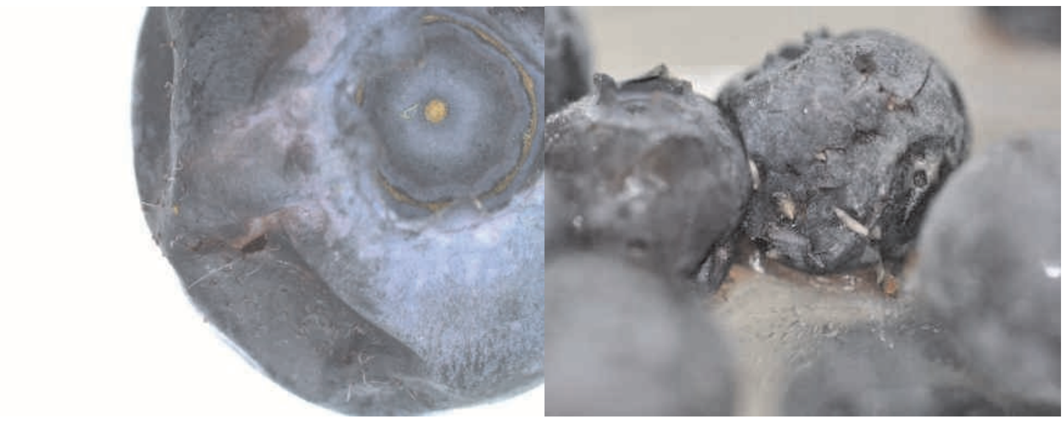
Australian Government

Biosecurity Australia

Draft pest risk analysis report for *Drosophila suzukii*



October 2010

Cite this report as:
Biosecurity Australia (2010) *Draft pest risk analysis report for* Drosophila suzukii. Biosecurity Australia, Canberra.

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Cover images: Adult *Drosophila suzukii*, female (left) and male (right) (Hauser & Damus 2009), oviposition and initial damage on blueberry (respiratory tubes can be seen) and larval damage on blueberry (white larvae can be seen) (Oregon State University 2010)

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Acronyms and abbreviations

Acronym or abbreviation	Definition
ALOP	Appropriate level of protection
APHIS	Animal and Plant Health Inspection Service
AQIS	Australian Quarantine and Inspection Service
ARS	Agricultural Research Service
DAFF	Australian Government Department of Agriculture, Fisheries and Forestry
FAO	Food and Agriculture Organization of the United Nations
IPM	Integrated Pest Management
IPPC	International Plant Protection Convention
IRA	Import Risk Analysis
ISPM	International Standard for Phytosanitary Measures
NPPO	National Plant Protection Organisation
ODA	Oregon Department of Agriculture
OSU	Oregon State University
PRA	Pest Risk Analysis
SPS	sanitary and phytosanitary
USA	United States of America
USDA	United States Department of Agriculture

Summary

Biosecurity Australia has undertaken a pest risk analysis to assess the quarantine risks posed by *Drosophila suzukii* which attacks a range of soft fruits, including caneberries, strawberries, cherries, blueberries, grapes and stone fruit.

The pest risk analysis meets Australia's obligations under the International Plant Protection Convention and the International Standards for Phytosanitary Measures (ISPM No. 1) to review emergency phytosanitary measures that were notified on 7 April 2010 through the World Trade Organization.

This draft pest risk analysis report identified two pathways, of several commodity groups, as potential pathways for the introduction of *Drosophila suzukii* with an unrestricted risk that exceeds Australia's acceptable level of protection (ALOP).

- Fresh fruit: caneberries, stone fruit, strawberry, blueberry, grapes, mulberries, hardy kiwis, silverberries, dogwood, Surinam cherry, red bayberry, orange jessamine, American pokeweed
- Fresh flowers: Camellia and Japanese snowbell.

This draft pest risk analysis report recommends that additional measures be applied to fresh fruit and flowers of identified plant species being sourced from areas where *Drosophila suzukii* is known to occur.

A combination of risk management measures and operational systems are proposed to reduce the risks associated with the importation of identified commodities. Specifically, the proposed measures are:

- For fruit potentially carrying life stages of *Drosophila suzukii*:
  - area freedom from *Drosophila suzukii*; or
  - a systems approach for fruit with pre- and post-harvest measures to ensure that fruit are not infested with *Drosophila suzukii*; or
  - application to fruit of a treatment known to be effective against all life stages of *Drosophila suzukii*; and
  - supporting operational systems to maintain and verify phytosanitary status.
- For fresh flowers potentially carrying life stages of *Drosophila suzukii*:
  - area freedom from *Drosophila suzukii*; or
  - application to fruit of a treatment known to be effective against all life stages of *Drosophila suzukii*; and
  - supporting operational systems to maintain and verify phytosanitary status.

The draft report has been released for a period of 60 days to allow stakeholders' to comment before a final report is issued.

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 pest risk analysis (PRA) 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 PRAs 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.

1.2 This pest risk analysis

1.2.1 Background

A pest attacking a range of soft fruits was first recorded from North America in the Watsonville area of California in 2008 (Bolda 2009; Hauser *et al*. 2009). Samples of the pest obtained in September 2008 were identified as a species of *Drosophila*. Species of *Drosophila* are attracted to fermenting, over-ripe and rotting fruit, and are well known nuisance pests in restaurants, grocery stores, fruit markets and homes (Jacobs 2010). Since *Drosophila* species were not known to attack fruit after harvest in the USA, and

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

are attracted to over-ripe fruit, it was not considered to be a pest of concern for commercial fruit growers (Hauser *et al*. 2009).

However, reports of damage continued in spring of 2009 and several adults submitted for identification were determined to be *Drosophila suzukii,* a species which caused damage to fruit in Japan (Hauser *et al*. 2009). In September 2009, the initial reports of *Drosophila suzukii* attacking commercial fruit in Western USA were confirmed by an Oregon Department of Agriculture pest alert (ODA 2009).

Drosophila suzukii has subsequently been confirmed as present in Canada (British Columbia) (NAPPO 2010a) and the USA (California, Florida, Oregon and Washington) (NAPPO 2010b) in North America. *Drosophila suzukii* was detected in Italy in September 2009 (EPPO 2010a) and has been reported as present in Spain and France (Calabria *et al*. *in press*). *Drosophila suzukii* is also native to several Asian countries including Japan, South Korea, China and India (Kanzawa 1939; Toda 1991; Hauser *et al*. 2009).

The presence of this new pest in the USA and the potential for its introduction 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 cherries (*Prunus avium*), strawberries (*Fragaria* x *ananassa*), stone fruit (*Prunus* spp.) and table grapes (*Vitis* spp.) for human consumption from all countries.

In response to Australia's concerns over *Drosophila suzukii*, and the imminent emergency measures notification, the USA proposed interim conditions for the importation of strawberries, cherries and table grapes. In accordance with international obligations under the Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement), Australia is obliged to consider emergency measures that could address the risk of a pest entering and establishing in Australia. For strawberries, cherries and table grapes, emergency measures included methyl bromide fumigation based on preliminary fumigation data for each commodity that showed 100% mortality of *Drosophila suzukii*. Until a complete submission on the efficacy of methyl bromide fumigation could be accepted, emergency measures included an additional verification inspection, using fruit cuts and optical magnification, to confirm the efficacy of the treatment. Stakeholders were notified of the interim import conditions via Australian Quarantine Inspection Service (AQIS) alerts, PQA0655 (strawberry) on 30 March and PQA0665 (cherry) on 18 May and PQA0679 (table grape) on 13 August on the Import Conditions (ICON) database. The interim conditions are in addition to existing policy (Table 1.1).

Biosecurity Australia commenced a pest risk analysis (PRA) for *Drosophila suzukii,* consistent with Australia's international obligations, to assess the risks posed by the importation of fresh fruit commodities. Stakeholders were notified of the commencement of the pest initiated PRA by a Biosecurity Australia Advice on 31 March 2010. The PRA considers all fruit pathways, because although *Drosophila suzukii* is mostly found on members of the Rosaceae, it has been reported from plants in the Ericaceae, Vitaceae, Actinidaceae, Moraceae, Cornaceae and Myricaceae families (Dreves *et al*. 2009; NAPPO 2010a). These hosts include a range of cultivated and non-cultivated plants that are widely distributed in Australia (AVH 2010).

Recently, *Drosophila suzukii* has been confirmed to attack the flowers of *Styrax japonicus* (Japanese snowbell) where adults successfully emerged from the flowers (Mitsui *et al*. 2010).

1.2.2 Scope

This PRA assesses the biosecurity risks of the importation of *Drosophila suzukii* in the following pathways:

- commercial grade fruit identified as hosts; and
- commercial grade flowers identified as hosts.

The risk for these pathways was assessed using information on the biology, ecology and impact of *Drosophila suzukii*.

Phytosanitary conditions exist for the import of a number of fresh fruit identified as hosts for *Drosophila suzukii*. Depending on the commodity and the risk posed by other pests of quarantine concern, these conditions include:

- pre-clearance or on-arrival inspection by the Australian Quarantine and Inspection Service (AQIS) of fruit from specified countries;
- methyl bromide fumigation; and
- carbon dioxide/sulphur dioxide fumigation.

However, this pest risk analysis does not consider these specific phytosanitary measures during the pest risk assessments for the fruit pathways as existing measures will vary depending on the commodity and where the fruit is sourced. Phytosanitary measures already in place are considered during the development of risk management measures, if required, following the pest risk assessment.

Imported commercial grade fruit will be produced to a standard suitable for retail sale. It is expected the commercial grade fruit sent to Australia will be graded and sorted to meet retail quality requirements and is likely to be sound and undamaged. The pathway analysis will take into consideration the commercial standard of the fruit in accordance with relevant international standards (FAO 2004).

The PRA considers fresh fruit or flowers that are commercially produced in greenhouses or the field.

1.2.3 Existing policy

Australia has existing conditions in place to allow the importation of a range of fresh fruits and flowers that are suitable hosts for *Drosophila suzukii*. Fresh fruits for which Australia has imposed emergency measures to manage the risk of *Drosophila suzukii*, and their exisiting import conditions, are listed in Table 1.1. There are no existing import conditions for fresh flowers considered to be hosts of *Drosophila suzukii* (Table 1.2). Nursery stock can be imported and standard import conditions include methyl bromide fumigation followed by three months in post entry quarantine. In addition, it is standard practise to remove reproductive structures to improve vegetative growth of the imported nursery stock. Import conditions can be viewed on the AQIS ICON database available at http://www.aqis.gov.au/icon.

Table 1.1: Import conditions for fresh fruits hosts for *Drosophila suzukii*

Family	Host	ICON Conditions Fresh Fruit permitted?
Rosaceae	*Rubus* spp. Caneberries	**No** (C6066)
	Fragaria spp. Strawberry	**Yes** USA (C6000, C6044, C6030) **Yes** NZ (C6000, C6044, C6012)
	Prunus persica var. *nucipersica* Nectarines	**Yes** NZ (C6000, C6012, C10579)
	Prunus persica Peaches	**Yes** NZ (C6000, C6012, C10579)
	Prunus armeniaca Apricots	**Yes** NZ (C6000, C6012, C10579)
	Prunus avium Cherry	**Yes** NZ (C6000, C6012). **Yes** USA (C18469, C6000)
	Prunus domestica Plums	**Yes** NZ (C6000, C6012, C10579)
Ericaceae	*Vaccinium augustifolium* and *V. corymbosum* Blueberry	**Yes** NZ (C6000, C6012, C10049)
Vitaceae	*Vitis* spp. grapes	**Yes** NZ (C6000, C6051, C6015; No access for WA, C9814) **Yes** Chile (C10523) **Yes** USA (C9287)
	Vitis labrusca Concord grapes	**No**
Moraceae	*Morus* spp. Mulberry	**No** (C6066)
Actinidiaceae	*Actinidia arguta* Hardy kiwi	**Yes** NZ (C6000, C6012)
Myrtaceae	*Eugenia uniflora*	**No** (C6066)
Cornaceae	*Cornus kousa* Dogwood	**No**
Myricaceae	*Myrica rubra* Red bayberry	**No**
Elaegnaceae	*Elaeagnus multiflora* Silver berry	**No**
Rutaceae	*Murraya paniculata*	**No**
Garryaceae	*Aucuba japonica*	**No**
Phytolaccaceae	*Phytolacca americana*	**No**

Table 1.2: Import conditions for fresh flower hosts for *Drosophila suzukii*

Family	Host	ICON Conditions Fresh Flowers permitted?
Styracaceae	*Styrax japonicus*	**Fresh Flowers – No** **Nursery stock – Yes** (C7301, C7302, C7300)
Theaceae	*Camellia japonica*	**Fresh Flowers – No** **Nursery stock** – **No** Canada (C15015) **No** European countries (C15015) **No** NZ (C15015) **No** USA (C15015) **Yes** All other countries (nursery stock permitted; C15020)

2 Method for pest risk analysis

This section sets out the method used for the pest risk analysis (PRA) in this report. Biosecurity Australia has conducted this PRA in accordance with the International Standards for Phytosanitary Measures (ISPMs), including ISPM 2: *Framework for Pest Risk Analysis* (FAO 2007) and ISPM 11: *Pest Risk Analysis for Quarantine Pests, including analysis of environmental risks and living modified organisms* (FAO 2004).

A PRA is 'the process of evaluating biological or other scientific and economic evidence to determine whether an organism is a pest, whether it 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 from imports; and the consequences should this happen. These two components are combined to give an overall estimate of the risk.

Unrestricted risk is estimated taking into account the existing commercial production practices of the exporting country and that, on arrival in Australia, AQIS will verify that the consignment received is as described on the commercial documents and its 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/or 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 PRA 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.

For *Drosophila suzukii*, careful consideration was given to identify the potential pathways for the entry of this pest into Australia.

For this PRA, the 'PRA area' is defined as all of Australia.

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).

The following three, consecutive steps were used in this pest risk assessment:

2.2.1 Pest categorisation

Pest categorisation is a process to examine, for each pest, whether the criteria for a quarantine pest are satisfied. A quarantine pest is defined as '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). The process of pest categorisation is summarised by the IPPC in the five elements outlined below:

- 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.

This report is a pest initiated PRA that considers the risk of one pest that could enter by multiple pathways. The results for pathway association for *Drosophila suzukii* are listed in Appendix B and are summarized in Chapter 4.

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 PRA.

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, the generation and disposal of waste and the presence and availability of suitable hosts in Australia. In particular, the ability of the pest to survive is considered for each of these various stages.

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 (e.g. grading and sorting) 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 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 are given in Table 2.1.

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 *P* [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 likelihoods of entry *P* [entry] and establishment P[establishment]. The result is then combined with the likelihood of spread *P* [spread] to determine the overall likelihood of entry, establishment and spread *P* [EES]. A working example is provided below;

P [importation] x *P* [distribution] = *P* [**entry**] e.g. **low x moderate = low**

P [entry] x *P* [establishment] = *P* [**EE**] e.g. **low x high = low**

P [**EE**] x [spread] = ***P* [EES]** e.g. **low x very low = 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.

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 2.4 were adjusted accordingly.

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

Impact score	Local	District	Region	Nation
G	Major significance	Major significance	Major significance	Major significance
F	Major significance	Major significance	Major significance	Significant
E	Major significance	Major significance	Significant	Minor significance
D	Major significance	Significant	Minor significance	Indiscernible
C	Significant	Minor significance	Indiscernible	Indiscernible
B	Minor significance	Indiscernible	Indiscernible	Indiscernible
A	Indiscernible	Indiscernible	Indiscernible	Indiscernible

Geographic scale

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 likelihood 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 Pest information

3.1 Summary

Scientific name	*Drosophila suzukii* Matsumura, 1931 [Diptera: Drosophilidae]
Synonyms	*Drosophila indicus* Parshad & Paika, 1965 *Leucophenga suzukii* Matsumura, 1931 *Drosophila suzukii* subsp. *indicus* Pashan & Paika, 1964
Common name	Spotted wing drosophila, cherry drosophila
Known hosts	Includes *Fragaria* spp., *Prunus* spp., *Rubus* spp., *Vaccinium* spp., *Vitis* spp., and *Morus* spp. (see Appendix B for a full list)
Distribution	Asia, North America and Europe (see table 3.1)

3.2 Drosophila suzukii

The family Drosophilidae is composed of over 3 750 species worldwide and over 2 000 of these are species of *Drosophila* (Ashburner *et al*. 2005; Van Der Linde and Houle 2008; O'Grady and Markow 2009). Species of *Drosophila* are well known because of the extensive use of *Drosophila melanogaster* in genetic studies and as common vinegar flies associated with over-ripe and rotting fruit (Ashburner *et al*. 2005; Hauser *et al*. 2009; Jacobs 2010). Species of *Drosophila* are well known nuisance pests in restaurants, grocery stores, fruit markets and homes (Jacobs 2010).

In Australia there are approximately 34 described species of *Drosophila* and 22 of these are from the Sophophora sub genus group (AFD 2010). *Drosophlia suzukii* is one of 180 species of the melanogaster species group within the Sophophora sub genus group (Ashburner *et al*. 2005). *Drosophila suzukii* is part of a poorly described *suzukii* sub group of Oriental species that is considered polyphyletic (composed of more than one ancestral lineage).

In June, 1916, insect larvae were found to be infesting cherries (*Prunus avium*) pre harvest in Yamacho, Higashi Yamanashi County, Yamanashi Prefecture, Japan (Kanzawa 1935). Infested fruit was collected and the adult flies that emerged were confirmed as a species of *Drosophila* (Kanzawa 1935). The species was later described in 1931 by Dr Shounen Matsumura as *Drosophila suzukii* Matsumura, and he gave it the common name of cherry drosophila (Kanzawa 1935).

Recently the taxonomic status of the *Drosophila* genus has been the subject of scientific debate (Van Der Linde and Houle 2008; O'Grady and Markow 2009). It is considered likely the next revision of the *Drosophila* genus will elevate the Sophophora sub genus to genus level in its own right (Dalton 2010). The melanogaster species group, including *Drosophila suzukii*, is part of the Sophophora sub genus (Dalton 2010). A proposal to the International Committee of Zoological Nomenclature to maintain the *melanogastor* group within the *Drosophila* genus, because of the importance of *Drosophila melanogaster* to genetic research, has been rejected by the Committee (Dalton 2010). It is expected that the name *Drosophila suzukii* will eventually be revised to *Sophophora suzukii*.

3.3 Distribution of *Drosophila suzukii*

Drosophila suzukii is considered native to Asia (Kanzawa 1935; Dreves *et al*. 2009; Hauser *et al*. 2009). It is widespread in China, Japan and Korea (Hauser *et al*. 2009; Kanzawa 1935; Lee 1964), but has a restricted distribution in India and Pakistan being limited to higher elevations of the northern regions (Hauser *et al*. 2009; Singh and Bhatt 1988; Singh and Negi 1989; Amin ud Din *et al*. 2005). In Myanmar, adult flies have been collected at two locations in the central north of the country (Toda 1991). There is little information on the distribution of *Drosophila suzukii* within far east Russia and Thailand.

In North America, *Drosophila suzukii* has been recorded from the USA and Canada. *Drosophila suzukii* was first recorded in Hawaii in 1980 and is typically recorded from elevations above 1 000m (Kaneshiro 1983; O'Grady 2002), but it has been recorded from lower elevations (Asquith and Messing 1992; Kido *et al*. 1996). It was first recorded from California in 2008 (species identity confirmed in 2009) and has since spread to Florida, Oregon, Washington and British Columbia in 2009 (Steck *et al*. 2009; ODA 2009; WSUE 2009; Hueppelsheuser 2009; Snyder 2010). The USA has not imposed quarantine restrictions (NAPPO 2010b) and the distribution of *Drosophila suzukii* is expected to expand to the mid western and eastern States during 2010 (Hauser *et al*. 2009). *Drosophila suzukii* has recently been confirmed as present in South Carolina, North Carolina, Louisiana and Utah (Burrack 2010; OSU 2010c; Davis *et al*. 2010).

Drosophila suzukii has been reported in Central and South America (Ashburner *et al*. 2005). It has recently been reported that *Drosophila suzukii* has been in Costa Rica since 1997, where it was considered abundant, and from Ecuador since 1998 (Calabria *et al*. *in press*). There is no information on the extent of the distribution in these countries.

Drosophila suzukii was first confirmed present in Europe from the Province of Trento in Italy in 2009 (EPPO 2010a). Since this detection it has been confirmed in Tuscany and in Calabria in the south of Italy (EPPO 2010c). More recent publications have confirmed it present from several locations along the Mediterranean region of Europe including Spain in 2008 and France in 2009 (Calabria *et al*. *in press*; Cazaubon 2010; EPPO 2010b; EPPO 2010c). The media has also reported that *Drosophila suzukii* has been recorded attacking grapes from in the Azores Islands, Portugal (Reign of Terroir 2010b) although these reports are yet to be verified. Table 3.1 summarizes of the distribution of *Drosophila suzukii*.

Table 3.1: Distribution of *Drosophila suzukii*

Region	Country	State/Areas
Asia	China (Toda 1991)	Numerous locations from the north to the south and south west of China (Damus 2009, Toda 1991). Recorded from the following provinces; Heilongjiang, Jilin, Liaoning, Beijing, Shanxi, Shandong, Jiangsu, Anhui, Shanghai, Zhejiang, Jiangxi, Hunan, Fujian, Guangdong, Hainan, Guangxi, Sichuan, Guangzhou, Yunnan (Kai *et al*. 1993).
	India (Singh and Negi 1989)	Kashmir (Hauser *et al*. 2009) and northern India (Toda 1991). Also Uttar Pradesh (Chamoli & Pauri region) for *Drosophila suzukii indicas* at approximately 5 000 feet (Singh and Negi

		1989) or at 6 000 feet (1 800m) above sea level (Singh and Bhatt 1988).
	Japan (Kanzawa 1935)	The four main Islands of Japan, Ryukyu, Bonin, Kume-jima and Iriomote-jima Islands (Damus 2009, Toda 1991; Kondo and Kimura 2008).
	Myanmar (Toda 1991)	From the central north of the country including the highlands highlands (Toda 1991)
	Pakistan (Amin ud Din *et al.* 2005)	Kashmir region (Amin ud Din *et al.* 2005)
	Russia (Toda *et al.* 1996)	Far east Russia (Toda *et al.* 1996)
	South Korea (Lee 1966)	Numerous location across Korea (Damus 2009; Lee 1964) including Quelpart Island (Lee 1966).
	Thailand (Hauser *et al.* 2009; Toda 1991)	Present; no further information
Central America	Costa Rica (Ashburner *et al.* 2005)	Reported from collections in 1997 and considered common (Calabria *et al. in press*).
South America	Ecuador (Ashburner *et al.* 2005)	Reported from collections in 1998 and considered rare (Calabria *et al. in press*).
North America	Canada (BCMAL 2009)	Recorded from two locations in western British Columbia (Hueppelsheuser 2009)
	United States (Hauser *et al.* 2009)	Hawaii Islands (Kaneshiro 1983), California (Bolda 2009), Oregon (Dreves *et al.* 2009), Washington (WSUE 2009), Florida (CAPS 2009), North and South Carolina (Burrack 2010), Louisiana (OSU 2010c) and Utah (Davis *et al.* 2010).
Europe	France (Calabria *et al. in press*)	Recorded from the Departments of Corsica, Herault, Gard, Alps Maritame, Var, Tarn et Garonne, Isere and Rhone (Calabria *et al. in press*; Cazaubon 2010; Seigle Vatte 2010)
	Italy (EPPO 2010a)	Province of Trento, Pisa (Tuscany) and the region of Calabria (EPPO 2010a; EPPO 2010b; EPPO 2010c)
	Spain (Calabria *et al. in press*)	Near the town of Rasquera and in the city of Barcelona (Calabria *et al. in press*)
	Portugal (Reign of Terroir 2010b)	Reported attacking grapes in the Island of San Miguel, Azores Islands. This record is based on a media report only.

3.4 Morphology and Biology of *Drosophila suzukii*

3.4.1 Morphology

Adults of *Drosophila suzukii* are a small fly approximately 2–3 mm long with a wing span of 6–8 mm (Kanzawa 1939; Kawase and Uchino 2005). Males are typically smaller than females. Males can be distinguished easily from most other species of *Drosophila* and females by the small dark spots on the end of their wings (Figure 3.1). Females have a distinct double serrated ovipositor (Figure 3.1) that is used to puncture intact skin of suitable fruit (Kanzawa 1939; Dreves *et al*. 2009; Hauser *et al*. 2009). This feature distinguishes females from other species of *Drosophila* in North America.

Figure 3.1: Adult male (left) and female (middle) of *Drosophila suzukii.* The serrated ovipositor can be seen in close up (right) (Dreves *et al*. 2009)

Eggs are white in colour and are on average 0.62 x 0.18 mm wide (Kanzawa 1939). The eggs have two tubes that extend from one end of the egg (Figure 3.2), that are used for respiration, and on average are 0.67 mm long. There are three larval instars that range in size (length x width) from 0.67 x 0.17 mm, 2.13 x 0.40 mm and 3.94 bx 0.88 mm on average for first, second and third instars respectively (Kanzawa 1939). The larvae are white to cream in colour (Figure 3.2).

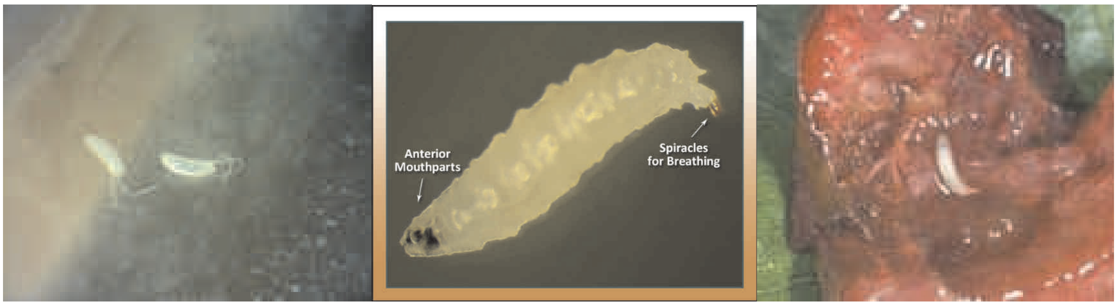

Figure 3.2: Eggs showing breathing tubes (left), larvae (middle), and larvae in a cherry, of *Drosophila suzukii* (BCMAL 2009; WSU 2009; Bolda *et al*. 2009)

The pupae of *Drosophila suzukii* are tan–brown in colour and measure 3 mm long by 1 mm wide (Kanzawa 1939; Figure 3.3). The breathing structures are an additional 0.3 mm long and have distinctive pairs of horn-shaped protrusions made by the jutting out of the anterior respiratory organs on both sides of the head. The respiratory organs further divide into seven to eight branches at the ends (Kanzawa 1935).

Figure 3.3: Pupae of *Drosophila suzukii*; removed from the fruit (left) and within the fruit (right) (Dreves *et al*. 2009; BCMAL 2009). Note the distinct breathing structures exposed to the atmosphere.

3.4.2 Life cycle

After emergence, the adults typically become sexually mature in one to two days with a maximum of 13 days recorded (Kanzawa 1935; Kanzawa 1939). Adults live for 21–66 days and females can oviposit 7–16 eggs per day with, on average, 384 eggs during her life in laboratory trials (Kanzawa 1939). A maximum of 160 eggs have been recorded to be laid in a day by a single female in trials by USA researchers (Smyth and Saverimuttu 2010). Eggs, larvae and pupae all vary in development time depending on the environmental conditions and generations over summer have the shortest development times. Eggs typically hatch in 1 day though they can hatch as quickly as 20 hours or take as long as four days (Kanzawa 1939). On average larvae take between three to ten days to complete feeding and reach the pupal stage (Kanzawa 1939). The pupae require on average 4–14 days in the field to emerge as adults (Kanzawa 1939). The total development time from egg to adult ranges from 8–28 days in the field in Japan (Kanzawa 1935; Kanzawa 1939).

Under experimental conditions development time is directly dependant on temperature. Development time from egg to adult was from 21 to 25 days at 15 °C and 8–13 days at 25 °C (Kanzawa 1939). The short development time of *Drosophila suzukii* allows the fly to complete several generations in a season with up to 13 generations recorded in field conditions in Japan (Kanzawa 1939).

During autumn, as temperatures decrease, newly emerged *Drosophila suzukii* adults do not sexually mature and enter a winter diapause. When the temperature is below 5 °C, sexually mature adults can enter diapause and will not recommence activity until the following spring or when temperatures are suitable (Kanzawa 1939). Individual females can successfully oviposit hundreds of eggs prior to autumn, diapause through winter, and in the following spring, recommence oviposition. During this period females can live on average for over 200 days (maximum of 301 days) and oviposit, on average, 260 eggs during their lifespan (Kanzawa 1939).

In Japan, the eggs, larvae and pupae of *Drosophila suzukii* do not survive during winter, with the only over wintering stage being the adult (Kanzawa 1939). As the season warms, and temperatures increase above 10 °C, the adults that have over wintered become active from April to May in Japan (Kanzawa 1939; Sasaki and Sato 1995b).

Initial infestation levels on cherries are low and fruit are generally attacked in the lower portion of the tree out of the wind (Kanzawa 1935), but infestation levels can quickly reach high levels. For example, the first ripe cherries picked in early June can have no symptoms of attack by *Drosophila suzukii* but infestations levels can quickly increase to 26–100% of the fruit by the first week of July due to the high reproductive potential of the fly (Sasaki and Sato 1995a). Although *Drosophila suzukii* typically oviposits eggs singly, when infestations are high many eggs can be laid into a individual fruit (Mitsui *et al*. 2006) and fruit throughout the tree can be attacked and infestation levels can be high (Kanzawa 1935). For example, 62 adults have emerged from a single cherry fruit (Kanzawa 1939). However, due to larval competition that results in small adults, the reproductive capacity of females that successfully emerge from highly infested fruit is likely to be very low (Kanzawa 1939; Takahashi and Kimura 2005).

3.4.3 Ecology

Female *Drosophila suzukii* preferentially oviposit on ripe fruit but will also oviposit on unripe and over-ripe fruit (Kanzawa 1939). On cherry fruit, the preferred oviposition period is two to three days before harvest (Kanzawa 1939). Larval development in ripe fruit is high and is lower in fruit of other ripeness (Kanzawa 1939). Larvae feeding in fruit that is very acidic fail to complete development (Kanzawa 1935). When females are given a host choice with *Prunus* spp., compared to cherry, oviposition occurs in peaches and plums at a rate of 27% and 9% respectively. Oviposition trials on wine and table grapes have shown oviposition does not occur on undamaged grapes with low sugar levels (Malguashca *et al*. 2010). Oviposition will occur on damaged fruit with low sugar levels but larvae develop poorly and fail to pupate (Malguashca *et al*. 2010). In contrast, under the same experimental conditions, fully ripe table grapes are attacked at high levels (Malguashca *et al*. 2010).

During the reproductive season for *Drosophila suzukii* in Yamanashi Prefecture in central Honshu, Japan, numbers of adults are greatest during early summer and autumn with a sharp decrease in numbers through the hottest period of summer (Kanzawa 1939; Mitsui *et al*. 2010). The decrease in adult numbers is unlikely to be due to a lack of host material; *Drosophila suzukii* can attack a range of hosts that fruit throughout the season in Japan (Sasaki and Sato 1995b). It is more likely that high temperatures lead to a decrease in adult numbers. For example, further north in Honshu, in Fukushima Prefecture, where mean maximum temperatures are several degrees cooler in summer (JMA 2010), the bimodal peak in *Drosophila suzukii* abundance during early summer and autumn has not always been observed (Sasaki and Sato 1995c). In 1993, the abundance of *Drosophila suzukii* on a range of hosts steadily increased through the reproductive season until a peak population was reached in autumn. However, in 1991 and 1992 in Fukushima Prefecture, when mean summer temperatures were 2–4 °C higher than 1993 (JMA 2010), numbers of *Drosophila suzukii* decreased during the hottest period of summer (Sasaki and Abe 1993). The recent work of Mitsui *et al*. (2010) has shown as the season becomes warmer *Drosophila suzukii* migrates from low to high altitude. The increase in the *Drosophila suzukii* population at altitude coincides with a decrease in the population at the lower (hotter) altitudes in mid summer (Mitsui *et al*. 2010). Since suitable fruit would be available at the lower altitudes during this period (Sasaki and Sato 1995b) the decrease in population is likely to be due to unfavourably high temperatures.

The negative effect of high temperature has been recorded experimentally where 75% of female *Drosophila suzukii* die at a constant temperature of 33.3 °C for 24 hours (Kimura 2004). Males flies are less tolerant of high temperature and 75 % mortality is reached at 32.6 °C (Kimura 2004). Higher temperatures have been shown to kill immature stages of *Drosophila suzukii* over several days when the maximum daily temperature is above 35 °C (Sasaki and Sato 1995b). Under laboratory conditions, adults will die if kept at 35 °C for three hours (Walton *et al*. 2010) and pupae do not emerge if kept at temperatures of 32 °C or above (Sasaki and Sato 1995b). In addition to the negative effects of high temperature, laboratory workers have observed the adults are extremely sensitive to low moisture/humidity (Van Steenwyk 2010). Adult flies will die under normal room conditions in 6–24 hours without a moisture source (Smyth and Saverimuttu 2010; Walsh *et al*. *in press*). The sensitivity of *Drosophila suzukii* to low humidity is consistent with most other adult *Drosophila* that require >70% humidity for successful reproduction (Ashburner *et al*. 2005).

Drosophila suzukii has established and spread in the hot climate of Florida (Black 2003; Snyder 2010). However, the initial population of *Drosophila suzukii* has been shown to be sensitive to temperature with peak trap captures occurring during winter when mean temperature is between 9 °C and 20 °C (Dean 2010). During the summer-autumn period, the activity of *Drosophila suzukii,* so far, is very low (Dean 2010). The typically higher summer rainfall and high humidity of Florida's climate (Black 2003; NOAA 2010) may assist *Drosophila suzukii* surviving periods of unsuitable high temperatures. In Japan, the relative humidity over summer is also typically high (JMA 2010) and this may assist *Drosophila suzukii* surviving high summer temperatures in sufficient numbers to reproduce successfully, as temperatures become favourable, and damage host fruit that ripens in autumn.

The combined effect of low humidity and high temperature is likely to be unfavourable to the survival and reproduction of *Drosophila suzukii*. For example, although *Drosophila suzukii* is prevalent in California, there are no reports of it damaging fruit in the lower central valley during the summer months. However, *Drosophila suzukii* has been recorded to attack damaged citrus during late winter and then very early cherries in mid to late spring in the central valley (Walsh *et al*. *in press*) when the climate is more temperate (NCDC 2008; World Climate 2010). In summer, mean maximum temperatures exceed 35 °C and afternoon relative humidity is below 24 % (based on data for Fresno:- NCDC 2008; World Climate 2010). The poor suitability of hot and dry climates is supported by distribution models developed for North America based on the native distribution of *Drosophila suzukii* from Asia (Damus 2009).

In the related species, *Drosophila melanogaster*, increased adult desiccation resistance can be selected over many generations in laboratory trials (Bradley *et al*. 1999). The impact of increased desiccation resistance has not been tested on field populations of flies and whether this would lead to a change in their distribution or abundance. However, in India and Pakistan, *Drosophila suzukii* populations have only been recorded from higher elevations (see table 3.1) where the climate would be more temperate than lower hotter elevations.

In Japan, at the end of the reproductive season in autumn as temperatures become progressively cooler, adults seek out over wintering sites under leaf litter and stones (Kanzawa 1939). The adult diapause over winter is not in response to day length and is reported to be in response to temperature (Toda 1979). Recent evidence from Florida indicates *Drosophila suzukii* can successfully reproduce during the middle of winter if temperatures are suitable (Dean 2010). For diapausing adults, over wintering survival can be affected by low temperatures where a constant temperature of -1.8 °C and -0.7 °C for 24 hours will kill 75 % of the females and males respectively (Kimura 2004).

In Hokkaido, *Drosophila suzukii* is considered a domestic species associated with human habitation (Toda and Fukuda 1985). The species is believed to over winter in the colder north of Japan in sheltered human habitation sites, re-invading rural areas during summer. In Canada, *Drosophila suzukii* has been shown to be associated with grocery stores, fruit stands and outside a fruit packing house at the end of summer (BCMAL 2010). In Oregon, over wintering experiments have shown very low survival with only one adult in 1 000 surviving until spring (Smyth and Saverimuttu 2010). More recently, adult over-winter survival has shown be to higher depending on the experimental conditions (Walsh *et al*. *in press*). In over wintering trials in Japan, survival can vary from 0–23% and moisture may also play a role in the survival of adults during winter (Sasaki and Sato 1995b). In Oregon, milder temperatures over winter (mean = 8.6 °C) allow some larvae (6%) and pupae to survive to adulthood (Walsh *et al*. *in press*).

3.4.4 Host Damage

The oviposition scars and egg breathing tubes of *Drosophila suzukii* can be readily seen under magnification (x10–20) on smooth skinned fruit (see Figure 3.4) (Kanzawa 1939; Smyth and Saverimuttu 2010). *Drosophila suzukii* preferentially oviposits on mature fruit but can also oviposit on immature and spoiled fruit of suitable varieties at lower rates (Kanzawa 1939; Mitsui *et al*. 2006).

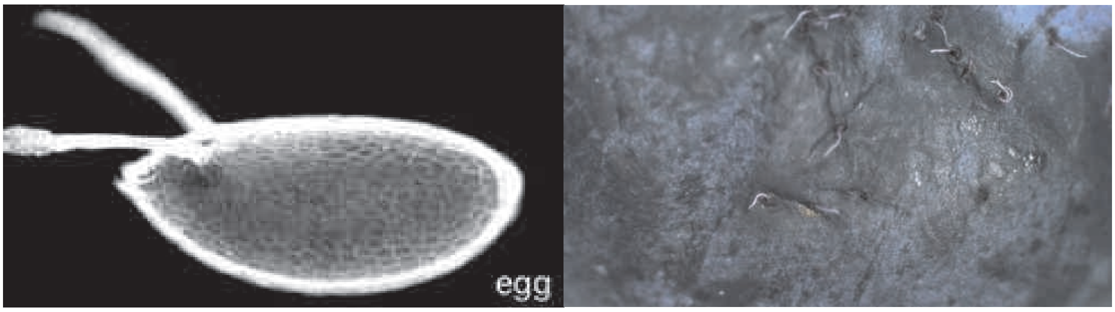

Figure 3.4: Eggs of *Drosophila suzukii*; removed from the fruit (left) and in blueberry fruit showing the white breathing tubes (right) (Hauser and Damus 2009; OSU 2010a).

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 (Figure 3.5). The oviposition scar exposes the fruit to secondary attack by pathogens and other insects (Figure 3.5) (Hauser and Damus 2009). The damage caused by *Drosophila suzukii* larvae renders the fruit unsuitable for sale (Bolda *et al*. 2010).

Figure 3.5: Initial larval damage of *Drosophila suzukii* showing collapse of fruit around oviposition point (left); larvae can be seen in a severely damaged blueberry (middle); secondary attack by pathogens (right) (Hauser and Damus 2009; OSU 2010a).

In its native range, *Drosophila suzukii* has been recorded to cause damage to a range of fruits including, cherry, grapes, blueberry and red bayberry (Kanzawa 1935; Kanzawa 1939; Sasaki and Sato 1995a; Tamada 2009; Uchino 2005; Kawase and Uchino 2005; Wu *et al*. 2007). It has also been recorded from mulberries, peaches, plums, strawberries and various caneberries (Kanzawa 1939; Sasaki and Sato 1995c). In North America, *Drosophila suzukii* has been recorded to cause damage to cherries, strawberries, blueberries and caneberries (Bolda 2009; Bolda *et al*. 2010; Coates 2009; Hauser *et al*. 2009). In addition, there have been media reports that commercial peaches have been attacked at high levels (CPAN 2009) and numerous other stone fruit, hardy kiwis and grapes have been recorded as hosts (Bolda 2009; Dreves *et al*. 2009; Hueppelsheuser 2009). In Europe, *Drosophila suzukii* has been recorded damaging strawberries, blueberries, raspberries and blackberries (EPPO 2010a).

Studies during the 1930's in Japan reported severe crop losses in some years and locations with crop losses of 100% for cherries and 80% for grapes (Kanzawa 1939). High levels of damage have also been recorded more recently from Japan with 26–100% of cherry fruit attacked in some locations (Sasaki and Sato 1995a). In blueberries, *Drosophila suzukii* is considered the most important pest in Japan (Tamada 2009; Kawase and Uchino 2005). In the USA, damage to cherries of 80% have been recorded in one locality (ODA 2009) and there are reports of maximum damage of 40% in blueberries and 70% in caneberries (Bolda *et al*. 2010).

In contrast to the reports of damage in temperate areas, there are no reports of commercial fruit damage in sub tropical regions where *Drosophila suzukii* has established. For example, *Drosophila suzukii* has been recorded from Hawaii since 1980 (Kaneshiro 1983) and it is reported to be the most ubiquitous Drosophilid on the island of Kauai (Asquith and Messing 1992), but there is no report of damage to commercial fruit. In Florida, although *Drosophila suzukii* has been trapped near preferred hosts (e.g. strawberry) there are no reports of commercial damage (Pers. comm., Dr David Dean, FDACS, 2 Sept. 2010). As discussed above, unfavourable high temperatures may play a role in limiting *Drosophila suzukii* populations in sub tropical regions.

3.4.5 Control

In Japan, a range of pre harvest control methods including trapping, pesticides, oviposition deterrents and fumigation have been trialled (Kanzawa 1939). The initial results showed trapping with a suitable attractant was effective at capturing large numbers of *Drosophila suzukii*. A trapping trial conducted over large areas (24 hectares) at several locations over a four year period, showed a mixture of diluted molasses and wine, trapped large numbers of flies and resulted in an average infestation rate of fruit by *Drosophila suzukii* of 3.2 % (based on a summary of the data in Kanzawa 1939). Trapping is most effective if in place when host fruit are unripe and before they are oviposited by adults that have over-wintered (Kanzawa 1939). Over the same period, at several sites where trapping was not instigated, average infestation rate was 50.8% (based on a summary of the data in Kanzawa 1939). The conclusion of the study was trapping was cost effective and a suitable method of controlling *Drosophila suzukii* in cherries.

Covering fruiting plants with a net has also been recommended in Japan to control damage by *Drosophila suzukii* (Kawase and Uchino 2005). A mesh size of <0.98mm has been shown to prevent all adult flies from passing through a protective net.

In North America initial control strategies have been based on the work of Kanzawa (1939) and methods for trapping *Drosophila suzukii* are summarized on the Oregon State University website (OSU 2010a). There are also recommendations for pesticide application, using a range of contact and persistent insecticides that target adult flies with crop sanitation playing a key part of the control strategy (Dreves *et al*. 2009; OSU 2010d; Van Steenwyk 2010). The Oregon State University is leading a collaborative research effort to understand the biology of *Drosophila suzukii* and develop control strategies. The latest information for this pest can be found at its website; http://swd.hort.oregonstate.edu/.

Currently in Santa Cruz County, California, where *Drosophila suzukii* was first recognised as a pest, trapping numbers during 2010 have remained very low, and below the levels recorded in 2008 and 2009 (Bolda 2009). It is believed the broad adoption of recommended management methods for *Drosophila suzukii* have contributed to the recorded decline in pest numbers (Bolda 2009).

4 Pathways

The initial information of *Drosophila suzukii* in North America has led to many reports of this pest attacking a large variety of fresh fruits. The known host range of *Drosophila suzukii* has been confused by the initial pests alerts and the numerous media reports of the pest attacking a large number of hosts. In this PRA report, two pathways are identified for *Drosophila suzukii* to enter Australia, fresh fruit and flowers.

4.1 Pathway – Fresh Fruit

The original research on *Drosophila suzukii* in Japan showed the host range, on intact undamaged fruit, is much narrower than on damaged, dropped or artificially cut fruit (Kanzawa 1935; 1939). The confirmed host range of *Drosophila suzukii* on undamaged fruit prior to harvest includes 36 taxa (species, varieties and hybrids) from 12 families that are listed in Appendix B. Another five species from the *Morus*, *Prunus* and *Rubus* genera are suspected to be hosts based on the high association of *Drosophila suzukii* with other species in those genera. An additional 20 taxa are recorded as hosts when the fruit is damaged or over ripe (Appendix B). Damaged and over ripe fruit from diverse families such as Rutaceae and Musaceae (citrus and bananas) have been recorded to be attacked (Price and Nagle 2009).

The status of apples and pears as hosts of *Drosophila suzukii* has been under particular scrutiny by stakeholders. For example, stakeholders lodged appeals with the Import Risk Analysis Appeals Panel when Biosecurity Australia did not list apple as a host for *Drosophila suzukii* in the import risk analysis (IRA) report for apples from China. On 24 June 2010, the Senate of the Parliament of Australia, referred the issue of the IRA process for the proposed importation of Chinese apples into Australia, to the Senate Standing Committee on Rural and Regional Affairs and Transport. The issue of apple as a host for *Drosophila suzukii* was a major concern raised by stakeholders that appeared before the Senate inquiry public hearing (RRA&T 2010). These concerns were based on the original pest alerts from the USA that listed apple as a host (Dreves *et al*. 2009; ODA 2009; Steck *et al*. 2009) and the USA Animal and Plant Health Inspection Service (APHIS) pest alert (APHIS 2010). As discussed below, these references have now been shown to be erroneous.

Officers from Biosecurity Services Group (BSG), within the Department of Agriculture, Fisheries and Forestry (DAFF), travelled to the USA in May 2010 to verify the status of *Drosophila suzukii,* including its host range. During this trip, the officers met with key researchers studying *Drosophila suzukii*, including the authors of a number of pest alerts from Oregon. The researchers confirmed that there have been no reports of undamaged apples and pears being attacked by *Drosophila suzukii*. The researchers advised that apple and pear was mistakenly listed as a host in the pest alerts on the basis of the English translation of an abstract of a paper written in Japanese, containing original research on *Drosophila suzukii*. In the main body of Kanzawa (1939), it is clarified that only damaged or cut apples and pears had been observed to host *Drosophila suzukii*. USA researchers have since revised their pest alerts and presentations and APHIS have reconfirmed that only damaged apples are recorded as a host (ODA 2010a; OSU 2010b; BA 2010a).

The BSG officers have also been in contact with researchers in the USA who specialise in pome fruit horticulture. They have confirmed that there have been no reports of undamaged apples or pears being attacked, even where *Drosophila suzukii* was prevalent in apple growing areas (Smyth and Saverimuttu 2010; Pers. comm., Janet Caprile, Farm Advisor, Contra Costa County, 26 June 2010). The researchers concluded that the skin of apples or pears is too thick for *Drosophila suzukii* to penetrate and that it therefore cannot successfully attack undamaged commercial quality apple and pear fruit. Subsequently, the USA Agricultural Research Service (ARS) confirmed they have exposed apples to gravid females and failed to record oviposition (BA 2010b). *Drosophila suzukii* is native to Asia and was first reported from Japan in 1916 (Kanzawa 1935). There are no reports of this pest attacking undamaged apple fruit where *Drosophila suzukii* is abundant in major apple growing regions in Japan (Sasaki and Abe 1993; Sasaki and Sato 1995a, 1995b & 1995c; Apple University 2009) even though it has been recorded near apple orchards (Ookuma and Beppu 1987). There are no records of any infestation or damage on apples or pears in any area where *Drosophila suzukii* occurs.

Canada's North American Plant Protection Organisation pest notification, and the Canadian Food Inspection Agency's (CFIA) draft Plant Health Risk Assessment for *Drosophila suzukii*, list pear as a host (NAPPO 2010a; CFIA 2010). Plant Biosecurity contacted the officer who prepared that risk assessment and they confirmed the host range was based on recent advice from a colleague in Japan. The CFIA officer then requested clarification from his colleague and they confirmed only damaged pear fruit was attacked (Pers. comm., Martin Damus, CFIA, 22 April 2010). The status of intact pear as a non host for *Drosophila suzukii* is supported by there being no records of pears damaged in the field by this pest and the original Japanese research that shows only cut fruit are hosts (Kanzawa 1939).

A recent publication from the USA has listed pears, without clarification of the state of the fruit or level of association, as a host of *Drosophila suzukii* (Walsh *et al. in press*). On contacting the authors they confirmed only over-ripe pears are attacked by *Drosophila suzukii* (Pers. comm. Vaughn Walton, OSU, 13 October 2010).

Table 4.1: Fruits host groupings[1] considered as pathways for *Drosophila suzukii*

Family	Grouping	Fruit Commodity (examples)	Consider further	Group
Rosaceae	*Rubus* spp. (caneberry)	Raspberry	**Yes**	**1**
		Blackberry		
		Boysenberry		
		Loganberry		
	Prunus avium	Cherry	**Yes**	**2**
	Prunus spp. (Stone fruit)	Peach	**Yes**	**3**
		Nectarine		
		Apricot		
		Plums		
		Hybrids–plumcots, pluots etc		
	Fragaria spp.	Strawberry	**Yes**	**4**
Ericaceae	*Vaccinium augustifolium* and *Vaccinium corymbosum*	Blueberry	**Yes**	**5**
Vitaceae	*Vitis vinifera*	Grapes	**Yes**	**6**
	Vitis labrusca			
Moraceae	*Morus alba*	Mulberry	**Yes**	**7**
	Morus rubra	Red mulberry		
Actinidaceae	*Actinidia arguta*	Hardy kiwi	**Yes**	**8**
Myricaceae	*Myrica rubra*	Red bayberry	**Yes**	**9**
Elaeagnaceae	*Elaeagnus multiflora*	Silver berries		
Cornaceae	*Cornus kousa*	Dogwood		
Myrtaceae	*Eugenia uniflora*	Surinam cherry		
Rutaceae	*Murraya paniculata*	Orange jessamine		
Phytolaccaceae	*Phytolacca americana*	American pokeweed		

1. Groupings based on host association of *Drosophila suzukii* in appendix B, taxonomic relatedness and/or production methods.

The undamaged fruit of 24 of the 36 taxa currently known to be hosts of *Drosophila suzukii* are from the Rosaceae family. An additional four species in the family are suspected to be hosts as they have been reared from fallen fruit or trapped near the species. Full details of the association is provided in Appendix B. There are over 300 genera in the Rosaceae (Tropicos 2010) and all but three species attacked by *Drosophila suzukii* are from the *Prunus* or *Rubus* genera. The remaining host plant families have only one or two host taxa each (Appendix B). Host fruit that are further considered in Appendix B are summarised in Table 4.1. The risk of entry of *Drosophila suzukii* through infested fruit is the first pathway considered, for the nine fresh fruit commodity groups, during the pathway analyses.

4.2 Pathway – Fresh Flowers

It has recently been reported that *Drosophila suzukii* adults can successfully emerge from flowers of *Styrax japonicus* and *Camellia japonica* (Mitsui *et al*. 2010; Damus 2010). Fresh cut flowers of *Styrax japonicus* and *Camellia japonica* are not permitted entry to Australia. Nursery stock of both species are permitted entry (Table 1.2). The importation of nursery stock with flowers, or fresh cut flowers, from countries where *Drosophila suzukii* is known to occur, could allow the importation of *Drosophila suzukii* into Australia.

The risk of entry of *Drosophila suzukii* through infested flowers is the second pathway considered during the pathway analyses.

5 Risk assessments for pathways

Drosophila suzukii is not present in Australia, has the potential for establishment and spread and economic consequences in Australia and therefore meets the criteria for a quarantine pest (Appendix A).

The risk assessments in this section focus on the fruit and flower pathways identified for the potential introduction of *Drosophila suzukii* in section 4 (see table 4.1). The analysis for the importation of fresh fruit is based on a generic assessment. Commodity specific information that may impact on the risk assessment is also presented. An individual likelihood rating is considered for each commodity grouping or species where it is considered appropriate.

The likelihood of distribution is considered under a generic assessment. The assessment approach is considered appropriate given that the survival of *Drosophila suzukii* is similar across its host range and because of the similar requirements for the handling and distribution of fresh fruit commodities.

A single assessment for the importation and distribution of fresh flowers (including nursery stock) has been conducted.

The probability of establishment and spread, and the consequences of *Drosophila suzukii's* establishment are not specifically linked to the pathway by which the pest might enter Australia. This is because the pathway of establishment considers factors only after the pest has transferred to a susceptible host in the PRA area. Therefore, the probability of establishment and spread, and the consequences of *Drosophila suzukii* have been assessed only once and the outcomes applied to all the pathways considered.

5.1 Pathway 1 – Fresh fruit

5.1.1 Probability of entry

Probability of importation

The likelihood that *Drosophila suzukii* will arrive in Australia with the trade in fresh fruit for consumption in a viable state from countries where the pest is present:

Caneberries (*Rubus* spp.)	**HIGH**
Cherry (*Prunus avium*)	**HIGH**
Stone fruit (*Prunus* spp.)	**HIGH**
Strawberry (*Fragaria* x *ananassa*)	**HIGH**
Blueberry (*Vaccinium* spp.)	**HIGH**
Table grapes (*Vitis* spp.)	**HIGH**
Hardy Kiwi (*Actinidia arguta*)	**LOW**
Mulberry (*Morus* spp.)	**HIGH**
Other recorded fresh fruit hosts	
– Dogwood (*Cornus kousa*)	**LOW**

- Surinam Cherry (*Eugenia uniflora*) **LOW**
- Orange Jessamine (*Murraya paniculata*) **LOW**
- Red Bayberry (*Myrica rubra*) **MODERATE**
- Silverberries *(Elaeagnus multiflora)* **MODERATE**
- Pokeweed (*Phytolacca americana*) **MODERATE**

- *Drosophila suzukii* is known to attack a range of fresh fruit (Appendix B). Three life stages (eggs, larvae and pupae) are internally associated with the fruit (Kanzawa 1939; Dreves *et al*. 2009).
- *Drosophila suzukii* preferentially oviposits on fruit two to three days before harvest and one to several eggs (or more) can be oviposited per fruit (Kanzawa 1939). It is likely eggs and larvae would be associated with fruit at harvest.
- The eggs of *Drosophila suzukii* are small (<0.7 mm long by 0.2 mm wide) and they are oviposited below the surface of fruit (Kanzawa 1939; OSU 2010a). *Drosophila suzukii* eggs have two white respiratory tubes, approximately 0.7 mm long, that protrude through the oviposition scar to the outside of the fruit (Kanzawa 1939; Uchino 2005). The small size of the respiratory tubes make them difficult to see with the naked eye.
- Although *Drosophila suzukii* preferentially attacks fruit prior to harvest, they also attack harvested fruits (Kanzawa 1939) and have been reported in association with packing houses in Canada (BCMAL 2009). Consequently, there is a risk of *Drosophila suzukii* adults being associated with fresh fruit in packing houses.
- The initial feeding damage of larvae in the fruit is small, typically seen as a small depression of the skin, that could easily be over looked (OSU 2010a). This would allow infested fruit to enter the packing house and escape detection during the sorting and grading of fruit.
- Total development times from egg to adult can range from to 25 days at 15 °C and eight to 13 days at 25 °C (Kanzawa 1939). Fresh fruit are highly perishable so short transport periods are preferred. Although the current distribution of *Drosophila suzukii* is restricted to the northern hemisphere (table 3.1) transport by air could mean the time between harvest to arrival in Australia is as short as 48 hours. Eggs, larvae or pupae could still be completing development within the fruit.
- Eggs and larvae of *Drosophila suzukii* have been shown to be susceptible to cold (Kanzawa 1939). At temperatures in the range of -0.6–2.2 °C, 5.5% of the eggs and larvae , survived for 72 hours but at 96 hours all eggs and larvae were dead (Kanzawa 1939). Although cold storage could increase mortality of *Drosophila suzukii* in fruit, the only study published was preliminary, included only limited replication, did not replicate commercial conditions and was conducted at temperatures typically lower than those used in commercial shipping and storage of fruit (Bolda 2009; Woolworths 2010).
- Adult *Drosophila suzukii* can successfully diapause over winter, and in the following spring become sexually active. During this period females can live on average for over 200 days (maximum of 301 days) (Kanzawa 1939). The ability of adults to survive cold conditions for extended periods could allow them to survive

fruit transport conditions which are most likely to be at temperatures between 0–13 °C (Woolworths 2010).

- *Drosophila suzukii* has recently invaded the USA, Canada and Italy and the likely source of the introduction was attributed to the trade in fresh fruit (NAPPOa 2010; NAPPOb 2010; EPPO 2010c). *Drosophila* larvae have been intercepted in commercial cherries exported from California to Florida and it is suspected they were *Drosophila suzukii* (Tri-ology 2009). In the USA, it is considered very likely the domestic movement of fruit will spread this pest to many other states within the country (Hauser *et al*. 2009; ODA 2010a).
- In the USA, even though trapping and management occurs in orchards that limits commercial damage, fruit infested by *Drosophila suzukii* can still be found (OSU 2010c).

Caneberries (*Rubus* spp.)

- Monitoring programs in the Northwest of the USA and Canada show trap catches in *Rubus* spp. orchards are high and they are a preferred host for *Drosophila suzukii* (OSU 2010b; OSU 2010c; BCMAL 2010; Peerbolt 2010). Research shows that exposed ripe fruit are preferentially attacked with 5% of pink fruit, and 80% of ripe fruit, containing eggs (Walsh *et al*. *in press*).
- In the USA in 2009, damage levels have been recorded to average 20% in the central coast region of California with around 10% of producers recording losses of 70% (Bolda *et al*. 2010).
- The uneven surface and hairs of *Rubus* spp. fruit will make the visual detection of eggs and respiratory tubes more difficult compared to smooth skinned fruit (Smyth and Saverimuttu 2010).

The demonstrated association of the pest with the pathway at its origin, presence of internal life stages that can be very difficult to detect by the naked eye, and its ability to survive the duration of transport support a probability rating of ‘high’ for the importation of *Drosophila suzukii* on fresh fruit of caneberries.

Cherry (*Prunus avium*)

- Monitoring programs in the Northwest of the USA show trap catches in cherry orchards are high and they are a preferred host for *Drosophila suzukii* (OSU 2010b; OSU 2010c; Peerbolt 2010).
- One to several eggs can be oviposited per fruit, or higher, and in Japan infestation levels of cherry fruit in orchards can regularly be over 50% and even reach 100% during the harvest period (Kanzawa 1939; Sasaki and Sato 1995a). In the USA, yield losses of 33% to 80% have been recorded in some localities and over a wide area of cherry production areas in California (Bolda *et al*. 2010; ODA 2010a; Walsh *et al*. *in press*).

The demonstrated association of the pest with the pathway at its origin, presence of internal life stages that can be very difficult to detect by the naked eye, and its ability to survive the duration of transport support a probability rating of ‘high’ for the importation of *Drosophila suzukii* on fresh cherry fruit.

Stone fruit (*Prunus* spp.)

- One to several eggs can be oviposited per fruit (or higher) though oviposition rates on stone fruit are only 9–27% compared to cherry in laboratory trials (Kanzawa 1939). Damaged fruit in orchards have been recorded for nectarines, peaches, plums and plumcots (Coates 2009; Coates 2010; Dreves *et al* 2009; Sasaki and Sato 1995c; BCMAL 2010). Infestation levels can be high enough in peaches to result in levels of damage ranging from 20–80% (CPAN 2009; Dreves 2010; ODA 2010a).
- In the USA, peaches are considered a preferred host and nectarines, plums and plumcots are considered secondary hosts for *Drosophila suzukii* (OSU 2010b). In Canada, it is strongly recommended to spray peaches, nectarines, plums and prunes to prevent fruit infestation (BCMAL 2010).
- In the USA, apricots are considered a less preferred host and attack has only been recorded when fruit is very late season, over-ripe or damaged (Coates 2009). However, there is a media report quoting a local agricultural official that apricots are being attacked by *Drosophila suzukii* in Corsica (Corsematin 2010).
- The densely hairy surface of peaches will make the detection with the naked eye of eggs and respiratory tubes more difficult compared to smooth skinned fruit (Smyth and Saverimuttu 2010).

The demonstrated association of the pest with the pathway at its origin, presence of internal life stages that can be very difficult to detect by the naked eye, and its ability to survive the duration of transport support a probability rating of 'high' for the importation of *Drosophila suzukii* on fresh stone fruit.

Strawberry (*Fragaria* x *ananassa*)

- Monitoring programs in the Northwest of the USA show trap catches in strawberry fields are high and they are a preferred host for *Drosophila suzukii* (OSU 2010b; OSU 2010c; Peerbolt 2010). In Eastern USA, high larval infestations in North Carolina have been reported (Burrack 2010).
- In California little economic damage has been recorded in strawberries and this is considered to be due to the short interval between fruit ripening and harvest (Bolda *et al*. 2010). Some commercial damage has been recorded in Oregon (OSU 2010c) and *Drosophila suzukii* was first recorded from Washington on strawberries (Walsh *et al*. *in press*). *Drosophila suzukii* has recently invaded Europe and has already been recorded to damage commercial strawberries (EPPO 2010a).

The demonstrated association of the pest with the pathway at its origin, presence of internal life stages that can be very difficult to detect by the naked eye, and its ability to survive the duration of transport support a probability rating of 'high' for the importation of *Drosophila suzukii* on fresh strawberry fruit.

Blueberry (*Vaccinium* spp.)

- Monitoring programs in the Northwest of the USA and Canada show trap catches in blueberry orchards are high and they are a preferred host for *Drosophila suzukii* (OSU 2010b; OSU 2010c; BCMAL 2010; Peerbolt 2010).

- In Japan, *Drosophila suzukii* is considered the main pest of blueberries (Tamada 2009). Infestations of blueberry fruit ranged from 2–4% for mature fruit and up to 14 % for fallen fruit (Uchino 2005). In the USA, maximum yield losses of 40% have been recorded in some localities (Bolda *et al*. 2010).

The demonstrated association of the pest with the pathway at its origin, presence of internal life stages that can be very difficult to detect by the naked eye, and its ability to survive the duration of transport support a probability rating of 'high' for the importation of *Drosophila suzukii* on fresh blueberry fruit.

Table grapes (*Vitis* spp.)

- During the 1930's in Japan, *Drosophila 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 *Drosophila suzukii* on grapes in Hokkaido (CFIA 2010).
- In the USA, *Drosophila suzukii* has been recorded from grapes though infestation rates remain low so far this season (OSU 2010c). However, in oviposition trials, larvae have been reared at high rates from table grapes that are fully ripe with sugar levels above 15% (Malguashca *et al*. 2010). In wine grapes that are not fully ripe, with lower sugar levels and higher acidity, few larvae have successfully pupated in the trials so far (Malguashca *et al*. 2010). It is expected as wine grapes ripen attack levels will increase (Malguashca *et al*. 2010).
- As fruit ripens during the later part of the season, attack levels may increase rapidly as *Drosophila suzukii* preferentially oviposits on fully ripe fruit two to three days before harvest (Kanzawa 1939).

The demonstrated association of the pest with the pathway at its origin, presence of internal life stages that can be very difficult to detect by the naked eye, and its ability to survive the duration of transport support a probability rating of 'high' for the importation of *Drosophila suzukii* on fresh table grapes.

Mulberry (*Morus* spp.)

- Undamaged *Morus alba* has been record to be attacked by *Drosophila suzukii* in Japan (Kanzawa 1939). More recently, high infestation rates of *Drosophila suzukii* in mulberries have been reported in Japan with 300 adults emerging from 60 fruit collected from the tree (Sato and Sasaki 1995c).
- In North America, *Drosophila suzukii* has been reported to attack *Morus rubra* in Florida (FDACS 2010) and *Morus* spp. in British Columbia (BCMAL 2009).

The known association with fruit, the presence of internal life stages that can be very difficult to detect by the naked eye and its ability to survive the duration of transport support a probability rating of 'high' for the importation of *Drosophila suzukii* on mulberries.

Hardy Kiwi (*Actinidia arguta*)

- Hardy kiwi has been confirmed as a host of *Drosophila suzukii* in Oregon with adults reared from field collected fruit (ODA 2009; Smyth and Saverimuttu 2010). In Canada, *Drosophila suzukii* is suspected to attack hardy kiwi in British Columbia;

larvae have been recorded infesting fruit at one location though these have not been reared out to adults to confirm identification (BCMAL 2009; Pers. comm., Tracey Hueppelsheuser, BC Ministry of Agriculture and Lands, 1 September 2010).

- Hardy kiwi is native to Northern Asia (CRFG 2010) and there are no reports of damage by *Drosophila suzukii* from this region.
- Monitoring programs in the Northwest of the USA and Canada show *Drosophila suzukii* are trapped in hardy kiwi orchards (OSU 2010b; OSU 2010c; BCMAL 2010; Peerbolt 2010). However, there are no reports of commercial damage to hardy kiwi fruit.

The presence of internal life stages that can be very difficult to detect by the naked eye and its ability to survive the duration of transport could support a probability rating of high. However, the lower association with hardy kiwi, compared to other hosts, and the lack of reports of commercial damage support a probability rating of 'low' for the importation of *Drosophila suzukii* on hardy kiwi fruit.

Other recorded fresh fruit hosts

- There is little information on the association of *Drosophila suzukii* with these hosts. For example, *Cornus kousa*, *Eugenia uniflora* and *Murraya paniculata* have been listed as hosts with no additional information on the state of the fruit, or prevalence and rate of attack (FDACS 2010; BCMAL 2009).
- There is a report of *Drosophila suzukii* in red bayberry in China and trapping efficacy studies have been conducted for *Drosophila suzukii* as it is considered a pest (Wu *et al*. 2007). However, the main host resource is fallen fruit (Wu *et al*. 2007).
- In Japan, *Drosophila suzukii* have been reared from fruit picked from the plant for *Phytolacca americana* and *Elaeagnus multiflora*, at low to moderate levels (Sato and Sasaki 1995c).

The presence of internal life stages that can be very difficult to detect by the naked eye and its ability to survive the duration of transport could support a probability rating of high for *Cornus kousa*, *Eugenia uniflora* and *Murraya paniculata*. However, they have only been reported as a host once and there are no further reports of these species being attacked at their origin. This information supports a probability rating of 'low' for the importation of *Drosophila suzukii* on *Cornus kousa*, *Eugenia uniflora* and *Murraya paniculata* on fresh fruit.

The presence of internal life stages that can be very difficult to detect by the naked eye and its ability to survive the duration of transport support a probability rating of high for *Myrica rubra*, *Phytolacca americana* and *Elaeagnus multiflora*. However, these hosts have only been reported infrequently as hosts with low to moderate levels of attack. This information supports a probability rating of 'moderate' for the importation of *Drosophila suzukii* on *Myrica rubra, Phytolacca americana* and *Elaeagnus multiflora* on fresh fruit.

Probability of distribution

The likelihood that *Drosophila suzukii* will be distributed within Australia in a viable state with imported fruit and transfer to a suitable host: **HIGH**.

- Fresh fruit infested with *Drosophila suzukii* would be distributed for retail sale to multiple destinations within the PRA area, so a portion of the fruit is likely to reach areas of host abundance.
- During distribution fruit may be kept at cool temperatures that may affect the survival of *Drosophila suzukii* (Kanzawa 1939). However, the perishable nature of fresh fruit would mean transit times will be short, and transit temperatures are likely to be above lethal levels (Kanzawa 1939; Woolworths 2010). At retail outlets, fruit will then be displayed at ambient temperature that would promote the survival and development of *Drosophila suzukii*.
- Hosts of *Drosophila suzukii* include 36 taxa from 12 plant families (Appendix B). Preferred hosts of *Drosophila suzukii* include strawberry, caneberry, cherry, stone fruit, blueberry and grapes (Kanzawa 1939; Sasaki and Sato 1995a; Kawase and Uchino 2005; EPPO 2010a; OSU 2010b). These species are widely distributed in commercial and domestic environments within Australia (AVH 2010).
- Although *Drosophila suzukii* is currently restricted in distribution to the northern hemisphere, and fresh fruit would be imported out of season, the broad host range would most likely result in some plant hosts having fruit during the import period and throughout the year. In addition, the continuous supply of fruit through the retail sector would ensure host fruits are available throughout the year in residential areas.
- Fresh fruit infested by mature larvae of *Drosophila suzukii* have a sunken surface and become rotten and unsuitable for sale (OSU 2010a; Bolda *et al*. 2010). Symptomatic fruits are likely to be considered unmarketable by wholesalers and retailers. These fruits are likely to be disposed of with general garbage or in compost bins prior to sale to the consumer.
- Asymptomatic fruit, with only eggs or recently hatched larvae, in sound condition would be distributed and sold through markets and retail chains.
- On imported fruit purchased at retail outlets for consumption, emerging flies would only need to move to fruit of a suitable host that may be in residential environments, including fruit bowls. The ability of *Drosophila suzukii* to utilise over ripe and damaged fruit will maximise the range and availability of host material they could reproduce on.
- Although the intended use of fresh fruit is human consumption, waste material would be generated (e.g. overripe and damaged fruit, uneaten portions). Whole or parts of the fruit may be disposed of at multiple locations throughout Australia in compost bins or amongst general household waste.
- Adult *Drosophila suzukii* associated with imported fruit could readily move to new host material. Adults are considered to be active fliers, can fly for several hours in a day, and are very active at temperatures between 20–25 °C (Kanzawa 1939). Closely related species of *Drosophila* are known to fly hundreds of metres towards preferred habitat (Coyne *et al*. 1987).

- The transfer of immature stages of *Drosophila suzukii* from fruit waste to a host would occur if they successfully completed development and emerged as a adult. *Drosophila suzukii* is known to complete development from egg to adult at high levels in sound fruit and at lower levels in rotten fruit (Kanzawa 1939).

The demonstrated association of the pest with the pathway, presence of internal life stages that can be very difficult to detect by the naked eye, its ability to survive the duration of transport and find one of its numerous hosts support a probability rating of 'high' for the distribution of *Drosophila suzukii* on fruit.

Overall probability of entry

The overall probability of entry is determined by combining the probability of importation with the probability of distribution using the matrix of rules shown in Table 2.2 on page 19.

The likelihood that *Drosophila suzukii* will enter Australia with imported fruit and transfer to a suitable host is summarised below:

Pathway	importation	distribution	Entry
Cherry	H	H	**H**
Caneberries	H	H	**H**
Stone fruit	H	H	**H**
Strawberry	H	H	**H**
Blueberry	H	H	**H**
Grape	H	H	**H**
Mulberry	H	H	**H**
Hardy kiwi	L	H	**L**
Other hosts			
Elaeagnus multiflora	L	H	**L**
Cornus kousa	L	H	**L**
Eugenia uniflora	L	H	**L**
Myrica rubra	M	H	**M**
Murraya paniculata	M	H	**M**
Phytolacca americana	M	H	**M**
N = Negligible, **EL** = Extremely low, **VL** = Very low, **L** = Low, **M** = Moderate, **H** = High			

5.2 Pathway 2 – Fresh Flowers

5.2.1 Probability of entry

Probability of importation

The likelihood that *Drosophila suzukii* will arrive in Australia with the trade in fresh flowers in a viable state from countries where the pest is present: **VERY LOW**.

- *Drosophila suzukii* is known to feed in fresh flowers (*Styrax japonicus and Camellia japonica*) and adults can successfully emerge (Mitsui *et al*. 2010; Damus 2010).
- Flowers are only known to be attacked by *Drosophila suzukii* in the absence of host fruit. Flowers have only been recorded to be attacked in spring, after adults emerge from winter dispause and before host fruit ripens in late spring (Mitsui *et al*. 2010; Damus 2010).
- It is not widely reported that *Drosophila suzukii* can successfully emerge from fresh flowers, eggs are small (Kanzawa 1939), and there is no information on the visual symptoms larval feeding may produce. It is likely that damage in *Drosophila suzukii* infested flowers could be easily over looked.
- Total development times from egg to adult can range from to 25 days at 15 °C and eight to 13 days at 25 °C in fruit (Kanzawa 1939. It is not known whether development times would be different for larvae feeding in flowers.
- Commercial flowers and nursery stock are likely to be transported at 2–4 °C to preserve freshness (Gollnow and Wade 2002).
- Eggs and larvae of *Drosophila suzukii* have been shown to be susceptible to cold (Kanzawa 1939). However, at temperatures tested in the range of –0.6– 2.2 °C, of the eggs and larvae tested, 5.5% survived for 72 hours and all eggs and larvae tested were dead by 96 hours (Kanzawa 1939). Although cold storage could increase mortality of *Drosophila suzukii* in flowers, the only study published was preliminary, with very low levels of replication, did not replicate commercial conditions and was conducted at temperatures lower than used commercially (Bolda 2009; Gollnow and Wade 2002).
- Adult *Drosophila suzukii* can successfully diapause over winter, and in the following spring become sexually active. During this period females can live on average for over 200 days (maximum of 301 days) (Kanzawa 1939). The ability of adults to survive cold conditions for extended periods could allow them to survive flower transport conditions.
- While fruit pathways were considered most important when *Drosophila suzukii* invaded the USA, the recent evidence of Mitsui *et al*. (2010) has shown fresh flowers could also be a pathway.

The presence of internal life stages that could be difficult to detect with the naked eye, and its ability to survive the duration of transport could support a probability rating of ‘high’ for the importation on flowers. However, the pest has infrequently been recorded from flowers, and then only for a restricted period of the year, support a probability rating of ‘very low’ for the importation of *Drosophila suzukii* on flowers.

Probability of distribution

The likelihood that *Drosophila suzukii* will be distributed within Australia in a viable state with imported flowers and transfer to a suitable host: **MODERATE**.

- Fresh flowers or nursery stock infested with *Drosophila suzukii* will be distributed for retail sale, or commercial propagation facilities, to multiple destinations within the PRA area, so a portion of the flower consignment is likely to reach areas of host abundance.
- It is not widely reported that *Drosophila suzukii* can successfully emerge from fresh flowers, eggs are small (Kanzawa 1939), and there is no information on the visual symptoms larval feeding may produce. It is likely *Drosophila suzukii* infested flowers could be easily over looked.
- During distribution flowers may be kept at cool temperatures that may affect the survival of *Drosophila suzukii* (Kanzawa 1939). However, the perishable nature of fresh flowers or nursery stock would mean transit times will be short and transit temperatures are likely to be above lethal levels (Kanzawa 1939; Gollnow and Wade 2002). After purchase, flowers will then be displayed at ambient temperature that would promote the survival and development of *Drosophila suzukii*.
- Hosts of *Drosophila suzukii* include 36 taxa from 12 plant families (Appendix B). Preferred hosts of *Drosophila suzukii* include the fruit of strawberry, cane berry, cherry, stone fruit, blueberry and grapes (Kanzawa 1939; Sasaki and Sato 1995a; Kawase and Uchino 2005; EPPO 2010a; OSU 2010b). These species are widely distributed in commercial and domestic environments within Australia (AVH 2010).
- Although *Drosophila suzukii* is currently restricted in distribution to the northern hemisphere, and flowers would be imported out of season, the broad host range would most likely result in some plant hosts are in fruit in the environment throughout the year. In addition, the continuous supply of fruit through the retail sector would ensure host fruits are available throughout the year in residential areas.
- On imported flowers purchased at retail outlets for residential display, emerging flies would only need to move to fruit of a suitable host in the domestic fruit bowl. The ability of *Drosophila suzukii* to utilise over ripe and damaged fruit (Kanzawa 1939) will maximise the range and availability of host material they could reproduce on.
- However, the ability of immature stages of *Drosophila suzukii* to successfully emerge from flowers is likely to be less than from its preferred fresh fruit hosts. For example, successful emergence in fruit is limited by decreasing sugar levels (Malguashca *et al*. 2010) and flowers are likely to have lower sugar levels than ripe fruit.
- Adult *Drosophila suzukii* associated with imported flowers could readily move to new host material. Adults are considered to be active fliers, can fly for several hours in a day, and are very active at temperatures between 20–25 °C (Kanzawa 1939).
- The transfer of *Drosophila suzukii* from flower waste to a host would occur if the larvae successfully completed development and emerged as a adult. It is not known how effectively *Drosophila suzukii* develops in fresh flowers (Kanzawa 1939).

There is a clear preference by females to oviposit in ripe fruit and successful adult emergence is reduced in less suitable fruit (Kanzawa 1939). It is considered likely that successful emergence from flowers will be lower than in ripe fruit.

The association of the pest with the pathway, presence of internal life stages that can be very difficult to detect, its ability to survive the duration of transport and the likely lower successful emergence from flowers, compared to fruit, support a probability rating of 'moderate' for the distribution of this species on flowers.

Overall probability of entry

The overall probability of entry is determined by combining the probability of importation with the probability of distribution using the matrix of rules shown in Table 2.2 on page 19.

The likelihood that *Drosophila suzukii* will enter Australia with imported flowers and transfer to a suitable host: **VERY LOW**.

5.3 Establishment and Spread

5.3.1 Probability of establishment

The likelihood that *Drosophila suzukii*, having entered on imported fresh fruit or fresh flowers and been transferred to a susceptible host, will establish within Australia, based on a comparison of factors in the source and destination areas considered pertinent to its survival and reproduction, is **HIGH**.

- *Drosophila suzukii* can attack a broad range of undamaged fruits including 36 taxa (plus five suspected species in the *Morus*, *Rubus* and *Prunus* genera) from 12 plant families (Appendix 1). In addition, *Drosophila suzukii* is known to attack the fruit of another 20 species when they are damaged or over ripe (Appendix 1). The broad host range, including fruit that is commercially available all year, including damaged and over ripe fruit, would ensure host material is available throughout the year and across the PRA area.
- The distribution of *Drosophila suzukii* is currently limited to the northern hemisphere (Table 3.1) and imported fruit is likely to arrive out of season in Australia. However, the broad range of host that *Drosophila suzukii* can attack and persist in increase the chances of this pest finding a suitable range of hosts to attack throughout the year. For example, strawberries are grown throughout winter in parts of Australia (SISP 2009) and would provide suitable host material for the establishment of this pest (Kanzawa 1939; Bolda 2009; Dreves *et al*. 2009).
- *Drosophila suzukii* occurs in Asia (China, Korea, Japan, Thailand Myanmar), the sub continent (India and Pakistan), Europe (Spain, France, Italy) and North America (Canada and the USA– Hawaii, California, Oregon, Washington, Florida), and Central and South America (Costa Rica and Ecuador) (Table 3.1).
- The climatic regions across this range are diverse and include Mediterranean, marine west coast, humid continental, sub tropical savannah, humid subtropical and tropical savannah (Espenshade 1990). There are similar climatic regions over large

parts of Australia that would be suitable for the establishment of *Drosophila suzukii* throughout the year.

- It is not known what number of individuals are required to establish a sustainable population. However, *Drosophila suzukii* is native to Asia and has successfully established in a broad range of locations including, Hawaii, Costa Rica, Ecuador, the west and east coast of the USA, Canada, Spain, France (including Corsica) and Italy (Table 3.1).
- Although *Drosophila suzukii* has been recorded from a diverse range of climatic regions, it is limited by environmental conditions.
- The negative effect of high temperature has been recorded experimentally where 75% of female *Drosophila suzukii* die at a constant temperature of 33.3 °C for 24 hours (Kimura 2004). Males flies are less tolerant of high temperature and 75 % mortality is reached at temperatures of 32.6 °C (Kimura 2004). Under laboratory conditions, adults will die if kept at 35 °C for three hours (Walton *et al*. 2010).
- Higher temperatures have been shown to kill immature stages of *Drosophila suzukii* over several days when the maximum daily temperature is above 35 °C (Sasaki and Sato 1995b). Pupae will not emerge at temperatures of 32 °C and above (Sasaki and Sato 1995b).
- The effect of temperature on *Drosophila suzukii* under experimental conditions is supported by field observation. In Yamanashi Prefecture in central Honshu, Japan, numbers of adults are greatest during early summer and autumn with a sharp decrease in numbers through the hottest period of summer (Kanzawa 1939; Mitsui *et al*. 2010). The decrease in adult numbers is not likely to be because of a lack of host material; *Drosophila suzukii* can attack a range of common hosts that fruit throughout the season in Japan (Sasaki and Sato 1995b).
- Further north in Honshu, in Fukushima Prefecture, where mean maximum temperatures are several degrees cooler in summer (JMA 2010), the bimodal peak in *Drosophila suzukii* abundance was not recorded during the 1993 season (Sasaki and Sato 1995c). Here, the abundance of *Drosophila suzukii* steadily increases on a range of hosts until a peak population is reached in autumn. However, in 1991 and 1992, when mean summer temperatures are 2–4 °C higher than 1993 (JMA 2010), numbers of *Drosophila suzukii* decrease during the hottest period of summer (Sasaki and Abe 1993).
- In Florida, populations of *Drosophila suzukii* have so far been very low through the hot summer months and significant population growth has only occurred during suitable cooler temperatures of winter (Dean 2010).
- *Drosophila suzukii* adults are extremely sensitive to low moisture/humidity. Adult flies will die under room temperature conditions in 6–24 hours without a moisture source (Smyth and Saverimuttu 2010). The sensitivity of *Drosophila suzukii* to low humidity is consistent with other *Drosophila* spp. that require humidity levels >70% for successful culture (Ashburner *et al*. 2005).
- In the USA, although recorded to be present in the central valley of California (Hauser 2010), *Drosophila suzukii* has not been recorded in high numbers and there

are no reports of damage on any host during summer. The hot arid conditions of the central valley could limit *Drosophila suzukii* populations (Van Steenwyck 2010).

- Over wintering survival can be affected by low temperatures where a constant temperature of -1.8 °C and -0.7 °C for 24 hours can kill 75 % of the females and males respectively (Kimura 2004).
- In Hokkaido, the far north of Japan, *Drosophila suzukii* is considered a domestic species associated with human habitation (Toda and Fukuda 1985). The species is believed to survive the cold winters in sheltered human habitation sites and then re-invades rural areas during summer.
- In Oregon, over wintering experiments have shown very low survival with only one adult in 1 000 surviving until spring (Smyth and Saverimuttu 2010). In over wintering trials in Japan, survival can vary from 0–23% and moisture may also play a role in the survival of adults during winter (Sasaki and Sato 1995b).
- The distribution of *Drosophila suzukii* in North America has been predicted based on current distribution and tolerance to environmental factors (Damus 2009). This model predicts *Drosophila suzukii* has preference for temperate maritime climates and abundance is limited by cold winters, high summer temperatures and low humidity (Damus 2009).
- In Australia, the moderate winters (compared to Northern Asia and North America) across most regions are unlikely to limit the abundance of *Drosophila suzukii*. Recent evidence has shown that larvae and pupae can survive winter at low levels when the temperature is moderate (Walsh *et al*. in press).
- The temperature requirements for reproduction (Toda 1979) may allow oviposition to continue through winter in warmer coastal and northern areas. However, typical summer conditions away from the coast in Australia, high temperature (> 35 °C) and low humidity (BOM 2010), are likely to be less suitable for fly reproduction and survival.
- *Drosophila suzukii* has a very high rate of reproduction with multiple generations per year. After pupal emergence, the adults typically become sexually mature in one to two days with a maximum of 13 days recorded (Kanzawa 1935; Kanzawa 1939).
- *Drosophila suzukii* is not known to be parthenogenic and newly emerged females would need to mate to produce viable eggs. It is not known if pheromones are used by *Drosophila suzukii* to attract mates. In other *Drosophila* spp., sex pheromones are known to elicit male courtship behaviour (Ashburner *et al*. 2005) but it is not known over what distance they can attract potential mates.
- Adult *Drosophila suzukii* are known to be associated with packing houses and they are attracted to picked fruit (BCMAL 2010). Adult females associated with imported fruit, that were mated prior to import, are likely to produce viable eggs. In the closely related species, *Drosophila melanogaster*, sperm are known to remain viable for at least two weeks after fertilisation (Ashburner *et al*. 2005).
- Females can oviposit on average 7–16 eggs per day with 384 eggs on average in laboratory trials (Kanzawa 1939). A maximum of 160 eggs have been recorded to be

laid in a single day (Smyth and Saverimuttu 2010). Eggs, larvae and pupae all vary in development time depending on the generation in the field.

- Generations over summer have the shortest development times. Eggs typically hatch in 1 day and on average larvae take between four to nine days to complete feeding (Kanzawa 1939). Pupae require on average four to 13 days in the field to emerge as adults (Kanzawa 1939). The total development time from egg to adult ranges from eight to 23 days in the field (Kanzawa 1935; Kanzawa 1939).
- The short development time of *Drosophila suzukii* allows the fly to complete several generations in a season; up to 13 generations recorded in field conditions in Japan (Kanzawa 1939).
- During autumn, when the temperature is below 5 °C, newly emerged *Drosophila suzukii* adults do not sexually mature and seek out over wintering sites under leaf litter and stones, and enter a winter diapause (Kanzawa 1939). Sexually mature adults can also enter diapause and will not recommence sexual activity until the following season (Kanzawa 1939). The adult diapause over winter is reported to be in response to temperature (Toda 1979).
- Individual females can successfully oviposit hundreds of eggs prior to autumn, diapause over winter, and in the following spring recommence oviposition. During this period females can live on average for over 200 days (maximum of 301 days) and oviposit on average 260 eggs (Kanzawa 1939).
- There are currently no insecticides registered for control of *Drosophila suzukii* (PUBCRIS 2010). However, insecticide application for other internal feeding pests (e.g. *Bactrocera tyroni*) may limit the establishment of *Drosophila suzukii* in commercial fruit production areas that require such control measures.
- In urban environments, insecticide applications just prior to harvest are unlikely to be common and would not occur in picked fruit that can serve as a host.

The suitability of the environment, presence of multiple host species throughout the PRA area and the year, high reproductive potential and proven ability to establish in several climatically different new regions supports an assessment of ‘high’ for the establishment of *Drosophila suzukii*.

5.3.2 Probability of spread

The likelihood that *Drosophila suzukii*, having entered on imported fresh fruit or flowers and established, will spread within Australia, based on a comparison of those factors in the source and destination areas considered pertinent to the expansion of the geographic distribution of the pest, is: **HIGH**.

- *Drosophila suzukii* was first reported in North America in 2008 in California and by 2009 was widespread in a range of hosts from Oregon, Washington (Hauser *et al*. 2009) and British Columbia (BCMAL 2009). This demonstrates the ability of *Drosophila suzukii* to spread if suitable hosts are present and climatic conditions are favourable.
- More recently in the USA, *Drosophila suzukii* has spread to South and North Carolina, Louisiana and Utah (Burrack 2010; OSU 2010c).

- The spread of *Drosophila suzukii* in North America has been repeated in Europe. The fly was first detected in Rasquera, Spain, in the autumn of 2008, then Alpes Maritime and Montpellier, France, in late summer–early autumn of 2009 and then in Trentino Province, Italy, in autumn 2009. (Calabria *et al. in press*; EPPO 2010a).
- By July 2010, *Drosophila suzukii* has been reported from additional regions in Italy of Calabria and Tuscany (EPPO 2010c). By September 2010, *Drosophila suzukii* has been reported from additional regions in France in the Departments of Corsica, Var, Gard, Tarn et Garonne, Isere and Rhone (Cazaubon 2010; Seigle Vatte 2010).
- At a regional level the rapid spread of *Drosophila suzukii* is demonstrated in Florida. *Drosophila suzukii* was first detected in Florida in August 2009 at two locations three miles apart in Hillsborough County (Steck *et al*. 2009). Since this first detection, *Drosophila suzukii* has spread across the southern Florida peninsula and has been recorded from 24 counties by June 2010 (Snyder 2010). The recorded spread in Florida includes distances of over 300 km in 11 months.
- There are similarities in the natural and managed environments of the above regions with many of those in Australia, which suggests that *Drosophila suzukii* could spread in Australia.
- Host plants that would support the spread of *Drosophila suzukii* are widespread in cities, towns and horticultural production areas throughout Australia and in the natural environment. For example, blackberry and other *Rubus* spp. are grown in horticultural and residential areas for fruit and they are widespread as weeds in agricultural and natural environments across much of temperate Australia (Parsons and Cuthbertson 2001).
- *Drosophila suzukii* feeds and reproduces on undamaged taxa from 12 plant families, including many commonly cultivated species including strawberry, peaches, nectarines, plums and grapes (Appendix B; AVH 2010).
- The similarities in climate between the current distribution of *Drosophila suzukii* and horticultural, residential and natural regions where hosts are present within Australia would suggest that this species could spread naturally in these areas.
- *Drosophila suzukii* is native to temperate and sub tropical Asia (Hauser *et al*. 2009; Espenshade 1990) and once it established in new regions, spread through the Hawaii Islands (Kaneshiro 1983; O'Grady 2002), the west and east coast of North America (Hauser *et al*. 2009; Dreves *et al.* 2009; WSU 2009; BCMAL 2009; Synder 2010), and Europe (EPPO 2010c; Calabria *et al. in press*) demonstrating its capacity to spread within a range of environments.
- *Drosophila suzukii* occurs in Asia (China, Korea, Japan, Thailand and Myanmar), the sub continent (India and Pakistan), Europe (Spain, France, Italy) and North America (Canada and the USA– Hawaii, California, Oregon, Washington, Florida), and Central and South America (Costa Rica and Ecuador) (Table 3.1).
- The climatic regions across this range are diverse and include Mediterranean, marine west coast, humid continental, sub tropical savannah, humid subtropical and tropical savannah (Espenshade 1990). There are similar climatic regions over large

parts of Australia that would be suitable for the spread of *Drosophila suzukii* through large regions of Australia.

- The presence of natural barriers such as arid areas, mountain ranges, climatic differentials and possible long distances between hosts may prevent long-range natural spread of *Drosophila suzukii*.
- *Drosophila suzukii* is able to disperse independently and is considered an active flier although actual dispersal distances are not mentioned (Kanzawa 1939). In the closely related *Drosophila melanogaster*, directional flights to preferred habitats of several hundreds meters have been recorded (Coyne *et al* 1987). However, there is indirect evidence to support flight distances of 10–20 kilometres across unsuitable environments (Coyne *et al* 1987).
- The arid regions surrounding many horticultural production areas in Australia may provide a natural barrier to the spread of this pest in the presence of a host (Van Steenwyck 2010). For example, *Drosophila suzukii* reproduction is reduced at temperatures above 30 °C and mortality is 100% at 35 °C for three hours (Van Steenwyck 2010; Walton *et al* 2010).
- *Drosophila suzukii* will take advantage of temperate and humid conditions during suitable seasons, and throughout the year in suitable regions, to multiply rapidly (Damus 2009; Dean 2010).
- Areas with cold winters may act as a barrier to spread as *Drosophila suzukii* can have poor over-wintering survival (Kanzawa 1939; Damus 2009; Sato and Sasaki 1995b). However, Australia has relatively short mild winters compared to Northern Asia and North America where this species is established (BOM 2010; JMA 2010; Worldclimate 2010).
- Should *Drosophila suzukii* be introduced to major commercial production areas (of host fruit) in Australia physical barriers are unlikely to be a limiting factor to the spread as the fly has the potential to gradually spread by human activity to all areas in Australia.
- Movement of host fruit would help the dispersal of *Drosophila suzukii* because it infests fruit. The movement of infested fruit is considered a major means of spread for *Drosophila suzukii* (Hauser *et al* 2009; ODA 2010a; EPPO 2010c).
- Initial studies in the native range found one parasite, a gall wasp (*Phaenopria* spp.), that was identified attacking *Drosophila suzukii* (Kanzawa 1939). The generation time of the wasp is twice as long *Drosophila suzukii* and its value in limiting the population of *Drosophila suzukii* is considered limited (Kanzawa 1939).
- A more recent study across the four main islands of Japan has found *Drosophila suzukii* pupae were parasitised by three parasitoid species; *Asobara tabida*, *Asobara japonica* and *Ganaspis xanthpoda* (Mitsui *et al*. 2007). The rate of parasitism in this study (4.2%) is unlikely to contribute to the control of *Drosophila suzukii* populations in any substantial way.
- In the USA an *Orius* spp., a native predator, has been observed feeding on the larvae of *Drosophila suzukii* (Smyth and Saverimuttu 2010). In preliminary laboratory trials predation levels of 11–68% have been recorded when *Orius* spp. are forced to

feed on *Drosophila suzukii* (Pers. comm. Jana Lee, ARS, 19 August 2010). The predation level in the field has not been quantified.

- It is not known if native parasites and predators in Australia would limit the abundance and spread of *Drosophila suzukii*.

The suitability of the environment, presence of multiple host species throughout the PRA area, potential for spread in domestic commodities, their ability to disperse independently and proven ability to spread rapidly supports an assessment of 'high' for the spread of this species.

5.3.3 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 on page 19.

The likelihood that *Drosophila suzukii* having entered on imported fruit, be distributed in a viable state to suitable hosts, establish in the PRA area and subsequently spread throughout Australia: **high**.

5.4 Consequences

The consequences of the entry, establishment and spread of *Drosophila suzukii* in Australia have been estimated according to the methods described in Table 2.3. The assessment of potential consequences is provided below:

Impact scores for *Drosophila suzukii*	
Criterion	**Estimate and justification**
Direct	
Plant life or health	**F –** Major significance at the regional level *Drosophila suzukii* is known to attack a range of important commercial crops including (and not limited to) strawberry, cherry, stone fruit and grapes (Kanzawa 1939; Bolda *et al* 2010; OSU 2010b). These industries are significant in Australia; – Strawberry industry was valued at $308 million in the financial year 2007/2008 (SISP 2009) – Cherry industry was valued at $54 million in the financial year 2001-2002 (ACIR 2006) – Stone fruit industry was valued at approximately $200 million in 2002 (Summerfruit Australia 2010) – The table grape industry is valued at $135 million annually (AustraliaFresh 2010) – The wine grape industry was valued at $4.6 billion in the financial year 2005/2006 (ABS 2007) In the 1930's, *Drosophila suzukii* was considered a major pest on cherry and grapes in Japan with damage reaching 80–100% in years and localities (Kanzawa 1939 & 1935). More recently, *Drosophila suzukii* has been recorded to be the main pest damaging cherry in Fukushima Prefecture (Sasaki and Sato 1995a). Damage levels are low at the start of harvest and have been recorded to reach a maximum of 77% by the end of the season (Sasaki and Sato 1995a). Peaches are considered a major host and crop losses of 80% at localities have been recorded (OSU 2010b; ODA 2010a; CPAN 2009). Maximum crop losses of 40% for blueberries, 70% for blackberries and raspberries, and 33% for cherries have been observed in the USA (Bolda *et al* 2010). Wine grapes are also considered at risk since *Drosophila suzukii* damage

	allows secondary infections to occur that could reduce the quality of the grape juice (OSU 2009; Walsh *et al*. 2010; Reign of Terroir 2010a). Based on these initial reports in 2009, an estimated average damage across all growing regions could result in a combined damage of US$500 million per year (Bolda *et al* 2010). Bolda *et al*. (2010) caution the values used across industries are estimates and the realised damage into the future will depend on many factors. In the USA in 2010, the levels of damage are much lower and no significant damage has been recorded (Bolda 2009: OSU 2010c; ODA 2010b). The low damage levels observed in 2010 are considered to be due to the adoption of monitoring and spraying programs by commercial growers (Bolda 2009; OSU 2010c). In contrast, residential and 'pick your' growers, are recording high levels of damage (OSU 2010c). In commercial situations in Oregon and Washington, when orchards are under managed, trap catches of *Drosophila suzukii* are increasing as the season progresses and there is potential for commercial losses (OSU 2010c). However, it is likely the distribution and abundance of *Drosophila suzukii* will be affected by environmental conditions (see section 3.4.3 Ecology). High levels of damage are more likely in regions with moderate temperatures and high humidity's. For example, The are no reports of damage over summer from the arid central valley of California. If not managed, this pest could threaten the economic viability of commercial producers in a range of across Australia where the environment is suitable. Other host plants in the environment, including residential plants will be affected by *Drosophila suzukii* attack. Infested fruit is not suitable for consumption.
Any other aspects of environment	**B-** Minor significance at local level There may be some impact on insect or animal species that feed on host plants due to the reduced availability of fruits through larval competition or highly damaged fruits. *Drosophila suzukii* is less likely to affect the reproduction of plants as there is no record that larval feeding affects seed production or viability. However, poor quality fruit from larval feeding may reduce bird and mammal dispersal of seeds.
Indirect	
Eradication, control, etc.	**E-** Major significance at district level There are no insecticides registered for the control *of Drosophila suzukii* (PUBCRIS 2010). However, there are several insecticides registered for use on host plants in Australia that have been shown to be effective in the USA (OSU 2010d). The use of some key insecticides, for internal feeding pests, permitted for use in several crops in Australia are currently under review and their use may be restricted in the future (APVMA 2010). Trapping of *Drosophila suzukii* proved cost effective in limiting damage over four years at multiple locations with damage reduced from 50% to 3.6% in Japan (Kanzawa 1939). However, effective control was obtained by placing a trap on every fruit bearing tree that was inspected every three days (Kanzawa 1939). Today's labour costs may limit the cost effectiveness of trapping. Eradication of *Drosophila suzukii* would require the removal of large numbers of native, amenity, weedy and commercial host fruit within the vicinity of outbreaks and/or the broad scale application of insecticides to control adult and juvenile life stages. Due to the large number of host plants affected, the likely human assisted and natural spread the costs of any eradication campaign are likely to be substantial. However*, Drosophila suzukii* has recently been found in multiple countries and none have attempted eradication. The high reproductive capacity and dispersal abilities of this pest would make early detection vital if eradication was to be successful. While potentially able to be managed in commercial production, the

	presence of *Drosophila suzukii* will increase the production costs through the regular application of broad spectrum insecticides (OSU 2010c). The application of insecticides could also affect integrated pest management programs that could allow currently manageable pests to increase in importance. *Drosophila* spp. have been shown to vector plant pathogens (Schneider 2000) and *Drosophila suzukii* has been reported to vector yeasts and bacteria (Walsh *et al*. 2010). However, no species are identified and it is not clear whether oviposition by *Drosophila suzukii* vectors yeasts and bacteria or simply allows an entry point for endemic species to colonise fruit. However, no new pathogens have been reported from areas where *Drosophila suzukii* have established in recent years. The consequences of yeast or bacteria that may be associated with the pest is likely to be low.
Domestic trade	**E** Major significance at district level The presence of *Drosophila suzukii* in production areas would likely result in domestic movement restrictions for host commodities. Currently, the only effective post harvest control, based on preliminary efficacy data is methyl bromide fumigation and this treatment would significantly affect the quality of fruit and production costs.
International trade	**E-** Major significance at district level The presence of *Drosophila suzukii* in production areas would limit access to some overseas markets and make market access negotiations more difficult. Some important markets for Australian host fruit, such as Japan, Korea, Thailand and China, already have the pest but other areas do not. Due to the importance and value of some host fruits, disruption to trade is expected to be significant to growers and production areas.
Environmental and non-commercial	**D –** Significant at local level Large scale removal of alternate host plants may affect the environment. Broad-scale application of broad spectrum insecticides directed against *Drosophila suzukii* would have some impacts on native insects.

Based on the decision rules described in Table 2.4, that is, where the consequences of a pest with respect to a single criterion has an impact of **'F'**, the overall consequences are estimated to be **High**.

5.5 Unrestricted risk

Unrestricted risk is the result of combining the probability of entry, establishment and spread with the estimate of consequences using the risk estimation matrix shown in Table 2.5. The unrestricted risk estimates for *Drosophila suzukii* for fresh fruit and fresh flower pathways are set out in Table 5.1.

5.6 Risk assessment conclusion

The results of the pathway risk assessments for *Drosophila suzukii* are set out in Table 5.1.

The unrestricted risk for *Drosophila suzukii* for the fruit pathways, depending on the host, has been assessed as from '**moderate–high'**, which is above Australia's ALOP. The unrestricted risk for *Drosophila suzukii* for the flower pathways has been assessed as '**low'**, which is above Australia's ALOP. Therefore, specific risk management measures are required to ensure that the pest does not enter, establish and spread though these pathways.

Table 5.1: Summary of pathway risk assessments for *Drosophila suzukii*

Pathway	Entry			Establishment	Spread	P[EES]	Consequences							URE
	importation	distribution	Overall				direct		indirect				Overall	
							PLH	OE	EC	DT	IT	ENC		
Rubus spp.	H	H	**H**	H	H	H	F	B	E	E	E	D	H	H
Cherry	H	H	**H**			H								
Stone fruit	H	H	**H**			H								
Strawberry	H	H	**H**			H								
Blueberry	H	H	**H**			H								
Grape	H	H	**H**			H								
Mulberry	H	H	**H**			H								
Hardy kiwi	L	H	**L**			L								M
Other host fruit														
Elaeagnus multiflora	L	H	**L**			L								M
Cornus kousa	L	H	**L**			L								M
Eugenia uniflora	L	H	**L**			L								M
Myrica rubra	M	H	**M**			M								H
Murraya paniculata	M	H	**M**			M								H
Phytolacca americana	M	H	**M**			M								H
Fresh flowers	VL	M	**VL**			VL								L

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	**Consequences** Consequences from pest entry, establishment and spread are on an ascending scale from A to G (see method section 4). **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	**URE** = Unrestricted risk estimate

6 Pest risk management

6.1 Pest risk management measures and phytosanitary procedures

Pest risk management evaluates and selects risk management options to reduce the risk of entry of *Drosophila suzukii* for the pathways where the unrestricted risk exceeds Australia's ALOP. Risk management measures are required to reduce this risk to achieve Australia's ALOP.

The pathway risk assessment identified two pathways that had an unrestricted risk above Australia's ALOP. The proposed pest risk management measures and operational system proposed for *Drosophila suzukii* for these pathways are summarised in Table 6.1.

Table 6.1: Phytosanitary measures proposed for *Drosophila suzukii*

Pest	Pathway	Measures
Drosophila suzukii	Fresh fruit	Area freedom*; or Systems approach for fruit with pre- and post-harvest measures; or Fruit treatment known to be effective against all life stages of *Drosophila suzukii* (e. g. methyl bromide fumigation)
	Fresh flowers (Nursery stock)	Flower treatment known to be effective against all life stages of *Drosophila suzukii* (e. g. methyl bromide fumigation)
	Fresh flowers (Cut flowers)	Flower treatment known to be effective against all life stages of *Drosophila suzukii* (e. g. methyl bromide fumigation)
*: Area freedom may include pest free areas, pest free places of production or pest free production sites		

This PRA was conducted to meet Australia's international obligations in response to the introduction of emergency measures for *Drosophila suzukii*. Unlike a commodity focused import risk analysis, that assesses the risk of pests establishing in Australia from one country, this PRA considers all pathways that could allow the introduction and establishment of this pest. Given the number of pathways *Drosophila suzukii* could enter Australia, and the number of countries from which commodities could be sourced, suitable risk management measures have not been developed for all pathways, or to a standard that they could be considered a stand alone treatment.

Subject to the provision of suitable efficacy data, Biosecurity Australia considers that the risk management measures proposed in this pest risk analysis will achieve Australia's ALOP.

The procedures described in the following section are proposed as the basis for the import conditions for hosts of *Drosophila suzukii* from all sources into Australia. While the following measures are considered feasible by Biosecurity Australia, any other measure that provides an equivalent level of protection would be considered.

Note that these measures are for *Drosophila suzukii* and are in addition to the existing import conditions for the commodities covered by this PRA.

6.1.1 Fresh fruit

The pathway risk assessment identified fruits from several species had an unrestricted risk above Australia's ALOP. Risk mitigation measures are required to reduce the risk to meet Australia's ALOP. In the pathway risk assessment, it was established that host fruit could be infested with the eggs, larvae and/or pupae, or contaminated with adults of *Drosophila suzukii* and that these infested fruit or adult flies may not be detected and enter Australia, leading to the establishment and spread of *Drosophila suzukii*. A number of options may be available to reduce these risks.

Area freedom from *Drosophila suzukii*

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).

If area freedom from *Drosophila suzukii* could be demonstrated for areas or countries, the probability of entry would be reduced from 'high' to at least 'extremely low'. The unrestricted risk would then be reduced to at least 'very low', which would achieve Australia's ALOP.

Any proposal for area freedom status will need to be assessed by Biosecurity Australia.

Systems approach for fruit including pre- and post-harvest measures

A systems approach combining crop monitoring and *Drosophila suzukii* control with post-harvest measures could be used to reduce the risk of *Drosophila 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).

Biosecurity Australia considers a systems approach to address the risks posed by *Drosophila suzukii* on host fruit may be feasible. This approach is based on a combination of crop monitoring and pest control with post-harvest measures. Crop monitoring could include areas of low pest prevalence or a 'seasonal window' when climatic conditions limit the activity of *Drosophila 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 exporting countries for their commodities.

Treatment of fruit

A treatment that is known to be effective against all life stages of *Drosophila suzukii* is a measure that might be applied to manage the risk posed by this pest in imports of host fruit. Treatment of fruit, with suitable efficacy, would reduce the probability of entry of infested fruit to at least 'extremely low'. The unrestricted risk would then be reduced to at least 'very low', which would achieve Australia's ALOP

Biosecurity Australia has reviewed preliminary methyl bromide fumigation efficacy data that has shown 100% mortality on all life stages. Methyl bromide fumigation of exported fruit is a treatment that that could achieve Australia's ALOP as a stand alone treatment. However, before methyl bromide could be recommended as a permanent quarantine measure for *Drosophila suzukii* in fruit, a complete efficacy treatment proposal would need to be reviewed and accepted by Biosecurity Australia.

Cold treatment is another treatment that may be suitable in managing the risk of *Drosophila suzukii* infested fruit. There is original research conducted in Japan that shows mortality of eggs and larvae can reach 100% after 96 hours exposure to temperatures of 1.7–2.2 °C (Kanzawa 1939). However, replication levels in this trial are low (<100 eggs or larvae), did not replicate commercial conditions and where not conducted to current international standards accepted by importing countries. However, before a cold treatment could be recommended as a quarantine measure, a complete efficacy treatment proposal, showing mortality of all life stages, 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.

If a treatment effective against *Drosophila suzukii* could be demonstrated to a suitable efficacy for fresh fruit, the probability of entry would be reduced from 'high' to at least 'extremely low'. The unrestricted risk would then be reduced to at least 'very low', which would achieve Australia's ALOP.

Treatments for fruit by other methods will be considered by Biosecurity Australia if proposed by the exporting country.

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

Commercial fruits not considered as hosts for *Drosophila suzukii*

The PRA identified fruit pathways, based on the consideration of commercial quality fruit, as defined in the scope of the PRA. In addition to the host fruits assessed to be above Australia's ALOP, the PRA also identified several fruits that can be attacked by *Drosophila suzukii* when damaged or over-ripe, and provide a pathway for this pest to enter Australia (Appendix B). It is likely that *Drosophila suzukii* could attack a wide range of fresh fruits if they are damaged or over-ripe. To ensure fresh fruits that are not considered hosts of *Drosophila suzukii* are not pathways for the entry and establishment of this pest, commercial fruit quality standards will need to be maintained by the exporting country for fruit where *Drosophila suzukii* is known to occur.

The mandatory AQIS inspection of commodities (pre-clearance or on-arrival), for imported fresh fruit from where *Drosophila suzukii* is known to occur, will verify the quality standard of the fruit exported to Australia.

Suspected fruit hosts

The PRA identified the fruits of several species from *Morus*, *Rubus* and *Prunus* genera that have been recorded to be associated with *Drosophila suzukii* without confirmation that undamaged ripe fruit can be attacked before harvest. These species are suspected to be fruit hosts because of the high association of *Drosophila suzukii* with other species in those genera (Appendix B). If an application to import the fruit of these species, or other species from those genera, is made to AQIS, Biosecurity Australia will review the host association of these suspected hosts, before these species can be imported into Australia.

6.1.2 Fresh Flowers

Australia has existing mandatory conditions for nursery stock (on-arrival methyl bromide fumigation and three months post-entry quarantine) and cut flowers (on-arrival methyl bromide fumigation with exemptions allowed; ICON 2010).

If methyl bromide fumigation against *Drosophila suzukii* could be demonstrated to a suitable efficacy for fresh flowers, the probability of entry would be reduced from 'high' to at least 'extremely low'. The unrestricted risk would then be reduced to at least 'very low', which would achieve Australia's ALOP.

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

Treatments for cut flowers by other methods will be considered by Biosecurity Australia if proposed by the exporting country.

6.2 Operational systems for the maintenance and verification of phytosanitary status

A system of operational procedures is necessary to maintain and verify the phytosanitary status of fresh fruit during production and export to Australia. This is to ensure that the recommended risk management measures have been met and are maintained.

Biosecurity Australia proposes a system for this purpose that is consistent with ones currently in place for the importation of fresh fruits from other sources. Details of this system, or of an equivalent one, will be determined by agreement with the National Plant Protection Organisation (NPPO) of the exporting country.

Recognition of the competent authority

The NPPO of the exporting country will be recognised as the competent authority.

The objectives of the competent authority are to ensure that:

- proposed service and certification standards are met by all relevant agencies participating in this program
- proposed administrative processes are established that provide assurance that the proposed requirements of the program are being met.

Registration of packing houses and auditing of procedures

All packing houses intending to export fruit to Australia will be required to be registered with the NPPO.

Packinghouses will be required to be able to identify the source of fruit processed in the facility using the registration number of the export greenhouses or fields so cartons and pallets (that is, one source per pallet) can be labelled with this number.

The objectives of this proposed procedure are to ensure that:

- fruit is only sourced from NPPO registered packing houses where fruit is cleaned and graded to export standard to ensure it is not contaminated by quarantine pests or regulated articles[3]
- registration numbers of export greenhouses or fields can be used for trace-back and auditing purposes.

Packaging and labelling

The objectives of this proposed procedure are to ensure that:

- secure packaging is used to ensure that fruit of host species is not re-contaminated after washing, grading and packing
- unprocessed packing material (which may vector pests not identified as being on the pathway) is not imported with the fruit
- all wood material used in packaging the commodity complies with AQIS conditions (see AQIS publication 'Cargo Containers: Quarantine aspects and procedures' at http://www.daffa.gov.au/aqis/import/cargo/aspects-procedures)
- all cartons or pallets (one source per pallet) must be labelled with the registration numbers of the export greenhouses or fields. The palletised product is to be identified by attaching a uniquely numbered pallet card to each pallet or part pallet to enable trace-back to registered greenhouses or fields.

Specific conditions for storage and movement

Arrangements for secure storage and movement of produce are to be developed by the NPPO in consultation with AQIS.

The objectives of this proposed procedure are to ensure that:

- product for export to Australia is maintained in secure conditions that will prevent mixing with fruit for domestic consumption or export to other destinations
- the quarantine integrity of the commodity is maintained during storage and movement.

Phytosanitary inspection by the NPPO

The NPPO will inspect all consignments in accordance with official procedures for all visually detectable quarantine pests and regulated articles. Sample rates must achieve a confidence level of 95% that not more than 0.5% of the units in the consignment are

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3 The IPPC defines a regulated article as 'any plant, plant product, storage place, packaging, conveyance, container, soil and any other organism, object or material capable of harbouring or spreading pests, deemed to require phytosanitary measures, particularly where international transportation is involved'.

infested/infected. This equates to a level of zero units infested/infected by quarantine pests in a random sample size of 600 units from the homogenous inspection lot[4] in the consignment[5], where one unit is one fruit or one bunch of fruit depending on the commodity.

Detection of live quarantine pests or regulated articles will result in failure of the consignment. If a consignment fails inspection by the NPPO, the exporter will be given the option of treatment and re-inspection of the consignment or removal of the consignment from the export pathway.

Records of the interceptions made during these inspections (live or dead quarantine pests, and regulated articles) are to be maintained by the NPPO and made available to Biosecurity Australia or AQIS as requested. The detection of live or dead quarantine pests for which area freedom is claimed will result in the suspension of area freedom arrangements, pending review. This information will assist in future reviews of this import pathway and consideration of the appropriateness of the phytosanitary measures that have been applied.

The objectives of this proposed procedure are to ensure that:

- all consignments are inspected by the NPPO
- only consignments where no quarantine pests or other regulated articles are found during inspection are exported to Australia.

Phytosanitary certification by the NPPO for known fruit hosts

The NPPO will issue a phytosanitary certificate for each consignment after completion of the pre-export phytosanitary inspection. Each phytosanitary certificate is to contain the following additional declaration:

> *The fruit in this consignment has been produced in accordance with the conditions governing entry of host fruit of Drosophila suzukii to Australia and inspected and found free of quarantine pests*

consistent with International Standards for Phytosanitary Measures No. 7 *Export Certification System* (FAO 1997).

The objectives of this proposed procedure are to ensure that:

- formal documentation is provided to AQIS verifying that the relevant measures have been undertaken offshore.

The objectives of this proposed procedure are to ensure that:

- formal documentation is provided to AQIS verifying that the relevant measures have been undertaken offshore.

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[4] An inspection lot is the number of boxes presented for a single phytosanitary inspection.

[5] A consignment is the number of boxes of fresh fruits in a shipment to Australia covered by one phytosanitary certificate.

Phytosanitary certification by the NPPO for fresh flowers

The NPPO will issue a phytosanitary certificate for each consignment after completion of the pre-export phytosanitary inspection. Each phytosanitary certificate is to contain the following additional declaration:

> *The fresh flowers in this consignment has been produced in accordance with the conditions governing entry of host flowers of Drosophila suzukii to Australia and inspected and found free of quarantine pests*

consistent with International Standards for Phytosanitary Measures No. 7 *Export Certification System* (FAO 1997).

The objectives of this proposed procedure are to ensure that:

- formal documentation is provided to AQIS verifying that the relevant measures have been undertaken offshore.

Pre-clearance or on-arrival phytosanitary inspection by AQIS

Consignments will be inspected by AQIS using the standard AQIS inspection protocol. The detection of live quarantine pests, dead quarantine pests for which area freedom is claimed, or other regulated articles will result in the failure of the inspection lot[6]. No land bridging of goods will be permitted unless goods have cleared quarantine.

In consultation with the NPPO, AQIS may complete the inspection as a pre-clearance inspection in the exporting country. For pre-clearance inspections, AQIS will confirm that a Declaration of Intent (DOI) to export is completed and related to the product presented for inspection, undertake inspection of the inspection lot, and authorise the DOI. For pre-cleared consignments, AQIS will undertake a documentation compliance examination for consignment verification purposes at the port of entry in Australia prior to the release from quarantine.

The objectives of this proposed procedure are to ensure that:

- all lots are inspected by AQIS for quarantine pests and other regulated articles
- the detection of live quarantine pests, dead quarantine pests for which area freedom is claimed, or other regulated articles will result in the rejection of the inspection lot.

Remedial action(s) for non-compliance

The objectives of this proposed procedure are to ensure that:

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

Should non-compliance with the import conditions be detected, the trade may be suspended or the import conditions amended until remedial action is completed and Biosecurity Australia and/or AQIS is satisfied that trade can recommence under the conditions set out in this pest risk analysis.

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6 An inspection lot is the number of boxes presented for a single phytosanitary inspection.

7 Conclusion

The findings of this draft PRA report are based on a comprehensive analysis of relevant scientific and other appropriate literature.

Biosecurity Australia considers that the risk management measures proposed in this draft PRA report will achieve Australia's appropriate level of protection against the fresh fruit and fresh flower pathways for *Drosophila suzukii* identified in this risk analysis. Various risk management measures may be suitable to manage the risk of *Drosophila suzukii* in the pathways associated with the import of host fruit and flowers into Australia. Biosecurity Australia will consider any other measures suggested by stakeholders that provide an equivalent level of phytosanitary protection.

Appendices

Appendix A: Categorisation of spotted wing drosophila (*Drosophila suzukii*)

Pest	Distribution	Potential to be present on the pathway	Present within Australia	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
DOMAIN ANIMALIA						
Order DIPTERA						
Drosophila suzukii Matsumura [Drosophilidae]	Asia, North America, Central and South America, Europe (see Table 3.1)	Yes. *Drosophila suzukii* is known to infest a range of fresh fruit before harvest (Kanzawa 1939) has the potential to be imported on a number of fresh fruit pathways	No records found	Yes. *Drosophila suzukii* has established and spread outside its native range (Hauser *et al*. 2009)	Yes. *Drosophila suzukii* is known to cause economic damage to a range of commercial fruits (Bolda *et al*. 2010)	**Yes**

Appendix B: Known hosts of the spotted wing drosophila (*Drosophila suzukii*)

Host	Common name	Host association	Present in Australia	Consider further
Actinidiaceae				
*Actinidia arguta (*Siebold & Zucc.) Planch. ex Miq.	Hardy kiwis	Adult flies reared from field collected fruit (Dreves *et al*. 2009; Smyth and Saverimuttu 2010).	Yes (Hibbert 2004)	**Yes**
Actinidia chinensis Planch.	Chinese gooseberries	*Actinidia* spp. have been recorded as potential hosts in Canada though the plant species was not recorded and larvae were not reared out to species to confirm *Drosophila suzukii* (Hueppelsheuser 2009; BCMAL 2009). Biosecurity Australia has contacted the author the pest alerts and they confirmed fly maggots were found in *Actinidia arguta* (Pers. comm., Tracey Hueppelheuser, British Columbia Ministry of Agriculture and Lands, 1 Sept 2010). *Actinidia deliciosa* and *Actinidia deliciosa* are grown in Northwest USA (Strik 2005) and there are no reports of either species being attacked by *Drosophila suzukii.*	Yes (Hibbert 2004)	No
Actinidia deliciosa (A. Chev.) C. F. Liang & A. R. Ferguson	Kiwi fruit		Yes (Hibbert 2004)	No
Adoxaceae				
Viburnum dilatatum Thunb.	Linden viburnum	Reared from fallen fruit only (Mitsui *et al*. 2010).	Yes (Randall 2007)	No
Cornaceae				
Alangium platanifolium (Sieb. et Zucc.) Harms		Reared from fallen fruit only (Mitsui *et al*. 2010).	Yes (Hibbert 2004)	No
Cornus controversa Hemsl. ex Prain	Dogwood	Reared from fallen fruit only (Mitsui *et al*. 2010).	Yes (Hibbert 2004)	No

Host	Common name	Host association	Present in Australia	Consider further
Cornus kousa Hance	Dogwood	Recorded as a host (BCMAL 2009). However, there is no information on the association and rate of attack by *Drosophila suzukii*.	Yes (Hibbert 2004)	**Yes**
Ebenaceae				
Diospyros kaki Thunb.	Persimmon	Although listed as a host (ODA 2009), adults have only emerged from fruit that was either split, damaged, dropped or cut (Kanzawa 1939).	Yes (Hibbert 2004)	No
Elaegnaceae				
Elaeagnus multiflora Thunb.	Silver berry	Recorded from whole fruit (Kanzawa 1939).	Yes (Hibbert 2004)	**Yes**
Ericaceae				
Gaultheria adenothrix (Miq.)	Akamono	Reared from fallen fruit only (Mitsui *et al*. 2010).	Yes (Randall 2007)	No
Vaccinium angustifolium Aiton	Blueberry	Injurious to fruit in Japan (Uchino 2005).	Yes (Hibbert 2004)	**Yes**
Vaccinium corymbosum L.				
Garryaceae				
Aucuba japonica Thunb.	Spotted laurel	Reared from fallen fruit only (Mitsui *et al*. 2010).	Yes (Hibbert 2004)	No
Grossulariaceae				
Ribes spp.	Black currant, Red currant, Gooseberry	Recorded as a host (NAPPO 2010a). However, Canadian authorities have confirmed *Ribes* spp. are hosts only when damaged (Pers. comm., Martin Damus, CFIA, 22 April 2010).	Yes (Hibbert 2004)	No

Host	**Common name**	**Host association**	**Present in Australia**	**Consider further**
Moraceae				
Ficus carica L.	Figs	Recorded as a host (Dreves *et al*. 2010; OSU 2010b). However, there are no reports of damage even though *Drosophila suzukii* has been trapped near figs (Peerbolt 2010). Figs have only been recorded to be attacked when the fruit is over-ripe (Pers. comm., Vaughn Walton, OSU 12 October 2010).	Yes (Hibbert 2004)	No
Morus alba L	Mulberry	Adult flies can emerge from whole fruit (Kanzawa 1939).	Yes (Hibbert 2004)	**Yes**
Morus australis Poir. [=*Morus bombycis* Koidz.]	Silkworm mulberry	Reared from fallen fruit only (Mitsui *et al*. 2010). However, other species in this genus have been confirmed to be attacked at high levels and this species is a suspected host.	Yes (Hibbert 2004)	**Yes**
Morus rubra L	Red mulberry	Recorded as a host (FDACS 2010).	Yes (Randall 2007)	**Yes**
Musaceae				
Musa acuminata Colla x *M. balbisiana* Colla	Bananas	Over ripe fruit only (Price and Nagle 2009).	Yes (BA 2008)	No
Myricaceae				
Myrica rubra Lour.	Red Bayberry	Recorded as a host (Wu *et al*. 2007).	Yes (Randall 2007)	**Yes**
Myrtaceae				
Eugenia uniflora L.	Surinam Cherry	Recorded as a host (FDACS 2010).	Yes (Hibbert 2004)	**Yes**
Psidium cattleianum Sabine	Strawberry guava	Recorded from rotting fruit only (Kido *et al*. 1996)	Yes (Randall 2007)	No
Phytolaccaceae				

Host	Common name	Host association	Present in Australia	Consider further
Phytolacca americana L.	American pokeweed	Adult flies reared from field collected fruit (Sasaki & Sato 1995c).	Yes (Hibbert 2004)	**Yes**
Rosaceae				
Cerasus mahaleb L. *(syn=Prunus mahalab)*	Mahaleb cherry	Recorded as a host from whole fruit (Kanzawa 1939).	Yes (Hnatiuk 1990)	**Yes**
Cerasus vulgaris L. (syn=*Prunus cerasus)*	Dwarf cherry	Recorded as a host from whole fruit (Kanzawa 1939).	Yes (Hibbert 2004)	**Yes**
Eriobotrya japonica (Thunb.) Lindl.	Loquat	Only on damaged fruit or cut surfaces (Kanzawa 1939).	Yes (Hibbert 2004)	No
Fragaria x *ananassa* Duchesne ex Rozier (syn = *Fragaria* x *grandifolia,* Ehrs)	Strawberry	Recorded as a host from whole fruit (Kanzawa 1939).	Yes (Hibbert 2004)	**Yes**
Malus domestica Borkh.	Apples	Apples have been recorded a host (ODA 2009; Dreves *et al*. 2009; APHIS 2010). However, only damaged or dropped fruit are attacked (Kanzawa 1939).	Yes (Hibbert 2004)	No (see section 4.1 for more detail)
Prunus armeniaca L.	Apricots	Recorded as a host from dropped fruit (Kanzawa 1939). Attack has been recorded from very late fruit (Coates 2009). More recently it has been reported from Corsica attacking tree ripe fruit (Corsematin 2010).	Yes (Hibbert 2004)	**Yes**
Prunus armeniaca x *salicina*	Plumcots	Recorded as a host (Bolda 2009).	No record found	**Yes**
Prunus avium (L.) L.	Cherry	Preferred host (Kanzawa 1939).	Yes (Hibbert 2004)	**Yes**

Host	**Common name**	**Host association**	**Present in Australia**	**Consider further**
Prunus buergeriana Miq.	Shirozakura	Adult flies reared from field collected fruit (Sasaki & Sato 1995c).	No record found	**Yes**
Prunus caroliniana Aiton	Sherry laurel	Adults collected in a multi-lure trap set near *Prunus caroliniana* and there are no reports of larvae in fruit (Tri-ology 2009). However, the high association of *Drosophila suzukii* with this genus suggests this species is likely to be attacked and it is a suspected host.	Yes (Randall 2007)	**Yes**
Prunus domestica L.	Plum	Recorded as a host from whole fruit (Kanzawa 1939).	Yes (Hibbert 2004)	**Yes**
Prunus donarium Sieber	Wild cherry	Recorded as a host from whole fruit (Kanzawa 1939).	No record found	**Yes**
Prunus japonica Thunb.	Korean cherry	Adult flies reared from field collected fruit (Sasaki & Sato 1995c).	Yes (Randall 2007)	**Yes**
Prunus mume Siebold & Zucc.	Asian plum/Japanese apricot	Recorded as a host in California (Hauser & Damus 2009).	Yes (Hibbert 2004)	**Yes**
Prunus nipponica Matsumura		Reared from fallen fruit only (Mitsui *et al*. 2010). However, the high association of *Drosophila suzukii* with this genus suggests this species is likely to be attacked and it is a suspected host.	Yes (Randall 2007)	**Yes**
Prunus persica (L.) Batsch	Peaches	Adult flies reared from field collected fruit (Sasaki & Sato 1995c).	Yes (Hibbert 2004)	**Yes**
Prunus persica var. *nucipersica* (Suckow) C. K. Schneid. (syn. = *Prunus persica var. nectarina* (Aiton) Maxim.)	Nectarines	Recorded as a host in California (Hauser & Damus 2009).	Yes (Hibbert 2004)	**Yes**

Host	Common name	Host association	Present in Australia	Consider further
Prunus salicina Lindl.	Japanese plum	Recorded as a host in California (Bolda *et al*. 2009).	Yes (Hibbert 2004)	**Yes**
Prunus sargentii Rehder	Sargents cherry	Recorded as a host from whole fruit (Kanzawa 1935).	Yes (RBGSYD 2010)	**Yes**
Prunus serrulata Lindl. var. *spontanea* (Maxim.) E. H. Wilson (syn=*Prunus jamasakura* Siebold ex Koidz.)	Japanese mountain cherry	Adult flies reared from field collected fruit (Sasaki & Sato 1995c).	Yes (Hibbert 2004)	**Yes**
Prunus yedoensis Matsum.	Tokyo cherry	Adult flies reared from field collected fruit (Sasaki & Sato 1995c).	Yes (Hibbert 2004)	**Yes**
Pyrus communis L.	Pears	Pears have been recorded a host (NAPPO 2010a). However, Canadian authorities have confirmed *Ribes* spp. are hosts only when damaged (Pers. comm. Martin Damus, CFIA, 22 April 2010).	Yes (Hibbert 2004)	No (see section 4.1 for more detail)
Pyrus pyrifolia (Burm. f.) Nakai	Asian & nashi pears	Pears have been recorded a host (NAPPO 2010a). However, only cut fruit are attacked (Kanzawa 1939).	Yes (Hibbert 2004)	No (see section 4.1 for more detail)
Rubus armeniacus Focke	Himalayan blackberry	A preferred host in natural environments (WSUE 2009).	Yes (AVH 2010)	**Yes**
Rubus crataegifolius Bunge.	niu die du	Reared from fallen hosts only (Mitsui *et al*. 2010). However, the intact fruit of many other species in the genus have been recorded to be attacked and this species is a suspected host.	No record found	**Yes**
Rubus fruticosus aggr.	Blackberry & Marionberry	Recorded as a host in California (Hauser & Damus 2009) and found in high numbers in blackberry (Kansawa 1939).	Yes (Parsons and Cuthbertson 2001)	**Yes**

Host	Common name	Host association	Present in Australia	Consider further
Rubus idaeus L.	Raspberry	Recorded as a host in California (Hauser & Damus 2009).	Yes (Hibbert 2004)	**Yes**
Rubus laciniatus Willd.	Evergreen blackberry	A preferred host in natural environments (WSUE 2009).	Yes (AVH 2010)	**Yes**
Rubus loganobaccus L. H. Bailey	Boysenberry	Recorded as a host in California (Hauser & Damus 2009).	Yes (Hibbert 2004)	**Yes**
Rubus x *loganobaccus*	Loganberry	Recorded as a host in Washington (WSU 2009).	Yes (Hibbert 2004)	**Yes**
Rubus microphyllus L. f.		Reared from fallen fruit only (Mitsui *et al*. 2010). However, the intact fruit of many other species in the genus have been recorded to be attacked and this species is a suspected host.	No record found	**Yes**
Rubus parvifolius L. [syn. = *Rubus triphyllus* Thunb.]	Japanese Raspberry	Recorded as a host from whole fruit (Kanzawa 1939).	Yes (Hibbert 2004)	**Yes**
Rutaceae				
Citrus sinensis (L.) Osbeck	Orange	Recorded from Citrus in Florida (Tri-ology 2010). However, it is only recorded from fallen fruit (Price and Nagle 2009).	Yes (Hibbert 2004)	No
Citrus x *paradisi*	Grapefruit	Recorded from Citrus in Florida (Tri-ology 2010). However, it is only recorded from fallen fruit (Price and Nagle 2009).	Yes (Hibbert 2004)	No
Murraya paniculata (L.) Jack	Orange Jessamine	Recorded as a host (FDACS 2010).	Yes (Hibbert 2004)	**Yes**
Solanaceae				
Lycopersicon esculentum L	Tomatoes	Attacked ripe fruit in the laboratory (ODA 2010a). Only on cut fruit in Japan (Kanzawa 1939).	Yes (Hibbert 2004)	No

Host	Common name	Host association	Present in Australia	Consider further
Taxaceae				
Torreya nucifera (L.) Siebold & Zucc.	Japanese torreya	Reared from fallen fruit only (Mitsui *et al*. 2010).	Yes (Randall 2007)	No
Vitaceae				
Vitis vinifera L.	Table grapes Wine grapes	Preferred host (Kanzawa 1939; OSU 2009).	Yes (Hibbert 2004)	**Yes**
Vitis labrusca L.	Concord grape	Reported as a host (Kanzawa 1939).	Yes (Randall 2007)	**Yes**

Appendix C: Australia's Biosecurity Policy 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 and 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 quarantine 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. Our 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 and 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[7], 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.

[7] 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 the establishment and implementation of risk management measures across the biosecurity continuum, and:

- **Pre-border** conducts, through Biosecurity Australia, risk analyses, including IRAs, and develops recommendations for biosecurity policy as well as providing quarantine policy advice to the Director of Animal and Plant Quarantine
- **At the border** develops, through the Australian Quarantine and Inspection Service, 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
- **Post-border** 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 Biosecurity Services Group works in partnership with state and territory governments to address regional differences in pest and disease status and risk within Australia, and develop appropriate sanitary and phytosanitary measures to account for those differences. Australia's partnership approach to quarantine is supported by a formal Memorandum of Understanding that provides for consultation between the Australian Government and the state and territory governments. Depending on the nature of the good being imported or proposed for importation, Biosecurity Australia may consult other Australian Government authorities or agencies in developing its recommendations and providing advice.

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

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

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

Australian quarantine legislation

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

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

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

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

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

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

> reference in this Act to a *level of quarantine risk* is a reference to:
>
> (a) the probability of:
>
> (i) a disease or pest being introduced, established or spread in Australia, the Cocos Islands or Christmas Island; and

(ii) the disease or pest causing harm to human beings, animals, plants, other aspects of the environment, or economic activities; and

(b) the probable extent of the harm.

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

- define both a standard and an expanded IRA
- identify certain steps which must be included in each type of IRA
- specify time limits for certain steps and overall timeframes for the completion of IRAs (up to 24 months for a standard IRA and up to 30 months for an expanded IRA)
- specify publication requirements
- make provision for termination of an IRA and
- allow for a partially completed risk analysis to be completed as an IRA under the Regulations.

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

International agreements and standards

The process set out in the *Import Risk Analysis Handbook 2007* (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 and
- assesses the probable extent of the harm that would result.

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

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

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

Glossary

Term	Definition
Additional declaration	A statement that is required by an importing country to be entered on a phytosanitary certificate and which provides specific additional information pertinent to the phytosanitary condition of a consignment in relation to regulated pests (FAO 2009).
Appropriate level of protection	The level of protection deemed appropriate by the Member establishing a sanitary or phytosanitary measure to protect human, animal or plant life or health within its territory (WTO 1995).
Area	An officially defined country, part of a country or all or parts of several countries (FAO 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.
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).
Establishment potential	Likelihood of the establishment of a pest.
Fresh	Living; not dried, deep-frozen or otherwise conserved (FAO 2009).
Fruits and vegetables	A commodity class for fresh parts of plants intended for consumption or processing and not for planting (FAO 2009).
Host	A species of plant capable, under natural conditions, of sustaining a specific pest.
Import Permit	Official document authorising importation of a commodity in accordance with specified phytosanitary import requirements (FAO 2009).
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).
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).

Term	Definition
National Plant Protection Organisation	Official service established by a government to discharge the functions specified by the IPPC (FAO 2009).
Official control	The active enforcement of mandatory phytosanitary regulations and the application of mandatory phytosanitary procedures with the objective of eradication or containment of quarantine pests or for the management of regulated non-quarantine pests (FAO 2009).
Pathway	Any means that allows the entry or spread of a pest (FAO 2009).
Pest	Any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products (FAO 2009).
Pest categorisation	The process for determining whether a pest has or has not the characteristics of a quarantine pest or those of a regulated non-quarantine pest (FAO 2009).
Pest free area	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 risk analysis	The process of evaluating biological or other scientific and economic evidence to determine whether an organism is a pest, whether it should be regulated and the strength of any phytosanitary measures to be taken against it (FAO 2009).
Pest risk assessment (for quarantine pests)	Evaluation of the probability of the introduction and spread of a pest and the magnitude of the associated potential economic consequences (FAO 2009).
Pest risk management (for quarantine pests)	Evaluation and selection of options to reduce the risk of introduction and spread of a pest (FAO 2009).
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).
Polymerase chain reaction	A technique that utilises a heat stable DNA polymerase to amplify a piece of DNA by *in vitro* enzymatic replication, initiating a chain reaction in which the DNA template is exponentially amplified, generating millions or more copies of the target DNA.
Polyphagous	Feeding on a relatively large number of host plants from different plant families.
Protected area	A regulated area that an NPPO has determined to be the minimum area necessary for the effective protection of an endangered area (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, packaging, conveyance, container, soil and any other organism, object or material capable of harbouring or spreading pests, deemed to require phytosanitary measures, particularly where international transportation is involved (FAO 2009).
Restricted risk	Risk estimates with phytosanitary measures applied.
Spread	Expansion of the geographical distribution of a pest within an area (FAO 2009).

Term	Definition
SPS Agreement	WTO Agreement on the Application of Sanitary and Phytosanitary Measures (WTO 1995).
Stakeholders	Government agencies, individuals, community or industry groups or organisations, whether in Australia or overseas, including the proponent/applicant for a specific proposal
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 phytosanitary protection (FAO 2009).
Unrestricted risk	'Unrestricted' risk estimates apply in the absence of risk management measures.

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