built on in the import policies for pears from China (AQIS 1998b), Fuji apples from Japan (AQIS 1998a), pears from Korea (AQIS 1999), unshu mandarins from Japan (Biosecurity Australia 2009a) and apples from China (Biosecurity Australia 2010b). *Pl. kraunhiae* was included in the import policy for table grapes from China (Biosecurity Australia 2010c) which built on the import policy for unshu mandarins from Japan (Biosecurity Australia 2009a).The assessment of *Ps. comstocki* and *Pl. kraunhiae* presented here builds upon the previous assessment for table grapes from China (Biosecurity Australia 2010c). However, differences in horticultural practices, climatic conditions and the prevalence of the pest between Korea and China make it necessary to re-assess the likelihood that *Ps. comstocki* and *Pl. kraunhiae* will be imported into Australia with table grapes from Korea. The probability of distribution for *Ps. comstocki* and *Pl. kraunhiae* after arrival in Australia with table grapes from Korea would be similar to that for table grapes from China. The probability of establishment and of spread in Australia, and the consequences the pest may cause will be the same for any commodity or country from which the species is imported into Australia, as these probabilities relate specifically to events that occur in Australia and are independent of the importation pathway. Accordingly, there is no need to re-assess these components, and the likelihood estimates for distribution, establishment, spread and consequences as set out for *Ps. comstocki* and *Pl. kraunhiae* in the China table grape IRA (Biosecurity Australia 2010c) will be adopted for this assessment.

4.7.1 Reassessment of probability of importation

The likelihood that *Pseudococcus comstocki* and *Planococcus kraunhiae* will arrive in Australia with the importation of table grapes from Korea is: **HIGH**.

Supporting information for this assessment is provided below:

- *Ps. comstocki* has been reported on table grapes in Korea (APHIS 2002; NPQS 2007).
- *Pl. kraunhiae* has been reported on table grapes in Korea, where it is found on leaves, branches and fruit of grapevines (NPQS 2007).
- *Ps. comstocki* and *Pl. kraunhiae* adult female mealybugs and male and female nymphs are small (1.4–3 mm), oval shaped, often inconspicuous, lack wings and have limited mobility (Spangler and Agnello 1991).
- Once mealybugs find a suitable feeding site, they insert their stylets and suck plant sap from the fruit. This procedure anchors the mealybugs to the fruit, where they generally remain and are dislodged with difficulty. Once feeding begins, they secrete a waxy mealy coating that helps to protect their bodies (Williams 2004).
- In Korea, agricultural chemicals registered with the Korean government are used to control pests, providing they meet the standards for residues of chemicals from Australia.

These chemicals will likely reduce the number of surviving mealybugs on bunches. Rough bark is peeled in March to remove mealybugs and sprayed with lime sulphur in April before new buds emerge (NPQS 2007).

- Procedures carried out in the vineyard and at the packing house are directed towards maintaining a standard quality of fruit. Damaged fruit and those infested by pests are removed from the packing line and destroyed (NPQS 2007). Although all bunches are inspected, the procedures are not specifically directed towards detecting small arthropod pests in protected spaces. Therefore, mealybugs hiding on grape bunches may not be detected during routine visual quality inspection procedures in the vineyards and within packing houses in Korea. Fruit packed for export may therefore contain them.
- *Ps. comstocki* mealybugs overwinter on vine trunks and branches in China (Li 2004; Zhang 2005; AQSIQ 2007) and therefore may survive cold storage and transportation.
- No records could be found regarding overwintering sites for *Pl. kraunhiae* mealybugs on grapevines. It is unknown whether they would be likely to survive cold storage and transportation.
- There is a strong potential for viable mealybugs to be associated with grapes after storage and transportation, as *Pseudococcus* and *Planococcus* spp. live specimens have been intercepted on Chilean table grapes imported into New Zealand (MAF New Zealand 2009).

The association of mealybugs with fruit, the small size, sessile and cryptic nature of most life stages and their previous interceptions on arrival, all support a likelihood estimate for importation of 'high'.

4.7.2 Probability of distribution, of establishment and of spread

As indicated above, the probability of distribution for *Ps. comstocki* and *Pl. kraunhiae* will be the same as that assessed for table grapes from China (Biosecurity Australia 2010c). The probability of establishment and of spread for *Ps. comstocki* and *Pl. kraunhiae* will be the same as those assessed for unshu mandarin from Japan (Biosecurity Australia 2009a), which were adopted for table grapes from China (Biosecurity Australia 2010c). The likelihood estimates from the previous assessment are presented below:

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

4.7.3 Overall probability of entry, establishment and spread

The overall probability of entry, establishment and spread is determined by combining the probability of entry, of establishment and of spread using the matrix of rules shown in Table 2.2.

The likelihood that *Ps. comstocki* and *Pl. kraunhiae* will enter Australia as a result of trade in table grapes from Korea, be distributed in a viable state to a susceptible host, establish in Australia and subsequently spread within Australia: **MODERATE**.

4.7.4 Consequences

The consequences of the establishment of *Ps. comstocki* and *Pl. kraunhiae* in Australia have been estimated previously for unshu mandarin from Japan (Biosecurity Australia 2009a) and adopted for table grapes from China (Biosecurity Australia 2010c). This estimate of impact scores is provided below.

Plant life or health	**D**
Other aspects of the environment	**C**
Eradication, control etc.	**D**
Domestic trade	**D**
International trade	**D**
Environment	**B**

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

4.7.5 Unrestricted risk estimate

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

Unrestricted risk estimate for *Pseudococcus comstocki* and *Planococcus kraunhiae*	
Overall probability of entry, establishment and spread	**Moderate**
Consequences	**Low**
Unrestricted risk	**Low**

As indicated, the unrestricted risk estimate for *Ps. comstocki* and *Pl. kraunhiae* of 'low' exceeds Australia's ALOP. Therefore, specific risk management measures are required for these pests.

4.8 Leafrollers

Eupoecilia ambiguella EP and *Sparganothis pilleriana* EP

The species listed above belong to the Tortricidae or the leafroller family. Their biology is similar enough to justify considering them under a single risk assessment. In this assessment, the term ‘leafrollers’ will be used to refer to both species unless specified otherwise.

The Tortricidae family is of great economic importance, as the larvae of many species cause major damage to horticultural crops, including grapes, pome and stone fruits, citrus fruits, ornamental crops, tea, coffee, cereals and cotton (Meijerman and Ulenberg 2000). Leafroller larvae damage fruit of a wide range of economic species by chewing large holes that usually cause fruit rot (Frolov 2009a; Frolov 2009b). Leafrollers have four life stages: egg, larva, pupa and adult (Frolov 2009a; Frolov 2009b).

Eupoecilia ambiguella is commonly known as the European grapevine or grape berry moth. *E. ambiguella* is a known pest of grapevines in a number of countries across the temperate zones of the Palearctic and Indo-Oriental regions, in parts of Asia, South America and Europe (CABI 2011). They cause considerable losses in both quality and yield of grapevines in Germany (Ibrahim 2004).

The larvae of *Eupoecilia ambiguella* attack a number of host plants, feeding on flower buds and fruits of grapes, buckthorn, Cornelian cherries, honeysuckle, ivy, lilac, maple, viburnum and other arboreous and fruticose plants (INRA 1997; Frolov 2009a). However, larvae seem rare on hosts other than grapes (Roehrich and Boller 1991b). *E. ambiguella* adults are relatively small, about 10 mm long with a wingspan of 14–18 mm and with a greyish-brown head with yellow scales and yellow-brown hairs. The body is yellow and covered with shiny black scales. Mature larvae are 14 mm long (Frolov 2009a).

There are two generations per year although a third generation is reported in Central Asia (Frolov 2009a). First generation adult moths emerge from over-wintering pupae, between spring to early summer, depending on the region and the climate (INRA 1997; Frolov 2009a). First generation moths lay up to 100 eggs (Frolov 2009a) on grape buds in humid sheltered sites on the grapevine, at a rate of one egg per bud (Frolov 2009a). Eggs are laid in the afternoon and evening and are slightly elliptical, light yellow and measure 0.8 mm in length (INRA 1997). First generation larvae emerge from eggs after 6–13 days. Emergence is dependent on temperature (13 days at 15 °C, 6–7 days at 19–25 °C) (Frolov 2009a). Larvae are light grey turning dark red or pinkish with black heads and thoracic plate (Frolov 2009a). They move about on the grapevine for a few minutes before joining 2–3 flower buds together with silk threads to form a web in which they feed (INRA 1997). As the larvae feed on grape buds and flowers, webs can become dense, leading to the complete destruction of the buds (INRA 1997). First generation larvae feed in the evening as well as early in the morning (Ibrahim 2004). Mature larvae pupate on the dried remains of the damaged buds or on leaves, sprouts or in leaf folds (Frolov 2009a). First generation larval development lasts 15–25 days from egg laying to pupation (Frolov 2009a).

Second generation or summer moths emerge after 14 days as pupae, 2–2.5 months after the first generation moths emerge (i.e. July–August) (INRA 1997). They mate between midnight and early morning then lay second generation eggs on immature grapes (INRA 1997). The lifespan of adult moths is unknown. Emerging larvae gnaw round holes and bore into unripe berries, feeding on the grape pulp and immature seeds before the seeds harden (Frolov 2009a). One larva may damage 9–17 berries (Frolov 2009a). Damaged grapes dry up like raisins and may become mouldy in rainy weather (Frolov 2009a). Second generation larvae pupate in greyish or brownish cocoons spun under the old bark of the vine-stock or in stake-posts cracks between late summer and early autumn (INRA 1997).

The development of *E. ambiguella* is strongly influenced by weather conditions and hot dry environments reduce percentage egg hatch (Frolov 2009a). Optimum conditions for insect development are 70–90% relative humidity and air temperatures of 18–25 °C (Frolov 2009a).

Sparganothis pilleriana is commonly known as the leaf rolling tortrix. It causes severe damage in vine growing areas across Europe (Louis *et al.* 2002); some 40% of Spanish grape production areas estimated to be infested by *S. pilleriana* (Cabezuelo 1980). *S. pilleriana* has a wide distribution extending from north-western Europe (Sweden) south to the Middle East (Iran and Iraq) and east through the Causcus and central Asia (including China, the Korean Peninsula and Japan) to the Kamchatka peninsula (Russian Federation) and North and Central America (Frolov 2009b). It is a polyphagous species capable of developing on more than 100 species of cultivated and wild host plants from 30 families (INRA 2005; Frolov 2009b). Larvae are capable of causing economic damage by attacking grape leaves, inflorescences, fresh shoots and berries. Entire grape bunches can be affected, reducing the amount of fruit produced (Picard 1913; Pykhova 1968; Schmidt-Tiedemann *et al.* 2001).

Adult *Sparganothis pilleriana* have a wingspan of 18–25 mm (Frolov 2009b). The eggs are flat, oval, laid in batches of 5 to 175 (55 on the average), covered with foamy excretions of the female (Frolov 2009b). Larvae construct shelters from leaves webbed together with silk (Crouzat 1918). There are two generations per year (Frolov 2009b). For the second generation, first instar larvae usually do not eat after hatching, but overwinter in thin but dense silky cocoons inside bark crevices, on plant residues, or in the top 10 cm of surface soil. Time required for development depends largely on temperature, with eggs developing in 9–20 days, larvae (after overwintering) in 30–50 days, pupae in 10–15 days. The life span of the adult is up to 22 days; average fecundity is 200–250 eggs (with a maximum of 450) (Frolov 2009b).

The risk scenario of concern for these two leafrollers is that larvae may be imported in bunches of table grapes.

E. ambiguella and *S. pilleriana* were included in the provisional final import policy for table grapes from China (Biosecurity Australia 2010c). The assessment of *E. ambiguella* and *S. pilleriana* presented here builds on this previous assessment. However, differences in horticultural practices, climatic conditions and the prevalence of the pest between Korea and China make it necessary to re-assess the likelihood that *E. ambiguella* and *S. pilleriana* will be imported into Australia with table grapes from Korea. The probability of distribution for *E. ambiguella* and *S. pilleriana* after arrival in Australia with table grapes from Korea would be similar to that for table grapes from China. The probability of establishment and of spread in Australia, and the consequences the pest may cause will be the same for any commodity or country from which the species is imported into Australia, as these probabilities relate specifically to events that occur in Australia and are independent of the importation pathway.

Accordingly, there is no need to re-assess these components, and the likelihood estimates for distribution, establishment, spread and consequences as set out for *E. ambiguella* and *S. pilleriana* in the China table grape IRA (Biosecurity Australia 2010c) will be adopted for this assessment.

4.8.1 Reassessment of the probability of importation

The likelihood that *Eupoecilia ambiguella* and *Sparganothis pilleriana* will arrive in Australia with the importation of table grapes from Korea is: **MODERATE**.

Supporting information for this assessment is provided below:

- *E. ambiguella* and *S. pilleriana* have been reported in Korea associated with grapes (APHIS 2002; NPQS 2007; Frolov 2009a). *E. ambiguella* is a known pest of fruit of grapes (Frolov 2009a). *S. pilleriana* as a pest of grape leaves in Korea (NPQS 2007) but has only been reported as a pest of grape berries in Moldova and Ukraine.
- *E. ambiguella* eggs hatch in 8–12 days. Larvae gnaw round holes and bore into unripe berries, feeding on the grape pulp and immature seeds before the seeds harden. One larva may damage 9–12 berries. Damaged grapes rot and dry up like raisins and may become mouldy in rainy weather (Frolov 2009a). Damaged grapes may be conspicuous, as fruit nibbled by larva will rot (INRA 1997) and entry holes may be visible.
- *E. ambiguella* second generation moths emerge in summer between July–August, mate, then lay up to 100 eggs on immature grapes. As grapes are harvested between August and October in Korea (NPQS 2011), eggs and newly emerged larvae of *E. ambiguella* may be associated with grape bunches.
- As some overwintering larvae of *S. pilleriana* seek shelter within residual plant materials (Frolov 2009b), it is feasible that a few larvae may construct shelters within grape bunches prior to them being harvested. Newly emerged, pre-overwintering larvae seeking a sheltering site may also become associated with grape bunches.
- Adult leafrollers are capable of flight. While *E. ambiguella* is mainly active at night through to early morning, some leafrollers may be active during daylight hours (Horak 1999). However, they are unlikely to remain on the fruit during picking, sorting and packing, but fly away.
- Leafroller larvae have been detected several times on imported fresh apricots, avocados, cherries, nectarines, and peaches from New Zealand (DAFF 2003; DAFF 2006 in Biosecurity Australia 2010c), indicating that they can survive cold storage and transport.
- During harvesting, processing, packing and inspection procedures, table grapes infested by these leafrollers may be identified and removed from the export pathway (NPQS 2011). Infested fruit may be visibly detected due to feeding damage and the presence of silk webbing and frass. However, eggs of *E. ambiguella* and early instar/hibernating larvae of *S. pilleriana* may be less easily detected due to their size.
- Similar species of leafroller larvae can survive cold conditions experienced during refrigerated transport, but survival rate decreases to around 6% after two weeks at less than 1 °C (Horak 1999).

The known and potential distribution of these leafrollers in Korea, moderated by the leafrollers' conspicuous fruit damage that may result in their removal from the pathway, supports a likelihood estimate for importation of 'moderate'.

4.8.2 Probability of distribution, of establishment and of spread

As indicated above, the probability of distribution, of establishment and of spread for *E. ambiguella* and *S. pilleriana* will be the same as that assessed for table grapes from China (Biosecurity Australia 2010c). The likelihood estimates from the previous assessment are presented below:

Probability of distribution: **MODERATE**

Probability of establishment: **HIGH**

Probability of spread: **HIGH**

4.8.3 Overall probability of entry, establishment and spread

The overall probability of entry, establishment and spread is determined by combining the probabilities of entry, of establishment and of spread using the matrix of rules for combining qualitative likelihood shown in Table 2.2.

The likelihood that *E. ambiguella* and *S. pilleriana* will enter Australia as a result of trade in table grapes from Korea, be distributed in a viable state to a susceptible host, establish in Australia and subsequently spread within Australia: **LOW**.

4.8.4 Consequences

The consequences of the establishment of *E. ambiguella* and *S. pilleriana* in Australia have been estimated previously for table grapes from China (Biosecurity Australia 2010c). This estimate of impact is provided below.

Plant life or health	**E**
Any other aspects of the environment	**D**
Eradication, control, etc.	**E**
Domestic trade	**D**
International trade	**D**
Environment	**B**

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

4.8.5 Unrestricted risk estimate

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

Unrestricted risk estimate for *Eupoecilia ambiguella* and *Sparganothis pilleriana*	
Overall probability of entry, establishment and spread	**Low**
Consequences	**Moderate**
Unrestricted risk	**Low**

As indicated, the unrestricted risk estimate for *E. ambiguella* and *S. pilleriana* of 'low' exceeds Australia's ALOP. Therefore, specific risk management measures are required for this pest.

4.9 Grape plume moth

Nippoptilia vitis EP

Nippoptilia vitis belongs to the Pterophoridae or plume moth family and is known as the grape plume moth (Li 2004). Most adult species of Pterophoridae have wings divided into narrow lobes that resemble feathers or "plumes" because of the long fringe scales along the lobe margins (Herbison-Evans *et al.* 2009). *Nippoptilia vitis* is present in Korea (NPQS 2007).

Grapes (*Vitis vinifera*) are the only recorded hosts of *Nippoptilia vitis* (Li 2004).

There is little published information on *Nippoptilia vitis* biology and ecology within Korea. Therefore, the information from the table grapes from China (Biosecurity Australia 2010c) document will be used as the basis for this pest risk assessment.

Nippoptilia vitis has four life stages: egg, larva, pupa and adult. *N. vitis* adults are 9–10 mm long with a wingspan of 17–19 mm with a greyish-brown head with yellow scales and yellow-brown hairs. The body is yellow and covered with shiny black scales (BAIRC 2007).

Nippoptilia vitis has two or three overlapping generations a year, depending upon geographical location (BAIRC 2007). For example, in Guizhou, China, there are three generations of *N. vitis* and the mature larvae overwinter in leaf litter and infested branches (BAIRC 2007). Guizhou has a humid, sub-tropical monsoonal climate with warm winters, mild summers and unclear seasonal contrasts and a mean annual temperature of 14–16 °C (China Maps 2007).

N. vitis overwinters as an adult (Li 2004; Zhang 2005; AQSIQ 2007) in the north and as mature larvae in the south (Li 2004; BAIRC 2007). As most table grapes are grown in the northern part of China, the life cycle where *N. vitis* overwinters as an adult is described below.

N. vitis adults overwinter in grasses or cracks in the soil or in dead branches or leaf folds. Adult *N. vitis* can live from 2–12 days after overwintering, with most of them living for 3–4 days (BAIRC 2007). They are active and lay eggs at night (BAIRC 2007). Females lay 39–98 eggs with an average of 71 eggs (BAIRC 2007). Eggs are mainly laid on grape flowers and tendrils during early vine growth stage and then on pedicels and the base of fruit as the fruit develop. Each individual egg is laid and located separately. Eggs are ovoid, 0.8 mm in diameter, light yellow initially but turning brown before larval hatching (Li 2004; Zhang 2005; BAIRC 2007). The full lifespan of this pest is unknown.

N. vitis larvae bore into the fruit from the stem end. They usually attack immature fruit but also cause damage to the grape leaves and stem (APHIS 2004) and feed on the pulp and seeds of grapes, usually causing the young fruit to drop to the ground (AQSIQ 2007). Larvae produce frass while they bore into fruits and the frass forms curved lines on the fruit surface, also accumulating around the entry holes or on grape stalks (Li 2004; Zhang 2005; BAIRC 2007). Each larva can attack more than 10 grapes with the larva moving to a new grape before fruit drop of the previous infested grape. The entry holes are very small and hard to detect but the exit holes on the dropped fruits are bigger and visible. Some of the infested fruit shrink and dry and remain on the fruit bunch but most of the damaged fruit will fall to the ground after 3–5 days causing a decrease in yield. The mature larva is 9–12 mm long and yellow-green with a light yellow head with two black spots on the front and dark brown-yellow stripes on the sides of the body (Li 2004; Zhang 2005).

The peak damage periods caused by *N. vitis* are early-mid July and mid-late August and the most severe damage occurs between late July and mid-August as during this period two generations overlap and damage grapes at the same time (BAIRC 2007). Fruit drops start to occur from early-mid July. The damage is less severe after late-August and no more damage occurs after mid-September. Mature larvae pupate on the grape stems. Pupae are about 9 mm long, green initially but turning yellow-green then brown. In early-mid September, adults emerge and overwinter as adults. After adult emergence the pupal shell usually remains on the fruit bunch and is clearly visible after mid-September. Damaged grapes remaining on the bunch are conspicuous due to their abnormal shape and visible larval exit holes (Li 2004).

The risk scenario of concern for *N. vitis* is that first and second generation eggs, larvae and pupae, may be imported in table grapes.

N. vitis was included in the provisional final import policy for table grapes from China (Biosecurity Australia 2010c). The assessment of *N. vitis* presented here builds on this previous assessment. However, differences in horticultural practices, climatic conditions and the prevalence of the pest between Korea and China make it necessary to re-assess the likelihood that *N. vitis* will be imported into Australia with table grapes from Korea. The probability of distribution for *N. vitis* after arrival in Australia with table grapes from Korea would be similar to that for table grapes from China. The probability of establishment and of spread in Australia, and the consequences the pest may cause will be the same for any commodity or country from which the species is imported into Australia, as these probabilities relate specifically to events that occur in Australia and are independent of the importation pathway. Accordingly, there is no need to re-assess these components, and the likelihood estimates for distribution, establishment, spread and consequences as set out for *N. vitis* in the China table grape IRA (Biosecurity Australia 2010c) will be adopted for this assessment.

4.9.1 Reassessment of probability of importation

The likelihood that *Nippoptilia vitis* will arrive in Australia with the importation of table grapes from Korea is: **MODERATE**.

Supporting information for this assessment is provided below:

- *N. vitis* has been reported on table grapes in Korea (NPQS 2007).
- In the northern provinces of China (e.g. Jilin, latitude 42^{o}), *N. vitis* overwinters as adults in grasses or cracks in the soil or in dead branches or leaf folds (Li 2004) and is unlikely to be present on grape bunches. It is unknown whether the egg, larval and pupal stages are as cold tolerant as the adult stage. In the southern provinces of China (e.g. Guizhou, latitude 27^{o}), *N. vitis* overwinters as mature larvae (Zheng *et al.* 1993). Guizhou has warm winters (Ministry of Culture 2003), suggesting that mature larvae may remain in harvested grape bunches but may not survive cold temperatures during cold storage and during transportation. The grape growing regions of Korea lie at latitude 36^{o} midway

between these two China provinces mentioned, so adults are unlikely to be associated with fruit and larvae are unlikely to tolerate cold storage temperatures.

- In Korea, table grapes for export are usually harvested and exported between August and October each year (NPQS 2007), as is the case in China (AQSIQ 2008). BAIRC (2007) reported that in vineyards in China growing multiple varieties, 1.1% of fruit from early season varieties are damaged by *N. vitis* whilst up to 60% of fruit are damaged in late season varieties. However, in single variety vineyards serious damage can occur any time whether the variety being grown is harvested early or late (BAIRC 2007). It is unknown whether the vineyards discussed were commercial or not.
- In China, larvae of *N. vitis* can feed in grape bunches from early-July to mid-September (BAIRC 2007). The larvae bore into the young grape, mainly from the stem end but some enter around the calyx end. Frass is extruded from the infested grape. After larvae have fed, damaged grapes shrink and eventually fall from the grape bunch in 3–5 days (BAIRC 2007).
- In China, pupae of *N. vitis* may be present in the harvested grape bunches, as larvae tend to pupate on grape stalks within the grape bunch (Li 2004). Pupae are about 9 mm long, initially green but turning yellow-green then brown (Li 2004; Zhang 2005).
- In Korea, agricultural chemicals registered with the Korean government are used to control pests, providing they meet the standards for residues of chemicals from Australia (NPQS 2007). These chemicals will likely reduce the number of surviving larvae and pupae on the fruit.
- Damaged, infested or infected fruit is removed during sorting and packing of table grapes in Korea (NPQS 2011). Table grapes infested by *N. vitis* may be identified and removed from the export pathway during harvesting, processing and packing, due to their abnormal shape, the presence of frass, visible larval exit holes and the presence of the pupae attached to the stalks of grape bunches (Li 2004).
- Pupae may survive the post-harvest processes and the cold temperature during storage and transportation, but no information appears to be available for pupal survival under these conditions.

The association of larvae and pupae with the fruit, moderated by conspicuous fruit damage that may result in removal of infested fruit, supports a likelihood estimate for importation of ‘moderate’.

4.9.2 Probability of distribution, of establishment and of spread

As indicated above, the probability of distribution, of establishment and of spread for *N. vitis* will be the same as those assessed for table grapes from China (Biosecurity Australia 2010c). The likelihood estimates from the previous assessment are presented below:

Probability of distribution: **LOW**

Probability of establishment: **LOW**

Probability of spread: **LOW**

4.9.3 Probability of entry, establishment and spread

The overall probability of entry, establishment and spread is determined by combining the probabilities of entry, establishment and of spread using the matrix of rules for combining qualitative likelihood shown in Table 2.2.

The likelihood that *N. vitis* will enter Australia as a result of trade in table grapes from Korea, be distributed in a viable state to a susceptible host, establish in Australia and subsequently spread within Australia: **VERY LOW**.

4.9.4 Consequences

The consequences of the establishment of *N. vitis* in Australia have been estimated previously for table grapes from China (Biosecurity Australia 2010c). This estimate of impact is provided below.

Plant life or health	**D**
Any other aspects of the environment	**A**
Eradication, control etc.	**B**
Domestic trade	**C**
International trade	**C**
Environment	**B**

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

4.9.5 Unrestricted risk estimate

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

Unrestricted risk estimate for *Nippoptilia vitis*	
Overall probability of entry, establishment and spread	**Very low**
Consequences	**Low**
Unrestricted risk	**Negligible**

As indicated, the unrestricted risk estimate for *N. vitis* of 'negligible' achieves Australia's ALOP. Therefore, specific risk management measures are not required for this pest.

4.10 Apple heliodinid

Stathmopoda auriferella EP

Stathmopoda auriferella belongs to the family Oecophoridae and is commonly known as the apple heliodinid. This genus includes other pest species of fruit, such as *Stathmopoda masinissa*, the persimmon fruit moth.

Stathmopoda auriferella has a wide host range, including commercial fruit producing species such as grapes, citrus, mango, avocado, peach (Yamazaki and Sugiura 2003; CABI 2010), and some weed (*Acacia nilotica*) and ornamental (*Albizia altissima*) species (Robinson *et al.* 2007), facilitating its transfer to new areas.

Stathmopoda auriferella larvae cause webbing of the flower buds and newly set fruit, often causing affected plant parts to drop from the vine; and burrow in to the green berries, which may split, shrivel or fall of when damaged (APHIS 2004).

S. auriferella has four life stages: egg, larva, pupa and adult. Adults are small, with an average wingspan of 12 mm. Eggs are about 0.1 mm. Mature larvae are 10 mm in length. Pupae are 6 mm long. This species appears to have two generations per year on kiwifruit in Korea (Park *et al.* 1994).

While *S. auriferella* has been found on table grapes (NPQS 2007), the biology of this species on table grapes has not been reported in detail. Therefore, available information of its biology on other fruits (e.g. kiwifruit) is used for the risk assessment.

The risk scenario of concern for *S. auriferella* is the potential for larvae to burrow into and eggs to be laid upon grape bunches.

Stathmopoda auriferella was included in the provisional final import policy for table grapes from China (Biosecurity Australia 2010c) which built on the import policies for unshu mandarin from Japan (Biosecurity Australia 2009a), citrus from Egypt (Biosecurity Australia 2002) and Fuji apples from Japan (AQIS 1998a). The assessment of *S. auriferella* presented here builds on the previous assessment adopted for table grapes from China. However, differences in horticultural practices, climatic conditions and the prevalence of the pest between Korea and China make it necessary to re-assess the likelihood that *S. auriferella* will be imported into Australia with table grapes from Korea. The probability of distribution for *S. auriferella* after its arrival in Australia would be similar to that for table grapes from China. The probability of establishment and of spread in Australia, and the consequences the pest may cause will be the same for any commodity or country from which the species is imported into Australia, as these probabilities relate specifically to events that occur in Australia and are independent of the importation pathway. Accordingly, there is no need to re-assess these components, and the likelihood estimates for distribution, establishment, spread and consequences as set out for *S. auriferella* in the China table grape IRA (Biosecurity Australia 2010c) will be adopted for this assessment.

4.10.1 Reassessment of probability of importation

The likelihood that *Stathmopoda auriferella* will arrive in Australia with the importation of table grapes from Korea is: **MODERATE**.

Supporting information for this assessment is provided below:

- *S. auriferella* is reported from Korea on fruit of grapes (APHIS 2002; NPQS 2007).
- *S. auriferella* is associated with fruit of table grapes in South Korea (NPQS 2007) and is identified as a quarantine pest for Korean table grapes to the USA (APHIS 2002; APHIS 2004). This pest usually infests kiwifruit, stone fruit and apples (Biosecurity Australia 2002).
- *S. auriferella* appears to have two generations per year on kiwifruit (Park *et al.* 1994). In Korea, adults occur from late May to mid-July and again from mid-August to early September, with peaks in early to mid-June and late August, respectively. Larvae are commonly found throughout July, whereas pupae start to appear in mid-July, and are commonly found in August (Park *et al.* 1994). No information is available on where they pupate.
- *S. auriferella* larvae cause webbing of the flower buds and newly set fruit, often causing affected plant parts to drop from the grapevine (APHIS 2004).
- Larvae burrow into the green berries, which may split, shrivel, or fall off when damaged (APHIS 2004).
- On kiwifruit, 70% of the damage by *S. auriferella* occurred on the fruit apex, and 11% on the fruit stalk which is on the fruit surface (Park *et al.* 1994). This may also be true for damage on table grapes.
- Packing house procedure would be able to eliminate the split and shrivelled fruit (NPQS 2011) but may not remove the internally damaged fruit with larvae.
- Eggs are very small (0.10–0.13 mm) (Park *et al.* 1994), and they are unlikely to be detected on infested fruit. Data obtained from the related species *S. masinissa* suggests that egg numbers laid per female are relatively small from 10–25 per female at different temperatures (Park *et al.* 2001).
- Adult moths are unlikely to stay on the fruit during picking, sorting and packing, in contrast to the egg and larval stages.

The potential presence of *S. auriferella* eggs on fruit and the association of larvae with fruit of table grapes, moderated by its likely detection in normal packing and inspection processes, support a likelihood estimate for importation of 'moderate'.

4.10.2 Probability of distribution, of establishment and of spread

As indicated, the probability of distribution for *S. auriferella* will be the same as that assessed for table grapes from China (Biosecurity Australia 2010c). The probabilities of establishment and of spread for *S. auriferella* will be the same as that assessed for unshu mandarin from Japan (Biosecurity Australia 2009a), which were adopted for table grapes from China

(Biosecurity Australia 2010c). The likelihood estimates from the previous assessment are presented below:

Probability of distribution: **HIGH**

Probability of establishment: **HIGH**

Probability of spread: **HIGH**

4.10.3 Overall probability of entry, establishment and of spread

The overall probability of entry, establishment and spread is determined by combining the probabilities of entry, of establishment and of spread using the matrix of rules shown in Table 2.2.

The likelihood that *S. auriferella* will enter Australia as a result of trade in table grapes from Korea, be distributed in a viable state to a susceptible host, establish in Australia and subsequently spread within Australia is: **MODERATE**.

4.10.4 Consequences

The consequences of the establishment of *S. auriferella* in Australia have been estimated previously for unshu mandarin from Japan (Biosecurity Australia 2009a) and adopted for table grapes from China (Biosecurity Australia 2010c). This estimate of impact score is provided below.

Plant life or health	**C**
Other aspects of the environment	**B**
Eradication, control etc.	**C**
Domestic trade	**D**
International trade	**D**
Environment	**B**

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

4.10.5 Unrestricted risk estimate

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

Unrestricted risk estimate for *Stathmopoda auriferella*	
Overall probability of entry, establishment and spread	**Moderate**
Consequences	**Low**
Unrestricted risk	**Low**

As indicated, the unrestricted risk estimate for *S. auriferella* of 'low' exceeds Australia's ALOP. Therefore, specific risk management measures are required for this pest.

4.11 Thrips

Frankliniella occidentalis EP, NT

Frankliniella occidentalis is not present in the Northern Territory and is a pest of regional quarantine concern for this territory.

Frankliniella occidentalis belongs to the Thripidae family and is known as the western flower thrips (WFT). *F. occidentalis* is considered the most harmful thrips in viticulture (Roditakis and Roditakis 2007). *F. occidentalis* is also a vector of several tospoviruses, including the tomato spotted wilt virus (TSWV) and the Impatiens necrotic spot virus (INSV) (Wijkamp and Peters 1993; Morse and Hoddle 2006). Tospoviruses are persistently transmitted by *F. occidentalis*, i.e. once the thrips has acquired the virus, it remains infective for life. Tospoviruses are not passed on to the next generation (Wijkamp *et al.* 1996). *F. occidentalis* nymphs are also known vectors of tobacco streak ilarvirus (TSV) (Roques 2006).

Adult thrips are very small (less than 2 mm long), narrow-bodied insects with four narrow wings. They are commonly found feeding on leaves, stems, flowers and fruit of grapevines (Childers 1997; Roques 2006). Adult thrips reproduce sexually and parthenogenetically (Roques 2006). *Frankliniella occidentalis* only produces males through parthenogenesis (Roques 2006).

Frankliniella occidentalis has four life stages: egg, nymph, pupa and adult (Roques 2006). Adult females lay between 20–40 eggs. Eggs are laid in leaves, flower tissue and fruits (Roques 2006). Eggs hatch into nymphs, which are found on leaves, buds, flowers and fruits. Thrips are present throughout the year and their life cycle and development is dependent on optimum temperature and relative humidity conditions (Mau and Martin-Kessing 1993). The overall life cycle for *F. occidentalis* lasts from 44 days at 15 °C to 15 days at 30 °C (Roques 2006). Roditakis and Roditakis (2007) report that in the laboratory, *F. occidentalis* took 10 days to develop from nymph to adult on ripe grape berries at 25 °C.

F. occidentalis is an important pest species due to the significant cosmetic damage it causes feeding upon developing flowers, leaves and fruit of grapes and a number of commercial and wild host plants (PlantPro 2005; Roditakis and Roditakis 2007). In general, thrips are a minor problem on wine and raisin grapes; however table grapes are quite susceptible to thrips damage (PlantPro 2005). Thrips mouthparts are used to rupture and suck sap from plant cells, causing silvering effect on leaves or corky layer on fruit that can reduce crop yield, productivity and marketability (Mau and Martin-Kessing 1993). They can also transmit pathogens while feeding (Roques 2006; Roditakis and Roditakis 2007).

The risk scenario of concern for *F. occidentalis* is the presence of eggs, nymphs and adults in table grape bunches.

F. occidentalis is absent from the Northern Territory (DPINT 2008), and there are restrictions in place regarding the movement of host materials into Australia (DPINT 2008).

F. occidentalis was included in the provisional final import policy for table grapes from China (Biosecurity Australia 2010c) which built on import policies for unshu mandarin from

Japan (Biosecurity Australia 2009a), capsicum from Korea (Biosecurity Australia 2009b), stone fruit from New Zealand (Biosecurity Australia 2006), table grapes from Chile (Biosecurity Australia 2005a), oranges from Italy (Biosecurity Australia 2005b) and tomatoes from the Netherlands (DAFF 2003b). The assessment of *F. occidentalis* presented here builds on the previous assessment adopted for table grapes from China. However, differences in horticultural practices, climatic conditions and prevalence of the pests between the previous export China and Korea make it necessary to re-assess the likelihood that thrips will be imported into the Northern Territory with table grapes from Korea. The probability of distribution for *F. occidentalis* after arrival in the Northern Territory with table grapes from Korea would be similar to that for table grapes from China. The probability of establishment and of spread in the Northern Territory, and the consequences the pest may cause will be the same for any commodity or country from which the species is imported into the Northern Territory, as these probabilities relate specifically to events that occur in the Northern Territory and are independent of the importation pathway. Accordingly, there is no need to re-assess these components, and the likelihood estimates for distribution, establishment, spread and consequences as set out for *F. occidentalis* in the China table grape IRA (Biosecurity Australia 2010c) will be adopted for this assessment.

4.11.1 Reassessment of probability of importation

The likelihood that *Frankliniella occidentalis* will arrive in the Northern Territory with the importation of table grapes from Korea is: **HIGH**.

Supporting information for this assessment is provided below:

- *F. occidentalis* has been recorded in Korea associated with table grapes (APHIS 2002; NPQS 2007).
- *F. occidentalis* can scar berries with its feeding which may appear as silvering or corky scabs on the fruit, which renders certain varieties unmarketable (Lopes *et al.* 2002). Table grapes with such symptoms may be detected during sorting and packing processes but at low levels of infestation may be difficult to detect.
- *F. occidentalis* nymph and adult thrips are very small (less than 2 mm) (Roques 2006) and inconspicuous. Thrips prefer cryptic habitats i.e. small crevices and tightly closed plant parts (Morse and Hoddle 2006). Adults and immature forms may hide within bunches (i.e. in crevices on grape stalks and stems) (Roditakis and Roditakis 2007).
- Female *F. occidentalis* thrips can produce 20–40 eggs (Roques 2006). The eggs are very small and may be laid on, or inserted under the skin of fruit or leaves (Mau and Martin-Kessing 1993).
- Adults, eggs and nymphs may escape detection, particularly when present in low numbers.
- *F. occidentalis* is opportunistic, well adapted to surviving difficult conditions, and first instar nymphs are capable of tolerating temperatures below freezing over extended periods (McDonald *et al.* 1997).

- Agricultural chemicals are used in early and late June and August to control for thrips (NPQS 2011). These practices may reduce the number of adults and eggs present on the fruit.
- Thrips have been recorded on produce entering the Netherlands from 30 different countries over a thirteen-year period (1980-1993), and approximately 1000 thrips specimens are intercepted by USA border inspectors annually (Morse and Hoddle 2006). Therefore, thrips appear to be capable of surviving packing house procedures, cold storage and transport conditions.

The small size and cryptic nature of thrips, their cold tolerance and the association of several life stages with table grape bunches, all support a likelihood estimate for importation of 'high'.

4.11.2 Probability of distribution, of establishment and of spread

As indicated above, the probability of distribution for *F. occidentalis* will be the same as that assessed for table grapes from China (Biosecurity Australia 2010c). The probability of establishment and of spread for *F. occidentalis* will be the same as that assessed for unshu mandarin from Japan (Biosecurity Australia 2009a), which was adopted for table grapes from China (Biosecurity Australia 2010c). The likelihood estimates from the previous assessment are presented below:

Probability of distribution: **MODERATE**

Probability of establishment: **HIGH**

Probability of spread: **HIGH**

4.11.3 Overall probability of entry, establishment and spread

The overall probability of entry, establishment and spread is determined by combining the probabilities of entry, establishment and of spread using the matrix of rules shown in Table 2.2.

The likelihood that *F. occidentalis* will enter the Northern Territory as a result of trade in table grapes from Korea, be distributed in a viable state to a susceptible host, establish in the Northern Territory and subsequently spread within the Northern Territory is: **MODERATE**.

4.11.4 Consequences

The consequences of the establishment of *F. occidentalis* in the Northern Territory have been estimated previously for unshu mandarin from Japan (Biosecurity Australia 2009a) and adopted for table grapes from China (Biosecurity Australia 2010c). This estimate of impact scores is provided below.

Plant life or health	**D**
Other aspects of the environment	**B**
Eradication, control etc.	**D**
Domestic trade	**D**

International trade **D**
Environment **B**

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

4.11.5 Unrestricted risk estimate

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

Unrestricted risk estimate for *Frankliniella occidentalis*	
Overall probability of entry, establishment and spread	**Moderate**
Consequences	**Low**
Unrestricted risk	**Low**

As indicated, the unrestricted risk estimate for *F. occidentalis* of 'low' exceeds Australia's ALOP. Therefore, specific risk management measures are required for this pest.

4.12 Grape cluster black rot

Physalospora baccae EP

Physalospora baccae, commonly known as grape cluster black rot, is a fungal disease of grapes found in Korea (Korean Society of Plant Protection 1986). There has been some debate about the nomenclature of the organism. The name *Physalospora baccae* Cavara is a *nomen dubium* of unknown application. It is not known if the grape pathogen to which this name is applied in Japan and Korea is the same as the original European pathogen. The grape pathogen should be designated as '*Physalospora baccae* sensu Asian authors' (Harman 2009). In China, *Physalospora baccae* Cavara has been considered to be a synonym of *Guignardia baccae* (Cav.) Jacz. (Qi *et al.* 2007), which is not a valid name. The pycnidial stage of the fungus is identical with *Macrophoma reniformis* (Viala & Ravaz) Cavara (Nishikado 1921). Little information is formally published on *P. baccae,* grape cluster black rot or axle blotch disease.

Physalospora baccae infects grape berries, leaves, pedicels and peduncles. Wind, rain and insects spread the conidia and ascospores in May and June with the peak disease period being from July to September when the weather is warm and humid. Fruit are likely to develop disease symptoms from when they start to ripen up until harvest (Zhang 2005).

The risk scenario of concern for *P. baccae* is that the fungus will be present on or in the harvested grape bunches, infected bunches will be imported and the pathogen will establish in Australia.

Physalospora baccae was included in the provisional final import policy for table grapes from China (Biosecurity Australia 2010c). The assessment of *P. baccae* presented here builds on this previous assessment. However, differences in horticultural practices, climatic conditions and the prevalence of the pest between Korea and China make it necessary to re-assess the likelihood that *P. baccae* will be imported into Australia with table grapes from Korea. The probability of distribution for *P. baccae* after arrival in Australia with table grapes from Korea would be similar to that for table grapes from China. The probability of establishment and of spread in Australia, and the consequences the pest may cause will be the same for any commodity or country from which the species is imported into Australia, as these probabilities relate specifically to events that occur in Australia and are independent of the importation pathway. Accordingly, there is no need to re-assess these components, and the likelihood estimates for distribution, establishment, spread and consequences as set out for *P. baccae* in the China table grape IRA (Biosecurity Australia 2010c) will be adopted for this assessment.

4.12.1 Reassessment of probability of importation

The likelihood that *Physalospora baccae* will arrive in Australia with the importation of table grapes from Korea is: **HIGH**.

Supporting information for this assessment is provided below:

- *Physalospora baccae* is present in Korea, resulting in grape stalk necrosis and Caucasian black rot (Shin *et al.* 1984; Tanaka & Takanashi 1976).
- *Physalospora baccae* overwinters as pycnidia and perithecia on infected peduncles, pedicels and fruit as well as on fallen leaves and trash within the vineyards. It can also overwinter as mycelia in the infected tissues and produce perithecia the next spring (Zhang 2005; BAIKE 2009; NYZSW 2009). Fruiting structures, spores and mycelia of the pathogen are likely to survive cold storage and transport
- During periods of wet weather in spring when temperatures rise, overwintered pycnidia and perithecia of *P. baccae* release conidia and ascospores (BAIKE 2009; NYZSW 2009). Wind, rain and insects spread the conidia and ascospores to infect grape clusters in May and June. Symptoms start to appear in July, with the peak disease period from July to September when the weather is warm and humid. Fruit are likely to develop disease from when they start to ripen until harvest (Zhang 2005).
- The reported timing suggests a period of symptomless infection of two months or more, i.e. from May until July. No other information was found concerning symptomless infection, but it was considered that it might occur after July. Fungicide applications may delay and modify or mask symptom expression.
- Infected pedicels develop light brown spots around the junction with the fruit (Zhang 2005; NYZSW 2009). Pedicels dry and shrink when the brown spots encircle them and infections then spread to the fruit and peduncles.
- After infection, peduncles develop brown spots that slowly turn black and enlarge and then the peduncles dry out (Zhang 2005; NYZSW 2009).
- Infected berries develop irregular brown spots that spread to cover the whole fruit (Zhang 2005; NYZSW 2009). Infected berries then turn purple or black and dry out. Small black spots (pycnidia) develop on their surface. The infected mummified berries remain in the grape cluster on the vine and do not drop off.
- The reported information suggests pycnidia may release conidia during summer and autumn, allowing spores to contaminate the surfaces of grape clusters.
- *P. baccae* has been reported from Korea in 1961 and 1993. In the 1993 survey it was found in fruits at the rate of 0–1% in orchards with poor risk management (NPQS 2010).
- During commercial harvesting procedures, pickers would likely select and harvest bunches of normal fruit, discarding inferior, diseased, or damaged bunches.
- In the packing house damaged and infected fruits are removed from the packing line and destroyed (NPQS 2011). This will not remove fruit with symptomless infection.

The occurrence of this pathogen in Korea, the potential for infected grape clusters to be symptomless and the likelihood that the pathogen will survive storage and transport, all support a likelihood estimate for importation of ‘high’.

4.12.2 Probability of distribution, of establishment and of spread

As indicated, the probability of distribution, of establishment and of spread for *P. baccae* will be the same as that assessed for table grapes from China (Biosecurity Australia 2010c). The likelihood estimates from the previous assessment are presented below:

Probability of distribution: **MODERATE**

Probability of establishment: **HIGH**

Probability of spread: **HIGH**

4.12.3 Overall probability of entry, establishment and spread

The overall probability of entry, establishment and spread is determined by combining the probabilities of entry, of establishment and of spread using the matrix of rules for combining qualitative likelihood shown in Table 2.2.

The likelihood that *P. baccae* will enter Australia as a result of trade in table grapes from Korea, be distributed in a viable state to a susceptible host, establish in Australia and subsequently spread within Australia: **MODERATE**.

4.12.4 Consequences

The consequences of the establishment of *P. baccae* in Australia have been estimated previously for table grapes from China (Biosecurity Australia 2010c). This estimate of impact is provided below.

Plant life or health	**E**
Any other aspects of the environment	**A**
Eradication, control, etc.	**E**
Domestic trade	**E**
International trade	**D**
Environment	**B**

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

4.12.5 Unrestricted risk estimate

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

Unrestricted risk estimate for *Physalospora baccae*	
Overall probability of entry, establishment and spread	**Moderate**
Consequences	**Moderate**
Unrestricted risk	**Moderate**

As indicated, the unrestricted risk estimate for *P. baccae* of 'moderate' exceeds Australia's ALOP. Therefore, specific risk management measures are required for this pest.

4.13 Grapevine leaf rust

Phakopsora euvitis EP

The pathogen responsible for grapevine leaf rust in Asia is *Phakopsora euvitis*, not *Phakopsora ampelopsidis* or *Phakopsora vitis* which are restricted to other host plants (Ono 2000). *Phakopsora euvitis* is the name proposed by Ono (2000) for the species that causes leaf rust of cultivated grapes in Asia.

Before 2000, records in the literature identified the grape leaf fungus present in Asia as *Phakopsora ampelopsidis*. Work by Ono (2000), in Japan, based on morphological characteristics, identified three populations differing in life cycle and host specificity as three separate species. The species occurring on grapes was described as *Phakopsora euvitis*. Further work by Chatasiri and Ono (2008) using molecular phylogenetic analyses on material collected from Australia, East Timor and Japan confirm the distinctiveness of the three species recognised by Ono (2000). The samples of *P. euvitis* collected from East Timor and Australia (where an incursion has been eradicated) are genetically distinct from the Japanese collections and may represent a separate species (Chatasiri and Ono 2008). Korea's NPQS reported *P. ampelopsidis* as a potential pest of grapevine in Korea (NPQS 2007). It is not known if the rust present on grapes in Korea has been subjected to comparative molecular analyses with samples from Japan. Therefore, for the purpose of the pest risk assessment presented here it is assumed that all records of grape leaf rust in east Asia are of *P. euvitis*, including the earlier literature on *P. ampelopsidis* and *P. vitis* when reported on grape (*Vitis* spp.) hosts.

The *Vitis* hosts that *Phakopsora euvitis* has been recorded on in Korea include *Vitis vinifera*, *V. coignetiae* and *V. labrusca* (Farr and Rossman 2010). In Korea, *P. ampelopsidis* has been recorded on *V. vinifera* and *V. flexuosa* (Farr and Rossman 2010). Based on the work by Ono (2000), the records of *P. ampelopsidis* on *Vitis* species are assumed to be *P. euvitis.*

The alternate hosts of *P. euvitis* are *Meliosma* spp. and *Cissus* spp. (Farr and Rossman 2010). In Korea the aecial state (*Aecidium meliosmae-myrianthi*) has been recorded from *Meliosma myriantha* and *M. oldhamii* (Farr and Rossman 2010). *Meliosma* spp. are not distributed in Australia (Australia's Virtual Herbarium 2010). The anamorph state, *Physopella vitis* has been recorded from *Cissus simplex* in the Philippines and *Cissus sp.* and *Muscadinia munsoniana* in Madagascar (Farr and Rossman 2010). A number of species within the *Cissus* genus are distributed throughout the coastal and rainforest regions of Australia but there are no records of *M. munsoniana* in Australia (Australia's Virtual Herbarium 2010).

P. euvitis was detected in Darwin in 2001 (Weinert *et al*. 2003) and declared eradicated in 2006 (Liberato et al. 2007). During that outbreak, laboratory and field trials demonstrated infection by *P. euvitis* on *Ampelocissus acetose* and *A. frutescens.* However, the distributions of *A. acetose* and *A. frutescens* are restricted to parts of northern Australia where little or no commercial production of grapes occurs (Daly *et al.* 2005).

Spores of *P. euvitis* can easily be transported by wind. Mycelium may persist in grapevine shoots during winter and then urediniospores formed on these shoots become the primary infection source (EPPO 2002; Weinert *et al.* 2003). Uredospores require water for germination and germinate at temperatures of 8–32 °C, with an optimum of 24 °C. Teliospores germinate between 10 °C and 30 °C, with an optimum range between 15 °C and 25 °C. High humidity at night is necessary for development of epidemics (Leu 1988).

P. euvitis usually infects leaves (Ono 2000). *P. euvitis* also infects fruits, stems (APHIS 2002) and occasionally shoots, petioles and rachises (Leu 1988). The symptoms are yellowish to pale brownish spots or irregular shaped lesions, with masses of yellowish orange urediniospores on the abaxial surface of the lesion. The telia are crust-like and orange-brown, becoming dark brown or almost blackish. Heavy infection is common and can cause early senescence and leaf drop (CABI 2010).

The risk scenario for *P. euvitis* is that the fungus and/or urediniospores will be present on grape bunches imported into Australia.

P. euvitis was included in the provisional final import policy for table grapes from China (Biosecurity Australia 2010c). The assessment of *P. euvitis* presented here builds on this previous assessment. However, differences in horticultural practices, climatic conditions and the prevalence of the pest between Korea and China make it necessary to re-assess the likelihood that *P. euvitis* will be imported into Australia with table grapes from Korea. The probability of distribution for *P. euvitis* after arrival in Australia with table grapes from Korea would be similar to that for table grapes from China. The probability of establishment and of spread in Australia, and the consequences the pest may cause will be the same for any commodity or country from which the species is imported into Australia, as these probabilities relate specifically to events that occur in Australia and are independent of the importation pathway. Accordingly, there is no need to re-assess these components, and the likelihood estimates for distribution, establishment, spread and consequences as set out for *P. euvitis* in the China table grape IRA (Biosecurity Australia 2010c) will be adopted for this assessment.

4.13.1 Reassessment of probability of importation

The likelihood that *Phakopsora euvitis* will arrive in Australia with the importation of table grapes from Korea is: **MODERATE**.

Supporting information for this assessment is provided below:

- *P. euvitis* is present in Korea (CABI 2010; Farr and Rossman 2010) where it has been recorded from *Vitis vinifera, V. coignetiae, V. labrusca*, and *V. flexuosa* (Farr and Rossman 2010).
- The table grape varieties that Korea has proposed for export are Campbell Early, Kyoho, Sharidan, Muscat Bailey A, Black Olympia and Delaware. These are varieties of *V. vinifera, V. labrusca* and *V. labruscana* and interspecific hybrids of *V. vinifera* and *V. labrusca,* so are therefore considered susceptible hosts.
- The pathogen infects rachises, leaves, shoots, stems, petioles and fruit (Leu 1988; APHIS 2002) and may be present in harvested bunches.
- The ability to overwinter in temperate regions (Leu 1988) may indicate this fungus could survive being transported at low temperatures.

- NPQS (2010b) reports that *P. euvitis* was last recorded in Korea in 1993 in an orchard with poor management in Naju.

The presence of this fungus in Korea, the possibility that this fungus will survive storage and transport and that urediniospores may be a contaminant, moderated by the fact that the fungus only occasionally infects rachises and fruit, support a likelihood estimate for importation of 'moderate'.

4.13.2 Probability of distribution, of establishment and of spread

As indicated, the probability of distribution, of establishment and of spread for *P. euvitis* will be the same as that assessed for table grapes from China (Biosecurity Australia 2010c). The likelihood estimates from the previous assessment are presented below:

Probability of distribution: **MODERATE**

Probability of establishment: **MODERATE**

Probability of spread: **HIGH**

4.13.3 Overall probability of entry, establishment and spread

The overall probability of entry, establishment and spread is determined by combining the probabilities of entry, of establishment and of spread using the matrix of rules for combining qualitative likelihood shown in Table 2.2.

The likelihood that *P. euvitis* will enter Australia as a result of trade in table grapes from Korea, be distributed in a viable state to a susceptible host, establish in Australia and subsequently spread within Australia: **LOW**.

4.13.4 Consequences

The consequences of the establishment of *P. euvitis* in Australia have been estimated previously for table grapes from China (Biosecurity Australia 2010c). This estimate of impact is provided below.

Plant life or health	**E**
Any other aspects of the environment	**A**
Eradication, control, etc.	**D**
Domestic trade	**D**
International trade	**D**
Environment	**B**

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

4.13.5 Unrestricted risk estimate

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

Unrestricted risk estimate for *Phakopsora euvitis*	
Overall probability of entry, establishment and spread	**Low**
Consequences	**Moderate**
Unrestricted risk	**Low**

As indicated, the unrestricted risk estimate for *P. euvitis* of ‘low’ exceeds Australia’s ALOP. Therefore, specific risk management measures are required for this pest.

4.14 Phomopsis cane and leaf spot

Phomopsis viticola [EP, WA]

Phomopsis viticola is not present in the state of Western Australia and is a pest of regional quarantine concern for that state.

Phomopsis cane and leaf spot, or dead arm, is caused by the fungus *Phomopsis viticola.* It is an important disease in several viticultural regions of the world (Nair *et al.* 1994), especially where rain following bud break keeps grapevines wet for several days (Hewitt and Pearson 1994). *Phomopsis viticola* is established in New South Wales, Queensland, South Australia, Tasmania and Victoria (Mostert *et al.* 2001; APPD 2010) but is not known to be present in Western Australia. The fungus overwinters in infected canes and rachises on the vine (Ellis and Erincik 2005). Pycnidium germination and conidia production require at least 10 hours of wet with relatively low temperatures (Rawnsley and Wicks 2002). A further 8–10 hours of very high relative humidity or surface wetness is required for infection to occur (Emmett *et al.* 1992).

Phomopsis viticola infects leaves, young shoots, rachises, petioles and fruit (Hewitt and Pearson 1994). Grapevines are susceptible throughout the growing season. After infection of juvenile fruit, symptoms do not appear until the fruit matures. On the fruit, the early symptoms are browning and shrivelling (Ellis and Erincik 2005). On rachises, the symptoms are chlorotic spots with dark centres (Hewitt and Pearson 1994). These spots enlarge to form dark brown streaks and blotches that turn black (Hewitt and Pearson 1994). Rachises may become brittle from numerous infections and break, resulting in loss of fruit (Hewitt and Pearson 1994). Pycnidia are subepidermal. Yellowish spore masses are exuded and then the berries shrivel and mummify (Gubler and Leavitt 1992). *P. viticola* conidia are splash dispersed and usually spread only short distances, i.e. within a vine or adjacent vines. Long distance spread is usually by movement of infected or contaminated propagation material (Hewitt and Pearson 1994).

The risk scenario of concern for *Phomopsis viticola* is the presence of the fungus on mature bunches of grapes.

P. viticola was included in the provisional final import policy for table grapes from China (Biosecurity Australia 2010c) which built on the import policy for table grapes from Chile (Biosecurity Australia 2005a). The assessment of *P. viticola* presented here builds on the China pest risk assessment. However, differences in horticultural practices, climatic conditions and the prevalence of the pest across Korea and China make it necessary to re-assess the likelihood that *P. viticola* will be imported into Western Australia with table grapes from Korea. The probability of distribution for *P. viticola* after arrival in Australia with table grapes from Korea would be similar to that for table grapes from China. The probability of establishment and of spread in Western Australia, and the consequences the pest may cause will be the same for any commodity or country from which the species is imported into Western Australia, as these probabilities relate specifically to events that occur in Western Australia and are independent of the importation pathway. Accordingly, there is no need to re-assess these components, and the likelihood estimates for distribution, establishment, spread and consequences as set out for *P. viticola* in the China table grape IRA (Biosecurity Australia 2010c) will be adopted for this assessment.

4.14.1 Reassessment of probability of importation

The likelihood that *Phomopsis viticola* will arrive in Western Australia with the importation of table grapes from Korea is: **HIGH**.

Supporting information for this assessment is provided below:

- *P. viticola* has been reported in Korea on grapes (APHIS 2002; Farr and Rossman 2010).
- Berry infection, either direct or via infected rachis tissues (Erincik *et al.* 2002) can occur throughout the growing season, but most fruit infections occur early in the season (Erincik *et al.* 2001). Once present inside green tissues of the berry, the fungus becomes latent (Erincik *et al.* 2002) and infected berries remain without symptoms until the fruit is mature (Ellis and Erincik 2005).
- *P. viticola* forms splash-dispersed conidia that infect leaves, young shoots, rachises, petioles and fruit (Hewitt and Pearson 1994). The teleomorph is not known.Infection is favoured by 20–30 hour wet periods during flowering (Rawnsley and Wicks 2002).
- Visual symptoms first appear close to harvest when infected berries turn brown and shrivel (Ellis and Erincik 2005), and black pycnidia are produced through the skin (Gubler and Leavitt 1992). These pycnidia exude yellowish spore masses before the berries finally shrivel and become mummified (Gubler and Leavitt 1992). Infected berries may abscise from the pedicel, leaving a dry scar (Hewitt and Pearson 1994).
- Recently infected rachises and fruit may not display symptoms and may be packaged for export.
- *P. viticola* has been intercepted using visual inspection on table grapes exported from South Africa to Lithuania (Raudoniene and Lugauskas 2005) but has not been intercepted using visual inspection on table grapes exported from Chile to New Zealand (MAF New Zealand 2005), or to the USA, or on table grapes exported to Australia from California where the pathogen also occurs (Biosecurity Australia 2005a).

Infected rachises and berries remaining without symptoms until they mature, the ability and susceptibility of the berries for infection throughout the growing season and interception on grapes exported from South Africa all support a likelihood estimate for importation of ‘high’.

4.14.2 Probability of distribution, of establishment and of spread

As indicated above, the probability of distribution for *P. viticola* will be the same as that assessed for table grapes from China (Biosecurity Australia 2010c). The probability of establishment and of spread for *P. viticola* will be the same as those assessed for table grapes from Chile (Biosecurity Australia 2005a) and adopted for table grapes from China (Biosecurity Australia 2010c). The likelihood estimates from the previous assessment are presented below:

Probability of distribution: **LOW**

Probability of establishment: **HIGH**

Probability of spread: **MODERATE**

4.14.3 Overall probability of entry, establishment and spread

The overall probability of entry, establishment and spread is determined by combining the probabilities of entry, of establishment and of spread using the matrix of rules shown in Table 2.2.

The likelihood that *P. viticola* will enter Western Australia as a result of trade in table grapes from Korea, be distributed in a viable state to a susceptible host, establish in Western Australia and subsequently spread within Western Australia is: **LOW**.

4.14.4 Consequences

The consequences of the establishment of *P. viticola* in Western Australia have been estimated previously for table grapes from Chile (Biosecurity Australia 2005a) and adopted for table grapes from China (Biosecurity Australia 2010c). This estimate of impact scores is provided below expressed in the current scoring system.

Plant life or health	**C**
Other aspects of the environment	**A**
Eradication, control etc.	**D**
Domestic trade	**B**
International trade	**B**
Environment	**B**

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

4.14.5 Unrestricted risk estimate

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

Unrestricted risk estimate for *Phomopsis viticola*	
Overall probability of entry, establishment and spread	**Low**
Consequences	**Low**
Unrestricted risk	**Very low**

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

4.15 Tomato ringspot virus

ToRSV EP

Tomato ringspot virus (ToRSV) is a member of the *Nepovirus* genus in family Comoviridae. In parts of the USA, the virus causes significant disease in a wide range of cultivated plants including grapes, apple, almond, apricot, nectarine, peach, plum, prune and sweet cherry, blackberry and raspberry (Brunt *et al.* 1996; CABI and EPPO 1996). The virus has been reported in Korea (ICTVdB 2006).

The virus was reported more than two decades ago in *Pentas lanceloata* (Egyptian starflower) in South Australia (Chu *et al.* 1983). The infected plants were removed and it has not been detected since that time in SA (Cartwright 2009), suggesting it has not spread and is probably now absent from Australia.

Tomato ringspot virus is probably transmitted and disseminated by several mechanisms. It is transmitted through soil between host plants by root-feeding ectoparasitic dagger nematodes of the *Xiphinema americanum* group. It is transmitted by grafting and might be introduced to orchards and vineyards in infected scionwood (Brunt *et al.* 1996). It may be maintained in soil contaminated with viruliferous nematodes or remnant roots (Pinkerton *et al.* 2008). Tomato ringspot virus is also transmitted through seed of several plant species including the common dandelion (*Taraxacum officinale*) and grapevine (*Vitis vinifera*) (Uyemoto 1975). Common dandelion is a reservoir host in the USA (Powell *et al.* 1984).

The risk scenario of concern is the import of fruit infected with ToRSV, germination of some seed, perhaps disseminated in fruit waste, seed-transmission of the virus, survival of infected seedlings, and the transmission of ToRSV to other host plants in Australia.

ToRSV was included in the provisional final import policy for table grapes from China (Biosecurity Australia 2010c). The assessment of ToRSV presented here builds on this previous assessment. However, differences in horticultural practices, climatic conditions and the prevalence of the pest between Korea and China make it necessary to re-assess the likelihood that ToRSV will be imported into Australia with table grapes from Korea. The probability of distribution for ToRSV after arrival in Australia with table grapes from Korea would be similar to that for table grapes from China. The probability of establishment and of spread in Australia, and the consequences the pest may cause will be the same for any commodity or country from which the species is imported into Australia, as these probabilities relate specifically to events that occur in Australia and are independent of the importation pathway. Accordingly, there is no need to re-assess these components, and the likelihood estimates for distribution, establishment, spread and consequences as set out for ToRSV in the China table grape IRA (Biosecurity Australia 2010c) will be adopted for this assessment.

4.15.1 Reassessment of probability of importation

The likelihood that tomato ringspot virus will arrive in Australia with the importation of table grapes from Korea is: **VERY LOW**.

Supporting information for this assessment is provided below:

- ToRSV occurs on lily in Korea (Kim and Choi 1990).
- ToRSV *sensu lato* and some strains of the virus have wide host ranges and infect common weed species as well as cultivated plants in North America (Powell *et al.* 1984; Brunt *et al.* 1996; CABI 2010).
- Common dandelion (*Taraxacum officinale*) is a reservoir host of ToRSV in USA (Powell *et al.* 1984). Common dandelion grows in Korea (CABI 2010).
- Two strains of ToRSV found in the USA, the yellow vein and decline strains, infect grapevine systemically (Gilmer and Uyemoto 1972). Some ToRSV strains may not infect grapevine systemically. No information was found on the presence in Korea of grapevine-infecting strains of the virus.
- In addition to lily (Kim and Choi 1990), ToRSV may infect other plant species in Korea and could potentially be transmitted to grapevine from other host species. *Xiphinema* spp. nematodes are present in Korea (Korean Plant Protection Society 1986) and could include species that are vectors of ToRSV.
- The leaves of infected grapevines may be small and develop ringspot and chlorotic mottling and the canes may grow abnormally (Gilmer and Uyemoto 1972; Dias 1977). Infected vines may produce small grape bunches and the berries may develop unevenly and be small; some vines may produce no fruit (Gilmer and Uyemoto 1972; Dias 1977).
- Infected vines may be removed from production in Korea. Infected fruit and bunches showing symptoms may be culled during harvesting, grading and packing as grapes showing damage are removed during packing (NPQS 2007).
- Infected grapevines in the USA were symptomless, or nearly so, in the first year, and were difficult to identify (Gonsalves 1988). Fruit of infected vines may appear normal. Symptoms varied in intensity throughout the year. In Maryland USA, infected vines showed no obvious foliage symptoms, although fruit bunches were affected (Gonsalves 1988).
- At least one strain of ToRSV is transmitted at a low rate through the seed of infected grapevine (Uyemoto 1975).
- Normal looking grapes carrying ToRSV infected seed might be imported into Australia.

The possible asymptomatic infection of grapevine and production of normal looking grapes carrying the virus, moderated by lack of reports about the presence of grapevine-infecting strains in Korea, support a likelihood estimate for importation of ‘ very low’.

4.15.2 Probability of distribution, of establishment and of spread

As indicated, the probability of distribution, of establishment and of spread for ToRSV will be the same as those assessed for table grapes from China (Biosecurity Australia 2010c). The likelihood estimates from the previous assessment are presented below:

Probability of distribution: **MODERATE**

Probability of establishment: **LOW**

Probability of spread: **MODERATE**

4.15.3 Overall probability of entry, establishment and spread

The overall probability of entry, establishment and spread is determined by combining the probabilities of entry, of establishment and of spread using the matrix of rules for combining qualitative likelihood shown in Table 2.2.

The likelihood that ToRSV will enter Australia as a result of trade in table grapes from Korea, be distributed in a viable state to a susceptible host, establish in Australia and subsequently spread within Australia is: **VERY LOW**.

4.15.4 Consequences

The consequences of the establishment of ToRSV in Australia have been estimated previously for table grapes from China (Biosecurity Australia 2010c). This estimate of impact scores is provided below.

Plant life or health	**E**
Any other aspects of the environment	**A**
Eradication, control, etc.	**D**
Domestic trade	**C**
International trade	**C**
Environment	**B**

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

4.15.5 Unrestricted risk estimate

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

Unrestricted risk estimate for *Tomato ringspot virus*	
Overall probability of entry, establishment and spread	**Very low**
Consequences	**Moderate**
Unrestricted risk	**Very low**

As indicated, the unrestricted risk estimate for ToRSV of 'very low' achieves Australia's ALOP. Therefore, specific risk management measures are not required for this pest.

4.16 Pest risk assessment conclusions

Key to Table 4.1 (next page)

Genus species [EP]	pests for which policy already exists. The outcomes of previous assessments and/or reassessments in this IRA are presented in Table 4.1
Genus species [state/territory]	state/territory in which regional quarantine pests have been identified

Likelihoods for entry, establishment and spread

N	negligible
EL	extremely low
VL	very low
L	low
M	moderate
H	high
P[EES]	overall probability of entry, establishment and spread

Assessment of consequences from pest entry, establishment and spread

PLH	plant life or health
OE	other aspects of the environment
EC	eradication control etc.
DT	domestic trade
IT	international trade
ENC	environmental and non-commercial
A-G	consequence impact scores are detailed in section 2.2.3
URE	unrestricted risk estimate. This is expressed on an ascending scale from negligible to extreme.

Table 4.2 Summary of unrestricted risk estimates for quarantine pests associated with table grapes from Korea

Pest name	Likelihood of						Consequences							URE
	Entry			Establishment	Spread	P[EES]	direct		indirect				Overall	
	importation	distribution	Overall				PLH	OE	EC	DT	IT	ENC		
Kanzawa spider mite (Acari: Tetranychidae)														
Tetranychus kanzawai [WA, EP]	M	M	**L**	**H**	**M**	**L**	E	B	D	C	D	B	**M**	**L**
Ladybird (Coleoptera: Coccinellidae)														
Harmonia axyridis [EP]	M	H	**M**	**H**	**H**	**M**	C	D	D	E	D	E	**M**	**M**
Scarab beetles (Coleoptera: Scarabaeidae)														
Popillia mutans [EP]	L	H	**L**	**H**	**H**	**L**	E	E	E	D	C	D	**M**	**L**
Popillia quadriguttata [EP]	L	H	**L**	**H**	**H**	**L**	E	E	E	D	C	D	**M**	**L**
Spotted winged drosophila (Diptera: Drosophilidae)														
Drosophila suzukii [EP]	H	H	**H**	**H**	**H**	**H**	F	B	E	E	E	D	**H**	**H**
Phylloxera (Hemiptera: Phylloxeridae)														
Daktulosphaira vitifoliae [EP]	M	M	**L**	**H**	**M**	**L**	E	A	E	D	C	B	**M**	**L**
Soft scales (Hemiptera: Coccidiae)														
Parthenolecanium corni [WA, EP]	H	L	**L**	**H**	**M**	**L**	D	B	D	C	C	B	**L**	**VL**
Mealybugs (Hemiptera: Pseudococcidae)														
Planococcus kraunhiae [EP]	H	M	**M**	**H**	**H**	**M**	D	C	D	D	D	B	**L**	**L**
Pseudococcus comstocki [EP]	H	M	**M**	**H**	**H**	**M**	D	C	D	D	D	B	**L**	**L**

Pest name	Likelihood of						Consequences							URE
	Entry			Establishment	Spread	P[EES]	direct		indirect				Overall	
	importation	distribution	Overall				PLH	OE	EC	DT	IT	ENC		
Leafroller moths (Lepidoptera: Tortricidae)														
Eupoecilia ambiguella EP	M	M	**L**	**H**	**H**	**L**	E	D	E	D	D	B	**M**	**L**
Sparganothis pilleriana EP	M	M	**L**	**H**	**H**	**L**	E	D	E	D	D	B	**M**	**L**
Grape plume moth (Lepidoptera: Pterophoridae)														
Nippoptilia vitis EP	M	L	**L**	**L**	**L**	**VL**	D	A	B	C	C	B	**L**	**N**
Apple heliodinid (Lepidoptera: Oecophoridae)														
Stathmopoda auriferella EP	M	H	**M**	**H**	**H**	**M**	C	B	C	D	D	B	**L**	**L**
(Thysanoptera: Thripidae)														
Frankliniella occidentalis NT, EP	H	M	**M**	**H**	**H**	**M**	D	B	D	D	D	B	**L**	**L**
Fungi														
Physalospora baccae EP	H	M	**M**	**H**	**H**	**M**	E	A	E	E	D	B	**M**	**M**
Phakopsora euvitis EP	M	M	**L**	**M**	**H**	**L**	E	A	D	D	D	B	**M**	**L**
Phomopsis viticola WA, EP	H	L	**L**	**H**	**M**	**L**	C	A	D	B	B	B	**L**	**VL**
Viruses														
Tomato ringspot virus EP	VL	M	**VL**	**L**	**M**	**VL**	E	A	D	C	C	B	**M**	**VL**

5 Pest risk management

This chapter provides information on the management of quarantine pests identified with an unrestricted risk exceeding Australia’s appropriate level of protection (ALOP). The proposed phytosanitary measures are described below.

5.1 Pest risk management measures and phytosanitary procedures

Pest risk management evaluates and selects options for measures to reduce the risk of entry, establishment or spread of quarantine pests for Australia where they have been assessed to have an unrestricted risk above Australia’s ALOP. In calculating the unrestricted risk, existing commercial production practices in Korea have been considered, as have post-harvest procedures and packing of fruit.

In addition to Korea’s existing commercial production practices for the production of table grapes and minimum border procedures in Australia, specific pest risk management measures, including operational systems, are proposed to achieve Australia's ALOP.

In this section, Biosecurity Australia has identified risk management measures that may be applied to consignments of table grapes sourced from Korea. Finalisation of the quarantine conditions may be undertaken with input from AQIS and the Australian states and territories as appropriate.

Korea has proposed the following general framework for the management of pests and procedures for production of table grapes for export to Australia (NPQS 2010b; NPQS 2011):

- *Registration*: Table grapes for export to Australia must originate from vineyards and packing houses registered with NPQS each year (NPQS 2011). Exporting vineyards and packing houses will have a registration number for traceback to the production area or packing house respectively.
- *Personnel training*: In order to comply with the requirements of export partners, NPQS will conduct training more than once at the beginning of each year for farmers and packing house officials. These training sessions cover export requirements, the main quarantine pests of concern and sorting processes (NPQS 2010b; NPQS 2011).
- *Pest control and monitoring*: Quarantine pests of concern to Australia are to be monitored and controlled in export vineyards. The general pest control measures are: (i) vineyard sanitation measures including cultivation practices, soil covering, irrigation practices and rain sheltered greenhouses; (ii) monitoring and surveillance and (iii) integrated pest management measures including use of phylloxera resistant rootstocks, application of chemical control measures and fruit bagging (NPQS 2010b; NPQS 2011). Farmers must comply with the guidelines for the application and timing of agricultural pesticides under the supervision of the Agricultural Technology Centre (NPQS 2010b; NPQS 2011). NPQS will conduct monitoring of registered orchards and instruct farms to implement chemical control at the appropriate time (NPQS 2010b).

- *Pre-harvest auditing and supervision:* During cultivation, vineyards must comply with requirements including bagging and chemical spray. Only the vineyards that pass regular monthly inspections by the NPQS and have pest freedom will be registered for export (NPQS 2011).
- *Packing house management:* A sanitation program is to be carried out in packing houses to ensure they are kept clean. Windows and doors are to be insect-proof. The waste fruit is to be collected regularly for disinfection treatment. The processing line should be just used to grade export fruit or have sanitation between use for domestic market and export market.
- *Labelling*: The outside of cartons will be labelled with the registration numbers of vineyards and packing houses (NPQS 2010b).
- *Storage and transport*: The storage facilities should be clean and hygienic. Fruit for different export markets should be stored separately. The packing houses are to ensure that the relevant records are kept up to date.
- *Pre-export inspection and certification*: Upon receipt of application for an export inspection, a plant quarantine inspector will visit the site where the consignment is located. The inspector samples 2% of the total consignment and inspect for pests with a magnifying glass in accordance with the official export inspection procedures of Korea (NPQS 2010b; NPQS 2011). If any pests are detected during this process then remedial action will be taken. This may vary depending on the pest and may inlcude treatment, shipment to an alternative market or suspension of the vineyard from the export program for an appropriate period (NPQS 2010b; NPQS 2011). If no pests are detected, the consignment will be issued with a phytosanitary certificate stating:

  "*The consignment is free of quarantine pests of Australia*".

Biosecurity Australia has considered the components of Korea's proposed general framework. Biosecurity Australia will visit table grape production areas in Korea and observe and collect information related to the framework proposed by Korea for registration and management of vineyards and packing houses, pest management and storage and transport. There are general requirements to be fulfilled for table grape vineyards, packing houses and storage facilities to be eligible to register for export to any country and specific requirements to comply with the import conditions agreed between Korea and the importing country.

The requirements for vineyard registration include service of a plant protection officer to monitor and control pests and capacity for implementing quality management and complying with the conditions of export protocols.

Requirements for packing houses include good general hygiene, adequate functioning and maintenance of machinery, cold storage capacity, and capability for personnel training in quarantine and food safety issues.

The registration applications received are assessed and accepted after an initial and a final verification to confirm all the requirements are fulfilled. Fruit sourced from specific vineyards and packing houses can be traced back through segregation and labelling. Training of plant protection officers and growers in the identification and management of pests and diseases, including relevant food safety issues, forms an important component in the export program.

The pest risk management measures proposed by Biosecurity Australia are based on the mandatory requirement for Korea to adhere to existing commercial practices (refer to Chapter 3).

The proposed pest risk management measures will apply to all the table grape production areas from which Korea intends to export table grapes to Australia.

5.1.1 Pest risk management for pests

The pest risk analysis identified the quarantine pests listed in Table 5.1 as having an unrestricted risk above Australia's ALOP.

Table 5.1 Phytosanitary and sanitary measures proposed for quarantine pests for table grapes from Korea

<table>
<tr><th>Pest</th><th>Common name</th><th>Measures</th></tr>
<tr><td colspan="3">Arthropods</td></tr>
<tr><td>Harmonia axyridis [EP]</td><td>harlequin ladybird</td><td rowspan="2">Systems approach:
• Vineyard and packing management
• Visual inspection and remedial action**</td></tr>
<tr><td>Popillia mutans [EP]
Popillia quadriguttata [EP]</td><td>scarab beetles</td></tr>
<tr><td>Drosophila suzukii [EP]</td><td>spotted winged drosophila</td><td>• Area freedom*; or
• Systems approach for fruit with pre- and postharvest measures; or
• Fruit treatment known to be effective against all life stages of Drosophila suzukii (e. g. methyl bromide fumigation or cold treatment`)</td></tr>
<tr><td>Planococcus kraunhiae [EP]
Pseudococcus comstocki [EP]</td><td>mealybugs</td><td rowspan="5">Systems approach:
• Vineyard control and surveillance
• Fruit bagging
• Visual inspection and remedial action**</td></tr>
<tr><td>Eupoecilia ambiguella [EP]
Sparganothis pilleriana [EP]</td><td>leafroller moths</td></tr>
<tr><td>Stathmopoda auriferella [EP]</td><td>apple heliodinid</td></tr>
<tr><td>Frankliniella occidentalis [NT, EP]</td><td>thrips</td></tr>
<tr><td>Tetranychus kanzawai [WA, EP]</td><td>Kanzawa spider mite</td></tr>
<tr><td>Daktulosphaira vifitoliae [EP]</td><td>grape phylloxera</td><td>Area freedom*
OR
Sulphur pad treatment</td></tr>
<tr><td colspan="3">Pathogens</td></tr>
<tr><td>Physalospora baccae [EP]</td><td>grape cluster black rot</td><td>Area freedom*</td></tr>
</table>

Pest	Common name	Measures
Phakopsora euvitis EP	grapevine leaf rust	Area freedom* OR Systems approach: • Vineyard control and surveillance • Fruit bagging • Visual inspection and remedial action**
*: Area freedom may include pest free areas, pest free places of production or pest free production sites (vineyard freedom). **: Remedial action (depending on the location of the inspection) may include: treatment of the consignment to ensure that the pest is no longer viable; withdrawing the consignment from export to Australia; export of the consignment from Australia; or destruction of the consignment. EP: Species has been assessed previously and import policy already exists.		

This draft risk analysis builds on the existing policies for table grapes from Chile (Biosecurity Australia 2005a) pears and apples from China (Biosecurity Australia 2005c; Biosecurity Australia 2010b) and table grapes from California (AQIS 2000) and the provisional final import policy for table grapes from China (Biosecurity Australia 2010c), which include many of the pests identified in Table 5.1.

Equivalent management measures have been considered for the same or similar pests and proposed in this risk analysis. Thus, the management options proposed are consistent with these existing policies. They include:

- a systems approach for Kanzawa spider mite, mealybugs, moths, thrips, harlequin ladybird and scarab beetles
- area freedom, systems approach or fruit treatment for spotted wing drosophila
- area freedom or sulphur pad treatment for phylloxera
- area freedom for grape cluster black rot
- area freedom or a systems approach for grapevine leaf rust

Consideration of alternative measures

Consistent with the principle of equivalence detailed in ISPM 11: *Pest risk analysis for quarantine pests including analysis of environmental risks and living modified organisms* (FAO 2004), Biosecurity Australia will consider any alternative measure proposed by NPQS, providing that it achieves an equivalent level of quarantine protection. Evaluation of such measures or treatments will require a technical submission from NPQS that details the proposed treatment and includes data from suitable treatment trials.

Management for *Drosophila suzukii*

The fruit fly, *Drosophila suzukii* (spotted wing drosophila) was assessed to have an unrestricted risk estimate that exceeds Australia's ALOP. Measures are therefore required to manage these risks.

Biosecurity Australia proposes area freedom with the options of pest free areas or pest free places of production (vineyard freedom), the following systems approach based on vineyard monitoring and control and post-harvest measures or treatment of the fruit to reduce the risks associated with this arthropod pest to meet Australia's ALOP.

Area freedom

Area freedom is a measure that might be applied to manage the risk posed by *Drosophila suzukii*. The requirements for establishing pest free areas or pest free places of production are set out in ISPM No. 4: *Requirements for the establishment of pest free areas* (FAO 1996) and ISPM No. 10: *Requirements for the establishment of pest free places of production and pest free production sites* (FAO 1999). Any proposal for area freedom status will need to be assessed by Biosecurity Australia.

Systems approach

A systems approach combining crop monitoring and *Drosophila suzukii* control with post-harvest measures could be used to reduce the risk of *D. suzukii* being imported to Australia with consignments of host fruit. More information on a systems approach is set out in ISPM No. 14: *The use of integrated measures in a systems approach for pest risk management* (FAO 2002).

Crop monitoring could identify areas of low pest prevalence or a 'seasonal window' when climatic conditions limit the activity of *D. suzukii*. The approach could be used to progressively reduce the risk of infested fruit being imported to Australia with consignments of fruit.

Biosecurity Australia will consider the effectiveness of any system proposed by Korea.

Treatment of fruit

The options for treatments that may be effective against all life stages of *D. suzukii* include methyl bromide fumigation and cold treatment. Preliminary methyl bromide efficacy data has shown 100% mortality on all life stages. Original research on cold treatment with low replication levels (<100 eggs or larvae) showed mortality of eggs and larvae can reach 100% after 96 hours exposure to temperatures of 1.7–2.2 °C (Kanzawa 1939). For both of these options, a complete efficacy treatment proposal would need to be reviewed and accepted by Biosecurity Australia.

Additional measures may be required in the packing house to limit post-harvest contamination by flies that are attracted to ripe fruit.

Treatments for table grapes by other methods will be considered by Biosecurity Australia if proposed by Korea.

Treatments for table grapes will need to be applied offshore to ensure that any live adult flies in consignments of fruit do not enter Australia.

The objective of these risk management measures (area freedom or a systems approach or treatment of fruit) is to reduce the likelihood of importation to at least 'extremely low'. The unrestricted risk would then be reduced to at least 'very low', which would achieve Australia's ALOP.

Management for *Harmonia axyridis, Popillia mutans and Popillia quadriguttata*

The ladybird, *Harmonia axyridis* (harlequin ladybird); and the scarab beetles, *Popillia mutans* (scarab beetle) and *Popillia quadriguttata* (Chinese rose beetle) were assessed to have an unrestricted risk estimate that exceeds Australia's ALOP. Measures are therefore required to manage these risks.

Biosecurity Australia proposes the following systems approach based on vineyard and packing management, and pre-export visual inspection and remedial action to reduce the risks associated with these arthropod pests to meet Australia's ALOP.

Systems approach

Vineyard and packing management

Registered growers must implement a vineyard and packing management regime that will ensure that table grapes for export to Australia are free from harlequin ladybird and scarab beetles. Vineyard monitoring must be conducted at a frequency appropriate to the vine growth stage and the life stage of these pests until the completion of harvest.

Fruit must be inspected for any contaminating harlequin ladybird or scarab beetles during the harvesting and processing stage. Those grape bunches suspected of being infested with these pests must be examined closely, and if any live adults or juvenile or eggs are detected the fruit will be removed from the export pathway or subject to remedial action.

The objective of vineyard and packing management as an element of the systems approach is to maintain awareness of the status of these pests in the vineyard to reduce their numbers to a low level, and to detect and remove any pests prior to completion of packing.

Visual inspection and remedial action

The objective of visual inspection as components of this systems approach is to ensure that any consignments of table grapes from Korea infested with these pests are identified and subjected to appropriate remedial action. The remedial action will reduce the risk associated with ladybirds and scarab beetles to a very low level to meet Australia's ALOP.

Adult ladybirds and scarab beetles are external pests, 5–8 mm and 8–11 mm long respectively, that can be detected by trained quarantine inspectors using optical enhancement where necessary. The iridescent green, black and copper of scarab beetles and the light orange to red elytra with black spots of the harlequin ladybird also aid in their detection. Therefore, the standard 600 unit quarantine inspection undertaken by AQIS would be effective in identifying consignments infested with these pests.

Remedial action, if required, could include any treatment known to be effective against the target pests. Currently, standard methyl bromide fumigation rates for external pests are recognised. However, Biosecurity Australia would also consider any other treatment that NPQS proposes, if it provides an equivalent level of protection.

The consignment would not be released from quarantine until the remedial action has been undertaken.

The objective of all these measures (a systems approach) is to reduce the likelihood of importation for these pests to at least ‘very low’. The restricted risk would then be reduced to at least ‘very low’, which would achieve Australia’s ALOP.

Management for *Tetranychus kanzawai, Pseudococcus comstocki, Planococcus kraunhiae, Eupoecilia ambiguella, Sparganothis pilleriana, Stathmopoda auriferella and Frankliniella occidentalis*

The mite, *Tetranychus kanzawai* (Kanzawa spider mite); mealybugs, *Pseudococcus comstocki* (Comstock’s mealybug) and *Planococcus kraunhiae* (Japanese mealybug); leafroller moths, *Eupoecilia ambiguella* (European grape berry moth) and *Sparganothis pilleriana* (leaf rolling tortrix); apple heliodinid (*Stathmopoda auriferella*) and thrips *Frankliniella occidentalis* (western flower thrips) were assessed to have an unrestricted risk estimate that exceeds Australia’s ALOP. Measures are therefore required to manage these risks.

Biosecurity Australia proposes the following systems approach based on vineyard control and surveillance, fruit bagging and pre-export visual inspection and remedial action to reduce the risks associated with these arthropod pests to meet Australia’s ALOP.

Systems approach

Vineyard control and surveillance

Registered growers would implement a vineyard control program (i.e. good agricultural practice/integrated pest management (IPM) programs for export table grapes). Programs would be approved by NPQS, and incorporate field sanitation and appropriate pesticide applications for the management of quarantine arthropod pests.

NPQS would be responsible for ensuring that the export table grape growers are aware of pests of quarantine concern to Australia and that the export vineyards are subject to field sanitation and control measures. Registered growers would be required to keep records of control measures for auditing. Details of the arthropod pest control program would need to be provided to DAFF by NPQS before trade commences.

Monitoring and surveillance for pests that require vineyard management measures must be conducted regularly in vineyards registered for export to Australia to verify the effectiveness of the measures. NPQS will maintain annual survey results using a standardised reporting form. These will be made available to DAFF if requested.

The objective of vineyard control and surveillance as an element of the systems approach is to reduce the number of pests in the vineyard to a low level.

Fruit bagging

NPQS has indicated that table grapes produced in Korea for export have the bunches enclosed in a bag for a period of the grape fruit development and maturation until harvest

(NPQS 2010b; NPQS 2011). Fruit bagging has been shown in Korea to be effective in preventing pests and providing some protection to the developing table grapes, particularly from their skin. Bagging also prevents water from settling on the grapes and encouraging the settlement of pathogens (NPQS 2011).

The bagging of table grapes in Korean vineyards occurs prior to the start of July. Some farms may carry out bagging later than this depending upon the effectiveness of their rain-proof cultivation practices. Bags are not removed until the harvest period of August–October (NPQS 2011).

Biosecurity Australia proposes fruit bagging of the developing and maturing grape bunches for a minimum of two months as part of the systems approach for the arthropod pests listed above. The developing grape bunches must be bagged when the berries are approximately 8–10 mm in diameter, which for some regions and varieties would occur in mid-June. The bags must remain intact on the bunches until mid-August for the grapes harvested in late August. Pest control measures, including pesticide sprays, must be applied at the appropriate time to manage each of the quarantine pests prior to bagging to ensure that the vineyards in general, and the developing fruit in particular, are free from these pests.

NPQS has advised that the bags are not removed until harvest time. NPQS (2011) states that table grapes can be harvested from August to October depending on the cultivars and region. This means that the bags would be removed from late August to early October.

NPQS would develop the monitoring and inspection procedures to demonstrate effective management of these pests is achieved during this period. These procedures must be documented and provided to DAFF for approval before trade commences. The results of monitoring and inspection, along with the recorded dates of initial bagging of the grape bunches and removal of bags, must also be made available to DAFF for auditing purposes.

The objective of fruit bagging as an element of the systems approach is to minimise access to the developing grape bunch through the protection or physical barrier offered by the bags. Biosecurity Australia acknowledges that there is no data to support the effect the bags have on the identified target arthropod pests of table grapes. However, the bagging and the associated practices as outlined, together with the vineyard surveillance and control, are considered to further reduce the potential for the pests to be found on the fruit bunch when presented for visual inspection.

Visual inspection and remedial action

The objective of visual inspection as a component of this systems approach is to ensure that any consignments of table grapes from Korea infested with these pests are identified and subjected to appropriate remedial action. The remedial action will reduce the risk associated with mites, mealybugs, moths, beetles and thrips to a very low level to meet Australia's ALOP.

Mites, mealybugs, moths, beetle and thrips are external pests and can be detected by trained quarantine inspectors using optical enhancement where necessary. Therefore, the standard 600 unit quarantine inspection undertaken by AQIS would be effective in identifying consignments infested with these pests.

Remedial action, if required, could include any treatment known to be effective against the target pests. Currently, standard methyl bromide fumigation rates for external pests are recognised. However, Biosecurity Australia would also consider any other treatment that NPQS proposes, if it provides an equivalent level of protection.

The consignment would not be released from quarantine until the remedial action has been undertaken.

The objective of all these measures (a systems approach) is to reduce the likelihood of importation for these pests to at least ‘very low’. The restricted risk would then be reduced to at least ‘very low’, which would achieve Australia’s ALOP.

Management for *Daktulosphaira vitifoliae*

Daktulosphaira vitifoliae (grape phylloxera) was assessed to have an unrestricted risk estimate that exceeds Australia’s ALOP. Measures are therefore required to manage this risk.

Biosecurity Australia has considered that visual inspection of fruit alone may not be an appropriate risk management measure for *D. vitifoliae* because signs of infestation may not be visible. Options proposed are area freedom or treatment with sulphur pads.

Area freedom

Area freedom is a measure that might be applied to manage the risk posed by *D. vitifoliae*. The requirements for establishing pest free areas or pest free places of production are set out in ISPM 4: *Establishment of pest free areas* (FAO 1996) and ISPM 10: *Requirements for the establishment of pest free places of production and pest free production sites* (FAO 1999). *D. vitifoliae* is recorded from Cheonan and Anseong regions of Korea but is under control (Song 2010). In some important regions like Cheonan, Anseong, Naju, Youngdong, and Kimchoen, farmers try to mass produce grafted nursery plants using phylloxera resistant rootstocks (Song 2010). Table grapes may be able to be sourced from identified and verified phylloxera-free production areas.

Sulphur pad treatment

Biosecurity Australia requires that commercial sulphur pads with proven efficacy against *D. vitifoliae* must be packed inside the plastic liner in all cartons of table grapes for export to manage the risk posed by this pest. The sulphur pads must be a registered product containing a minimum of 970 g/kg anhydrous sodium metabisulphite used at the rate specified on the label (PIRSA 2010).

The objective of these risk management measures (area freedom or sulphur pads) is to reduce the survival of *D. vitifoliae* associated with packed table grapes and packaging and the likelihood of introduction to at least ‘very low’. The restricted risk would then be reduced to at least ‘very low’, which would achieve Australia’s ALOP.

Other potential measures for arthropod pests

Other potential mitigation measures for arthropod pests could include area freedom (pest free areas or pest free places of production or pest free production sites), areas of low pest prevalence, treatments using heat, cold, chemical sprays, fumigants or irradiation, or a combination of these measures.

However, development of final import conditions will be dependent on NPQS providing additional scientific information supporting the establishment of pest free areas, pest free production sites or areas of low pest prevalence, or efficacy of treatments against the arthropod pests that reduce the level of risk in line with Australia's ALOP.

The use of ionising treatments, such as gamma rays and x-rays for quarantine purposes is recognised as a potential mitigation measure for all arthropod pests. The ISPM 18: *Guidelines for the use of irradiation as a phytosanitary measure* (FAO 2003) outlines a number of issues for consideration in accepting irradiation as a phytosanitary measure.

The arthropod pests identified in this risk analysis report include: a fly, *Drosophila suzukii* (spotted winged drosophila); phylloxera, *Daktulosphaira vitifoliae* (grape phylloxera); a mite, *Tetranychus kanzawai* (Kanzawa spider mite); a ladybeetle, *Harmonia axyridis* (harlequin ladybird); two scarab beetles, *Popillia mutans* (scarab beetle) and *Popillia quadriguttata* (Chinese rose beetle); two mealybugs, *Pseudococcus comstocki* (Comstock's mealybug) and *Planococcus kraunhiae* (Japanese mealybug); two leafroller moths, *Eupoecilia ambiguella* (European grape berry moth) and *Sparganothis pilleriana* (leaf rolling tortrix); a heliodinid, *Stathmopoda auriferella* (apple heliodinid) and a thrips *Frankliniella occidentalis* (western flower thrips).

FAO (2003) provides an estimated minimum absorbed dose for certain responses for selected pest groups including spider mites, scarab beetles, leafroller moths, heliodinids and thrips but not ladybirds, mealybugs or phylloxera. The minimum absorbed doses for ladybirds, mealybugs, scales and phylloxera would need to be confirmed and/or determined before irradiation is accepted as the treatment against these species.

Currently, irradiated grapes are not permitted to be sold in Australia due to regulations managed by the Food Standards Australia New Zealand (FSANZ). However, application may be made to FSANZ by any interested stakeholder to change the Australia New Zealand Food Standards Code to allow grapes or additional fruits treated with irradiation for phytosanitary purposes to be sold in Australia. Information on these applications can be viewed at the FSANZ web site.

Management for *Physalospora baccae*

Physalospora baccae (grape cluster black rot) was assessed to have an unrestricted risk estimate that does not achieve Australia's ALOP. Measures are therefore required to manage this risk.

Visual inspection of fruit alone is not considered to be an appropriate management option for these pathogens as external signs of infection are not always present and there may be late developing infections or latent infections. Visual inspection of fruit cannot detect symptomless infection. If *P. baccae* was present in the export vineyard, developing grapes could be infected prior to the bagging of the grape bunch and infected fruit would develop symptoms before the removal of the bags and the disease symptoms would become evident.

As symptoms appear in July to September, symptoms should be detected during packing house inspection.

Biosecurity Australia proposes area freedom with the options of pest free areas or pest free places of production (vineyard freedom) as management measures.

Area freedom

Pest free areas

A pest free area, as described in ISPM 4: *Requirements for the establishment of pest free areas* (FAO 1996) and ISPM 10: *Requirements for the establishment of pest free places of production and pest free production sites* (FAO 1999), would require systems to be put in place by NPQS to establish, maintain and verify that *P. baccae* does not occur within that area. Freedom from this pathogen in an area would reduce the overall likelihood of importation to 'very low'. The restricted risk would then be reduced to at least 'very low', which achieves Australia's ALOP.

P. baccae is present in Korea in low levels (NPQS 2010b; Shin *et al.* 1984). No pest free areas for this pathogen have been identified by Korea. Establishment and maintenance of pest free areas may not be technically feasible.

A measure to manage the risk is to source table grapes from export vineyards free of the disease; that is to establish pest free places of production as outlined in ISPM No.10: *Requirements for the establishment of pest free places of production and pest free production sites* (FAO 1999). Biosecurity Australia proposes pest free places of production (vineyard freedom) as a suitable measure to reduce the risk associated with these pathogens to an acceptable level.

Pest free places of production (vineyard freedom)

Table grapes for export to Australia would need to be sourced from export vineyards free of the disease. This measure would require systems to be put in place for the establishment, maintenance and verification of vineyard freedom from *P. baccae* under the supervision and responsibility of NPQS and be supported by the appropriate documentation. These documents should be made available to Biosecurity Australia if requested.

The inspection and monitoring of vines in the export vineyard at appropriate times to detect evidence of the pathogen must be undertaken and supported by appropriate documentation. The inspection method, including details of the timing and size of the sampling to be undertaken for each vineyard, appropriate for the pathogen and disease would be developed by NPQS and subject to approval by DAFF. Results of the inspections would be subsequently made available to DAFF for auditing purposes.

If *P. baccae* is detected in any export vineyard, fruit from that export vineyard will not be eligible for the export program to Australia.

To prevent any potential contamination from the processing of table grapes destined to domestic or other export markets, processing equipment in packing houses must be suitably cleaned prior to the commencement of processing and packing fruit for export to Australia.

If grape cluster black rot is detected on fruit for export at pre-export inspection or detected on export fruit in Australia, then the fruit will be rejected and registration of the vineyard/s would be suspended, pending the outcome of an investigation.

The objective of this measure is to reduce the likelihood of importation for *P. baccae* to at least 'very low'. The restricted risk would then be reduced to 'very low', which achieves Australia's ALOP.

Management for *Phakopsora euvitis*

Phakopsora euvitis (grapevine leaf rust) was assessed to have an unrestricted risk estimate that does not achieve Australia's ALOP. Measures are therefore required to manage this risk.

Visual inspection of fruit alone is not considered to be an appropriate management option for these pathogens as external signs of infection are not always present. Inspection of fruit cannot detect symptomless infection. Biosecurity Australia proposes area freedom (pest free areas, pest free places of production, vineyard freedom) as discussed above, or a systems approach based on vineyard control and surveillance, fruit bagging and pre-export visual inspection and remedial action to reduce the risk associated with these pathogens to an acceptable level.

Area freedom

Pest free areas

P. euvitis occurs in grape production areas sporadically throughout Korea (APHIS 2002; Farr and Rossman 2010; CABI 2011). No pest free areas have been identified by Korea for grapevine leaf rust. Establishment and maintenance of pest free areas may not be technically feasible.

Pest free places of production (vineyard freedom)

A second option to manage the risk is to source table grapes from export vineyards free of these diseases, that is to establish pest free places of production, as outlined in ISPM No.10: *Requirements for the establishment of pest free places of production and pest free production sites* (FAO 1999). These could be a pest free place of production (vineyard freedom) for which freedom from *P. euvitis* symptoms is established, maintained and verified by NPQS.

This measure would require the place of production, under the supervision and responsibility of NPQS, to establish, maintain and verify freedom from *P. euvitis* supported by the appropriate documentation. These documents should be made available to Biosecurity Australia if requested.

Systems approach

As a third option, Biosecurity Australia proposes the following systems approach based on vineyard control and surveillance, and fruit bagging, in addition to pre-export visual inspection and remedial action to reduce the risk associated with these pathogens to an acceptable level.

Vineyard control and surveillance

Registered growers must implement a vineyard control program (i.e. acceptable agricultural practice and integrated disease management (IDM) program for export table grapes). Programs must be approved by NPQS, and incorporate field sanitation and appropriate fungicide applications for the management of pathogens of quarantine concern to Australia.

NPQS is responsible for ensuring that export table grape growers are aware of diseases of quarantine concern to Australia, field sanitation and control measures. Registered growers must keep records of control measures for auditing purposes. Details of the pathogen control program must be provided by NPQS to DAFF for approval before trade commences.

Vineyard control and surveillance for these pathogens and the diseases they cause must include:

- Vineyard sanitation/hygiene: the removal and destruction of infected plant parts, weed control and pruning
- Monitoring/detection surveys for *P. euvitis* to verify the effectiveness of the vineyard control measures:
  - Regular surveys of vineyards registered for export by accredited personnel are required to ensure that they are free from symptoms of the diseases caused by these pathogens. NPQS is required to maintain annual survey results for the regular surveys, using a standard reporting format
  - Inspection of all export vineyards and adjacent properties by accredited personnel, to ensure that the grapevines and bunches are free from symptoms of the diseases caused by these pathogens. The inspection method appropriate for these diseases, including details of the timing and size of the sampling to be undertaken for each vineyard, must be developed by NPQS. Results of the final vineyard inspections must subsequently be required to be made available to DAFF for auditing purposes.

Fruit bagging

NPQS has indicated that table grapes produced in Korea for export are bagged for a period of fruit development and maturing (NPQS 2010b; NPQS 2011). Fruit bagging has been shown in Korea to be effective in preventing pests and providing some protection to the developing table grapes, particularly from their skin. Bagging also prevents water from settling on the grapes and encouraging the settlement of pathogens (NPQS 2011).

The bagging of table grapes in Korean vineyards occurs before the start of July. Some farms may carry out bagging later than this depending upon the effectiveness of their rain-proof cultivation practices. Bags may not be in place for the full duration of the development and maturation of the grape bunches, as discussed earlier in the chapter in relation to the proposed systems approach for arthropod pests. Bags are not removed until the harvest period of August-October (NPQS 2011).

Biosecurity Australia proposes fruit bagging of the developing and maturing grape bunches for a minimum of two months as part of the systems approach for *P. euvitis*. The developing grape bunches must be bagged when the berries are approximately 8-10 mm in diameter, which for some regions and varieties must occur in mid-June. The bags must remain intact on the bunches until mid-August for grapes harvested in late August. Disease control measures, including fungicide sprays, need to be applied at the appropriate time to manage each of the quarantine pathogens prior to bagging to ensure that the vineyards in general, and the developing fruit in particular, are free from these pathogens.

Prior to the removal of bags NPQS must ensure that the level of pests in registered export vineyards is reduced so that the risk of fruit being infected after the removal of bags is minimised, especially for *P. euvitis*. This may be achieved through monitoring and inspecting the vineyards before removing the bags and maintaining the health status of the vineyard until the fruit is harvested.

NPQS would develop the monitoring and inspection procedures to demonstrate effective management of this pest is achieved during this period. These procedures must be documented and provided to DAFF for approval before trade commences. The results of monitoring and inspection along with the recorded dates of initial bagging of fruit and removal of bags, must also be made available to DAFF for auditing purposes.

Visual inspection and remedial action

The objective of visual inspection as a component of this systems approach is to ensure that any consignments of table grapes from Korea infected with these pathogens are identified and subjected to appropriate remedial action. The remedial action will reduce the risk associated with grapevine leaf rust to a very low level.

Remedial action, if required, would include the removal of the consignment from the export pathway. Biosecurity Australia would also consider any treatment that NPQS proposes, if it provides an equivalent level of protection.

The objective of these risk management measures (a systems approach or area freedom) is to reduce the likelihood of importation for *P. euvitis* to at least ‘very low’. The restricted risk would then be reduced to at least ‘very low’, which would achieve Australia’s ALOP.

Other potential measures for pathogens

Consistent with the principle of equivalence detailed in ISPM 11: *Pest risk analysis for quarantine pests including analysis of environmental risks and living modified organisms* (FAO 2004), Biosecurity Australia will consider any alternative measure recommended by NPQS, providing that it achieves an equivalent level of quarantine protection. Evaluation of such measures or treatments will require a technical submission from NPQS that details the recommended measure or treatment and includes data from suitable treatment trials.

5.1.2 Operational systems for maintenance and verification of phytosanitary status

A system of operational procedures is necessary to maintain and verify the phytosanitary status of table grapes from Korea. This is to ensure that the recommended risk management measures have been met and are maintained.

It is proposed that Korea's NPQS or other relevant agency nominated by NPQS, prepare a documented work plan for approval by Biosecurity Australia/AQIS that describes the phytosanitary procedures for the pests of quarantine concern for Australia and the various responsibilities of all parties involved in meeting this requirement.

Details of the operational system, or equivalent, will be determined by agreement between Biosecurity Australia and NPQS.

Provisions for traceability

Registration of export vineyards

The objectives of this proposed procedure are to ensure that:

- table grapes are sourced from registered export vineyards producing export quality fruit, as the pest risk assessments are based on existing commercial production practices
- export vineyards from which table grapes are sourced can be identified so investigation and corrective action can be targeted rather than applying it to all contributing export vineyards in the event that live pests are regularly intercepted during pre-clearance inspection.

Registration of packing houses and treatment facilities and auditing of procedures

The objectives of this proposed procedure are to ensure that:

- table grapes are sourced only from NPQS-registered packing houses, processing export quality fruit, as the pest risk assessments are based on existing commercial packing activities
- reference to the packing house and the vineyard source (by name or a number code) are clearly stated on cartons destined for export of table grapes to Australia for trace back and auditing purposes.

It is proposed that NPQS registers the packing houses before commencement of harvest each season. The list of registered packing houses must be kept by NPQS and provided to AQIS prior to exports commencing, with updates provided if packing houses are added or removed from the list.

Registration of packing houses and treatment facilities in the initial export season would include an audit program conducted jointly by AQIS and NPQS before exports commence. After the initial approval, NPQS would be required to audit facilities at the beginning of each season to ensure that packing houses and treatment facilities are suitably equipped to carry out the specified phytosanitary tasks and treatments. Records of NPQS audits would be made available to AQIS on request.

Packing houses will be required to identify individual vineyards with a unique identifying system and identify fruit from individual vineyards by marking cartons or pallets (i.e. one vineyard per pallet) with a unique vineyard number or identification provided by NPQS.

Where table grapes undergo fumigation prior to export, this process could only be undertaken in facilities that have been registered with and audited by NPQS for that purpose. NPQS would be required to register all treatment facilities before export activity commences.

Packaging and labelling

The objectives of this proposed procedure are to ensure that:

- table grapes recommended for export to Australia are not contaminated by quarantine pests or regulated articles (e.g. trash, soil and weed seeds)
- unprocessed packing material (which may vector pests not identified as being on the pathway) is not imported with table grapes
- all wood material used in packaging of the commodity complies with AQIS conditions (see AQIS publication 'Cargo Containers: Quarantine aspects and procedures')
- secure packaging is used if consignments are not transported in sealed containers directly to Australia
- the packaged table grapes are labelled with the vineyard registration number for the purposes of trace back to registered vineyards
- the pre-cleared status of table grapes is clearly identified.

Specific conditions for storage and movement

The objectives of this proposed procedure are to ensure that:

- product for export to Australia that has been treated and/or inspected are kept secure and segregated at all times from any fruit for domestic or other markets, untreated/non pre-cleared product, to prevent product mixing or cross-contamination
- the quarantine integrity of the commodity during storage and transport is maintained.

Freedom from trash

All table grapes for export must be free from pests of quarantine concern to Australia and other regulated articles. Regulated articles are defined as any items other than the grape bunch. This may include leaf material, woody plant material, weeds, weed seeds, or any other contaminant, often referred as to as 'trash'. Freedom from trash will be confirmed by the inspection procedures. NPQS must provide details of how inspection for trash will occur before trade commences.

Pre-export phytosanitary inspection and certification

The objectives of this proposed procedure are to ensure that:

- all consignments are inspected by NPQS in accordance with official procedures for all visually detectable quarantine pests and other regulated articles (including soil, animal and plant debris) at a standard 600 unit sampling rate per lot whereby one unit is one bunch of table grapes

- an international phytosanitary certificate (IPC) is issued for each consignment upon completion of pre-export inspection and treatment to verify that the relevant measures have been undertaken offshore
- each IPC includes:
  - a description of the consignment (including vineyard number and packing house details)

  and

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

Requirement for pre-clearance

The objectives of the proposed requirement for pre-clearance are to ensure that:

- the recommended quarantine measures, including vineyard control and surveillance, product identification, AQIS inspection requirements, product security and documentation are met
- all lots are inspected by AQIS and NPQS in accordance with official procedures for all visually detectable quarantine pests and other regulated articles (including soil, animal and plant debris) at a standard 600 unit sampling rate per lot whereby one unit is one bunch of table grapes
- the detection of live quarantine pests will result in the rejection of the inspection lot and remedial action may be required.

Under pre-clearance arrangements, AQIS officers will be involved in vineyard inspections for pests of quarantine concern to Australia, in the direct verification of packing house procedures, treatments and in joint fruit inspection. It will further include their involvement in auditing of other arrangements including registration procedures, existing commercial practice, traceability, and handling of export fruit in a secure manner.

The pre-clearance arrangement is to be used at least for initial trade in the first year. Subsequently, subject to a review of the trade and agreement by DAFF and NPQS on a region by region basis, pre-clearance of lots in Korea may not be mandatory in the future and in this case AQIS will conduct the quarantine inspection on arrival in Australia.

Pre-clearance and on-arrival phytosanitary inspection by AQIS

A phytosanitary inspection of lots covered by each phytosanitary certificate issued by NPQS will be undertaken by AQIS either in the country of origin (mandatory or voluntary) as a pre-clearance, or on arrival of the consignment in Australia, as determined by DAFF. The inspection will be conducted using the standard AQIS inspection protocol for table grapes, using optical enhancement where necessary.

Action for non-compliance

The objectives of the proposed requirements for remedial action(s) for non-compliance are to ensure that:

- any quarantine risk is addressed by remedial action, as appropriate
- non-compliance with import requirements is addressed, as appropriate.

The detection of live quarantine pests or regulated articles during an inspection will result in the failure of the inspection lots during pre-clearance inspection and the entire consignment during on arrival inspection.

Where inspection lots are found to be non-compliant with Australian requirements, remedial action must be taken. The remedial actions for consignments (subject to pre-clearance or on-arrival inspection) where quarantine pests are detected will depend on the type of pest and the mitigation measure that the risk assessment has determined for that specific pest.

Remedial actions could include:

- withdrawing the consignment from export (if quarantine pests are detected during pre-clearance inspection)
- export of the consignment (if quarantine pests are detected during on-arrival inspection)
- destruction of the consignment (if quarantine pests are detected during on-arrival inspection)

or

- treatment of the consignment and re-inspection to ensure that the pest risk has been addressed (if quarantine pests are detected during either pre-clearance or on-arrival inspection).

Separate to the corrective measures mentioned above, there may be other breach actions necessary depending on the specific pest intercepted and the risk management strategy put in place against that pest in the protocol.

If product continually fails inspection, Biosecurity Australia/AQIS reserves the right to suspend the export program and conduct an audit of the risk management systems in Korea. The program will recommence only after Biosecurity Australia/AQIS (in consultation with the relevant state departments if required) is satisfied that appropriate corrective action has been taken.

Verification of documents and inspection on arrival where pre-clearance is not used

The objectives of this proposed procedure are to ensure that:

- consignments that have not been inspected under pre-clearance arrangements undergo appropriate quarantine inspection on arrival in Australia.

As proposed in the section 'Requirement for pre-clearance', it is recommended that the pre-clearance arrangement is to be used at least for initial trade. However, it is possible that this requirement may change and not be mandatory in the future. This section sets out the provisions that would apply to shipments that do not undergo pre-clearance.

AQIS will undertake a documentation-compliance examination for consignment verification purposes, followed by inspection, before release from quarantine.

5.2 Responsibility of competent authority

Korea's National Plant Quarantine Service (NPQS) is the designated NPPO under the International Plant Protection Convention (IPPC).

The NPPO's responsibilities include:

- inspecting plants and plant products moving in international trade
- issuing certificates relating to phytosanitary condition and origin of consignments of plants and plant products
- ensuring that all relevant agencies participating in this program meet the proposed service and certification standards and proposed work plan procedures
- ensuring that administrative processes are established to meet the requirements of the program.

5.2.1 Use of accredited personnel

Operational components and the development of risk management procedures may be delegated by NPQS to an accredited agent under an agency arrangement as appropriate. This delegation must be approved by AQIS and will be subject to the requirements of the pre-clearance system. NPQS is responsible for auditing all delegated risk management procedures.

Vineyard inspections must be undertaken by NPQS or persons accredited by NPQS. Accredited persons must be assessed and audited as being competent in the recognition of disease symptoms of concern in the field. Accredited persons may include NPQS officers, agency staff, entomologists, plant pathologists, commercial crop monitors/scouts, or other accredited persons. The accrediting authority must provide NPQS with the documented criteria upon which accreditation is based and this must be available for audit by NPQS and AQIS. AQIS will audit these systems before commencement of trade.

5.3 Review of processes

5.3.1 Audit of protocol

The objectives of the proposed requirement for audit and verification are to ensure that:

- an effective approved documented system is in operation for the vineyard, the packing house and during transport.

The phytosanitary system for table grape export production, certification of export vineyards, pre-export inspection and certification is subject to audit by AQIS. Audits may be conducted at the discretion of AQIS at any time during the entire production cycle and as a component of any pre-clearance arrangement.

AQIS vineyard audits will measure compliance with vineyard registration and identification, pest/disease management including maintenance of vineyard control and crop monitoring, records, the administration and verification of area freedom status of the export areas for spotted winged drosophila, grape cluster black rot, phylloxera, grapevine leaf rust and any other relevant pests, if accepted by Australia.

AQIS packing house audits of participants involved in pre-clearance arrangements will include the verification of compliance with packing house responsibilities, traceability, labelling, segregation and product security, and the NPQS certification processes.

Prior to the first season of trade, a representative from Biosecurity Australia and AQIS will visit areas in Korea that produce table grapes for export to Australia. They will audit the implementation of agreed import conditions and measures including registration, operational procedures and treatment facilities.

5.3.2 Review of policy

Biosecurity Australia reserves the right to review the import policy after the first year of trade or when there is reason to believe that the pest and phytosanitary status in Korea has changed. The pre-clearance arrangement requirement may be reviewed after initial substantial trade.

NPQS must inform Biosecurity Australia/AQIS immediately on detection in Korea of any new pests of table grapes that are of potential quarantine concern to Australia. For example, should area freedom from spotted wing drosophila be recognised for the areas exporting table grapes to Australia, NPQS must immediately advise Biosecurity Australia and AQIS if any spotted wing drosophila are detected in the exporting provinces.

5.4 Uncategorised pests

If an organism is detected on table grapes, 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. Assessment is also required if the detected species was categorised as not likely to be on the import pathway. If the detected species was categorised as on the pathway but assessed as having an unrestricted risk that achieves Australia's ALOP due to the rating for likelihood of importation, then it would require reassessment. The detection of any pests of quarantine concern not already identified in the analysis may result in remedial action and/or temporary suspension of trade while a review is conducted to ensure that existing measures continue to provide the appropriate level of protection for Australia.

Appendices

Appendix A Initiation and categorisation for quarantine pests of table grapes from the Republic of Korea[1]

[1]This pest categorisation table does not represent a comprehensive list of all the pests associated with the entire plant of an imported commodity. Reference to soilborne nematodes, soilborne pathogens, wood borer pests, root pests or pathogens, and secondary pests have not been listed or have been deleted from the table, as they are not directly related to the export pathway of table grapes and would be addressed by Australia's current approach to contaminating pests.

Table A1 Quarantine pests of table grapes from the Republic of Korea

This list contains pests present on the commodity pathway and absent from Australia (or absent from part of Australia but under official control). Initiation (columns 1 – 4) identifies quarantine pests of table grapes that have the potential to be on table grapes produced in the Republic of Korea using commercial production and packing procedures. Pest categorisation (columns 5 - 7) identifies which of the quarantine pests with the potential to be on table grapes require further consideration. Details of the method used in this risk analysis are given in Section 2: Method for pest risk analysis.

Pest	Present in the Republic of Korea	Present on the pathway	Present within Australia	Potential for establishment and spread	Potential for economic consequences	Consider further in PRA
DOMAIN FUNGI						
Class Dothideomycetes						
Order Botryosphaeriales						
Guignardia bidwellii (Ellis) Viala & Ravez 1892 (Anamorph *Phyllosticta ampelicida* (Engelm.) Aa 1973) black rot	No *Guignardia bidwellii* was listed by NPQS in its market access submission of 2007 as being present in Korea. NPQS later clarified that there had only been one record of the disease in Korea in 1958 (NPQS 2010b), which likely refers to Park 1958 (in APHIS 2002). NPQS (2010b) advised that the pest has not been detected since 1958 and that it was not detected in a nationwide survey conducted between 1992 and 1993 (Ryu *et al.* 1993 in NPQS 2010b).	Yes Affects grape leaf, stem, peduncle and fruit (Ramsdell and Milholland 1988; NPQS 2007; CABI 2010).	No (CABI 2010; Farr and Rossman 2010)	Not assessed	Not assessed	No Not present in Korea

Pest	Present in the Republic of Korea	Present on the pathway	Present within Australia	Potential for establishment and spread	Potential for economic consequences	Consider further in PRA
Class Puccinimycetes						
Order Pucciniales						
Phakopsora euvitis Y. Ono 2000 grapevine rust	Yes (Farr and Rossman 2010)	Yes Infects leaves of *Vitis* spp. (CABI 2010) and young shoots (Li 2004). Uredospores may contaminate bunches during harvest (Zhang 2005).	No The pest was recorded in the Northern Territory (Weinert *et al.* 2003) but declared eradicated in 2006 (Liberato *et al.* 2007).	Yes *Phakopsora euvitis* established in Northern Territory before eradication (Weinert *et al.* 2003). Rust fungi spores are wind dispersed (Deacon 2005).	Yes Rust disease caused by *Phakopsora euvitis* is very destructive. Heavy infection causes early senescence of the leaves and premature leaf fall. The disease can cause poor shoot growth, reduction of fruit quality and yield loss. (CABI and EPPO 2006).	Yes
Class Sordariomycetes						
Order Diaporthales						
Phomopsis viticola (Sacc.) Sacc. 1915 Synonyms: *Cryptosporella viticola* (Reddick) Shear; *Fusicoccum viticola* Reddick (1909) *Phomopsis* cane and leaf spot; excoriose (Europe); dead arm (USA)	Yes (APHIS 2002; NPQS 2007)	Yes Infects all parts of the grape bunch including rachis, pedicels and berries (Hewitt and Pearson 1994; APHIS 2002).	Yes (APPD 2010) *Phomopsis viticola* is absent from WA (Merrin *et al.* 1995; Burges *et al.* 2005).	Yes *Phomopsis viticola* is established in temperate climatic regions throughout the viticultural world and has been reported in Africa, Asia, Australia (except WA), Europe and North America (Hewitt and Pearson 1994). *P. viticola* is dispersed by rain splash and insects within the vineyard. Long distance dispersal occurs by movement of contaminated propagation material, pruning equipment and agricultural machinery (Burges *et al.* 2005).	Yes *Phomopsis viticola* is a serious pathogen of grapes in several viticultural regions of the world (Hewitt and Pearson 1994) and can cause vine stunting and reduced fruit yield (Burges *et al.* 2005).	Yes (WA)

Pest	Present in the Republic of Korea	Present on the pathway	Present within Australia	Potential for establishment and spread	Potential for economic consequences	Consider further in PRA
Class Ascomycetes						
Order Amphisphaeriales						
Physalospora baccae Cavara 1888 grape cluster black rot; axle blotch	Yes (Shin *et al.* 1984; APHIS 2002)	Yes *Physalospora baccae* mainly infects peduncles, pedicels and fruits of grapes (APHIS 2002; BAIKE 2009; NYZSW 2009). During May and June, conidia and ascospores spread to grape clusters by wind and rain and insects (NYZSW 2009). Symptoms start to appear in July. The peak infection period is from July to September when the weather is warm and humid. Infections are most likely to occur from the onset of ripening to harvest (BAIKE 2009; NYZSW 2009).	No records	Yes *Physalospora baccae* is present across the major grape growing regions of China (Liu *et al.* 2006; BAIKE 2009; NYZSW 2009) and is present in South Korea, Japan, east Europe, Portugal and Spain (Nishikado 1921; Bensaude 1926; Berro Aguilera 1926; Vekesciaghin 1933; Shin *et al.* 1984). This suggests that this fungus can establish and spread under a wide range of climatic environments. Many other *Physalospora* species are already present and established in Australia (APPD 2010).	Yes *Physalospora baccae* mainly infects peduncles, pedicels and fruit of grapes (BAIKE 2009; NYZSW 2009). The disease incidence is high in some years with hot and, humid weather from July to September and in vineyards which are not well managed. For example, up to 75% of fruit was infected in a vineyard in Jiangxi province in China (Li 1984). High disease incidences (of about 30% fruit infection) were also reported in vineyards in the provinces of Hunan, Fujian and Shanxi in China (Hu and Lin 1993; Gao *et al.* 1999).	Yes

Pest	Present in the Republic of Korea	Present on the pathway	Present within Australia	Potential for establishment and spread	Potential for economic consequences	Consider further in PRA
DOMAIN VIRUSES						
POSITIVE SENSE SINGLE-STRANDED DNA						
Tomato ringspot virus Synonyms: *tomato ringspot nepovirus* yellow vein (common name when in grapes)	Yes (APHIS 2002; CABI 2010)	Yes Infects systemically; present in fruits, seeds and whole plant (Uyemoto 1975; APHIS 2002).	No Listed in CABI (2010) as present in Australia based on a record in South Australia (Chu *et al.*1983). There have been no records since then. The virus has not been recorded in any other Australian state and is believed to be absent.	Yes This virus is seedborne in grapes (Uyemoto 1975). Also transmitted by nematodes (*Xiphinema* spp.) and by grafting (Stace-Smith 1984).	Yes Tomato ringspot virus causes disease in *Gladiolus* spp., *Malus pumila* (apple), *Pelargonium* (geranium), *Prunus* spp. (almond, apricot, nectarine, peach, plum, prune and sweet cherry), *Rubus* spp. (blackberry and raspberry), *Solanum lycopersicum* (tomato) and *Vitis* spp. (grapes) (Brunt *et al.* 1996; CABI 2010). Most of these species are commercially produced in Australia (Horticulture Australia Limited 2009).	Yes

Pest	Present in the Republic of Korea	Present on the pathway	Present within Australia	Potential for establishment and spread	Potential for economic consequences	Consider further in PRA
VIROIDS						
Hop stunt viroid [Pospiviroidae: Hostuviroid]	Yes (Pethybridge *et al.* 2008), also an unconfirmed record of 'present' within CABI (2010).	Yes Infects systemically; present in leaves, fruit and seed (Little and Rezaian 2003; Albrechtsen 2006; Li *et al.* 2006).	Yes SA, Vic. (Koltunow *et al.* 1988). Not recorded in WA (DAWA 2006). The movement of fruit into WA from eastern states where *Hop stunt viroid* occurs is regulated.	Yes Transmitted by grafting, abrasion and through seed (Little and Rezaian 2003; Singh *et al.* 2003).	No No symptoms of disease observed when *Hop stunt viroid* infects grapevine (Little and Rezaian 2003). Grapevine viroids are not known to cause noticeable economic effects on winegrape production (Randles 2003). No record of economic losses caused by *Hop stunt viroid* in table grapes has been found. A single study on Cabernet Sauvignon vines inoculated with a mixture of GYSVd-1, GYSVd-2 and *Hop stunt viroid* resulted in grape juice with lower titrable acidity and slightly higher pH and no effect on vegetative growth (Wolpert *et al.* 1996). As the inoculation was done concomitantly with the three viroids it is not possible to determine which viroid is responsible for the effect. Given that HSVd does not cause any disease symptoms it is likely that the other two viroids are responsible for this effect.	No No economic consequence

Pest	Present in the Republic of Korea	Present on the pathway	Present within Australia	Potential for establishment and spread	Potential for economic consequences	Consider further in PRA
Citrus exocortis viroid [Pospiviroidae: Pospiviroid]	Yes (CABI 2010)	Yes Infects systemically; present in leaves, fruit and seed (Little and Rezaian 2003; Albrechtsen 2006; Li *et al.* 2006).	Yes (Semancik 2010) Not recorded in WA (DAWA 2006) however *Citrus exocortis viroid* is not listed in the WA Plant Diseases Regulations (GWA 1989).	Yes Transmitted by grafting, abrasion and through seed (Little and Rezaian 2003; Singh *et al.* 2003).	No No symptoms of disease observed when *Citrus exocortis viroid* infects grapevine (Little and Rezaian 2003). Grapevine viroids are not known to cause noticeable economic effects on winegrape production (Randles 2003).No record of economic losses caused by *Citrus exocortis viroid* in table grapes has been found. *Citrus exocortis viroid* can infect all varieties of citrus but is symptomless in most. Disease symptoms develop when infected budwood is grown on susceptible rootstocks. *Citrus exocortis viroid* was a major disease of australian citrus trees on trifoliate orange rootstock in the 1940s and 50s, but is now rarely seen because of the use of pathogen-free budwood (Hardy *et al.* 2008).	No No economic consequence
DOMAIN EUKARYA						
ANIMALIA (Animal Kingdom)						
ARTHROPODA: Arachnidia: Acari (Phylum: Class Sub-class)						
Acari (Mites)						
Tetranychus kanzawai Kishida, 1927 *Synonym: Tetranychus hydrangea Pritchard & Baker, 1955* [Acari: Tetranychidae] Kanzawa spider mite	Yes (APHIS 2002; NPQS 2007)	Yes *Tetranychus kanzawai* mites and webbing are often found on the under surfaces of the leaves, but can occasionally attack and breed on grape berries (Ho and Chen 1994; Ashihara 1996).	Yes (Halliday 2000; Flechtmann and Khinicki 2002), though not present in WA (Poole 2010).	Yes *Tetranychus kanzawai* has established in Queensland (CSIRO-DAFF 2004i).	Yes *Tetranychus kanzawai* is a significant polyphagous pest subject to quarantine measures in many parts of the world (Navajas *et al.* 2001).	Yes (WA)

Pest	Present in the Republic of Korea	Present on the pathway	Present within Australia	Potential for establishment and spread	Potential for economic consequences	Consider further in PRA
ARTHROPODA: Insecta (Phylum: Class)						
Coleoptera (Beetles and Weevils)						
Harmonia axyridis (Pallas, 1773) [Coleoptera: Coccinellidae] harlequin ladybird	Yes (Coderre *et al.* 1995; Koch 2003; Brown *et al.* 2008a)	Yes Associated with grape berries (Missouri State University 2005; Kenis *et al.* 2008). Adults of *Harmonia axyridis* can attack ripe fruit and aggregate in clusters during harvest and wine processing. This insect cannot directly damage, or penetrate grape skins. *H. axyridis* only feed on berries that have been previously damaged by other insects, birds, diseases, or splitting (Kovach 2004; Galvan *et al.* 2006).	No (Walker 2008)	Yes *Harmonia axyridis* was introduced as a biological control agent of aphids and coccids in Europe, North America, Africa and South America (Koch *et al.* 2006; Brown *et al.* 2008a). *H. axyridis* has a wide host range (i.e. multiple prey species), ability to establish and disperse, indirect and direct effects on non-target species. In Europe, *H. axyridis* is considered to be an invasive alien species (Brown *et al.* 2008a).	Yes *Harmonia axyridis* is a concern to the wine industry. Due to their noxious odor, even small numbers of beetles inadvertently processed along with grapes can taint the flavour of wine. Tainted wine has reportedly resulted in millions of dollars in losses to the wine industry throughout the Eastern USA and Southern Canada (Potter *et al.* 2005; Galvan *et al.* 2006). Recent studies suggest that infestations can cause allergies in some individuals, ranging from eye irritation to asthma which may incur medical costs. *H. axyridis* has also invaded buildings, incurring cleanup and pest control costs (Potter *et al.* 2005).	Yes

Pest	Present in the Republic of Korea	Present on the pathway	Present within Australia	Potential for establishment and spread	Potential for economic consequences	Consider further in PRA
Popillia mutans Newman, 1838 [Coleoptera: Scarabaeidae] scarab beetle	Yes (NPQS 2007)	Yes Adults feed on leaves and occasionally on fruit of grape (Li 2004; Zhang 2005).	No records	Yes Little is known of the biology of *Popillia mutans*. It is known to damage flowers and calyxes of sweet persimmon in Korea (Lee *et al.* 2002c) and was listed as an important pest of cotton in China feeding on the plant in the adult stage (Li and Ma 1934). The biology of the closely allied *P. japonica* enabled it to become established and widespread through large areas of North America (Fleming 1972).	*Popillia mutans* damages sweet persimmon, cotton and grape (Li and Ma 1934; Lee *et al.* 2002c; Li 2004). The lack of published information on its biology is a likely indication of its lower economic importance. However, the closely allied *P. japonica* is of little significance in its native habitat but has become a serious pest in Northern America, where it causes millions of dollars worth of damage annually (Reding and Krause 2005).	Yes
Popillia quadriguttata (Fabricius, 1787) [Coleoptera: Scarabaeidae] Chinese rose beetle	Yes (NPQS 2007)	Yes Larvae feed on roots of grapevines and adults feed on leaves, flowers and fruit of grapes (Zhang 2005; AQSIQ 2006).	No records	The biology of *Popillia quadriguttata* is thought to be similar to *P. japonica* as it was mistaken for the latter until 1990. *P. japonica* is now known to be found in Japan whereas *P. quadriguttata* is found in Korea and China. (Ku *et al.* 1999) *P. quadriguttatta* feeds on many ornamental and agricultural plants and is a known pest of turf (Lee *et al.* 2002a, Lee *et al.* 2007), so would have sufficient host material to establish in Australia. The reproductive potential of the closely allied *P. japonica* has allowed itto become established and widespread through large areas of North America (Fleming 1972).	*Popillia quadriguttatta* feeds on many ornamental plants, native raspberry, agricultural crops including soybean, corn, pear, apple, peach and is a pest of turf (Lee et al 2002a; Lee *et al.* 2007). The closely allied *P. japonica* is of little significance in its native habitat but has become a serious pest in Northern America, where it causes millions of dollars worth of damage annually (Reding and Krause 2005).	Yes

Pest	Present in the Republic of Korea	Present on the pathway	Present within Australia	Potential for establishment and spread	Potential for economic consequences	Consider further in PRA
Diptera (True Flies)						
Drosophila suzukii Matsumara, 1931 [Diptera: Drosophilidae] spotted winged drosophila	Yes (The Korean Society of Plant Protection 1986; APHIS 2002)	Yes Associated with grape berries (APHIS 2002). Both wine grapes and table grapes have been recorded as hosts (Kanzawa 1936; Walsh *et al.* 2010 in press).	No records	Yes *Drosophila suzukii* can attack a broad range of undamaged fruits from 36 taxa in 12 plant families (Biosecurity Australia 2010a). Availability of host material in the PRA area would not be a limiting factor for the establishment of this pest. *Drosophila suzukii* occurs in Asia, the subcontinent, Europe, and North America, Central America and South America (Biosecurity Australia 2010a). There are similar climatic conditions across Australia that would be conducive to the establishment of this pest.	Yes This pest can cause significant economic losses to caneberries, cherries, grapes, strawberries, blueberries and stone fruit (Biosecurity Australia 2010a).	Yes

Pest	Present in the Republic of Korea	Present on the pathway	Present within Australia	Potential for establishment and spread	Potential for economic consequences	Consider further in PRA
Hemiptera (True bugs)						
Daktulosphaira vitifoliae (Fitch, 1855) Synonym: *Viteus vitifoliae* (Fitch, 1855) [Hemitera: Phylloxeridae] grape phylloxera	Yes (CABI 2010)	Yes The first instar 'crawler' stage is the most dispersive stage and can be found on the soil surface and on the foliage or fruit of vines (Buchanan and Whiting 1991). For domestic quarantine purposes within Australia, table grapes are considered a potential risk for the movement of *D. vitifoliae* and phytosanitary conditions are applied.	Yes Present only in isolated areas of Victoria and New South Wales. The pest is under official control in these areas and strict quarantine conditions apply (PGIBSA 2009).	Yes *Daktulosphaira vitifoliae* is already established in small areas of Australia, where it is under official control (NVHSC 2008). In Australia, several generations develop in each growing season (NVHSC 2005). *D. vitifoliae* can be spread by human activities, notably movement of grapevine nursery stock and related products including soil associated with infested roots (e.g. carried on footwear or vehicle tyres). Harvesting machinery, other equipment and tools are also implicated with their spread (NVHSC 2005). The potential for spread on harvested table grapes is also a concern (Buchanan and Whiting 1991).	Yes *Daktulosphaira vitifoliae* only causes direct harm to grapevines (*Vitis* spp.). The only reliable control measure for *D. vitifoliae* is the complete removal of infested vines and their replacement with grapevines grown on resistant rootstock. This measure has a devastating effect on grape production albeit temporary (Buchanan and Whiting 1991).	Yes
Parthenolecanium corni (Bouche, 1844) [Hemiptera: Coccidae] European fruit lecanium	Yes (NPQS 2007)	Yes This species sucks sap from branches, leaves and fruit of grapevines (Zhang 2005).	Yes NSW, Victoria and Tasmania (Snare 2006; APPD 2010). Absent in WA (Poole 2010).	Yes This pest is widely distributed in temperate and subtropical regions (Ben-Dov *et al.* 2010), so would be able to readily establish in Australia. As it is highly polyphagous (Ben-Dov *et al.* 2010) it would readily be able to use a range of hosts to disperse.	Yes This pest is highly polyphagous, attacking over 190 plant species (Ben-Dov *et al.* 2010).	Yes (WA)

Pest	Present in the Republic of Korea	Present on the pathway	Present within Australia	Potential for establishment and spread	Potential for economic consequences	Consider further in PRA
Planococcus kraunhiae (Kuwana, 1902) [Hemiptera: Pseudococcidae] Japanese mealy bug	Yes (NPQS 2007)	Yes Associated with grape branches, fruit and leaves (NPQS 2007).	No records	Yes *Planococcus kraunhiae* is a polyphagous species known to feed on citrus, persimmon, fig and coffee (Ben-Dov 1994; CABI 2010). It is found in California, Taiwan, China, Japan and Korea (Ben-Dov 1994) and its climatic tolerance may allow it to establish and spread in Australia.	Yes *Planococcus kraunhiae* infests horticultural plants commercially produced in Australia including citrus, persimmon, fig, coffee (Ben-Dov 1994). Mealybugs are important pests that directly damage their hosts by feeding on plant sap and promoted by their excretion of honeydew. (Park *et al.* 2010). Mealybugs reduces plant productivity and by depleting sap and promoting the growth of sooty mould through production of honeydew (Williams 2004).	Yes
Pseudococcus comstocki (Kuwana, 1902) [Hemiptera: Pseudococcidae] Comstock mealy bug	Yes (APHIS 2002; NPQS 2007)	Yes Associated with grape branches, fruit and leaves (APHIS 2002; NPQS 2007).	No records	Yes *Pseudococcus comstocki* has been collected from approximately 65 economically important hosts including lemon, pomegranate, peach, apple, quince and plum and a number of ornamental plants (Ervin *et al.* 1983). *P. comstocki* has been recorded from a number of countries throughout the world (Ben-Dov *et al.* 2010) indicating it has potential to become established and spread through new areas.	Yes *Pseudococcus comstocki* damages a large number of plant species including apple, banana, peach, pears, lemon, apricot, cherry, catalpa and mulberry in Asia and Europe (Ben-Dov *et al.* 2010). It damages the leaves and fruits of grapevines and produces honeydew on the fruit surface (Zhang 2005).	Yes

Pest	Present in the Republic of Korea	Present on the pathway	Present within Australia	Potential for establishment and spread	Potential for economic consequences	Consider further in PRA
Lepidoptera (Butterflies and moths)						
Eupoecilia ambiguella (Hubner, 1796) Synonym: *Clysia ambiguella* Hubner (1825) [Lepidoptera: Tortricidae] grapevine moth	Yes (APHIS 2002; Frolov 2009a)	Yes Associated with fruit (APHIS 2002). Recorded on *Vitis vinifera* (Robinson *et al.* 2008; Frolov 2009a) and considered a pest of grapes. Second generation *E. ambiguella* moths lay eggs on immature berries of grapes. Larvae gnaw out round holes and penetrate into berries, eating away pulp and unripe seeds before they harden. On average, one larva is able to damage 17 berries (Frolov 2009a).	No (Nielsen *et al.* 1996). CABI (2010) lists an unconfirmed record.	Yes *Eupoecilia ambiguella* larvae feed on a range of plants including lemon and currant, but is mainly a pest of grape (Frolov 2009a; Meijerman and Ulenberg 2010). This species has a wide distribution in Europe, Russia and Asia (Frolov 2009a), suggesting it would tolerate a range of climatic conditions that occur in Australia.	Yes *Eupoecilia ambiguella* larvae are polyphagous and can damage lemon and currant, but grape is the preferred host (Meijerman and Ulenberg 2010). First generation larvae eat floral structures, densely covering them with a web, while second generation larvae attack the grapes themselves. Larvae feed internally on berries, eating away pulp and unripe seeds before they harden. A single larva is able to damage up to 17 berries (Frolov 2009a).	Yes

Pest	Present in the Republic of Korea	Present on the pathway	Present within Australia	Potential for establishment and spread	Potential for economic consequences	Consider further in PRA
Nippoptilia vitis (Sasaki, 1913) Synonym: *Stenoptilia vitis* Sasaki 1913 [Lepidoptera: Pterophoridae] grape plume moth	Yes (NPQS 2007)	Yes Associated with grape berries (Yano 1963; AQSIG 2006; NPQS 2007). Recorded on *Vitis* (Robinson *et al.* 2008), *Vitis vinifera* and *Vitis thunbergia* (Yano 1963). *Nippoptilia vitis* larvae damage grapes resulting in severe fruit fall and partially abnormal fruit (Zheng *et al.*1993).	No records	Yes Adults are winged and mobile and feed only on grapes, which are widely but sporadically distributed in Australia (BAIRC 2007). This species is known from China, Japan, Korea, Taiwan and Thailand (Yano 1963; BAIRC 2007), countries with some climatic similarities to Australia.	Yes *Nippoptilia vitis* causes a significant decline in grape yield and fruit quality (BAIRC 2007).	Yes

Pest	Present in the Republic of Korea	Present on the pathway	Present within Australia	Potential for establishment and spread	Potential for economic consequences	Consider further in PRA
Sparganothis pilleriana (Denis & Schiffermüller, 1775) [Lepidoptera: Tortricidae] leaf-rolling tortrix	Yes (APHIS 2002; NPQS 2007)	Yes Associated with grape fruit, leaves and stem (APHIS 2002; NPQS 2007). The larvae of *Sparganothis pilleriana* may cause substantial economic damage by feeding on shoot tips, leaves, inflorescences, young grapes and grape bunches, also causing reduction in fruiting (Picard 1913; Pykhova 1968; Schmidt-Tiedemann *et al.* 2001; Louis *et al.* 2002). Infested and rolled leaves afford shelter to the insects before they attack the berry (Crouzat 1918).	No records	Yes Many of the hosts including grape, apple, pear, strawberry, tea, citrus, beans, pine (Meijerman and Ulenberg 2000) are present in Australia. Many parts of Australia have a similar climate to the countries where *S. pilleriana* is native, e.g. regions of Europe (Louis *et al.* 2002).	Yes The larvae may cause high economic damage by feeding on shoot tips, leaves, inflorescences and grape bunches (Schmidt-Tiedmann *et al.* 2001) and damage other economically important plants including apple, strawberry, tea, citrus and beans (Meijerman and Ulenberg 2000).	Yes

Pest	Present in the Republic of Korea	Present on the pathway	Present within Australia	Potential for establishment and spread	Potential for economic consequences	Consider further in PRA
Stathmopoda auriferella (Walker, 1864) [Lepidoptera: Oecophoridae] apple heliodinid	Yes (APHIS 2002; NPQS 2007)	Yes Associated with flowers, fruit and leaves (APHIS 2002; Yamazaki and Sugiura 2003; NPQS 2007). In Korea, *Stathmopoda auriferella* larvae cause webbing of the flower buds and newly set fruit, often causing affected plant parts to drop from the vine and burrow into the green berries, which may split, shrivel, or fall off when damaged (APHIS 2004).	No records	Yes *Stathmopoda auriferella* has a wide range of hosts including table grapes, *Acacia*, kiwifruit, mandarin, navel orange, coffee, sunflower, lacscale, fuji apple, mango, avocado, chir pine, peach, nectarine, pomegranate and sorghum (Robinson *et al.* 2001; CABI 2011). It has been reported from Japan, Korea and China (Park *et al.* 1994; Yamazaki and Sugiura 2003; Shanghai Insect Science Network 2005). The wide geographic range suggests that climatic conditions in parts of Australia would be suitable for its establishment and spread.	Yes *Stathmopoda auriferella* larvae damage the leaves, flowers and fruit of a range of agricultural crops including citrus, mango, grapes, *Prunus* spp, and sorghum and on important ecological species such as *Acacia* (Robinson *et al.* 2001, Yamazaki and Sugiura 2003; CABI 2011).	Yes
Thysanoptera (Thrips)						
Frankliniella occidentalis Pergande, 1895 [Thysanoptera: Thiripadae] western flower thrips	Yes (APHIS 2002; NPQS 2007)	Yes Associated with fruit and leaves (APHIS 2002; NPQS 2007). *Frankliniella occidentalis* is commonly found feeding on leaves, stems, flowers and fruit of grape plants (Childers 1997).	Yes (ABRS 2009; DPIPWE Tasmania 2010). Not recorded in NT (NTDRDPIFR 2009b). Listed as a notifiable pest in the Plant Diseases Control Act (NTGIDPIFR 2009a).	Yes *Frankliniella occidentalis* is a highly polyphagous species with a wide host range. It has already established and spread in most areas of Australia (CABI and EPPO 1989).	Yes Adult thrips attack most parts of their host plants as adults and larvae and lay their eggs directly into plant tissues. Their feeding activities can stress plants and reduce crop yields, as well as scarring fruit and flowers to render them unmarketable. They also vector tospoviruses, which contribute to reduction in crop yield and production of unmarketable produce. May cause entire crop losses (CABI 2010).	Yes (NT)

Table A2 Pests from Korea excluded from further categorisation

Pests in this table have been excluded from further consideration due to either not being a quarantine pest (already Present in Australia and not under official control) and/or not being associated with the pathway.

Pest	Reference for presence in Korea	Reason for exclusion
DOMAIN BACTERIA		
Class Alphaproteobacteria		
Order Rhizobiales (Agrobacterium, Rhizobium)		
Rhizobium radiobacter (Beijerinck & van Delden 1902) Young *et al.* 2001 (As *Agrobacterium tumefaciens* Smith and Townsend 1907 in NPQS (2007)) crown gall	(APHIS 2002; Park *et al.* 2006; NPQS 2007; CABI 2010)	**Present in Australia** (Bradbury 1986; DAWA 2006; APPD 2010)
Rhizobium vitis (Ophel & Kerr 1990) Young *et al.* 2001 Synonym: *Agrobacterium vitis* (Ophel & Kerr 1990) in NPQS (2007) crown gall of grapevine	(Park *et al.* 2000; Yun *et al.* 2003; NPQS 2007; CABI 2010)	**Present in Australia** (Gillings and Ophel-Keller 1995; APPD 2010)
Class Gammaproteobacteria		
Order Pseudomonadales		
Pseudomonas syringae pv. *syringae* van Hall 1902 bacterial canker	(APHIS 2002; CABI 2010)	**Present in Australia** (McCormick and Hollaway 1999; DAWA 2006; APPD 2010; CABI 2010)
Pseudomonas viridiflava (Burkholder,1930) Dowson 1939 bacterial leafblight	(Lee *et al.* 2000; APHIS 2002; CABI 2010)	**Present in Australia** (Padaga *et al.* 2000; DAWA 2006; APPD 2010)
DOMAIN FUNGI		
Class Agaricomycetes		
Order Agraricales		
Armillaria tabescens (Scop.) Emel (1921) *Armillaria* root rot	(CABI 2010)	**Not present on the export pathway** Only known to infect roots (Drake 1990; Li 2004).
Order Polyporales		
Corticium rolfsii Curzi (1931) sclerotium rot	(CABI 2010)	**Present in Australia** (DAWA 2006)
Class Ascomycetes		
Order Myriangiales		
Elsinoe ampelina Shear, 1929 grape anthracnose and berry rot; black spot; bird's eye spot	(APHIS 2002; Yun *et al.* 2003; NPQS 2007)	**Present in Australia** (Magarey *et al.* 1994; APPD 2010; CABI 2010)
Order Phyllachorales		
Colletotrichum acutatum Simmonds, 1968 ripe rot (Whitelaw-Weckert *et al.* 2007)	(Kim *et al.* 1999; APHIS 2002; Farr and Rossman 2010)	**Present in Australia** (DAWA 2006; Whitelaw-Weckert *et al.* 2007; APPD 2010)
Colletotrichum gleosporioides (Penz.) Penz. & Sacc.,1884 (Telemorph *Glomerella cingulata* (Stoneman) Spauld. & H. Schrenk 1903) anthrocnose; ripe rot	(Lee 1962; APHIS 2002; NPQS 2007)	**Present in Australia** (Chakraborty *et al.* 2004; DAWA 2006; APPD 2010)

Pest	**Reference for presence in Korea**	**Reason for exclusion**
Order Incertaesedis		
Macrophomina phaseolina (Tassi) Goid., 1947 charcoal rot	(APHIS 2002; CABI 2010)	**Present in Australia** (Stirling *et al.* 2004; DAWA 2006; APPD 2010; CABI 2010)
Class Basidiomycetes		
Order Agaricales		
Schizophyllum sp. Schizophyllum rot	(NPQS 2007)	**Not present on the export pathway** Schizophyllum rot affects the stem of grapevine (NPQS 2007). **Present in Australia** *Schizophyllum* species occur in Australia including those not identified to species level in NT, Qld, WA (APPD 2010).
Class Dothidiomycetes		
Order Acrospermales		
Acrospermum viticola Ikata & Hitomi,1931	(Farr and Rossman 2010)	**Not present on the export pathway** Only infects leaves of grape (Li 2004; AQSIQ 2006).
Order Botryosphaeriales		
Phyllosticta sp. leaf spot	(NPQS 2007)	**Not present on the export pathway** Phyllosticta leaf spot onlaffects leaves (NPQS 2007). **Present in Australia** Many species of *Phyllosticta* occur in Australia including unidentified species from NSW, NT, Qld, SA, Vic., WA (DAWA 2006; APPD 2010). Note: *Phyllosticta ampelicida* is considered under *Guignardia bidwellii*.
Botryosphaeria dothidea (Moug.) Ces. & De Not., 1863 macrophoma rot	(APHIS 2002; Koh *et al.* 2005; NPQS 2007)	**Present in Australia** (APPD 2010)
Order Capnodiales		
Septoria badhamii Berk. & Broome,1854	(APHIS 2002; NPQS 2007)	**Not present on the export pathway** Affects leaves (APHIS 2002; NPQS 2007).
Pseudocercospora vitis (Lév.) Speg. 1910 Synonym: *Phaeoisariopsis vitis* (Lév.) Sawada 1922; *Cercospora viticola* (Ces.) Sacc. 1886 leaf blight	(APHIS 2002)	**Present in Australia** (APPD 2010)
Order Pleosporales		
Alternaria alternata (Fr.) Keissl., 1912 berry rot	(APHIS 2002; Heo *et al.* 2006; Valero *et al.* 2006)	**Present in Australia** (Peever *et al.* 2002; DAWA 2006; APPD 2010)
Class Eurotiomycetes		
Order Eurotiales		
Penicillium digitatum (Pers.) Sacc. (1883) green mould	(CABI 2010)	**Present in Australia** (APPD 2010; CABI 2010)
Penicillium italicum Wehmer, 1894 blue mould	(CABI 2010)	**Present in Australia** (APPD 2010; CABI 2010)

Pest	Reference for presence in Korea	Reason for exclusion
Class Leotimycetes		
Order Erysiphales		
Botrytis cinerea Pers., 1794 (Teleomorph *Botryotinia fuckeliana* (de Bary, Whetzel 1945)) botrytis bunch rot and blight; grey mould	(APHIS 2002; NPQS 2007; CABI 2010)	**Present in Australia** (DAWA 2006; APPD 2010)
Uncinula necator (Schwein.) Burrill 1892 powdery mildew	(APHIS 2002; NPQS 2007)	**Present in Australia** (Savocchia *et al.* 2004; DAWA 2006; APPD 2010)
Order Helotiales		
Monilinia fructigena Honey 1945 apple brown rot; brown fruit rot	(APHIS 2002; CABI 2010; Farr and Rossman 2010)	**Not present on the export pathway** This disease has never been recorded associated with table grapes in Korea NPQS 2010b. It has only been recorded in Korea on Asian pears and apples (Lee *et al.* 2006; Farr and Rossman 2010) The only report of *Monilia fructigena* being associated with grapes is Qi et al. 1966 (in Tai 1979) who provided a single report of the anamorphic stage (*Monilia fructigena*) being associated with *Vitis vinifera* in the Jilin province of China. CABI (2010) and Farr and Rossman (2010) report grapevine as a host of *M. fructigena*. However, the former is unreferenced and the latter refers to the aforementioned Tai (1979). There is no published information on losses caused by *M. fructigena* on grapevine or any reports of *M. fructigena* associated with grapes since Qi *et al.* (1966).
Class Myxogastria		
Order Physarida		
Physarum sp. dusty mould	(NPQS 2007)	**Not present on the export pathway** *Physarum* mould occurs on leaves of grapevines. **Present in Australia** Many species of *Physarum occur* in Australia including unidentified species from NSW, NT, Qld, Tas., Vic., WA (Ing and Spooner 1994; APPD 2010).
Class Oomycetes		
Order Peronosporales		
Phytophthora cryptogea Pethybri. & Laff., 1919	(APHIS 2002)	**Present in Australia** (DAWA 2006; APPD 2010)
Phytophthora drechsleri Tucker ,1931	(NPQS 2007)	**Present in Australia** (CABI 1991; Weste 1994; DAWA 2006; APPD 2010)
Plasmopara viticola (Berk. & M.A. Curtis) Berl. & De Toni (1888) downy mildew	(APHIS 2002; NPQS 2007)	**Present in Australia** (DAWA 2006; Williams *et al.* 2007; APPD 2010) (Williams *et al.* 2007)
Class Puccinimycetes		
Order Pucciniales		

Pest	Reference for presence in Korea	Reason for exclusion
Phakopsora ampelopsidis Dietel & P. Syd. 1989 Synonym: *Physopella ampelopsidis* (Diet & P. Syd) Cummins & Ramachar, 1958 *Ampelopsis* rust fungus	(APHIS 2002; NPQS 2007) Note: the species NPQS and APHIS are listing as causing rust in grapes is most likely *Phakopsora euvitis* (see below) and not *Phakopsora ampelopsidis.*	**Not present on the export pathway** Not known to infect *Vitis* species (Ono 2000).
Class Sordariomycetes		
Order Diaporthales		
Pilidiella diplodiella (Speg.) Crous & Van Niekerk, 2004 Synonym: *Coniella diplodiella* (Speg.) Petr. & Syd. 1927; *Coniothyrium diplodiella* (Speg.) Sacc., 1884 white rot	(NPQS 2007)	**Present in Australia** (APPD 2010; Farr and Rossman 2010)
Order Hypocreales		
Haematonectria haematococca (Berk. & Broome) Samuels & Rossman, 1999 Synonym: *Nectria haematococca var. brevicona* (Wollenw.) Gerlach, 1981 (Anamorph *Fusarium solani* (Martius) Sacc., 1881)	(APHIS 2002)	**Present in Australia** (APPD 2010)
Nectria sp. nectria canker	(NPQS 2007)	**Not present on the export pathway** Only affects stem (NPQS 2007). **Present in Australia** Several *Nectria* species occur in Australia including those not identified to species level in NSW, Qld, SA, Tas., Vic., WA (APPD 2010). *Nectria galligena* (=*Neonectria galligena*) which infects fruit is a quarantine pest for Australia but *Vitis* is not a host.
Neonectria radicicola (Teleomorph) (Gerlach & L. Nilsson) Mantiri & Samuels,2001 (Anamorph *Cylindrocarpon destructans* (Zins.) Scholten 1964) black root of strawberry; cortical root rot	(APHIS 2002; Seifert *et al.* 2003)	**Present in Australia** (Summerell *et al.* 1990; APPD 2010; Iles *et al.* 2010)
Order Xylariales		
Monochaetia sp.	(APHIS 2002)	**Not present on the export pathway** Only affects leaves of grapevine (NPQS 2007). **Present in Australia** Several *Monochaetia* species recorded in NSW, Vic, WA and Qld including some not identified to species level in Qld, Vic., WA (DAWA 2006; APPD 2010).
Pestalotiopsis uvicola (Speg.) Bissett,1982 Synonym: *Pestalotia uvicola* Speg., 1878 berry rot; leaf spot	(APHIS 2002; NPQS 2007)	**Present in Australia** (Sergeeva *et al.* 2005; APPD 2010)
Rosellinia necatrix Berl. Ex Prill., 1904 white root rot	(APHIS 2002; NPQS 2007)	**Present in Australia** (Heaton and Dullahide 1990; DAWA 2006; APPD 2010)
Class Zygomycetes		
Order Mucorales		

Pest	Reference for presence in Korea	Reason for exclusion
Rhizopus stolonifer (Ehrenb. : Fr.) Vuill., 1902	(APHIS 2002)	**Present in Australia** (DAWA 2006; APPD 2010)
VIROIDS		
DOMAIN VIRUSES		
POSITIVE SENSE SINGLE-STRANDED DNA		
Alfalfa mosaic virus [Bromoviridae: Alfamovirus]	(CABI 2010)	**Present in Australia** (DAWA 2006; CABI 2010)
Broad bean wilt fabavirus [Comoviridae: Fabavirus]	(APHIS 2002)	**Present in Australia** (Schwinghamer *et al.* 2007; APPD 2010; CABI 2010)
Cucumber mosaic virus [Bromoviridae: Cucumovirus]	(CABI 2010)	**Present in Australia** (DAWA 2006; APPD 2010; CABI 2010)
Grapevine leafroll-associated virus 3 [Closteroviridae: Ampelovirus]	(Kim *et al.* 2000; NPQS 2007)	**Present in Australia** (Habili and Nutter 1997; Habili and Symons 2000; DAWA 2006; CABI 2010)
Grapevine fleck virus [Tymoviridae: Maculavirus]	(NPQS 2007)	**Not present on export pathway** Not seed transmitted, transmitted only by grafting, no known arthropod vector (CIHEAM 2006).
ANIMALIA		
ARTHROPODA: Arachnida: Acari (Phylum: Class: Sub-class)		
Acari (Mites)		
Brevipalpus lewisi McGregor, 1949 *[Acari: Tenuipalpidae]* *grape bunch mite*	(NPQS 2010a)	**Present in Australia** (Buchanan *et al.* 1980; Halliday 1998; CSIRO and DAFF 2004a; APPD 2010; Poole 2010)
Bryobia praetiosa Koch, 1835 [Acari: Tetranychidae] clover mite	(APHIS 2002; NPQS 2007)	**Present in Australia** (Halliday 1998; CSIRO and DAFF 2004b, APPD 2010; Gomez and Mizell III 2010; Poole 2010)
Panonychus citri (Mc Gregor, 1916) [Acari: Tetranychidae] citrus red mite	(Jeppson *et al.* 1975; Wu and Lo 1989)	**Not present on the export pathway** Feeds on the leaves of *Citrus* spp. Heavy infestations may result in leaf and fruit drop, twig dieback and even death of limbs. No information can be found to support its association with table grape bunches.
Panonychus ulmi (Koch, 1835) [Acari: Tetranychidae] European red mite	(APHIS 2002; NPQS 2007)	**Present in Australia** (CSIRO and DAFF 2004c; DAWA 2006; APPD 2010)
Phytonemus pallidus (Banks, 1899) [Acari: Tarsonemidae] Cyclamen mite	(APHIS 2002)	**Present in Australia** (CSIRO and DAFF 2004d; APPD 2010; Poole 2010)
Polyphagotarsonemus latus (Banks, 1904) [Acari: Tarsonemidae] broad mite	(Cho *et al.* 1996)	**Present in Australia** (CSIRO and DAFF 2004e; Fasulo 2007; APPD 2010; Poole 2010)

Pest	Reference for presence in Korea	Reason for exclusion
Tetranychus urticae Koch, 1835 Synonym: *Acarus telarius* Linnaeus, 1758 [Acari: Tetranychidae] two-spotted spider mite	(APHIS 2002; NPQS 2007)	**Present in Australia** (Gutierrez and Schicha 1983; CSIRO and DAFF 2004g; APPD 2010; Poole 2010)
ARTHROPODA: Insecta (Phylum: Class)		
Coleoptera (Beetles and Weevils)		
Acrothinium gaschkevitschii (Motschulsky, 1860) [Coleoptera: Chrysomelidae] grain leaf beetle	(APHIS 2002; NPQS 2007)	**Not present on export pathway** This species feeds on buds, leaves and flowers of grapevines (Zhang 2005; AQSIQ 2006).
Adoretus sinicus Burmeister,1855 Synonym: *Adoretus tenuimaculatus* Waterhouse [Coleoptera: Scarabaeidae] rose beetle	(APHIS 2002; NPQS 2007; CABI 2010)	**Not present on export pathway** Adults feed on plant foliage at night, creating a lace-like appearance on leaves by feeding on plant tissue between leaf veins. Larvae are commonly found in the soil of lawns, gardens, flower beds, and sometimes in cultivated fields, wherever considerable humus is present. The grubs do not attack living vegetable tissues and apparently are humus and detritus feeders (Mau and Martin Kessing 1991, APHIS 2002, NPQS 2007).
Ambrosiodmus rubricollis (Eichhoff,1875) Synonym: *Xyleborus rubricollis* Eichhoff, 1875 [Coleoptera: Curculionidae] black twig borer	(APHIS 2002)	**Present in Australia** (Rabaglia *et al.* 2006)
Anoplophora glabripennis Motschulsky, 1853 [Coleoptera: Cerambycidae] Asian long-horned beetle	(CABI and EPPO 1999)	**Not present on export pathway** *Anoplophora glabripennis* adults feed on leaves, stems and bark of many woody plant species (CABI and EPPO 1999). They are large beetles likely to be disturbed during harvest.
Anomala corpulenta Motschulsky, 1854 [Coleoptera: Scarabaeidae] copper green chafer	(Reed *et al.* 1991)	**Not present on export pathway** Larvae feed on roots and adults feed on leaves, buds, young shoots, flowers and fruit (Zhang 2005). Adults are likely to fly away when disturbed during harvesting. Post-harvest packing house processing is likely to remove any remaining Individuals.
Anomala cuprea Hope [Coleoptera: Scarabaeidae] cupreous chafer	(APHIS 2002)	**Not present on export pathway** *Anomala cuprea* is associated with leaves and roots (APHIS 2002). Not detected in Korean grape export inspections (NPQS 2010a).
Anomala geniculata Motschulsky, 1866 [Coleoptera: Scarabaeidae]	(APHIS 2002)	**Not present on export pathway** *Anomala geniculata* is associated with leaves and roots (APHIS 2002). Not detected in Korean grape export inspections (NPQS 2010a).
Anomala japonica Arrow [Coleoptera: Scarabaeidae]	(APHIS 2002)	**Not present on export pathway** *Anomala japonica* is associated with leaves and roots (APHIS 2002). Not detected in Korean grape export inspections (NPQS 2010a).

Pest	Reference for presence in Korea	Reason for exclusion
Anomala luculenta Erichson, 1847 [Coleoptera:Scarabaeidae]	(APHIS 2002; NPQS 2007)	**Not present on export pathway** *Anomala luculenta* is associated with leaves and roots (APHIS 2002; NPQS 2007).
Anomala octiescostata Burmeister, 1844 [Coleoptera: Scarabaeidae]	(APHIS 2002)	**Not present on export pathway** *Anomala octiescostata* is associated with leaves and roots (APHIS 2002). Not detected in Korean grape export inspections (NPQS 2010a).
Anomala orientalis Waterhouse, 1875 [Coleoptera: Scarabaeidae]	(APHIS 2002)	**Not present on export pathway** *Anomala orientalis* is associated with leaves and roots (APHIS 2002). Not detected in Korean grape export inspections (NPQS 2010a).
Aspidobyctiscus lacunipennis (Jekel, 1860) [Coleoptera: Attelabidae]	(APHIS 2002)	**Not present on export pathway** *Aspidobyctiscus lacunipennis* is associated with leaves (APHIS 2002). Not detected in Korean grape export inspections (NPQS 2010a).
Apoderus jekeli Roelofs, 1874. [Coleoptera: Attelabidae] chestnut leaf-cut weevil	(NPQS 2007)	**Not present on export pathway** *Apoderus jekeli* is associated with leaves (NPQS 2007).
Aulacophora femoralis chinensis Weise, 1923 (As *Aulacophora femoralis* Motschulsky in The Korean Society of Plant Protection (1986)) [Coleoptera: Chrysomelidae] curcurbit leaf beetle	(The Korean Society of Plant Protection 1986)	**Not present on export pathway** Adults feed on the leaves of grapes. Larvae live in the soil and feed on young plant roots (Li 2004).
Basilepta fulvipes (Motschulsky, 1860) [Coleoptera: Chrysomelidae] golden green minute leaf beetle	(APHIS 2002; NPQS 2007)	**Not present on export pathway** *Basilepta fulvipes* is associated with leaves (APHIS 2002; NPQS 2007).
Brachyclytus singularis Kraatz, 1879 [Coleoptera: Cerambycidae]	(APHIS 2002)	**Not present on export pathway** *Brachyclytus singularis* is associated with stems (APHIS 2002). Not detected in Korean grape export inspections (NPQS 2010a).
Bromius obscurus (Linnaeus, 1758) [Coleoptera: Chrysomelidae] western grape rootworm	(APHIS 2002; NPQS 2007)	**Not present on export pathway** Adult beetles feed on the upper surfaces of leaves and can feign death when disturbed therefore they have the tendency to fall off (APHIS 2002; BCMAF 2011).
Byctiscus lacunipennis (Jekel, 1860) [Coleoptera: Rhynchitidae] grape leaf roller weevil	(NPQS 2007)	**Not present on the export pathway** This species eats leaves of grapevines (Zhang 2005).
Cerambycidae spp. [Coleoptera: Cerambycidae]	(APHIS 2002)	**Not present on the export pathway** Associated with stems (APHIS 2002). Cerambycid larvae feed internally on woody plant material. Not detected in Korean grape export inspections (NPQS 2010a).

Pest	**Reference for presence in Korea**	**Reason for exclusion**
Chlorophorus annularis (Fabricius, 1787) [Coleoptera: Cerambycidae] bamboo tiger longicorn	(APHIS 2002; NPQS 2007)	**Present in Australia** (Barak *et al.* 2009; APPD 2010)
Exomala orientalis (Waterhouse, 1875) Synonym: *Blitopertha orientalis* [Coleoptera: Scarabaeidae] oriental beetle	(NPQS 2007)	**Not present on the export pathway** *Exomala orientalis* is associated with leaves (NPQS 2007).
Glycyphana fulvistemma Motschulsky, 1858 [Coleoptera: Scarabaeidae] black flower chafer	(APHIS 2002; NPQS 2007)	**Not present on the export pathway** *Glycyphana fulvistemma* is associated with flowers and leaves (APHIS 2002; NPQS 2007).
Hayashiclytus acutivittis (Kraatz, 1879) [Coleoptera: Cerambycidae]	(National Science Museum 1997)	**Not present on the export pathway** Zhang (2005) lists this species as a pest of grapevine. It is unlikely that any life history stage will be present on the pathway, as cerambycid larvae generally feed internally on woody plant material (CSIRO 1991).
Holotrichia diomphalia (Bates, 1888) [Coleoptera: Scarabaeidae] Korean black chafer	(The Korean Society of Plant Protection 1986; CABI 2010)	**Not present on the export pathway** Larvae eat roots while adults feed on shoots, young leaves and flowers (AQSIQ 2007).
Hypothenemus eruditus Westwood, 1836 [Coleoptera: Curculionidae: Scolytinae] bark beetle	(APHIS 2002)	**Not present on the export pathway** Scolytine beetles bore in woody plant parts particularly bark (Luo *et al.* 2005).
Lema decempunctata Gebler, 1830 [Coleoptera: Chrysomelidae] ten-spotted lema	(NPQS 2007)	**Not present on the export pathway** *Lema decempunctata* is associated with leaves (NPQS 2007).
Maladera orientalis (Motschulsky, 1857) [Coleoptera: Scarabaeidae] smaller velvet chaffer	(NPQS 2007)	**Not present on the export pathway** Larvae feed on the roots of grapevines while adults feed on the young shoots, leaves, and flowers of grapes (Zhang 2005).
Melanotus erythropygus Candeze, 1873 [Coleoptera: Elateridae]	(APHIS 2002)	**Not present on the export pathway** *Melanotus erythropygus* is associated with roots (APHIS 2002). Not detected in Korean grape export inspections (NPQS 2010a).
Metabolus impressifrons Fairmaire, 1887 [Coleoptera: Scarabaeidae]	(NPQS 2007)	**Not present on the export pathway** *Metabolus impressifrons* is associated with leaves (NPQS 2007).
Mimela fusania Bates, 1888 [Coleoptera: Scarabaeidae]	(APHIS 2002)	**Not present on the export pathway** *Mimela fusania* is associated with leaves (APHIS 2002). Not detected in Korean grape export inspections (NPQS 2010a).
Miridiba coreana Mijima and Kinoshita [Coleoptera: Scarabaeidae]	(APHIS 2002)	**Not present on the export pathway** *Miridiba coreana* is associated with leaves (APHIS 2002). Not present in grape export inspections (NPQS 2010a).
Oides decempunctata (Bilberg, 1808) (As *Oides decempunctatus* in Park (2001)) [Coleoptera: Chrysomelidae] grape leaf beetle	(Kim *et al.* 2003)	**Not present on the export pathway** This species is recorded feeding on grapevine leaves (Zhang 2005).

Pest	Reference for presence in Korea	Reason for exclusion
Oxycetonia jucunda Faldermann, 1835 Synonym: *Gametis jucunda* (Faldermann, 1835) [Coleoptera: Scarabaeidae] smaller green flower chafer	(Reed *et al.* 1991)	**Not present on the export pathway** Larvae feed on roots while adults feed on grape flowers (Zhang 2005).
Paropsides duodecimpustulata (Gebler, 1825) [Coleoptera: Chrysomelidae]	(APHIS 2002; NPQS 2007)	**Not present on the export pathway** *Paropsides duodecimpustulata* is associated with leaves (APHIS 2002; NPQS 2007).
Phyllopertha diversa Waterhouse, 1875 [Coleoptera: Scarabaeidae] pale-brown chafer	(APHIS 2002; NPQS 2007)	**Not present on the export pathway** *Phyllopertha diversa* is associated with leaves (APHIS 2002; NPQS 2007).
Phymatodes maaki (Kraatz, 1879) [Coleoptera: Cerambycidae] red-banded long-horned beetle	(APHIS 2002)	**Not present on the export pathway** *Phymatodes maaki* is associated with stems (APHIS 2002). Not detected in Korean grape export inspections (NPQS 2010a).
Phymatodes albicinctus Bates, 1873 [Coleoptera: Cerambycidae] white-banded longicorn beetle	(APHIS 2002; NPQS 2007)	**Not present on the export pathway** Larvae of this species feed internally on woody parts of the grapevine (Luo *et al.* 2005).
Proagopertha lucidula (Faldermann, 1835) [Coleoptera: Scarabaeidae] apple fairy chafer	(Korea Forest Service 2009)	**Not present on the export pathway** Larvae feed on the roots of grapevines while adults feed on the buds, leaves, flowers or fruit of grapes. Adults fly off fruit, once disturbed, so this species is likely to be removed from the pathway during harvesting and processing of fruit (Zhang 2005; AQSIQ 2007).
Pseudotorynorrhina japonica (Hope, 1841) Synonym: *Rhomborrhina japonica* Hope, 1841 [Coleoptera: Scarabaeidae] cupreous polished chafer	(APHIS 2002, NPQS 2007)	**Not present on the export pathway** *Pseudotorynorrhina japonica* is associated with the flower and leaves of grapevines (APHIS 2002, NPQS 2007).
Protaetia brevitarsis Lewis, 1879 [Coleoptera: Scarabaeidae] flower beetle	(Yoo *et al.* 2007)	**Not present on the export pathway** Larvae feed on roots of grapevines while adults feed on leaves buds, flowers and fruit. Adults of *Protaetia brevitarsis* chew on the surface of the fruit and will be unlikely to stay with the fruit when disturbed during harvesting (Zhang 2005).
Scelodonta lewisii Baly, 1874 [Coleoptera: Chrysomelidae]	(NPQS 2010a)	**Not present on the export pathway** This species is recorded eating leaves of grapevines. Larvae live in the soil where they feed on the young roots causing very minor damage (Li 2004; AQSIQ 2006).
Sinoxylon japonicum Lesne, 1895 [Coleoptera: Bostrichidae] two-horned stem boring beetle	(The Korean Society of Plant Protection 1986)	**Not present on the export pathway** Adults and larvae bore into the roots, stems and branches of grapevines. Bostrichid beetles are woodboring specialists (Lawrence and Britton 1994; Zhang 2005; AQSIQ 2006).
Stenygrinum quadrinotatum Bates, 1873 [Coleoptera: Cerambycidae] longhorn beetle	(Samuelson and Gressitt 1965; The Korean Society of Plant Protection 1986)	**Not present on the export pathway** Larvae attack woody parts of grape plants as an internal borer (Luo *et al.* 2005).

Pest	Reference for presence in Korea	Reason for exclusion
Xyleborus adembratus Blandford [Coleoptera: Curculionidae]	(APHIS 2002)	**Not present on the export pathway** *Xyleborus adembratus* is associated with stems (APHIS 2002). Not detected in Korean grape export inspections (NPQS 2010a).
Xyleborus apicalis Blandford, 1894 [Coleoptera: Curculionidae]	(NPQS 2007)	**Not present on the export pathway** *Xyleborus apicalis* is associated with branches and stem (NPQS 2007).
Xyleborus saxesenii (Ratzeburg, 1837) [Coleoptera: Curculionidae]	(APHIS 2002)	**Not present on the export pathway** *Xyleborus saxesenii* is associated with stems (APHIS 2002). Not detected in Korean grape export inspections (NPQS 2010a).
Xylosandrus germanus Blandford, 1894 [Coleoptera: Curculionidae] black timber bark beetle	(NPQS 2007)	**Not present on the export pathway** *Xylosandrus germanus* is associated with branches and stems (NPQS 2007).
Xylotrechus pyrrhoderus Bates, 1873 [Coleoptera: Cerambycidae] grape borer	(APHIS 2002; NPQS 2007)	**Not present on the export pathway** Larvae bore into the roots, stems (AQSIQ 2006) and branches of grapevines (Zhang 2005). Eggs are laid in cracks in bark on stem (Public Health 2009).
Diptera		
Drosophila melanogaster Meigen, 1830 [Diptera: Drosophilidae] common fruit fly	(APHIS 2002)	**Present in Australia** (APPD 2010; Hoffmann and Weeks 2010)
Drosophila simulans Sturtevant, 1919 [Diptera: Drosophilidae]	(APHIS 2002)	**Present in Australia** (Vieira *et al.* 1999; APPD 2010; CABI 2010)
Hemiptera – Heteroptera (true bugs)		
Aphrophora intermedia Uhler, 1896 [Hemiptera: Aphrophoridae]	(APHIS 2002; NPQS 2007)	**Not present on the export pathway** *Aphrophor intermedia* is associated with branches and leaves (APHIS 2002; NPQS 2007).
Apolygus lucorum (Meyer-Dür, 1843) Synonym: *Lygocoris locorum* (Meyer-Dür, 1843) [Hemiptera: Miridae] plant bug	(Kim *et al.* 2000; APHIS 2002; NPQS 2007)	**Not present on the export pathway** Adults and nymphs suck sap from leaves, flowers and young shoots of grapevines (Zhang 2005).
Apolygus spinolae (Meyer-Dür, 1841) Synonym: *Lygocoris spinolae* (Meyer-Dür) [Hemiptera: Miridae] green grape caspid	(Kim *et al.* 2000; Kim *et al.* 2002; Lee *et al.* 2002b)	**Not present on the export pathway** Feeds on fruit, flowers, leaves and shoots (Kim *et al.* 2000; Kim *et al.* 2002; Lee *et al.* 2002b). Phytophagous mirids are flying, temporary (i.e. not affixed) feeders that are likely to fly away when grapes are disturbed (Wheeler 2000 in Schaefer and Panizzi eds 2000).
Dolycoris baccarum (Linnaeus, 1758) [Hemiptera: Pentatomidae] sloe bug	(NPQS 2007)	**Not present on the export pathway** Nymphs and adults suck sap from young buds, leaves, young shoots and fruit of grapevines (Zhang 2005). However, they are not likely to be carried by fruit (AQSIQ 2007) because Pentatomid bugs characteristically drop from their hosts when disturbed, or fly off (Alcock 1971). Harvest and existing processing measures will likely remove most pentatomid bugs from the pathway.

Pest	Reference for presence in Korea	Reason for exclusion
Halyomorpha halys (Stål, 1855) [Hemiptera: Pentatomidae] brown marmorated stink bug	(The Korean Society of Plant Protection 1986)	**Not present on the export pathway** In grapes, *H. halys* adults suck sap from the fruit of grapes and the nymphs feed on leaves, stems and fruit of grapes (Zhang 2005; AQSIQ 2007). Pentatomid bugs are not likely to be carried by fruit (AQSIQ 2007) because they characteristically drop from their hosts when disturbed, or fly off (Alcock 1971). Harvest and existing processing measures will likely remove most pentatomid bugs from the pathway.
Hypogeocoris itonis (Horvath, 1905) [Hemiptera: Lygaeidae]	(NPQS 2007)	**Not present on the export pathway** *Hypogeocoris itonis* is associated with leaves (NPQS 2007).
Metacanthus (Yemma) exilis (Horvath, 1905) [Hemiptera: Berytidae] stilt bug	(NPQS 2007)	**Not present on the export pathway** *Metacanthus exilis* is associated with leaves (NPQS 2007).
Orthotylus flavosparsus (C. R. Sahlberg, 1842) [Hemiptera: Miridae] green plant bug	(Lee *et al.* 2002b)	**Not present on the export pathway** Feed on young shoots, leaves and fruit (Lee *at al.* 2000b), However, as a temporary (i.e. not affixed) feeder that feeds with its stylet it is likely to fly away when grapes are disturbed during harvest (Wheeler 2000 in Schaefer and Panizzi eds 2000; Lee *et al.* 2002b).
Plautia stali (Scott, 1874) [Hemiptera: Pentatomidae] brown-winged green bug	(APHIS 2002; NPQS 2007)	**Not present on the export pathway** Pentatomid bugs are not likely to be carried by fruit (AQSIQ 2007) because they characteristically drop from their hosts when disturbed, or fly off (Alcock 1971). Harvest and existing processing measures will likely remove most pentatomid bugs from the pathway.
Ricania japonica Melichar, 1898 [Hemiptera: Ricaniidae]	(APHIS 2002)	**Not present on the export pathway** *Ricania japonica* is associated with leaves (APHIS 2002). Not detected in Korean grape export inspections (NPQS 2010a).
Riptortus clavatus (Thunberg, 1783) [Hemiptera: Alydidae] bean bug	(NPQS 2007)	**Not present on the export pathway** *Riptortus clavatus* is associated with leaves (NPQS 2007).
Riptortus pedestris (Fabricius, 1775) [Hemiptera: Alydidae] pod bug	(Kim and Lim 2010)	**Not present on the export pathway** Heteroptera are not likely to be carried by fruit (AQSIQ 2007) because they characteristically drop from their hosts when disturbed, or fly off (Alcock 1971).
Hemiptera – Auchenorrhyncha and Sternorrhyncha (cicadas, leafhoppers, aphids, scales)		
Aleurocanthus spiniferus (Quaintance, 1903) [Hemiptera: Aleyrodidae] citrus blackfly	(APHIS 2002)	**Present in Australia** NSW and Qld (APPD 2010). **Not present on the export pathway** *A. spiniferus* is associated with leaves and stem (APHIS 2002) primarily of citrus (Gyeltshen *et al.* 2008). Not detected in Korean grape export inspections (NPQS 2010a).

Pest	Reference for presence in Korea	Reason for exclusion
Aphis fabae Scopoli, 1763 [Hemiptera: Aphididae] black bean aphid	(CABI 2010)	**Not present on the export pathway** Young colonies develop on shoots and older colonies spread over aerial parts of the plant (Blackman and Eastop 1984). *Aphis fabae* nearly always feeds on the phloem of the main veins of leaves of broad bean (Miles 1987 in Minks and Harrewijn eds 1987) and is primarily a pest of beans, potatoes and beets. This species doesn't feed on grapes (Ingels *et al.* 1998), though it has been recorded feeding on grape plant (APHIS 2002). No dead or alive specimens have been intercepted on table grapes from USA to Australia from 1995 to present. Not detected in Korean grape export inspections (NPQS 2010a).
Aphis gossypii Glover, 1877 [Hemiptera: Aphididae] cotton aphid	(APHIS 2002; NPQS 2007)	**Present in Australia** (CABI 1968; APPD 2010; Poole 2010)
Aphis spiraecola Patch, 1914 [Hemiptera: Aphididae] brown citrus aphid	(APHIS 2002)	**Present in Australia** (APPD 2010; Poole 2010) Not detected in Korean grape export inspections (NPQS 2010a).
Arboridia kakogawana (Matsumura, 1932) [Hemiptera: Cicadellidae] Japanese grape cycad	(Ahn *et al.* 2005)	**Not present on the export pathway** Associated with leaves (Ahn *et al.* 2005).
Arboridia maculifrons (Vilbaste, 1968) [Hemiptera: Cicadellidae]	(Ahn *et al.* 2005)	**Not present on the export pathway** Adults and nymphs suck sap from the underside of leaves (Li 2004; Ahn *et al.* 2005).
Arboridia apicalis (Nawa, 1913) Synonym: *Zygina apicalis* Nawa 1913; *Erythroneura apicalis* Nawa 1913 [Hemiptera: Cicadellidae] grape leafhopper	(APHIS 2002; NPQS 2007)	**Not present on the export pathway** This species attacks grape, peach, apple, pear and cherry. Adults and nymphs suck sap from the underside of leaves (Li 2004).
Batracomorphus allioni (Turton, 1802) [Hemiptera: Cicadellidae]	(NPQS 2007)	**Not present on the export pathway** Associated with leaves (NPQS 2007).
Batracomorphus mundus (Uhler, 1896) [Hemiptera: Cicadellidae]	(APHIS 2002)	**Not present on the export pathway** Associated with leaves (APHIS 2002). Not detected in Korean grape export inspections (NPQS 2010a).
Bothrogonia japonica Ishihara, 1962 [Hemiptera: Cicadellidae] black-tipped leafhopper	(APHIS 2002; NPQS 2007)	**Not present on the export pathway** Associated with leaves (APHIS 2002; NPQS 2007).
Butragulus flavipes (Uhler, 1896) [Hemiptera: Membracidae] horned tree-hopper	(NPQS 2007)	**Not present on the export pathway** Associated with stem (NPQS 2007).
Chionaspis salicis (Linnaeus, 1758) [Hemiptera: Diaspididae] willow scale	(Ben-Dov *et al.* 2010)	**Not present on the export pathway** Associated mainly with broadleafed forest trees and shrubs (Alford 2007). Associated with bark and branches (Watson 2006).
Cicadella viridis (Linnaeus, 1758) [Hemiptera: Cicadellidae] leafhopper	(NPQS 2007)	**Not present on the export pathway** Associated with leaves (NPQS 2007).

Pest	Reference for presence in Korea	Reason for exclusion
Coccus hesperidium Linnaeus, 1758 [Hemiptera: Coccidae] soft brown scale	(APHIS 2002; NPQS 2007)	**Present in Australia** (Martin Kessing and Mau 2007; APPD 2010; Ben-Dov *et al.* 2010)
Comstockaspis perniciosa (Comstock) [Hemiptera: Diaspididae] San Jose scale	(APHIS 2002; NPQS 2007)	**Present in Australia** (APPD 2010; CABI 2010; Poole 2010)
Diaspis boisduvalii Signoret, 1869 [Hemiptera: Diaspididae] boisduval scale	(Ben-Dov *et al.* 2010)	**Present in Australia** (APPD 2010)
Empoasca vitis (Gothe, 1875) [Hemiptera: Cicadellidae] small green leafhopper	(APHIS 2002)	**Not present on the export pathway** Associated with leaves (APHIS 2002). Not detected in Korean grape export inspections (NPQS 2010a).
Epiacanthus stramineus (Motschulsky, 1861) [Hemiptera: Cicadellidae]	(APHIS 2002)	**Not present on the export pathway** Associated with leaves (APHIS 2002). Not detected in Korean grape export inspections (NPQS 2010a).
Eulecanium cerasorum (Cockerell, 1900) [Hemiptera: Coccidae]	(NPQS 2007)	**Not present on the export pathway** Associated with leaves and branches (NPQS 2007).
Eulecanium kunoense (Kuwana, 1907) [Hemiptera: Coccidae] plum globose scale	(APHIS 2002; NPQS 2007)	**Not present on the export pathway** Associated with leaves and stem (APHIS 2002; NPQS 2007).
Graptopsaltria nigrofuscata (Motschulsky, 1866) [Hemiptera: Cicadidae] large brown cicada	(APHIS 2002; NPQS 2007)	**Not present on the export pathway** Associated with roots and stem (APHIS 2002; NPQS 2007).
Kolla atramentaria (Motschulsky, 1859) [Hemiptera: Cicadellidae]	(APHIS 2002; NPQS 2007)	**Not present on the export pathway** Associated with leaves (APHIS 2002; NPQS 2007).
Ledra auditura Walker, 1858 [Hemiptera: Cicadellidae] auricled leafhopper	(APHIS 2002; NPQS 2007)	**Not present on the export pathway** Associated with leaves (APHIS 2002; NPQS 2007).
Lepidosaphes tubulorum Ferris, 1921 [Hemiptera: Diaspididae]	(APHIS 2002)	**Not present on the export pathway** Associated with stem (APHIS 2002). Not detected in Korean grape export inspections (NPQS 2010a).
Lopholeucaspis japonica (Cockerell, 1897) [Hemiptera: Diaspididae] Japanese baton scale; pear white scale	(Ben-Dov *et al.* 2010)	**Present in Australia** (CSIRO and DAFF 2004h).
Machaerotypus sibricus (Lethierry) [Hemiptera: Membracidae] brown treehopper	(APHIS 2002)	**Not present on the export pathway** Associated with leaves (APHIS 2002). Not detected in Korean grape export inspections (NPQS 2010a).
Orthobelus flavipes Uhler [Hemiptera: Membracidae]	(APHIS 2002)	**Not present on the export pathway** Associated with leaves and stem (APHIS 2002). Not detected in Korean grape export inspections (NPQS 2010a).

Pest	Reference for presence in Korea	Reason for exclusion
Parlatoria theae Cockerell, 1896 [Hemiptera: Diaspididae] tea black scale	(NPQS 2007)	**Not present on the export pathway** Associated with branches and leaves (NPQS 2007).
Parlatoria camelliae Comstock, 1883 [Hemiptera: Diaspididae]	(Ben-Dov *et al.* 2010)	**Present in Australia** (Ben-Dov *et al.* 2010)
Phenacoccus aceris (Signoret, 1875) [Hemiptera: Pseudococcidae] apple mealybug	(Ben-Dov *et al.* 2010)	**Not present on the export pathway** Occurs on leaves and stems of a variety of plants (Ben-Dov 1994) including grapevine (Sforza *et al.* 2003). No records found of this pest on fruit.
Lycorma delicatula (White, 1845) [Hemiptera: Fulgoridae] planthopper	(Lee *et al.* 2010)	**Not present on the export pathway** *Lycorma delicatula* damages grape, peach, apricot and pear by feeding on the branches and stems (Li 2004).
Hemiberlesia lataniae (Signoret, 1869) [Hemiptera: Diaspididae] lantana scale	(APHIS 2002)	**Present in Australia** (APPD 2010; Poole 2010) Not detected in Korean grape export inspections (NPQS 2010a).
Icerya purchasi (Maskell, 1876) [Hemiptera: Margarodidae] cottony cushion scale	(APHIS 2002; NPQS 2007)	**Present in Australia** (ABRS 2009; APPD 2010; Poole 2010)
Myzus persicae (Sulzer, 1776) [Hemiptera: Aphididae] green peach aphid	(NPQS 2007)	**Present in Australia** (CABI 1979; Wilson *et al.* 2002; APPD 2010; Poole 2010)
Macrosiphum euphorbiae Thomas, 1878 [Hemiptera: Aphididae] potato aphid	(APHIS 2002)	**Present in Australia** (Poole 2010; APPD 2010) Not detected in Korean grape export inspections (NPQS 2010a).
Parthenolecanium persicae (Fabricius, 1776) [Hemiptera: Coccidae] peach scale	(APHIS 2002; NPQS 2007)	**Present in Australia** (APPD 2010; Ben-Dov *et al.* 2010; Poole 2010)
Pinnaspis strachani (Cooley, 1899) [Hemiptera: Diaspididae] lesser snow scale	(APHIS 2002)	**Present in Australia** (ABRS 2009; APPD 2010; Poole 2010)
Planococcus citri Ferris, 1950 [Hemiptera: Pseudococcidae] citrus mealy bug	(APHIS 2002)	**Present in Australia** (APPD 2010; Poole 2010)
Pseudococcus longispinus (Targioni Tozzetti, 1867) [Hemiptera: Pseudococcidae] longtail mealybug	(Kwon *et al.* 2002)	**Present in Australia** (APPD 2010)
Pseudococcus viburni (Signoret, 1875) [Hemiptera: Pseudococcidae] obscure mealybug	(Ben-Dov *et al.* 2010)	**Present in Australia** (APPD 2010)

Pest	Reference for presence in Korea	Reason for exclusion
Pseudaulacaspis pentagona (Targioni Tozzetti, 1886) [Hemiptera: Diaspididae] mulberry scale	(APHIS 2002; NPQS 2007)	**Present in Australia** (ABRS 2009; APPD 2010; Ben-Dov *et al.* 2010)
Saissetia coffeae (Walker, 1852) [Hemiptera: Coccidae] hemispherical scale	(APHIS 2002)	**Present in Australia** (Waterhouse and Sands 2001; APPD 2010; Poole 2010)
Trialeurodes vaporariorum (Westwood, 1856) [Hemiptera: Aleyrodidae] greenhouse white fly	(NPQS 2007)	**Present in Australia** (QDPI 2009; APPD 2010; Poole 2010)
Hymenoptera (Wasps, ants, bees and sawflies)		
Polistes chinensis antennalis Pérez, 1905 [Hymenoptera: Vespidae] Asian paper wasp	(NPQS 2010a)	**Not present on export pathway** Adults eat the flesh of grape, apple and pear fruits. They are often found in vineyards, as the adults prey on other insects associated with grapes (Li 2004). *Polistes* species are aggressive and wary insects capable of inflicting a painful sting to humans. They would almost certainly fly off grapes before they were picked and would likely sting if handled.
Polistes snelleni De Saussure, 1862 [Hymenoptera: Vespidae] paper wasp	(APHIS 2002)	**Not present on export pathway** Adults eat the flesh of grape, apple and pear fruits. They are often found in vineyards, as the adults prey on other insects associated with grapes (Li 2004). *Polistes* species are aggressive and wary insects capable of inflicting a painful sting to humans. They would almost certainly fly off grapes before they were picked and would likely sting if handled. Not detected in Korean grape export inspections (NPQS 2010a).
Vespa mandarina Smith, 1852 [Hymenoptera: Vespidae] Asian giant hornet	(APHIS 2002)	**Not present on export pathway** Adult *Vespa* species feed on nectar and sugars from fruit (Spradbery 1973). *Vespa* species are aggressive and wary insects capable of inflicting a painful sting to humans. They would almost certainly fly off grapes before they were picked and would likely sting if handled.
Vespa xanthoptera Cameron, 1903 [Hymenoptera: Vespidae] Japanese hornet	(APHIS 2002)	**Not present on export pathway** Adult *Vespa* species feed on nectar and sugars from fruit (Spradbery 1973). *Vespa* species are aggressive and wary insects capable of inflicting a painful sting to humans. They would almost certainly fly off grapes before they were picked and would likely sting if handled. Not detected in Korean grape export inspections (NPQS 2010a).
Lepidoptera (Butterflies and moths)		
Acosmeryx naga (Moore, 1858) [Lepidoptera: Sphingidae] snout grape hawk moth	(APHIS 2002; NPQS 2007)	**Not present on export pathway** Recorded from *Vitis* sp. (Pittaway and Kitching 2006) but only feeds on leaves (APHIS 2002). In general, sphingids feed on foliage (Common 1990).

Pest	**Reference for presence in Korea**	**Reason for exclusion**
Acronicta rumicis (Linnaeus 1758) [Lepidoptera: Noctuidae] knotgrass moth	(APHIS 2002;CABI 2010)	**Not present on export pathway** Associated with leaves (APHIS 2002). The larvae of *A. rumicis* are polyphagous and feed on whole leaves (CABI 2010).
Adoxophyes orana (Fischer von Roslerstamm, 1834) [Lepidoptera: Tortricidae] summerfruit tortrix	(NPQS 2007)	**Not present on export pathway** Associated with leaves of grapevine (Davis *et al.* 2005; NPQS 2007). *A. orana* is a polyphagous leafroller, and is primarily a pest of apple and pear. Larvae will feed externally on apple and pear fruit marked creating a "gnawed" or misshapen appearance (Davis *et al.* 2005).
Adris tyrannus amurensis Staudinger, 1892 Synonym: *Adris tyrannus* (Guenée, 1852); *Eudocima tyrannus* (Guenée,1852) [Lepidoptera: Noctuidae] Akebia leaf-like moth	(APHIS 2002; NPQS 2007)	**Not present on export pathway** This is a fruit-piercing moth. Fruit is attacked by adults only (APHIS 2002; NPQS 2007) which, as noctuids moths, are also eminently nocturnal (Richards and Davies 1977). Therefore moths are not likely to be present on fruit during harvest. In Japan, *A. tyrannus amurensis* attacks ripe fruits including grape, peach, orange, and pear (Hattori 1969; Tian *et al.* 2007). *Adris tyrannus amurensis* was surveyed on grapes in Korea (Yoon and Lee 1974). Fruit-piercing moths are known to pierce and suck the juice from ripening fruits, causing the fruits to rot and drop. Larvae generally feed on leaves at night and often fall to the ground when disturbed (Hattori 1969).
Agrotis segetum (Denis & Schiffermuller, 1775) [Lepidoptera: Noctuidae] turnip moth	(APHIS 2002)	**Not present on export pathway** Associated with stem (APHIS 2002). The larvae make short feeding visits to the foliage during the day. The fourth, fifth and sixth instars feed voraciously on roots and the bases of stems and cause severe damage (CABI 2010). Not detected in Korean grape export inspections (NPQS 2010a).
Ampelophaga rubiginosa Bremer & Grey, 1853 [Lepidoptera: Sphingidae]	(APHIS 2002; NPQS 2007)	**Not present on export pathway** Larvae of this species feed upon the leaves of grapevines (Zhang 2005).
Amphipyra erebina Butler, 1878 [Lepidoptera: Noctuidae] large pale- tipped black moth	(APHIS 2002; NPQS 2007)	**Not present on export pathway** Associated with leaves (APHIS 2002; NPQS 2007).
Amphipyra livida (Denis & Schffermuller, 1775) [Lepidoptera: Noctuidae] black moth	(Yoon and Lee 1974; NPQS 2007)	**Not present on export pathway** This is a fruit-piercing moth. Fruit is attacked by adults only (APHIS 2002; NPQS 2007). As noctuid moths are also eminently nocturnal (Richards and Davies 1977) they are not likely to be present on fruit during harvest.
Amphipyra pyramidea (Linnaeus, 1758) [Lepidoptera: Noctuidae] copper underwing	(APHIS 2002; NPQS 2007)	**Not present on export pathway** This pest has been listed as a leaf-feeder only (APHIS 2002; McLeod 2006; AQSIQ 2007). Zhang (2005) reported that larvae fed on leaves and externally on the fruit skin of grapes. This species is likely to be removed from the pathway during harvesting and processing of fruit.
Ancylis hylaea Meyrick, 1912 [Lepidoptera: Tortricidae]	(NPQS 2007)	**Not present on export pathway** Associated with leaves (NPQS 2007).

Pest	Reference for presence in Korea	Reason for exclusion
Anomis mesogona (Walker, 1858) [Lepidoptera: Noctuidae] fruit piercing moth	(Yoon and Lee 1974; The Korean Society of Plant Protection 1986)	**Not present on export pathway** *Anomis mesogona* is a fruit piercing moth. Adults pierce and suck juice from fleshy fruits at night. They are large, wary moths who shelter in foliage away from fruit during daylight hours (APHIS 2002), so are not likely to be present at time of harvest.
Aporia crataegi (Linneaus, 1758) [Lepidoptera: Pieridae] black-veined white moth	(The Korean Society of Plant Protection 1986; Grichanov and Ovsyannikova 2009a)	**Not present on export pathway** Larvae of *A. crataegi* are recorded to feed on foliage of many fruiting plants including grapes (*Vitis* spp.) (Robinson *et al.* 2008; Grichanov and Ovsyannikova 2009a).
Agrius convolvuli (Linnaeus, 1758) [Lepidoptera: Sphingidae] Palaearctic sweet potato horn worm	(APHIS 2002; NPQS 2007)	**Present in Australia** (Nielsen *et al.* 1996; APPD 2010; Poole 2010)
Agrotis ipsilon (Hufnagel, 1766) Synonym: *Phalaena ipsilon* Hufnagel, 1766 [Lepidoptera: Noctuidae] black cutworm	(Yoon and Lee 1974; APHIS 2002)	**Present in Australia** (Nielsen *et al.* 1996; APPD 2010; Poole 2010)
Arcte coerula (Guenee, 1852) Synonym: *Cocytodes coerulea* Guenee, 1852 [Lepidoptera: Noctuidae] China grass banded caterpillar	(Yoon and Lee 1974; APHIS 2002; NPQS 2007)	**Present in Australia** (Nielsen *et al.* 1996)
Artena dotata (Fabricius, 1794) Synonym: *Noctua dotata* Fabricius, 1794 [Lepidoptera: Noctuidae] fruit piercing moth	(APHIS 2002)	**Present in Australia** (Nielsen *et al.* 1996)
Asteropetes noctuina (Butler, 1878) *[Lepidoptera: Noctuidae]*	(APHIS 2002)	**Present in Australia** (Nielsen *et al.* 1996)
Bambalina sp. [Lepidoptera: Psychidae] mulberry bagworm	(APHIS 2002)	**Not present on export pathway** Associated with leaves and stem (Maddison 1993; APHIS 2002). Not detected in Korean grape export inspections (NPQS 2010a).
Callygris compositata (Guenee 1857) [Lepidoptera: Geometridae] wavy-striped white geometrid	(APHIS 2002; NPQS 2007)	**Not present on export pathway** Associated with leaves (APHIS 2002; NPQS 2007).
Calyptra gruesa Draudt 1950 Synonym: *Calpe gruesa* Draudt, 1950 [Lepidoptera: Noctuidae]	(Hattori 1969)	**Not present on export pathway** This is a fruit-piercing moth. Fruit is attacked by adults only and as noctuids moths are also eminently nocturnal (Richards and Davies 1977). In Japan, fruit-piercing moths are known to pierce and suck the juice from ripening fruits, causing the fruits to rot and drop. Larvae generally feed on leaves at night and often fall to the ground when disturbed (Hattori 1969). Moths are not likely to be associated with fruits at time of harvest.
Calyptra lata (Butler, 1881) Synonym: *Calpe lata* (Butler, 1881) (As *Oraesia lata* Butler, 1881 in Yoon and Lee (1974)) [Lepidoptera: Noctuidae]	(Yoon and Lee 1974; APHIS 2002; NPQS 2007)	**Present in Australia** (Nielsen *et al.* 1996)

Pest	Reference for presence in Korea	Reason for exclusion
Calyptra thalictri (Borkhausen, 1790) (As *Calpe thalictri (Borhausen, 1790)* in Yoon and Lee (1974)) [Lepidoptera: Noctuidae] fruit piercing moth	(Yoon and Lee 1974; APHIS 2002; NPQS 2007)	**Present in Australia** (Nielsen *et al.* 1996)
Catocala actaea Felder et Rogenhofer, 1874 [Lepidoptera: Noctuidae] white-mark hind winged noctuid	(NPQS 2007)	**Not present on export pathway** In Korea, this species is recorded to feed on grapes and leaves (NPQS 2007). Larvae of Catocalinae are generally foliage feeders (Barlow 1982). As no information can be found on this species, and as Catocalinae larvae are foliage feeders it is assumed that it is the adults that feed on fruit. Apart from being non-affixed feeders, as they are nocturnal noctuids they would not be on grapes at the time of harvest.
Catocala duplicata Butler, 1855 [Lepidoptera: Noctuidae]	(APHIS 2002; NPQS 2007)	**Not present on export pathway** Associated with leaves (APHIS 2002; NPQS 2007). The Holarctic noctuid moth genus *Catocala* larvae feed on leaves (Gall 1987).
Catocala fulminea (Scopoli, 1763) [Lepidoptera: Noctuidae]	(APHIS 2002)	
Catocala praegnax Walker, 1858 [Lepidoptera: Noctuidae]	(APHIS 2002)	
Chrysorithrum amatum Brem 1852 Synonym: *Chrysorithrum rufescens* Butler 1881 (As *Chrysorithrum amatum rufescens* Butler, 1881 in Yoon and Lee (1974)) [Lepidoptera: Noctuidae]	(Yoon and Lee 1974)	**Not present on export pathway** The fruit sucking moth, *C. amatum*, was surveyed on grapes in Korea (Yoon and Lee 1974). Being a fruit-piercing moth, fruit is attacked by adults only and as noctuids moths are also eminently nocturnal (Richards and Davies 1977) moths are unlikely to be associated with fruits at time of harvest.
Clania variegata (Snellen, 1879) [Lepidoptera: Psychidae] Paulownia bagworm	(Gries *et al.* 2006)	**Present in Australia** (Gries *et al.* 2006; APPD 2010)
Conogethes punctiferalis (Guenee, 1854) Synonym: *Dichocrocis punctiferalis* Guenee, 1854 [Lepidoptera: Pyralidae] yellow peach moth	(APHIS 2002)	**Present in Australia** (Gour and Sriramulu 1992; DAWA 2006; APPD 2010)
Cossus cossus Linneaus, 1758 [Lepidoptera: Cossidae] goat moth	(The Korean Society of Plant Protection 1986)	**Not present on export pathway** Cossid moth larvae feed internally on woody parts of plants (Grichanov 2009) and are not associated with fruits.
Deilephila elpenor (Linnaeus, 1758) [Lepidoptera: Sphingidae] reddish hawk moth	(APHIS 2002; NPQS 2007)	**Not present on export pathway** Although recorded from grapes (Pittaway and Kitching 2006), Sphingids generally feed only on foliage (Common 1990).
Dermaleipa zuno Dalman [Lepidoptera: Noctuidae]	(Yoon and Lee 1974)	**Not present on export pathway** The fruit-sucking moth, *D. zuno*, was surveyed on grapes in Korea (Yoon and Lee 1974). Noctuid adults feed on flowers, overripe fruit or fermenting liquids. A few are able to pierce the rind of fruits to suck the juices (Common 1990).

Pest	Reference for presence in Korea	Reason for exclusion
Deuterocopus albipunctatus Fletcher, 1910 [Lepidoptera: Pterophoridae]	(Yano 1964; APHIS 2002)	**Not present on export pathway** Associated with leaves (APHIS 2002). The Australian genera in the family Pterophoridae feed on flowers, flower buds and the underside of leaves (Nielsen *et al.* 1996).Not detected in Korean grape export inspections (NPQS 2010a).
Diaphania indica (Saunders, 1851) Synonym: *Palipta indica* (Saunders, 1851) [Lepidoptera: Sphingidae] hawk moth	(The Korean Society of Plant Protection 1986)	**Present in Australia** (Common 1990; APPD 2010; Poole 2010)
Dysgonia maturata (Walker, 1858) Synonym: *Parallelia maturate* (As *Paralleia maturata* Walker, Holloway, 1976 in Yoon and Lee (1974)) [Lepidoptera: Noctuidae]	(Yoon and Lee 1974; APHIS 2002; NPQS 2007)	**Not present on export pathway** Associated with leaves (APHIS 2002; NPQS 2007). Many Noctuid adults feed on flowers, overripe fruit or fermenting liquids. A few are able to pierce the rind of fruits to suck the juices. The larvae of most Noctuids feed on the live foliage of woody or herbaceous plants (Common 1990). Adults and larvae are not likely to be present on harvested fruit.
Endoclyta excrescens (Butler, 1877) [Lepidoptera: Hepialidae] swift moth	(APHIS 2002; NPQS 2007)	**Not present on export pathway** The larvae of this species bore into the stems and branches of grapevines (Zhang 2005).
Eudocima fullonia (Clerck, 1764) Synonym: *Ophideres fullonica* Linneaus 1758; *Othreis fullonia* (Clerck, 1764) [Lepidoptera: Noctuidae] fruit sucking moth	(Yoon and Lee 1974; APHIS 2002)	**Present in Australia** (Reddy *et al.* 2007; Poole 2010)
Eudocima tyrannus (Guenee, 1852) Synonym: *Adris tyrannus* (Guenee, 1852) [Lepidoptera: Noctuidae] noctuid moth	(APHIS 2002)	**Not present on export pathway** Adult *Eudocima* species feed on overripe or fermenting fruit at night, but shelter elsewhere during the day (Common 1990; Reddy *et al.* 2007). They will not be associated with grapes during harvest and will not enter the pathway.
Eulithis ledereri (Bremer, 1864) [Lepidoptera: Geometridae] oriental grape vine looper	(APHIS 2002; NPQS 2007)	**Not present on export pathway** Associated with leaves (APHIS 2002; NPQS 2007).
Euproctis piperita Oberthür, 1880 Synonym: *Atraxa piperita* Oberthür, 1880 [Lepidoptera: Lymantriidae]	(APHIS 2002; NPQS 2007)	**Not present on export pathway** Associated with leaves (APHIS 2002; NPQS 2007).
Euproctis similis (Fuessly, 1775) [Lepidoptera: Lymantriidae] brown-tail moth	(APHIS 2002; NPQS 2007)	**Not present on export pathway** Associated with leaves (APHIS 2002; NPQS 2007). *E. similis* has a wide host range including forest trees, ornamentals and cultivated crops like sweet potato. Young larvae feed in groups, usually on the lower leaf surface (Vasquez and Amante 2010).
Everes argiades (Pallas, 1771) [Lepidoptera: Lycaenidae] swift moth	(APHIS 2002)	**Not present on export pathway** Associated with leaves (APHIS 2002). Not detected in Korean grape export inspections (NPQS 2010a).
Hippotion celerio (Linnaeus, 1758) [Lepidoptera: Sphingidae] silver-striped hawk-moth	(APHIS 2002)	**Present in Australia** (Common 1990; APPD 2010; Poole 2010)

Pest	Reference for presence in Korea	Reason for exclusion
Helicoverpa armigera (Hübner, 1805) Synonym: *Heliothis armigera* (Hübner, 1805) [Lepidoptera: Noctuidae] <u>cotton bollworm</u>	(The Korean Society of Plant Protection 1986)	**Present in Australia** (Nielsen *et al.* 1996)
Herpetogramma luctuosalis (Guenee, 1854) [Lepidoptera: Pyralidae] <u>grape leaf roller</u>	(APHIS 2002; NPQS 2007)	**Not present on export pathway** The larvae feed on grape leaves by rolling the leaves into a cylinder and feeding on them from the inside. Wild and cultivated grapes are the only known hosts (Li 2004).
Hyphantria cunea (Drury, 1773) [Lepidoptera: Arctiidae] <u>mulberry moth</u>	(APHIS 2002; Grichanov and Ovsyannikova 2009b)	**Not present on export pathway** *Hyphantria cunea* larvae feed on foliage only (FAO 2007a; Grichanov and Ovsyannikova 2009b).
Illiberis tenuis (Butler, 1877) [Lepidoptera: Zygaenidae] <u>grape leaf worm</u>	(APHIS 2002; NPQS 2007; Kim *et al.* 2010)	**Not present on export pathway** Larvae feed on young shoots, flowers, leaves and occasionally on young fruit of grapevines (Zhang and Li 2005).
Ischyja manlia (Cramer, 1776) [Lepidoptera: Noctuidae] <u>fruit piercing moth</u>	(Sohn *et al.* 2005)	**Present in Australia** (Walker 2007; APPD 2010)
Lemyra imparilis (Butler, 1877) Synonym: *Spilosoma imparilis* Butler 1877 [Lepidoptera: Arctiidae] <u>mulberry tiger moth</u>	(APHIS 2002; NPQS 2007)	**Not present on export pathway** Associated with leaves (APHIS 2002; NPQS 2007). *Spilosoma imparilis* caterpillers tie the leaves together with a dense web, and feed on leaves (Kim *et al.* 2004).
Lyonetia clerkella (Linnaeus, 1758) [Lepidoptera: Lyonetiidae] <u>peach leaf miner</u>	(NPQS 2007; Ovsyannikova and Grichanov 2010)	**Not present on export pathway** Associated with leaves (NPQS 2007). The pest is counted in a complex of leaf-mining moths of plum, cherry and apple tree. Gnawing through conduction tracts, the caterpillars break leaf metabolism and cause abscission of leaves (Ovsyannikova and Grichanov 2010).
Mamestra brassicae (Linnaeus 1758) Synonym: *Barathra brassicae* Linnaeus, 1758 [Lepidoptera: Noctuidae] <u>cabbage moth</u>	(APHIS 2002)	**Not present on export pathway** Larvae feed only on foliage of grapevines (Ovsyannikova and Grichanov 2009).
Marumba *gaschkewitschii* (Bremer & Grey, 1852) [Lepidoptera: Sphingidae] <u>peach horn worm</u>	(Kim *et al.* 2006)	**Not present on export pathway** Larvae feed only on foliage (Zhang and Li 2005).
Metopta rectifasciata (Menetries, 1863) [Lepidoptera: Noctuidae]	(Yoon and Lee 1974; APHIS 2002)	**Not present on export pathway** This is a fruit-piercing moth. Fruit is attacked by adults only (APHIS 2002) and as noctuids moths are also eminently nocturnal (Richards and Davies 1977). Moths are unlikely to be associated with fruits at time of harvest.
Mocis undata (Fabricius, 1775) [Lepidoptera: Noctuidae] <u>fruit piercing moth</u>	(The Korean Society of Plant Protection 1986)	**Not present on export pathway** As adults are nocturnal fruit piercers, feeding on grapes and other fruiting plants, they will not be on the pathway at harvest (Li 2004). The larvae of this species attack the foliage of a range of plants, but do not feed on grapes (Robinson *et al.* 2008).

Pest	Reference for presence in Korea	Reason for exclusion
Mythimna turca Linnaeus 1761 [Lepidoptera: Noctuidae] double line moth	(APHIS 2002; NPQS 2007)	**Not present on export pathway** This is a fruit-piercing moth. Fruit is attacked by adults only (APHIS 2002) and as noctuids moths are also eminently nocturnal (Richards and Davies 1977) this pest is unlikely to follow the pathway. *Mythimna* species are nocturnal and hide during the day. The larvae start feeding at the onset of darkness and are rarely seen during the day (Ganesghan and Rajabalee 1996).
Naenia contaminata (Walker, 1865) [Lepidoptera: Noctuidae] Rumex black cutworm	(NPQS 2007)	**Not present on export pathway** Associated with leaves (NPQS 2007). Many Noctuid adults feed on flowers, overripe fruit or fermenting liquids. A few are able to pierce the rind of fruits to suck the juices (Common 1990).
Nokona regalis (Butler, 1878) Synonym: *Paranthrene regalis* Butler, 1878 [Lepidoptera: Sesiidae] grape clearwing moth	(The Korean Society of Plant Protection 1986)	**Not present on export pathway** The larvae bore into the tender shoots of grapevines after hatching. They develop, overwinter and pupate within the stem of grapevines (Wu and Huang 1986; Zhou 1999) and are not associated with fruit.
Ophiusa tirhaca (Cramer, 1777) Synonym: *Anua tirhaca* Cramer, 1777 [Lepidoptera: Noctuidae]	(Yoon and Lee 1974; APHIS 2002)	**Present in Australia** (APPD 2010; Poole 2010) **Not present on export pathway** Only the adults are associated with fruit (APHIS 2002). Many Noctuid adults feed on flowers, or overripe fruit or fermenting liquids. A few are able to pierce the rind of fruits to suck the juices (Common 1990).
Oraesia excavata Butler, 1878 [Lepidoptera: Noctuidae] fruit piercing moth	(APHIS 2002)	**Not present on export pathway** This species is a nocturnal fruitpiercing moth. As with other fruitpiercing Noctuid moths, adults shelter in foliage during the day (Li 2004) and will not be associated with grapes at harvest.
Oraesia emarginata (Fabricius, 1794) [Lepidoptera: Noctuidae] smaller oraesia	(Yoon and Lee 1974; APHIS 2002; NPQS 2007)	**Present in Australia** (Nielsen *et al.* 1996)
Othreis fullonia Clerck, 1764 Synonym: *Eudocima fullonia* (Clerck, 1764) [Lepidoptera: Noctuidae] fruit sucking moth	(APHIS 2002; NPQS 2007)	**Present in Australia** (Nielsen *et al.* 1996; APPD 2010)
Palpita indica Saunders, 1851 *Synonym: Diaphania indica (Saunders, 1851)* *[Lepidoptera: Pyralidae]* *cucumber moth*	(NPQS 2007)	**Present in Australia** (Choi *et al.* 2009; APPD 2010; MacLeod 2010; Poole 2010)
Paranthrene regalis (Butler, 1878) [Lepidoptera: Sesiidae] grape clearwing moth	(APHIS 2002; NPQS 2007)	**Not present on export pathway** The larvae bore into the tender shoots of grapevines after hatching. They develop, overwinter and pupate within the stem of grapevines (Wu and Huang 1986; Zhou 1999) and are not associated with fruit.

Pest	Reference for presence in Korea	Reason for exclusion
Peridroma saucia (Hübner, 1808) [Lepidoptera: Noctuidae] variegated cutworm	(Choi *et al.* 2009)	**Not present on export pathway** *P. saucia* is primarily a foliage feeder. There are reports of large outbreaks in which larvae are found feeding on developing grapes. In such situations the presence of the pest in the vineyard would be very evident. Given that an outbreak would be an unusual and obvious event, only affecting immature fruit, the chance of infested fruit being harvested is very unlikely (MAF New Zealand 2009).
Polygonia c-auerum (Linnaeus, 1758) [Lepidoptera: Nymphalidae]	(APHIS 2002)	**Not present on export pathway** Associated with leaves (APHIS 2002). Not detected in Korean grape export inspections (NPQS 2010a).
Psorosa taishanella Roesler, 1975 [Lepidoptera: Pyralidae]	(NPQS 2007)	**Not present on export pathway** Associated with leaves (NPQS 2007).
Rhagastis mongoliana (Butler, 1876) [Lepidoptera: Sphingidae] velvet hawk moth	(APHIS 2002; NPQS 2007)	**Not present on export pathway** *Rhagastis mongoliana* have been recorded on *Vitis* (Pittaway and Kitching 2006) but sphingid larvae are foliage feeders (Common 1990).
Sarbanissa subflava (Moore, 1877) Synonym: *Seudyra subflava* Moore, 1877 [Lepidoptera: Noctuidae] Boston ivy tiger-moth	(APHIS 2002; NPQS 2007)	**Not present on export pathway** The larvae feed on young shoots and leaves of grapevines (Zhang 2005).
Serrodes campana Guenee, 1852 [Lepidoptera: Noctuidae] fruit piercing moth	(Yoon and Lee 1974; APHIS 2002; NPQS 2007)	**Present in Australia** (Nielsen *et al.* 1996; APPD 2010)
Sphecodina caudata (Bremer & Grey, 1853) [Lepidoptera: Sphingidae]	(Beck and Kitching 2010)	**Not present on export pathway** The larvae feed only on leaves of grapevines (Zhang 2005).
Spilarctia subcarnea (Walker, 1855) Synonym: *Spilosoma subcarnea* Walker 1855 [Lepidoptera: Arctiidae] white tiger moth	(NPQS 2007)	**Not present on export pathway** Associated with leaves (NPQS 2007).
Spirama retorta (Clerck 1764) (As *Speiredonia retorta* Clerck, 1764 in Yoon and Lee (1974)) [Lepidoptera: Noctuidae] fruit-sucking moth	(APHIS 2002; NPQS 2007)	**Not present on export pathway** Adults are nocturnal fruit piercers, sucking the juices of grape, apple, pear and citrus, causing fruit rot (Li 2004). As with other fruit-piercing noctuid moths, adults shelter in foliage during the day and will not be associated with grapes at harvest.
Spodoptera exigua (Hubner, 1808) [Lepidoptera: Noctuidae] beet armyworm	(NPQS 2007)	**Present in Australia** (Nielsen *et al.* 1996; APPD 2010; Poole 2010)
Spodoptera litura (Fabricius, 1775) [Lepidoptera: Noctuidae] cotton leafworm	(NPQS 2007)	**Present in Australia** (Nielsen *et al.* 1996; APPD 2010; Poole 2010)
Synanthedon hector (Butler, 1878) [Lepidoptera: Sesiidae] Cherry tree borer	(NPQS 2007)	**Not present on export pathway** Associated with stem (NPQS 2007).

Pest	Reference for presence in Korea	Reason for exclusion
Theretra clotho (Drury, 1773) Synonym: *Sphinx clotho* (Drury, 1773) [Lepidoptera: Sphingidae]	(APHIS 2002)	**Present in Australia** (Common 1990; Nielsen *et al.* 1996; APPD 2010; Poole 2010)
Theretra alecto (Linneaus, 1758) [Lepidoptera: Sphingidae] hawk moth	(Pittaway and Kitching 2006)	**Not present on export pathway** Larvae feed on grapevine shoots (Pittaway and Kitching 2006). Sphingid adults feed on nectar (Common 1990).
Theretra boisduvalii (Bugnion, 1839) Synonym: *Sphinx boisduvalii* [Lepidoptera: Sphingidae] hawk moth	(Pittaway and Kitching 2006)	**Not present on export pathway** Although recorded from grapevines (Pittaway and Kitching 2006), sphingid larvae are foliage feeders. Adults feed on nectar (Common 1990).
Theretra japonica (Boisdual, 1869) [Lepidoptera: Sphingidae] small hawk moth	(APHIS 2002; NPQS 2007)	**Not present on export pathway** The larvae feed on grapevine leaves (Zhang 2005). Sphingid adults feed on nectar (Common 1990).
Theretra oldenlandiae (Fabricius, 1775) [Lepidoptera: Sphingidae] striped-back hawk moth	(APHIS 2002; NPQS 2007)	**Present in Australia** (Nielsen *et al.* 1996; Robinson *et al.* 2008; APPD 2010; Poole 2010)
Thinopteryx crocoptera Kollar, 1844 [Lepidoptera: Geometridae] colourful looper moth	(APHIS 2002; NPQS 2007)	**Not present on export pathway** Geometrid larvae are foliage feeders. This species pupates in folded leaves of the host (Barlow 1982).
Thyas dotata Fabricius [Lepidoptera: Noctuidae] fruit-piercing moth	(Yoon and Lee 1974)	**Not present on export pathway** Adults feed on grapes (Yoon and Lee 1974). As noctuids are nocturnal they only feed at night. The larvae of most noctuids feed on the live foliage of woody or herbaceous plants (Common 1990). Adults and larvae would not be associated with harvested fruit.
Thyas juno (Dalman, 1823) Synonym: *Lagoptera juno* Dalman 1823 [Lepidoptera: Noctuidae] Rose of Sharon leaflike moth	(The Korean Society of Plant Protection 1986; APHIS 2002; NPQS 2007)	**Not present on export pathway** A nocturnal fruit-piercing moth, whose adults suck the juice of fruit and shelter in foliage during the day. Larvae feed on the leaves of grape, apple, pear and walnut and are not found on fruit (Li 2004).
Trichosea champa (Moore, 1879) Synonym: *Moma champa* Moore 1879 [Lepidoptera: Noctuidae]	(The Korean Society of Plant Protection 1986)	**Not present on export pathway** Larvae feed on foliage of their host plants (Wu 1977).
Xestia c-nigram (Linnaeus, 1758) [Lepidoptera: Noctuidae] spotted cutworm	(APHIS 2002)	**Not present on export pathway** Larvae feed on foliage close to ground level at night and shelter in litter on the ground during the day (TFREC 2008; Pfeiffer 2009). They are unlikely to be associated with the fruit at time of harvest (TFREC 2008; MAF New Zealand 2009).
Zeuzera pyrina (Linnaeus, 1761) Synonym: *Zeuzera leucontum* (Butler) [Lepidoptera: Cossidae] leopard moth	(CABI 1973)	**Not present on export pathway** The larvae tunnel inside the stems and branches of grapevines where they feed on the phloem and xylem. They are not associated with grape berries (Li 2004).
Orthoptera (Grasshoppers, crickets, katydids and locusts)		
Gryllotalpa africana Palisot de Beauvois, 1805 [Orthoptera: Gryllotalpidae]	(APHIS 2002)	**Present in Australia** (CABI 1971; APPD 2010; Poole 2010)

Pest	Reference for presence in Korea	Reason for exclusion
Oecanthus indicus Saussure, 1878 [Orthoptera: Gryllotalpidae] singing tree cricket	(Kim *et al.* 2006)	**Not present on export pathway** This species lays its eggs into mature branches of grapevines, sometimes causing stem breakage (Zhang 2005).
Gryllotalpa orientalis (Burmeister, 1838) [Orthoptera: Gryllotalpidae] oriental mole cricket	(NPQS 2007)	**Not present on export pathway** Associated with soil surface (NPQS 2007). They feed on the underground parts of almost all upland crops. They occasionally cause heavy damage to the roots and basal parts of rice plants growing in raised nursery beds or upland conditions (CBIT 2010).
Holochlora japonica Brunner von Watternwyl, 1878 [Orthoptera: Tettigoniidae]	(APHIS 2002)	**Not present on export pathway** Associated with leaves (APHIS 2002). Not detected in Korean grape export inspections (NPQS 2010a).
Oecanthus longicauda Matsumura, 1904 [Orthoptera: Gryllidae] tree cricket	(APHIS 2002)	**Not present on export pathway** APHIS (2002) reports an association with the entire plant. Biosecurity Australia has determined that this reference is invalid and unsupported. Oecanthinae occur on trees and bushes (Richards and Davies 1977). Not detected in Korean grape export inspections (NPQS 2010a).
Thysanoptera (Thrips)		
Heliothrips haemorrhoidalis (Bouche, 1833) [Thysanoptera: Thiripadae]	(APHIS 2002)	**Present in Australia** (Mound 2006; APPD 2010; CABI 2010; Poole 2010)
Hercinothrips femoralis (Reuter, 1981) [Thysanoptera: Thiripadae] banded greenhouse thrips	(CABI 2010)	**Present in Australia** (Houston *et al.* 1991; APPD 2010; CABI 2010)
Scirtothrips dorsalis Hood, 1919 [Thysanoptera: Thiripadae] chilli thrips	(APHIS 2002; NPQS 2007)	**Present in Australia** (CSIRO and DAFF 2004f; CABI 2010; Poole 2010)
Thrips flavus Schrank, 1776 [Thysanoptera: Thiripadae] honey suckle thrips	(NPQS 2007)	**Not present on export pathway** Associated with flowers and leaves (NPQS 2007; CABI 2010). *Thrips flavus* damage appears as necrosis on the leaves and results in curling, deformation and withering and early senescence or deformation of flowers and inflorescences (CABI 2010).
Thrips hawaiiensis (Morgan, 1913) [Thysanoptera: Thiripadae] Hawaiian flower thrips	(APHIS 2002)	**Present in Australia** (NTDRDPIFR 2003; APPD 2010; CABI 2010; Poole 2010)
Thrips tabaci Lindeman, 1889 [Thysanoptera: Thiripadae] potato thrips	(APHIS 2002)	**Present in Australia** (APPD 2010; CABI 2010; Poole 2010)

Appendix B Additional quarantine pest data

Quarantine pest	***Tetranychus kanzawai* Kishida, 1927** [WA, EP]
Synonyms	*Tetranychus hydrangeae* Pritchard & Baker, 1955
Common name(s)	Kanzawa spider mite, hydrangea spider mite (CSIRO and DAFF 2004i; CABI 2010)
Main hosts	*Arachis hypogaea* (groundnut), *Camellia sinensis* (tea), *Carica papaya* (papaw), *Citrus*, *Fragaria ananassa* (strawberry), *Glycine max* (soybean), *Hydrangea* (hydrangea), *Humulus lupulus* (hop), *Malus domestica* (apple), *Morus alba* (mora), *Prunus avium* (sweet cherry), *Prunus persica* (peach), *Pyrus communis* (European pear), *Solanum melongena* (aubergine), *Vitis vinifera* (grapevine) (CABI 2010).
Distribution	Presence in Australia: Yes (Flechtmann and Knihicicki 2002; Halliday 2000; CSIRO and DAFF 2004i). Presence in Korea: Yes (APHIS 2002; NPQS 2007). Presence elsewhere: *Tetranychus kanzawai* has been reported from a variety of environments including North America (Mexico), Africa (South Africa), Asia (China, India, Japan, Korea, Thailand, Indonesia) and Oceania (Australia, Papua New Guinea) (Migeon and Dorkeld 2006; CABI 2010).
Quarantine pest	***Harmonia axyridis* (Pallas, 1773)** [EP]
Synonyms	None
Common name(s)	Harlequin ladybird, Multicoloured Asian lady beetle
Main hosts	Predator of soft bodied insects (e.g. aphids, scales) (Koch 2003; Brown *et al.* 2008a) in a wide range of arboreal (broadleaf and conifer) and herbaceous habitats (Ker and Carter 2004; Koch *et al.* 2006). *Cucurbita moschata* (pumpkin), *Malus domestica* (apple), *Pyrus communis* (pear), *Prunus domestica* (plum), *Prunus persica* (peach), *Rubus* (raspberry) and *Vitis vinifera* (grapevine) (Koch and Galvan 2008; EPPO 2009).
Distribution	Presence in Australia: No record found. Presence in Korea: Yes (Coderre *et al.* 1995; Koch 2003; Brown *et al.* 2008a). Presence elsewhere: China, Argentina, Austria, Belarus, Belgium, Brazil, Canada, Czech Republic, Denmark, France, Germany, Greece, Hungary, Italy, Japan, Jersey, Luxemburg, Mexico, Netherlands, Norway, Poland, Portugal, Romania, and eastern Russia (Siberia), Serbia, Slovakia, Spain, Sweden, Switzerland, Ukraine, United Kingdom and USA (Komai and Chino 1969; de Almeida and da Silva 2002; Koch 2003; Koch *et al.* 2006; Brown *et al.* 2008a; Roy and Roy 2008; EPPO 2009; Su *et al.* 2009).
Quarantine pest	***Drosophila suzukii* Matsumara, 1931** [EP]
Synonyms	None
Common name(s)	Spotted winged drosophila
Main hosts	*Cornus kousa* (Kousa dogwood), *Fragaria* spp. (strawberry), *Prunus* spp. (stone fruit), *Pyrus* spp. (pears), *Ribes* spp. (currants), *Rubus* spp. (blackberry, raspberry), *Vaccinium* spp. (blueberries) and *Vitis* spp. (grape) (CABI 2010).
Distribution	Presence in Australia: No record found. Presence in Korea: Yes (The Korean Society of Plant Protection 1986; APHIS 2002). Presence elsewhere: China, Japan, Canada and USA (CABI 2010).
Quarantine pest	***Popillia mutans* Newman, 1838** [EP]
Synonyms	*Popillia indigonacea* Motschulsky, 1854
Common name(s)	Scarab beetle, tumble-bug
Main hosts	*Dimocarpus longan* (longan) (AQSIQ 2003a), *Diospyros kaki* (sweet persimmon) (Lee et *al.* 2002c), *Litchi chinensis* (lychee) and *Vitis Vinifera* (grapevine) (AQSIQ 2003a).
Distribution	Presence in Australia: No record found. Presence in Korea: Yes (NPQS 2007). Presence elsewhere: China, French Indochina, northern India and Russia (Anonymous 2003; Li 2004; Lobl and Smetana 2006).
Quarantine pest	***Popillia quadriguttata* (Fabricius, 1787)** [EP]
Synonyms	*Trichus biguttatus* Fabricius, 1794

	Popillia chinensis Frivaldszky, 1890 *P. ruficollis* Kraatz, 1892 *P. uchidai* Niijima & Kinoshita, 1923 *P. bogdsanowi* Ballion, 1871 *P. castanoptera* Hope, 1843 *P. chinensis* Frivaldszky, 1890 *P. dichroa* Blanchard, 1851 *P. frivaldszkyi* Kraatz, 1892 *P. purpurascens* Kraatz, 1892 *P. sordida* Kraatz, 1892 *P. straminipennis* Kraatz, 1892 Previously confused with *P. japonica*; Korean specimens of *P. japonica* are apparently misidentified *P. quadriguttata* (Lee *et al.* 2007).
Common name(s)	Chinese rose beetle, white grub
Main hosts	*Acalypha australis* (Asian acalypha); *Arachis hypogaea* (peanut); *Artemisia princeps* var. *orientalis*; *Camellia sinensis* var. *sinensis* (Chinese tea); *Corylus heterophylla* (Siberian hazelnut); *Crataegus pinnatifida* (Chinese hawthorn); *Dimocarpus longan* (longan); *Dioscorea nipponica*; *Dioscorea septemloba*; *Diospyros kaki* (Japanese persimmon); *Glycine max* (soybean); *Hibiscus syriacus* (rose of Sharon); *Ilex crenata* (box-leaf holly, Japanese holly); *Ipomoea batatas* (sweet potato); *Ligustrum obtusifolium* (border privet); *Liriodendron tulipifera* (tulip tree); *Litchi chinensis* (lychee); *Malus* spp.; *Oenothera odorata* (fragrant evening primrose); *Platanus orientalis* (Oriental plane); *Populus simonii* (Chinese poplar); *Prunus* spp.; *Pteridium aquilinum* (bracken fern); *Punica granatum* (pomegranate); *Pyrus* spp.; *Quercus sp*; *Rubus* spp.; *Salix koreensis*; *Solanum* spp., including *S. tuberosum*; *Sorghum vulgare* (sorghum); *Tilia mandshurica* (Manchurian linden); *Wisteria floribunda* (Japanese wisteria); *Ulmus* spp.; *Vitis coignetiae* (crimson gloryvine); *Zanthoxylum* spp. and *Zea mays* (maize) (Sang 1979; Chung 1983; Yang *et al.* 1991; Tan 1998; Lee *et al.* 2002a; AQSIQ 2003a; AQSIQ 2003b).
Distribution	Presence in Australia: No record found. Presence in Korea: Yes (NPQS 2007). Presence elsewhere: China (AQSIQ 2006), Taiwan and Vietnam (Kim 2001) and Russian Federation (Amurland) (Lobl and Smetana 2006).
Quarantine pest	***Daktulosphaira vitifoliae* (Fitch, 1855) [EP]**
Synonyms	*Daktulosphaira vitifoliae* (Fitch) *Phylloxera vastatrix* Planchon *Phylloxera vitifoliae* (Fitch)
Common name(s)	Grapevine phylloxera, vine louse
Main hosts	The principal economic hosts are *Vitis* spp.
Distribution	Presence in Australia: NSW, Vic. (PGIBSA 2009; CABI 2010). Presence in Korea: Yes (CABI 2010). Presence elsewhere: Algeria, Argentina, Armenia, Austria, Azerbaijan, Bermuda, Bolivia, Bosnia and Herzegovina, Brazil, Bulgaria, Canada, China, Colombia, Croatia, Czech Republic, EU, France, Georgia, Germany, Greece (but not Crete), Hungary, India, Israel, Italy, Japan, Jordan, Lebanon, Luxembourg, Macedonia, Malta, Mexico, Moldova, Morocco, New Zealand, Panama, Peru, Portugal, Romania, Russia (southern), Slovakia, Slovenia, South Africa, Spain, Switzerland, Syria, Turkey, Tunisia, UK, Ukraine, Uruguay, USA, Venezuela, Yugoslavia, Zimbabwe (AQSIQ 2009; CABI 2010).
Quarantine pest	***Parthenolecanium* corni (Bouché, 1844) [WA, EP]**
Synonyms	*Coccus rosarum* Snellen van Volenhoven, 1862, *C. tiliae* Fitch, 1851, *Eulecanium corni corni* (Bouché); *E. fraxini* King, 1902, *E. guignardi* King, 1901, *E. kansasense* (Hunter) King, 1901, *E. rosae* King, 1901, *E. vini* (Bouché) Cockerell, 1901, *Lecanium* (*Eulecanium*) *armeniacum* Craw; Cockerell & Parrott, 1899, *L. (E.) assimile* Newstead; Reh, 1903, *L. (E.) aurantiacum* Hunter, 1900, *L. (E.) canadense* Cockerell; Cockerell & Parrott, 1899, *L. (E.) caryarum* Cockerell, 1898, *L. (E.) corylifex* Fitch; Cockerell, 1896, *L. (E.) crawii* Ehrhorn Cockerell & Parrott, 1899, *L. (E.) cynosbati* Fitch, Cockerell & Parrott, 1899, *L. (E.) fitchii* Cockerell & Parrott, 1899, *L. (E.) kingii* Cockerell, 1898, *L. (E.) lintneri* Cockerell & Bennett; Cockerell, 1895, *L. (E.) maclurarum* Cockerell, 1898, *L. (E.) ribis* Fitch, Cockerell & Parrott, 1899, *L. (E.) rugosum* Signoret; Cockerell, 1896, *L. (E.) rugosum* Signoret; Cockerell, 1896, *L. (E.) vini* Bouché, King & Reh, 1901, *L. adenostomae* Kuwana, 1901, *L. armeniacum* Craw, 1891, *L. assimile* Newstead, 1892, *L. canadense* Cockerell; Cockerell, 1899, *L. caryae canadense* Cockerell, 1895, *L. corni* Bouché, 1844, *L. corni robiniarum* Marchal, 1908, *L. coryli* (Linnaeus), Sulc, 1908 (misidentification), *L. corylifex* Fitch, 1857, *L. crawii* Ehrhorn, 1898, *L. cynosbati* Fitch, 1857, *L. fitchii* Signoret, 1872, *L. folsomi* King,

	1903, *L. juglandifex* Fitch, 1857, *L. kansasense* Hunter, 1899, *L. lintneri* Cockerell & Bennett in Cockerell, 1895, *L. maclurae* Hunter, 1899, *L. obtusum* Thro, 1903, *L. persicae crudum* Green, 1917, *L. pruinosum armeniacum* Craw, Tyrell, 1896, *L. rehi* King in King & Reh, 1901, *L. ribis* Fitch, 1857, *L. robiniarum* Douglas, 1890, *L. rugosum* Signoret,1873, *L. tarsalis* Signoret, 1873, *L. vini* Bouché, 1851, *L. websteri* King, 1902, *L. wistariae* Signoret, 1873, *Parthenolecanium corni* (Bouché); Borchsenius, 1957, *P. coryli* (Linnaeus); Sulc, 1908 (misidentification) (CABI 2010).
Common name(s)	European fruit lecanium, brown scale, peach scale
Main hosts	*Parthenolecanium corni* is highly polyphagous, attacking some 350 plant species placed in 40 families. It attacks a wide range of crops, mostly woody fruit trees and ornamentals. Primary hosts are: *Crataegus* (hawthorns), *Malus* (ornamental species apple), *Prunus domestica* (damson), *Prunus persica* (peach), *Ribes nigrum* (blackcurrant), *Ribes rubrum* (red currant), *Rosa* (roses), *Vitis vinifera* (grapevine) (CABI 2010).
Distribution	Presence in Australia: Yes (NSW, Vic. and Tas.) (Snare 2006; APPD 2010). Presence in Korea: Yes (NPQS 2007). Presence elsewhere: Afghanistan, Albania, Algeria, Argentina, Armenia, Austria, Azerbaijan, Belgium, Brazil, Bulgaria, Canada, China, Chile, Czech Republic, Denmark, Egypt, Finland, France, Georgia (Republic), Germany, Greece, Hungary, India, Iran, Italy, Japan, Kazakhstan, Korea (North), Korea (South), Kyrgyzstan, Latvia, Lebanon, Libya, Lithuania, Luxembourg, Malta, Mexico, Moldova, Mongolia, Netherlands, New Zealand, Norway, Pakistan, Peru, Poland, Portugal, Romania, Russian Federation, Serbia/Montenegro, Slovakia, Spain, Sweden, Switzerland, Syria, Tajikistan, Turkey, Turkmenistan, Ukraine, United Kingdom, USA, Uzbekistan, Yugoslavia (AQSIQ 2009; CABI 2010).
Quarantine pest	***Planococcus kraunhiae*** **(Kuwana, 1902)** [EP]
Synonyms	*Dactylopius kraunhiae* Kuwana, 1902 *Planococcus siakwanensis* Borchsenius, 1962 *Dactylopius krounhiae* Kuwana, 1917 *Planococcus kraunhiae* Ferris, 1950 *Pseudococcus kraunhiae* Fernald, 1903
Common name(s)	Japanese mealybug
Main hosts	*Actinidia* (kiwifruit), *Agave americana* (Century plant), *Artocarpus lanceolata*, *Broussonetia kazinoki* (Japanese paper mulberry), *Casuarina stricta* (she oak), *Citrus junos* (yuzu), *Citrus nobilis* (tangor), *Citrus paradisi* (grapefruit), *Codiaeum variegatum pictum* (variegated laurel), *Coffea arabica* (coffee), *Crinum asiaticum* (poison bulb), *Cucurbita moschata* (pumpkin), *Cydonia sinensis* (quince), *Digitaria sanguinalis* (crab-grass), *Diospyros* kaki (Japanese kaki), *Ficus carica* (fig), *Gardenia jasminoides* (common gardenia), *Ilex* (holly), *Magnolia grandiflora* (magnolia), *Mallotus japonicus* (green tiger lotus), *Morus alba* (white mulberry), *Musa basjoo* (Japanese banana), *Nandina domestica* (heavenly bamboo), *Nerium indicum* (Indian oleander), *Olea chrysophylla* (African olive), *Platanus orientalis* (oriental planetree), *Portulaca oleracea* (pigweeds), *Pyrus ussuriensis* (ornamental pear), *Rhododandron indicum* (azalea), *Trachycarpus exelsus fortunei* (wind-mill palm), *Wisteria floribunda* (Japanese wisteria) (Ben-Dov *et al.* 2010).
Distribution	Presence in Australia: No record found (ABRS 2009; APPD 2010). Presence in Korea: Yes (NPQS 2007). Presence elsewhere: China, Japan, Philippines, South Korea, USA (Kawai 1980; Fang *et al.* 2001; Ben-Dov *et al.* 2010).
Quarantine pest	***Pseudococcus comstocki*** **(Kuwana, 1902)** [EP]
Synonyms	*Dactylopius comstocki* Kuwana, 1902
Common name(s)	Comstock mealybug
Main hosts	*Acer, Aesculus* spp. (horse chestnut), *Aglaia odorata* (Chinese perfume tree), *Alnus japonica* (Japanese alder), *Amaryllis vittata*, *Artemisia*, *Buxus microphylla* (littleleaf boxwood), *Camellia japonica* (camellia), *Castanea* (chestnut), *Catalpa* (northern catalpa), *Celtis willdenowiana* (enoki), *Cinnamomum camphorae* (camphor tree), *Citrus* (citrus), *Crassula tetragona* (miniature pine tree), *Cydonia oblonga* (quince), *Cydonia sinensis* (Chinese quince), *Deutzia parviflora typical* (gaura), *Dieffenbachia picta* (dumb cane), *Erythrina indica* (rainbow eucalyptus), *Euonymus alatus* (winged euonymus), *Fatsia japonica* (Japanese aralia), *Ficus carica* (fig), *Fiwa japonica*, *Forsythia koreana* (forsythia), *Gardenia jasminoides* (gardenia), *Ginkgo biloba* (ginkgo), *Hydrangea* (hydrangea), *Ilex cornuta* (Chinese holly), *Ilex crenata microphylla* (Korean gem), *Kraunhia*, *Lagerstroemia indica* (crepe myrtle), *Ligustrum ibota angustifolium*, *Lonicera* (honeysuckle), *Loranthus* (mistletoe), *Malus pumila* (paradise apple), *Malus sylvestris* (crab apple), *Masakia japonica* (Japanese euonymus), *Monstera deliciosa* (monstera), *Morus alba* (white mulberry), *Morus kagayamae* (mulberry), *Musa* (bananas), *Nephelium lappaceum* (rambutan), *Opuntia dillenii* (prickly pear), *Orixa japonica* (Japanese orixa), *Pandanus* (screwpines), *Persica vulgaris* (peach), *Pinus thunbergiana* (Japanese black pine), *Populus* (poplar), *Prunus mume* (Japanese apricot), *Punica*

	granatum (pomegranate), *Pyrus communis* (European pear), *Pyrus serotina culta* (black cherry), *Rhamnus* (buckthorn), *Rhododendron mucronulatum* (Korean Rhododendron), *Sasamorpha* (bamboo), *Taxus* (yew), *Torreya nucifera* (Japanese torreya), *Trema orientalis* (nalita), *Viburnum awabucki* (acacia confuse), *Zinnia elegans* (zinnia) (Ben-Dov *et al.* 2010).
Distribution	Presence in Australia: No record found (APPD 2010; ABRS 2009). Presence in Korea: Yes (APHIS 2002; NPQS 2007). Presence elsewhere: Afghanistan, Argentina, Armenia, Azerbaijan, Brazil, Canada, Canary Islands, China, Columbia, Federated States of Micronesia, Indonesia, Iran, Italy, Japan, Kampuchea, Kazakhstan, Kyrgyzstan, Madeira Islands, Malaysia, Mexico, Moldova, Northern Mariana Islands, Russia, Saint Helena, Sri Lanka, Tajikistan, Turkmenistan, USA, Uzbekistan, Vietnam (Ben-Dov *et al*. 2010; CABI 2010).
Quarantine pest	***Eupoecilia ambiguella* (Hübner, 1796) [EP]**
Synonyms	*Clysia ambiguella* Hübner, 1796 *Clysiana ambiguella* Hübner *Cochylis ambiguella* Hübner, 1879 *Conchylis ambiguella* Hübner, 1796 *Tinea ambiguella* Hübner, 1796
Common name(s)	Grape moth, grape berry moth, grapevine moth, grape bud moth, vine moth
Main hosts	*Ampelopsis* (Virginia creeper), *Fraxinus* (ash), *Galium* (yellow bedstraw), *Prunus domestica* (plum), *Prunus salicina* (Japanese plum), *Prunus spinosa* (blackthorn), *Ribes nigrum* (blackcurrant), *Viburnum lantana*, *Vitis vinifera* (grapevine) (INRA 1997; CABI 2010).
Distribution	Present in Australia: No (Nielsen *et al.* 1997). CABI (2010) lists an unconfirmed record. Present in Korea: Yes (APHIS 2002; Frolov 2009a). Presence elsewhere: Armenia, Austria, Azerbaijan, Belgium, Brazil, Bulgaria, China, Czechoslovakia, Denmark, England, Finland, France, Georgia, Germany, Hungary, India, Italy, Japan, Kazakhstan, Kyrgyzstan, Latvia, Luxembourg, Moldova, Montenegro, Norway, Pakistan, Poland, Portugal, Romania, Russia, Serbia, Spain, Switzerland, Ukraine and Uzbekistan (Frolov 2009a; CABI 2010).
Quarantine pest	***Nippoptilia vitis* (Sasaki, 1913) [EP]**
Synonyms	*Stenoptilia vitis* Sasaki, 1913
Common name(s)	Grape plume moth, Small grape plume moth
Main hosts	*Vitis vinifera* (Zhang 2005).
Distribution	Presence in Australia: No record found (Nielsen *et al.* 1996). Presence in Korea: Yes (NPQS 2007). Presence elsewhere: Japan (Hori 1933) and China (Zheng *et al.* 1993; Wu and Li 1998; Li 2004; Zhang 2005; AQSIQ 2006; AQSIQ 2007).
Quarantine pest	***Sparganothis pilleriana* (Denis & Schiffermuller, 1775) [EP]**
Synonyms	*Oenophthira pilleriana* Denis & Schiffermuller, 1775 *Tortrix pilleriana* (Denis & Schiffermuller, 1775)
Common name(s)	Leaf rolling tortrix, grape berry moth
Main hosts	*Abies sachalinensis*, *Beta vulgaris* (beet), *Camellia* (tea), *Castanea*, *Centaurea*, *Citrus*, *Clematis*, *Crataegus*, *Disporum smilacinum*, *Eucalyptus* sp., *Fragaria* (strawberry), *Glycine max* (soy bean), *Helianthus annuus* (sunflower), *Humulus*, *Iris*, *Limonium vulgare*, *Lespedeza thunbergia*, *Malus* (apple), *Malus pumila*, *Medicago sativa* (alfalfa), *Narthecium*, *Origanum*, *Phaseolus vulgaris* (green bean), *Pinus* spp. (pine), *Plantago*, *Pteridium aquilinum*, *Prunus* spp (plum, apricot, cherry),. *Pyrus* (pear), *Quercus* sp., *Robina*, *Rosa* sp. (rose), *Sambucus nigra*, *Solanum tuberosum* (potato), *Stachys*, *Salix repens*, *Trifolium* sp. (clover), *Vitis vinifera* (grapevine), *Wisteria brachybotrys* and *Zea mays* (maize) (Carter 1984; Zhang 1994; Meijerman and Ulenberg 2000; INRA 2005; Frolov 2009b).
Distribution	Presence in Australia: No record found. Presence in Korea: Yes (APHIS 2002; NPQS 2007). Presence elsewhere: Middle and southern areas of the European part of the former USSR, North Caucasus, Transcaucasia, Ural, Kazakhstan, the south of Siberia, Amur Region, Primorskii Territory, southern Kuril Islands, Kamchatka. It is also distributed throughout Western Europe (northward to Sweden), North Africa, Asia Minor, China, Iran, Iraq, Mongolia, Japan, North and Central America (Carter 1984; Zhang 1994; Frolov 2009b).

Quarantine pest	***Stathmopoda auriferella* (Walker, 1864) [EP]**
Synonyms	*Gelechia auriferella* Walker, 1864 *Stathmopoda adulatrix* Meyrick, 1917 *Stathmopoda theoris* Meyrick, 1906
Common name(s)	Apple heliodinid
Main hosts	The larvae feed on the fruit, flowers and leaves of *Citrus unshiu* Marcow (unshu mandarin) in Japan (MAFF 2008). Other hosts include: *Acacia nilotica* (babul) (Robinson *et al.* 2007), *Actinidia deliciosa* (kiwifruit) (Yamazaki and Sugiura 2003), *Albizia altissima* (Sonoran desert) (Robinson *et al.* 2007), *Citrus reticulata* (mandarin) (Yamazaki and Sugiura 2003), *Citrus sinensis* (navel orange) (CABI 2010), *Cocos nucifera* (coconut palm), *Coffea canephora* (coffee), *Coffea liberica* (liberica coffee), *Helianthus annuus* (sunflower) (Yamazaki and Sugiura 2003), *Kerria communis* (lac scale) (Robinson *et al.* 2007), *Malus pumila* var. *domestica* (fuji apple) (MAFF 2008), *Mangifera indica* (mango) (CABI 2010); *Persea* spp. (avocado) (Yamazaki and Sugiura 2003), *Nephelium ophiodes*, *Pinus roxburghii* (chir pine), *Prunus salicina*, *Prunus persica* (peach), *Prunus persica* var. nucipersica (nectarine), *Punica granatum* (pomegranate) (Yamazaki and Sugiura 2003), *Sorghum bicolor bicolor* (sorghum), *Tistania* sp. (Robinson *et al.* 2007), *Vitis vinifera* (grapevine) (Yamazaki and Sugiura 2003).
Distribution	Presence in Australia: No record found (Nielsen *et al.* 1996). Presence in Korea: Yes (APHIS 2002; NPQS 2007). Presence elsewhere: China (Hiramatsu *et al.* 2001; Shanghai Insect Science Network 2009), Egypt (Badr *et al.* 1983); Greece (Nel and Nel 2003); India (Robinson *et al.* 2007); Indonesia, Japan (Osaka City, Honshu) (Yamazaki and Sugiura 2003); Malaysia, Pakistan, Philippines, Seychelles, Sri Lanka, Thailand (Robinson *et al.* 2007).
Quarantine pest	***Frankliniella occidentalis* Pergande, 1895 [NT, EP]**
Synonyms	*Euthrips helianthi* Moulton, 1911 *Euthrips tritici californicus* Moulton, 1911 *Frankliniella chrysanthemi* Kurosawa, 1941 *Frankliniella canadensis* Morgan, 1925 *Frankliniella claripennis* Morgan, 1925 *Frankliniella conspicua* Moulton, 1936 *Frankliniella dahliae* Moulton, 1948 *Frankliniella dianthi* Moulton, 1948 *Frankliniella nubila* Treherne, 1924 *Frankliniella occidentalis brunnescens* Priesner, 1932 *Frankliniella occidentalis dubia* Priesner, 1932 *Frankliniella syringae* Moulton, 1948 *Frankliniella trehernei* Morgan, 1925 *Frankliniella tritici maculata* Priesner, 1925 *Frankliniella tritici moultoni* Hood, 1914 *Frankliniella umbrosa* Moulton, 1948 *Frankliniella venusta* Moulton, 1936
Common name(s)	Western flower thrips
Main hosts	*Allium cepa* (onion), *Amaranthus palmeri* (Palmer amaranth), *Arachis hypogaea* (groundnut), *Begonia*, *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*, *Solanum lycopersicum* (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 2010).
Distribution	Presence in Australia: NSW, Qld, SA, WA, Tas., Vic. (ABRS 2009; CABI 2010; DPIPWE Tasmania 2010). Presence in Korea: Yes (APHIS 2002; NPQS 2007). Presence elsewhere: Albania, Algeria, Argentina, Austria, Belgium, Brazil, Bulgaria, Canada, Chile, China, Colombia, Costa Rica, Croatia, Cyprus, Czech Republic, Denmark, Dominican Republic, Ecuador, Estonia, Finland, France, Germany, Greece, Guana, Guatemala, Hungary, Ireland, Israel, Japan, Kenya, Kuwait, Lithuania, Macedonia, Malaysia, Malta, Martinique, Mexico, Morocco, Netherlands, New Zealand, Norway, Peru, Poland, Portugal, Puerto Rico, Romania, Russia, Serbia/Montenegro, Slovakia, Slovenia, South Africa, Spain, Sri Lanka, Swaziland, Sweden, Switzerland, United Kingdom, USA, Turkey, Uruguay, Venezuela, Zimbabwe (Ren 2006; Wu *et al.* 2009; CABI 2010).
Quarantine pest	***Physalospora baccae* Cavara 1888** [EP]
Synonyms	There has been some debate about the taxonomy of *Physalospora baccae*. The name *Physalospora baccae* Cavara is a *nomen dubium* of unknown application. There is therefore no way of establishing that the grape pathogen to which this name is applied in Japan and Korea is the same as the original European pathogen. The grape pathogen should be designated as '*Physalospora baccae* sensu Asian authors' (Harman 2009). Japanese usage appears to be based on studies such as Nishikado (1921), which applied old and outdated taxonomic concepts. However, '*Physalospora baccae* sensu Nishikado non Cavara' has been listed in NIAS Genebank as the current name for *Physalospora baccae* recorded in Japan. In China, *Physalospora baccae* Cavara has been known as a synonym of *Guignardia baccae* (Cav.) Trcz. (Qi *et al.* 2007), which itself is not a valid name. *Guignardia baccae* (Cav.) Trcz was included in the pest list provided by AQSIQ (2006).
Common name(s)	Grape cluster black rot
Main hosts	Host range is *Vitis* spp. (Zhang 2005; NYZSW 2009).
Distribution	Presence in Australia: No record found (APPD 2010). Presence in Korea: Yes (Shin *et al.* 1984; APHIS 2002). Presence elsewhere: Besarabia, China, Japan, Portugal, Spain (Nishikado 1921; Bensaude 1926; Berro Aguilera 1926; Vekesciaghin 1933; Shin *et al.* 1984; Zhang 2005; NYZSW 2009).
Quarantine pest	***Phakopsora euvitis* Y. Ono 2000** [EP]
Synonyms	*Aecidium meliosmae-myrianthae* Henn. & Shirae *Phakopsora ampelopsidis* pro parte *Physopella ampelopsidis* pro parte *Physopella vialae* (Lagerh.) Buriticá & J.F. Hennen *Physopella vitis* (Thüm.) Arthur *Uredo vialae* Largerh *Uredo vitis* Thüm
Common name(s)	Grapevine rust
Main hosts	*Vitis* spp. (mainly *V. labrusca*, *V. vinifera*, but also *V. amurensis*, *V. coignetiae*, *V. ficifolia*, *V. flexuosa*). *Phakopsora euvitis* is a heteroecious rust. Pycnidia and aecia have only been observed in Japan on *Meliosma myriantha*. In most other areas, only uredia and telia are produced.
Distribution	Presence in Australia: No. The pest was recorded in the Northern Territory (Weinert *et al.* 2003) but declared eradicated in 2006 (Liberato *et al.* 2007). Presence in Korea: Yes (Farr and Rossman 2010). Presence elsewhere: Bangladesh, Barbados, Brazil, Colombia, China, Costa Rica, Cuba, Guatemala, India, Indonesia, Jamaica, Japan, Korea, Malaysia, Myanmar, Nepal, Philippines, Puerto Rico, Russian Far East, Sri Lanka, Thailand, Trinidad and Tobago, USA, Venezuela, Vietnam, Virgin Islands (AQSIQ 2009; CABI 2010).
Quarantine pest	***Phomopsis viticola* (Sacc.) Sacc. 1915** [WA, EP]
Synonyms	*Phoma viticola* Sacc., *Phoma flaccida* Viala & Ravaz, *Cryptosporella viticola* Shear, *Diaporthe viticola* Nitschke, *Fusicoccum viticolum* Reddick, *Diplodia viticola* Desm. (CABI 2010)
Common name(s)	Phomopsis cane and leaf spot, Phomopsis cane and leaf blight, grapevine black knot, grapevine necrosis, grapevine dead arm (CABI 2010)
Main hosts	*Parthenocissus quinquefolia* (Virginia creeper), *Vitis labrusca* (fox grape), *Vitis rupestris* (North American grapevine) and *Vitis vinifera* (Eurasian grapevine) (CABI 2010). *Ampelopsis quiquefolia*, *Vitis aestivalis* (summer grape) and *Vitis rotundifolia* (Muscadine grape). There is a report of *P. viticola* being isolated from blueberries (*Vaccinium* spp.) but no symptoms were associated with the pathogen on blueberries (Espinoza *et al.* 2008).

Distribution	Presence in Australia: NSW, Vic. and SA but not in WA (Merrin *et al.* 1995); Qld (APPD 2009); Tas. (Mostert *et al.* 2001). Presence in Korea: Yes (APHIS 2002; NPQS 2007). Presence elsewhere: Austria, Belgium, Bosnia/Herzegovina, Brazil, Brunei Darussalam, Bulgaria, Canada, Chile, China, Croatia, Egypt, France, Georgia, Germany, Greece, Hungary, India, Italy, Japan, Kenya, Macedonia, Mexico, Moldova, Netherlands, New Zealand, Poland, Portugal, Romania, Russian Federation, Serbia/Montenegro, Slovenia, South Africa, Spain, Switzerland, Turkey, Ukraine, United Kingdom, USA, Venezuela, Yugoslavia, Zimbabwe (Hewitt and Pearson 1994; AQSIQ 2007; CABI 2010).
Quarantine pest	***Tomato ringspot virus*** **EP**
Synonyms	Tobacco ringspot No. 2 Nicotiana virus 13 Peach yellow bud mosaic virus (strain) Blackberry (Himalaya) mosaic virus Winter peach mosaic virus Grape yellow vein virus (strain) (CABI and EPPO 1997)
Common name(s)	Ringspot and mosaic (in various hosts), Eola rasp leaf (in cherries), yellow bud mosaic (in peaches), yellow vein (in grapes), stunt or stub head (in Gladiolus), decline, crumby berry and yellow blotch curl (in raspberries), chlorosis (in Pelargonium) (English), Tomatenringfleckenkrankheit (German) (CABI and EPPO 1997)
Main hosts	*Cornus* sp. (dogwood), *Cucumis sativus* (cucumber), *Euonymus* spp., *Fragaria* x *ananassa* (strawberry), *Fraxinus americana* (ash), *Gladiolus* sp., *Glycine max* (soybean), *Hydrangea* sp., *Lotus corniculatus* (birdsfoot-trifoil), *Malus domestica* (apple), *Nicotiana tabacum* (tobacco), Orchidaceae, *Pelargonium* sp., *Pentas lanceolata* (Egyptian starflower), *Phaseolus vulgaris* (common bean), *Prunus* spp., *Ribes nigrum* (black currant), *Ribes rubrum* (red current), *Ribes uva-crispa* (gooseberry), *Rubus* sp. (blackberry), *Rubus idaeus* (raspberry), *Sambucus canadensis* (elderberry), *Solanum lycopersicum* (tomato), *Solanum tuberosum* (potato), *Vaccinium corymbosum* (blueberry), *Vigna unguiculata* (cowpea), *Vitis vinifera* (grapevine) (Chu *et al.* 1983; Stace-Smith 1984; Sherf and MacNab 1986; Brown *et al.* 1993; CABI and EPPO 1997; EPPO 2005; Adaskaveg *et al.* 2009; Gubler *et al.* 2009) and weeds, including *Chenopodium berlandieri* (lambsquarters), *Cichorium intyhus* (chicory), *Euphorbia* spp. (spurge), *Malva parviflora* (little mallow), *Medicago lupulina* (black medic), *Picris echioides* (bristly oxtongue), *Plantago* spp. (plaintain), *Prunella vulgaris* (healall), *Rumex acetosell* (sheep sorrel), *Stellaria* spp. (common chickweed), *Taraxacum officinale* (dandelion), *Trifolium repens* (white clover), *Verbascum* spp. (mullein) and *Verbascum blattaria* (moth mullein) (Powell *et al.* 1984; Tuttle and Gotlieb 1985; Gubler *et al.* 2009).
Distribution	Presence in Australia: No. Listed in CABI (2010) as present in Australia based on a record in South Australia (Chu *et al.*1983). There have been no records since then. The virus has not been recorded in any other Australian state and is believed to be absent. Presence in Korea: Yes (APHIS 2002; CABI 2010). Presence elsewhere: Argentina, Belarus, Canada, Chile, China, Croatia, Egypt, Finland, France, Germany, Greece, Iran, Ireland, Italy, Japan, Jordan, Lithuania, Mexico, New Zealand, Oman, Pakistan, Peru, Russian Federation, Serbia and Montenegro, Puerto Rico, Slovakia, Slovenia, Taiwan, Togo, Tunisia, Turkey, UK, USA, Venezuela (CABI and EPPO 1997; CABI 2010).

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[3], 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.

[3] 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).

The Biosecurity Services Group (BSG) within the Department takes the lead in biosecurity and quarantine policy development and implementation of risk management measures across the biosecurity continuum, and:

- through 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
- through the Australian Quarantine and Inspection Service (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
- 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. The BSG works in partnership with state and territory governments to address regional differences in pest and disease status and risk within Australia, and develops 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 (update 2009)* is consistent with Australia's international obligations under the SPS Agreement. It also takes into account relevant international standards on risk assessment developed under the International Plant Protection Convention (IPPC) and by the World Organisation for Animal Health (OIE).

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

Notification obligations

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

Risk analysis

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

In conducting a risk analysis, Biosecurity Australia:

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

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

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

Risk analyses are conducted across a spectrum of scientific complexity and available scientific information. An IRA is a type of risk analysis with key steps regulated under the Quarantine Regulations 2000. Biosecurity Australia's assessment of risk may also take the form of a non-regulated analysis of existing policy or technical advice to AQIS. Further information on the types of risk analysis is provided in the *Import Risk Analysis Handbook 2007 (update 2009).*

Glossary

Term or abbreviation	Definition
Additional declaration	A statement that is required by an importing country to be entered on a phytosanitary certificate and which provides specific additional information on a consignment in relation to regulated pests (FAO 2009).
Appropriate level of protection (ALOP)	The level of protection deemed appropriate by the Member establishing a sanitary or phytosanitary measure to protect human, animal or plant life or health within its territory (WTO 1995).
Area	An officially defined country, part of a country or all or parts of several countries (FAO 2009).
Area of low pest prevalence	An area, whether all of a country, part of a country, or all parts of several countries, as identified by the competent authorities, in which a specific pest occurs at low levels and which is subject to effective surveillance, control or eradication measures (FAO 2009).
Biosecurity Australia	The unit, within the Biosecurity Services Group, responsible for recommendations for the development of Australia's biosecurity policy.
Biosecurity Services Group (BSG)	The group responsible for the delivery of biosecurity policy and quarantine services within the Department of Agriculture, Fisheries and Forestry.
Certificate	An official document which attests to the phytosanitary status of any consignment affected by phytosanitary regulations (FAO 2009).
Consignment	A quantity of plants, plant products and/or other articles being moved from one country to another and covered, when required, by a single phytosanitary certificate (a consignment may be composed of one or more commodities or lots) (FAO 2009).
Control (of a pest)	Suppression, containment or eradication of a pest population (FAO 2009).
Endangered area	An area where ecological factors favour the establishment of a pest whose presence in the area will result in economically important loss (FAO 2009).
Entry (of a pest)	Movement of a pest into an area where it is not yet present, or present but not widely distributed and being officially controlled (FAO 2009).
Establishment	Perpetuation, for the foreseeable future, of a pest within an area after entry (FAO 2009).
Fresh	Living; not dried, deep-frozen or otherwise conserved (FAO 2009).
Host range	Species capable, under natural conditions, of sustaining a specific pest or other organism (FAO 2009).
Import permit	Official document authorising importation of a commodity in accordance with specified phytosanitary import requirements (FAO 2009).
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 2009).
Inspection	Official visual examination of plants, plant products or other regulated articles to determine if pests are present and/or to determine compliance with phytosanitary regulations (FAO 2009).
Intended use	Declared purpose for which plants, plant products, or other regulated articles are imported, produced, or used (FAO 2009).
Interception (of a pest)	The detection of a pest during inspection or testing of an imported consignment (FAO 2009).
International Standard for Phytosanitary Measures (ISPM)	An international standard adopted by the Conference of the Food and Agriculture Organization, the Interim Commission on phytosanitary measures or the Commission on phytosanitary measures, established under the IPCC (FAO 2009).
Introduction	The entry of a pest resulting in its establishment (FAO 2009).
Lot	A number of units of a single commodity, identifiable by its homogeneity of composition, origin etc., forming part of a consignment (FAO 2009).
National Plant Protection Organization (NPPO)	Official service established by a government to discharge the functions specified by the IPPC (FAO 2009).

Term or abbreviation	Definition
Official control	The active enforcement of mandatory phytosanitary regulations and the application of mandatory phytosanitary procedures with the objective of eradication or containment of quarantine pests or for the management of regulated non-quarantine pests (FAO 2009).
Pathway	Any means that allows the entry or spread of a pest (FAO 2009).
Pest	Any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products (FAO 2009).
Pest categorisation	The process for determining whether a pest has or has not the characteristics of a quarantine pest or those of a regulated non-quarantine pest (FAO 2009).
Pest free area (PFA)	An area in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained (FAO 2009).
Pest free place of production	Place of production in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained for a defined period (FAO 2009).
Pest free production site	A defined portion of a place of production in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this conditions is being officially maintained for a defined period and that is managed as a separate unit in the same way as a pest free place of production (FAO 2009).
Pest risk analysis (PRA)	The process of evaluating biological or other scientific and economic evidence to determine whether an organism is a pest, whether it should be regulated, and the strength of any phytosanitary measures to be taken against it (FAO 2009).
Pest risk assessment (for quarantine pests)	Evaluation of the probability of the introduction and spread of a pest and of the associated potential economic consequences (FAO 2009).
Pest risk management (for quarantine pests)	Evaluation and selection of options to reduce the risk of introduction and spread of a pest (FAO 2009).
Phytosanitary certificate	Certificate patterned after the model certificates of the IPPC (FAO 2009).
Phytosanitary measure	Any legislation, regulation or official procedure having the purpose to prevent the introduction and/or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests (FAO 2009).
Phytosanitary regulation	Official rule to prevent the introduction and/or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests, including establishment of procedures for phytosanitary certification (FAO 2009).
Polyphagous	Feeding on a relatively large number of hosts from different genera.
PRA area	Area in relation to which a pest risk analysis is conducted (FAO 2009).
Quarantine pest	A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled (FAO 2009).
Regulated article	Any plant, plant product, storage place, packing, conveyance, container, soil and any other organism, object or material capable of harbouring or spreading pests, deemed to require phytosanitary measures, particularly where international transportation is involved (FAO 2009).
Restricted risk	Risk estimate with phytosanitary measure(s) applied.
Spread	Expansion of the geographical distribution of a pest within an area (FAO 2009).
SPS Agreement	WTO Agreement on the Application of Sanitary and Phytosanitary Measures (WTO 1995).
Stakeholders	Government agencies, individuals, community or industry groups or organizations, whether in Australia or overseas, including the proponent/applicant for a specific proposal, who have an interest in the policy issues.
Systems approach(es)	The integration of different risk management measures, at least two of which act independently, and which cumulatively achieve the appropriate level of protection against regulated pests (FAO 2009).
Unrestricted risk	Unrestricted risk estimates apply in the absence of risk mitigation measures.

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