



DEPARTMENT
OF
AGRICULTURE

Categorisation of –

PESTS OF STONE FRUIT FROM EASTERN AUSTRALIA



Final State Import Risk Analysis of –

CHERRY FRUIT (*Prunus avium*) FROM SOUTH AUSTRALIA INTO WESTERN AUSTRALIA

STATE IMPORT RISK ANALYSIS

September
2001

PROTECTING AGRICULTURE IS EVERYONE'S BUSINESS

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RECOMMENDATION

The following is my recommendation in relation to the Department of Agriculture's¹ policy relating to the categorisation of pests associated with fresh fruit of apricot (*Prunus armeniaca*), cherry (*P. avium*), peach and nectarine (*P. persica*), Japanese plum (*P. salicina*) and European plum (*P. domestica*) from eastern Australia and the importation of fresh cherry fruit from South Australia into Western Australia.

It will be recommended that the Plant Diseases Regulations 1989 be amended to allow the entry of cherry fruit from South Australia under the protocol outlined in this final report. I am satisfied that the entry of fresh cherry fruit from registered orchards in South Australia into Western Australia, for consumption, subject to the conditions specified in this analysis, are in accord with Western Australia's obligations under the national Memorandum of Understanding on Animal and Plant Quarantine Measures, maintain an appropriate level of protection for Western Australia and that the correct process has been followed.

The 28 pests identified in this paper are considered by Western Australia to be quarantine pests for stone fruit and will form the basis of future assessments for stone fruit imports into the State.

Rob Delane
EXECUTIVE DIRECTOR
AGRICULTURE PROTECTION

21 September 2001

¹ Agriculture Western Australia's (AGWEST) name was changed to the Department of Agriculture on 1 July 2001.

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EXECUTIVE SUMMARY

The importation of stone fruit (*Prunus* spp.) into Western Australia from any source is prohibited, due essentially to the historical absence of brown rot caused by *Monilinia fructicola* and *M. laxa*. Stone fruit have not always been prohibited into the State. The prohibition of plants and parts of plants capable of transmitting brown rot was introduced following the establishment of the disease in eastern Australia.

Brown rot of stone fruit was discovered in Western Australia in 1997. At the time of detection the disease was found to be established in the State and widespread. In 1999 the presence of both *M. fructicola* and *M. laxa* was confirmed.

Western Australia's previous freedom from brown rot had led to prohibition of the importation of stone fruit into the State, as there was no effective disinfection treatment or other phytosanitary measure for the disease. This prohibition has been in place for many years and there has been no formal assessment of other exotic pests or diseases that could be introduced into Western Australia with imported interstate stone fruit. Since the establishment of brown rot in Western Australia and to meet subsequent import requests, it was necessary to identify pests of quarantine concern, evaluate the risk posed by these pests and determine the need for and extent of any quarantine measures necessary to provide the appropriate level of protection for the State, whilst minimising any impediments to trade.

In 1999, a draft pest risk assessment was conducted for stone fruit [apricot (*Prunus armeniaca*), cherry (*P. avium*), peach and nectarine (*P. persica*), Japanese plum (*P. salicina*) and European plum (*P. domestica*)] from eastern Australia. The draft was circulated to all States and Territories and views were sought on proposed measures to address each of the identified quarantine pests. Interest in exporting stone fruit to Western Australia was shown only by South Australia for cherries alone.

The pest risk assessment for all stone fruit from interstate was revised and formed the basis of the pest risk analysis of cherry fruit from South Australia.

On 23 March 2001, a draft paper incorporating a "Categorisation of Pests of Stone Fruit from Eastern Australia" and a "State Import Risk Analysis of Cherry Fruit (*Prunus avium*) from South Australia into Western Australia" was released for stakeholder comment. The paper was sent to 81 stakeholders.

The Department of Agriculture received six written responses to the draft. Four of the six respondents had no major concerns with the draft analysis, supported the analysis or did not oppose the importation of cherries. All the respondents suggested a number of minor modifications for consideration. The other two respondents suggested that the evaluation period be extended until sufficient information is obtained to support the judgements in the analysis or until conservative reanalysis of the risks was conducted. No specific comments were received on the draft categorisation of pests of stone fruit outside of the context of the South Australian cherry risk analysis. The comments made by stakeholders have been considered and where appropriate have been incorporated into the final risk analysis.

In completing the final analysis, the initial pest list was reviewed and records verified. 127 insects, 6 mites, 1 spider and 103 pathogens (including nematodes) were identified as being associated with stone fruit production in Australia. Of these pests, 49 insects, 2 mites, 1 spider and 60 pathogens are not known to occur in Western Australia. These 112 pests were evaluated and 19 insects, 2 mites and 8 pathogens were considered to be present on the fruit

pathway and retained as potential quarantine pests for further consideration. With the exception of a fungus mite, the remaining 28 pests met the definition of a quarantine pest.

These 28 species are considered by Western Australia to be quarantine pests of stone fruit and will form the basis of future assessments for stone fruit imports into the State. The 28 quarantine pests of stone fruit were further assessed and 8 quarantine pests were identified as present on the importation pathway of cherry fruit from South Australia.

This Final State Import Risk Analysis proposes a number of phytosanitary measures aimed at reducing the likelihood of introduction, establishment and spread of pests of quarantine concern to Western Australia. It is the Department of Agriculture's assessment that the application of the phytosanitary measures recommended in this analysis will effectively manage the risk posed by the importation of fresh cherry fruit from registered orchards in South Australia into Western Australia for consumption and enable an appropriate level of protection to be maintained for Western Australia. It is recommended that the current prohibition in the Plant Diseases Regulations be amended to allow the entry into Western Australia of fresh cherry fruit from registered orchards in South Australia under the recommended protocol.

The protocol recommended in this Final State Import Risk Analysis is consistent with Western Australia's obligations under the Memorandum of Understanding on Animal and Plant Quarantine Measures (MOU) between the States/Territories and the Commonwealth.

GLOSSARY OF TERMS AND ABBREVIATIONS

AFFA	Commonwealth Department of Agriculture, Fisheries and Forestry - Australia
The Department of Agriculture	The Western Australian Department of Agriculture
AGWEST	Agriculture Western Australia - Agriculture Western Australia's name was changed to the Department of Agriculture on 1 July 2001.
ALOP	Appropriate Level of Protection; the level of protection deemed appropriate for establishing sanitary or phytosanitary measures to protect human, animal or plant life or health.
AQIS	Australian Quarantine and Inspection Service, a section within AFFA.
Area	An officially defined country, part of a country, or all or parts of several countries.
Biosecurity Australia	A branch within the Commonwealth Department of Agriculture, Fisheries and Forestry – Australia responsible for conducting import risk analyses for plants, animals and their products from overseas.
Clearance (of a consignment)	Verification of compliance with phytosanitary regulations.
Commodity	A type of plant, plant product or other regulated article being moved for trade or other purposes.
Consignment	A quantity of plants, plant products and/or other regulated articles being moved from one area to another and covered by a single plant health certificate. A consignment may be composed of one or more lots.
Eastern Australia or Eastern States	New South Wales, Victoria, Queensland, South Australia, Tasmania and the Northern Territory.
Endangered area	An area where ecological factors favour the establishment of a pest whose presence in the area will result in economically important loss.
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.

Entry potential	Likelihood of the entry of a pest, i.e. the likelihood that a quarantine pest species will enter the PRA area as a result of trade in a given commodity, and be distributed in a viable state to the endangered area.
Establishment	The perpetuation, for the foreseeable future, of a pest within an area after entry.
Establishment potential	Likelihood of the establishment of a pest.
FAO	Food and Agriculture Organisation of the United Nations
GATT	General Agreement on Trade and Tariffs.
Harmonisation	The establishment, recognition and application by different countries of phytosanitary measures based on common standards.
Introduction (of a pest)	Entry of a pest resulting in its establishment.
Introduction Potential	The likelihood that a given pest species will remain viable and undetected on or associated with the commodity as it moves from the exporting area to the endangered area where it may establish.
IPHC	Interstate Plant Health Certificate; a document attesting to the health status of plants and plant products for interstate trade, analogous to the international phytosanitary certificate.
IPHRWG	Interstate Plant Health Regulatory Working Group; a working group under the Standing Committee on Agriculture and Resource Management's (SCARM) Plant Health Committee.
IPM	Integrated pest management
IPPC	International Plant Protection Convention.
IRA	Import Risk Analysis, the process through which quarantine policy is developed or reviewed, incorporating risk assessment, risk management and risk communication.
ISPM	International Standards for Phytosanitary Measures.
Lot	A number of units of a single commodity, identifiable by its homogeneity of composition, origin, etc., forming part of a consignment.
MOU	Memorandum of Understanding on Animal and Plant Quarantine Measures (MOU) between the Commonwealth and States/Territories signed in December 1995.

National Plant Protection Organisation (NPPO)	Official service established by a government of a country to discharge the functions specified by the IPPC (AFFA is Australia's NPPO).
Official	Established, authorised or performed by a National Plant Protection Organisation.
Pathway	Any means that allows the entry or spread of a pest.
Pest	Any species, strain or biotype of plant or animal, or any pathogenic agent, injurious to plants or plant products.
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.
Pest of quarantine concern	Any species, strain or biotype of plant or animal, or any other biological agent that will or could cause significant damage to human beings, animals, plants, other aspects of the environment or economic activities. A “quarantine pest” (as defined by the IPPC) is a group of organisms within “pests of quarantine concern” that are injurious to plants or plant products.
Pest risk analysis (PRA)	Pest risk assessment and pest risk management.
Pest risk assessment	Determination of whether a pest is a quarantine pest and evaluation of its introduction potential.
Pest risk communication	The processes by which information and opinions regarding risks are gathered from potentially affected and interested parties prior to and during a risk assessment and the process by which the results of the risk assessment and proposed risk management measures are communicated to the decision-makers and interested parties.
Pest risk management	The decision making process of reducing the risk of introduction of a quarantine pest.
Phytosanitary measure	Any legislation, regulation or official procedure having the purpose to prevent the introduction and/or spread of quarantine pests.
Phytosanitary regulation	Official rule to prevent the introduction and/or spread of quarantine pests, by regulating the production, movement or existence of commodities or other articles, or the normal activity of persons, and by establishing schemes for phytosanitary certification.
PIRSA	Primary Industries and Resources South Australia.

Polyphagous	Feeding on a relatively large number of host plants from different plant families.
PRA	Pest risk analysis - Pest risk assessment and pest risk management.
PRA area	Area in relation to which a pest risk analysis is conducted.
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.
Restricted Risk	Restricted risk estimates are derived following that application of specific phytosanitary measures.
SIRA	State Import Risk Analysis; a process for assessing the risk and determining measures needed for the movement of plants and animals and their products between the States and Territories of Australia.
Spread	Expansion of the geographical distribution of a pest within an area.
Spread potential	Likelihood of the spread of a pest.
SPS Agreement	An Agreement under the WTO on the application of Sanitary and Phytosanitary Measures.
Unrestricted Risk	‘Unrestricted’ risk estimates are those derived: (a) in the complete absence of risk management, (b) using only internationally accepted risk management strategies, or, (c) with reference to normal standards of practice for the production of a given plant-derived commodity in the exporting country.
WAQIS	Western Australian Quarantine and Inspection Service.
WTO	World Trade Organisation.

Source: (FAO, 1999a; FAO, 1999c; FAO, 1996a; AFFA, 2000; AQIS, 1997)

INTRODUCTION

This document contains four parts.

Part one describes the events leading up to the initiation of the analysis, background to the State Import Risk Analysis process, obligations under the World Trade Organisation’s Sanitary and Phytosanitary Agreement and scope of the analysis.

Part two describes the risk analysis methodology used by the Department of Agriculture for State Import Risk Analyses. The methodology used is that specified in the International Standards for Phytosanitary Measures and used by Biosecurity Australia for national import risk analyses for plants and plant products.

Part three is the pest risk analysis. As part of the pest risk analysis for cherry fruit from South Australia, a comprehensive list was compiled of all pests associated with stone fruit in Australia. These pests have been categorised to determine whether the criteria for a quarantine pest are met. It is this list of quarantine pests that will form the basis of future assessments of stone fruit into Western Australia. From this list of quarantine pests a subset of those that are present on the cherry fruit pathway and present in South Australia are further evaluated and risk management measures proposed for those that exceed Western Australia’s Appropriate Level of Protection.

Part four deals with stakeholder consultation and variations to the draft analysis. It responds to the issues raised by stakeholders to the draft and summarises the variation that have been made and incorporated into the final analysis.

PART ONE

BACKGROUND TO THE ANALYSIS

Brown rot of stone fruit was discovered in Western Australia in 1997. At the time of detection the disease was found to be established in the State and widespread. In 1999 the Department of Agriculture and Central Science Laboratories, United Kingdom, confirmed the presence of both *Monilinia fructicola* and *M. laxa*. Following the establishment of brown rot in Western Australia, a number of requests were received to import stone fruit into the State from eastern Australia and New Zealand. An analysis is currently being undertaken jointly with Biosecurity Australia for New Zealand stone fruit.

Western Australia's previous freedom from brown rot had essentially enabled a prohibition on the importation of stone fruit into the State, as there was no effective disinfection treatment or other phytosanitary measure for the disease. This prohibition has been in place for many years and there has been no formal analysis of other exotic pests that could be introduced into Western Australia with imported stone fruit.

Following the requests to import stone fruit into the State, the Department of Agriculture embarked on a formal assessment of stone fruit from eastern Australia using the State Import Risk Analysis process. The first step in the analysis was to determine the pest status of Western Australia and the other States and to conduct a pest risk assessment² (biological threat assessment).

In this assessment, factors such as the biology, host range, distribution, presence on the pathway (fruit) and introduction, establishment and spread potential and economic consequences were taken into account. The draft pest risk assessment identified pests of stone fruit of concern to Western Australia and considered to have a significant risk of introduction, establishment and spread.

The draft assessment identified 22 insects, 1 mite and 8 pathogens as quarantine pests that are present on the pathway and to have a significant likelihood of introduction, establishment and spread given unrestricted entry of stone fruit into the State from eastern Australia. These pests satisfied the International Plant Protection Convention (IPPC) definition of a quarantine pest i.e. "*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*".

On 29 August 1999, the draft pest risk assessment was sent to the following stakeholders for verification and comment on the pest list, categorisation and quarantine status:

The Western Australian Fruit Growers Association, Western Australian Cherry Growers Association, other States through members of the Interstate Plant Health Regulatory Working Group (IPHRWG) and the Australian Quarantine and Inspection Service (AQIS).

Views were also sought, particularly from the IPHRWG and AQIS, on proposed measures (such as disinfection treatment and area freedom) to address each of the quarantine pests

² Pest risk assessment: Determination of whether a pest is a quarantine pest and evaluation of its introduction potential.

identified in the assessment. (The Northern Territory was not included in the assessment due to the absence of any stone fruit industry, however the Territory IPHRWG member was consulted as part of the process.) Comments were sought by 26 September 1999.

As no responses were received from the IPHRWG by 24 November 1999, all members were asked whether their respective State intended to respond and if so for an approximate date. Two States advised that they were intending to respond by the end of January 2000 and another at some future point in time.

At the May 2000 IPHRWG meeting, members were notified by the Department of Agriculture that there may be difficulties in finalising a decision on the importation of stone fruit from interstate in time for the 2000/01 season, as no responses had been received.

On 13 July 2000, Primary Industries and Resources South Australia (PIRSA) responded seeking access for cherries from registered commercial orchards. Following the receipt of the PIRSA response, the Department of Agriculture initiated a State Import Risk Analysis.

Written comments to the initial pest risk assessment have also been received from local cherry growers, WA Fruit Growers Association, the Country Women's Association of WA and AQIS.

On 23 March 2001, a draft paper incorporating a "Categorisation of Pests of Stone Fruit from Eastern Australia" and a "State Import Risk Analysis of Cherry Fruit (*Prunus avium*) from South Australia into Western Australia" was released for stakeholder comment. The paper was sent to 81 stakeholders in two forms; as a complete version or as an overview.

SCOPE OF ANALYSIS

In this final State Import Risk Analysis, the Department of Agriculture has considered the pests³ associated with stone fruit [i.e. apricot (*Prunus armeniaca*), cherry (*P. avium*), peach and nectarine (*P. persica*), Japanese plum (*P. salicina*) and European plum (*P. domestica*)] from eastern Australia. These pests have been categorised and assessed to determine whether the criteria for a quarantine pest are met. This pest list and categorisation will form the basis of future policy in respect to the entry of stone fruit into Western Australia. Utilising this information, the analysis has assessed the quarantine risks that may be associated with the importation of fresh cherry fruit into Western Australia from South Australia. Cherry fruit is defined as fresh, mature fruit (including the peduncle; the stalk of the fruit cluster and pedicel; the stalk of a single fruit) of *Prunus avium* of the family Rosaceae imported for the purpose of consumption from registered export orchards in South Australia.

INTERNATIONAL FRAMEWORK

General Agreement on Trade and Tariffs and the World Trade Organisation

Since 1948 national animal health, plant health, and food safety measures that affect international trade have been subject to the General Agreement on Trade and Tariffs (GATT). On 1 January 1995, the World Trade Organisation (WTO) superseded the GATT. The creation of the WTO gave rise to a number of Agreements, the most relevant to quarantine being the Agreement on the Application of Sanitary and Phytosanitary Measures, also known as the "SPS Agreement". As a WTO Member Australia supports and is required to conform to the SPS Agreement.

³ Any species, strain or biotype of plant or animal, or any pathogenic agent, injurious to plants or plant products

Under the SPS Agreement, WTO Members have the right to impose measures that are necessary to protect animal, plant or human life or health. However, this right is constrained by the obligation to ensure that sanitary (animal and human life and health) and phytosanitary (plant life and health) measures do not create arbitrary or unjustified barriers to trade. Under the SPS Agreement, measures a country puts in place may be based on an international standard (in which case no risk assessment is required), or to deliver a level of protection of its own choosing, in which case its measures must be supported by a scientific risk analysis. Where measures are based on a risk analysis the analysis must:

- identify the pests or diseases whose entry, establishment or spread within its territory a WTO Member wants to prevent, as well as the potential biological and economic consequences associated with the entry, establishment or spread of the pest or disease;
- evaluate the likelihood of entry, establishment or spread of the pest or disease, as well as the associated potential biological and economic consequences; and
- evaluate the likelihood of entry, establishment or spread of the pest or disease according to the SPS measures that might be applied.

A WTO Member may only apply measures that are sufficient to ensure that its appropriate level of protection is achieved, by reducing risk to an acceptably low level. The measures chosen must be the least trade restrictive means available for achieving this objective. This risk management decision must be made in such a way that it avoids arbitrary or unjustifiable distinctions in the level of protection determined to be appropriate in different situations if the result would be to restrict trade. A WTO Member must pursue a consistent approach to the acceptance of risk and cannot, for example, take a more conservative approach to risk in relation to the entry of one commodity and be willing to accept a much higher level of risk in relation to another, perhaps because the latter commodity does not provide competition against a local industry (AQIS 2000a).

Article 6 of the SPS Agreement recognises that risk may not be evenly distributed across a country and that, where practicable, different risk reduction measures should be imposed within a country to achieve a country's appropriate level of protection in the least trade restrictive manner.

Where it is necessary to implement phytosanitary measures⁴ to maintain the appropriate level of protection, they are to be applied in accordance with the key provisions of the SPS Agreement (AQIS 2000a):

- SPS measures to be applied only to the extent necessary to protect human, animal or plant life or health.
- SPS measures to be based on scientific principles and not maintained without sufficient evidence.
- SPS measures not to be applied in a way that arbitrarily or unjustifiably discriminates between countries where identical or similar conditions prevail, including between conditions within a country and other countries.
- SPS measures not to be applied in a manner that would constitute a disguised restriction on international trade.

⁴ Phytosanitary measure: Any legislation, regulation or official procedure having the purpose to prevent the introduction and/or spread of quarantine pests.

- SPS measures to be based on international standards, guidelines or recommendations, where these exist, except to the extent that there is scientific justification for a more stringent measure, or where a Member determines in a non-discriminatory way that a higher level of protection is appropriate to its circumstances.
- SPS measures conforming to international standards, guidelines or recommendations are presumed to be consistent with the Agreement. Other measures must be based on a risk assessment taking into account available scientific evidence and relevant economic factors. The use of risk analysis in determining measures to provide the appropriate level of protection in the least trade disruptive manner.
- An importing country may adopt provisional measures when there is insufficient scientific evidence, but additional information must be sought to allow a decision to be made within a reasonable period of time.
- The concept of regionalisation of pests or diseases. The SPS Agreement obliges Members to take into account in establishing their measures that imported products may originate from and be destined to pest or disease free areas. The identification and maintenance of such pest or disease free areas is known as "regionalisation".
- The concept of equivalence of measures between Members, i.e. the acceptance of phytosanitary measures that are not identical but which provide the same level of protection.

International Standards for Phytosanitary Measures (ISPMs)

The SPS Agreement recognises the standards, guidelines and recommendations for plant health developed by the International Plant Protection Convention as the relevant international authority. The International Plant Protection Convention is a convention under the auspices of the Food and Agriculture Organisation (FAO) of the United Nations. ISPMs are prepared by the Secretariat of the International Plant Protection Convention as part of the United Nations FAO's global program of policy and technical assistance in plant quarantine. This program makes available to FAO Members and other interested parties these standards, guidelines and recommendations to achieve international harmonisation of phytosanitary measures, with the aim to facilitate trade and avoid the use of unjustifiable measures as barriers to trade.

This analysis utilises the following ISPMs:

- ISPM No. 2: *Guidelines for Pest Risk Analysis* (FAO, 1996a);
- Draft ISPM titled *Pest Risk Analysis for Quarantine Pests* (FAO, 1999a);
- ISPM No. 4: *Requirements for the Establishment of Pest Free Areas* (FAO, 1996b);
- ISPM No. 5: *Glossary of Phytosanitary Terms* (FAO, 1999c);
- ISPM No. 8: *Determination of Pest Status in an Area* (FAO, 1998);
- ISPM No. 10: *Requirements for the Establishment of Pest Free Places of Production and Pest Free Production Sites* (FAO 1999b).

Australia is a signatory to the International Plant Protection Convention and contributes to the development of ISPMs. A list of published ISPMs can be found at www.fao.org/ag/AGP/AGPP/PQ/En/Publ/ISPM/ispms.htm.

Memorandum of Understanding on Animal and Plant Quarantine Measures

A key element of the SPS Agreement is that there can be no discrimination between quarantine measures applied within a Member's country and the measures applied to similar imported commodities that present equivalent risks.

To ensure that Australia can comply with this and other relevant obligations under the SPS Agreement, representatives of the Australian Commonwealth, States and Territories signed a Memorandum of Understanding on Animal and Plant Quarantine Measures (MOU) in December 1995. The elements of the MOU requires that States and Territories:

- Consult with the Commonwealth before implementing sanitary or phytosanitary measures which could inhibit trade into Australia and which may not conform to the provisions of the SPS Agreement.
- In consultation with the Commonwealth, review existing sanitary and phytosanitary measures and identify provisions that may be inconsistent with the SPS Agreement.
- Shall not apply any relevant sanitary or phytosanitary measures within their jurisdictions that would not conform to the provisions of the SPS Agreement.

STATE IMPORT RISK ANALYSIS PROCESS

Western Australia's quarantine objective is to protect the State's plant and animal health status against the introduction, establishment and spread of pests of quarantine concern by the application of sanitary and phytosanitary measures, in the least trade restrictive manner necessary to maintain Western Australia's appropriate level of protection. A zero risk policy is unachievable and impracticable, as all movement into the State would have to cease. To achieve the quarantine objective it is necessary to assess and manage risks through a science based, structured and transparent process.

Significant changes made to import conditions for products entering Western Australia can affect many stakeholders and has the potential to be controversial. To ensure that significant changes are not contentious, the decision making process needs to be:⁵

- Conducted in a consultative framework;
- A scientific process, and therefore politically independent;
- A transparent and open process;
- Consistent with both government policy and national obligations;
- Harmonised through taking account of national and international standards and guidelines;
- Subject to appeal on the process.

The Department of Agriculture has developed a State Import Risk Analysis (SIRA) process (Appendix 2). It is a process by which significant variations to legislation, Ministerial and Chief Executive Officer approvals, regarding the import of plants, animals and their products, are made in a scientific and transparent manner. The SIRA process incorporates risk assessment, risk management and risk communication. This process has been modelled on the Australian Quarantine and Inspection Service's Import Risk Analysis Process set out in *The AQIS Import Risk Analysis Process Handbook* (AQIS, 1997).

⁵ Adapted from Nairn, M.E., Allen P.G., Inglis A.R. and C Tanner (1996) *Australian Quarantine a shared responsibility*, Department of Primary Industries and Energy, Canberra

The State Import Risk Analysis process is designed to ensure that:

- Likelihoods of introduction, establishment and spread, the potential economic consequences of pests and the ensuing risks are fully evaluated;
- Imports are only permitted when such risks can be managed in a manner consistent with Western Australia's very conservative approach to acceptance of pest risk;
- Stakeholders are fully informed and are satisfied that the process has been followed and understand the basis for decisions.

The State process involves consultation with stakeholders at both the State and National level and an appeal mechanism, should any stakeholder be of the view that the process has not been followed or a relevant body of information has not been considered. An important facet of the State's process is consultation with the Commonwealth Department of Agriculture Fisheries and Forestry – Australia (AFFA) prior to implementing any measure. Where measures are inconsistent with those imposed by AQIS at the overseas barrier, further consultation will take place to resolve the issue. This process is consistent with Western Australia's obligations under the Memorandum of Understanding on Animal and Plant Quarantine Measures.

International Obligations and Standards

The majority of the plant quarantine restrictions applied by Western Australia must also be addressed at the overseas barrier to fully protect the State from pests of quarantine concern. For these measures to be applied by either AQIS or the Department of Agriculture, the quarantine restriction must meet the relevant international standards and obligations. These rights and obligations are derived from the SPS Agreement and international standards published by the International Plant Protection Convention of the FAO.

CURRENT QUARANTINE POLICY ON CHERRY FRUIT

National

The Quarantine Act 1908, including Quarantine Proclamation 1998 as amended, prohibits except by permit the entry of all fresh fruit, including cherry, into Australia. Permits are issued by AQIS for the entry of cherry fruit into Australia, but not Western Australia, from New Zealand and parts of the United States of America, subject to certain conditions, (AQIS, 2000b and AQIS, 2000c).

Interstate

Under the Plant Diseases Act 1914 and Regulations 1989 the importation of stone fruit is prohibited and the entry of stone fruit plants, parts of plants, cuttings, budwood and seeds are regulated. These measures are all under review with the establishment of brown rot in Western Australia.

OUTLINE OF CHERRY INDUSTRY IN SOUTH AUSTRALIA

South Australia has had a well established cherry industry for many years. Traditionally the production areas were in the Adelaide Hills where winter/spring rainfall was sufficient to mature a crop of cherries. Currently the main production areas still include parts of the Adelaide Hills immediately east of Adelaide and further east extending from Kersbrook, through Lenswood/Norton Summit to Ashbourne. Small plantings have been made in the Riverland from the lower Murray (Swan Reach/Blanchetown) to Lyrup nearer the Victorian border. This area has sufficient winter chilling and hot spring weather which leads to early

fruit maturity. Growers of the small quantities of fruit now produced receive very good market returns due to production being so early.

There are about 110 cherry growers in South Australia, with around 150 000 trees planted, over two thirds of which are not yet in full production. Industry production in 1995/96 was 561 tonnes with a gross value of \$4.26 million (South Australian Cherry Industry Development Plan, 1998). Over 1991-1996, the areas of both bearing trees and non-bearing trees have increased considerably, hence there is a large potential to increase cherry production in South Australia over the next few years as these young trees come into bearing, (South Australian Cherry Industry Development Plan, 1998).

OUTLINE OF CHERRY INDUSTRY IN WESTERN AUSTRALIA

The Western Australian industry is about one third the size of the South Australian industry (i.e., approx. \$1.5m per annum). It is in a strong growth phase and appears set to double in size over the next few years. In 1995/96 there were over 37,000 cherry trees in Western Australia.

PART TWO

PEST RISK ANALYSIS - METHODOLOGY

Pest risk assessment - Determination of whether a pest is a quarantine pest and evaluation of its introduction potential (FAO, 1996a). This is also known as a biological threat assessment.

Pest risk management - The decision making process of reducing the risk of introduction of a quarantine pest (FAO, 1996a).

Pest risk analysis (PRA) - Pest risk assessment and pest risk management (FAO, 1996a).

Pest risk communication - The processes by which information and opinions regarding risks are gathered from potentially affected and interested parties prior to and during a risk assessment and the process by which the results of the risk assessment and proposed risk management measures are communicated to the decision-makers and interested parties (AQIS, 1997).

Import Risk Analysis (IRA) - The process through which quarantine policy is developed or reviewed, incorporating pest risk assessment, pest risk management and pest risk communication (AQIS, 1997).

The methodology adopted by the Department of Agriculture for State IRAs is that specified in the International Standards for Phytosanitary Measures and used by the Commonwealth Department of Agriculture Fisheries and Forestry – Australia (AFFA) for National IRAs of plants and plant products, to ensure conformance with international standards and national consistency. Analyses conducted by the Department of Agriculture for pests present in Australia, but not Western Australia, may need to be added into or used as part of national IRAs conducted by AFFA. For these reasons it is considered by the Department of Agriculture that the methodology used in State level analyses is as close to the national IRA model as possible.

As part of the overall IRA process, a PRA is conducted based on the relevant International Plant Protection Convention standard. ISPM No.2, describes the process of pest risk analysis for plant pests for preparing phytosanitary regulations and is accepted as the standard framework for PRA's. Also used is the draft ISPM *Pest Risk Analysis for Quarantine Pests*, which provides further details for conducting a PRA. The elements of the process are summarised below.

Pest risk analysis consists of three stages:

- Stage 1 - Initiating the pest risk analysis
- Stage 2 - Pest risk assessment
- Stage 3 - Pest risk management

Initiating the process involves identifying a pest(s) and/or pathway(s)⁶ for which the PRA is required.

⁶ Any means that allows the entry or spread of a pest.

Pest risk assessment begins with the categorisation of individual pests to determine whether the criteria for a quarantine pest are met. Risk assessment continues with an evaluation of the probability of pest introduction, establishment and spread, and of their potential economic consequences.

Pest risk management involves developing, evaluating and selecting phytosanitary measures for reducing the risk to an acceptable level in the least trade restrictive manner.

STAGE 1: INITIATION OF THE PEST RISK ANALYSIS

The aim of Stage 1 is to identify the objectives of the pest risk analysis, including identifying the initiation point and the PRA area, i.e. area in relation to which a pest risk analysis is conducted.

The initiation is often in response to the establishment or identification of a pathway created through the importation of a commodity, which would otherwise allow the introduction of a quarantine pest, without the application of phytosanitary measures. A PRA may also be initiated in response to the variation of a pest(s)' quarantine status, associated with existing pathways or as a review of existing phytosanitary measures.

An important facet of the initiation stage is to identify the pests, their current distribution and association with host plants, commodities, etc. and their presence on the pathway.

STAGE 2: PEST RISK ASSESSMENT

Stage 2 describes the process of identifying pests of quarantine concern from those identified in Stage 1 and estimating the risk associated with each.

Risk assessment includes the following steps:

- Pest categorisation;
- Assessment of introduction, establishment, and spread potential;
- Assessment of potential economic consequences.

PEST CATEGORISATION

An essential part of the risk analysis is the categorisation of pests identified in Stage 1 into quarantine and non-quarantine pests. The process of categorisation considers the pests individually against the criteria for a quarantine pest to determine if the pest fulfils the necessary requirements of the definition.

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, 1996a).

In this context the area endangered is defined by the IPPC as: “An area in which ecological factors favour the establishment of a pest whose presence in the area will result in economically important loss” (FAO, 1996a).

The draft ISPM, “*Pest Risk Analysis for Quarantine Pests*” (FAO, 1999a), includes the following criteria in pest categorisation:

- Identity of the pest;
- Presence or absence in the PRA area;
- Regulatory status;
- Potential for introduction, establishment and spread in PRA area;
- Potential for economic consequences in the PRA area.

Identity of Pest

The identity of the pest should be clearly defined to ensure that the assessment is being performed on an identifiable organism. Where possible the pest should be identified as a distinct taxonomic entity. If this is not possible because the causal agent of particular symptoms has not yet been fully identified, then it should have been shown to produce consistent symptoms and to be transmissible. The taxonomic unit for the pest is generally a species.

Presence or absence in the PRA area

The pest should be absent from all or part of the PRA area. In most instances absence is identified as not known to occur. If the pest is absent from the PRA area, then it satisfies this aspect of the definition of a quarantine pest.

If the pest is present in the PRA area and has reached the limits of its ecological range (i.e. is widely distributed), then the pest does not satisfy the definition of a quarantine pest.

Regulatory status

If the pest is present in the PRA area and has not reached the limits of its ecological range (i.e. not widely distributed), and the pest is subject to, or considered for, official control in the PRA area, then the pest satisfies this aspect of the definition of a quarantine pest.

If the pest is not widely distributed but is under consideration of future official control in the PRA area, then the analysis can determine whether the pest should be placed under official control. If the conclusion is reached that the pest should be subject to official control, then the pest satisfies this aspect of the definition of a quarantine pest.

If the pest is not widely distributed and is not subject to official control, or consideration of future official control in the PRA area, then the pest does not satisfy the definition of a quarantine pest.

Potential for introduction, establishment and spread in PRA area

Evidence should be available to support the conclusion that the pest could enter and become established or spread in the PRA area. Host species should be present in the PRA area and the PRA area should have ecological and climatic conditions suitable for the establishment and spread of the pest.

Potential for economic consequences in PRA area

There should be clear indications that the pest is likely to have an unacceptable economic impact should it become established in the PRA area. If a pest has no potential economic importance in the PRA area, then it does not satisfy the definition of a quarantine pest.

METHODOLOGY FOR ASSESSING THE PROBABILITY OF INTRODUCTION, ESTABLISHMENT AND SPREAD OF A PEST

Probability of introduction is obtained by considering the “**entry**” and “**establishment**⁷” pathway(s) for the pest on the commodity and the likelihood that a given pest species will remain viable and undetected on, or associated with, the commodity as it moves from the exporting area to the endangered area⁸ where it may establish.

Probability of Establishment and **Probability of spread** are independent of the pathway and are obtained by examining biological and other factors in the endangered area that may influence a pest’s ability to become established and subsequently spread to other areas.

All three are considered in terms of **probabilities** and expressed as **likelihoods** using the generic nomenclature outlined in Table 1 below. The introduction, establishment and spread **potential** for each quarantine pest are combined using Table 2 (Matrix of rules) to provide the overall probability of introduction, establishment and spread and represents the “cumulative likelihood” that these events will occur.

Table 1: Generic nomenclature for qualitatively describing likelihoods

Likelihood	Descriptive definition
Extreme	The event would be virtually certain to occur
High	The event would be 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
Negligible	The event would almost certainly not occur

The decision rules used to determine the cells in this matrix (Table 2) were obtained by assigning broad probability ranges to each of the qualitative descriptors, i.e. ‘extreme’, ‘high’, ‘moderate’, ‘low’, ‘very low’ and ‘negligible’. This approach enabled the qualitative terms to be combined within a logical, rather than arbitrary, framework. This approach also enabled the qualitative descriptors to be assigned to combinations in a consistent and transparent manner.

The results of the approach illustrate that where a ‘high’ or ‘extreme’ likelihood is multiplied by a lower likelihood, the result will generally fall into the same range as the lower of the two. This is not unexpected, since a high or extreme probability is close to one, and therefore should not alter the value with which it is combined. Conversely, Table 2 shows that ‘negligible’ likelihoods tend to dominate when they are combined with higher likelihoods. Once again, this is not unexpected, since a negligible probability is very close to zero, and it is clear that anything multiplied by a figure very close to zero will also be very close to zero.

⁷ Note that the use of establishment as a component of the probability of introduction is different to that used for the independent event - probability of establishment. The first type of establishment is pathway related while the second is independent of the pathway.

⁸ An area, within the PRA area, where ecological factors favour the establishment of a pest whose presence in the area will result in economically important loss.

Table 2: Matrix of rules (Combination of likelihoods)

		Likelihood 2					
		extreme	high	moderate	low	very low	negligible
Likelihood 1	Extreme	extreme					
	High	high	high				
	Moderate	moderate	moderate	low			
	Low	low	low	low	low		
	Very low	very low	very low	very low	very low	very low	
	Negligible	negligible	negligible	negligible	negligible	negligible	negligible

PROBABILITY OF INTRODUCTION

Pest introduction is comprised of both entry and establishment. The probability of introduction describes the likelihood that the quarantine pest will enter the PRA area as a result of trade in the commodity, and be distributed in a viable state to the endangered area where it can establish. The probability of introduction is dependent on the pathway(s) from the exporting area to the destination, and the frequency and quantity of pests associated with them. It takes into account normal practices used in sourcing (i.e. orchard management, pack-house procedures) and importing fruit (i.e. inspection).

The following partial checklist has been used to estimate the introduction potential divided into those factors that may affect the likelihood of entry and those factors that may affect the likelihood of establishment.

Entry:

- Pest levels in the production system in the source area;
- Seasonal timing;
- Pest management applied at the place of origin;
- Survival of pest under pack-house procedures and other post-harvest practices;
- Opportunity for contamination of commodities or conveyances by the pest;
- Survival of the pest under the environmental conditions of transport and storage;
- Ease or difficulty of detecting the pest at inspection on-arrival.

Establishment:

- Number and frequency of consignments of the commodity;
- Number of individuals of a given pest associated with the means of conveyance;
- Survival of the pest under the environmental conditions of transport and storage after arrival in destination;
- Intended use of the commodity;
- Distribution of infected/infested commodity discarded as waste;
- Transfer of pests to susceptible hosts;
- Environmental conditions and availability of hosts at the destination and during transport in the PRA area.



PROBABILITY OF ESTABLISHMENT

In order to assess the probability of establishment of a pest in relation to a specific PRA area, reliable scientific biological information is required. This may be obtained from areas where the pest currently occurs. The PRA area can then be carefully compared with the areas where it occurs and expert judgement used to assess the probability of establishment.

Unlike the probability of introduction, which is pathway dependent and where there are a number of events considered, the probability of establishment is independent of the pathway. It is determined from expert opinion, derived by the evaluation of the following factors:

- Availability, quantity and distribution of hosts in the PRA area - whether hosts, alternate hosts or near relatives occur in sufficient numbers and geographical proximity to allow the pest to complete its life cycle, and whether known vectors or suitable alternate species are present in the PRA area or likely to be introduced.
- Environmental suitability of the PRA area - whether environmental factors such as climate, soil type, pest and host competition are suitable for the pest and any identified hosts or vectors. The probability of establishment in protected environments such as a glasshouse can also be considered. Where possible climate modelling systems, such as Climex[®], can be used to compare the climatic data of the areas where the pest occurs to that of the PRA area.
- Potential for adaptation of the pest - whether the species is polymorphic⁹ and the degree to which the pest has demonstrated the ability to adapt to conditions present in the PRA area. The genetic variability is considered an indication of a pest's ability to withstand environmental fluctuations, to adapt to a wide range of habitats, to develop pesticide resistance and to overcome host resistance.
- Reproductive strategy of the pest and method of pest survival - characteristics that enable the pest to reproduce effectively in the new environment, such as parthenogenesis¹⁰, self-crossing, duration of the life cycle, number of generations per year, the presence of a resting stage, etc.
- Cultural practices and control measures - identify any differences in cultural practices between the PRA area and the areas where the pest occurs that may influence its ability to establish. Pest control programs or natural enemies already in the PRA area which prevent establishment or keep populations at a level that prevents the organism from reaching pest status, should be considered. This is more likely to occur where pesticides are the major means of control, or where establishment is only likely in glasshouses. Pests for which control is not feasible should be considered to present a greater risk than those for which treatment is easily accomplished. The availability (or lack) of suitable methods for eradication should also be investigated.

The overall probability may then be expressed using the qualitative likelihoods outlined in Table 1.

If a pest has no probability of establishment in the PRA area then it does not satisfy the definition of a quarantine pest and does not need to be considered any further.

⁹ Polymorphic – Having many forms; of great variability.

¹⁰ Parthenogenesis – the ability to reproduce without fertilisation; a common reproductive strategy among mites and some insects such as thrips and aphids.

PROBABILITY OF SPREAD

In order to estimate the probability of spread of a pest, reliable biological information is obtained from areas where the pest is known to occur. This information is carefully compared with the PRA area and expert judgement used to assess the probability of spread. Case histories of comparable pests can also be considered.

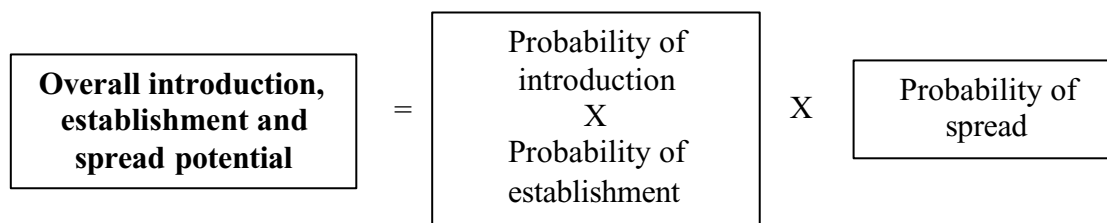
Factors considered when determining the probability of spread include:

- The suitability of the natural and/or managed environment for natural spread of the pest;
- Movement of the pest with commodities, packaging materials or conveyances;
- The intended use of the commodities;
- Potential vectors for the pest in the PRA area;
- Potential natural enemies of the pest in the PRA area.

The information on probability of spread is used to estimate how rapidly a pest's potential economic importance may be expressed within the PRA area. This also has significance if the pest is liable to enter and establish in an area of low potential economic importance and then spread to an area of high potential economic importance.

OVERALL INTRODUCTION, ESTABLISHMENT AND SPREAD POTENTIAL

The overall introduction, establishment and spread potential is the product of their respective probabilities, derived from the matrix of rules shown in Table 2. The matrix of rules is used to combine the probability of introduction and the probability of establishment, then the result is combined with the probability of spread. The probabilities are combined in this manner, as it is necessary for a pest to be introduced before it can establish. Likewise, a pest must first establish before it can spread. The overall introduction, establishment and spread potential is the probability all the events will occur.



METHOD FOR ASSESSING ECONOMIC CONSEQUENCES

In order to estimate the potential economic importance of the pest, information is obtained from areas where the pest currently occurs. Consideration is given to whether the pest causes major, minor or no damage; frequently or infrequently. The situation in the PRA area is then carefully compared with that in the areas where the pest occurs. Case histories concerning comparable pests can also be considered. Expert judgement is then used to assess the potential economic consequences of the pest's establishment and spread in the PRA area.

Economic assessments carried out for each quarantine pest are based on available information regarding each of the *direct* and *indirect* consequences outlined below. It should be noted that, in many instances, information regarding the likely consequences of incursions of the identified quarantine pests is often limited. In addition, it is often the case that the consequences of a pest in one country or environment are different to those in another. Given these limitations, the economic assessment is based on information available for each identified

quarantine pest, or on information obtained for similar pests. In some cases, this means that a subset of the direct and indirect criteria listed below were considered in the assessment.

The **direct consequences** considered included:

- Crop losses (yield and grade);
- Control and surveillance measures;
- Environmental effects.

The **indirect consequences** considered included:

- Effects on domestic and export markets - this should include a consideration of any phytosanitary measures imposed by trading partners in the event of a pest incursion;
- Changes to producer costs or input demands;
- Changes to domestic or foreign consumer demand for a product resulting from quality changes;
- Environmental or other undesired effects of control measures;
- Feasibility and cost of eradication or containment;
- Capacity to act as a vector for other pests;
- Resources needed for additional research and advice;
- Social and other effects.

In common with the probability of establishment, if the pest has no significant economic consequence in the PRA area then it does not satisfy the definition of a quarantine pest and does not need to be considered any further.

In assessing the economic consequences the following nomenclature and criteria were used:

Table 3: Nomenclature for the description of economic consequence

Consequence	Description
Negligible	The impact is unlikely to be recognised by directly affected parties.
Very low	The impact on a given criterion is likely to be minor to directly affected parties. The impact is unlikely to be discernible at any other level.
Low	The impact is likely to be recognised within an affected geographic region and significant to directly affected parties. It is not likely that the impact will be recognised at the State level.
Moderate	The impact is likely to be recognised at a State level, and significant within affected geographic regions. The impact is likely to be highly significant to directly affected parties.
High	The impact is likely to be significant at a State level, and highly significant within the affected geographic regions. This classification implies that the impact would be of State concern. However, the effect on economic stability, societal values or social well-being would be limited to a given geographic region.
Extreme	The impact is likely to be highly significant at the State level. This classification implies that the impact would be of significant State concern. Economic stability, societal values or social well-being would be seriously affected in more than one geographic region.

METHOD FOR ESTIMATING RISK

As with the overall probability of introduction, establishment and spread where the events are combined, the expected loss, or risk, also requires each of the events to occur, i.e. a pest to be introduced, to establish and spread, with the ensuing economic consequences. Therefore risk estimation represents the integration of likelihood and consequence, with the objective of deriving a measure of the expected loss, or 'risk', associated with each quarantine pest.

$$\boxed{\text{Unrestricted risk estimate (expected loss)}} = \boxed{\text{Introduction, establishment and spread}} \times \boxed{\text{Economic consequence of entry, establishment and spread}}$$

In the context of a risk analysis, it is important to recognise that the terms 'likelihood', 'consequence' and 'risk' cannot be used interchangeably. That is, 'likelihood' describes the probability of an event, 'consequence' describes its impact or the loss associated with the event, while the term 'risk' denotes the product of likelihood and consequence - the so-called 'expected loss'. In this sense, it is incorrect to refer to a likelihood as a 'risk' or to interpret the simple likelihood of an event in terms of its relative magnitude or seriousness. For example, the statement "the risk of introduction is considered to be high" should be rephrased as "the likelihood of introduction is considered to be high".

The distinction between likelihood, consequence and risk is particularly important when interpreting the risk estimation matrix shown in Table 4 below. Here it can be seen that the likelihood (or probability) of introduction, establishment and spread has been combined with the consequence of introduction, establishment and spread to give a measure of 'risk' or expected loss. The cells in this table describe expected loss in the same descriptive terms as used in the consequence assessment (Table 3). For example, a designation of 'low' infers that when the likelihood of a pest incursion and its consequences are combined, the expected loss will be equivalent to the scale of monetary or social impact described as 'low' in the preceding section. Likewise, it can be seen that the level of consequence is not reduced by a 'high' or 'extreme' likelihood - that is, that the 'expected loss' is the same as the raw or unadjusted consequence. This is not unexpected, since a 'high' or 'extreme' probability is close to one, and therefore should not substantially alter the value with which it is combined.

When interpreting the risk estimation matrix (Table 4), it should be remembered that although the descriptive terms used on each axis are the same (i.e. 'low', 'moderate', 'high', etc.), the vertical axis refers to **probability** (and has a value between zero and one), while the horizontal axis refers to **consequence** (which is a qualitative proxy for economic impact). The implication of this is that a 'negligible' probability combined with an 'extreme' consequence, is not the same as an 'extreme' probability combined with a 'negligible' consequence. As such, the matrix is **not symmetrical**.

Table 4: Risk estimation matrix

Probability of introduction, establishment and spread	Extreme	<i>negligible</i>	very low	<i>low</i>	<i>moderate</i>	<i>high</i>	<i>extreme</i>
	High	<i>negligible</i>	very low	<i>low</i>	<i>moderate</i>	<i>high</i>	<i>extreme</i>
	Moderate	<i>negligible</i>	<i>negligible</i>	very low	<i>low</i>	<i>moderate</i>	<i>high</i>
	Low	<i>negligible</i>	<i>negligible</i>	<i>negligible</i>	very low	<i>low</i>	<i>moderate</i>
	very low	<i>negligible</i>	<i>negligible</i>	<i>negligible</i>	<i>negligible</i>	very low	<i>low</i>
	Negligible	<i>negligible</i>	<i>negligible</i>	<i>negligible</i>	<i>negligible</i>	<i>negligible</i>	very low
		negligible	Very low	low	moderate	high	extreme
Consequence of introduction, establishment and spread							

A feature of the matrix is the non-linear band of shaded cells marked ‘very low’, that represents Western Australia’s Appropriate Level of Protection. If the unrestricted risk for a quarantine pest is above the appropriate level of protection (i.e. very low), then these quarantine pests will proceed to Stage Three where risk management measures are considered. Otherwise, the risk analysis for the quarantine pest stops at this point.

Regional Approach to Risk Management

The SPS Agreement defines "*appropriate level of sanitary or phytosanitary protection*" as the level of protection deemed appropriate by the Member in establishing a sanitary or phytosanitary measure to protect human, animal or plant life or health within its territory.

Australia has one appropriate level of protection (ALOP) for international trade that has been defined as “very low”. This is consistent with Western Australia’s ALOP for interstate trade. However, the risk to particular regions of some threats, such as Johne’s disease in animals or fire blight in apples, may be greater in one than another. This variation may be a function of pest or disease status (presence or absence) or of the level of risk (expressed as probability of an adverse event occurring as well as the magnitude of consequences of such an event). Therefore it follows that the sanitary and phytosanitary measures needed to meet the national ALOP can vary from one region to another depending on the level of risk posed by the pest.

Article 6 of the SPS Agreement recognises that risk may not be evenly distributed across a country and that, where practicable, different risk reduction measures should be imposed within a country to achieve a country’s ALOP in the least trade restrictive manner.

As an example, the unrestricted risk estimate of fire blight on apples from infected countries to the Northern Territory could be considered to be negligible and no measures would be needed to achieve the ALOP of very low. However, the risk to Western Australia may be considered to be significantly higher and therefore more restrictive measures are needed.

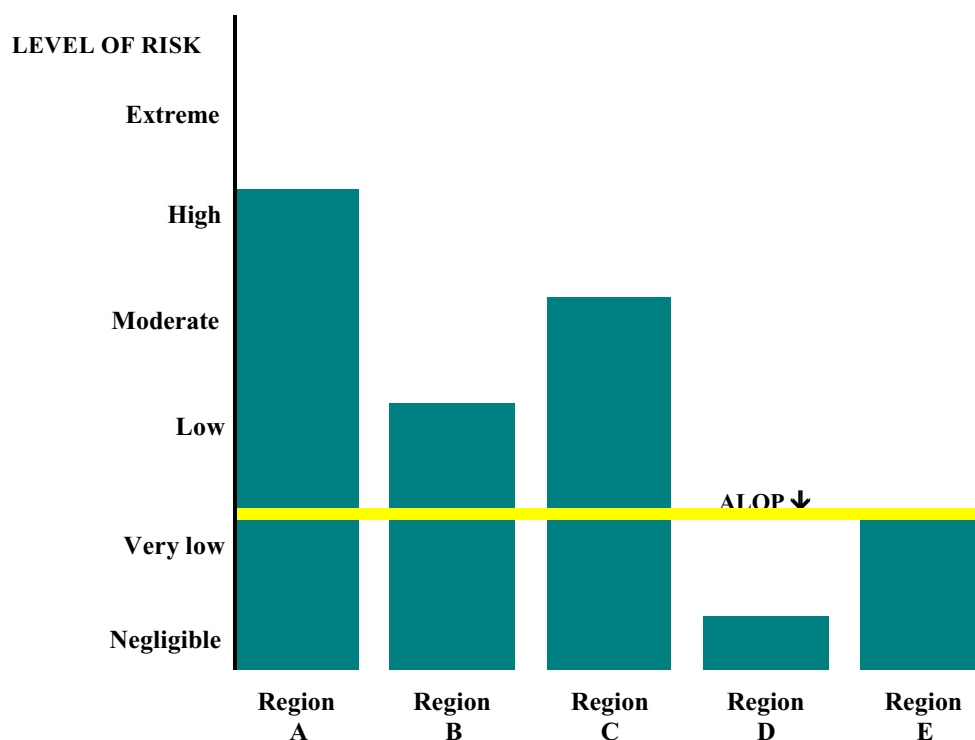
It can be seen that while there is one level of protection for Australia, regions can argue a higher (or lower) unrestricted risk estimate and therefore more (or less) restrictive measures are needed for imports into those regions to meet the ALOP.



However, regions can only argue on this basis if there are internal quarantine barriers in place, (or are practical to put in place), to restrict the entry of the commodity once imported into another part of the country at risk. For example, apples from fire blight affected countries could not be allowed into the Northern Territory without any restrictions as they could easily be moved to States that would be at higher risk, such as New South Wales, where there are insufficient measures in place to prevent the entry from interstate. This is what makes Western Australia and Tasmania unique in this respect. However, smaller regions are possible provided quarantine barriers are practical.

The application of a regional approach to risk management has the benefit of being the least restrictive to trade whilst providing effective protection to regions most at risk. This can be seen graphically in Figure 1. The area above the ALOP line (set at “very low”) is the magnitude of the sanitary and phytosanitary measures needed to meet Australia’s ALOP for each region. This assumes that there are effective internal quarantine measures in place to prevent the domestic movement of the commodity.

Figure 1: Regional approach to ALOP



STAGE 3: PEST RISK MANAGEMENT

The conclusions from the pest risk assessment are used to decide whether risk management is required and the strength of measures needed to meet the ALOP. Since zero risk is not a reasonable or achievable option, the guiding principle for risk management should be to manage risk to achieve the required degree of safety that can be justified and is feasible within the limits of available measures and resources.

Pest risk management describes the process of identifying, evaluating and recommending the most appropriate phytosanitary measures to achieve the appropriate level of protection for Western Australia, while at the same time ensuring that any negative effects on trade are minimised. The management options proposed should be proportional to the risk identified in

Stage 2, applied to the minimum area necessary and in the least trade restrictive manner, while providing effective protection of the endangered area.

Consistent with Australia, Western Australia has traditionally maintained a very conservative approach to quarantine risk. A risk of very low was considered sufficiently conservative to meet Western Australia's ALOP. The band of shaded cells in the risk estimation matrix (Table 4) illustrates a very low risk and provides a benchmark or point above which the implementation of risk management measures is necessary.

Steps in the selection of risk management strategies to reduce the risk to a level of very low are described below.

- From Stage 2, where for each quarantine pest, the level of risk, or expected loss, associated with the unrestricted¹¹ importation of the commodity is evaluated using the risk estimation matrix (Table 4). If the unrestricted risk was 'negligible' or 'very low', then it is considered to be acceptable as it is within Western Australia's ALOP and further risk management is not required. It is however necessary to recommend measures that are needed to ensure that future changes to the pest risk status are identified.
- If the unrestricted risk is above 'very low', (i.e. low, moderate, high or extreme), then risk management strategies are identified and, for each, the risk recalculated.
- Where the subsequent restricted risk¹² derived, using a particular risk management strategy, is 'very low', that strategy is considered to be acceptable.
- Where the restricted risk derived, using a particular risk management strategy, is 'negligible', the strategy is considered unnecessarily restrictive.
- Overly restrictive risk management strategies are either rejected or modified to be less restrictive under the principle of minimal impact¹³.

This procedure provides a set of acceptable risk management strategies for each quarantine pest for which the unrestricted risk is considered higher than "very low" (Western Australia's ALOP). The relative cost-effectiveness and practicality of acceptable risk management strategies are investigated. This process is described as 'option evaluation'. Option evaluation allows strategies considered equivalent¹⁴ to be identified. The investigation and recognition of equivalent risk management strategies is one of Australia's obligations under the SPS Agreement and, in turn, Western Australia's under the MOU.

Prohibition of Commodities

If no satisfactory measure can be found to reduce the risk to a level of 'very low', the final option can be to prohibit importation of the commodity. This is viewed as a measure of last resort. As it is highly trade restrictive there needs to be clear scientific evidence to justify such a measure. Prohibition may not be as efficacious as expected especially in instances where the incentives for illegal import may be significant.

¹¹ In this IRA, unrestricted risk estimates have been derived in the absence of specific risk management, accepting normal standards of practice used in the production of export quality cherry fruit in South Australia (see Appendix 1). The unrestricted risk estimates also include the standard pre shipment and on-arrival inspections of 600 fruit.

¹² In this document, a "restricted" risk estimate is one derived after *risk management* has been applied.

¹³ Phytosanitary measures shall be consistent with the pest risk involved and shall represent the least restrictive measures available, which result in the minimum impediment to the movement of people, commodities and conveyances (FAO 1995).

¹⁴ In accordance with the SPS Agreement, an *equivalent* risk management strategy is one that is not identical but provides the same level of phytosanitary protection, or at least enough protection to meet the ALOP.

Monitoring and Review of Phytosanitary Measures

The principle of "modification" states: *"As conditions change, and as new facts become available, phytosanitary measures shall be modified promptly, either by inclusion of prohibitions, restrictions or requirements necessary for their success, or by removal of those found to be unnecessary"* (ISPM No. 1, *Principles of plant quarantine as related to international trade*, FAO, 1995). Therefore, the implementation of phytosanitary measures is not considered to be permanent. After application, the success of the measures in achieving their aim will be determined by monitoring during use. This is often achieved by inspection of the commodity on-arrival, noting any interceptions or any entries of the pest to the PRA area. The information supporting the pest risk analysis will be periodically reviewed to ensure that any new information that becomes available will be used to evaluate the need to modify any phytosanitary measures in place.

PART THREE

PEST RISK ANALYSIS

STAGE 1: INITIATION

Initiation of this analysis followed the confirmation in 1999 that brown rot of stone fruit, (*Monilinia fructicola* and *M. laxa*), had established in Western Australia and the subsequent requests to import stone fruit into the State. In July 1999, the Department of Agriculture embarked on a formal assessment of stone fruit from interstate. On 13 July 2000, Primary Industries and Resources South Australia (PIRSA) responded seeking access for fresh cherry fruit for consumption from registered export orchards.

The “PRA area” is defined in this State Import Risk Analysis as the State of Western Australia. The ‘endangered area’ is defined as any area within Western Australia, where susceptible hosts are present, and in which ecological factors favour the establishment of a pest that might be introduced in association with cherry fruit from South Australia. The pathway is considered to be fresh cherry fruit for consumption from registered export orchards in South Australia.

From the 1999 draft pest risk assessment of stone fruit from New South Wales, Victoria, Queensland, South Australia and Tasmania, an initial list of pests was identified. 128 insect and mite species and 54 pathogens (excluding nematodes) were shown to be associated with stone fruit in Australia. This list was derived from information obtained from State Departments of Agriculture via IPHRWG members, AQIS, the published body of scientific literature and databases on stone fruit pests.

In completing this analysis the initial pest list has been reviewed and records verified. 127 insects, 6 mites, 1 spider and 103 pathogens (including nematodes) were identified as being associated with stone fruit production in Australia (Appendix 4: Table 14a and Table 14b).

STAGE 2: RISK ASSESSMENT

PEST CATEGORISATION

STONE FRUIT - AUSTRALIA

The first step in the process is to determine which of the pests associated with stone fruit in Australia meet the definition of a quarantine pest, i.e. *"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, 1996a).

The pests of potential quarantine significance have been determined through the identification of a species absence from Western Australia, presence on the pathway (stone fruit), potential for establishment and economic importance. These factors are used in the following tables to categorise and subsequently identify the quarantine pests of stone fruit for Western Australia. If pests are identified as being present in Western Australia and not under official control or consideration for official control, or the pests do not have the potential for establishment or economic importance, then further consideration is not required as they do not meet the definition of a quarantine pest.

Of the 127 insects, 6 mites, 1 spider and 103 pathogens associated with the production of stone fruit in Australia, 49 insects, 2 mites, 1 spider and 60 pathogens (Appendix 4: Table 15a and Table 15b) are not known to occur in Western Australia.

There are no stone fruit pests present in Western Australia that are under official control.

These 112 species were then assessed for their presence on the stone fruit pathway (fruit) (Appendix 4, Table 15a and Table 15b). Of the 112 species, 19 insects, 2 mites and 8 pathogens were considered to be present on the pathway and retained as potential quarantine pests for further consideration.

The 29 potential quarantine pests were assessed against the remaining criteria for a quarantine pest, i.e. feasibility of establishment in Western Australia and economic importance (Table 5). Where there was doubt or contention regarding presence on the pathway, distribution, occurrence or species level identity of a given pest, it was retained on the list as a ‘potential quarantine pest’ for further consideration.

One pest *Tarsonemus waitei* (fungus mite) was not considered to have any potential economic importance and was rejected as a quarantine pest. *T. waitei* feeds on sooty mould and can be found in association with mealybugs or other species producing honeydew.

Table 5: Quarantine pests associated with mature stone fruit¹⁵ in Australia

Scientific Name	Common name(s)	Establishment potential	Reference	Potential economic importance	Reference	Quarantine pest status
Arthropods						
1. <i>Bactrocera cucumis</i> [Diptera: Tephritidae]	Cucumber fruit fly	Yes ¹⁶	Drew <i>et al.</i> (1978)	Yes	White & Hancock (1997)	YES
2. <i>Bactrocera kraussi</i> [Diptera: Tephritidae]	Krauss' fruit fly	Yes	White & Hancock (1997)	Yes	Hancock <i>et al.</i> (2000)	YES
3. <i>Bactrocera mayi</i> [Diptera: Tephritidae]	None known	Yes	Drew <i>et al.</i> (1978)	Yes	Drew <i>et al.</i> (1978)	YES
4. <i>Bactrocera melas</i> [Diptera: Tephritidae]	None known	Yes	Drew <i>et al.</i> (1978)	Yes	Drew <i>et al.</i> (1978)	YES
5. <i>Bactrocera neohumeralis</i> [Diptera: Tephritidae]	Lesser Queensland fruit fly	Yes	Drew <i>et al.</i> (1978)	Yes	Drew <i>et al.</i> (1978)	YES
6. <i>Bactrocera tryoni</i> [Diptera: Tephritidae]	Queensland fruit fly	Yes	Drew <i>et al.</i> (1978)	Yes	Drew <i>et al.</i> (1978)	YES
7. <i>Caedicia strenua</i> [Orthoptera: Tettigoniidae]	Citrus katydid	Yes	Rentz (1996)	Yes	Hely <i>et al.</i> (1982)	YES
8. <i>Cydia pomonella</i> [Lepidoptera: Tortricidae]	Codling moth	Yes	Jenkins (1988)	Yes	Hely <i>et al.</i> (1982)	YES
9. <i>Eulecanium tiliae</i> [Hemiptera: Coccidae]	Coccid scale	Yes	Semmens <i>et al.</i> (1992)	Yes	Ben-Dov (1993)	YES
10. <i>Euproctis paradoxa</i> (<i>Porthesia paradoxa</i>) [Lepidoptera: Lymantriidae]	Tussock moth	Unknown		Yes	Hely <i>et al.</i> (1982)	YES

¹⁵ Stone fruit is considered in this analysis to encompass fruit of apricot (*Prunus armeniaca*), cherry (*P. avium*), peach and nectarine (*P. persica*), Japanese plum (*P. salicina*) and European plum (*P. domestica*).

¹⁶ The Department of Agriculture is of the view that if a host can be grown as a commercial crop in the PRA area then it is feasible that pests associated with that crop could establish. However if there is clear evidence to the contrary the establishment potential will be modified.

Scientific Name	Common name(s)	Establishment potential	Reference	Potential economic importance	Reference	Quarantine pest status
11. <i>Grapholita molesta</i> [Lepidoptera: Tortricidae]	Oriental fruit moth	Yes	Jenkins (1988)	Yes	Hely <i>et al.</i> (1982)	YES
12. <i>Isotenes miserana</i> [Lepidoptera: Tortricidae]	Orange fruit borer	Yes	Smith <i>et al.</i> (1997)	Yes	Smith <i>et al.</i> (1997)	YES
13. <i>Myzus cerasi</i> [Hemiptera: Aphididae]	Cherry aphid	Yes	CABI (2000)	Yes	Hely <i>et al.</i> (1982)	YES
14. <i>Panonychus ulmi</i> [Acarina: Tetranychida]	European red mite	Yes	CABI (2000)	Yes	Hely <i>et al.</i> (1982)	YES
15. <i>Parthenolecanium corni</i> [Hemiptera: Coccidae]	European fruit scale	Yes	Ben-Dov (1993)	Yes	Ben-Dov (1993)	YES
16. <i>Phenacoccus graminicola</i> [Hemiptera: Pseudococcidae]	Ryegrass mealybug	Yes	Williams (1985)	Yes	Williams (1985)	YES
17. <i>Pseudaulacaspis pentagona</i> [Hemiptera: Diaspididae]	Peach white scale	Yes	CABI (2000)	Yes	Hely <i>et al.</i> (1982)	YES
18. <i>Pseudococcus calceolariae</i> [Hemiptera: Pseudococcidae]	Citrophilus mealybug	Yes	Smith <i>et al.</i> (1997)	Yes	Smith <i>et al.</i> (1997)	YES
19. <i>Pulvinaria hydrangeae</i> [Hemiptera: Coccidae]	Hydrangea scale	Yes	Pfeiffer (1997)	Yes	Pfeiffer (1997)	YES
20. <i>Quadraspidiotus ostreaeformis</i> [Hemiptera: Diaspididae]	Oystershell scale	Yes	Brookes & Hudson (1969)	Yes	McLaren (1989)	YES
21. <i>Tarsonemus waitei</i> [Acarina: Tarsonemidae]	Fungus mite	Yes	Smith <i>et al.</i> (1997)	No	Smith <i>et al.</i> (1997)	NO
Pathogens						
22. <i>Pseudomonas syringae</i> pv. <i>morsprunorum</i>	Bacterial canker	Yes	Hattingh & Roos (1995)	Yes	Hattingh & Roos (1995)	YES
23. <i>Blumeriella jaapii</i>	Cherry leaf spot	Yes	Jones (1995)	Yes	Jones (1995)	YES
24. <i>Cercospora circumscissa</i>	Cercospora leaf spot	Yes	Szteinberg (1995)	Yes	Szteinberg (1995)	YES

Scientific Name	Common name(s)	Establishment potential	Reference	Potential economic importance	Reference	Quarantine pest status
25. <i>Podosphaera tridactyla</i>	Powdery mildew	Yes	Grove (1995)	Yes	Grove (1995)	YES
26. <i>Rhizopus arrhizus</i>	Fruit rot	Yes	Ogawa (1995)	Yes	Persley <i>et al.</i> (1989)	YES
27. <i>Taphrina pruni</i>	Plum pockets	Yes	Hickey (1995)	Yes	Hickey (1995)	YES
28. <i>Taphrina wiesneri</i>	Cherry leaf curl	Yes	Pscheidt (1995)	Yes	Pscheidt (1995)	YES
29. <i>Venturia cerasi</i>	Cherry scab	Yes	Hendrix (1995)	Yes	Sivanesan & Holliday (1981)	YES

Pest Categorisation – Stone fruit from Eastern Australia
Final State Import Risk Analysis - Cherries from South Australia

Of the 29 potential quarantine pests associated with stone fruit in Australia identified in Table 5, 28 species fully satisfy the definition of a quarantine pest (Table 6). Based on the information presented in this analysis, these 28 species will be considered by Western Australia to be quarantine pests for stone fruit and will form the basis of future assessments of this commodity into the State.

Should the situation change, such as the detection of new pests on stone fruit in eastern or Western Australia, the likelihood of establishment in the State or the potential economic consequences, then the list will be revised.

Table 6: Quarantine pests associated with mature stone fruit¹⁷ in Australia not known to occur in Western Australia

Species	Common name	Species	Common name
Arthropods		Arthropods (con't.)	
1. <i>Bactrocera cucumis</i> [Diptera: Tephritidae]	Cucumber fly	16. <i>Phenacoccus graminicola</i> [Hemiptera: Pseudococcidae]	Ryegrass mealybug
2. <i>Bactrocera kraussi</i> [Diptera: Tephritidae]	Krauss' fruit fly	17. <i>Pseudaulacaspis pentagona</i> [Hemiptera: Diaspididae]	Peach white scale
3. <i>Bactrocera mayi</i> [Diptera: Tephritidae]	None known	18. <i>Pseudococcus calceolariae</i> [Hemiptera: Pseudococcidae]	Citrophilus mealybug
4. <i>Bactrocera melas</i> [Diptera: Tephritidae]	None known	19. <i>Pulvinaria hydrangeae</i> [Hemiptera: Coccidae]	Hydrangea scale
5. <i>Bactrocera neohumeralis</i> [Diptera: Tephritidae]	Lesser Queensland fruit fly	20. <i>Quadraspidiotus ostreaeformis</i> [Hemiptera: Diaspididae]	Oystershell scale
6. <i>Bactrocera tryoni</i> [Diptera: Tephritidae]	Queensland fruit fly	Pathogens	
7. <i>Caedicia strenua</i> [Orthoptera: Tettigoniidae]	Citrus katydid	21. <i>Pseudomonas syringae</i> pv. <i>morsprunorum</i>	Bacterial canker
8. <i>Cydia pomonella</i> [Lepidoptera: Tortricidae]	Codling moth	22. <i>Blumeriella jaapii</i>	Cherry leaf spot
9. <i>Eulecanium tiliae</i> [Hemiptera: Coccidae]	Coccid scale	23. <i>Cercospora circumscissa</i>	Cercospora leaf spot
10. <i>Euproctis paradoxa</i> (<i>Porthesia paradoxa</i>) [Lepidoptera: Lymantriidae]	Tussock moth	24. <i>Podosphaera tridactyla</i>	Powdery mildew
11. <i>Grapholita molesta</i> [Lepidoptera: Tortricidae]	Oriental fruit moth	25. <i>Rhizopus arrhizus</i>	Rhizopus rot
12. <i>Isotenes miserana</i> [Lepidoptera: Tortricidae]	Orange fruit borer	26. <i>Taphrina pruni</i>	Plum pockets
13. <i>Myzus cerasi</i> [Hemiptera: Aphididae]	Cherry aphid	27. <i>Taphrina wiesneri</i>	Cherry leaf curl
14. <i>Panonychus ulmi</i> [Acarina: Tetranychida]	European red mite	28. <i>Venturia cerasi</i>	Cherry scab
15. <i>Parthenolecanium corni</i> [Hemiptera: Coccidae]	European fruit scale		

¹⁷ Stone fruit is considered in this analysis to encompass fruit of apricot (*Prunus armeniaca*), cherry (*P. avium*), peach and nectarine (*P. persica*), Japanese plum (*P. salicina*) and European plum (*P. domestica*).



CHERRY FRUIT – SOUTH AUSTRALIA

Having determined the quarantine pests of stone fruit from eastern Australia, consideration can now be given to determining which of these pests are present in South Australia and on the cherry fruit pathway. Of the 28 quarantine pests identified in the previous section as occurring on stone fruit in eastern Australia, 20 do not occur in South Australia, or have not been recorded on cherry fruit (Table 7). Presence on the cherry fruit pathway and occurrence in South Australia was verified from the scientific literature and pest records provided by PIRSA.

Table 7: Potential Quarantine pests of cherry fruit from South Australia

Species	Common name	Presence on the pathway (Cherry fruit)	Reference	Presence in South Australia	Reference	Consider further
Arthropods						
1. <i>Bactrocera cucumis</i> [Diptera: Tephritidae]	Cucumber fruit fly	No	Hancock <i>et al.</i> (2000)	No	Hancock <i>et al.</i> (2000)	NO
2. <i>Bactrocera kraussi</i> [Diptera: Tephritidae]	Krauss' fruit fly	No	Hancock <i>et al.</i> (2000)	No	Hancock <i>et al.</i> (2000)	NO
3. <i>Bactrocera mayi</i> [Diptera: Tephritidae]	None known	No	Hancock <i>et al.</i> (2000)	No	Hancock <i>et al.</i> (2000)	NO
4. <i>Bactrocera melas</i> [Diptera: Tephritidae]	Non known	No	Hancock <i>et al.</i> (2000)	No	Hancock <i>et al.</i> (2000)	NO
5. <i>Bactrocera neohumeralis</i> [Diptera: Tephritidae]	Lesser Queensland fruit fly	No	Hancock <i>et al.</i> (2000)	No	Hancock <i>et al.</i> (2000)	NO
6. <i>Bactrocera tryoni</i> [Diptera: Tephritidae]	Queensland fruit fly	Yes	Hancock <i>et al.</i> (2000)	No	Cartwright (2000)	NO
7. <i>Caedicia strenua</i> [Orthoptera: Tettigoniidae]	Citrus katydid	Unknown		No	Baker (1998)	NO
8. <i>Cydia pomonella</i> [Lepidoptera: Tortricidae]	Codling moth	Yes	Moffitt (1992)	Yes	Baker (1998)	YES
9. <i>Eulecanium tiliae</i> [Hemiptera: Coccidae]	Coccid scale	No	Cartwright (2000)	No	Baker (1998) Cartwright (2000)	NO
10. <i>Euproctis paradoxa</i> (<i>Porthesia paradoxa</i>) [Lepidoptera: Lymantriidae]	Tussock moth	No	Hely <i>et al.</i> (1982)	No	Baker (1998) Cartwright (2000)	NO
11. <i>Grapholita molesta</i> [Lepidoptera: Tortricidae]	Oriental fruit moth	Yes	Yokoyama <i>et al.</i> (1998)	Yes	Baker (1998)	YES
12. <i>Isotenes miserana</i> [Lepidoptera: Tortricidae]	Orange fruit borer	No	Brough <i>et al.</i> (1996)	No	Baker (1998)	NO

Species	Common name	Presence on the pathway (Cherry fruit)	Reference	Presence in South Australia	Reference	Consider further
13. <i>Myzus cerasi</i> [Hemiptera: Aphididae]	Cherry aphid	Yes	Hely <i>et al.</i> (1982)	Yes	Baker (1998)	YES
14. <i>Panonychus ulmi</i> [Acarina: Tetranychida]	European red mite	Yes	McLaren <i>et al.</i> (1999)	Yes	Baker (1998)	YES
15. <i>Parthenolecanium corni</i> [Hemiptera: Coccidae]	European fruit scale	Yes	McLaren (1989)	No	Baker (1998) Cartwright (2000)	NO
16. <i>Phenacoccus graminicola</i> [Hemiptera: Pseudococcidae]	Ryegrass mealybug	No	Cartwright (2000)	Yes	Baker (1998)	NO
17. <i>Pseudaulacaspis pentagona</i> [Hemiptera: Diaspididae]	Peach white scale	Yes	Kozar (1990)	No	Baker (1998) Cartwright (2000)	NO
18. <i>Pseudococcus calceolariae</i> [Hemiptera: Pseudococcidae]	Citrophilus mealybug	Yes	Ben-Dov (1994)	Yes	Baker (1998) Cartwright (2000)	YES
19. <i>Pulvinaria hydrangeae</i> [Hemiptera: Coccidae]	Hydrangea scale	Yes	Pfeiffer (1997)	No	Baker (1998) Cartwright (2000)	NO
20. <i>Quadraspidiotus ostreaeformis</i> [Hemiptera: Diaspididae]	Oystershell scale	Yes	McLaren (1989)	Yes	Brookes & Hudson (1969)	YES
Pathogens						
21. <i>Pseudomonas syringae</i> pv. <i>morsprunorum</i>	Bacterial canker	Yes	Foulkes and Lloyd (1980)	No	No records	NO
22. <i>Blumeriella jaapii</i>	Cherry leaf spot	Yes	Jones (1995)	No	Cook and Dube (1989)	NO
23. <i>Cercospora circumscissa</i>	Cercospora leaf spot	Yes	McAlpine (1902)	Yes	Cook and Dube (1989)	YES
24. <i>Podosphaera tridactyla</i>	Powdery mildew	No	Grove (1995)	Yes	Wicks (2001)	NO
25. <i>Rhizopus arrhizus</i>	Fruit rot	Yes	Ogawa (1995)	No	No records	NO
26. <i>Taphrina pruni</i>	Plum pockets	Yes	Zehr (1995)	No	Cartwright (2000)	NO
27. <i>Taphrina wiesneri</i>	Cherry leaf curl	Yes	Pscheidt (1995)	No	Cartwright (2000)	NO
28. <i>Venturia cerasi</i>	Cherry scab	Yes	Hendrix (1995)	Yes	Cartwright (2000)	YES

Of the 28 quarantine pests of stone fruit from eastern Australia, 6 arthropod pests, *Cydia pomonella*, *Grapholita molesta*, the cherry aphid *Myzus cerasi*, the tetranychid mite *Panonychus ulmi*, the mealybug *Pseudococcus calceolariae* and the diaspid scale *Quadraspidiotus ostreaeformis*, and 2 pathogens, *Cercospora circumscissa* and *Venturia cerasi* are retained as quarantine pests for cherry fruit from South Australia (Table 8).

Table 8: Quarantine pests of cherry fruit from South Australia

	Species	Common name
Arthropods		
1.	<i>Cydia pomonella</i> [Lepidoptera: Tortricidae]	Codling moth
2.	<i>Grapholita molesta</i> [Lepidoptera: Tortricidae]	Oriental fruit moth
3.	<i>Myzus cerasi</i> [Hemiptera: Aphididae]	Cherry aphid
4.	<i>Panonychus ulmi</i> [Acarina: Tetranychida]	European red mite
5.	<i>Pseudococcus calceolariae</i> [Hemiptera: Pseudococcidae]	Citrophilus mealybug
6.	<i>Quadraspidiotus ostreaeformis</i> [Hemiptera: Diaspididae]	Oystershell scale
Pathogens		
7.	<i>Cercospora circumscissa</i>	Cercospora leaf spot
8.	<i>Venturia cerasi</i>	Cherry scab

ASSESSMENT OF THE LIKELIHOOD OF INTRODUCTION, ESTABLISHMENT AND SPREAD AND ECONOMIC CONSEQUENCES

The next step in the pest risk assessment process carried out in Stage 2 is to assess the risk posed by the quarantine pests that have been identified. This is undertaken by assessing the introduction, establishment and spread potential for the quarantine pests along with the potential economic consequences.

Pest data sheets have been compiled for the 8 quarantine pests of cherry fruit from South Australia. The data sheets provide a summary of the biology of the pest and the rationale for determining the probabilities for introduction, establishment and spread and the potential economic consequences of the pest to Western Australia.

PEST DATA SHEETS

Throughout the development of the pest data sheets and determination of the unrestricted risk estimate, consideration has been given to current crop management, pack-house procedures used in the production of export quality cherry fruit in South Australia and the standard pre-shipment and on-arrival inspection of 600 units of fruit. Details of these standards of practice were supplied by PIRSA and form part of the conditions of entry. These standards of practice are detailed in Appendix 1. These assessments were considered ‘unrestricted’ since they were derived in the absence of specific risk management measures.

Likelihoods and consequences were described using the nomenclature outlined in Tables 1 and 3 respectively and then combined in Tables 2 and 4 (see Part 2 “Pest Risk Analysis - Methodology”).

Oriental Fruit Moth

Scientific name: *Grapholita molesta* (Busck) [Lepidoptera: Tortricidae]

Synonyms: *Cydia molesta* Busck
Laspeyresia molesta Busck
Carpocapsa molesta Busck

Other common names: Oriental peach moth
Peach tip moth

Common host plants: Peach (Bailey, 1984), nectarine (Weakley *et al.*, 1987), cherry (Bailey, 1985), apricot, plum (Yokoyama *et al.*, 1988), hawthorn, quince, almond, pear, cotoneaster, loquat, grapevine (Hely *et al.*, 1982), apple (Zhao, 1989; Reis, 1988).

Plant part affected: Fruit and vegetative shoots

Australian distribution: South Australia (Bailey, 1979)
New South Wales (Bailey, 1984)
Victoria (McLaren *et al.*, 1981)
Queensland (Swaine *et al.*, 1991)
Tasmania (Terauds *et al.*, 1989).

Biology:

Oriental fruit moth is a small dark-grey moth with a wing span of 10-16 mm. When resting, the moth's wings are held in a roof-like position over the body with the antennae bent backward over the wings. However, a definitive identification of Oriental fruit moth involves investigation of the genitalia. Eggs are white to yellow, round to slightly oval, measuring about 0.7 mm across. The final instar larvae are approximately 12 mm long and are pink to red. The head, prothoracic notum and anal plate are brown and a black anal fork, above the anal opening, is also present (Rothschild, 1991).

Egg deposition usually begins 2-5 days after the females emerge and continues for 7-10 days. 50-200 eggs are laid on the underside of leaves near the growing tips. Larval development lasts 6-22 days, varying with temperature, humidity and feeding conditions. Life cycle development is temperature dependant and ranges from 11-40 days.

Oriental fruit moth overwinters as cocooned larvae. The cocoon is the protective covering for the full-grown larva and pupa. It is made of silken threads and particles of the objects on which it rests. The pupa itself is reddish-brown. Cocoons can be found on the host within fissures, under bark, on the ground beneath the leaf litter, under mummified fruit and within the soil. Overwintering larvae usually emerge from August to October. The adults of the first generation survive 30-40 days, compared to 11-17 days in later generations (Rothschild, 1991). Dispersal of Oriental fruit moth within an orchard is by flight, however as the moths are not strong fliers, dispersal between orchards can be attributed to infested nursery stock, fruit and equipment such as picking boxes (Hely *et al.*, 1982).

Oriental fruit moth is native to north-west China and is thought to have established in Australia at the beginning of the twentieth century. Oriental fruit moth is considered a major pest of stone fruit throughout the world and has a host range including peach, nectarine, cherry, apricot, plum, almond, pear, quince, apple, and loquat. In spring, larvae infest the young shoots of fruit trees and fruits in summer. An infestation results in tip dieback and damaged fruit. Tip dieback results from larvae burrowing into the growing tips, this type of injury interferes with the structural development of young trees (Hely *et al.*, 1982). Fruit can be attacked at any stage resulting in a downgrading of fruit quality and an increase in fruit drop. Injuries from Oriental fruit moth often predispose fruit to brown rot infections.

Oriental fruit moth has been previously detected in Western Australia at Bickley in 1952 (Anon, 1952). A delimiting survey of the Bickley valley east of Perth found extensive tunnelling of peach tips typically caused by this species. Eradication measures were initiated in the area and established the valley as an Oriental fruit moth quarantine area. Eradication began in 1953 (Anon, 1953) with applications of DDT or DDT and Parathion on a weekly rotation basis. A winter survey of twig growth in adjoining areas showed no evidence that the outbreak had spread. Eradication procedures continued in 1954 and 1955 (Anon, 1954; Anon, 1955) with no infestations recorded. In 1955, with no infestations recorded, the pest was considered eradicated. The latest survey for Oriental fruit moth (using pheromone traps) was conducted in 1994 to 1996 in the Darling Scarp horticultural area, including the Bickley Valley (Poole *et al.*, 1998). This survey did not detect the presence of the pest.

Probability of introduction: Moderate

Any pest species that includes some or all of its life-cycle associated with fruit has an ambit claim of a high probability of introduction if no corrective phytosanitary action is undertaken at any point on the commodity pathway, i.e. the event¹⁸ would be likely to occur. Although Oriental fruit moth is considered a major pest of stone fruit, such as peach and nectarine, it is not a major pest of cherry fruit. In addition, gummy exudates can protrude from the entry hole, particularly in association with the later instars. Infested fruit exhibiting gum or superficial feeding areas would be rejected during routine quality inspection and detected at either the pre shipment or on-arrival inspection and as such a claim of a high probability of introduction cannot be justified.

Infested fruit exhibiting gum or surface scarring should be detected by standard on-arrival inspection. However, early instar larvae would be likely to escape detection during quarantine inspection due to a lack of gum or surface feeding scars and/or their small size. Larvae escaping detection are likely to survive storage and distribution to the area endangered. Larvae would be able to survive on disposed fruit before fruit desiccation or decay. Provided a sheltered site is available, mature larvae would be able to pupate and emerge as adults. A moderate probability of entry of Oriental fruit moth is therefore recognised, i.e. the introduction of the pest would occur with an even probability if no corrective phytosanitary action has been undertaken at any point on the commodity pathway from cherries imported into Western Australia from South Australia.

Probability of establishment: High

Any pest species having a polyphagous host range and the area endangered having a suitable climate for the pest to establish has an ambit claim of 'extreme probability of establishment', i.e. the establishment would be almost certain to occur. Oriental fruit moth does not have a

¹⁸ The likelihood that a given pest species will remain viable and undetected on or associated with the commodity as it moves from the exporting area to the endangered area where it may establish.

polyphagous host range but does include several major commercial crops and common home grown fruit trees. Peach and nectarine are considered the major host species for the pest. Other recorded host species include; cherry (Bailey, 1985), apricot, plum (Yokoyama *et al.*, 1988), hawthorn, quince, almond, pear cotoneaster, loquat, grapevine (Hely *et al.*, 1982), apple (Zhao, 1989; Reis, 1988). The pest is not reliant on fruit to establish, as larvae emerging in spring will attack new vegetative shoots. In addition, a previously eradicated incursion of Oriental fruit moth indicates that Western Australia has an environment suitable for establishment should it enter.

As Oriental fruit moth does not have a polyphagous host range, a claim of extreme probability of establishment cannot be justified. A high probability of establishment is therefore recognised, i.e. establishment would be likely to occur if the pest is introduced into Western Australia.

Probability of spread: High

Any pest species having dispersal capabilities both independent of host material and in association with host material have an ambit claim of 'extreme probability of spread', i.e. the spread would be almost certain to occur. Oriental fruit moth can disperse both independently and in association with host material. Spread that is independent of host material is facilitated by adult flight, albeit a weak flier, and in association with farm equipment and packaging. Oriental fruit moth can also be dispersed in association with host material and as such, long distant dispersal is facilitated by the commercial distribution of the host fruit and nursery stock. As the pest has weak flying capabilities, an extreme probability of spread cannot be justified. A high probability of spread of Oriental fruit moth is therefore recognised, i.e. spread would be likely to occur if established in Western Australia.

Probability of introduction, establishment and spread: Moderate

Economic consequences: High

Oriental fruit moth is considered a major pest of peach and nectarine production throughout the world and has a host range including peach, nectarine, apricot, plum, prune, almond, cherry, apple and pear, (Hely *et al.*, 1982). Regular insecticide usage within the Western Australian stone fruit industry is largely limited to the control of Mediterranean fruit fly and would increase should Oriental fruit moth become established. Insecticide usage would continue until such time as alternative control measures such as pheromone disruption techniques become established. The impact of Oriental fruit moth, should it establish in Western Australia, is likely to be recognised at a State level and would be significant within affected geographical regions requiring restrictions in the movement of fruit. The economic consequences, as a result of management restructuring, is likely to be highly significant to affected growers. However, any impacts on economic stability, societal value or social well-being impacts such as orchard profitability or value adding will be limited to a given geographical region.

Unrestricted risk estimate: Moderate

Standard risk management protocols would not meet Western Australia's appropriate level of protection.

Quarantine status: Quarantine pest

Codling Moth

Scientific name: *Cydia pomonella* Linnaeus [Lepidoptera: Tortricidae]

Synonyms: *Laspeyresia pomonella* Linnaeus
Carpocapsa pomonella Linnaeus
Carpocapsa pomonana Treitschke
Enarmonia pomonella Linnaeus
Phalaena pomonella Linnaeus

Other common names: Codling moth.

Common host plants: Primary host species; apple, pear.

Other recorded host species; quince, crab apple, walnuts, orange, persimmon, pomegranate, hawthorn, damson, chestnut (Hely *et al.*, 1982), cherry (Moffitt, 1991), nectarines, peaches, apricot and plums (Yokoyama *et al.*, 1988).

Plant part affected: Fruit

Australian distribution: Victoria (Vickers, 1993)
New South Wales (Vickers, 1993)
South Australia (Wicks *et al.*, 1989)
Queensland (Swaine *et al.*, 1991)
Tasmania (Hely *et al.*, 1982)

Biology:

Codling moth is a small grey-brown tortricid moth with a wingspan of approximately 18 mm. Forewings have a large, coppery circular marking near the tip, the hindwings are brown. Eggs are flattened, oval and translucent when first laid, measuring about 1.0 mm in size. About 250-300 eggs are laid singly on or near developing fruits or on leaves and twigs near the fruit. Eggs hatch in 10-15 days depending on temperature. First instar larvae are whitish, developing later to appear pale pink. The head and prothoracic plate are brown. Accurate identification of codling moth larvae depends on setal characteristics. Pupae are 8.0-11.5 mm long and dark brown in colour. Life cycle development varies seasonally but has an average of 68 days. Larvae can measure up to 20 mm in length.

Codling moth overwinters as cocooned larvae and can be found on the host in cracks and under bark. Cocoons can also be found in fruit containers and other equipment (Hely *et al.*, 1982). Overwintering larvae usually emerge from mid-October to early January, with second generation larvae emerging from mid-December to mid-February (Hely *et al.*, 1982). Codling moth can disperse within an orchard by flight, but as tortricid moths are not strong fliers, dispersal between orchards is most likely to be attributed to infested fruit and infested equipment such as picking boxes (Hely *et al.*, 1982).

Probability of introduction: Very low.

Any pest species requiring some or all of its life-cycle associated with fruit have an ambient claim of an extreme probability of introduction if no corrective phytosanitary action has been undertaken, i.e. the introduction into Western Australia would be virtually certain to occur. Although apple and pear are the main host plants for codling moth, the pest has been reported to develop on sweet cherry as well as walnut, quince, apricot, peach, almond and Japanese plum. Where codling moth infestations have been recorded from cherry orchards they have

been in close proximity to apple orchards and no evidence was reported that populations were maintained (Barnes, 1991).

There is an absence in Australian and rarity in the scientific literature world-wide regarding field infestations of cherry fruit by codling moth. Indeed, Wearing and McLaren (2001) indicate that, apart from 3 papers published between 1926 and 1931, no records of field infestations of sweet cherries by codling moth have been published. The non-status of cherry fruit as a host of codling moth has been pursued in New Zealand. The results of field trials conducted within an enclosed orchard containing apple, nectarine and cherry trees showed that 82% of apple fruit were infested with codling moth yet no cherry or nectarine fruit were infested. The results of over 150,000 pre-export cherry fruit inspections in New Zealand did not detect any codling moth (Wearing *et al.*, 1996). Wearing *et al.*, (1996) also include the results of surveys indicating no codling moth damage in cherry and nectarine over three years where apple and stone fruit occur in the same orchard.

Therefore, a claim of an extreme probability of introduction cannot be justified. A very low probability of introduction of codling moth is therefore recognised, i.e. introduction into Western Australia would be very unlikely to occur if no corrective phytosanitary action has been undertaken at any point on the commodity pathway for cherries imported from South Australia.

Probability of establishment: Extreme

Current legislation in Western Australia prohibits the importation of apples and pears into Western Australia. However, several codling moth outbreaks have occurred and have been successfully eradicated. This is a clear indication of the suitability of the area endangered for establishment should codling moth enter Western Australia. An extreme probability of establishment is therefore recognised, i.e. establishment would be virtually certain to occur if codling moth is introduced into Western Australia.

Probability of spread: High

Pest species having dispersal capabilities both independent of, and in association with host material have an ambit claim of extreme probability of spread. Codling moth can disperse independently and in association with host material and packaging. Spread independent of host material is facilitated by adult flight, albeit a weak flier, and in association with farm equipment. Codling moth can also be spread in association with host material and as such, long distant dispersal is facilitated by commercial distribution of the host fruit and nursery stock. As the pest has weak flying capabilities, an extreme probability of spread cannot be justified. A high probability of spread of codling moth is therefore recognised, i.e. spread would be likely to occur if the pest establishes in Western Australia.

Probability of introduction, establishment and spread: Very low

Economic consequences: High

Codling moth is a major pest of apples and pears and is considered an important pest wherever it has established in Australia. Codling moth occurs world-wide where pome fruits are grown with the exception of Western Australia and Japan. Infestation levels at the epicentre of previous outbreaks in Western Australia have reached 70% (Woods, 2000). Insecticide usage within the Western Australian pome fruit industry is largely limited to the control of Mediterranean fruit fly and would increase should codling moth become established and continue until such time as alternative control measures, such as pheromone disruption techniques become established. The impact of codling moth, should it establish in Western

Australia, is likely to be significant at a State level and highly significant within affected geographical regions requiring restrictions in the movement of fruit and other host material. The economic consequences, as a result of management restructuring, is likely to be highly significant to affected growers. However, any impacts on economic stability, societal value or social well-being impacts such as orchard profitability or value adding will be limited to a given geographical region.

Unrestricted risk estimate: Very Low

Standard risk management protocols meet Western Australia's appropriate level of protection.

Quarantine status: Quarantine pest

European Red Mite

Scientific name: *Panonychus ulmi* Koch [Acarina: Tetranychidae]

Synonyms: *Metatetranychus pilosus* (Canestrini & Fanzago)

Metatetranychus mali

Oligonychus ulmi

Paratetranychus pilosus occidentalis

Paratetranychus ulmi

Tetranychus pilosus

Tetranychus ulmi

Paratetranychus pilosus (Canestrini & Fanzago)

Metatetranychus ulmi Koch

Other common names: Fruit tree red spider mite
European red spider mite
European fruit tree red spider mite

Common host plants: *Acacia longifolia*, *Aesculus hippocastanum*, *Alnus glutinosa*, *Alnus incana*, *Alnus* sp., *Amaranthus* sp., *Amelanchier* sp., *Artocarpus heterophyllus*, *Atropa belladonna*, *Avena sativa*, *Betula pubescens*, *Betula* sp., *Betula verrucosa*, *Calystegia sepium*, *Camellia sinensis*, *Castanea sativa*, *Chenopodium* sp., *Citrus aurantiifolia*, *Citrus aurantium*, *Citrus grandis*, *Convolvulus arvensis*, *Corylus avellana*, *Cotoneaster tomentosus*, *Crataegus monogyna*, *Crataegus* sp., *Crataegus succulenta*, *Cucumis* sp., *Cucurbita maxima*, *Cucurbita pepo*, *Cydonia oblonga*, *Dalbergia sissoo*, *Daucus carota*, *Desmodium canescens*, *Diospyros* sp., *Eriobotrya japonica*, *Fagus sylvatica*, *Ficus carica*, *Fragaria* sp., *Fragaria vesca*, *Frangula alnus*, *Fraxinus excelsior*, *Fraxinus* sp., *Gardenia jasminoides*, *Hibiscus* sp., *Hydrangea macrophylla*, *Juglans regia*, *Juncus maritimus*, *Laburnum alpinum*, *Lonicera japonica*, *Malus domestica*, *Malus* sp., *Malva* sp., *Medicago sativa*, *Morus nigra*, *Morus* sp., *Myrica pensylvanica*, *Petroselinum crispum*, *Phaseolus* sp., *Phlox* sp., *Polygonum aviculare*, *Populus* sp., *Populus tremula*, *Potentilla fruticosa*, *Prunus americana*, *Prunus armeniaca*, *Prunus avium*, *Prunus cerasus*, *Prunus chinensis*, *Prunus divaricata*, *Prunus domestica*, *Prunus dulcis*, *Prunus insititia*, *Prunus padus*, *Prunus persica*, *Prunus* sp., *Prunus spinosa*, *Pyracantha* sp., *Pyrus baccata*, *Pyrus communis*, *Pyrus pyrifolia*, *Pyrus sargentii*, *Pyrus* sp., *Quercus* sp., *Rhamnus frangula*, *Rhamnus* sp., *Ribes aureum*, *Ribes sanguineum*, *Ribes* sp., *Robinia pseudoacacia*, *Rosa canina*, *Rosa multiflora*, *Rosa palustris*, *Rosa* sp., *Rubus idaeus*, *Rubus occidentalis*, *Rubus* sp., *Rumex obtusifolius*, *Salix alba*, *Salix caprea*, *Sapindus saponaria*, *Sasa kurilensis*, *Sophora japonica*, *Sorbus aria*, *Sorbus aucuparia*, *Sorbus*

chrysophylla, *Sorbus conradina*, *Sorbus fennica*, *Sorbus hostii*, *Sorbus scandica*, *Sorghum halepense*, *Symphoricarpos foetidus*, *Syzygium* sp., *Tilia cordata*, *Trifolium pratense*, *Trifolium* sp., *Triticum aestivum*, *Ulmus americana*, *Ulmus campestris*, *Ulmus glabra*, *Ulmus hollandica*, *Ulmus procera*, *Ulmus rubra*, *Ulmus scabra*, *Ulmus* sp., *Vicia sativa*, *Vitis labrusca*, *Vitis* sp., *Vitis vinifera*, *Wisteria sinensis*, *Zea mays*. (Bollard *et al.*, 1998).

Plant part affected: Leaves, stems and fruit.

Australian distribution: Queensland (Thwaite, 1991)
New South Wales (Thwaite, 1991)
Victoria (Thwaite, 1991)
South Australia (Thwaite, 1991)
Tasmania (Thwaite, 1991)

Biology:

The European red mite *Panonychus ulmi* is a small arthropod ranging in size from 0.25-0.5mm. European red mites are brownish red with conspicuous white spots at the base of the long dorsal setae. The female body is oval and strongly convex and has short pale legs. The adult male is smaller, yellowish-green to bright red and with a narrower pear-shaped body, tapering to the rear with legs longer relative to the body. Development stages includes egg, larvae, protonymph, deutonymph and adult. The destructive stages of this pest include the nymphal and adult stages.

Female European red mites produce two types of eggs, namely winter and summer eggs. Resilient winter eggs enable the mite to 'overwinter' and are produced from late summer to late autumn. The majority of winter eggs are laid on the bark of the host trees. However, winter eggs can be laid on leaves (Beament, 1951) and on late season fruit (Hely *et al.*, 1982) if population pressures are high enough. Summer eggs are usually produced from adults hatched from winter eggs and hatch within 12 days depending on weather conditions. Lifecycle development from eggs to adult usually takes 28 days depending on weather conditions and successive generations can occur over a season.

European red mite is considered a major pest of deciduous fruit and in particular pome fruit throughout the world. European red mite has an extensive host range with pome fruit, stone fruit, grapevine and citrus included in the 45 genera within 17 families listed as host species. Damage caused by European red mite results from leaf feeding injury. Symptoms initially present as leaf speckling, progressing to leaf bronzing and defoliation under heavy infestation pressures. Depending on the severity of an infestation, fruit production can be affected via small size and poor quality fruit.

Probability of introduction: Low

Any pest species that include some or all of their life-cycle associated with fruit has an ambit claim of 'high probability of introduction' if no corrective phytosanitary action has been undertaken on the commodity pathway, i.e. the introduction of European red mite into Western Australia would be likely to occur. Although European red mites are principally foliage feeding mites they may become associated with the host fruit;

- a) under high population pressures;
- b) as a contaminant of fruit in picking bins due to its aerial dispersal capabilities;
- c) in association with leaves attached to the fruit spurs at harvest.

In addition, egg laying can occur on the fruit under high population pressure where normally egg laying occurs on the bark and stems.

Standard post-harvest practices for export cherries in South Australia will minimise the occurrence of adult European red mites on the fruit; this includes a 60-second immersion of the fruit into chlorinated water prior to the application of post-harvest fungicides. This procedure will physically remove the pest rather than have an insecticidal effect. Temperature and day length stimuli for the production of the resilient overwintering eggs occur from late summer to late autumn which is after the cherry harvest window. However, any eggs present, particularly summer eggs, on the fruit would most likely escape detection by inspection due to their small size. The presence of European red mite on the pathway only under high population pressures, together with harvest timing and standard post-harvest procedures, make a claim of a high or moderate probability of introduction unjustified. A low probability of introduction of European red mite is therefore recognised, i.e. the introduction of the pest would be unlikely to occur if no corrective phytosanitary action has been undertaken at any point on the commodity pathway from cherries imported into Western Australia from South Australia.

Probability of establishment: Moderate

Any pest species having a polyphagous host range and the area endangered having a suitable climate for the pest to establish has an ambit claim of 'extreme probability of establishment', i.e. the establishment would be virtually certain to occur. European red mite is virtually polyphagous in nature with host species present in 45 genera within 17 families including several major commercial crops and common home grown fruit trees. European red mite is not reliant on fruit to establish as the species is principally foliage feeding. Preliminary climate modelling scenarios, with Climex[®], using data from locations where European red mite occurs in Australia and world-wide, indicate that the Western Australian climate may not be ideal for the establishment of the pest (Astbury, 2000), however, environmental adaptations are known to occur (Boudreaux, 1963). Preliminary climate modelling scenarios with Climex[®] using sites in South Africa where European red mite is present (Botha, 2000) indicate that the Western Australian climate is also marginal for establishment of the pest, should it be introduced into the State.

Although European red mite has what is arguably a polyphagous host range, a claim of either extreme or high probability of establishment cannot be justified, as climatic conditions in Western Australia is marginal for the establishment of the pest. However, given the environmental adaptations that are known to occur with this species (e.g. occurrence in the Nile Delta (Tadros, 1974)), a moderate probability of establishment is therefore recognised. In other words, establishment would occur with an even probability if the pest is introduced into Western Australia with the importation of cherries from South Australia.

Probability of spread: High

Any pest species having dispersal capabilities both independent and in association with host material has an ambit claim of 'extreme probability of spread'. Spread, independent of host material, is facilitated by adult 'ballooning'; a dispersal mechanism that is typical of Tetranychidae species where strands of webbing are used to 'balloon' with the prevailing wind (Lawson *et al.*, 1996). This dispersal mechanism also increases the likelihood of European red mite presence on the fruit pathway prior to harvest or contaminating fruit in picking bins, harvesting equipment or via field workers. European red mite can also be spread in association with host material and as such, long distant dispersal is facilitated by commercial distribution of the host fruit and nursery stock. As the dispersal mechanisms independent of host material are passive, an extreme probability of spread cannot be justified. A high probability of spread

of European red mite is therefore recognised, i.e. spread would be likely to occur if the pest does establish in Western Australia.

Probability of introduction, establishment and spread: Low

Economic consequences: Moderate

European red mite has an extensive host range (Bollard, 1998) and is considered a major pest of deciduous fruit and especially so of pome fruit throughout the world. Damage arising from European red mite impacts on fruit production via small size and/or poor quality fruit. The pest was of relatively minor importance up until the end of World War 2 when, as a result of the widespread use of DDT and the more broad spectrum insecticides, such as tar, mineral oils, DNC and parathion, a dramatic increase in the pest and production losses occurred. The dramatic increase has been attributed to the removal of the pest's natural enemies by the insecticides popular in post war agriculture (Masse, 1951, FAO, 1954). It has been widely reported that damage from European red mite is rare in neglected orchards where no fungicides or insecticides are used (FAO, 1954).

More recently, the significance of the pest has dropped markedly. This is attributed largely to the development of miticides that are more pest specific and to the use of predators in an integrated pest management approach. There are, for example, an increasing number of Tasmanian apple orchards where the need to apply miticides for European red mite control rarely occurs, if at all, and the only mites that can be found are predators (Williams, 1996). This view is largely borne out in the literature with relatively few recent references to chemical control of European red mite (Stuart, 2000).

Further justification was based on preliminary climatic modelling (Astbury, 2000) and expert opinion (Botha, 2000) indicating the marginal suitability of the Western Australian environmental conditions for the establishment of European red mite, potentially limiting the economic consequences. This is further reinforced by the observation that alternate pathways for the introduction of European red mite into Western Australia have existed for many years prior to the establishment of brown rot in Australia, without the introduction of European red mite into the State.

Considering the above it is reasonable to conclude that the economic consequences of the pest would not be any greater than moderate.

The economic consequences, if the mite were to establish in Western Australia, would be recognised at a State level and be significant within affected regions requiring restrictions on the movement of fruit and nursery stock. The economic consequence, as a result of management restructuring, is likely to be highly significant to affected growers. However, it is unlikely to have any serious effect on economic stability, societal value or social well-being in a given geographical region.

Unrestricted risk estimate: Very Low

Standard risk management protocols meet Western Australia's appropriate level of protection.

Quarantine status: Quarantine pest

Cherry Aphid

Scientific name: *Myzus cerasi* Fabricius [Hemiptera: Aphididae]

Synonyms: *Aphis cerasi* Fabricius
Myzoides cerasi Fabricius
Myzus asperulae Walker
Myzus alectorolophi Heinze
Aphis asperulae Walker
Myzus callange Essig
Aphis cerasi Müller
Myzoides cerasi van der Goot
Aphis euphrasiae Walker
Myzus quasipyrinus Theobald
Aphis veronicae Walker

Other common names: Cherry black aphid
Black cherry aphid
Cherry black fly

Host plants: *Prunus cerasus*, *P. avium*, *P. pennsylvanica*, *P. serrulatus*, *P. sieboldii*, *P. yedoensis*, *P. virginiana*, *Galium* spp., *Veronica* spp., *Euphrasia officinalis*, *Capsella* spp., *Cardamine* spp., *Lepidium* sp. (Blackman and Eastop, 1985)

Plant part affected: Young terminal growth and fruit

Australian distribution: South Australia (Baker, 1998)
New South Wales (Paton, 1998)
Victoria (Sharkey, 1998)
Queensland (Brough *et al.*, 1996)
Tasmania (Terauds *et al.*, 1989)

Biology:

The cherry aphid is a small, shiny, very dark brown to black sap sucking insect approximately 4 mm in length. The legs and antennae are yellow and black. Developmental stages include egg, nymphs and adult. The destructive stages of this pest are the nymphs and adults. Eggs are laid around the bases of buds by egg laying females in autumn. The overwintering eggs begin to hatch in August to September. Females developing from overwintering eggs are viviparous, producing live young that can mature in nine days (Zeck, 1936).

Cherry aphid form dense colonies at the growing apices of cherry trees in spring. Initial damage manifests as leaf curling with prolonged feeding causing shoot growth deformities and the formation of pseudogalls (CABI, 1999). Honeydew production can also become a problem as it promotes sooty mould production and can affect fruit quality (Hely *et al.*, 1982). Cherry aphid is able to vector wilt and decline diseases of cherries (Blackman *et al.*, 1985).

Dispersal of cherry aphid within an orchard is by flight. Dispersal between orchards can be attributed to infested nursery stock (Hely *et al.*, 1982).

Probability of introduction: Low

Any pest species present with high field populations at harvest may have an ambit claim of 'moderate probability of introduction' if no corrective phytosanitary action has been taken, i.e. the introduction of cherry aphid into Western Australia would occur with an even probability.

Although this species primarily colonise new growth, it can be present on the fruit (McLaren *et al.*, 1999). The presence of high numbers of cherry aphid will be in association with highly visible honeydew production and associated sooty mould. Fruit harvested under these conditions are likely to be detected during pack-house quality control inspection and by standard on-arrival inspection. The presence of highly visible markers to the presence of cherry aphid makes a claim of a moderate probability of introduction unjustified. Standard post-harvest practices for export cherries in South Australia should also help minimise the occurrence of adult cherry aphid on the fruit; this includes a 60 second immersion of the fruit into chlorinated water prior to the application of post-harvest fungicides. This procedure will physically remove the pest rather than have an insecticidal effect.

A low probability of introduction of cherry aphid is therefore recognised, i.e. the introduction of cherry aphid would be unlikely to occur if no corrective phytosanitary action has been undertaken at any point on the commodity pathway for cherries imported into Western Australia from South Australia.

Probability of establishment: Moderate

Any pest species requiring one viviparous female for establishment, having a polyphagous host range and the area endangered having a suitable climate for the pest to establish have an ambit claim of a 'extreme probability of establishment', i.e. the establishment would be almost certain to occur. Cherry aphid has the ability to establish a colony from one viviparous adult, however cherry aphid has a limited host range with cherry considered the primary host and other *Prunus* species considered secondary host species. Cherry aphid is not reliant on fruit to establish, as the species feed on apical growth. Climate modelling scenarios, with Climax[®] using climate data from where cherry aphid occurs in Australia indicate that Western Australia has a climate suitable for the establishment of cherry aphid.

Although cherry aphids produce viviparous females and regions in Western Australia would be suitable, a claim of extreme or high probability of establishment cannot be justified as the pest has a primary host range limited to cherries. A moderate probability of establishment is therefore recognised, i.e. establishment would occur with an even probability if the pest is introduced into Western Australia.

Probability of spread: Moderate

Any pest species having dispersal capabilities both independent of host material and in association with host material have an ambit claim of 'extreme probability of spread', i.e. the spread would be almost certain to occur. Cherry aphids can disperse independently but is more likely to disperse in association with host material such as fruit and nursery stock. Spread independent of host material is facilitated by adult flight although the pest is a weak flier. Cherry aphid's limited host range would also restrict independent dispersal. Long distant dispersal would be facilitated by commercial distribution of nursery stock. As cherry aphid has weak flying capabilities, an extreme or high probability of spread cannot be justified. A moderate probability of spread of cherry aphid is therefore recognised, i.e. spread would occur with an even probability if cherry aphid establishes in Western Australia.

Probability of introduction, establishment and spread: Low

Economic consequences: Moderate

Cherry aphid has a limited host range but is considered a significant pest of cherry production wherever it has established. Damage arising from cherry aphid impacts on fruit production as trees may become unproductive or die if left infested for several years. Honeydew production and associated sooty mould production is also detrimental to fruit quality. Regular insecticide usage within the Western Australian stone fruit industry, including the cherry industry, is largely limited to the control of Mediterranean fruit fly and would increase should cherry aphid become established in Western Australia. The economic consequences of cherry aphid, if it were to establish in Western Australia, is likely to be recognised at a State level, and significant within the affected regions and be highly significant to affected growers, with those growers requiring additional plant protection inputs such as management practices and/or insecticide usage.

Unrestricted risk estimate: Very Low

Standard risk management protocols meet Western Australia's appropriate level of protection.

Quarantine status: Quarantine pest

Citrophilus Mealybug

Scientific name: *Pseudococcus calceolariae* (Maskell) [Hemiptera Pseudococcidae]

Synonyms: *Pseudococcus gahani* Green 1915
Dactylopius calceolariae Maskell 1879
Pseudococcus citrophilus Clausen 1915
Pseudococcus fragilis Brain 1912
Erium calceolariae (Maskell) Lindinger 1935

Other common names: Scarlet mealybug
Currant mealybug

Common host range: **Anacardiaceae:** *Schinus molle*. **Apocynaceae:** *Nerium oleander*.
Araliaceae: *Hedera helix*, *Polyscias*. **Boraginaceae:** *Heliotropium arborescens*.
Buddlejaceae: *Buddleja madagascariensis*. **Chenopodiaceae:** *Chenopodium*. **Compositae:**
Helianthus, *Traversia*, *Vernonia appendiculata*. **Crassulaceae:** *Aeonium balsamiferum*,
Kalanchoe beharensis. **Cruciferae:** *Brassica*. **Cucurbitaceae:** *Sechium edule*. **Ericaceae:**
Rhododendron. **Euphorbiaceae:** *Schizogyne sericea*. **Geraniaceae:** *Geranium*, *Pelargonium*.
Gramineae: *Lolium*. **Juglandaceae:** *Juglans regia*. **Labiatae:** *Lavandula staechas*.
Lauraceae: *Persea indica*. **Leguminosae:** *Arachis hypogaea*, *Laburnum*, *Melilotus*, *Pisum*
sativum, *Sophora microphylla*. **Malvaceae:** *Abutilon*, *Hibiscus*, *Malva*. **Moraceae:** *Ficus*.
Myrtaceae: *Eugenia*. **Oleaceae:** *Gymnelaea lanceolata*, *Ligustrum*. **Pinaceae:** *Pinus radiata*.
Pittosporaceae: *Pittosporum tobira*, *P. undulatum*. **Polygonaceae:** *Rheum rhaponticum*.
Proteaceae: *Grevillea banksii*. **Ranunculaceae:** *Aguilegia*. **Rhamnaceae:** *Ceanothus*.
Rosaceae: *Crataegus*, *Cydonia oblonga*, *Fragaria*, *Malus pumila*, *M. silvestris*, *Prunus*, *Pyrus*
communis, *Rosa*, *Rubus*. **Rubiaceae:** *Coprosma australis*. **Rutaceae:** *Choisya ternala*, *Citrus*
medica, *C. paradisi*. **Santalaceae:** *Exocarpos*. **Sapindaceae:** *Dodonaea viscosa*.
Saxifragaceae: *Ribes sanguineum*. **Scrophulariaceae:** *Digitalis*. **Solanaceae:** *Solanum*
tuberosum. **Sterculiaceae:** *Brachychiton*, *Theobroma cacao*. **Umbelliferae:** *Conium*

inaculatum, *Daucus carota*. **Vitaceae:** *Vitis vinifera*. **Welwitschiaceae:** *Welwitschia mirabilis* (Ben-Dov, 1994)

Plant part affected: Foliage, fruit and twigs

Australian distribution: South Australia (Smith *et al.*, 1997)
New South Wales (Smith *et al.*, 1997)
Victoria (Smith *et al.*, 1997)
Queensland (Williams, 1985)
Tasmania (Williams, 1985)

Biology:

Citrophilus mealybug, *Pseudococcus calceolariae*, is a slow moving oval shaped insect approximately 3-4 mm in length, native to eastern Australia. Developmental stages include egg, 3-4 larval stages, pupae (male) and adults. Eggs are laid in groups of up to 500 in egg sacs and 3-4 generations can occur throughout the year (Smith *et al.*, 1997).

The economically important stage of this pest is the female adult and nymphs. During feeding, citrophilus mealybug produce honeydew, an exudate high sugar that encourages the development of sooty mould (Hely *et al.*, 1982). The presence of honeydew and sooty mould on the fruit downgrades its quality. Citrophilus mealybug is considered a pest of citrus in South Australia (Smith *et al.*, 1997) and has been recorded from 40 host families (CABI, 1999). Dispersal mechanisms for citrophilus mealybug include wind, animals and orchard workers. Dispersal between orchards can be attributed to infested fruit, animals and workers (Hely *et al.*, 1982).

Probability of introduction: Very low

Citrophilus mealybug is considered a major pest of citrus in South Australia. Although Smith *et al.* (1997) and Ben-Dov (1994) consider *Prunus* spp. as host plants, world-wide literature indicates that citrophilus mealybug is not a common pest of cherry fruit production. The lack of Australian literature on the occurrence of citrophilus mealybug on cherry trees also indicates that mealybug is of little concern to cherry fruit production, a view also tendered by Cartwright (2000).

Probability of establishment: High

If the area endangered has a suitable climate for a pest to establish and the pest species is polyphagous or has hosts plants under production, an ambit claim of 'extreme probability of establishment' is considered, i.e. the establishment would be virtually certain to occur. Utilising Climex[®] modelling software, climate matching scenarios were generated using data from where citrophilus mealybug occurs in Australia and these suggest that certain regions within Western Australia are suitable for the establishment of the pest. Citrophilus mealybug has an extensive host range that includes several major commercial crops and commonly grown 'backyard' fruit and ornamental trees.

Although citrophilus mealybug has an extensive host range, the areas suitable for establishment are limited and as such a claim of extreme probability of establishment cannot be justified. A high probability of establishment is therefore recognised, i.e. establishment would be likely to occur if the pest is introduced into Western Australia.

Probability of spread: Moderate

Any pest species having dispersal capabilities both independent of host material and in association with its host material has an ambit claim of 'extreme probability of spread'.



Citrophilus mealybug is typical of the Family Pseudococcidae in that it has limited independent dispersal capabilities and is more likely to disperse in association with host material such as infested fruit, nursery stock and equipment. Long distant dispersal would be facilitated by commercial distribution of nursery stock. As citrophilus mealybug has limited independent dispersal mechanisms, an extreme or high probability of spread cannot be justified. A moderate probability of spread of citrophilus mealybug is therefore recognised, i.e. spread would occur with even probability if the mealybug does establish in Western Australia.

Probability of introduction, establishment and spread: Very low

Economic importance: Low

Although of limited economic importance in stone fruit, citrophilus mealybug has an extensive host range and in particular can be a major pest of citrus. Honeydew and sooty mould production degrades fruit quality and would require in-field and post-harvest management strategies to maintain fruit quality. Regular insecticide usage within the Western Australian stone fruit and citrus industries, including the cherry industry, is largely limited to the control of Mediterranean fruit fly and would increase should citrophilus mealybug become established in Western Australia. The economic consequences of citrophilus mealybug, if it were to establish in Western Australia, is likely to be recognised within the affected regions and be significant to affected growers, with those growers requiring additional plant protection inputs such as management practices and/or insecticide inputs.

Unrestricted risk estimate: Negligible

Standard risk management protocols meet Western Australia's appropriate level of protection.

Quarantine status: Quarantine pest.

Oystershell Scale

Scientific name: *Quadraspidiotus ostreaeformis* (Curtis) [Hemiptera: Diaspididae]

Synonyms: *Diaspidiotus ostreaeformis* (Curtis) Borchsenius
Aspidiotus betulae Baerensprung, 1849
Aspidiotus ostreaeformis Curtis, 1843
Mytilococcus ellipticus (Amerling, 1858)
Aspidiotus hippocastani Signoret, 1869
Aspidiotus oxyacanthae Signoret, 1869
Aspidiotus ostreaeformis var. *oblongus* Goethe, 1899
Aspidiotus almaatensis Borchsenius, 1935
Quadraspidiotus williamsi (Takagi, 1958) Danzig, 1993

Other common names: pear oyster scale
 European fruit scale
 yellow plum scale

Host plants: Cherry, peach, nectarine, plum (European and Japanese), almond, apple, pear, metagouri, broom (McLaren, 1989), *Carpinus betulus*, *Fagus sylvatica*, *Quercus* spp., *Ulmus* spp., *Tilia* spp., *Sorbus* spp., *Acer* spp., *Aesculus* spp., *Fraxinus* spp., *Salix* spp., *Populus* spp., *Betula* spp., *Alnus* spp. (Zahradnik, 1990).



Plant part affected: Fruit, branches (Davidson and Miller, 1990)

Australian distribution: South Australia (Brookes and Hudson, 1969)
Tasmania (Brookes and Hudson, 1969)
Victoria (Brookes and Hudson, 1969)

Biology:

The mature adult female of oystershell scale (*Quadraspidiotus ostraeoformis*) is grey coloured, conically shaped and approximately 1.3 mm in diameter. Oystershell scale has a similar appearance and is often confused with the more important San Jose scale (*Quadraspidiotus perniciosus*) (McLaren, 1989) which is established in Western Australia (Woods *et al.*, 1996) and other regions of Australia (Brookes and Hudson, 1969). Developmental stages for oystershell scale include eggs, nymphs and adult. The nymphs and adult female are the destructive stage of this pest where they settle on fruit and branches of the host plant. The mature male, is typical of diaspid scales, being seldom seen and approximately 1 mm in length (Giliomee, 1990). The male develops through the pupal stages and emerges as a mobile winged insect devoid of mouth parts and lives from 1-3 days. The male is attracted to the female by pheromones and dies after mating. Oystershell scale reproduces sexually with one annual generation. Oviposition occurs in the early summer with eggs being laid under the female covering. Mobile crawlers emerge from late summer to early autumn and as such are unlikely to settle on cherry fruit as the main harvest occurs before this point. Overwintering occurs as a diapausing second instar larvae.

Oystershell scale does not cause serious damage to its host plants but its similarity to San Jose scale makes oystershell scale a pest of quarantine concern in areas where San Jose scale is not established or in low numbers (McLaren, 1989). Mobile crawlers are the dispersal mechanism for diaspid scales, including oystershell scale, with most crawlers settling within the host plant. However, wind assisted dispersal can also occur (McClure, 1990). Long distance dispersal is facilitated by the distribution of infested nursery stock (Beardsley and Gonzalez, 1975).

Probability of introduction: Very low

Any pest species requiring some or all of its life-cycle associated with fruit have an ambit claim of a high probability of introduction if no corrective phytosanitary action has been undertaken, i.e. the introduction into Western Australia would be likely to occur. Oystershell scale can complete its lifecycle on the branches of its host and does not require the presence of fruit. Also, the biology of oystershell scale indicates that the crawler stage will emerge and settle on its host from late summer, after the main cherry fruit crop has been harvested. Adult scale settling on late harvest cherry fruit would be rejected during routine quality inspection or detected at either the pre shipment or on-arrival inspection and as such a claim of a high probability of introduction cannot be justified.

Although fruit infested with adult scales should be detected by standard on-arrival inspection, early instar crawlers would be likely to escape detection during standard quarantine inspection due to their small size. Crawlers escaping detection are likely to survive storage and distribution to the area endangered. Crawlers would be able to survive on disposed fruit before fruit desiccation or decay. However, the crawlers would be very unlikely to find a suitable host to settle on as dispersal between hosts, normally achieved by wind currents, would not be effective at this point. A very low probability of entry of oystershell scale is therefore recognised, i.e. the introduction of the pest would be very unlikely to occur if no corrective

phytosanitary action has been undertaken at any point on the commodity pathway for cherries imported into Western Australia from South Australia.

Probability of establishment: High

If the area endangered has a suitable climate for a pest to establish and the pest species is polyphagous or has host plants under production, an ambit claim of 'extreme probability of establishment' is considered, i.e. the establishment would be virtually certain to occur.

Australian (Brookes and Hudson, 1969) and New Zealand (McLaren, 1989) distribution of oystershell scale suggests that Western Australian climatic conditions may not be suitable for establishment. Also, utilising Climex[®] modelling software, climate-matching scenarios were generated using data from where oystershell scale occurs in Australia and these suggest that only limited regions within Western Australia are suitable for the establishment of the pest. Oystershell scale has an extensive host range that includes several major commercial crops and commonly grown 'backyard' fruit and ornamental trees.

Although oystershell scale has a wide host range, the areas suitable for establishment would be limited and as such a claim of extreme probability of establishment cannot be justified. A high probability of establishment is therefore recognised, i.e. establishment would be likely to occur if the pest is introduced into the endangered area in Western Australia.

Probability of spread: Moderate

Any pest species having dispersal capabilities both independent and in association of host material has an ambit claim of 'extreme probability of spread'. Oystershell scale is typical of the Family Diaspididae and has limited independent dispersal capabilities, with mobile crawlers being limited to dispersal within a host and passive dispersal by wind currents achieving short distance dispersal between hosts (McClure, 1990). Long distant dispersal is facilitated by the distribution of infested nursery stock (Beardsley and Gonzalez, 1975). As oystershell scale has very limited independent dispersal mechanisms, an extreme or high probability of spread cannot be justified. A moderate probability of spread of oystershell scale is therefore recognised, i.e. spread would occur with even probability if the scale establishes in Western Australia.

Probability of introduction, establishment and spread: Very Low

Economic consequences: Very low

Oystershell scale is not considered an economically significant species in the areas where it has established in Australia and New Zealand. It is, however, considered to be a pest of quarantine concern due to its similarity to the economically significant San Jose scale. As San Jose scale is well established in Western Australia, the impact on a given criterion is likely to be minor to directly affected parties. The impact is unlikely to be discernible at any other level.

Unrestricted risk estimate: Negligible

Standard risk management protocols meet Western Australia's appropriate level of protection.

Quarantine status: Quarantine pest

Cercospora Leaf Spot

Scientific name: *Cercospora circumscissa* Sacc. (1878), anamorph-[Hyphomycete: Moniliales], teleomorph *Mycosphaerella cerasella* Aderhold (1900) [Dothidiales, Ascomycotina].

Synonym: *C. cerasella* Sacc. (1878).

Other common names: Leaf spot
Shothole
Cherry leaf spot fungus

Common hosts plants: Sweet cherry – *Prunus avium*, Sour cherry – *P. cerasus*, Almonds – *P. amygdalus*, Peaches – *P. persica*, Plums – *P. domestica*, Blackthorn – *P. spinosa* (Little, 1987). Ogawa *et al.* (1995) reported that the pathogen affected a wide range of *Prunus* spp. including those mentioned by Little (1987).

Plant part affected: Mostly leaves but is also found on twigs and on fruit on rare occasions.

Australian Distribution: New South Wales (Paton, 1998)
Victoria (Sharkey, 1998)
Queensland (Simmonds, 1966)
South Australia (Cook and Dube, 1989)

Biology:

Lesions of *Cercospora* leaf spot disease appear as round necrotic spots that are reddish brown at first. Later, as lesions enlarge to 4-5 mm in diameter, the central portion becomes light brown with brownish red edges. Lesions may coalesce to form large necrotic areas, which develop on both leaf surfaces. Occasionally the necrotic tissue drops out, leaving shot-hole symptoms. The disease causes defoliation and severely affected trees may be completely defoliated by the beginning of summer. Premature defoliation can stimulate new growth in autumn (e.g. flowering, development of new leaves) which further decreases tree vigour. Mature lesions on leaves are covered with dark brown stromata from which conidiophores and conidia arise. Conidiophores (3-5 x 20-70 µm) are pale brown to brown, sparingly septate and geniculate. Conidia (2.7~5 x 28-118 µm) are initially hyaline but with maturity become olivaceous, obclavate, straight to mildly curved and one to seven-septate (Little, 1987).

Cercospora leaf spot disease overwinters in leaf debris on the orchard floor. In the spring, characteristic conidiophores and conidia of the pathogen develop from substomatal stromata of the fungus; conidia are the primary source of inoculum. Conidia from current-season lesions, disseminated by wind and splashing water, produce secondary cycles. High humidity, rain and dew are favourable conditions for development of the disease. Optimal temperature for the disease development is 20-25°C. The role of ascospores in the epidemiology of the disease is unknown (Ogawa *et al.*, 1995).

Probability of introduction: Very low

Cercospora leaf spot disease is a primary pathogen of non-fruiting plant and leaf tissue. The fungus, however, could gain entry into Western Australia on rare occasions via infected fruit and infected fruit spurs. South Australian crop management practices for export cherries, in-season brown rot control with fungicides and post-harvest dips will discourage fruit infection and further reduce the probability of introduction. This risk is further reduced by the strict pack-house procedures whereby contaminants, that may include infected leaves and spurs, will

be removed prior to packing of the export fruit. Any fungal conidia present on the fruit surface during harvesting are unlikely to survive the recommended post-harvest fungicidal dips (iprodione and procymidone), thereby reducing the probability of introduction of the pathogen as infective conidia. The pathogen primarily causes very low level infections of twigs and leaves, therefore the likelihood of this fungus being introduced into Western Australia would be higher on dormant stone fruit nursery stock than fruit.

Probability of establishment: High

This pathogen can establish on a wide range of stone fruit (*Prunus* spp.) that are grown in the south-west of Western Australia. The close proximity of stone fruit orchards and favourable environmental conditions from autumn to spring would encourage the disease to establish in Western Australia. If introduced, the pathogen is likely to become established in Western Australia as it has in the eastern States.

Probability of spread: Low

If the pathogen establishes in Western Australia, it may spread due to close proximity of many orchards and the presence of a range of susceptible *Prunus* hosts. The current season fungal inocula (conidia) are spread short distances by wind and rain splash. Long distance spread may only occur via movement of infected plant material, as ascospores are not known to initiate infection. The probability of the spread of *Cercospora* leaf spot is considered to be low, as this pathogen is not widespread in the eastern States (New South Wales, Victoria, Queensland and South Australia) where it is recorded.

Probability of introduction, establishment and spread: Very low

Economic consequences: Very low

It does not appear to be an economically significant disease and there are no specific control measures for this in the eastern States. This disease is well managed with measures taken to control important diseases such as brown rot. After the establishment of brown rot of stone fruit in Western Australia, growers have to follow disease management guidelines that include regular fungicide applications, which will also manage this pathogen. It is unlikely that any additional measures would be required, if the disease became established in Western Australia.

Unrestricted risk estimate: Negligible

Standard risk management protocols meet Western Australia's appropriate level of protection.

Quarantine status: Quarantine pest

Cherry Scab

Scientific name: *Venturia cerasi*, Aderhold, 1900 [Dothideales, Ascomycotina]

Synonym/s: *Fusicladium cerasi* (Rabenh.) Sacc., 1886
Acrosporium cerasi (Rabenh. in Braun), 1854
Cladosporium cerasi (Rabenh.) Aderhold, 1901
Megacladosporium cerasi (Rabenh.) Vienn-Bourg., 1949

Host plants: Sour cherries – *Prunus cerasus*; Sweet cherries – *P. avium* - only low infection reported (Sivanesan and Holliday, 1981; Ogawa *et al.*, 1995).

Plant part affected: Leaves, twigs and sometimes as sunken spots on fruit. Affected fruits usually do not ripen and fall off prematurely.

Australian Distribution: Victoria (Sharkey, 1998)
South Australia (Cartwright, 2000)

Biology:

Pseudothecia form in dead leaves which are sub-epidermal, globose, setose, up to 120 µm diameter, with a papillate ostiole. Asci are cylindrical, short stalked, bitunicate, 8 spored, 50-100 x 8-10 µm. Ascospores unequally bi-cellular, constricted at the septum, pale brown, 10-14 x 4-6 µm, pseudoparaphyses filiform, hyaline and branched. Fresh infection results in sub-cuticular stromata, composed of few thin walled cells. Conidiophores short, arising in dense clusters from the stroma, 9-18.5 x 4.5-9 µm, mostly non-septate, rarely one septate, smooth, olivaceous brown, with prominent scars on projections of the conidiogenous cells. Conidia smooth or rugulose, broadly fusiform, olivaceous, mostly one celled, rarely one septate, pointed at the apex, truncate at the base, sometimes catenate, 16-23 x 5-7 µm (Sivanesan and Holliday, 1981).

The fungus overwinters in fallen leaves and on scabbed shoots in a manner similar to *Venturia carpophila*, which is present in Western Australia and known as common scab. Coinciding with bud-burst, ascospores and conidia are released to infect new leaves. Later new shoots also become infected. Symptoms of infection by conidia on fruit are small, circular, sometimes with sunken spots that are dark olive and velvety. Ripening can be prevented and fruits fall.

Probability of introduction: Very low

The fungus can be introduced on fruit, which record low levels of infection. The incidence of this disease in South Australia is rare (Cartwright, 2000). Cherries with disease symptoms usually do not ripen and fall off prematurely. Fruit showing symptoms are likely to be discarded following the stringent pack-house procedures for export cherries. Recommended post-harvest fungicidal dips, such as iprodione and procymidone, for management of important pathogens like *Monilinia* spp., will eliminate any in-season conidia present on the fruit. A very low probability of introduction of the fungus as fruit infection is justified. The probability of introduction of the fungus on scabby shoots of dormant sweet cherry nursery stock is higher than on fruit.

Probability of establishment: Low

If the fungus is introduced, its inoculum can survive the dry summer on discarded infected fruit and sporulate to produce conidia during winter and spring rain. The conidia are dispersed by wind and rain-splash. The probability of establishment is considered to be low, as its sole host is cherries (sweet and sour), which are grown in the south-west of Western Australia.

Probability of spread: Moderate

Infection and survival in leaf debris provide an efficient long distance dispersal mechanism. The probability of spread could be considered higher than moderate as its spread is similar to common scab caused by *Venturia carpophila*. The close proximity of cherry orchards in the south west of Western Australia will favour the spread of this fungus. However, cherry scab in Victoria and South Australia is not as widely distributed as common scab caused by *Venturia carpophila*. A moderate probability of spread in Western Australia is justified.

Probability of introduction, establishment and spread: Very low

Economic consequences: Very low

This is reported as a very minor disease of stone fruit (Sivanesan and Holliday, 1981) and is of little concern in Victoria and South Australia, thus no specific control measures are undertaken. This lack of specific control measures is attributed to fungicide applications and post-harvest dips, required for brown rot management, which adequately control this pathogen. Stone fruit growers in Western Australia have to spray fungicides to effectively manage common scab and brown rot. It is unlikely that any significant additional management measures would be required if this disease became established in Western Australia.

Unrestricted risk estimate: Negligible

Standard risk management protocols meet Western Australia’s appropriate level of protection.

Quarantine status: Quarantine pest

RISK ASSESSMENT CONCLUSION

Five arthropod quarantine pests (codling moth, cherry aphid, citrophilus mealybug, oystershell scale and European red mite) and two pathogens (cercospora leaf spot and cherry Scab) have an unrestricted risk estimate of very low or negligible and therefore do not require the application of any specific phytosanitary measures in order to maintain Western Australia’s appropriate level of protection (Table 9). It is important to note that the risk estimates are derived for cherry fruit from registered export orchards in South Australia and are likely to be different for the same pest on alternate pathways and origins.

Oriental fruit moth is shown on Table 9 to have an unrestricted risk estimate of *Low*, which is above Western Australia’s appropriate level of protection. Risk mitigation measures are required to be applied to imports of cherry fruit from South Australia to reduce the risk to within Western Australia’s appropriate level of protection. Assessment of the available risk management measures is dealt with in the next section, Stage 3: Risk Management.

Table 9: Unrestricted risk summary

Scientific Name	Common name	Probability of			Overall Probability of introduction and establishment and spread ¹⁹	Economic Consequences	Unrestricted Risk ²⁰
		Introduction	Establishment	Spread			
Arthropods							
1. <i>Cydia pomonella</i>	Codling moth	Very Low	Extreme	High	Very Low	High	Very Low
2. <i>Grapholita molesta</i>	Oriental fruit moth	Moderate	High	High	Moderate	High	Moderate
3. <i>Myzus cerasi</i>	Cherry aphid	Low	Moderate	Moderate	Low	Moderate	Very Low
4. <i>Panonychus ulmi</i>	European red mite	Low	Moderate	High	Low	Moderate	Very Low
5. <i>Pseudococcus calceolariae</i>	Citrophilus mealybug	Very low	High	Moderate	Very Low	Low	Negligible
6. <i>Quadraspidothous ostreaeformis</i>	Oystershell scale	Very low	High	Moderate	Very low	Very low	Negligible
Pathogens							
7. <i>Cercospora circumscissa</i>	Cercospora leaf spot	Very Low	High	Low	Very Low	Very Low	Negligible
8. <i>Venturia cerasi</i>	Cherry Scab	Very Low	Low	Moderate	Very Low	Very Low	Negligible

¹⁹ The ‘introduction, establishment and spread potential’ is the product of the probabilities of introduction, establishment and spread. This product is achieved by using the matrix of rules shown in Table 2 to cumulatively combine; (a) the probability of introduction and the probability of establishment, and, (b) the result of this with the probability of spread.

²⁰ Unrestricted risk is the product of; (a) probability of introduction, establishment and spread; and, (b) the consequence of introduction, establishment and spread, using the rules set out in Table 4, to give a measure of ‘risk’, or expected loss.

Environmental Impact

Weed Risk Assessment

An assessment was made of the potential weed risk associated with importation of cherry fruit from South Australia. It was concluded that the risk posed by weed contamination of imported cherry fruit and by viable cherry seed is negligible. Cherry (*Prunus avium*) is a permitted plant under Schedule 5 of the Plant Diseases Regulations.

Pests of Quarantine Concern

There is another group of pests of quarantine concern to Western Australia. These however do not meet the FAO definition of a quarantine pest. The International Standards for Phytosanitary Measures defines a “pest” as “*any species, strain or biotype of plant or animal, or any pathogenic agent, injurious to plants or plant products.*” It is clear that to meet the definition of a quarantine pest an organism must be injurious to plants. This definition excludes pests that may have adverse impacts on human and animal life and health. For example, it does not include biological control agents such as predatory mites and parasitic wasps.

The uncontrolled entry of biological control agents and non-plant pest species into Western Australia may result in a significant likelihood of harm to the natural environment in the form of predation, parasitism or competition of or with native arthropod species, along with harm to humans. These quarantine concerns are encompassed by the SPS Agreement, which provides the right to impose measures that are necessary to protect animal, plant or human life or health. It is not restricted to those that are injurious to plant life.

No pests of quarantine concern, other than those already identified as quarantine pests, have been identified in the analysis. However, any organism that is detected on cherries from South Australia that has not been categorised will be treated as a pest of quarantine concern until it has been assessed and a determination made. The detection of any significant pests of quarantine concern not already identified in the analysis may result in the suspension of the trade and a review conducted to ensure that the measures provide the appropriate level of protection for Western Australia.

STAGE 3: RISK MANAGEMENT

The probability of introduction, establishment and spread of exotic pests in Western Australia through the importation of cherries from South Australia together with the economic consequences has been established in Stage 2 of the pest risk analysis. The next stage in the process is risk management, which is the process of identifying the measure(s) needed to achieve the appropriate level of protection for Western Australia, while at the same time ensuring that any negative effects on trade are minimised. A zero risk policy is unachievable and impracticable as all movement into the State would need to cease.

From Stage 2 only one pest, Oriental fruit moth, requires the use of risk management measures over and above the standard practice used in the production of export quality cherry fruit in South Australia and the standard pre shipment and on-arrival inspection of fruit.

AVAILABLE QUARANTINE MEASURES

There are numerous methods available for managing the risk posed by Oriental fruit moth on cherry fruit from South Australia, either individually or in combination with other measures.

These include:

- Area/orchard freedom;
- Orchard application of insecticides at appropriate growth stages;
- Mandatory disinfestation treatments such as fumigation with methyl bromide;
- Pre-harvest orchard inspection;
- Pheromone trapping.

Area/orchard freedom

Area freedom or pest free area is considered acceptable. However, in accordance with ISPM No. 4, (FAO, 1996b) there are 3 main components in the establishment and maintenance of a pest free area:

- Systems to establish freedom;
- Phytosanitary measures to maintain that freedom;
- Checks to verify that freedom has been maintained.

With the need to clearly define the area, ensure appropriate monitoring and effective maintenance of the pest free status, this option was considered more trade restrictive than a pre-harvest orchard inspection or pheromone trapping.

Application of insecticides at appropriate growth stages

There is insufficient information available to assess the availability or effectiveness of these methods in South Australia. This option can be considered at a future point in time.

Mandatory disinfestation treatment - fumigation

Mandatory disinfestation treatments, such as fumigation with methyl bromide, are an effective measure to eliminate Oriental fruit moth. However, methyl bromide fumigation is likely to damage the fruit or reduce the shelf life and is therefore considered to be more trade restrictive than other options.

Pre-harvest orchard inspection or pheromone trapping for Oriental fruit moth

Pre-harvest orchard inspection or pheromone trapping for Oriental fruit moth are measures that will, in addition to fruit inspection, reduce the probability of introduction of Oriental fruit moth sufficiently to maintain Western Australia's appropriate level of protection.

Oriental fruit moth's presence in South Australia is restricted to the Riverland region. The nearest incidence to the Adelaide Hills production area is Morgan, approximately 100 km away. The pest has not been recorded from peaches or other stone fruit (including unsprayed orchards and backyard trees) in the Barossa, Adelaide Hills, Adelaide plains or Adelaide metropolitan areas in spite of diligent attempts to detect it (Dr Peter Bailey in Cartwright, 2000).

The purpose of the pre-harvest orchard inspection is to identify tip growth dieback caused by Oriental fruit moth infestation. Inspections undertaken by PIRSA or an approved crop scout are to be carried out on a random sample of host trees within an orchard up to 4 weeks prior to harvest to determine with a 95% certainty that an infestation occurs at a level of no greater than 0.5%.

Pheromone trapping undertaken by PIRSA or an approved crop scout for Oriental fruit moth can be used as an alternative to pre-harvest orchard inspection for Oriental fruit moth. Pheromone traps are to be in place prior to September, when new season adults emerge (Bailey, 1985) and remain in place until harvest. Traps are to be inspected weekly to ensure that any moth specimens are in a suitable condition for taxonomic identification. Optimum trap densities have been suggested (Rice *et al.*, 1982) at a minimum of 3 traps per orchard to 1 trap per 2 hectares. As Oriental fruit moth flights are light and temperature dependant, (Rothschild and Minks, 1974) with most activity taking place 2-3 hours before sunset, traps should be placed such that the pheromone plume stays within the monitoring area at these times. To ensure the pheromone traps remain efficient, the lures are to be replaced monthly. Growers must certify that no mating disruption dispensers are in use within the orchards as these have a detrimental effect on trapping efficiency.

Upon the detection of Oriental fruit moth a visual inspection for tip dieback is required on a random sample of host trees within the affected orchard to determine with a 95% certainty that the infestation level is no greater than 0.5% of trees. The Department of Agriculture reserves the right to audit both orchard inspections and pheromone trapping results.

This method of risk management will provide a consistent level of protection while avoiding future problems in the event of altered distributions of the Oriental fruit moth within South Australia.

A pre-harvest orchard inspection or pheromone trapping for Oriental fruit moth is not essential to export cherry fruit to Western Australia, however, in the absence of either of these measures, methyl bromide fumigation will be required.

Optional disinfestation treatment – fumigation with methyl bromide for Oriental fruit moth

In the absence of the pre-harvest orchard inspection or pheromone trapping for Oriental fruit moth, an efficacious treatment such as fumigation with methyl bromide is considered acceptable. The treatment can be performed either pre-shipment or on-arrival.

Yokoyama *et al.* (1988) demonstrated that Oriental fruit moth eggs were the least susceptible life stage to methyl bromide fumigation and that a concentration time (CT) product of 47ghr/m³ at 21°C resulted in 100% egg mortality.

It is proposed that where fumigation with methyl bromide is utilised it must be carried out for a duration of 2 hours according to the specifications below:

- 32g/m³ at a cherry pulp temperature of 21°C or greater – minimum CT product of 47 ghr/m³;
- 40g/m³ at a cherry pulp temperature of 16°C or greater but less than 21°C - minimum CT product of 58 ghr/m³;
- 48g/m³ at a cherry pulp temperature of 11°C or greater but less than 16°C - minimum CT product of 70 ghr/m³.

Details on the rationale behind CT products, how they are used and calculated are discussed in the section **Interstate Phytosanitary Measures**.

Fruit is not to be fumigated if the cherry pulp temperature is below 11°C. The loading ratio should not exceed 80% of the chamber volume and the gas concentrations are not to fall below

those specified in Table 10. Fumigation is to be carried out in accordance with AQIS fumigation standards, “*AQIS Quarantine Treatments Aspects and Procedures Version 1.0.*” (AQIS, 2001).

Consignments treated pre-shipment to be accompanied by an Interstate Plant Health Certificate (IPHC) containing the following details. However, if the details are contained on a fumigation certificate only the certificate number needs to be included on the IPHC.

- Name of the fumigation facility;
- Date of fumigation;
- Rate of methyl bromide used, i.e. initial dosage(g/m^3);
- Concentration time (CT) product of methyl bromide achieved by the fumigation (ghr/m^3);
- Duration of fumigation (hours);
- Ambient air temperature during fumigation($^{\circ}\text{C}$);
- Minimum cherry pulp temperature during fumigation($^{\circ}\text{C}$);
- Statement that “the fumigation has been performed in accordance with AQIS fumigation standards”.

INTERSTATE PHYTOSANITARY MEASURES

This section details the standards of practice used in the production of export quality cherry fruit in respect to crop management, pack-house procedures, pre-shipment and on-arrival inspections and the action taken should a pest of quarantine concern be detected.

Notification by PIRSA of pest detection

It is a condition of entry that PIRSA notify the Department of Agriculture should *Phenacoccus graminicola* (Ryegrass mealybug) be detected on *Prunus avium* (cherry) plants or fruit. PIRSA must also notify the Department of Agriculture, of the detection in South Australia on stone fruit plants or fruit, of any pest listed as absent from South Australia on Table 7 or not listed on Tables 14a and 14b. The detection of any significant pest of quarantine concern not already identified in the analysis may result in the suspension of the trade and a review conducted to ensure that the current measures provide the appropriate level of protection for Western Australia.

Disinfestation treatment – fumigation methyl bromide (pests of quarantine concern)

It is proposed that should pests of quarantine concern, other than mite eggs, be detected at inspection, fumigation with methyl bromide for a duration of 2 hours must be carried out according to the specifications below:

- $32\text{g}/\text{m}^3$ at a cherry pulp temperature of 21°C or greater;
- $40\text{g}/\text{m}^3$ at a cherry pulp temperature of 16°C or greater but less than 21°C ;
- $48\text{g}/\text{m}^3$ at a cherry pulp temperature of 11°C or greater but less than 16°C .

The loading ratio should not exceed 80% of the chamber volume and the gas concentrations are not to fall below those specified on Table 10. Fumigation to be carried out in accordance with AQIS fumigation standards, as specified in the document “*AQIS Quarantine Treatments Aspects and Procedures Version 1.0.*” (AQIS, 2001).

Table 10: Standard concentrations required at specific monitoring times

Monitoring times	Required concentration of the original fumigant dosage
0.5 hours	75% or more
2 hours	60% or more
4 hours	50% or more

Methyl bromide is used extensively as a measure against many pests, by quarantine authorities in Australia and around the world. However, there is a great deal of uncertainty over the efficacy of methyl bromide treatment for insects and mites at the rates commonly used for fresh fruit and vegetables. The Department of Agriculture does not support the use of proxy data to be reliable grounds for assuming that the proposed methyl bromide treatment is efficacious against all species.

One of the important factors in determining the efficacy of the treatment is the amount of gas acting on the insect over a certain period of time. It is this measure that is referred to as the concentration time (CT) product (Bond, 1984). Recommendations based on the CT product principle provide a sound means of ensuring that the treatment is adequate to control the target pest. The usefulness of CT products is that it is a consistent value that can be used for comparison of treatments against a specified pest where variation occurs in rates, times, sorption effects, leakage, chamber loading ratios, commodities and packaging.

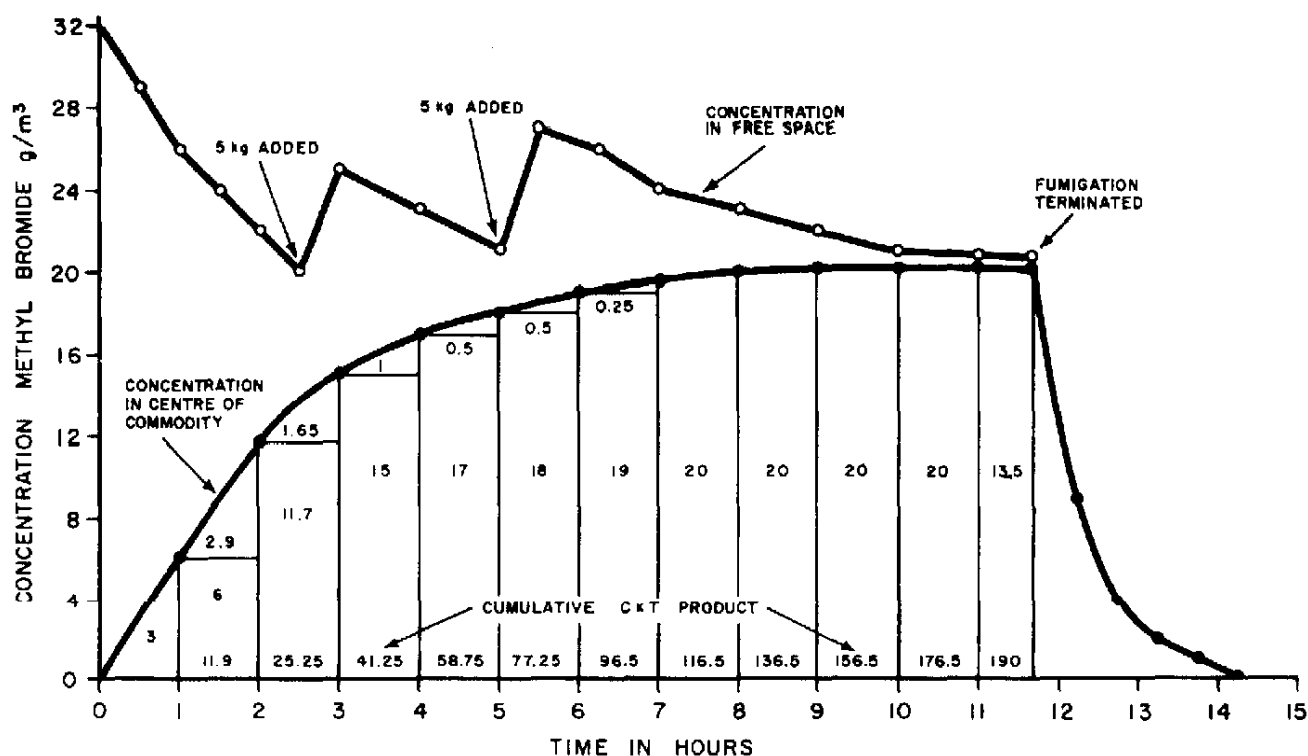
Bond, (1984) provides an example of a CT product, where to kill larvae of *Tenebroides mauritanicus* at 20°C a concentration of 33.2 grams per cubic meter must be maintained for 5 hours, providing a CT product of 166ghr/m³. The key words in this statement are “must be maintained” for the 5 hour period. It is rare that a fumigation can maintain the initial gas concentration without adding additional gas, as there are a number of factors that reduce the gas concentration over time including, adsorption, absorption and leakage.

A more realistic example is provided by Bond (1984) where the fumigant concentration is not maintained at the original dosage for the entire fumigation period. Table 11 and Figure 2 show how an integrated CT product of methyl bromide may be applied. In this instance, a hypothetical situation is illustrated in simplified form to show how the method is applied where there is gas loss over the fumigation period. The target of the fumigation is an insect which requires for complete control, under the prevailing conditions of temperature and humidity, a CT product of 190ghr/m³.

Table 11: Integrated concentration x time products within the infested commodity (Bond, 1984)

Hours	Rectangle	Triangle	Total area	Cumulative
	g/m ³			ghr/m ³
1		3	3	3
2	6	2.9	8.9	11.9
3	11.7	1.65	13.35	25.25
4	15	1	16	41.25
5	17	0.5	17.5	58.75
6	18	0.5	18.5	77.25
7	19	0.25	19.25	96.5
8	20	-	20	116.5
9	20	-	20	136.5
10	20	-	20	156.5
11	20	-	20	176.5
11.7	13.5	-	13.5	190.0

Figure 2: Chart of progress of a fumigation with methyl bromide designed to achieve a cumulative CT product 190ghr/m³ (Bond, 1984)



There is no published data on fumigation rates, times or CT products for many pests of quarantine concern. Eggs of many insects and especially mites are known to be more tolerant of fumigants than other life stages (Bond, 1984).

For example, western flower thrips are killed by fumigating with methyl bromide at the CT of 96ghr/m³ at a temperature as low as 16°C. Red legged earth mite requires a CT of 144ghr/m³ at 21°C, *Steneotarsonemus laticeps* (bulb scale mite) a CT of 200ghr/m³ at 18°C. Complete control of the stored product mite *Carpoglyphus lactis* was obtained when exposed to a CT of 144ghr/m³. The European and Mediterranean Plant Protection Organisation has adopted a standard of 96ghr/m³ at 20°C for control of *Rhizoglyphus* spp. on various bulbs. Trials conducted by the Department of Agriculture have shown that a fumigation achieving a CT product of 52ghr/m³ at 20°C were effective in killing western flower thrips (Seaton, 1993). Over wintering eggs of European red mite and eggs of other mite species have been shown to be highly tolerant to treatments with methyl bromide (DPIE, 1990). Hearne and Bond (1981) demonstrated that European red mite eggs could not be controlled with fumigation regimes having CT products in the range 58-105 ghr/m³.

Utilising the minimum gas concentrations in Table 10 and the fumigation rate of 32g/m³, a CT product of approximately 41 ghr/m³ to 64 ghr/m³ can be achieved. However as already stated it is rare for a fumigation to maintain the initial gas dosage over the full treatment period. Without comprehensive and detailed testing of a variety of life stages of species of concern, it is not possible to state what CT product is actually effective in providing the necessary level of control against pests of quarantine concern, should they be detected on the cherry fruit at inspection.

If the objective of fumigation with methyl bromide is to disinfest the commodity of all arthropods of quarantine concern, then doses commonly used, including those proposed in this analysis appear to be inadequate. However, to increase the CT will invariably damage the fruit and in this analysis alternate approaches that are less restrictive to trade need to be considered.

It is the Department of Agriculture's view that the use of methyl bromide at the common rate used for soft bodied external feeding arthropods (other than mite eggs), i.e. the rates proposed in this analysis, conducted in accordance with the AQIS fumigation standards, will provide an acceptable level of protection, if inspection is performed following the completion of the treatment. Therefore, all consignments of cherries will be subject to inspection if pre-shipment fumigated or following treatment, if fumigated on-arrival.

It is well documented that arthropods take some time to die following fumigation. Dr D. Hardie (*pers. com.* 1999) reports that recent trial work on western flower thrips indicated that there was a delay in mortality and it was not uncommon to find individuals still alive up to 48 hours following fumigation. It has also been an AQIS procedure to wait for a period of time following fumigation to ensure that all pests have died prior to re-inspecting consignments.

This analysis does not make any recommendations on the period needed, following fumigation, before reinspection can take place. However, the shorter the period the greater the likelihood that live insects may be detected and further corrective action required. The period between the completion of the fumigation and reinspection will be at the discretion of the importer, subject to the standard safety requirements relevant to methyl bromide fumigation. Reinspection cannot be undertaken until the licensed fumigator responsible for the fumigation gives approval.

However, given the demonstrated inadequacy of the treatment against mite eggs, in particular European red mite, fumigation at the proposed rates is not considered acceptable should mite eggs be detected and an alternative will need to be found. For a perishable commodity such as cherry fruit, inspection is not considered a suitable alternative as it is not operationally possible to determine whether the eggs are viable or not in the time available. Consequently, should any mite eggs be found on inspection, re-export or destruction will be required in the absence of any efficacious treatment(s).

Fruit Inspection

Inspection is a practical measure for pests that are visible, or which produce visible symptoms on plants and plant products. To ensure consistency with imports from overseas for similar pests, inspection of cherry fruit is to be carried out following AQIS fruit inspection guidelines, outlined in “*Sampling procedures for non-protocol fresh fruit and vegetables*”, otherwise referred to as the National Sampling Plan. This plan is consistent with internationally accepted procedures and applies to imports as well as exports (AFFA, 2000).

The sampling protocol (Table 12) is designed to detect the presence of any quarantine pest in the sample beyond a certain level of infestation. The sample rates achieve at a 95% confidence level that no more than 0.5% of the units (a unit being a single cherry fruit) in the consignment are infested. This equates to an acceptance level of zero units infested by quarantine pests in a random sample from homogenous lots in the consignment. To put it another way, an inspection utilising 600 units is capable of detecting an infestation level of 1 infested unit per 200 units, 95% of the time. This level of confidence depends on each fruit in the ‘lot’ having about the same likelihood of being infested by a quarantine pest (homogeneity) and the inspection technique being able to reliably detect all quarantine pests in the sample.

Table 12: Sample sizes for inspection

Lot size (units)	Sample size required (units)
1,000 –1,600	450
1,600 - 4000	500
4,000 – 10,000	550
10,000+	600

Adapted from Cannon and Roe, (1982)

Note: Sample size has been rounded to the nearest ten for ease of use.

A lot is the quantity of units (single cherry fruit) identifiable by its homogeneity of composition, origin, etc. A lot may form part of a consignment or comprise the entire consignment (AQIS, 1998b). To maintain the confidence level it is important that the sample is taken at random and applied to every lot in a consignment.

Where a pest of quarantine concern is intercepted in a sample, the lot from which it is drawn will be rejected and corrective action required, such as treatment, re-export or destruction.

Under this sampling protocol consignments over 10,000 units require a ‘fixed’ sample size of 600 units. One common misconception is that the chance of detecting arthropod pests in a large lot of 10,000,000 units for example, would be reduced with a fixed sample size (600 units) because of the relative decrease in the proportion of fruit sampled. However if the lot is



infested at a rate of 0.5%, then the number of infested fruit in a lot would increase as the lot size is increased. This increase in the number of infested fruits counteracts the decrease in the proportion of fruit inspected using a fixed size sample. The overall result is that there is no loss of confidence in the sampling scheme for detecting pests in large consignments.

In contrast to a fixed sample size (e.g. 600 units for lots over 10 000 units), a fixed sampling rate (such as 2%) would not provide the necessary confidence of detecting an 0.5% prevalence of a pest in a lot less than 30 000 units, and give a unnecessary high level of confidence for larger lots (AQIS, 1998b, AFFA, 2000).

The inspection rate for other fruit types entering Western Australia from interstate is currently under review.

Orchard control program

PIRSA would be required to ensure that cherry fruit exported to Western Australia is sourced from commercial orchards that are registered for export to Western Australia. Growers would be expected to undertake orchard pest control programs that ensure quarantine pests for Western Australia are adequately managed. PIRSA has provided information on the management of export quality cherry fruit throughout the growing season, from dormancy to post-harvest. A copy of the South Australian orchard program is attached at Appendix 1.

Freedom from leaves and stem material and soil

All cherry fruit entering Western Australia must be free from leaves, stem material, other plant debris and soil. Should any of this material be detected on-arrival the lot will require cleaning under quarantine supervision. Cherry fruit are permitted entry with the peduncle (the stalk of the fruit cluster) and pedicel (the stalk of a single fruit).

Freedom from fruit flies

South Australia is free from all fruit flies that are known to infest stone fruit. Queensland fruit fly has been detected in South Australia but has never been detected in the Adelaide Hills production area. Monitoring and eradication programs maintained by PIRSA ensure a rapid response to a detection of Queensland fruit fly, thus maintaining the fruit fly area freedom status of the State (Cartwright, 2000).

Given the serious nature of many fruit flies it is required that PIRSA immediately notify the Department of Agriculture should any of the following fruit flies be detected in South Australia; *Bactrocera cucumis* (Cucumber fruit fly), *Bactrocera kraussi* (Krauss' fruit fly), *Bactrocera mayi*, *Bactrocera melas*, *Bactrocera neohumeralis* (Lesser Queensland fruit fly), *Bactrocera tryoni* (Queensland fruit fly).

CONDITIONS FOR IMPORTATION OF CHERRY FRUIT FROM SOUTH AUSTRALIA INTO WESTERN AUSTRALIA

1. Only cherry fruit grown and packed in South Australia is permitted entry.
2. Orchards and pack-houses are to be inspected and registered annually by PIRSA to ensure that they meet the appropriate standard of practice used in the production of export quality cherry fruit, as defined in Appendix 1.

3. Each consignment to be accompanied by an Interstate Plant Health Certificate endorsed by PIRSA with the following additional information:
 - (a) Name and address of property on which the cherry fruit was grown; **and**
 - (b) Name and address of the pack-house; **and**
 - (c) “Orchard and pack-house has been approved by PIRSA for export to WA”; **and**
 - (d) “Fruit has been inspected according to the agreed protocol and found free of pests of quarantine concern to Western Australia”; **and**
 - (e) A statement that the cherry fruit was;
 - “grown on a property that has been found free of Oriental fruit moth (*Grapholita molesta*) by pheromone trapping prior to harvest according to the agreed protocol”; **or**
 - “grown on a property that has been inspected prior to harvest according to the agreed protocol and found free of Oriental fruit moth (*Grapholita molesta*)”; **or**
 - “fumigated with methyl bromide in accordance with the AQIS fumigation standards”, and specifying:
 - Name of the fumigation facility;
 - Date of fumigation;
 - Rate of methyl bromide used, i.e. initial dosage(g/m^3);
 - Concentration time (CT) product of methyl bromide achieved by the fumigation (ghr/m^3);
 - Duration of fumigation (hours);
 - Ambient air temperature during fumigation($^{\circ}\text{C}$);
 - Minimum cherry pulp temperature during fumigation($^{\circ}\text{C}$).
4. Cartons to state;
 - (a) name and address of the property on which the cherry fruit was grown; **and**
 - (b) name and address of the pack-house.
5. The cherries must be packed in clean, new packaging.
6. Consignments must be free from leaves, soil and other plant debris.
7. All consignments to be inspected on-arrival in Western Australia at the rate specified on Table 12.
8. If live pests of quarantine concern are detected on-arrival, the consignment must be treated to the satisfaction of the Department of Agriculture, re-exported or destroyed. Consignments that are treated with the fumigant methyl bromide are to be reinspected as per 7 above following completion of the treatment. Any pests of quarantine concern found alive on reinspection will result in re-treatment, re-export or destruction.
9. PIRSA must notify the Department of Agriculture should *Phenacoccus graminicola* (Ryegrass mealybug) be detected on *Prunus avium* (cherry) plants or fruit. PIRSA must also notify the Department of Agriculture of the detection in South Australia, on stone fruit plants or fruit, of any pest listed as absent from South Australia on Table 7 or not

listed on Tables 14a and 14b. The detection of any significant pest(s) of quarantine concern not already identified in the analysis will result in a review to ensure that the current measures provide the appropriate level of protection for Western Australia and may result in the suspension of the trade.

10. PIRSA must immediately notify the Department of Agriculture should any of the following fruit flies be detected in South Australia; *Bactrocera cucumis* (Cucumber fruit fly), *Bactrocera kraussi* (Krauss' fruit fly), *Bactrocera mayi*, *Bactrocera melas*, *Bactrocera neohumeralis* (Lesser Queensland fruit fly), *Bactrocera tryoni* (Queensland fruit fly).

RESTRICTED RISK ESTIMATE

Following the application of the quarantine measures the risk estimates have been recalculated, i.e. the restricted risk estimate, Table 13. All quarantine pests now fall within the appropriate level of protection for Western Australia.

REVIEW OF IMPORT REQUIREMENTS

The trade in cherry fruit from South Australia will be monitored and reviewed at the end of the first season. The measures may be revised after that time should the situation change or new information become available.

Table 13: Restricted risk summary

Scientific Name	Common name	Probability of			Overall Probability of Introduction, Establishment and Spread ²¹	Economic Consequences	Restricted Risk ²²
		Introduction	Establishment	Spread			
Arthropods							
1. <i>Cydia pomonella</i>	Codling moth	Very Low	Extreme	High	Very Low	High	Very Low
2. <i>Grapholita molesta</i>	Oriental fruit moth	Very Low	High	High	Very Low	High	Very Low
3. <i>Myzus cerasi</i>	Cherry aphid	Low	Moderate	Moderate	Low	Moderate	Very Low
4. <i>Panonychus ulmi</i>	European red mite	Low	Moderate	High	Low	Moderate	Very Low
5. <i>Pseudococcus calceolariae</i>	Citrophilus mealybug	Very Low	High	Moderate	Very Low	Low	Negligible
6. <i>Quadraspidiotus ostreaeformis</i>	Oystershell scale	Very low	High	Moderate	Very low	Very low	Negligible
Pathogens							
7. <i>Cercospora circumscissa</i>	Cercospora leaf spot	Very Low	High	Low	Very Low	Very Low	Negligible
8. <i>Venturia cerasi</i>	Cherry Scab	Very Low	Low	Moderate	Very Low	Very Low	Negligible

²¹ The 'introduction, establishment and spread potential' is the product of the probabilities of introduction, establishment and spread. This product is achieved by using the matrix of rules shown in Table 2 to cumulatively combine; (a) the probability of introduction and the probability of establishment, and, (b) the result of this with the probability of spread

²² Restricted risk is the product of; (a) probability of introduction, establishment and spread; and, (b) the consequence of introduction, establishment and spread, using the rules set out in Table 4, to give a measure of 'risk', or expected loss following the application of risk management measures.

PART FOUR

STAKEHOLDER CONSULTATION

The Department of Agriculture circulated the draft State import risk analysis and pest categorisation to 81 stakeholders in two forms; as a complete version or as an overview. A significant proportion of stakeholders were sent only a copy of the overview and advised that it should not be used as the basis of any submission on the pest categorisation or risk analysis. Any formal response should be based on the main report available from the contact officer.

The Department of Agriculture received six written responses to the draft, consisting of three from Western Australian stone fruit/cherry growers (two of these made identical comments), Victorian Department of Natural Resources and Environment, Primary Industries and Resources South Australia and the South Australian Farmers Federation on behalf of the cherry growers in that State.

Four of the six respondents had no major concerns with the draft analysis, supported the analysis or did not oppose the importation of cherries. All these respondents suggested a number of minor modifications for consideration. The other two respondents that made identical comments suggested that the evaluation period be extended until sufficient information is obtained to support the judgements in the current analysis or until conservative reanalysis of the risks was conducted.

No specific comments were received on the draft categorisation of pests of stone fruit outside of the context of the cherry risk analysis.

ISSUES RAISED BY STAKEHOLDERS

Issues raised by stakeholders in response to the draft State import risk analysis of cherry fruit are listed below in italics followed by the Department of Agriculture's response. Where appropriate changes have been made to the analysis. A summary of the changes is included at the end of this section.

Arthropod Pests

1. *“Eulecanium sp. is a generic pest name only and is not precise enough. E. pruinorum is on the cherry fruit pathway.”*

No species name for *Eulecanium* sp. was provided in the original data from Tasmania. However, further literature reviews indicated that two *Eulecanium* species are present in Tasmania, i.e. *E. pruinorum* and *E. tiliae* (Semmens *et al.*, 1992). *E. pruinorum* is present in Western Australia and although *E. tiliae* has been recorded from several *Prunus* spp. this coccid scale has not been recorded from *Prunus avium* (Ben-Dov, 1993). Relevant tables have been updated to reflect this information.

2. *“Pseudaulacaspis pentagona is listed as occurring on the pathway yet no mention of cherry as a host given in reference (Hely *et al.*, 1982).”*

No specific host record for the diaspid scale *Pseudaulacaspis pentagona*, in relation to *Prunus avium*, could be found. However, Kozar (1990) considers this species as polyphagous and therefore able to infest *P. avium*. *P. pentagona* was not considered to be on the pathway (cherry fruit) as it has not been recorded in South Australia.

3. “*Pseudococcus calceolariae* is listed as occurring on the pathway yet the reference given, (Ben-Dov, 1994) lists host as “*Prunus*”, not specifically cherry.”

The Department of Agriculture considers Ben-Dov's (1994) listing of the genus *Prunus* as a host for *Pseudococcus calceolariae* to include all species of the genus *Prunus*, as opposed to *Prunus* sp. a single species in the genus, or *Prunus* spp. several species in the genus.

4. “Re-evaluation of the unrestricted quarantine risk estimate for the five arthropod pests (codling moth, cherry aphid, citrophilus mealybug, oystershell scale and European red mite) using a more conservative approach rather than the overly unconservative approach exhibited in the current analysis. It will be necessary to implement additional risk management strategies for each disease on completion of the reanalysis.”

Refer to response to issues 27 and 32.

5. In the context of point 4 above, more specific comments were made for 3 of the arthropod pests.

Codling moth.

“The probability of introduction of this pest was judged to be low, but this evaluation overlooks the likelihood that SA cherry orchards do not occur in areas isolated from all other fruit trees. It is highly probable that cherries from any cherry orchard adjacent to an apple orchard or any apple trees (in the same orchard or nearby properties) could be infested with codling moth. The evaluation that a very low probability of introduction is incorrect and, given insufficient information relevant to WA conditions, should be evaluated as a more conservative moderate probability.”

The probability of introduction of this pest was judged to be very low, not low as indicated. This assessment was based on two issues. Firstly, the absence in Australian and rarity in scientific literature world-wide regarding field infestations of cherry fruit by codling moth. Wearing and McLaren (2001) indicate that, apart from three papers published between 1926 and 1931, no records of field infestations of sweet cherries by codling moth have been published.

Secondly the results of field trials conducted within an enclosed orchard containing apple, nectarine and cherry trees showed that 82% of apple fruit were infested with codling moth yet no cherry or nectarine fruit were infested (Wearing *et al.*, 1996). Wearing *et al.*, (1996) also included the results of over 150,000 pre-export cherry fruit inspections without any codling moth being detected. This paper also includes the results of surveys indicating no codling moth damage in cherry and nectarine over three years where apple and stone fruit occur in the same orchard.

The pest data sheet has been modified to explain more clearly the introduction potential.

Based on this information a more conservative assessment of a moderate probability of introduction of codling moth via cherry fruit, (i.e. the event would occur with an even probability), cannot be justified.

European red mite

“The evaluation that moderate economic consequences are likely to occur should introduction, establishment and spread of European red mite occur is a gross oversight of the true likely consequences. It is unjustified that the analysis make the judgement that there is unlikely to be any serious effects on economic stability, societal value or social well-being in a given geographic area should the pest breach quarantine barriers. There is no information to support such a statement, thus necessitates adoption of a more

conservative analysis (more likely that high consequences could occur) or additional research of the consequences.”

European red mite has been regarded as one of the principal pests of apple, plum, damson and other deciduous fruits, and more recently grapes, in most parts of the world. The pest was of relatively minor importance up until the end of World War 2 when, as a result of the widespread use of DDT and the more broad spectrum insecticides, such as tar, mineral oils, DNC and parathion, a dramatic increase in the pest and production losses occurred. The dramatic increase has been attributed to the removal of the pest's natural enemies by the insecticides popular in post war agriculture (Masse, 1951, FAO, 1954). It has been widely reported that damage from European red mite is rare in neglected orchards where no fungicides or insecticides are used (FAO, 1954).

More recently the significance of the pest has dropped markedly. This is attributed largely to the development of miticides that are more pest specific and to the use of predators in an integrated pest management approach. There are, for example, an increasing number of Tasmanian apple orchards where the need to apply miticides for European red mite control rarely occurs, if at all, and the only mites that can be found are predators (Williams, 1996). This view is largely borne out in the literature with relatively few recent references to chemical control of European red mite (Stuart, 2000).

Further justification was based on preliminary climatic modelling (Astbury, 2000) and expert opinion (Botha, 2000) indicating the marginal suitability of the Western Australian environmental conditions for the establishment of European red mite, potentially limiting the economic consequences. This view is further reinforced by the observation that alternate pathways for the introduction of European red mite into Western Australia existed for many years prior to the establishment of brown rot in Australia, without the introduction of European red mite into the State.

Considering the above together with the information provided in the data sheet it is reasonable to conclude that the economic consequences of the pest will not be any greater than moderate.

Changes have been made to the pest data sheet to provide further explanation of the economic consequences.

“The unrestricted risk estimate should be low rather than very low given that low probability of introduction, establishment and spread combined with moderate economic consequences produces low overall unrestricted risk.”

The pest data sheet for European red mite considers the likelihood of introduction as low, the likelihood of establishment as moderate and the likelihood of spread as high. Using the *matrix of rules*, Table 2, to combine these likelihoods provides an overall likelihood of introduction, establishment and spread of low. Using the *risk estimation matrix* at Table 4 to combine a low likelihood of introduction, establishment and spread with moderate economic consequences, provides an overall unrestricted risk estimate of very low.

Cherry aphid

“There is no justification for the evaluation that a low risk of introduction of this pest is likely. No evidence is presented to suggest that a 60 second immersion of the fruit into chlorinated water before packing will physically remove the pest. In light of little available evidence to support minimal introduction a moderate risk should be assigned to this stage.”

Although there is a lack of data supporting the mechanical removal of cherry aphid by post-harvest washing, the basic biology of the pest indicates a very low risk of occurrence on the cherry fruit. If infestation on the leaves are very high, then the copious honeydew residues and associated sooty mould would show a failure of standard crop management practices that is mandatory for export of cherry fruit from South Australia. This will result in a highly visible indicator to the presence of the pest as well as impacting on the export quality of the fruit.

The data sheet has been modified to emphasise this point.

Over the last 10 year period of importing stone fruit into eastern Australia from New Zealand there have been only 2 interceptions of *Myzus* spp., both *Myzus persicae*, one on peaches and the other on nectarines (AFFA, 2001)

Based on this information a more conservative assessment of a moderate probability of introduction of cherry aphid via cherry fruit (i.e. the event would occur with an even probability) cannot be justified.

“Evaluation of low economic consequences should introduction occur is unfounded without an understanding of the cost structures of the businesses concerned or the areas likely to be impacted. A conservative estimate for the consequences should at least be estimated to be moderate.”

The economic consequences of the introduction of cherry aphid into Western Australia has been reassessed to moderate, i.e. the impact is likely to be significant at a State level, and significant within affected geographical regions. The impact is likely to be highly significant to directly affected parties. This increases the unrestricted risk estimate from negligible to very low.

The data sheet has been modified to reflect the change.

Refer to response to issue 27.

Plant Pathogens

6. *“The Victorian Plant Research Institute herbarium holds five verified specimens of Podosphaera tridactyla collected from South Australia.”*

The Department of Agriculture notes that *Podosphaera tridactyla* is present in South Australia (Wicks, 2001) and changes have been made to Table 14b. This however does not affect the outcome of the analysis as *P. tridactyla* is not considered to be on the cherry fruit pathway. This is based on the following:-

Powdery mildew caused by *Oidium* sp. or *P. tridactyla* has not been recorded on cherries in Australia (Simmonds, 1966; Cook and Dube, 1982; Sampson and Walker, 1982; Washington and Nancarrow, 1983; Shivas, 1989; Penrose, 1990). Similarly *P. tridactyla* in the USA has been reported not to be associated with cherries (Anon, 1960; Keil and Wilson, 1961; Ogawa and Charles, 1956; Weinhold 1952, all cited by Kable *et al.*, 1980). Changes have been made to Table 7.

Cherry fruit, foliage and shoots are susceptible to powdery mildew caused by *P. clandestina* (Grove, 1995). This pathogen has been recorded in Western Australia on apples and pears (Shivas, 1989).

7. “*Pseudomonas syringae pv. morsprunorum* is reported from South Australia in *International Mycological Institute Distribution maps of Plant Diseases (1996)*.”

The International Mycological Institute’s pathogen distribution map (No. 132, edition 4 of 1996) has quoted Talbot (1964) for the “record” of *Pseudomonas syringae pv. morsprunorum* on nectarines in South Australia. Talbot did however state in his paper that the reference is only a compilation from published and unpublished sources without, in most cases, the identification having been confirmed. Further to this, the fact that pathovar *morsprunorum* was recorded on nectarines, which is not listed as a primary or secondary host by CABI (1999) and not on susceptible hosts such as sweet and sour cherries, European and Japanese plums, raises doubts about the validity of this record. In addition, the updated disease list of South Australia (Cook and Dube, 1989) does not list pathovar *morsprunorum*’s presence in that state. Dr Trevor Wicks, Senior Plant Pathologist with South Australian Research & Development Institute, PIRSA has confirmed that apart from Talbot (1964) there are no other records of *Pseudomonas syringae pv morsprunorum* in SA.

Therefore this State IRA has not included *Pseudomonas syringae pv morsprunorum* as being present in SA. However, the pest status of South Australia will be closely monitored and should any changes occur in the pest status, this State IRA would be reviewed.

8. “*Re-evaluation of the unrestricted quarantine risk estimate for the two pathogens (cercospora leaf spot and cherry scab) using a more conservative approach rather than the overly unconservative approach exhibited in the current analysis. It will be necessary to implement additional risk management strategies for each disease on completion of the reanalysis.*”

Refer to the response to issue 27.

The two diseases (cercospora leaf spot - *Cercospora circumscissa* and cherry scab - *Venturia cerasi*) are not known as diseases of high economic importance in eastern Australia and are of little concern worldwide (Sztejnberg, 1995; Hendrix, 1995). Due to this reason, there is little published literature on these two pathogens. However, these two pathogens are not established in Western Australia and have the potential to cause economic damage, albeit small, and therefore are treated as quarantine pathogens.

The probability of introduction, establishment and spread is based on available literature and their known behaviour in Australia and overseas. For example, cercospora leaf spot affects mostly leaves but is also found on twigs and fruit on rare occasions. Only a low level of infection of *P. avium* (sweet cherries) by cherry scab is reported in the literature and affected fruits usually do not ripen and fall off prematurely (Ogawa *et al.*, 1995).

Stone fruit including cherries were imported into Western Australia from eastern Australia for a significant period of time before being prohibited to reduce the likelihood of establishment of brown rot caused by *Monilinia fructicola* and *M. laxa*. Despite the trade the two pathogens have not established here. Both these pathogens have a much higher probability of being introduced into Western Australia on nursery stock.

Although the two diseases are of little concern to growers in South Australia standard crop management and pack-house procedures for export cherry fruit have been considered to provide appropriate level of protection for Western Australia.

Orchard Registration

9. *“The majority of export pack houses operate under a Quality Assurance program that has previously been subject to official AQIS audit. It is also understood that AQIS have or are in the process of moving to third party auditing of such premises. On this basis it is proposed that Agriculture WA consider the possible acceptance of third party auditing of export facilities and orchards with either PIRSA or AQIS “auditing the auditor”. ”*

A separate proposal will need to be made. However, providing clear protocols have been agreed and established, third party auditing is not considered to diminish the effectiveness of the import protocols in maintaining an appropriate level of protection for Western Australia.

10. *“The acknowledgement of currently utilised Quality Assurance programs and the ability for said QA programs to oversee auditing requirements.”*

Refer to response to issue 9.

Pre-Harvest Inspection

11. *“Oriental fruit moth has only ever been recorded in the Riverland area of South Australia and not closer to the Adelaide Hills production area than the Morgan area along the river Murray (~12km away). The current proposal is for the options of area freedom, pre-harvest orchard inspection or methyl bromide fumigation. Given the previous use of pheromone traps as part of the demonstration of area freedom of Oriental fruit moth in the Darling Scarp horticultural area, it is suggested that the use of pheromone traps be considered as an alternative to pre-harvest orchard inspection for OFM.”*

Pheromone trapping has been added as an alternative to pre-harvest orchard inspection or methyl bromide fumigation, as outlined in the section ‘Pre-harvest orchard inspection or pheromone trapping for Oriental fruit moth’.

12. *“If the preharvest orchard inspection for Oriental fruit moth finds greater than nil that there be no exporting to Western Australia.”*

If a pre-harvest orchard inspection detects Oriental fruit moth and for trade from that orchard to continue, the proposed conditions would require cherry fruit from that orchard to be fumigated with methyl bromide. These measures are outlined in the section ‘Pre-harvest orchard inspection or pheromone trapping for Oriental fruit moth’.

13. *“In the draft IRA on page 63 of 132 there is mention of random sampling of trees within an orchard up to 4 weeks prior to harvest, this should stipulate a minimum number of say 10% (or greater) of the trees in a block and trees at random throughout the entire block.”*

The sample size would be dependant on the number of host trees in an orchard and is mathematically based to achieve a 95% confidence in detecting a 0.5% infestation of Oriental fruit moth. This has been determined to be an appropriate level of sampling in dealing with detection of insect pests of this type. This measure needs to be considered in the context of other factors that mitigate against the entry of the pest, such as inspection and low (less than 0.5%) to nil pest levels in the production area.

To provide an example of how the sample size will vary with tree numbers, 1 to 120 trees would require all trees to be sampled, 1,000 trees would require 450 trees to be sampled, 1,600 to 10,000 trees would require between 500 to 600 trees to be sampled and anything greater than 10,000 trees would require 600 trees to be sampled (Cannon and Roe, 1982). Sample sizes in relation to lot sizes are listed at Appendix 3.

14. *“Pre harvest inspection by PIRSA should be an essential condition of importation.”*

Mandatory pre-harvest inspections to ensure compliance would be resource intensive and are considered overly trade restrictive. Conditions, as specified in Appendix 1, require monitoring and the upkeep of spray diaries for auditing to remain compliant. It should be noted that it is not a requirement of registration that the orchard is free from all quarantine pests as there are a range of steps in the import process that will contribute to the reduction in risk. These include post-harvest procedures, monitoring in the pack-house, inspection pre-shipment and on arrival.

15. *“No measures in place to ensure that local growers will conform to pre-harvest inspection and reporting for subsequent years.”*

This is not considered necessary. There is no incentive for South Australian cherry growers to have high pest levels in their orchards. Should this occur, the likelihood of rejection at the pre export inspection increases. Furthermore, there is no advantage for South Australian cherry growers to send infested fruit to Western Australia, as the consequence almost certainly will result in the consignment being held up pending identification of the pest, and if treated, the delays and potential damage to the fruit could be significant.

Repeat detection of pests of quarantine concern will result in further investigation and may lead to a review of the import conditions.

16. *“Orchard registration appears to be a one off process and should be repeated each year.”*

Orchard registration is to occur yearly.

17. *“Not in the growers interest to report events of high pest occurrence since this will compromise the export status of the orchard.”*

It is in the South Australian cherry growers interests to report events of high disease/insect occurrences as not doing so would jeopardise valuable interstate and international export markets, not only from a phytosanitary but also from a quality viewpoint. This would also be the case for Western Australian cherry growers in accessing interstate and international export markets.

Refer to response to issues 15 and 18.

Inspection, Pest Detections

18. *“If fruit from an individual orchard in SA breaches quarantine conditions on more than two occasions in the same season (as identified by AGWEST inspections), exports from this orchard to cease until it can be established that quarantine measures have been upgraded in the SA orchard.”*

Detection of quarantine pests at the on-arrival inspection does not imply a breach of the import conditions by South Australian exporters. The inspection itself is part of the measures imposed and it would be expected that detections will occur from time to time. However the frequency and type of pests detected may mean that certain aspects of the import conditions are not being met. Repeat detections will result in further investigation and may lead to a review of the import conditions.

See also response to issue 15.

19. *“Of significant concern, particularly from the point of view of cost, is the proposed requirement for a pre-shipment 600 fruit inspection on a per lot basis per consignment*

AND the subsequent requirement for a 600 fruit inspection per consignment on arrival in WA.”

“While the logic behind the inspection program either pre-export or on-arrival can be seen, the combination of the two inspections is seen as excessive given the unrestricted risk assessments for the pests and diseases of concern to WA. The proposed requirement is also seen as resulting in unnecessary costs to both exporters and importers which will effectively be passed on to the WA consumer by way of unnecessarily high prices for imported cherry fruit.”

Almost all fruit imported from overseas is subject to inspection prior to export and a phytosanitary certificate issued attesting to the consignment’s freedom from quarantine pests and substantial freedom from injurious pests. Imported cherries from the United States of America are subject to inspection prior to shipment, following fumigation and again on-arrival in Australia. If cherries were to be imported into Western Australia from the USA then at least two inspections, both pre-shipment and on-arrival, are likely to be required.

Under the SPS Agreement a measure may not be applied in a way which arbitrarily or unjustifiably discriminates between countries where identical or similar conditions exist; this includes between conditions within the country imposing the measure and other countries (this is the concept of national treatment). ISPM No 1, under the principle of *Non-discrimination*, states that “In the case of a quarantine pest within a country, measures shall be applied without discrimination between domestic and imported consignments”. With the aim of achieving a consistent approach to the acceptance of risk, as required under the SPS Agreement, similar measures are required for the issuance of an Interstate Plant Health Certificate attesting to the freedom from pests of quarantine concern. However, the SPS Agreement also endorses the principle of equivalence where alternative measures can be adopted if they can be shown to provide the same level of protection.

The view that two inspections is excessive as the unrestricted risk estimate is very low is incorrect. The determination of the unrestricted risk estimate is made on the basis of an inspection prior to shipment and another on-arrival. The draft analysis states in the introduction to the pest data sheets that “Throughout the development of the pest data sheets and determination of the unrestricted risk estimate, consideration has been given to current crop management, pack-house procedures used in the production of export quality cherry fruit in South Australia and the standard pre shipment and on-arrival inspection of fruit”.

20. *“Boxes within each consignment to be labelled with the variety of the fruit contained within.”*

See response to issue 21.

21. *“All varieties (within each consignment) to be inspected at the rate of 600 units per lot on arrival in WA.”*

The risk analysis did not find any evidence of significant differences in the susceptibility or resistance of cherry varieties to infestation by the quarantine pests and as such all cherry varieties were considered equally susceptible. Therefore, different varieties from the same origin are considered a homogeneous lot. However if on inspection differences are detected at a variety level a review of the sampling protocol will occur.

22. *“A lot should be defined as being discriminated not only by consignment but also by orchard (planted allotment rather than simply company trading name) and variety. This will ensure success of the fixed rate inspection in detecting infection/infestation frequencies exceeding 0.4% between boxes from an orchard.”*

A lot is not determined by consignment as several lots can make up a consignment; refer to the definition of lot in the section on ‘Fruit Inspection’. As this assessment is dealing with biological entities, the definition of origin is considered as the physical orchard and not the orchard trading name, which could consist of several orchards of differing locations and therefore a failure in homogeneity. Condition 3(a) and 4(a) require that the name and address of the property on which the fruit is grown to be endorsed on the Interstate Plant Health Certificate and cartons. This information will allow inspectors to identify lots based on the physical location of the orchard. Therefore, consignments made up of multiple lots will require multiple inspections.

A lot is not determined by variety; refer to comments on issue 21.

The sample size for inspection is not strictly a fixed 600 unit but is dependant on the number of units in the lot. It is mathematically based to achieved 95% confidence in detecting an infestation level of 0.5% not a fixed 0.4% as indicated. This has been determined to be an appropriate level of protection in dealing with detection of insect pests of this type.

An example of how the sample size will vary with lot size: 1 to 120 units would require all units to be sampled, 1,000 units would require 450 units to be sampled, 1,600 to 10,000 units would require between 500 to 600 units to be sampled and anything greater than 10,000 units would require 600 units to be sampled. Given that almost all consignments will be made up of lots in excess of 10 000 individual cherries, 600 units is the most likely sample size to be used. See sample sizes in relation to lot sizes at Table 12.

The randomised sampling plan for each lot ensures that each unit (cherry fruit from the orchard) in that lot has an equal chance of being sampled.

23. *“Details (addresses and contact) of Western Australian importers, wholesalers and retailers handling imported cherry fruit should be documented and reported back to AGWEST.”*

Adoption of this proposal is not considered to provide any significant increase in the level of protection given the current trade in other host commodities. This issue however, will be considered in the future in the broader context of the State’s biosecurity.

24. *“Importation should cease if the WA state government fails to provide resources (or pursue full cost recovery) to conduct the necessary inspections of imported cherry fruit and maintain strict records of the details of imported fruit (consisting of both origin, frequencies of quarantine breaches and distribution paths within WA).”*

The Western Australian Government through the Department of Agriculture provides a cost recovered inspection service to ensure that inspection protocols are met. Inspection records will be kept for all consignments. The inspection record will document the following information for each consignment:

- Interstate Plant Health Certificate number;
- Date and place of inspection;
- Name of the importer, exporter, pack-house, and grower for each lot;
- Number of lots in consignment;
- Number of cartons in each lot;

- Sample size(s);
- Variety
- Inspector(s) name(s);
- Time taken;
- Results of each inspection, including the identification of any pests found;
- Any relevant comments;

25. *“Growers in Western Australia should have access to the inspection records of fruit imported into this State.”*

The information contained on the inspection records will be made available to stakeholders on request. Any commercial information such as exporter, importer, and grower names will be kept confidential.

26. *“If there is an infestation of other pests not now present in South Australia cherry fruit orchards that they be prioritised in importance status so that imports cease.”*

Should pests not currently present in South Australia be detected, part 9 of the conditions comes into effect, i.e. will result in a review to ensure the current measures provide the appropriate level of protection for Western Australia and may result in the suspension of trade.

Risk analysis methodology

27. *“The State Import Risk Analysis Process is not considered to be a “very conservative approach to the acceptance of pest risk” as was the stated intention of the process. It is recommended that the analysis and evaluation period be extended until sufficient information is obtained to support the judgements in the current analysis or until realistic conservative re-analysis of the risks are conducted.”*

The methodology adopted for State import risk analyses is that specified in the International Standards for Phytosanitary Measures and used by the Commonwealth Department of Agriculture Fisheries and Forestry – Australia (AFFA) for National IRAs of plants and plant products. This ensures conformance with international standards and national consistency. Analyses conducted by the Department of Agriculture for pests present in Australia but not Western Australia may need to be added into, or used as part of, national IRAs conducted by AFFA. For these reasons it is considered that the methodology used is as close to the national IRA model as possible.

The Department of Agriculture considers that the methodology used has been appropriately conservative and the proposed import conditions provide an appropriate level of protection for Western Australia. Any significant changes to the methodology or the acceptance of risk will need to be considered in the national context. Should any changes in methodology occur that impact on the risk estimates, the analysis would be reviewed.

28. *“As stated in the draft, the risk analysis process is intended to be a scientific process to remove the subjective effects of political issues. However in conducting the analysis, the use of subjective assessments of pests/disease introduction, establishment and spread potential along with economic consequences compromises this objective.”*

The scientific process of risk evaluation is not restricted to numerical data or what is commonly called a ‘quantitative approach’, but includes expert opinion and referenced literature, as outlined in the IPPC guidelines (FAO, 1999) for risk analysis.

29. *“A major problem with the import risk analysis is the failure to adopt a conservative approach, consistent with sound scientific principles and the objectives of the process. This is clear from the evaluation of the probability of introduction, establishment and spread where there is a failure to err on the side of at least moderate likelihood, rather than the very low likelihood in the absence of sound, WA specific scientific information. Best guessing by scientific experts without data support from studies relevant to WA conditions cannot be considered to adequately provide information to make judgements of low to very low probabilities.”*

The very low probability of introduction, establishment and spread is the result of combining the respective likelihoods. The value that has been obtained is considered to be appropriately conservative. All of the 8 quarantine pests identified in the analysis are already being managed in some way, either on stone fruit nursery stock or other host plants, fruit and vegetables imported from eastern Australia. It could be argued that nursery stock, in particular stone fruit stock, poses a higher likelihood of introducing the pests into the State. This is valid State specific data. To argue that the pests have a moderate likelihood of introduction, i.e. the event would occur with an even probability, is not supported by the available evidence.

In evaluating establishment and spread potential, use of data from studies relevant to Western Australia is asking for specific information that is practically unobtainable, because it requires observations of a pest that is not present in the State. The extrapolation of the data by scientific experts is a valid process under IPPC guidelines (FAO, 1999).

The many points taken into consideration when making qualitative assessments are outlined in Part 2 ‘Methodology for assessing the probability of introduction, establishment and spread of a pest’. Information to address these points have been derived from scientific and other literature and put into perspective, with regard to Western Australian conditions, by departmental entomologists and plant pathologists who have extensive field experience researching pest interactions within Western Australian production systems.

Addressing the codling moth example, there is an absence in Australian and rarity in the scientific literature world-wide regarding field infestations of cherry fruit by codling moth. Indeed, Wearing and McLaren (2001) indicate that, apart from three papers published between 1926 and 1931, no records of field infestations of sweet cherries by codling moth have been published. Records of codling moth on cherries are from artificial laboratory and field “no choice” experiments. There are no records of the pest in cherries in South Australia. It is, therefore, a reasonable conclusion that the risk of introduction is at worst “very low”.

Refer also to response to issue 5.

30. *“Evaluation of economic consequences is unclear and largely subjective. There is no analysis of potential impact areas, the orchards within these and the likely costs associated with accidental introductions. Furthermore, it is not clear from the document whether the consequences are being evaluated at a State, regional or individual business level.”*

Economic consequences are evaluated at the State, regional and individual level, refer to Table 3. Impacts at scales greater than individual levels include regional, social and economic stability, refer to Table 3.

Refer also to response to issue 27.

31. *“Economic consequences should include an analysis of the impacts on future pest control costs and lost export markets rather than an analysis of consequences for the current production system, based on experiences in the Eastern Australian States.”*

Economic consequences consider the impacts of future pest control costs and lost export markets, within the criteria specified in Table 3.

Refer also to response to issue 27.

32. *“Re-evaluation of the unrestricted quarantine risk estimates of the five arthropod pests and two pathogens using a more conservative approach, rather than the overly unconservative approach exhibited in the current analysis.”*

The unrestricted risk estimates are considered to be appropriately conservative. Throughout the development of the pest data sheets and determination of the unrestricted risk estimate, consideration has been given to current crop management, pack-house procedures used in the production of export quality cherry fruit in South Australia and the standard pre shipment and on-arrival inspection of fruit. This may give the impression of an unconservative approach to likelihoods as all these factors contribute to the reduction in likelihood of a pest's presence on the pathway.

Refer also to responses to issues 5 and 8.

General

33. *“An annual review of the import process, allowing for some of the more onerous fruit and crop inspection tasks to be refined or even removed in time.”*

The trade in cherry fruit from South Australia will be monitored and reviewed at the end of the first season. The measures may be revised after that time should the situation change or new information become available.

If the same level of protection can be achieved utilising less restrictive measures the situation will be reviewed. Stakeholders will be consulted should this occur.

VARIATIONS TO THE DRAFT STATE IMPORT RISK ANALYSIS

1. Agriculture Western Australia (AGWEST) changed its name to the Department of Agriculture on 1 July 2001.
2. The pest data sheet for *Myzus cerasi* (cherry aphid) has been modified to explain more clearly the introduction potential.
3. The economic consequence of the introduction of *Myzus cerasi* (cherry aphid) into Western Australia has been reassessed to moderate. This increases the unrestricted risk estimate from negligible to very low.
4. The pest data sheet for *Cydia pomonella* (codling moth) has been modified to explain more clearly the introduction potential.
5. Changes have been made to the pest data sheet of *Panonychus ulmi* (European red mite) to provide further explanation of the economic consequences.
6. Further information has been obtained identifying the Coccid scale *Eulecanium* sp. as *Eulecanium tiliae*. This pest is not known to occur in Western Australia. Changes have been made to Tables 5, 6, 7, 14a and 15a.

7. The Department of Agriculture notes that *Podosphaera tridactyla* (Powdery mildew) is present in South Australia and changes have been made to Tables 7 and 14b. This however does not affect the outcome of the analysis as *P. tridactyla* is not on the cherry fruit pathway.
8. The use of pheromone traps for *Grapholita molesta* (Oriental fruit moth) detection has been added as an alternative to orchard inspection and fumigation.
9. *Otiorhynchus sulcatus* (black vine weevil) has been added to the pest list and Tables 14a and 15a updated. This inclusion does not affect the outcome of the analysis, as the pest is not on the cherry fruit pathway.
10. Table 12 has been added to prescribe more clearly the sample sizes for differing sized lots, in particular for those of less than 10,000 pieces of fruit.

APPENDIX 1

STANDARD CROP MANAGEMENT AND PACK-HOUSE PROCEDURES FOR EXPORT CHERRY FRUIT

In the response to the initial draft pest risk assessment, PIRSA in consultation with the South Australian cherry industry, proposed a range of quality field control measures, post-harvest treatment and pack-house procedures applied by export growers during the cherry season, to safeguard against the potential risks. The application of these procedures are not considered to be a phytosanitary or trade restrictive measure in relation to cherry exports from South Australia, however, they do afford a level of protection and this has been taken into account in deriving the unrestricted and restricted risk estimates.

FIELD PROGRAM

1. Cherry orchards intending to export cherries must be registered with PIRSA. Registration is also required to facilitate trace back of export fruit.
2. Growers must agree with and observe the conditions and management systems required for orchard management (pest monitoring and spray controls) or nominate a crop monitor who is responsible for the monitoring and spray programs.
3. Routine application of registered insecticides prior to harvest - cherry aphid, maintenance of spray diaries.
4. Routine application of fungicides for the control of bacterial canker and cherry scab - maintenance of spray diaries.
5. Rejection of damaged and discoloured fruit during the harvesting process.
6. Prescribed spraying regimes must include but is not limited to the following program and to include the registered chemicals and treatments recommended by “SAFF Horticulture Cherry Growers of SA Pest and Disease Control Guide May 2000”

Month	Timing of spray	Target
April	50% leaf fall 90% leaf fall	Bacterial Canker
June	Dormant	Bacterial Canker <i>Monilinia laxa</i>
August	Advanced bud-swell to early white	Bacterial Canker Aphids San Jose Scale Bryobia Mite
September - December	Early full bloom and early petal fall 14 days later every 14 days throughout spring	Brown Rot Blossom Blight Shot Hole Bacterial Canker Aphids
Late November, post-harvest spray		Pear & Cherry Slug

Pest and Disease Sprays

TARGET	CHEMICAL TN-TRADE NAME
Bacterial Canker	Copper as Hydroxide; TN Blue Shield DF Kocide DF Copper Sulphate and Lime = Bordeaux mix Copper; copper oxychloride; various
San Jose Scale Aphids Bryobia Mite	Oil petroleum; TN Vicol \winter Oil
Brown Rot	Propiconazole; TN Tilt 250EC Procymidone; TN Sumisclax 500 Iprodione; TN Rovral Aquaflo Captan; TN Captan WG Chlorothalonil; Bravo 500 Chlorothalonil 500 EC , Rover 500 Triforine; Saprol Thiram 800 g/kg; Thiragranz
Shot Hole	Chlorothalonil; TN Bravo 500 Chlorothalonil 500EC, Rover 500 Mancozeb; TN Manzate DF Thiram 800 g/kg; TN Thiragranz
Aphids	Dimethoate; TN Perpekthion EC, Dimethoate 400 Imidacloprid; TN Confidor 350 SC Thiometon; TN Ekatin Demeton-s-methyl; TN Metasustox Pirimicarb; TN Pirimor
Pear & Cherry Slug	Carbaryl 800g/kg; TN Carbaryl 800WP Carbaryl 500g/kg; TN Bugmaster
Thrips	Tau-fluvalinate; TN Mavrik Aquaflo.

The above management system is subject to audit by PIRSA.

POST-HARVEST PROGRAM

1. Washing of fruit prior to application of post-harvest fungicides.
2. Careful screening of fruit during sorting and rejection of damaged or discoloured fruit prior to packing.
3. Export fruit must be clearly identified by label, with destination, variety and grower's registration numbers on bin cards. Registration is required to facilitate trace back of export fruit. All export consignments should be clearly marked with individual grower consignment numbers and packaged to allow effective fumigation if the fruit is to be treated following grading and packing.
4. Pack-houses and cool stores must be registered.
5. Pack-houses must have quality controllers and quality supervisors for recording of defective fruit and examinations for quarantine pests throughout the packing period.



6. Pack-houses must be thoroughly cleaned prior to the commencement of each season, with cleaning maintenance records in each packing shed.
7. Records of daily monitoring must be maintained.
8. Fruit must be moved into cool store facilities immediately after packing and not be left standing unsecured for extended periods.
9. Fruit culled for pest damage must be collected and removed regularly from pack-houses, stored outside, collected and disposed of daily.
10. Records of culled fruit must be maintained.
11. Lighting in inspection areas must be a minimum of 600 lux and inspection aids must include a x10 hand lens and knife.
12. Wherever possible export fruit should be kept in separate cool rooms before and after packing.
13. If not possible, bins for export fruit must be covered with tarpaulins and separated by at least 30cm from other fruit.

As with the field program the post-harvest program is also subject to audit by PIRSA.

APPENDIX 2

PROPOSED WESTERN AUSTRALIAN IMPORT RISK ANALYSIS PROCESS FOR PLANTS AND PLANT PRODUCTS

STATE IMPORT RISK ANALYSIS PROCESS

- 1. Import Proposal Lodged with the Department of Agriculture** – A request for the development, review or modification of import legislation or policy can be made by any stakeholder or internally by the Department of Agriculture.
- 2. Application Acknowledged** – All applications will be acknowledged. For proposals necessitating a State import risk analysis (IRA), notification will be sent to stakeholders advising of the application.
- 3. Applications Prioritised:** - The Department of Agriculture has a commitment to consider all applications in a timely manner, within the constraints of available resources. The Department of Agriculture will prioritise applications taking into account a range of factors, including industry/community impact, data availability, known risk, level and nature of the interest by stakeholders.
- 4. State Import Risk Analysis Conducted** – The State IRA is conducted by the Department of Agriculture using internal procedures based on international standards and national risk analysis methodology. Input may be sought from, or consultation may be undertaken with stakeholders and external technical experts, including the Commonwealth Department of Agriculture Fisheries and Forestry – Australia (AFFA) and Departmental officers, as appropriate.

Stakeholders to be consulted, as appropriate, on the draft risk analysis.

The draft State IRA and recommendations are referred to the Executive Director of Agriculture Protection on the basis of consensus. If consensus cannot be achieved differences of view will be clearly identified and referred to the Executive Director for a decision.

- 5. Circulate Draft State IRA and Recommendations for Regulatory Change to Stakeholders for Comment** – The draft State IRA paper covering technical issues of pest risk and its management, together with the proposed regulatory change will be circulated to stakeholders, including the Agriculture Protection Board (APB), Industry Partnership Groups, AFFA, other States and Territories (via IPHRWG members), relevant Department of Agriculture Program/Project Managers and CALM, for comment within 60 days. The period may be varied at the discretion of the Executive Director.
- 6. Review Comments and Finalise Risk Analysis Recommendations for Regulatory Change** – Stakeholder comments will be reviewed by the Department of Agriculture in the context of consistency with accepted practices, technical justification and national obligations. Should any new or important information come to light that may have a significant effect on the State IRA there may be a need for more than one consultation prior to finalisation.
- 7. The State IRA Recommendations for Regulatory Change Submitted to Executive Director for Approval.** - The State IRA recommendations are submitted to the Executive

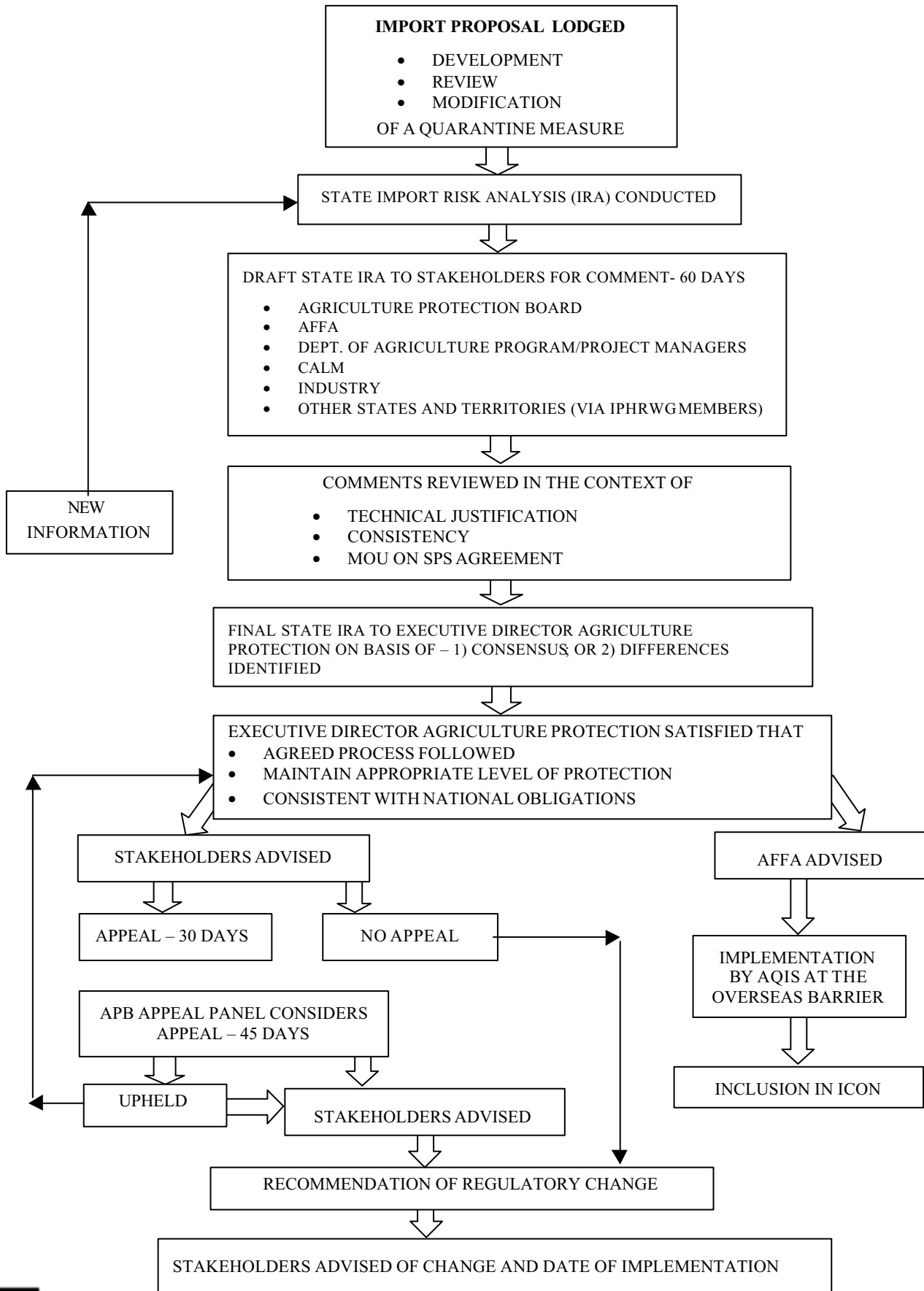
Director for approval on the basis of consensus. If consensus cannot be achieved differences of view will be clearly identified and referred to the Executive Director for a decision.

- 8. Proposal Considered by Executive Director**– Prior to approval, the Executive Director must be satisfied that the State IRA process has been carried out in accordance with the agreed process, that the recommendations for regulatory change maintain Western Australia’s appropriate level of protection, is where necessary consistent with AQIS import conditions and otherwise in accordance with Western Australia’s rights and obligations. If there is a need for a quarantine measure that is inconsistent with current AQIS measures at the overseas barrier, consultation will occur to resolve the issue. Interim procedures are put in place (if not already) at both the State and overseas barriers to address the risk.
- 9. Applicant and Stakeholders Advised** – The final State IRA will be sent to the applicant and stakeholders who have 30 days to appeal the decision. If no appeals are received within 30 days, the regulatory change will be recommended to the Minister for Primary Industry and Fisheries or delegated authority.
- 10. Appeals to Chair of the Agriculture Protection Board (APB)** - Any stakeholder or applicant disagreeing with the process followed, including the failure of the State IRA to consider a significant body of relevant scientific or technical information, may appeal to the Chair of the APB.
- 11. Appeal considered by the State IRA Appeal Panel** – The appeal is considered by the State IRA Appeal Panel, and a decision made within 45 days. The State IRA Appeal Panel consists of the Chair of the APB, a member of the APB with expertise relevant to the analysis and the Chief Executive Officer of the Department of Agriculture.
- 12. Notification of Stakeholders of Appeal Outcome**– If the appeal is upheld, the State IRA Appeal Panel refers its conclusions to the Department of Agriculture for rectification of the deficiency. All stakeholders are notified of the decision.
- 13. Application of the Legislation** – Once the State IRA is complete, appropriate regulatory changes are recommended to the Minister for Agriculture or delegated authority. On approval, new or revised conditions will be circulated to all stakeholders and relevant parties.

This process is summarised in Figure 3.

Figure 3: STATE IRA PROCESS

REGULATORY CHANGE AND MINISTERIAL/DIRECTOR GENERAL APPROVALS



APPENDIX 3

SAMPLE SIZE

The table below provides the sample size required to be 95% certain (confidence level) of detecting at least one infested unit in a lot with an infestation level of 0.5%.

Lot size (units)	Sample size required (units)
10	10
20	20
30	30
40	40
50	50
60	60
70	70
80	80
90	90
100	100
120	120
140	139
160	157
180	174
200	190
250	228
300	260
350	287
400	311
450	331
500	349
600	379
700	402
800	421
900	437
1,000	450
1,200	471
1,400	487
1,600	499
1,800	509
2,000	517
3,000	542
4,000	556
5,000	564
6,000	569
7,000	573
8,000	576
9,000	579
10,000	581
10,000+	598

Adapted from Cannon and Roe (1982).

APPENDIX 4

CATEGORISATION OF PESTS ASSOCIATED WITH STONE FRUIT IN AUSTRALIA

Table 14a: Categorisation of insects and mites associated with stone fruit²³ in Australia²⁴ (Australian distribution)

Classification	Scientific name	Common name	Australian Distribution	Reference	Eligible for further consideration
Acari					
1.	Anystidae <i>Anystis baccharum</i>	European whirligig mite	WA SA	AGWEST (2000) Baker (1998)	NO
2.	Eriophyidae <i>Aculus fockeui</i>	Peach silver mite	WA SA NSW QLD VIC	AGWEST (2001) AQIS (1998) Hely <i>et al.</i> (1982) Brough <i>et al</i> (1996) Malipatil <i>et al.</i> (1996)	NO
3.	Tarsonemidae <i>Tarsonemus waitei</i>	Fungus mite	SA	Baker (1998)	YES
4.	Tetranychidae <i>Bryobia rubrioculus</i>	Brown almond mite	WA SA NSW VIC TAS	Woods <i>et al.</i> (1996) Halliday (1998) Hely <i>et al.</i> (1982) Sharkey (1998) Miller (1966)	NO
5.	<i>Panonychus ulmi</i>	European red mite	SA QLD NSW VIC TAS	Thwaite (1991) Thwaite (1991) Thwaite (1991) Thwaite (1991) Thwaite (1991)	YES

²³ Stone fruit is considered in this analysis to encompass apricot (*Prunus armeniaca*), cherry (*P. avium*), peach and nectarine (*P. persica*), Japanese plum (*P. salicina*) and European plum (*P. domestica*).

²⁴ List based on the document "Draft Biological Assessment of Pests and Diseases of Stone Fruit from New South Wales, Victoria, Queensland, South Australia and Tasmania of Concern to Western Australia".

Table 14a (con't): Categorisation of insects and mites associated with stone fruit in Australia (Australian distribution)

Classification	Scientific name	Common name	Australian Distribution	Reference	Eligible for further consideration
6.	<i>Tetranychus urticae</i>	Two-spotted mite	WA SA QLD NSW VIC TAS	Herron <i>et al.</i> (1997) Baker (1998) Brough <i>et al.</i> (1996) Hely <i>et al.</i> (1982) Sharkey (1998) Anon. (1998)	NO
Araneida					
7.	<i>Araneidae</i> <i>Celaenia excavata</i>	Orchard spider	SA QLD NSW VIC TAS	Child (1977) Child (1977) Child (1977) Child (1977) Anon. (1998)	YES
Coleoptera					
8.	Cantharidae <i>Chauliognathus lugubris</i> (<i>Chauliognathus pulchellus</i>)	Soldier beetle	WA NSW TAS	AGWEST (2000) Hely <i>et al.</i> (1982) Anon. (1998)	NO
9.	Cerambycidae <i>Scolecobrotus westwoodi</i>	Australian longicorn beetle	WA SA TAS	AGWEST (2000) Baker (1998) Semmens <i>et al.</i> (1992)	NO
10.	Chrysomelidae <i>Altica corusca</i> (<i>Halitica corrusca</i>)	Metallic flea beetle	SA NSW TAS	Baker (1998) Hely <i>et al.</i> (1982) Samuelson (1973)	YES
11.	<i>Aulacophora hilaris</i>	Pumpkin beetle	WA SA NSW	Jenkins (1945) Baker (1998) Hely <i>et al.</i> (1982)	NO

Table 14a (con't): Categorisation of insects and mites associated with stone fruit in Australia (Australian distribution)

Classification	Scientific name	Common name	Australian Distribution	Reference	Eligible for further consideration
12.	<i>Cryptocephalus</i> sp.	Cryptocephalus beetle	WA SA QLD NSW VIC TAS	AGWEST (2000) Baker (1998) AGWEST (2000) AGWEST (2000) AGWEST (2000) AGWEST (2000)	YES
13.	<i>Ditropidus concolor</i>	Ditropidus beetle	WA SA	AGWEST (2000) Baker (1998)	NO
14.	Coccinellidae <i>Harmonia conformis</i>	Common spotted ladybird	WA VIC TAS	Jenkins (1946) Malipatil <i>et al.</i> (1996) Anon. (1998)	NO
15.	<i>Stethorus nigripes</i>	Mite eating ladybird	WA SA QLD NSW VIC TAS	Houston (1980) Houston (1980) Houston (1980) Houston (1980) Houston (1980) Anon. (1998)	NO
16.	Curculionidae <i>Asynonychus cervinus</i>	Fuller's rose weevil	WA SA QLD NSW VIC TAS	Woods <i>et al.</i> (1996) Baker (1998) Smith <i>et al.</i> (1997) Hely <i>et al.</i> (1982) Sharkey (1998) Anon. (1998)	NO
17.	<i>Graphognathus leucoloma</i>	Whitefringed weevil	WA VIC	Matthiessen <i>et al.</i> (1995) Sharkey (1998)	NO
18.	<i>Leptopius squalidus</i>	Fruit tree root weevil	NSW VIC	Hely <i>et al.</i> (1982) Sharkey (1998)	YES
19.	<i>Listroderes costirostris</i> (<i>Listroderes difficilis</i>)	Vegetable weevil	WA	Buckland <i>et al.</i> (1990)	NO

Table 14a (con't): Categorisation of insects and mites associated with stone fruit in Australia (Australian distribution)

Classification	Scientific name	Common name	Australian Distribution	Reference	Eligible for further consideration
20.	<i>Orthorhinus cylindrirostris</i>	Elephant weevil	WA NSW TAS	AGWEST (2000) Hely <i>et al.</i> (1982) Semmens <i>et al.</i> (1992)	NO
21.	<i>Orthorhinus klugi</i>	Vine weevil	NSW TAS	Hely <i>et al.</i> (1982) Semmens <i>et al.</i> (1992)	YES
22.	<i>Otiorynchus cribricollis</i>	Apple weevil	WA SA NSW	Woods <i>et al.</i> (1996) Baker (1998) Hely <i>et al.</i> (1982)	NO
23.	<i>Otiorynchus sulcatus</i>	Black vine weevil	NSW VIC SA TAS	Fletcher (2001) Maynard (2001) Baker (2001) Curran (1992)	YES
24.	<i>Perperus</i> spp	Apple root weevils	NSW VIC TAS	Hely <i>et al.</i> (1982) Sharkey (1998) Semmens <i>et al.</i> (1992)	YES
25.	<i>Phlyctinus callosus</i>	Garden weevil	WA VIC TAS	Learmonth <i>et al.</i> (1990) Sharkey (1998) Anon. (1998)	NO
26.	Elatерidae <i>Conoderus</i> sp	Click beetle/wireworm	WA SA TAS	AGWEST (2000) Baker (1998) Semmens <i>et al.</i> (1992)	YES
27.	Lathridiidae <i>Corticaria</i> sp.	Mould beetles	WA SA TAS	AGWEST (2000) Baker (1998) Semmens <i>et al.</i> (1992)	YES
28.	Melyridae <i>Carphurus</i> sp.	Carphurus beetle	WA SA TAS	AGWEST (2000) Baker (1998) Semmens <i>et al.</i> (1992)	YES

Table 14a (con't): Categorisation of insects and mites associated with stone fruit in Australia (Australian distribution)

Classification	Scientific name	Common name	Australian Distribution	Reference	Eligible for further consideration
29.	<i>Dicranolaius belliius</i>	Pollen beetle	WA SA	AGWEST (2000) Baker (1998)	NO
30.	Nitidulidae <i>Carpophilus</i> spp	Dried fruit beetle	WA SA QLD NSW VIC TAS	James <i>et al.</i> (2000) James <i>et al.</i> (1995) Brough <i>et al.</i> (1996) Hely <i>et al.</i> (1982) Sharkey (1998) Semmens <i>et al.</i> (1992)	NO ²⁵
31.	<i>Carpophilus davidsoni</i>	Dried fruit beetle	WA SA QLD NSW VIC	James <i>et al.</i> (2000) James <i>et al.</i> (1995) James <i>et al.</i> (2000) James <i>et al.</i> (2000) James <i>et al.</i> (2000)	NO
32.	<i>Carpophilus gaveni</i>	Dried fruit beetle	WA SA QLD NSW VIC	James <i>et al.</i> (2000) James <i>et al.</i> (1995) James <i>et al.</i> (2000) James <i>et al.</i> (1995) James <i>et al.</i> (1995)	NO
33.	<i>Carpophilus hemipterus</i>	Dried fruit beetle	WA SA QLD NSW VIC TAS	James <i>et al.</i> (2000) James <i>et al.</i> (1995) James <i>et al.</i> (2000) James <i>et al.</i> (2000) James <i>et al.</i> (2000) Semmens <i>et al.</i> (1992)	NO

²⁵ Species complex similar in Western Australia and South Australia.

Table 14a (con't): Categorisation of insects and mites associated with stone fruit in Australia (Australian distribution)

Classification	Scientific name	Common name	Australian Distribution	Reference	Eligible for further consideration
34.	<i>Carpophilus humeralis</i>	Dried fruit beetle	WA SA QLD NSW VIC	James <i>et al.</i> (2000) James <i>et al.</i> (1995) James <i>et al.</i> (2000) James <i>et al.</i> (1995) James <i>et al.</i> (2000)	NO
35.	<i>Carpophilus marginellus</i>	Dried fruit beetle	WA SA QLD NSW VIC	James <i>et al.</i> (2000) James <i>et al.</i> (1995) James <i>et al.</i> (2000) James <i>et al.</i> (2000) James <i>et al.</i> (1995)	NO
36.	<i>Carpophilus mutilatus</i>	Dried fruit beetle	WA SA QLD NSW VIC	James <i>et al.</i> (2000) James <i>et al.</i> (1995) James <i>et al.</i> (2000) James <i>et al.</i> (1995) James <i>et al.</i> (2000)	NO
37.	<i>Haptoncura imperialis</i>	Nitidulid beetle	SA	Baker (1998)	YES
38.	<i>Haptoncura lindensis</i>	Nitidulid beetle	SA	Baker (1998)	YES
39.	Scarabaeidae <i>Anoplognathus</i> spp	Christmas beetles	WA NSW TAS	AGWEST (2000) Hely <i>et al.</i> (1982) Semmens <i>et al.</i> (1992)	NO
40.	<i>Clambus</i> sp.	Clambus beetle	SA	Baker (1998)	YES
41.	<i>Diphucephala colaspidoides</i>	Green scarab beetle	SA VIC TAS	Baker (1998) AGWEST (2000) Anon (1998)	YES
42.	<i>Heteronychus arator</i>	African black beetle	WA NSW	Matthiessen <i>et al.</i> (1998) Hely <i>et al.</i> (1982)	NO

Table 14a (con't): Categorisation of insects and mites associated with stone fruit in Australia (Australian distribution)

Classification	Scientific name	Common name	Australian Distribution	Reference	Eligible for further consideration
43.	<i>Heteronyx</i> sp.	Honey beetle	WA SA TAS	AGWEST (2000) Baker (1998) Semmens <i>et al.</i> (1992)	YES
44.	Scolytidae <i>Xyleborus saxeseni</i>	Fruit-tree pinhole borer	WA QLD NSW VIC	Abbott (1985) Brough <i>et al.</i> (1996) Hely <i>et al.</i> (1982) Sharkey (1998)	NO
45.	Tenebrionidae <i>Adelium brevicoryne</i>	Bronzed field beetle	WA SA NSW VIC TAS	Michael <i>et al.</i> (2000) Baker (1998) Carter (1926) AGWEST (2000) Carter (1926)	NO
Dermaptera					
46.	Forficulidae <i>Forficula auricularia</i>	European earwig	WA SA NSW VIC TAS	Rees <i>et al.</i> (1995) Baker (1998) Hely <i>et al.</i> (1982) Sharkey (1998) Semmens <i>et al.</i> (1992)	NO
Diptera					
47.	Drosophilidae <i>Drosophila</i> spp	Ferment fly	WA SA QLD NSW VIC TAS	AGWEST (2000) Evenhuis (1989) Evenhuis (1989) Evenhuis (1989) Sharkey (1998) Evenhuis (1989)	NO
48.	Tephritidae <i>Bactrocera aquilonis</i>	Northern Territory fruit fly	WA	Hancock <i>et al.</i> (2000)	NO
49.	<i>Bactrocera cucumis</i>	Cucumber fly	QLD NSW	Hancock <i>et al.</i> (2000) Hancock <i>et al.</i> (2000)	YES

Table 14a (con't): Categorisation of insects and mites associated with stone fruit in Australia (Australian distribution)

Classification	Scientific name	Common name	Australian Distribution	Reference	Eligible for further consideration
50.	<i>Bactrocera jarvisi</i>	Jarvis' fruit-fly	WA QLD NSW	Drew (1989) Drew (1989) Drew (1989)	NO
51.	<i>Bactrocera kraussi</i>	Krauss' fruit fly	QLD	Hancock <i>et al.</i> (2000)	YES
52.	<i>Bactrocera mayi</i>		QLD	Hancock <i>et al.</i> (2000)	YES
53.	<i>Bactrocera melas</i>		QLD	Hancock <i>et al.</i> (2000)	YES
54.	<i>Bactrocera neohumeralis</i>	Lesser Queensland fruit fly	QLD NSW	Hancock <i>et al.</i> (2000) Hancock <i>et al.</i> (2000)	YES
55.	<i>Bactrocera tryoni</i>	Queensland fruit fly	QLD NSW VIC	Brough <i>et al.</i> (1996) Hely <i>et al.</i> (1982) Sharkey (1998)	YES
56.	<i>Ceratitidis capitata</i>	Mediterranean fruit fly	WA	AGWEST (2000)	NO
57.	<i>Dirioxa pornia</i>	Island fruit fly	WA QLD NSW	Hancock <i>et al.</i> (2000) Hancock <i>et al.</i> (2000) Hancock <i>et al.</i> (2000)	NO
Hemiptera					
58.	<i>Aphididae Aphis gossypii</i>	Cotton aphid	WA SA QLD NSW VIC TAS	Berlandier (1997) Baker (1998) Hughes <i>et al.</i> (1964) Hughes <i>et al.</i> (1964) Hughes <i>et al.</i> (1964) Hughes <i>et al.</i> (1964)	NO
59.	<i>Aphis spiraeicola</i>	Spiraea aphid	SA QLD NSW VIC TAS	AGWEST (2000) Hughes <i>et al.</i> (1964) Hughes <i>et al.</i> (1964) Hughes <i>et al.</i> (1964) Hughes <i>et al.</i> (1964)	NO

Table 14a (con't): Categorisation of insects and mites associated with stone fruit in Australia (Australian distribution)

Classification	Scientific name	Common name	Australian Distribution	Reference	Eligible for further consideration
60.	<i>Brachycaudus helichrysi</i>	Leafcurl plum aphid	WA SA QLD NSW VIC TAS	Berlandier (1999) Hughes <i>et al.</i> (1964) Hughes <i>et al.</i> (1964) Hughes <i>et al.</i> (1964) Hughes <i>et al.</i> (1964) Hughes <i>et al.</i> (1964)	NO
61.	<i>Brachycaudus persicae</i>	Black peach aphid	WA SA QLD NSW VIC TAS	Berlandier (1999) Baker (1998) Brough <i>et al.</i> (1996) Hely <i>et al.</i> (1982) Sharkey (1998) Anon. (1998)	NO
62.	<i>Eriosoma lanigerum</i>	Woolly aphid	WA VIC TAS	Sproul (1981) Malipatil (1996) Semmens <i>et al.</i> (1992)	NO
63.	<i>Hysteroneura setariae</i>	Rusty plum aphid	WA SA	Berlandier (1997) Baker (1998)	NO
64.	<i>Macrosiphum euphorbiae</i>	Potato aphid	WA TAS	Michael <i>et al.</i> (1982) Semmens <i>et al.</i> (1992)	NO
65.	<i>Myzus ascalonicus</i>	Shallot aphid	TAS	Anon. (1998)	YES
66.	<i>Myzus cerasi</i>	Cherry aphid	SA QLD NSW VIC TAS	Baker (1998) Brough <i>et al.</i> (1996) Hely <i>et al.</i> (1982) Sharkey (1998) Anon. (1998)	YES

Table 14a (con't): Categorisation of insects and mites associated with stone fruit in Australia (Australian distribution)

Classification	Scientific name	Common name	Australian Distribution	Reference	Eligible for further consideration
67.	<i>Myzus persicae</i>	Green peach aphid	WA SA QLD NSW VIC TAS	Berlandier (1997) Baker (1998) Brough <i>et al.</i> (1996) Hely <i>et al.</i> (1982) Sharkey (1998) Anon. (1998)	NO
68.	Cicadellidae <i>Edwardsiana crataegi</i> (<i>Edwardsiana australis</i>)	Apple leafhopper	WA NSW TAS	Anon. (1970) Hely <i>et al.</i> (1982) Semmens <i>et al.</i> (1992)	NO
69.	<i>Exitanus capicala</i>	Leafhopper	SA	Baker (1998)	YES
70.	Cicadidae <i>Melampsalta</i> sp.	Black cicada	SA NSW	Baker (1998) Greenup (1967)	YES
71.	Coccidae <i>Parthenolecanium corni</i>	European fruit scale	TAS	Semmens <i>et al.</i> (1992)	YES
72.	<i>Parthenolecanium persicae</i>	Grapevine scale	WA SA QLD NSW VIC	Woods <i>et al.</i> (1996) Brookes (1957) Brough <i>et al.</i> (1996) Hely <i>et al.</i> (1982) Sharkey (1998)	NO
73.	<i>Parthenolecanium pruinorum</i> (<i>Eulecanium pruinorum</i>)	Frosted scale	WA SA NSW VIC TAS	Learmonth (1997) Baker (1998) Hely <i>et al.</i> (1982) Sharkey (1998) Semmens <i>et al.</i> (1992)	NO
74.	<i>Eulecanium tiliae</i> .	Coccid scale	TAS	Semmens <i>et al.</i> (1992)	YES
75.	<i>Pulvinaria hydrangeae</i>	Hydrangea scale	NSW TAS	Pfeiffer (1997) Semmens <i>et al.</i> (1992)	YES

Table 14a (con't): Categorisation of insects and mites associated with stone fruit in Australia (Australian distribution)

Classification	Scientific name	Common name	Australian Distribution	Reference	Eligible for further consideration
76.	<i>Saissetia oleae</i>	Black scale	WA SA QLD NSW VIC TAS	Smith <i>et al.</i> (1997) Smith <i>et al.</i> (1997) Smith <i>et al.</i> (1997) Smith <i>et al.</i> (1997) Smith <i>et al.</i> (1997) Semmens <i>et al.</i> (1992)	NO
77.	Coreiidae <i>Amblypelta lutescens lutescens</i>	Banana spotting bug	WA QLD	AGWEST (2000) Brough <i>et al.</i> (1996)	NO
78.	Diaspididae <i>Lepidosaphes ulmi</i>	Apple mussel scale	WA NSW TAS	Powell (1938) Hely <i>et al.</i> (1982) Semmens <i>et al.</i> (1992)	NO
79.	<i>Pseudaulacaspis pentagona</i>	Peach white scale	NSW QLD	Hely <i>et al.</i> (1982) Brimblecombe (1962)	YES
80.	<i>Quadraspidiotus perniciosus</i>	San Jose scale	WA SA NSW QLD VIC	Woods <i>et al.</i> (1996) Baker (1998) Hely <i>et al.</i> (1982) Brough <i>et al.</i> (1996) Sharkey (1998)	NO
81.	<i>Quadraspidiotus ostreaeformis</i>	Oystershell scale	SA VIC TAS	Brookes and Hudson (1969) Brookes and Hudson (1969) Brookes and Hudson (1969)	YES
82.	Lygaeidae <i>Melanerythrus mactans</i>	Lygaeid bug	WA SA	AGWEST (2000) Baker (1998)	NO
83.	<i>Nysius vinitor</i>	Rutherglen bug	WA QLD NSW VIC TAS	Buckland <i>et al.</i> (1990) Brough <i>et al.</i> (1996) Hely <i>et al.</i> (1982) Sharkey (1998) Semmens <i>et al.</i> (1992)	NO

Table 14a (con't): Categorisation of insects and mites associated with stone fruit in Australia (Australian distribution)

Classification	Scientific name	Common name	Australian Distribution	Reference	Eligible for further consideration
84.	<i>Oxycarenus arctatus</i>	Coon bug	WA NSW QLD	Anon. (1970) Hely <i>et al.</i> (1982) Malipatil (1979)	NO
85.	<i>Oxycarenus luctuosus</i>	Cottonseed bug	WA SA TAS	Jenkins (1945) Baker (1998) Semmens <i>et al.</i> (1992)	NO
86.	<i>Plinthisus</i> sp.	Lygaeid bug	WA SA TAS	AGWEST (2000) Baker (1998) Semmens <i>et al.</i> (1992)	YES
87.	<i>Spilostethus hospes</i>	Milkweed bug	WA SA	AGWEST (2000) Baker (1998)	NO
88.	Miridae <i>Campylomma liebknechti</i>	Apple dimpling bug	WA SA QLD NSW VIC	Malipatil (1992) Baker (1998) Malipatil (1992) Malipatil (1992) Malipatil (1992)	NO
89.	<i>Creontiades dilutus</i>	Green mirid	WA QLD NSW VIC TAS	AGWEST (2000) Brough <i>et al.</i> (1996) Hely <i>et al.</i> (1982) Sharkey (1998) Semmens <i>et al.</i> (1992)	NO
90.	<i>Tayloriyygus pallidulus</i> (<i>Tayloriyygus apicalis</i>)	Brokenback bug	SA QLD NSW TAS	Cassis & Gross (1995) Cassis & Gross (1995) Cassis & Gross (1995) Semmens <i>et al.</i> (1992)	YES
91.	Pentatomidae <i>Anaxilaua vesiculosis</i>	Shield bug	WA TAS	AGWEST (2000) Anon. (1998)	NO

Table 14a (con't): Categorisation of insects and mites associated with stone fruit in Australia (Australian distribution)

Classification	Scientific name	Common name	Australian Distribution	Reference	Eligible for further consideration
92.	<i>Nezara viridula</i>	Green vegetable bug	WA NSW TAS	Clarke (1992) Hely <i>et al.</i> (1982) Semmens <i>et al.</i> (1992)	NO
93.	<i>Plautia affinis</i>	Green stink bug	WA NSW	AGWEST (2000) Hely <i>et al.</i> (1982)	NO
94. Pseudococcidae	<i>Phenacoccus graminicola</i> (<i>Phenacoccus graminiosus</i>)	Ryegrass mealybug	SA QLD VIC	Williams (1985) Williams (1985) Williams (1985)	YES
95.	<i>Pseudococcus calceolariae</i>	Citrophilus mealybug	SA QLD NSW VIC TAS	Smith <i>et al.</i> (1997) Ben-Dov (1994) Ben-Dov (1994) Williams (1985) Ben-Dov (1994)	YES
96.	<i>Pseudococcus longispinus</i>	Longtailed mealybug	WA SA QLD NSW VIC TAS	Ben-Dov (1994) Ben-Dov (1994) Ben-Dov (1994) Ben-Dov (1994) Ben-Dov (1994) Ben-Dov (1994)	NO
97. Pyrrhocoridae	<i>Dindymus versicolor</i>	Harlequin bug	WA SA TAS	AGWEST (2000) Baker (1998) Anon. (1998)	NO
98.	<i>Dysdercus sidae</i>	Pale cotton stainer	WA SA	Jenkins (1945) Hely <i>et al.</i> (1982)	NO
99. Ricaniidae	<i>Scalypopa australis</i>	Passionvine hopper	TAS QLD NSW	Anon (1998) Smith <i>et al.</i> (1997) Hely <i>et al.</i> (1982)	YES

Table 14a (con't): Categorisation of insects and mites associated with stone fruit in Australia (Australian distribution)

Classification	Scientific name	Common name	Australian Distribution	Reference	Eligible for further consideration
Hymenoptera					
100.	Formicidae <i>Amblyopone australis</i>	Ant	WA SA TAS	AGWEST (2000) Anon. (1998) Semmens <i>et al.</i> (1992)	NO
101.	<i>Solenopsis froggatti</i>	Ant	TAS	Anon. (1998)	YES
102.	Tenthredinidae <i>Caliroa cerasi</i>	Pear and cherry slug	WA SA QLD NSW VIC TAS	Jenkins (1944) Baker (1998) Brough <i>et al.</i> (1996) Hely <i>et al.</i> (1982) Sharkey (1998) Anon. (1998)	NO
Lepidoptera					
103.	Cossidae <i>Macrocyttara expressa</i>	Wood moth	SA QLD	Baker (1998) Common (1990)	YES
104.	Geometridae <i>Ectropis excursaria</i>	Twig borer	WA SA QLD NSW VIC TAS	Common (1990) Baker (1998) Common (1990) Common (1990) Common (1990) Common (1990)	NO
105.	Limacodidae <i>Doratifera</i> spp	Cup moth	WA NSW TAS	AGWEST (2000) Hely <i>et al.</i> (1982) Semmens <i>et al.</i> (1992)	YES
106.	Lymantriidae <i>Acyphas semiochrea</i> (<i>A. leucomelas</i>)	Omnivorous tussock moth	WA SA QLD NSW VIC TAS	Common (1990) Common (1990) Common (1990) Common (1990) Common (1990) Common (1990)	NO

Table 14a (con't): Categorisation of insects and mites associated with stone fruit in Australia (Australian distribution)

Classification	Scientific name	Common name	Australian Distribution	Reference	Eligible for further consideration
107.	<i>Euproctis paradoxa</i> (<i>Porthesia paradoxa</i>)	Tussock moth	NSW	Hely <i>et al.</i> (1982)	YES
108.	<i>Teia anartoides</i> (<i>Orgyia anartoides</i>)	Painted apple moth	SA QLD NSW VIC TAS	Baker (1998) Brough <i>et al.</i> (1996) Hely <i>et al.</i> (1982) Sharkey (1998) Anon. (1998)	YES
109.	Noctuidae <i>Cosmodes elegans</i>	Green blotched moth	WA SA NSW? QLD? VIC? TAS	AGWEST (2000) Baker (1998) Common (1990) Common (1990) Common (1990) Common (1990)	NO
110.	<i>Helicoverpa punctigera</i>	Native budworm	WA SA QLD NSW TAS	Matthews (1999) Baker (1998) Brough <i>et al.</i> (1996) Smith <i>et al.</i> (1997) Semmens <i>et al.</i> (1992)	NO
111.	<i>Helicoverpa</i> spp.	Budworm	WA VIC TAS	AGWEST (2000) Sharkey (1998) Semmens <i>et al.</i> (1992)	YES
112.	<i>Othreis fullonica</i>	Fruitpiercing moth	WA QLD NSW	Common (1990) Common (1990) Common (1990)	NO
113.	<i>Othreis materna</i>	Fruitpiercing moth	WA QLD NSW	Common (1990) Common (1990) Common (1990)	NO

Table 14a (con't): Categorisation of insects and mites associated with stone fruit in Australia (Australian distribution)

Classification	Scientific name	Common name	Australian Distribution	Reference	Eligible for further consideration
114. Oecophoridae	<i>Cryptophasa albacosta</i>	Small fruit-tree borer	TAS QLD NSW VIC	Anon. (1998) Common (1990) Common (1990) Common (1990)	YES
115.	<i>Cryptophasa</i> sp.	Fruit-tree borer	WA TAS	AGWEST (2000) Anon. (1998)	YES
116.	<i>Maroga melanostigma</i> (<i>Cryptophasa melanostigma</i>)	Fruit tree borer	SA QLD NSW VIC	Baker (1998) Brough <i>et al.</i> (1996) Hely <i>et al.</i> (1982) Sharkey (1998)	YES
117. Psychidae	<i>Hyalarcta huebneri</i>	Leaf case moth	WA NSW	AGWEST (2000) Hely <i>et al.</i> (1982)	NO
118. Pyralidae	<i>Conogethes punctiferalis</i>	Yellow peach moth	WA SA NSW QLD	AGWEST (2000) Hely <i>et al.</i> (1982) Smith <i>et al.</i> (1997) AGWEST (2000)	NO
119.	<i>Ectomyelois ceratoniae</i>	Carob moth	WA SA	Michael (1968) Baker (1998)	NO
120.	<i>Nacoleia rhoealis</i>	Pyralid moth	WA SA	AGWEST (2000) Baker (1998)	NO
121. Tortricidae	<i>Cydia pomonella</i>	Codling moth	SA QLD NSW VIC TAS	Hely <i>et al.</i> (1982) Hely <i>et al.</i> (1982) Hely <i>et al.</i> (1982) Hely <i>et al.</i> (1982) Anon. (1998)	YES

Table 14a (con't): Categorisation of insects and mites associated with stone fruit in Australia (Australian distribution)

Classification	Scientific name	Common name	Australian Distribution	Reference	Eligible for further consideration
122.	<i>Epiphyas positivittana</i>	Light brown apple moth	WA SA QLD NSW VIC TAS	Geier <i>et al.</i> (1976) Baker (1998) Brough <i>et al.</i> (1996) Hely <i>et al.</i> (1982) Sharkey (1998) Anon. (1998)	NO
123.	<i>Epiphyas pulla</i>	Light brown apple moth complex	WA	AGWEST (2000)	NO
124.	<i>Epiphyas xyloides</i>	Light brown apple moth complex	WA TAS	AGWEST (2000) Anon. (1998) Powell (1985)	NO
125.	<i>Grapholita molesta</i>	Oriental fruit moth	SA QLD NSW VIC TAS	Baker (1998) Brough <i>et al.</i> (1996) Hely <i>et al.</i> (1982) Sharkey (1998) Anon. (1998)	YES
126.	<i>Isotenes miserana</i>	Orange fruit borer	QLD NSW VIC	Brough <i>et al.</i> (1996) Smith <i>et al.</i> (1997) Smith <i>et al.</i> (1997)	YES
Orthoptera					
127.	Acrididae <i>Phaulacridium vittatum</i>	Wingless grasshopper	WA NSW VIC TAS	Buckland <i>et al.</i> (1990) Hely <i>et al.</i> (1982) Sharkey (1998) Semmens <i>et al.</i> (1992)	NO
128.	Gryllidae <i>Teleogryllus commodus</i>	Black field cricket	WA SA VIC TAS	Button (1967) AGWEST (2000) Sharkey (1998) Semmens <i>et al.</i> (1992)	NO

Table 14a (con't): Categorisation of insects and mites associated with stone fruit in Australia (Australian distribution)

Classification	Scientific name	Common name	Australian Distribution	Reference	Eligible for further consideration
129.	Tettigoniidae <i>Caedicia otivacea</i> (<i>Caedicia simplex</i>)	Inland katydid	WA SA QLD NSW VIC TAS	Rentz (1996) Smith <i>et al.</i> (1997) Brough <i>et al.</i> (1996) Hely <i>et al.</i> (1982) Smith <i>et al.</i> (1997) Anon. (1998)	NO
130.	<i>Caedicia strenua</i>	Citrus katydid	NSW	Hely <i>et al.</i> (1982)	YES
Thysanoptera					
131.	Thripidae <i>Chaetanaphothrips</i> sp.		SA QLD NSW	Baker (1998) Mound (1996) Mound (1996)	YES
132.	<i>Desmothrips propinquus</i>	Desmothrips	SA	Baker (1998)	YES
133.	<i>Heliothrips haemorrhoidalis</i>	Greenhouse thrips	WA NSW TAS	Mound (1996) Hely <i>et al.</i> (1982) Semmens <i>et al.</i> (1992)	NO
134.	<i>Thrips imaginis</i>	Plague thrips	WA SA QLD NSW VIC TAS	Newman <i>et al.</i> (1933) Baker (1998) Brough <i>et al.</i> (1996) Hely <i>et al.</i> (1982) Sharkey (1998) Semmens <i>et al.</i> (1992)	NO

Table 14b: Categorisation of plant pathogens associated with stone fruit²⁶ in Australia²⁷ (Australian distribution)

Classification	Scientific name	Common name	Australian Distribution	Reference	Eligible for further consideration
Bacteria					
1.	<i>Agrobacterium tumefaciens</i> (S. & Townsend 1907) Conn 1942	Crown Gall	WA SA QLD NSW VIC TAS	Shivas (1989) Cook & Dube (1989) Simmonds (1966) Paton (1998) Washington & Nancarrow (1983) AQIS (1998)	NO
2.	<i>Pseudomonas syringae</i> pv. <i>syringae</i> van Hall	Bacterial Canker	WA SA QLD NSW VIC TAS	Shivas (1989) Cook & Dube (1989) Persley et al. (1989) Paton (1998) Washington & Nancarrow (1983) AQIS (1998)	NO
3.	<i>Pseudomonas syringae</i> pv. <i>morsprunorum</i> Wornald	Bacterial canker	NSW	Foulkes & Lloyd (1980)	YES
4.	<i>Pseudomonas viridiflava</i> (Burkholder) Dowson		QLD NSW	Moffett (1983) Moffett (1983)	YES
5.	<i>Xanthomonas campestris</i> pv. <i>pruni</i> (E.F. Smith) Dowson	Bacterial spot	WA SA QLD NSW VIC	Shivas (1989) Cook & Dube (1989) Persley et al. (1989) Paton (1998) Washington & Nancarrow (1983)	NO

²⁶ Stone fruit is considered in this analysis to encompass apricot (*Prunus armeniaca*), cherry (*P. avium*), peach and nectarine (*P. persica*), Japanese plum (*P. salicina*) and European plum (*P. domestica*)

²⁷ List taken from the document "Draft Biological Assessment of Pests and Diseases of Stone Fruit from New South Wales, Victoria, Queensland, South Australia and Tasmania of Concern to Western Australia".

Table 14b (con't): Categorisation of plant pathogens associated with stone fruit in Australia (Australian distribution)

Classification	Scientific name	Common name	Australian Distribution	Reference	Eligible for further consideration
Fungi					
6.	<i>Armillaria luteobubalina</i> Watling & Kile	Armillaria root rot	WA SA QLD NSW VIC TAS	Shivas (1989) Cook & Dube (1989) Persley et al. (1989) Paton (1998) Sharkey (1998) AQIS (1998)	NO
7.	<i>Blumeriella jaapii</i> (Rehm) v. Arx	Cherry leaf spot	SA – Eradicated	Cook & Dube (1989)	YES
8.	<i>Botryosphaeria stevensii</i> Shoemaker	Twig blister	NSW – Eradicated	AQIS (1998)	YES
9.	<i>Botryosphaeria obtusa</i> (Schw.) Shoemaker	Fruit rot	VIC WA SA NSW	AQIS (1998) Shivas (1989) Cook & Dube (1989) Paton (1998)	NO
10.	<i>Botrytis cinerea</i> Pers.: Fr.	Botrytis rot	WA SA QLD NSW VIC TAS	Shivas (1989) Cook & Dube (1989) AQIS (1998) Paton (1998) Sharkey (1998) Sampson & Walker (1982)	NO
11.	<i>Cercospora circumscissa</i> Sacc.	Cercospora leaf spot	SA QLD NSW VIC	Cook & Dube (1989) Simmonds (1966) Paton (1998) Sharkey (1998)	YES

Table 14b (con't): Categorisation of plant pathogens associated with stone fruit in Australia (Australian distribution)

Classification	Scientific name	Common name	Australian Distribution	Reference	Eligible for further consideration
12.	<i>Chondrostereum purpureum</i> (Pers. ex Fr.) Pouz	Silver leaf	SA QLD NSW VIC TAS	Cook & Dube (1989) AQIS (1998) Paton (1998) Washington & Nancarrow (1983) Sampson & Walker (1982)	YES
13.	<i>Colletotrichum gleosporides</i> (Penz.) Penz. & Sacc.	Leaf spot and fruit rot	WA SA QLD NSW VIC TAS	Shivas (1989) Cook & Dube (1989) AQIS (1998) Paton (1998) Washington & Nancarrow (1983) ²⁸ Sampson & Walker (1982) ²⁸	NO
14.	<i>Corioliolus versicolor</i> (L. ex Fr.) Quel.	Wood rot	WA SA QLD VIC TAS	Shivas (1989) Cook & Dube (1989) AQIS (1998) AQIS (1998) AQIS (1998)	NO
15.	<i>Eutypa lata</i> (Pers.: Fr.) Tul.	Eutypa canker	SA VIC TAS	Cook & Dube (1989) Sharkey (1998) AQIS (1998)	YES
16.	<i>Fusarium lateritium</i> Nees emend. Snyder & Hanson		WA SA VIC TAS	Shivas (1989) Cook & Dube (1989) Washington & Nancarrow (1983) Sampson & Walker (1982) ²⁸	NO

²⁸ Present in the state but not recorded on *Prunus* spp.

Table 14b (con't): Categorisation of plant pathogens associated with stone fruit in Australia (Australian distribution)

Classification	Scientific name	Common name	Australian Distribution	Reference	Eligible for further consideration
17.	<i>Leucostoma cinctum</i> (Fr.:Fr.) Höhn.	Leucostoma canker	SA NSW VIC	Cook & Dube (1989) Paton (1998) Sharkey (1998)	YES
18.	<i>Macrophomina phaseolina</i> (Tassi) Goid.	Charcoal rot	WA SA QLD VIC TAS	Shivas (1989) Cook & Dube (1989) Simmonds (1966) ²⁹ Sharkey (1998) Sampson & Walker (1982) ²⁹	NO
19.	<i>Monilinia fructicola</i> (Wint.) Honey	Brown rot	WA SA QLD NSW VIC TAS	AGWEST (2000) Cook & Dube (1989) Simmonds (1966) ³⁰ Paton (1998) Sharkey (1998) Sampson & Walker (1982)	NO
20.	<i>Monilinia laxa</i> (Aderh. & Ruhl.) Honey.	Brown rot	WA SA NSW VIC TAS	AGWEST (2000) Cook & Dube (1989) Paton (1998) Sharkey (1998) Sampson & Walker (1982)	NO
21.	<i>Oidium</i> sp.	Powdery mildew	WA SA NSW VIC TAS	Shivas (1989) Cook & Dube (1989) Paton (1998) Washington & Nancarrow (1983) Sampson & Walker (1982)	NO

²⁹ Present in the state but not recorded on *Prunus* spp.

³⁰ Recorded as *Sclerotinia fructicola*

Table 14b (con't): Categorisation of plant pathogens associated with stone fruit in Australia (Australian distribution)

Classification	Scientific name	Common name	Australian Distribution	Reference	Eligible for further consideration
22.	<i>Phoma prunicola</i> (Opiz) Wollenw. & Hochapf.	Leaf spot	WA SA QLD VIC TAS	Shivas (1989) Cook & Dube (1989) AQIS (1998) Washington & Nancarrow (1983) Sampson & Walker (1982) ³¹	NO
23.	<i>Phytophthora cinnamomi</i> Rands	Stem rot	WA SA QLD NSW VIC TAS	Shivas (1989) Cook & Dube (1989) ³¹ Simmonds (1966) Paton (1998) Washington & Nancarrow (1983) Sampson & Walker (1982) ³¹	NO
24.	<i>Phytophthora cryptogea</i> Pethybr. & Lafferty	Root rot	WA SA VIC TAS	Shivas (1989) Cook & Dube (1989) Washington & Nancarrow (1983) ³¹ Sampson & Walker (1982) ³¹	NO
25.	<i>Phytophthora syringae</i> (Kleb.) Kleb.	Canker, crown and root rot	SA	Cook & Dube (1989)	YES
26.	<i>Podosphaera clandestina</i> (Wallr.:Fr) Lev.	Cherry powdery mildew	WA TAS	Shivas (1989) Sampson & Walker (1982)	NO
27.	<i>Podosphaera tridactyla</i> (Wallr.) de Barry	Powdery mildew	QLD SA NSW VIC	Simmonds (1966) Wicks (2001) Paton (1998) Sharkey (1998)	YES
28.	<i>Punctularia strigosa-zonata</i>	Die back	WA NSW	Shivas (1989) AQIS (1998)	NO

³¹ Present in the state but not recorded on *Prunus* spp.

Table 14b (con't): Categorisation of plant pathogens associated with stone fruit in Australia (Australian distribution)

Classification	Scientific name	Common name	Australian Distribution	Reference	Eligible for further consideration
29.	<i>Pycnoporus coccineus</i> (Schw.) Talbot	Wood rot	WA SA NSW VIC	Shivas (1989) Cook & Dube (1989) Paton (1998) AQIS (1998)	NO
30.	<i>Pythium aphanthermatum</i> (Edson) Fitzp.	Damping-off	WA SA QLD	Shivas (1989) Cook & Dube (1989) Simmonds (1966) ³²	NO
31.	<i>Pythium irregulare</i> Buisman	Damping-off	WA SA QLD NSW TAS	Shivas (1989) Cook & Dube (1989) Simmonds (1966) ³² AQIS (1998) Sampson & Walker (1982) ³²	NO
32.	<i>Pythium ultimum</i> Trow	Damping-off	WA SA QLD VIC TAS	Shivas (1989) Cook & Dube (1989) ³² Simmonds (1966) ³² Washington & Nancarrow (1983) ³² Sampson & Walker (1982)	NO
33.	<i>Rhizopus stolonifer</i> (Ehrenb.: Fr.) Vuill	Fruit rot	WA SA QLD VIC TAS	Shivas (1989) Cook & Dube (1989) ³² Simmonds (1966) Washington & Nancarrow (1983) Sampson & Walker (1982) ³²	NO
34.	<i>Rhizopus arrhizus</i> A. Fischer	Fruit rot	QLD VIC	Simmonds (1966) Washington & Nancarrow (1983)	YES

³² Present in that state but not recorded on *Prunus* spp.

Table 14b (con't): Categorisation of plant pathogens associated with stone fruit in Australia (Australian distribution)

Classification	Scientific name	Common name	Australian Distribution	Reference	Eligible for further consideration
35.	<i>Schizophyllum commune</i> Fr.	Wood rot	WA SA QLD NSW VIC TAS	Shivas (1989) Cook & Dube (1989) Simmonds (1966) Paton (1998) Washington & Nancarrow (1983) Sampson & Walker (1982)	NO
36.	<i>Sclerotinia sclerotiorum</i> (Lib.) de Bary	Fruit rot	WA SA QLD NSW VIC TAS	Shivas (1989) Cook & Dube (1989) ³³ Simmonds (1966) AQIS (1998) Washington & Nancarrow (1983) Sampson & Walker (1982)	NO
37.	<i>Spaerotheca pannosa</i> (Wallr.: Fr.) Lev.	Powdery mildew	WA SA QLD NSW VIC TAS	Shivas (1989) Cook & Dube (1989) ³³ Simmonds (1966) ³³ Paton (1998) Washington & Nancarrow (1983) Sampson & Walker (1982) ³³	NO
38.	<i>Stereum hirsutum</i> (Willd.) Pers.: Gray	Wood rot	WA NSW	Shivas (1989) AQIS (1998)	NO
39.	<i>Taphrina deformans</i> (Berik.) Tul.	Peach leaf curl	WA SA QLD NSW VIC TAS	Shivas (1989) Cook & Dube (1989) Simmonds (1966) Paton (1998) Washington & Nancarrow (1983) Sampson & Walker (1982)	NO

³³ Present in that state but not recorded on *Prunus* spp.

Table 14b (con't): Categorisation of plant pathogens associated with stone fruit in Australia (Australian distribution)

Classification	Scientific name	Common name	Australian Distribution	Reference	Eligible for further consideration
40.	<i>Taphrina pruni</i> Tul.	Plum pockets	NSW VIC	Paton (1998) Sharkey (1998)	YES
41.	<i>Taphrina wiesneri</i> (Rathay) Mix.	Cherry leaf curl	NSW VIC TAS	Paton (1998) AQIS (1998) AQIS (1998)	YES
42.	<i>Tranzschelia discolor</i> (Fueckel) Tranz. & Litv.	Rust	WA SA QLD NSW VIC TAS	Shivas (1989) Cook & Dube (1989) Simmonds (1966) ³⁴ Paton (1998) Washington & Nancarrow (1983) Sampson & Walker (1982)	NO
43.	<i>Venturia carpophila</i> E.E. Fisher	Common scab	WA ⁸ SA QLD NSW VIC TAS	Shivas (1989) Cook & Dube (1989) Simmonds (1966) Paton (1998) Sharkey (1998) Sampson & Walker (1982)	NO
44.	<i>Venturia cerasi</i> Aderhold	Cherry scab	SA VIC	Cartwright (2000) Sharkey (1998)	YES

³⁴ Present in the state but not recorded on *Prunus* spp.

Table 14b (con't): Categorisation of plant pathogens associated with stone fruit in Australia (Australian distribution)

Classification	Scientific name	Common name	Australian Distribution	Reference	Eligible for further consideration
45.	<i>Verticillium dahliae</i> Kleb.	Black heart	WA SA QLD NSW VIC TAS	Shivas (1989) Cook & Dube (1989) Simmonds (1966) AQIS (1998) Washington & Nancarrow (1983) Sampson & Walker (1982)	NO
46.	<i>Wilsonomyces carpophilus</i> (Lév.) Adaskaveg, Ogawa, and Butler	Shot hole	WA SA QLD NSW TAS	Shivas (1989) ³⁵ Cook & Dube (1989) Simmonds (1966) Paton (1998) Sampson & Walker (1982)	NO
Viruses and Mycoplasma					
47.	Apple chlorotic leafspot		WA NSW VIC TAS	McLean & Price (1984) Paton (1998) AQIS (1998) Sampson & Walker (1982) ³⁶	NO
48.	Prune dwarf		WA SA QLD NSW VIC TAS	McLean & Price (1984) Cook & Dube (1989) AQIS (1998) Paton (1998) Washington & Nancarrow (1983) AQIS (1998)	NO

³⁵ Recorded in WA as *Cladosporium carpophilum*

³⁶ Present in the state but not recorded on *Prunus* spp.

Table 14b (con't): Categorisation of plant pathogens associated with stone fruit in Australia (Australian distribution)

Classification	Scientific name	Common name	Australian Distribution	Reference	Eligible for further consideration
49.	<i>Prunus necrotic ringspot</i>		WA SA QLD NSW VIC TAS	McLean & Price (1984) Cook & Dube (1989) Simmonds (1966) Paton (1998) Washington & Nancarrow (1983) Sampson & Walker (1982)	NO
Nematodes					
50.	<i>Aglenchus agricola</i> (de Man)	Andrássy	WA	McLeod <i>et al.</i> , (1994)	NO
51.	<i>Belonolaimus</i> sp.		NSW	McLeod <i>et al.</i> , (1994)	YES
52.	<i>Costenichus costatus</i> (de Man)	Siddiqi	QLD	McLeod <i>et al.</i> , (1994)	YES
53.	<i>Criconema</i> sp.		VIC	McLeod <i>et al.</i> , (1994)	YES
54.	<i>Criconemoides</i> sp.		WA NSW	McLeod <i>et al.</i> , (1994) McLeod <i>et al.</i> , (1994)	NO
55.	<i>Filenchus</i> sp.		NSW	McLeod <i>et al.</i> , (1994)	YES
56.	<i>Ditylenchus</i> sp.		QLD	McLeod <i>et al.</i> , (1994)	YES
57.	<i>Ditylenchus anchilispodosomus</i> (Tajjan)	Fortuner	QLD	McLeod <i>et al.</i> , (1994)	YES
58.	<i>Helicotylenchus</i> sp.		QLD NSW	McLeod <i>et al.</i> , (1994) McLeod <i>et al.</i> , (1994)	YES
59.	<i>Helicotylenchus dihystrera</i> (Cobb)	Sher.	QLD NSW	McLeod <i>et al.</i> , (1994) McLeod <i>et al.</i> , (1994)	YES
60.	<i>Helicotylenchus multincinctus</i> (Cobb)	Golden	NSW	McLeod <i>et al.</i> , (1994)	YES
61.	<i>Hemicycliophora iwia</i>	Brzeski	NSW	McLeod <i>et al.</i> , (1994)	YES
62.	<i>Hemicycliophora truncata</i>	Colbran	QLD	McLeod <i>et al.</i> , (1994)	YES
63.	<i>Hemicycliophora typica</i>	De Man	SA	McLeod <i>et al.</i> , (1994)	YES

Table 14b (con't): Categorisation of plant pathogens associated with stone fruit in Australia (Australian distribution)

Classification	Scientific name	Common name	Australian Distribution	Reference	Eligible for further consideration
64.	<i>Longidorus</i> sp.		NSW	McLeod <i>et al.</i> , (1994)	YES
65.	<i>Macroposthonia curvata</i> (Raski) de Grisse & Loof		QLD	McLeod <i>et al.</i> , (1994)	YES
66.	<i>Macroposthonia ornata</i> (Raski) de Grisse & Loof		NSW	McLeod <i>et al.</i> , (1994)	YES
67.	<i>Macroposthonia similis</i> (Cobb) de Grisse & Loof		SA NSW	McLeod <i>et al.</i> , (1994) McLeod <i>et al.</i> , (1994)	YES
68.	<i>Macroposthonia teres</i> (Raski) de Grisse & Loof		NSW	McLeod <i>et al.</i> , (1994)	YES
69.	<i>Macroposthonia xenoplax</i> (Raski) de Grisse & Loof.		WA SA QLD VIC	McLeod <i>et al.</i> , (1994) McLeod <i>et al.</i> , (1994) McLeod <i>et al.</i> , (1994) McLeod <i>et al.</i> , (1994)	NO
70.	<i>Meloidogyne arenaria</i> (Neal) Chitwood		SA NSW	McLeod <i>et al.</i> , (1994) McLeod <i>et al.</i> , (1994)	YES
71.	<i>Meloidogyne incognita</i> (Kofoid & White) Chitwood		SA NSW	McLeod <i>et al.</i> , (1994) McLeod <i>et al.</i> , (1994)	YES
72.	<i>Meloidogyne javanica</i> (Trueb.) Chitwood		WA SA NSW	McLeod <i>et al.</i> , (1994) McLeod <i>et al.</i> , (1994) McLeod <i>et al.</i> , (1994)	NO
73.	<i>Merlinius brevidens</i> (Allen) Siddiqi		NSW	McLeod <i>et al.</i> , (1994)	YES
74.	<i>Neopsilenchus magnidens</i> (Thorne) Thorne & Malek		QLD	McLeod <i>et al.</i> , (1994)	YES
75.	<i>Paratrichodorus lobatus</i> (Colbran) Siddiqi		SA QLD NSW	McLeod <i>et al.</i> , (1994) McLeod <i>et al.</i> , (1994) McLeod <i>et al.</i> , (1994)	YES

Table 14b (con't): Categorisation of plant pathogens associated with stone fruit in Australia (Australian distribution)

Classification	Scientific name	Common name	Australian Distribution	Reference	Eligible for further consideration
76.	<i>Paratrichodorus minor</i> (Colbran) Siddiqi		SA QLD NSW	McLeod <i>et al.</i> , (1994) McLeod <i>et al.</i> , (1994) McLeod <i>et al.</i> , (1994)	YES
77.	<i>Paratrichodorus prorsus</i> (Allen) Siddiqi		NSW	McLeod <i>et al.</i> , (1994)	YES
78.	<i>Paratylenchus hamatus</i> Thorne & Allen		SA QLD	McLeod <i>et al.</i> , (1994) McLeod <i>et al.</i> , (1994)	YES
79.	<i>Paratylenchus nanus</i> Cobb		NSW	McLeod <i>et al.</i> , (1994)	YES
80.	<i>Paratylenchus neoamblycephalus</i> Geraert		WA	McLeod <i>et al.</i> , (1994)	NO
81.	<i>Paratylenchus projectus</i> Jenkins		NSW	McLeod <i>et al.</i> , (1994)	YES
82.	<i>Pratylenchus</i> sp.	Root lesion	WA SA NSW VIC	McLeod <i>et al.</i> , (1994) McLeod <i>et al.</i> , (1994) McLeod <i>et al.</i> , (1994) McLeod <i>et al.</i> , (1994)	NO
83.	<i>Pratylenchus brachyurus</i> (Godfrey) Filipjev & Sch. Stekhoven	Root lesion	QLD	McLeod <i>et al.</i> , (1994)	YES
84.	<i>Pratylenchus coffeae</i> (Zimmerman) Filipjev & Sch. Stekhoven	Root lesion	SA QLD NSW	McLeod <i>et al.</i> , (1994) McLeod <i>et al.</i> , (1994) McLeod <i>et al.</i> , (1994)	YES
85.	<i>Pratylenchus crenatus</i> Loof	Root lesion	VIC	McLeod <i>et al.</i> , (1994)	YES
86.	<i>Pratylenchus neglectus</i> (Rensch) Filipjev & Sch. Stekhoven	Root lesion	SA QLD NSW	McLeod <i>et al.</i> , (1994) McLeod <i>et al.</i> , (1994) McLeod <i>et al.</i> , (1994)	YES
87.	<i>Pratylenchus penetrans</i> (Cobb) Filipjev & Sch. Stekhoven	Root lesion	WA QLD NSW VIC	McLeod <i>et al.</i> , (1994) McLeod <i>et al.</i> , (1994) McLeod <i>et al.</i> , (1994) McLeod <i>et al.</i> , (1994)	NO

Table 14b (con't): Categorisation of plant pathogens associated with stone fruit in Australia (Australian distribution)

Classification	Scientific name	Common name	Australian Distribution	Reference	Eligible for further consideration
88.	<i>Pratylenchus vulvius</i> Allen & Jensen	Root lesion	SA NSW	McLeod <i>et al.</i> , (1994) McLeod <i>et al.</i> , (1994)	YES
89.	<i>Pratylenchus zaeae</i> Graham	Root lesion	NSW VIC	McLeod <i>et al.</i> , (1994) McLeod <i>et al.</i> , (1994)	YES
90.	<i>Rotylenchus brevicaudatus</i> Linford & Oliveira		QLD	McLeod <i>et al.</i> , (1994)	YES
91.	<i>Rotylenchus gracilidens</i> Linford & Oliveira		VIC	McLeod <i>et al.</i> , (1994)	YES
92.	<i>Rotylenchus robustus</i> (de Man) Filipjev		NSW	McLeod <i>et al.</i> , (1994)	YES
93.	<i>Scutellonema brachyurum</i> (Ateiner) Andrásy		QLD VIC	McLeod <i>et al.</i> , (1994) McLeod <i>et al.</i> , (1994)	YES
94.	<i>Tylenchorchynchus</i> sp.		NSW VIC	McLeod <i>et al.</i> , (1994) McLeod <i>et al.</i> , (1994)	YES
95.	<i>Tylenchorchynchus capitatus</i> Allen		QLD	McLeod <i>et al.</i> , (1994)	YES
96.	<i>Tylenchulus semipenetrans</i> (Cobb) Geraert		SA	McLeod <i>et al.</i> , (1994)	YES
97.	<i>Tylenchus</i> sp.		NSW	McLeod <i>et al.</i> , (1994)	YES
98.	<i>Xiphinema ameriakanum</i> Cobb.		WA SA	McLeod <i>et al.</i> , (1994) McLeod <i>et al.</i> , (1994)	NO
99.	<i>Xiphinema brevicolle</i> Lordello & da Costa		QLD NSW	McLeod <i>et al.</i> , (1994) McLeod <i>et al.</i> , (1994)	YES
100.	<i>Xiphinema elongatum</i> Sch. Stekhoven & Teunissen		NSW VIC	McLeod <i>et al.</i> , (1994) McLeod <i>et al.</i> , (1994)	YES
101.	<i>Xiphinema monohysterum</i> Brown		QLD	McLeod <i>et al.</i> , (1994)	YES
102.	<i>Xiphinema obtusa</i> Thorne		NSW	McLeod <i>et al.</i> , (1994)	YES
103.	<i>Xiphinema radicola</i> Goodey		SA NSW	McLeod <i>et al.</i> , (1994) McLeod <i>et al.</i> , (1994)	YES

Table 15a: Categorisation of Insects and Mites associated with stone fruit in Australia (presence on pathway)

Classification	Scientific name	Common name	Present on pathway	Comment	Pathway association	Reference	Eligible for further consideration
Acari							
1.	Tarsonemidae <i>Tarsonemus waitiei</i>	Fungus mite	YES	In association with sooty mould		Smith <i>et al.</i> (1997)	YES
2.	Tetranychidae <i>Panonychus ulmi</i>	European red mite	YES	Adults and nymphs can feed on fruit, leaves, stems and bark.		Hely <i>et al.</i> (1982)	YES
Araneida							
3.	Araneidae <i>Celaenia excavata</i>	Orchard spider	NO	Lives on foliage		Child (1977)	NO
Coleoptera							
4.	Chrysomelidae <i>Altica corusca</i> (<i>Haltica corrusca</i>)	Metallic flea beetle	NO	Highly mobile leaf eater		Hely <i>et al.</i> (1982)	NO
5.	<i>Cryptocephalus</i> sp.	Cryptocephalus beetle	NO	Adults feed on foliage, larvae feed on leaf litter		Lawrence <i>et al.</i> (1994)	NO
6.	Curculionidae <i>Leptopius squalidus</i>	Fruit tree root weevil	NO	Larvae feed on roots, adults feed on roots		Hely <i>et al.</i> (1982)	NO
7.	<i>Orthorhinus klugi</i>	Vine weevil	NO	Larvae are wood boring		Hely <i>et al.</i> (1982)	NO
8.	<i>Otiorhynchus sulcatus</i>	Black vine weevil	NO	Larvae feed on roots, adults feed on foliage		Kerruish (1997)	NO
9.	<i>Perperus</i> spp	Apple root weevils	NO	Larvae feed on roots, adults feed on buds & foliage		Hely <i>et al.</i> (1982)	NO
10.	Elatерidae <i>Conoderus</i> sp	Click beetle/wireworm	NO	Larvae feed underground, adults can visit flowers		Matthews (1985)	NO

Table 15a (con't.): Categorisation of Insects and Mites associated with stone fruit in Australia (presence on pathway)

Classification	Scientific name	Common name	Present on pathway	Comment	Pathway association	Reference	Eligible for further consideration
11.	Melyridae <i>Carphurus</i> sp.	Carphurus beetle	NO	Adults and larvae are predatory, adults often found in flowers		Matthews (1992)	NO
12.	Lathridiidae <i>Corticaria</i> sp.	Mould beetles	NO	Adults feed on moulds within the canopy		Matthews (1992)	NO
13.	Nitidulidae <i>Haptoncura imperialis</i>	Nitidulid beetle	NO	Recorded from peach, limited information available in the literature indicate this genus is of little or no economic significance		Baker (1998) Masters (1885-1887)	NO
14.	<i>Haptoncura lindensis</i>	Nitidulid beetle	NO	Recorded from peach, limited information available in the literature indicate this genus is of little or no economic significance		Baker (1998) Masters (1885-1887)	NO
15.	Scarabaeidae <i>Clambus</i> sp.	Clambus beetle	NO	Genus feeds on leaf litter		Matthews (1987b)	NO
16.	<i>Diphucephala colaspidoidea</i>	Green scarab beetle	NO	Adults usually found in flowers, larvae feed on roots and humus		Matthews (1984)	NO
17.	<i>Heteronyx</i> sp.	Honey beetle	NO	Adults feed on foliage, larvae feed on roots.		Lawrence <i>et al.</i> (1994)	NO
Diptera							
18.	Tephritidae <i>Bactrocera tryoni</i>	Queensland fruit fly	YES	Larvae feed internally on fruit		Hancock <i>et al.</i> (2000)	YES
19.	<i>Bactrocera cucumis</i>	Cucumber fly	YES	Larvae feed internally on fruit		Hancock <i>et al.</i> (2000)	YES
20.	<i>Bactrocera kraussi</i>	Krauss' fruit fly	YES	Larvae feed internally on fruit		Hancock <i>et al.</i> (2000)	YES
21.	<i>Bactrocera mayi</i>		YES	Larvae feed internally on fruit		Hancock <i>et al.</i> (2000)	YES

Table 15a (con't.): Categorisation of Insects and Mites associated with stone fruit in Australia (presence on pathway)

Classification	Scientific name	Common name	Present on pathway	Comment	Pathway association	Reference	Eligible for further consideration
22.	<i>Bactrocera melas</i>		YES	Larvae feed internally on fruit		Hancock <i>et al.</i> (2000)	YES
23.	<i>Bactrocera neohumeralis</i>	Lesser Queensland fruit fly	YES	Larvae feed internally on fruit		Hancock <i>et al.</i> (2000)	YES
Hemiptera							
24.	Aphididae <i>Myzus ascalonicus</i>	Shallot aphid	NO	Prunus not considered host genus		Blackman <i>et al.</i> (1985)	NO
25.	<i>Myzus cerasi</i>	Cherry aphid	YES	Aphid can be present on fruit		McLaren <i>et al.</i> (1999)	YES
26.	Cicadellidae <i>Exitanus capicala</i>	Leafhopper	NO	Adults and larvae of genus feed exclusively on grasses.		Fletcher (2000)	NO
27.	Cicadidae <i>Melampsalta</i> sp.	Black cicada	NO	Oviposition damage to wood		Greenup (1967)	NO
28.	Coccidae <i>Eulecanium tiliae</i>	Coccid scale	YES	Dispersing crawlers may be found on fruit		Pfeiffer (1997)	YES
29.	<i>Parthenolecanium corni</i>	European fruit scale	YES	Dispersing crawlers may be found on fruit		Pfeiffer (1997)	YES
30.	<i>Pulvinaria hydrangeae</i>	Hydrangea scale	YES	Scale attacks wood, although dispersing crawlers may be found on fruit		Pfeiffer (1997)	YES
31.	Diaspididae <i>Pseudaulacaspis pentagona</i>	Peach white scale	YES	Scale attacks wood, leaves and fruit		Hely <i>et al.</i> (1982)	YES
32.	<i>Quadraspidotus ostreaeformis</i>	Oystershell scale	YES	Scale attacks wood and fruit		McLaren <i>et al.</i> (1999)	YES
33.	Lygaeidae <i>Plinthisus</i> sp.	Lygaeid bug	NO	A flightless minute species feeding on seed litter		Carver <i>et al.</i> (1991)	NO

Table 15a (con't.): Categorisation of Insects and Mites associated with stone fruit in Australia (presence on pathway)

Classification	Scientific name	Common name	Present on pathway	Comment	Pathway association	Reference	Eligible for further consideration
34. Miridae	<i>Tayloriyygus pallidulus</i>	Brokenback bug	NO	Species feed on immature fruit	Species feed on immature fruit	Brough <i>et al.</i> (1996)	NO
35. Pseudococcidae	<i>Phenacoccus graminicola</i> (<i>Phenacoccus graminiosus</i>)	Ryegrass mealybug	YES	Although grasses are the primary host, the species has been recorded on <i>Malus</i> fruit, also <i>Prunus</i> and <i>Pyrus</i>	Although grasses are the primary host, the species has been recorded on <i>Malus</i> fruit, also <i>Prunus</i> and <i>Pyrus</i>	Cox (1987) Ward (1966)	YES
36. Pseudococcidae	<i>Pseudococcus calceolariae</i>	Citrophilus mealybug	YES	Species may be found at calyx and stem end of fruit	Species may be found at calyx and stem end of fruit	McLaren <i>et al.</i> (1999)	YES
37. Ricaniidae	<i>Scolypopa australis</i>	Passionvine hopper	NO	Adults and nymphs feed from leaves	Adults and nymphs feed from leaves	Hely <i>et al.</i> (1982)	NO
Hymenoptera							
38. Formicidae	<i>Solenopsis froggatti</i>	Ant	NO	Genus is considered cryptic i.e. foraging almost exclusively within the soil & litter.	Genus is considered cryptic i.e. foraging almost exclusively within the soil & litter.	Andersen (1991)	NO
Lepidoptera							
39. Cossidae	<i>Macrocystitara expressa</i>	Wood moth	NO	Larvae are wood boring	Larvae are wood boring	Common (1990)	NO
40. Limacodidae	<i>Doratifera</i> spp.	Cup moth	NO	Larvae are foliovores	Larvae are foliovores	Common (1990)	NO
41. Lymantriidae	<i>Euproctis paradoxa</i> (<i>Porthesia paradoxa</i>)	Tussock moth	YES	Larvae can graze fruit near stem	Larvae can graze fruit near stem	Hely <i>et al.</i> (1982)	YES
42. Noctuidae	<i>Teia anartoides</i> (<i>Orgyia anartoides</i>)	Painted apple moth	NO	Larvae are leaf feeders but green fruit can be grazed	Larvae are leaf feeders but green fruit can be grazed	Hely <i>et al.</i> (1982)	NO
43. Noctuidae	<i>Helicoverpa</i> spp.	Budworm	NO	Larvae feed on immature fruit	Larvae feed on immature fruit	Hely <i>et al.</i> (1982)	NO
44. Oecophoridae	<i>Cryptophasa albacosta</i>	Small fruit-tree borer	NO	Larvae are wood boring	Larvae are wood boring	Common (1990)	NO

Table 15a (con't.): Categorisation of Insects and Mites associated with stone fruit in Australia (presence on pathway)

Classification	Scientific name	Common name	Present on pathway	Comment	Pathway association	Reference	Eligible for further consideration
45.	<i>Cryptophasa</i> sp.	Fruit-tree borer	NO	Larvae are wood boring		Common (1990)	NO
46.	<i>Maroga melanostigma</i> (<i>Cryptophasa melanostigma</i>)	Fruit tree borer	NO	Larvae are wood boring		Hely <i>et al.</i> (1982)	NO
47.	Tortricidae <i>Cydia pomonella</i>	Codling moth	YES	Larvae feed internally on fruit		Hely <i>et al.</i> (1982)	YES
48.	<i>Grapholita molesta</i>	Oriental fruit moth	YES	Larvae feed internally on fruit		Hely <i>et al.</i> (1982)	YES
49.	<i>Isotenes miserana</i>	Orange fruit borer	YES	Larvae feed on maturing fruit		Common (1990)	YES
Orthoptera							
50.	Tettigoniidae <i>Caedicia strenua</i>	Citrus katydid	YES	Adults attack mature stone fruit		Hely <i>et al.</i> (1982)	YES
Thysanoptera							
51.	Thripidae <i>Chaetanaphothrips</i> sp.		NO	This South Australian record was of a single specimen collected in a Riverland peach orchard in the 1980's. No further collections have been made of thrips of this genus in South Australia		Cartwright (2000)	NO
52.	<i>Desmothrips propinquus</i>	Desmothrips	NO	Adults and larvae found in flowers		Mound <i>et al.</i> (1997)	NO

Table 15b: Categorisation of plant pathogens associated with stone fruit in Australia (presence on pathway)

Classification	Scientific name	Common name	Present on pathway	Comment	Pathway association	Reference	Eligible for further consideration
Bacteria							
1.	<i>Pseudomonas syringae</i> pv. <i>Morsprunorum</i>	Bacterial canker	YES	Infection found on fruit		Foulkes & Lloyd (1980)	YES
2.	<i>Pseudomonas viridiflava</i>		NO	Infection recorded on leaves		Moffett (1983)	NO
Fungi							
3.	<i>Blumeriella jaapii</i>	Cherry leaf spot	YES	Low levels of infection on fruit		Jones (1995)	YES
4.	<i>Botryosphaeria stevensii</i>	Twig blister	NO	Not a common disease of stone fruit		AQIS (1998)	NO
5.	<i>Cercospora circumscissa</i>	Cercospora leaf spot	YES	Rare infections of fruit & spurs		McAlpine (1902)	YES
6.	<i>Chondrostereum purpureum</i>	Silver leaf	NO	No infections on fruits		Tate (1995)	NO
7.	<i>Eutypa lata</i>	Eutypa canker	NO	No infections on fruits		Carter (1995)	NO
8.	<i>Leucostoma cinctum</i>	Leucostoma canker	NO	No infections on fruits		Biggs (1995)	NO
9.	<i>Phytophthora syringae</i> (Kleb.) Kleb.	Canker, crown and root rot	NO	A soil pathogen attacking roots and crowns of a wide range of plants		Bielenin & Jones (1988)	NO
10.	<i>Podosphaera tridactyla</i>	Powdery mildew	YES	Infection and inoculum may be present on fruit other than cherries		Grove (1995)	YES
11.	<i>Rhizopus arrhizus</i>	Fruit rot	YES	Causes infection in storage		Zehr (1995)	YES
12.	<i>Taphrina pruni</i>	Plum pockets	YES	Fruit infections are known		Hickey (1995)	YES

Table 15b (con't): Categorisation of plant pathogens associated with stone fruit in Australia (Presence on pathway)

Classification	Scientific name	Common name	Present on pathway	Comment	Pathway association	Reference	Eligible for further consideration
13.	<i>Taphrina wiesneri</i>	Cherry leaf curl	YES	Rare fruit infection reported		Pscheidt (1995)	YES
14.	<i>Venturia cerasi</i>	Cherry scab	YES	Rare fruit infection reported		Hendrix (1995)	YES
Nematodes							
15.	<i>Belonolaimus</i> sp.		NO	Soil pathogen, may be present on roots			NO
16.	<i>Coslenchus costatus</i>		NO	Soil pathogen, may be present on roots			NO
17.	<i>Criconema</i> sp.		NO	Soil pathogen, may be present on roots			NO
18.	<i>Filenchus</i> sp.		NO	Soil pathogen, may be present on roots			NO
19.	<i>Ditylenchus</i> sp.		NO	Soil pathogen, may be present on roots			NO
20.	<i>Ditylenchus anchilispomus</i>		NO	Soil pathogen, may be present on roots			NO
21.	<i>Helicotylenchus</i> sp.		NO	Soil pathogen, may be present on roots			NO
22.	<i>Helicotylenchus dihystrera</i>		NO	Soil pathogen, may be present on roots			NO
23.	<i>Helicotylenchus multincinctus</i>		NO	Soil pathogen, may be present on roots			NO
24.	<i>Hemicycliophora iwia</i>		NO	Soil pathogen, may be present on roots			NO

Table 15b (con't): Categorisation of plant pathogens associated with stone fruit in Australia (Presence on pathway)

Classification	Scientific name	Common name	Present on pathway	Comment	Pathway association	Reference	Eligible for further consideration
25.	<i>Hemicyliophora truncata</i>		NO	Soil pathogen, may be present on roots			NO
26.	<i>Hemicyliophora typica</i>		NO	Soil pathogen, may be present on roots			NO
27.	<i>Longidorus</i> sp.		NO	Soil pathogen, may be present on roots			NO
28.	<i>Macroposthonia curvata</i>		NO	Soil pathogen, may be present on roots			NO
29.	<i>Macroposthonia ornata</i>		NO	Soil pathogen, may be present on roots			NO
30.	<i>Macroposthonia similis</i>		NO	Soil pathogen, may be present on roots			NO
31.	<i>Macroposthonia teres</i>		NO	Soil pathogen, may be present on roots			NO
32.	<i>Meloidogyne arenaria</i>		NO	Soil pathogen, may be present on roots			NO
33.	<i>Meloidogyne incognita</i>		NO	Soil pathogen, may be present on roots			NO
34.	<i>Merlinius brevidens</i>		NO	Soil pathogen, may be present on roots			NO
35.	<i>Neopsilenchus magnidens</i>		NO	Soil pathogen, may be present on roots			NO
36.	<i>Paratrachodorius lobatus</i>		NO	Soil pathogen, may be present on roots			NO

Table 15b (con't): Categorisation of plant pathogens associated with stone fruit in Australia (Presence on pathway)

Classification	Scientific name	Common name	Present on pathway	Comment	Pathway association	Reference	Eligible for further consideration
37.	<i>Paratrichodorus minor</i>		NO	Soil pathogen, may be present on roots			NO
38.	<i>Paratrichodorus prorsus</i>		NO	Soil pathogen, may be present on roots			NO
39.	<i>Pratylenchus hamatus</i>		NO	Soil pathogen, may be present on roots			NO
40.	<i>Pratylenchus nanus</i>		NO	Soil pathogen, may be present on roots			NO
41.	<i>Pratylenchus projectus</i>		NO	Soil pathogen, may be present on roots			NO
42.	<i>Pratylenchus brachyurus</i>		NO	Soil pathogen, may be present on roots			NO
43.	<i>Pratylenchus coffeae</i>		NO	Soil pathogen, may be present on roots			NO
44.	<i>Pratylenchus crenatus</i>		NO	Soil pathogen, may be present on roots			NO
45.	<i>Pratylenchus neglectus</i>		NO	Soil pathogen, may be present on roots			NO
46.	<i>Pratylenchus vulvius</i>		NO	Soil pathogen, may be present on roots			NO
47.	<i>Pratylenchus zeae</i>		NO	Soil pathogen, may be present on roots			NO
48.	<i>Rotilenchus brevicaudatus</i>		NO	Soil pathogen, may be present on roots			NO

Table 15b (con't): Categorisation of plant pathogens associated with stone fruit in Australia (Presence on pathway)

Classification	Scientific name	Common name	Pathway association		Eligible for further consideration
			Present on pathway	Comment	
49.	<i>Rotylenchus gracilidens</i>		NO	Soil pathogen, may be present on roots	NO
50.	<i>Rotylenchus robustus</i>		NO	Soil pathogen, may be present on roots	NO
51.	<i>Scutellonema brachyurum</i>		NO	Soil pathogen, may be present on roots	NO
52.	<i>Tylenchorhynchus</i> sp.		NO	Soil pathogen, may be present on roots	NO
53.	<i>Tylenchorhynchus capitatus</i>		NO	Soil pathogen, may be present on roots	NO
54.	<i>Tylenchulus semipenetrans</i>		NO	Soil pathogen, may be present on roots	NO
55.	<i>Tylenchus</i> sp.		NO	Soil pathogen, may be present on roots	NO
56.	<i>Xiphinema brevicolle</i>		NO	Soil pathogen, may be present on roots	NO
57.	<i>Xiphinema elongatum</i>		NO	Soil pathogen, may be present on roots	NO
58.	<i>Xiphinema monohysterum</i>		NO	Soil pathogen, may be present on roots	NO
59.	<i>Xiphinema obtusa</i>		NO	Soil pathogen, may be present on roots	NO
60.	<i>Xiphinema radicum</i>		NO	Soil pathogen, may be present on roots	NO

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