Australian Government

Department of Agriculture, Water and the Environment

Final report for the review of biosecurity import requirements for fresh *Capsicum* spp. fruit from Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu

December 2021

Cataloguing data

This publication (and any material sourced from it) should be attributed as: DAWE 2021, *Final report for the review of biosecurity import requirements for fresh Capsicum spp. fruit from Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu*. Department of Agriculture, Water and the Environment, Canberra, December 2021. CC BY 4.0.

ISBN: 978-1-76003-498-6

This publication is available at awe.gov.au/biosecurity/risk-analysis/plant

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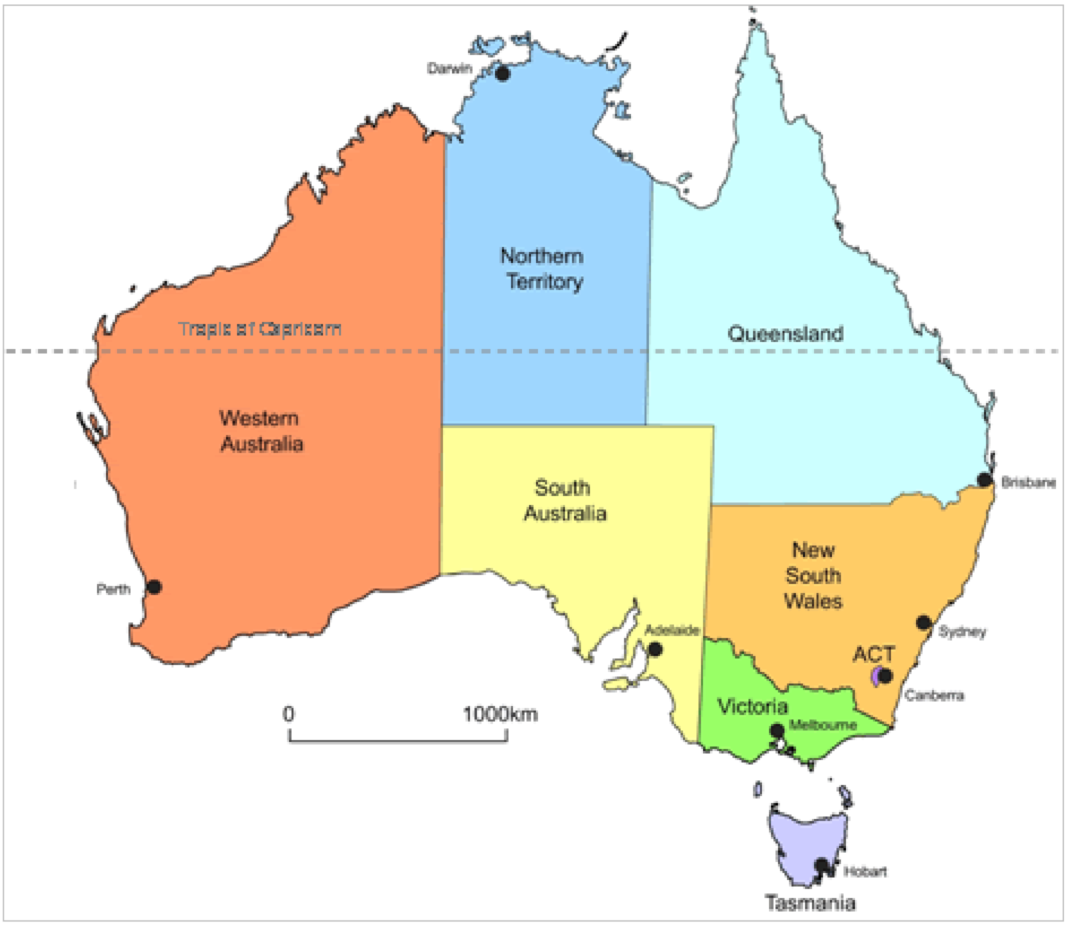

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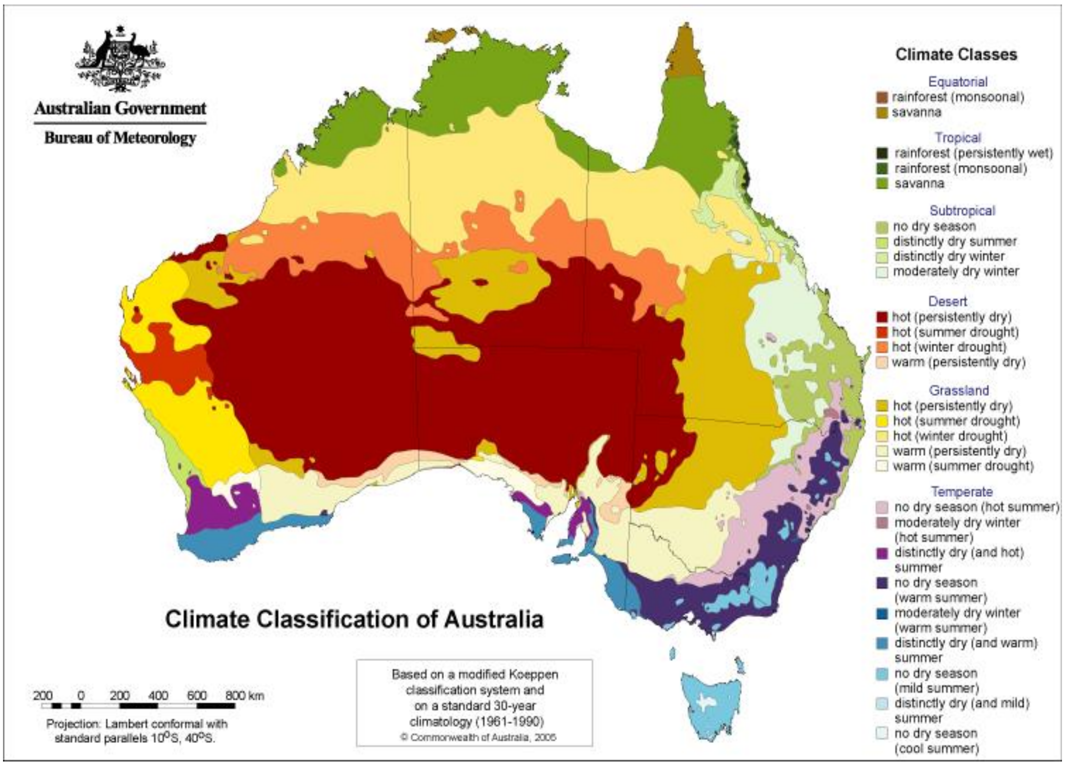

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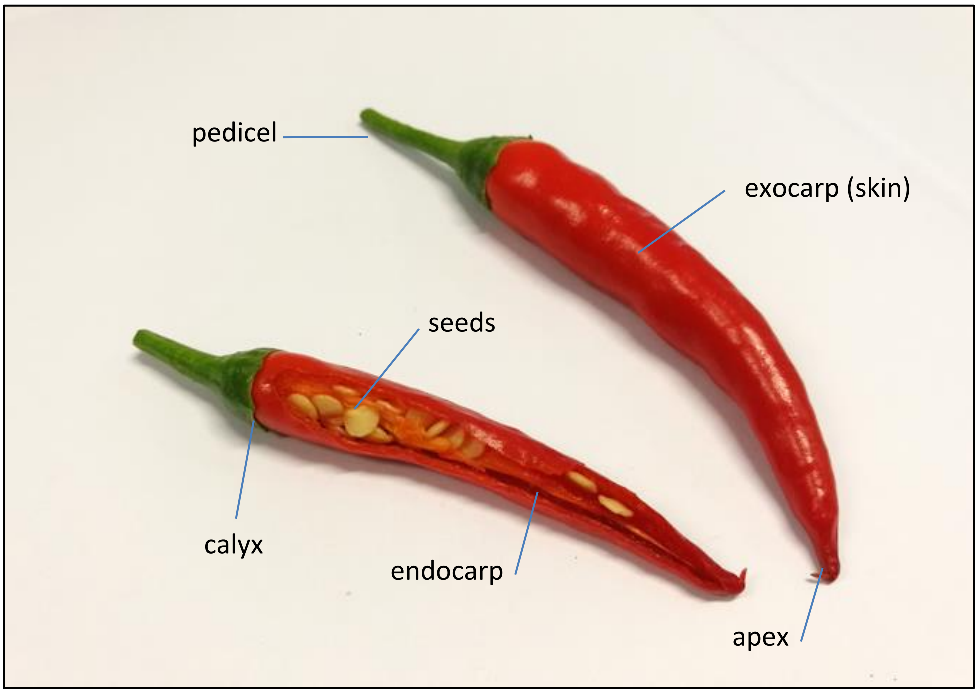

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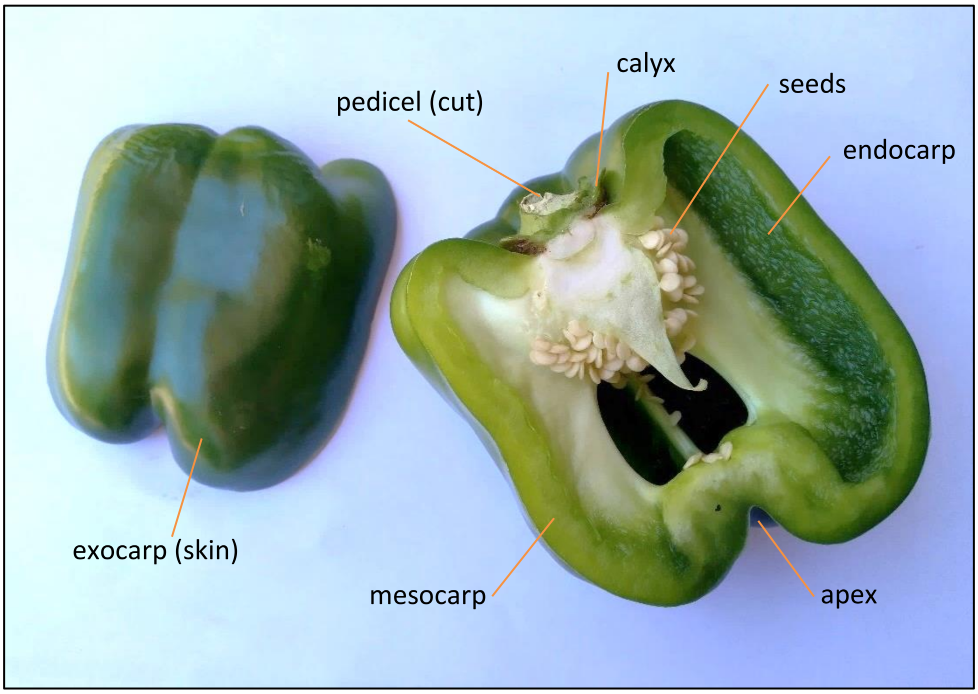


Source: Department of Agriculture, Water and the Environment

Acronyms and abbreviations

Term or abbreviation	Definition
ACT	Australian Capital Territory
ALOP	Appropriate level of protection
BA	Biosecurity Advice
BICON	Australia's Biosecurity Import Conditions System
BIRA	Biosecurity Import Risk Analysis
CSIRO	Commonwealth Scientific and Industrial Research Organisation
EP	Existing policy
FAO	Food and Agriculture Organization of the United Nations
IPPC	International Plant Protection Convention
ISPM	International Standard for Phytosanitary Measures
NSW	New South Wales
NPPO	National Plant Protection Organisation
NT	Northern Territory
PC	Phytosanitary certificate
PRA	Pest risk analysis
Qld	Queensland
SA	South Australia
spp.	Species plural. Two or more species
SPS Agreement	WTO agreement on the Application of Sanitary and Phytosanitary Measures
Tas.	Tasmania
the department	The Department of Agriculture, Water and the Environment
Vic.	Victoria
WA	Western Australia
WTO	World Trade Organization

Summary

The Department of Agriculture, Water and the Environment has prepared this final report to assess proposals by Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu for market access to Australia for fresh *Capsicum* spp. fruit (commonly referred to as chillies and capsicums) for human consumption.

Australia currently permits the importation of fresh capsicums (*Capsicum annuum*) and chillies (*C. annuum* and *C. frutescens*) from New Zealand, and greenhouse-grown capsicums and chillies (*C. annuum*) from the Republic of Korea for human consumption, provided they meet Australian biosecurity import conditions.

Australia previously imported fresh *Capsicum* spp. from Pacific Island countries (mostly from Fiji). However, trade was suspended in 1997 following a ban on the use of ethylene dibromide, which had been the phytosanitary treatment applied to mitigate the biosecurity risks associated with fruit flies. This assessment considers access for Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu, including alternative phytosanitary measures for fruit flies.

This final report recommends that the importation of fresh *Capsicum* spp. (chillies and capsicums) to Australia from all commercial production areas of Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu be permitted, subject to them meeting a range of biosecurity requirements, as summarised in this report.

This final report contains details of all known pests with the potential to be associated with the importation of fresh *Capsicum* spp. (chillies and capsicums) that may be of biosecurity concern to Australia. It also provides risk assessments for the identified quarantine pests and recommends risk management measures to reduce the biosecurity risk to an acceptable level.

Thirteen pests have been identified in this risk analysis as requiring risk management measures to reduce the biosecurity risk to an acceptable level. These pests are:

- fruit flies: oriental fruit fly (*Bactrocera dorsalis*), tropical fruit fly (*B. facialis*), fruit fly (*B. kirki*), Fijian fruit fly (*B. passiflorae*), New Guinea fruit fly (*B. trivialis*), Pacific fruit fly (*B. xanthodes*) and melon fly (*Zeugodacus cucurbitae*)
- whiteflies (*Bemisia tabaci* complex)
- mealybugs: Pacific mealybug (*Planococcus minor*) and Jack Beardsley mealybug (*Pseudococcus jackbeardsleyi*)
- thrips: chilli thrips (*Scirtothrips dorsalis*), melon thrips (*Thrips palmi*) and onion thrips (*T. tabaci*)

All 3 thrips species were assessed as regulated articles for all of Australia as they are capable of harbouring and spreading emerging orthotospoviruses that are quarantine pests for Australia, and therefore require risk management measures.

The recommended risk management measures take account of regional differences in pest distribution within Australia. Two pests requiring risk management measures, *P. minor* and *T. palmi*, have been identified as regional quarantine pests for Western Australia, and *T. palmi* has also been identified as a regional quarantine pest for South Australia because interstate quarantine restrictions and enforcement are in place for these species.

This final report recommends risk management measures, combined with an operational system, to ensure biosecurity standards are met. The recommended risk management measures will reduce the risks posed by the identified quarantine pests and regulated articles to achieve the appropriate level of protection for Australia. These measures are:

- For whiteflies, mealybugs and thrips:
  - pre-export visual inspection, and if found, remedial action, or
  - methyl bromide fumigation.
- For fruit flies:
  - area freedom (including pest free areas, pest free places of production or pest free production sites), or
  - fruit treatment considered to be effective against all life stages of fruit flies present in the exporting country, or
  - conditional non-host status for specific *Capsicum* spp. varieties and specific fruit fly species.

Written submissions on the draft report were received from 4 stakeholders. The department has made minor changes to the report following consideration of technical comments from stakeholders and subsequent review of literature. These changes include:

- amendments to text in Appendix A ‘Initiation and categorisation for pests of fresh *Capsicum* spp. fruit from Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu’ to update the distribution and pest status of some species
- the addition of Appendix B ‘Issues raised in stakeholder comments’, which summarises key stakeholder comments, and how they have been considered in this final report
- minor corrections, rewording and editorial changes for consistency and clarity.

1 Introduction

1.1 Australia's biosecurity policy framework

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

The risk analysis process is an important part of Australia's biosecurity policy development. It enables the Australian Government to formally consider the level of biosecurity risk that may be associated with proposals to import goods into Australia. If the biosecurity risks do not achieve the appropriate level of protection (ALOP) for Australia, risk management measures are recommended to reduce the risks to an acceptable level. If the risks cannot be reduced to an acceptable level, the goods will not be imported into Australia until suitable measures are identified or developed.

Successive Australian governments have maintained a stringent, but not a zero risk, approach to the management of biosecurity risks. This approach is expressed in terms of the ALOP for Australia, which is defined in the *Biosecurity Act 2015* as providing a high level of protection aimed at reducing risk to a very low level, but not to zero.

Australia's risk analyses are undertaken by the Department of Agriculture, Water and the Environment using technical and scientific experts in relevant fields and involve consultation with stakeholders at various stages during the process.

Risk analyses may take the form of a biosecurity import risk analysis (BIRA) or a review of biosecurity import requirements (such as scientific review of existing policy and import conditions, pest-specific assessments, weed risk assessments, biological control agent assessments or scientific advice).

Further information about Australia's biosecurity framework is provided in the *Biosecurity Import Risk Analysis Guidelines 2016* located on the Department of Agriculture, Water and the Environment website at https://www.awe.gov.au/biosecurity-trade/policy/risk-analysis/guidelines.

1.2 This risk analysis

1.2.1 Background

Australia historically imported small volumes of fresh fruit of various *Capsicum* species (*Capsicum* spp.) from Pacific Island countries (mostly from Fiji). However, trade was suspended in 1997 following a ban on the use of ethylene dibromide, which until that time had been the accepted phytosanitary treatment for mitigation of the biosecurity risks associated with fruit flies. Regaining market access for fresh *Capsicum* spp. with alternative phytosanitary measures has subsequently been a priority for a number of Pacific Island countries.

This risk analysis is reassessing the biosecurity risks associated with *Capsicum* spp. (commonly referred to as capsicums and chillies) from Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu (henceforth referred to as assessed Pacific Island countries), and considering appropriate phytosanitary measures to allow safe trade to resume.

Australia has received formal market access requests for fresh chillies from Fiji (2004 and 2012), Papua New Guinea (2017), Solomon Islands (2014) and Tonga (2013). Vanuatu (2006) and Samoa (2007) have also previously indicated interest in exporting chillies to Australia.

Fiji initially requested market access for fresh chillies on 1 July 2004, providing a pest list and details of the proposed production, pest management and export systems, and varieties proposed for export, specifically for varieties with a demonstrated non-host status for the fruit fly species present in Fiji. Fiji again requested market access in a new submission on 18 May 2012, for the same chilli varieties.

Australia currently has established conditions for the importation of fresh capsicums (*Capsicum annuum*) and chillies (*Capsicum annuum* and *Capsicum frutescens*) from New Zealand, and greenhouse-grown capsicums and chillies (*Capsicum annuum*) from the Republic of Korea.

A preliminary pest categorisation for *Capsicum* spp. from Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu indicated that the potential pests of biosecurity concern are the same, or of the same pest groups, as those associated with other horticultural commodities that have been assessed previously by the department, and for which risk management measures are established.

On 21 September 2018, the department notified stakeholders of the decision to progress a request for market access for fresh *Capsicum* spp. fruit from Pacific Island countries as a review of biosecurity import requirements. This analysis is conducted in accordance with the *Biosecurity Act 2015*.

Officers from the department visited major production areas in Fiji to observe the commercial production, pest management and export processes for fresh *Capsicum* spp. fruit. Officers have also observed commercial production of chillies and capsicums grown for domestic markets in Papua New Guinea, Solomon Islands, Tonga and Vanuatu.

1.2.2 Scope

The scope of this risk analysis is to consider the biosecurity risk that may be associated with the pathway of imported commercially produced fresh *Capsicum* spp. (commonly referred to as capsicums and chillies), from Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu, for human consumption in Australia. Although chillies are the main export focus, capsicums have also been assessed due to the similarity of the pest risks and the difficulty of distinguishing between the various closely related species, and high level of intraspecific variation.

The taxonomy of the *Capsicum* genus is contested, with disagreement over the total number of species (de Souza Macedo et al. 2017), even within the cultivated domesticated species (Zhigila et al. 2014). Five domesticated species are commonly recognised: *Capsicum annuum*, *C. baccatum*, *C. chinense, C. frutescens* and *C. pubescens*, although *Capsicum frutescens* is sometimes considered to be a synonym of *Capsicum annuum* (Zhang, Lu & D'Arcy 1994; Zhigila et al. 2014). The assessment will therefore consider these 5 domesticated *Capsicum* species.

Other non-domesticated *Capsicum* species are excluded from the assessment as there is insufficient information available on pests and diseases to assess the biosecurity risks – such species are unlikely to be grown commercially in the Pacific Islands for export.

In this risk analysis, fresh *Capsicum* spp. fruit are defined as individual fruit with a small amount of pedicel (stem) and excluding leaves (Figure 1 and 2). This risk analysis covers all commercially produced varieties of fresh *Capsicum annuum*, *C. baccatum*, *C. chinense*, *C. frutescens* and *C. pubescens* from all regions of Fiji (except for the island of Rotuma), Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu in which they are grown for export.

1.2.3 Existing policy

International policy

Australia permits the importation of fresh capsicums (*Capsicum annuum*) and chillies (*Capsicum annuum* and *Capsicum frutescens*) from New Zealand and greenhouse-grown capsicums and chillies (*Capsicum annuum*) from the Republic of Korea.

Risk analyses for other commodities include assessments of some pests, and all pest groups identified as potential pests of fresh *Capsicum* spp. fruit in the assessed Pacific Island countries. These import policies include fresh breadfruit from Fiji, Samoa and Tonga (Department of Agriculture 2019), papaya from Fiji (Biosecurity Australia 2002), apples from China (Biosecurity Australia 2010), lychee fruit from Taiwan and Vietnam (DAFF 2013b) and island cabbage leaves from the Cook Islands, Fiji, Samoa, Tonga and Vanuatu (DAFF 2013a).

The import requirements for these commodity pathways can be found in the department's Biosecurity Import Conditions (BICON) system on the department's website at https://bicon.agriculture.gov.au/BiconWeb4.0.

The department has considered all the pests and pest groups identified in previous policies and, where relevant, the information in those assessments has been taken into consideration in this risk analysis. The department has also reviewed the latest scientific literature and other information to ensure that the previous assessments are still valid.

The biosecurity risk posed by thrips and the orthotospoviruses they transmit was previously assessed for all countries in the *Final group pest risk analysis for thrips and orthotospoviruses on fresh fruit, vegetable, cut-flower and foliage imports* (thrips Group PRA) (DAWR 2017). Similarly, the biosecurity risk posed by mealybugs and the viruses they transmit was previously assessed for all countries in the *Final group pest risk analysis for mealybugs and the viruses they transmit on fresh fruit, vegetable, cut-flower and foliage imports* (mealybugs Group PRA) (DAWR 2019). These group policies are applicable for *Capsicum* spp. from the assessed Pacific Island countries. The department has determined that the information in those assessments can be adopted for the species under consideration in this risk analysis.

Domestic arrangements

The Australian Government is responsible for regulating the movement of goods, such as plants and plant products into and out of Australia. However, the state and territory governments are responsible for plant health controls within their individual jurisdiction. Legislation relating to resource management or plant health may be used by state and territory government agencies to control interstate movement of plants and their products. After imported plants and plant products have been cleared by Australian Government biosecurity officers, they may be subject to interstate movement regulations. It is the importer's responsibility to identify and ensure compliance with all requirements.

1.2.4 Contaminating pests

In addition to the pests of *Capsicum* spp. fruit from the assessed Pacific Island countries that are assessed in this risk analysis, there are other organisms that may arrive with the imported commodity. These organisms could include pests considered not to be associated with the fruit pathway, pests of other crops, or predators and parasitoids of other arthropods. The department considers these organisms to be contaminating pests that could pose sanitary risks (to human or animal life or health) or phytosanitary risks (to plant life or health). These risks are identified and addressed using existing operational procedures that require an inspection of all consignments during processing and preparation for export. Consignments will also undergo another inspection on arrival in Australia. The department will investigate if any pest identified through these processes is of biosecurity concern to Australia and thus may require remedial action.

1.2.5 Consultation

On 21 September 2018, the department notified stakeholders in Biosecurity Advice 2018/23, of the commencement of a review of biosecurity import requirements for fresh *Capsicum* spp. fruit from Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu for market access to Australia.

Prior to, and after the commencement of this risk analysis, the department engaged with AUSVEG and Growcom regarding the process and technical aspects of this risk analysis.

The department has also consulted with the Fijian and Papua New Guinean governments and Australian state and territory governments during the preparation of this report.

The draft report was released on 16 April 2021 (Biosecurity Advice 2021-P07) for a 60-day stakeholder consultation period that concluded on 15 June 2021.

The department received 4 written submissions on the draft report. All submissions received, and technical issues raised by stakeholders throughout the risk analysis process, were carefully considered, and where relevant, changes were made in this final report. A summary of key technical stakeholder comments and how they were considered is provided in Appendix B.

1.2.6 Next Steps

The final report will be published on the department's website along with a notice advising stakeholders of the release. The department will also notify the proposers, the registered stakeholders and the WTO Secretariat about the release of the final report. Publication of the final report represents the end of the risk analysis process.

Before any trade in *Capsicum* spp. fruit commences, the department will verify that Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu can implement the required pest risk management measures, and the systems of operational procedures necessary to maintain and verify the phytosanitary status of *Capsicum* spp. fruit for export to Australia (as specified in Chapter 5: 'Pest risk management' of this report). On verification of these requirements, the import conditions for *Capsicum* spp. fruit will be published in the department's Biosecurity Import Conditions (BICON) system.

2 Method for pest risk analysis

This chapter sets out the method used for the pest risk analysis (PRA) in this report. The Department of Agriculture, Water and the Environment has conducted this PRA in accordance with the International Standards for Phytosanitary Measures (ISPMs), including ISPM 2: *Framework for pest risk analysis* (FAO 2021a) and ISPM 11: *Pest risk analysis for quarantine pests* (FAO 2021f) that have been developed under the SPS Agreement (WTO 1995).

A PRA is 'the process of evaluating biological or other scientific and economic evidence to determine whether an organism is a pest, whether it should be regulated, and the strength of any phytosanitary measures to be taken against it' (FAO 2021c). A pest is 'any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products' (FAO 2021c). This definition is also applied in the *Biosecurity Act 2015*.

Biosecurity risk consists of 2 major components: the likelihood of a pest entering, establishing and spreading in Australia from imports; and the consequences should this happen. These 2 components are combined to give an overall estimate of the risk.

Unrestricted risk is estimated taking into account the existing commercial production practices of the exporting country and recognition that, on arrival in Australia, the department will verify that the consignment received is as described on the commercial documents and its integrity has been maintained.

Restricted risk is estimated with phytosanitary measure(s) applied. A phytosanitary measure is 'any legislation, regulation or official procedure having the purpose to prevent the introduction and/or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests' (FAO 2021c).

A glossary of the terms used in the risk analysis is provided at the end of this report.

The PRAs are conducted in the following 3 consecutive stages: initiation, pest risk assessment and pest risk management.

2.1 Stage 1 Initiation

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

Appendix A of this risk analysis report lists the pests with the potential to be associated with the exported commodity. This list is not intended to provide a comprehensive list of all pests associated with the entire plant. Contaminating pests that have no specific relation to the commodity or the export pathway have not been listed and would be addressed by Australia's current approach to contaminating pests.

The identity of the pests is given in Appendix A. The species name is used in most instances, but a lower taxonomic level is used where appropriate. Synonyms are provided where the current scientific name differs from that provided by the exporting country's National Plant Protection Organisation (NPPO) or where the cited literature used a different scientific name.

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

For pests that had been considered by the department in other risk assessments and for which import conditions already exist, this risk analysis considers the likelihood of entry of pests on the commodity and whether existing policy is adequate to manage the risks associated with its import. Where appropriate, the previous risk assessment was taken into consideration in this risk analysis. The outcomes of group pest risk analyses for thrips and mealybugs have also been adopted for this report, as explained in Section 2.2.7.

2.2 Stage 2 Pest risk assessment

A pest risk assessment (for quarantine pests) is the 'evaluation of the probability of the introduction and spread of a pest and of the magnitude of the associated potential economic consequences' (FAO 2021c).

The following 3, consecutive steps were used in pest risk assessment:

2.2.1 Pest categorisation

Pest categorisation identifies which of the pests with the potential to be on the commodity are quarantine pests for Australia and require pest risk assessment. A 'quarantine pest' is a pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled (FAO 2021c).

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

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

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

2.2.2 Assessment of the probability of entry, establishment and spread

Details of how to assess the 'probability of entry', 'probability of establishment' and 'probability of spread' of a pest are given in ISPM 11 (FAO 2021f). The SPS Agreement (WTO 1995) uses the term 'likelihood' rather than 'probability' for these estimates. In qualitative PRAs, the department uses the term 'likelihood' for the descriptors it uses for its estimates of likelihood of entry, establishment and spread. The use of the term 'probability' is limited to the direct quotation of ISPM definitions.

A summary of this process is given here, followed by a description of the qualitative methodology used in this risk analysis.

Likelihood of entry

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

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

For the purpose of considering the likelihood of entry, the department divides this step into 2 components:

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

Factors to be considered in the likelihood of importation may include:

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

Factors to be considered in the likelihood of distribution may include:

- commercial procedures (for example, refrigeration) applied to consignments during distribution in Australia
- dispersal mechanisms of the pest, including vectors, to allow movement from the pathway to a host
- whether the imported commodity is to be sent to a few or many destination points in the PRA area

- proximity of entry, transit and destination points to hosts
- time of year at which import takes place
- intended use of the commodity (for example, for planting, processing or consumption)
- risks from by-products and waste.

Likelihood of establishment

Establishment is defined as the 'perpetuation for the foreseeable future, of a pest within an area after entry' (FAO 2021c). In order to estimate the likelihood of establishment of a pest, reliable biological information (for example, lifecycle, host range, epidemiology, survival) is obtained from the areas where the pest currently occurs. The situation in the PRA area can then be compared with that in the areas where it currently occurs and expert judgement used to assess the likelihood of establishment.

Factors to be considered in the likelihood of establishment in the PRA area may include:

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

Likelihood of spread

Spread is defined as 'the expansion of the geographical distribution of a pest within an area' (FAO 2019). The likelihood of spread considers the factors relevant to the movement of the pest, after establishment on a host plant or plants, to other susceptible host plants of the same or different species in other areas. In order to estimate the likelihood of spread of the pest, reliable biological information is obtained from areas where the pest currently occurs. The situation in the PRA area is then carefully compared with that in the areas where the pest currently occurs and expert judgement used to assess the likelihood of spread.

Factors to be considered in the likelihood of spread may include:

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

Assigning likelihoods for entry, establishment and spread

Likelihoods are assigned to each step of entry, establishment and spread. Six descriptors are used: high; moderate; low; very low; extremely low; and negligible. Definitions for these descriptors and their indicative probability ranges are given in Table 2.1. The indicative probability ranges are only provided to illustrate the boundaries of the descriptors and are not used beyond this purpose in qualitative PRAs. These indicative probability ranges provide guidance to the risk analyst and promote consistency between different pest risk assessments.

Table 2.1 Nomenclature of likelihoods

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

Combining likelihoods

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

For example, if the likelihood of importation is assigned a descriptor of 'low' and the likelihood of distribution is assigned a descriptor of 'moderate', then they are combined to give a likelihood of 'low' for entry. The likelihood for entry is then combined with the likelihood assigned for establishment of 'high' to give a likelihood for entry and establishment of 'low'. The likelihood for entry and establishment is then combined with the likelihood assigned for spread of 'very low' to give the overall likelihood for entry, establishment and spread of 'very low'. This can be summarised as:

importation x distribution = entry [E] **low x moderate = low**

entry x establishment = [EE] **low x high = low**

[EE] x spread = [EES] **low x very low = very low**

Table 2.2 Matrix of rules for combining likelihoods

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

Time and volume of trade

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

The department normally considers the likelihood of entry on the basis of the estimated volume of 1 year's trade. This is a convenient value for the analysis that is relatively easy to estimate and allows for expert consideration of seasonal variations in pest presence, incidence and behaviour to be taken into account. The consideration of the likelihood of entry, establishment and spread and subsequent consequences takes into account events that might happen over a number of years even though only 1 year's volume of trade is being considered. This difference reflects biological and ecological facts, for example where a pest or disease may establish in the year of import but spread may take many years.

The use of a 1-year volume of trade has been taken into account when setting up the matrix that is used to estimate the risk and therefore any policy based on this analysis does not simply apply to 1 year of trade. Policy decisions that are based on the department's method that uses the estimated volume of 1 year's trade are consistent with Australia's policy on appropriate level of protection and meet the Australian Government's requirement for ongoing biosecurity protection. If there are substantial changes in the volume and nature of the trade in specific commodities then the department will review the risk analysis and, if necessary, provide updated policy advice.

In assessing the volume of trade in this risk analysis, the department assumed that a modest volume of trade will occur.

2.2.3 Assessment of potential consequences

The objective of the consequence assessment is to provide a structured and transparent analysis of the potential consequences if the pests or disease agents were to enter, establish and spread in Australia. The assessment considers direct and indirect pest effects and their economic and environmental consequences. The requirements for assessing potential consequences are given in Article 5.3 of the SPS Agreement (WTO 1995), ISPM 5 (FAO 2021c) and ISPM 11 (FAO 2021f).

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

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

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

- eradication, control
- domestic trade
- international trade
- non-commercial and environmental.

For each of these 6 criteria, the consequences were estimated over 4 geographic levels, defined as:

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

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

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

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

For each criterion, the magnitude of the potential consequence at each of these levels was described using 4 categories, defined as:

Indiscernible—pest impact unlikely to be noticeable.

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

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

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

The estimates of the magnitude of the potential consequences over the 4 geographic levels were translated into a qualitative impact score (A-G) using Table 2.3. For example, a consequence with a magnitude of 'significant' at the 'district' level will have a consequence impact score of D.

Table 2.3 Decision rules for determining the consequence impact score based on the magnitude of consequences at 4 geographic scales

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

Note: In earlier qualitative PRAs, the scale for the impact scores went from A to F and did not explicitly allow for the rating 'indiscernible' at all 4 levels. This combination might be applicable for some criteria. In this report, the impact scale of A to F has been changed to become B-G and a new lowest category A ('indiscernible' at all 4 levels) was added. The rules for combining impacts in Table 2.4 were adjusted accordingly.

The overall consequence for each pest is achieved by combining the qualitative impact scores (A–G) for each direct and indirect consequence using a series of decision rules (Table 2.4). These rules are mutually exclusive and are assessed in numerical order until 1 applies.

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

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

2.2.4 Estimation of the unrestricted risk

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

Table 2.5 Risk estimation matrix

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

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

2.2.5 The appropriate level of protection (ALOP) for Australia

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

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

2.2.6 Adoption of outcomes from previous assessments

Outcomes of previous risk assessments have been adopted in this assessment for pests for which the risk profile is assessed as comparable to previously assessed situations.

The prospective adoption of previous risk assessment ratings is considered on a case-by-case basis by comparing factors relevant to the current commodity/country pathway with those assessed previously. For assessment of the likelihood of importation, factors considered/compared include the commodity type, the prevalence of the pest and commercial production practices, whereas for assessment of the likelihood of distribution of a pest the factors include the commodity type, the time of year when importation occurs, and the availability and susceptibility of hosts at that time. After comparing these factors and reviewing the latest literature, previously determined ratings may be adopted if the department considers the likelihoods to be comparable to those assigned in the previous assessment(s).

The likelihood of establishment and of spread of a pest species in the PRA area (in this instance, Australia) will be comparable between risk assessments, regardless of the commodity/country pathway through which the pest is imported, as these likelihoods relate specifically to conditions and events that occur in the PRA area, and are independent of the importation pathway. Similarly, the estimate of potential consequences associated with a pest species is also independent of the importation pathway. Therefore, the likelihoods of establishment and of spread of a pest, and the estimate of potential consequences, are directly comparable between assessments, and may be adopted with confidence.

2.2.7 Application of Group PRAs to this risk analysis

Risk estimates derived from a Group PRA are ‘indicative’ in character. This is because the likelihood of entry (the combined likelihoods of importation and distribution) can be influenced by a range of pathway-specific factors, as explained in Section 2.2.6. Therefore, the indicative likelihood of entry from a Group PRA needs to be verified on a case-by-case basis.

In contrast, and as noted in Section 2.2.6, the risk factors considered in the likelihoods of establishment and spread, and the potential consequences associated with a pest species are not pathway-specific and are therefore comparable across all import pathways within the scope of the Group PRA. This is because at these latter stages of the risk analysis the pest is assumed to have already found a host within Australia at or beyond its point of entry. Therefore, a Group PRA assessment can be applied as the default outcome for any pest species on a plant import pathway once the previously assigned likelihood of entry has been verified.

In a scenario where the likelihood of entry for a pest species on a commodity is assessed as different to the indicative estimate, the Group PRA-derived likelihoods of establishment and spread and the estimate of consequences can still be used, but the overall risk rating may change.

Group PRAs applied to this risk analysis are:

- the *Final group pest risk analysis for thrips and orthotospoviruses on fresh fruit, vegetable, cut-flower and foliage imports* (DAWR 2017) (the thrips Group PRA)
- the *Final group pest risk analysis for mealybugs and the viruses they transmit on fresh fruit, vegetable, cut-flower and foliage imports* (DAWR 2019) (the mealybug Group PRA).

The Final group pest risk analysis for soft and hard scale insects on fresh fruit, vegetable, cut flower and foliage imports was finalised in June 2021. As the group policy was finalised after the release of the draft report for the review of biosecurity import requirements for fresh *Capsicum* spp. fruit from Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu, and conclusion of the stakeholder comment period, the group policy was not adopted for this risk analysis. However, its assessments and recommended risk management measures are consistent with the present analysis.

2.3 Stage 3 Pest risk management

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

The conclusions from pest risk assessment are used to decide whether risk management is required and if so, the appropriate measures to be used. Where the unrestricted risk estimate does not achieve the ALOP for Australia, risk management measures are required to reduce this risk to a very low level. The guiding principle for risk management is to manage risk to achieve the ALOP for Australia. The effectiveness of any recommended phytosanitary measures (or combination of measures) is evaluated, using the same approach as used to evaluate the unrestricted risk, to ensure the restricted risk for the relevant pest or pests achieves the ALOP for Australia.

ISPM 11 (FAO 2021f) provides details on the identification and selection of appropriate risk management options and notes that the choice of measures should be based on their effectiveness in reducing the likelihood of entry of the pest.

Examples given of measures commonly applied to traded commodities include:

- options for consignments—for example, inspection or testing for freedom from pests, prohibition of parts of the host, a pre-entry or post-entry quarantine system, specified conditions on preparation of the consignment, specified treatment of the consignment, restrictions on end-use, distribution and periods of entry of the commodity

- options preventing or reducing infestation in the crop—for example, treatment of the crop, restriction on the composition of a consignment so it is composed of plants belonging to resistant or less susceptible species, harvesting of plants at a certain age or specified time of the year, production in a certification scheme
- options ensuring that the area, place or site of production or crop is free from the pest—for example, pest-free area, pest-free place of production or pest-free production site
- options for other types of pathways—for example, consider natural spread, measures for human travellers and their baggage, cleaning or disinfestations of contaminated machinery
- options within the importing country—for example, surveillance and eradication programs
- prohibition of commodities—if no satisfactory measure can be found.

Risk management measures are identified for each quarantine pest where the level of biosecurity risk does not achieve the ALOP for Australia. These are presented in Chapter 5: Pest risk management, of this report.

3 Commercial production practices for *Capsicum* spp.

This chapter provides information on the pre-harvest, harvest and post-harvest practices, considered to be general practices in the assessed Pacific Island countries for the commercial production of fresh chillies and capsicums for export. The export capability of the countries is also outlined.

3.1 Assumptions used in estimating unrestricted risk

Fiji and Solomon Islands provided Australia with information on standard commercial practices used in the production of *Capsicum* spp. for all commercially produced varieties in those countries. This information has been complemented with data from other sources, such as published literature and observations during visits to production areas, all of which have been taken into consideration when estimating the unrestricted risks of pests that may be associated with the import of this commodity.

Officers from the Department of Agriculture, Water and the Environment visited *Capsicum* spp. production areas in Fiji (Sigatoka), Papua New Guinea (Port Moresby, Central Province and Morobe Province), Solomon Islands (Guadalcanal), Tonga (Tongatapu and Vava'u) and Vanuatu (Efate). As part of these visits, officers observed commercial production systems for chillies and capsicums and, where applicable, the harvest, processing and packing procedures for export. The department's observations and additional information provided during these visits confirmed the production and processing procedures described in this chapter as general commercial production practices for *Capsicum* spp. fruit for export.

In estimating the likelihood of pest introduction, it was assumed that the pre-harvest, harvest and post-harvest production practices for *Capsicum* spp. as described in this chapter are implemented for all regions and for all *Capsicum* spp. within the scope of this analysis.

3.2 *Capsicum* spp. production areas and climate in the assessed Pacific Island countries

Chillies and capsicums were first introduced to the Pacific by Portuguese sailors in the 16th Century and subsequently distributed throughout the islands by missionaries. Initially they were mainly adopted as ornamental garden shrubs rather than being grown for food, but over the centuries they have become a common ingredient in traditional Pacific cuisine.

Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu are countries in the Melanesian and Polynesian regions of the South Pacific. These countries all have a tropical maritime climate, with distinct wet and dry seasons. The wet season is typically from November to April, with the dry season from May to October. Within each country there are local climatic variations that can affect the suitability for growing particular crops. This is due to the prevailing trade winds and mountainous terrain, most notably in Papua New Guinea, and the different latitudes of islands, particularly in those with archipelagos spread over vast areas such as Tonga.

Fiji

The Republic of Fiji is in the Melanesian region of the western Pacific between New Caledonia and Samoa. It is an archipelago of around 110 inhabited islands, as well as many more uninhabited islands and islets. The islands of Viti Levu, Vanua Levu and Taveuni produce most of the agricultural commodities for export markets, including taro, ginger, sugar and copra.

Production of *Capsicum* spp. fruit in Fiji for export is mainly undertaken in the Sigatoka Valley, on the island of Viti Levu. The farms are typically small, less than a hectare in size, and often also produce other crops including beans, eggplant, okra and papaya. Current commercial production is mostly field production (Figure 3).

A wide variety of *Capsicum* spp. fruit are commercially grown in Fiji and are sold in local fresh produce markets. Production for export is much more limited, as there are few international markets currently available. The main export market is New Zealand, which has very specific import requirements. Exports to New Zealand are limited to 3 varieties of fresh chillies: red fire, hot rod and bird's eye, as these varieties are considered to be conditional non-hosts for *Bactrocera passiflorae* and *B. xanthodes*, the fruit fly species present in horticultural production areas in Fiji.

Figure 3 Field production of chillies, Sigatoka Valley, Fiji

Papua New Guinea

Papua New Guinea lies directly to the north of Australia and comprises the eastern half of the island of New Guinea, as well as a number of offshore islands including New Britain, New Ireland, and Bougainville. In addition, there are also several smaller outlying populated island groups, such as the Admiralty Islands, the Trobriand Islands, and the Louisiade Archipelago.

Commercial production of chillies and capsicums is widespread across Papua New Guinea. While much of the production is undertaken in the highlands, particularly in the Western Highlands Province, significant production also occurs in Central Province, Morobe Province and around Port Moresby. Field production is the normal practice, in particular for smallholder farmers. There are some larger commercial operations on the outskirts of Port Moresby, some of which utilise enclosed screenhouses (Figure 4). Such farms contain multiple screenhouses (Figure 5), with additional areas of unprotected field production. In addition to chillies and capsicums, these farms produce tomatoes, melons, lettuce and other vegetables.

Figure 4 Screenhouse capsicum production, Port Moresby, Papua New Guinea

Figure 5 Screenhouses, Port Moresby, Papua New Guinea

Samoa

Samoa has 2 main islands, Upolu and Savai'i, as well as a number of smaller islands and islets. The USA territory of American Samoa, which lies around 70km to the east of Upolu, is not part of the Independent State of Samoa (previously known as Western Samoa). The Samoan islands are volcanic in origin, with narrow coastal plains and rugged mountainous interiors. Much of the population is involved in subsistence agriculture, with the main commodities grown being coconuts, bananas, taro, yams, coffee and cocoa. Export volumes of fresh horticultural produce are small.

In Samoa, fresh chillies and capsicums have not previously been grown as an export crop, with only small-scale production for domestic consumption. In recent years the production of chillies has become more commercialised. This has been particularly oriented towards manufacture of value-added products such as chilli sauces, which are targeted at export markets. While many varieties of chillies and capsicums are grown in Samoa, the bird's eye variety is the most common variety produced for food processing.

Solomon Islands

Solomon Islands is located between Vanuatu and Bougainville. The capital, and most populous city, is Honiara, located on the island of Guadalcanal. The majority of the population is involved in subsistence agriculture or fishing, but with the exception of the northern part of Guadalcanal, relatively little of the available land has been cleared for agriculture.

Solomon Islands has not traditionally been a significant exporter of fresh chillies and capsicums, but some value-added chilli products are exported. Chillies are supplied to the tuna cannery at Noro in Western Province to produce canned chilli tuna, which is exported to international markets. Small volumes of whole dried chillies have also been exported.

Commercial chilli and capsicum production have predominantly been undertaken on the Guadalcanal Plains, east of Honiara, but repeated flooding in this area has seen production decline. The 2017 Agricultural Survey (Solomon Island Government 2019) indicated there was only around 320 hectares of chillies and capsicums in production in Solomon Islands, 2/3 of which consisted of farms of less than 0.6 hectares in size.

Figure 6 Capsicum production, Guadalcanal Plains, Solomon Islands

Chillies can be grown all year round in Solomon Islands, given the favourable climate. There are 6 main varieties of chilli grown commercially in Solomon Islands: bird's eye, tabasco, long, akabare, habanero and Indian.

Tonga

Tonga is an archipelago of 176 islands to the south of Samoa. The islands are widely spread across 700 000km^2 of the South Pacific in 2 parallel chains running north–south. The islands are administratively divided into 3 groups; the Vava'u group in the north, the Ha'apai group in the centre, and the Tongatapu group in the south. Most of the population live on the island of

Tongatapu, which is the main commercial hub, and where the capital Nuku'alofa and international airport are situated.

Commercial production of chillies for markets in Tonga is typically small scale, and chillies are often intercropped with taro, island cabbage, papaya, eggplant, squash and other crops. Tonga previously trialled exporting fresh chillies to New Zealand under a protocol requiring high temperature force air (HTFA) treatment for fruit flies. However, that treatment proved to be detrimental to the quality of the goods.

Vanuatu

Vanuatu lies to the northeast of New Caledonia, and consists of more than 80 islands, mostly mountainous and of volcanic origin, with narrow coastal plains. The population is mainly rural, with the main urban centres being Port Vila, on the island of Efate, and Luganville, on Santo Espiritu. Cash crops such as copra, timber and cocoa are important exports, although much of the agricultural sector is small scale, growing coconuts, coffee, kava, taro, yams, fruit and vegetables.

Vanuatu does not presently export fresh chillies, and most of the commercial chilli and capsicum production is for the domestic market. Some value-added chilli products are processed for export markets including chilli sauces, dried chillies, and chilli flakes. Many chilli and capsicum varieties are commercially grown in Vanuatu including bird's eye, habanero, cayenne, serrano, bishop's crown, banana chilli and bell peppers. While chillies and capsicums are grown throughout Vanuatu, commercial production is mainly concentrated in the peri-urban zones around Port Vila and Luganville, where the major fresh produce markets are located.

3.3 Pre-harvest

3.3.1 Cultivars

There is considerable intraspecific variability within the recognised *Capsicum* species, and a wide variety of chillies and capsicums are grown in the Pacific Islands. While this assessment is not limited to specific varieties, this section describes the common varieties of chillies and capsicums that are commercially grown, some of which are currently exported to other markets.

Hot rod chilli

The hot rod is a *Capsicum annuum* chilli variety, with shortish, smooth tapered fruit. They are initially green when immature but turn purplish and then whitish-yellow as they mature. When fully ripe the fruit may be orange or dark yellow in colour. This variety is exported from Fiji to New Zealand. Under the existing protocol for export to New Zealand, the fruit must be picked when still whitish-yellow.

Bird's eye chilli

Bird's eye (Figure 7) is a variety of *Capsicum annuum* commonly grown throughout the Pacific Islands. The fruit are small, usually around 2 to 3cm in length. This variety is exported from Fiji to New Zealand. Tonga has also exported fresh bird's eye chillies to New Zealand.

Figure 7 Bird's eye chillies, Boroko Market, Port Moresby, Papua New Guinea

Capsicum (bell pepper)

The bell pepper, more commonly known as capsicum in Australia and New Zealand, is a cultivar group of *Capsicum annuum* that typically produces large, mild fruit. Unlike other *Capsicum* spp. cultivars, this group does not produce capsaicin, the chemical that gives chillies their distinctive 'heat'. There are several varieties within this group, producing variations in colour and shape. Most commonly capsicum fruit are green in colour when immature, turning red as they reach maturity (Figure 8), but there are varieties that produce yellow, orange (Figure 9), purple or green fruit at maturity.

Figure 8 Immature and mature capsicums, Suva Municipal Market, Suva, Fiji

Figure 9 Orange capsicums in the supermarket, Port Moresby, Papua New Guinea

Red fire chilli

The red fire chilli (Figure 10) is a variety of *Capsicum annuum* and is the main chilli variety grown for export in Fiji. The fruit are long and slender, usually around 12 to 16cm long and 1 to 2cm wide, and relatively straight or with a slight curve. This variety is exported from Fiji to New Zealand. In Fiji the fruit are typically picked as they start to turn red for sale in local markets, but they are harvested at the mature green stage for export to New Zealand.

Figure 10 Red fire chillies harvested at the mature green stage, Sigatoka, Fiji

Habanero chilli

Habanero is a variety of *Capsicum chinense*, which produces lantern-shaped fruit, typically 2 to 6cm in length. Habanero chillies are one of the most pungent chilli varieties. Traditionally the mature fruit were red or orange in colour, but selective breeding has produced fruit with a wide range of colours including purple, yellow, brown and green. The habanero variety was first described from the Yucatán Peninsula in Mexico.

Fijian bongo chilli

The bongo chilli is highly pungent variety of *Capsicum chinense*, similar to the habanero, with deeply ribbed and elongated blocky shaped fruit that are often distorted (Figure 11). The fruit are usually around 5 to 7cm long and 2 to3cm wide, with considerable variability in shape and colour, ranging from yellow to dark red when mature. This variety is reported to be susceptible to fruit fly attack (Fiji Ministry of Agriculture 2015).

Figure 11 Fijian bongo chilli, Suva Municipal Market, Suva, Fiji

Bishop's crown chilli

This variety is a cultivar of *Capsicum baccatum* var. *pendulum*, with common names such as bishop's crown, joker's hat and Christmas bell due to the distinctive shape of the fruit (Figure 12). The fruit is relatively fleshy and is susceptible to attack from some fruit flies. This variety is not common in the Pacific Islands, but it is grown commercially in Papua New Guinea.

Figure 12 Bishop's crown chilli, Lae, Papua New Guinea

Lapid chilli

Lapid is a chilli variety grown in Port Moresby, Papua New Guinea, and one of the main chilli varieties sold in the supermarkets in Port Moresby (Figure 13). The fruit are still green at the time of harvest. Little information is available about this variety, but they are long and slender, around 10 to 12cm long and slightly curved.

Figure 13 Mature green Lapid chillies in the supermarket, Port Moresby, Papua New Guinea

Akabare chilli

The akabare is a *Capsicum annuum* chilli variety originating from Nepal (also known as akabare khursani). The mature fruit are round, about 1.5cm in diameter, and bright red in colour. They are sometimes known as cherry chillies due to their similar appearance to cherry fruit. This variety of chilli has been commercially grown in Solomon Islands (Figure 14).

Figure 14 Ripening akabare chillies in the field, Guadalcanal, Solomon Islands

3.3.2 Cultivation practices

Given the number of countries included in this assessment, and the range of *Capsicum* spp. varieties commercially grown, production systems and supply chains, the information presented here is indicative of general cultivation practices. When estimating the likelihood of importation in the pest risk assessments, it is assumed that only basic cultivation practices are undertaken.

The countries in this assessment have varying levels of extension assistance (education and support) provided to growers. In all countries, growers intending to produce *Capsicum* spp. fruit for export are registered with the relevant authority.

In the assessed Pacific Island countries, chillies and capsicums are typically field-grown, but there is also some screenhouse production in some countries. The plants are grown from seed, which are usually germinated and raised as seedlings in a nursery (Figure 15). The seedlings are transplanted into the field or screenhouse at the 3 to 4 leaf stage, around 6 to 8 weeks after sowing.

In Fiji, seeds for growing export crops are specifically produced at Ministry of Agriculture research stations (Fiji Ministry of Agriculture 2015), reducing the likelihood of introducing seed-borne diseases and ensuring varietal characteristics are maintained. Growers in Fiji are to be registered for export production, and a requirement for registration is the planting of approved seed.

For field production, the plants may be scattered, compact or arranged in rows within a plot, and may consist of a single crop or involve mixed cropping. Figure 16 is an example of planting arrangements of chilli plants arranged in rows in Fiji's Sigatoka Valley, with other crops such as eggplant growing in adjacent plots. Intercropping with leguminous crops and application of potash fertiliser and mulch may be recommended for field production to help improve the soil.

Rainfall is generally reliable, so irrigation is rarely required for field production, but drip irrigation is used in screenhouses.

Figure 15 Capsicum seedlings in the nursery, Port Moresby, Papua New Guinea

Figure 16 Rows of red fire chilli plants, Sigatoka Valley, Fiji

3.3.3 Pest management

Active pest management with pesticides is not routinely undertaken, but some growers may apply pesticides during production. All the assessed Pacific Island countries regulate the use of agricultural chemicals, but the range of chemicals approved for horticultural use varies between countries. For example, Fiji has banned the use of the insecticide imidacloprid and the herbicide paraquat, which were previously used.

Screenhouse production provides a more controlled environment to exclude pests. The screen walls and roof, and double entry doors provide a physical barrier to prevent the entry of pests such as fruit flies. Chlorine foot baths at the entrances assist to prevent soil borne pathogens being walked into the production area.

3.4 Harvesting and handling procedures

Mature fruit are harvested by hand and placed into field bins or buckets for transfer to the packing house. It is preferable to harvest early in the day when the conditions are cooler.

In Fiji, where multiple varieties are grown on the same farm for an export market (for example New Zealand), it is a requirement for the different fruit varieties to be harvested into separate containers and kept segregated.

3.5 Post-harvest

The export chains and postharvest procedures vary between countries, although common principles apply.

3.5.1 Packing house

Packing houses used for export are approved and registered with the respective NPPO to ensure they meet expected standards. The packing house details are to be clearly identified on carton labels after packing and any accompanying documentation.

Packing houses may receive fruit from multiple growers. Therefore, it is crucial that records are kept of which growers have supplied *Capsicum* spp. fruit for packing, and the varieties present.

On arrival, the fruit are generally washed, air dried, and sorted by packing house staff for quality control. In Solomon Islands, where washing is applied a chlorine solution (300ppm) or hot water dip at 53 to 55°C for 4 minutes is recommended for washing.

Fruit are checked for the presence of pests, trash, physical damage, and inconsistencies in shape, colour or size that do not meet market requirements or protocol specifications. The fruit are then packed into cardboard cartons, typically with a capacity of 8–10 kilograms. Chillies may be packed loose in 1-kilogram plastic bags before being placed in the cartons. Ventilation holes in the cartons, if present, are covered over. Cartons are stored in a secure room to prevent infestation by insects and other pests.

A pre-export phytosanitary inspection is undertaken by the NPPO to check for the presence of pests, trash and other contaminants.

3.5.2 Transport

Air freight is likely the preferred means of transport for exports to Australia, given the perishability of the goods and modest volume of typical export consignments, although sea freight is also an option. Air freight is the transport option used for current export markets. The cartons are transported by truck from the packing house to the airport where they are transferred into a unit load device (air freight container) before being loaded into the aircraft.

3.6 Export capability

Capsicum spp. fruit are produced all year round in Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu. Presently the production of *Capsicum* spp. for export is predominantly focused on value-added processed products such as chilli flakes, paprika and dried chillies.

Existing market access for fresh *Capsicum* spp. fruit into protocol markets is very limited, with only Fiji and Tonga having access for fresh chillies into New Zealand. The export season is largely determined by market opportunities in New Zealand when their local production is at its lowest and there is a favourable seasonal price window. Exports to Australia are likely to be similarly opportunistic, and predominantly focus on niche chilli varieties that attract a price premium.

4 Pest risk assessments for quarantine pests

Quarantine pests and regulated articles associated with fresh *Capsicum* spp. fruit from the assessed Pacific Island countries are identified in the pest categorisation process (Appendix A) and are listed in Table 4.1. This chapter assesses the likelihood of entry (importation and distribution), establishment and spread of these pests and the economic, including environmental, consequences these pests may cause if they were to enter, establish and spread in Australia.

Table 4.1 Quarantine pests and regulated articles of *Capsicum* spp. from Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu

Pest	Common name	Countries where pest is present
Fruit flies [Diptera: Tephritidae]		
Bactrocera dorsalis [EP]	Oriental fruit fly	Papua New Guinea
Bactrocera facialis [EP]	Tropical fruit fly	Tonga
Bactrocera kirki	Fruit fly	Samoa, Tonga, Fiji (Rotuma only)
Bactrocera passiflorae [EP]	Fijian fruit fly	Fiji
Bactrocera trivialis	New Guinea fruit fly	Papua New Guinea
Bactrocera xanthodes [EP]	Pacific fruit fly	Fiji, Samoa, Tonga
Zeugodacus cucurbitae [EP]	Melon fly	Papua New Guinea, Solomon Islands
Whiteflies [Hemiptera: Aleyrodidae]		
Bemisia tabaci complex [EP]	Whitefly	Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga, Vanuatu
Mealybugs [Hemiptera: Pseudococcidae]		
Planococcus minor [EP, WA]	Pacific mealybug	Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga, Vanuatu
Pseudococcus jackbeardsleyi [EP]	Jack Beardsley mealybug	Papua New Guinea
Thrips [Thysanoptera: Thripidae]		
Scirtothrips dorsalis [GP, RA]	Chilli thrips	Papua New Guinea, Solomon Islands
Thrips palmi [GP, RA, SA, WA]	Melon thrips	Fiji, Papua New Guinea, Samoa
Thrips tabaci [GP, RA]	Onion thrips	Fiji, Papua New Guinea, Solomon Islands

EP: Species has been assessed previously and import policy already exists. **GP** Species has been assessed previously in a Group PRA and the Group PRA has been applied. **RA:** Regulated article, refer to Section 4.4 for definition of a regulated article. **SA:** Regional quarantine pest for South Australia. **WA:** Regional quarantine pest for Western Australia.

Most of the identified quarantine pests or pest groups considered have been assessed previously by the department. Where appropriate, the outcomes of previous assessments for these pests have been adopted for this risk analysis, unless new information is available that suggests the risk would be different. The acronym 'EP' (existing policy) is used to identify those pests assessed previously for which import policy exists. The adoption of outcomes of previous assessments is outlined in Section 2.2.6.

Some pests identified in this assessment have been recorded in some regions of Australia, and due to interstate quarantine regulations and enforcement are considered regional quarantine pests. The acronym for the state or territory for which the regional pest status is considered, 'WA' (Western Australia) or 'SA' (South Australia), are used to identify these pests.

The biosecurity risk posed by thrips, and the orthotospoviruses they transmit, from all countries was previously assessed in the *Final group pest risk analysis for thrips and orthotospoviruses on fresh fruit, vegetable, cut-flower and foliage imports* ('thrips Group PRA') (DAWR 2017). Similarly, the biosecurity risk posed by mealybugs, and the viruses they transmit, from all countries was previously assessed in the *Final Group pest risk analysis for mealybugs and the viruses they transmit on fresh fruit, vegetable, cut-flower and foliage imports* (DAWR 2019). These Group PRAs have been applied to this risk analysis for fresh *Capsicum* spp. fruit from the assessed Pacific Island countries.

The acronym 'GP' (Group PRA) is used to identify species assessed previously in a Group PRA and for which the Group PRA was applied. The application of the thrips Group PRA and mealybug Group PRA to this risk analysis is outlined in Section 2.2.7. A summary of the assessment from the thrips Group PRA and mealybug Group PRA is presented in this chapter for convenience.

4.1 Fruit flies

Bactrocera dorsalis **(EP),** ***Bactrocera facialis*** **(EP),** ***Bactrocera kirki*****,** ***Bactrocera passiflorae*** **(EP),** ***Bactrocera trivialis*****,** ***Bactrocera xanthodes*** **(EP),** ***Zeugodacus cucurbitae*** **(EP)**

The biological characteristics and behaviours on the importation pathway of these 7 fruit fly species are considered sufficiently similar to justify combining them into a single assessment. In this assessment, the term 'fruit flies' is used to refer to these 7 species unless otherwise specified. The scientific name is used when the information is about a specific species.

Bactrocera dorsalis was assessed previously for other import policies, including apples from China (Biosecurity Australia 2010) and lychee and longan fruit from China and Thailand (DAFF 2004). *Zeugodacus cucurbitae* was assessed previously (as *B. cucurbitae*) for lychee fruit from Taiwan and Vietnam (DAFF 2013b). *Bactrocera passiflorae* and *B. xanthodes* were considered in the import policy for papaya from Fiji (Biosecurity Australia 2002) and breadfruit from Fiji, Samoa and Tonga (Department of Agriculture 2019). *Bactrocera facialis* was assessed for breadfruit from Fiji, Samoa and Tonga (Department of Agriculture 2019). *Bactrocera kirki* and *B. trivialis* have not been assessed previously but the biology and host association are considered sufficiently similar to the other closely related species for which previous policy exists.

The assessment of these fruit flies builds on the previous assessments indicated above. However, there are differences in horticultural practices, climatic conditions and pest prevalence between the previously assessed commodity/country pathways listed in the previous paragraph and *Capsicum* spp. fruit from the assessed Pacific Island countries. These differences make it necessary to reassess the likelihood that fruit flies will be imported into Australia with *Capsicum* spp. fruit from the assessed Pacific Island countries.

The likelihood of distribution of fruit flies has been previously assessed on apples from China, lychee fruit from China, Thailand, Taiwan and Vietnam, longan fruit from China and Thailand, and breadfruit from Fiji, Samoa and Tonga pathways. These previous assessments rated the likelihood of distribution as High.

It is expected that once *Capsicum* spp. fruit arrives in Australia from the assessed Pacific Island countries, it will be distributed throughout Australia for wholesale and retail sale. *Capsicum* spp. fruit disposed of as waste through managed waste systems are considered unlikely to distribute fruit flies into the environment. However, *Capsicum* spp. waste may be disposed in urban, rural and natural environments throughout Australia, including domestic compost, where at certain times of the year susceptible hosts may be available. On this basis, the same rating of High for the likelihood of distribution for *B. dorsalis*, *B. facialis*, *B. passiflorae*, *B. xanthodes* and *Z. cucurbitae* on previously assessed commodity/country pathways is adopted for the assessed fruit fly species for *Capsicum* spp. fruit from the assessed Pacific Island countries.

The likelihoods of establishment and spread of fruit flies in Australia and the consequences they may cause are considered to be similar to those of fruit flies previously assessed for apples from China, lychee fruit from China, Thailand, Taiwan and Vietnam, longan fruit from China and Thailand, and breadfruit from Fiji, Samoa and Tonga. These likelihoods relate specifically to events that occur in Australia and are principally independent of the import pathway. Therefore, the ratings for the likelihoods of establishment and spread and the rating for the overall consequences of fruit flies on the previously assessed import pathways have been adopted for the *Capsicum* spp. fruit from the assessed Pacific Island countries pathway.

The department has reviewed recent literature – for example Boontop (2016), De Mayer et al. (2015), Huang & Chi (2014), Kim & Kim (2018), PHA (PHA 2018), Qin et al. (2018) and Zeng et al. (2019) – and no new information has been identified that would significantly change the previously assessed risk ratings for distribution, establishment, spread and consequences as set out for fruit flies in the existing policies.

The risk scenario of biosecurity concern considered here is the presence of fruit fly eggs or larvae within imported fresh *Capsicum* spp. fruit.

4.1.1 Likelihood of entry

The likelihood of entry is considered in 2 parts, the likelihood of importation and the likelihood of distribution, which consider pre-border and post-border issues, respectively.

Likelihood of importation

The likelihood that *Bactrocera dorsalis*, *B. facialis*, *B. kirki*, *B. passiflorae*, *B. trivialis*, *B. xanthodes* and *Zeugodacus cucurbitae* will arrive in Australia with the importation of *Capsicum* spp. fruit from the assessed Pacific Island countries where these pests are present is assessed as High.

The following information provides supporting evidence for this assessment.

The assessed fruit fly species are present in the assessed Pacific Island countries.

- *Bactrocera dorsalis* and *B. trivialis* are present in Papua New Guinea (Tenakanai 1997).
- *Bactrocera facialis* is present in Tonga (Tupou et al. 2001).
- *Bactrocera kirki* is present in Samoa, Tonga (Heimoana et al. 1997b), and Fiji (but restricted to the island of Rotuma) (Tora Vueti 2000).
- *Bactrocera passiflorae* is present in Fiji (Tora Vueti 2000).
- *Bactrocera xanthodes* is present in Fiji, Samoa and Tonga (Leblanc et al. 2012).
- *Zeugodacus cucurbitae* is present in Papua New Guinea and Solomon Islands (Leblanc et al. 2012).
- Not all assessed fruit fly species are present in each of the assessed Pacific Island countries.

Capsicum spp. are hosts of many fruit fly species.

- Capsicums and chillies (*Capsicum* spp.) are reported hosts of the assessed fruit fly species (Allwood & Tora 1998; Clarke et al. 2005; McQuate, Liquido & Nakamichi 2017).
- While *Capsicum* spp. are recognised as hosts, susceptibility varies significantly, depending on the variety and particular fruit fly species – some chilli varieties are recognised as conditional non-hosts for some fruit fly species (Heimoana et al. 1997a).
- In Fiji, hot rod, red fire and bird's eye chillies have been demonstrated to be conditional non-hosts for *B. passiflorae* and *B. xanthodes* (Allwood & Tora 1998; Leweniqila & Ralulu 2001). Laboratory and field cage tests on these chilli varieties using fruit at various stages of maturity found that they could not sustain development of these fruit fly species.

Fruit fly eggs or larvae may be present in *Capsicum* spp. fruit exported from the assessed Pacific Island countries to Australia.

- Adult female flies oviposit eggs beneath the skin of the fruit, taking advantage of crevices and pre-existing damage or oviposition holes (Bateman 1972). In warmer conditions (24 to 30°C) hatching can occur within 24 to 32 hours following oviposition (Danjuma et al. 2014). Cooler conditions (below 20°C) can prolong hatching until 6 to 20 days after oviposition (Rwomushana et al. 2008).
- After hatching, fruit flies grow through 3 larval instars before they are ready to pupate (Shi et al. 2017). For *B. passiflorae*, third instar larvae emerge from the fruit to pupate 8 to 10 days after oviposition (Leweniqila et al. 1997). *Bactrocera dorsalis* can achieve their third instar (emergence stage) within 9 to 35 days (near 24°C) but can also achieve their third instar within 6 to 7 days under optimal conditions (30 to 32°C)(Christenson & Foote 1960).
- Adult fruit flies typically take flight when disturbed, so are unlikely to remain on the fruit during harvest or any pre-export handling. Therefore, they are unlikely to be present in imported consignments of *Capsicum* spp. fruit.
- However, it is feasible that adult female flies could attempt to oviposit on fruit being stored or packed in a facility that was not insect-proof.

Fruit infested with fruit fly larvae or eggs may not be detected during harvesting and post-harvest handling processes.

- Infested fruit may not be detected during sorting, packing and inspection procedures, particularly if oviposition occurs just before fruit are harvested.
- Following oviposition some necrosis may develop around the puncture mark, which is followed by decomposition of the fruit (CABI 2021). This fruit may be culled during harvesting and packing processes.
- Symptoms of fruit fly infestation may not be apparent until larval development is well-advanced, so the eggs and early larval instars can be difficult to detect (Putulan et al. 2004). If oviposition occurs shortly before harvest the affected fruit are unlikely to be detected and culled during harvesting and packing processes.

Fruit flies may survive transport and storage conditions for exported fresh *Capsicum* spp. fruit to Australia.

- The rate of larval development is influenced by temperature, relative humidity and the ripeness of the host fruit (Ibrahim & Gudom 1978; Leweniqila et al. 1997). Favourable temperatures for development of *B. dorsalis* range between 20 to 30°C (Danjuma et al. 2014; Rwomushana et al. 2008).
- The average time of development from oviposition to the completion of the third instar in *B. dorsalis* in chilli fruit was 12 days under laboratory conditions (Ibrahim & Gudom 1978). For *B. passiflorae* the third instar stage was completed in pawpaw and eggplant in 8 to 10 days under laboratory conditions (Leweniqila et al. 1997). However, the larval stages can be prolonged during cool storage of the fruit after harvest (Christenson & Foote 1960; Huang et al. 2020) and they could potentially survive for the duration of transport to Australia.
- Survivorship and development time deteriorate if temperatures are sustained below 18°C, or above 35°C (Rwomushana et al. 2008; Vargas et al. 2000). In a recent study on the effects of low temperatures on *Z. cucurbitae,* 50% of the eggs were killed at 1°C, and 50% of larvae at 2.8°C after 12 hours' exposure (Huang et al. 2020).

- However, *Capsicum* spp. fruit are generally transported and stored at 5–25°C, depending on the variety. Such conditions would not be lethal to any fruit fly larvae present.

Fruit flies associated with *Capsicum* spp. are widespread in Fiji, Papua New Guinea, Samoa, Solomon Islands, and Tonga. *Capsicum* spp. are hosts of fruit flies. However, it is recognised that some chilli varieties may be conditional non-hosts for *B. passiflorae* and *B. xanthodes*. The potential for fruit fly eggs or larvae to be present in imported *Capsicum* spp. fruit, the internal feeding behaviour of the larval stages, the difficulty of excluding them from the export pathway where external symptoms of infestation may not be evident, and the potential to survive transport and storage, support a likelihood estimate for importation of fruit flies on *Capsicum* spp. fruit from the assessed Pacific Island countries, where the assessed fruit fly species are present, of High.

Likelihood of distribution

The likelihood that the assessed fruit flies will be distributed within Australia in a viable state as a result of the processing, sale or disposal of *Capsicum* spp. fruit from the assessed Pacific Island countries, and subsequently transfer to susceptible hosts is likely to be similar to *B. dorsalis*, *B. facialis*, *B. passiflorae*, *B. xanthodes* and *Z. cucurbitae* on previously assessed import pathways. Therefore, the same rating of High for the likelihood of distribution for *B. dorsalis*, *B. facialis*, *B. passiflorae*, *B. xanthodes* and *Z. cucurbitae* on previously assessed import pathways is adopted for the assessed fruit fly species for *Capsicum* spp. fruit from the assessed Pacific Island countries.

Overall likelihood of entry

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

The likelihood that the assessed fruit flies (*B. dorsalis, B. facialis, B. kirki, B. passiflorae, B. trivialis*, *B. xanthodes* and *Z. cucurbitae*) will arrive in Australia with the importation of fresh *Capsicum* spp. fruit from any of the assessed Pacific Island countries where these species are present, and be distributed in a viable state to a susceptible host, is assessed as High.

4.1.2 Likelihood of establishment and spread

The likelihoods of establishment and spread for the assessed fruit flies are independent of the import pathway, and are considered similar to those of *B. dorsalis*, *B. facialis*, *B. passiflorae*, *B. xanthodes* and *Z. cucurbitae* in previously assessed import pathways. The ratings from previous assessments are:

Likelihood of establishment: High
Likelihood of spread: High

These ratings are also considered to be applicable to *B. kirki* and *B. trivialis*, which have similar biology, climatic preferences and host availability to *B. dorsalis*, *B. facialis*, *B. passiflorae*, *B. xanthodes* and *Z. cucurbitae*.

4.1.3 Overall likelihood of entry, establishment and spread

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

The overall likelihood that the assessed fruit flies will enter Australia as a result of trade in fresh *Capsicum* spp. fruit from any of the assessed Pacific Island countries where these species are present, be distributed in a viable state to a susceptible host, establish in Australia and subsequently spread within Australia is assessed as High.

4.1.4 Consequences

The potential consequences of the entry, establishment, and spread of the assessed fruit flies in Australia are similar to those of *B. dorsalis*, *B. facialis*, *B. passiflorae*, *B. xanthodes* and *Z. cucurbitae* in the import pathways previously assessed. The overall consequences in the previous assessments were assessed as 'High'. The potential consequences of *B. kirki* and *B. trivialis* are not considered to be significantly different to *B. dorsalis*, *B. facialis*, *B. passiflorae*, *B. xanthodes* and *Z. cucurbitae*.

Therefore, the overall consequences for the assessed fruit flies on the *Capsicum* spp. fruit from the assessed Pacific Island countries pathway are also assessed as High.

4.1.5 Unrestricted risk estimate

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

Unrestricted risk estimate for fruit flies	
Overall likelihood of entry, establishment and spread	High
Consequences	High
Unrestricted risk	High

The unrestricted risk estimate for *B. dorsalis*, *B. facialis*, *B. kirki*, *B. passiflorae*, *B. trivialis*, *B. xanthodes* and *Z. cucurbitae* on the *Capsicum* spp. fruit from the assessed Pacific Island countries pathway has been assessed as High, which does not achieve the ALOP for Australia. Therefore, specific risk management measures are required for these fruit fly species on this pathway.

4.2 Whiteflies

Bemisia tabaci complex (EP)

Bemisia tabaci whiteflies are phloem-feeding insects that live predominantly on herbaceous plants (de Barro et al. 2011). They have become serious pests of a wide range of vegetable, ornamental, grain and cotton crops in many parts of the world. They cause damage directly by feeding on plant hosts, which can result in irreversible physiological disorders, as well as indirect damage caused by vectoring of begomoviruses, and honeydew contamination, which encourages growth of sooty mould (de Barro, Liebregts & Carver 1998).

Bemisia tabaci was first reported as a pest in 1889, but it was generally considered to be relatively unimportant until the mid-to late 1970s, when a serious outbreak was first reported in Sudan, followed by an outbreak in the south-western United States in the early 1980s (de Barro et al. 2011). There was a major global invasion event in the late 1980s, facilitated by the trade in ornamental plants from the Middle East/Asia Minor, affecting at least 54 countries (de Barro et al. 2011).

It was apparent from these major outbreaks that the invading whiteflies behaved quite differently from indigenous *B. tabaci* populations, having different host ranges and being reproductively incompatible. Different biotypes were proposed, defined by a range of biological characteristics, including host range, fecundity, insecticide resistance, the capacity to disperse widely, the capacity to transmit begomoviruses, the capacity to induce silverleafing and yellow vein in hosts, and the capacity to produce female offspring after inter-biotype mating (de Barro et al. 2011; Hsieh, Wang & Ko 2006).

Bemisia tabaci has subsequently been recognised as a cryptic complex of closely related whitefly species, with at least 44 different putative species identified (Kanakala & Ghanim 2019). Although they are morphologically indistinguishable, molecular analysis has revealed significant genetic variation, particularly in the bacterial endosymbionts associated with the whiteflies. The present species differentiation is based on a mitochondrial cytochrome oxidase gene sequence divergence of 3.5 to 4.0% (Kanakala & Ghanim 2019). Nomenclature of these putative species reflects their geographical origin.

Bemisia tabaci sensu lato is present in all Pacific Island countries, as well as in Australia (de Barro, Liebregts & Carver 1998). The 'Nauru biotype', 'Australian native biotype' and 'B biotype' were previously recognised in the Pacific region (de Barro, Liebregts & Carver 1998), although the 'Nauru' biotype was not known to be present in Australia. These groups have subsequently been split into a number of new species, and the species status of the populations in each country is not resolved. Australia has at least 2 native species of the *B. tabaci* complex, Australia I (AUSI) and Australia II (AUS II), as well as the introduced Middle East Asia Minor 1 (MEAM 1) (Wongnikong et al. 2020).

The department has previously assessed the *B. tabaci* complex in the import policies for island cabbage (*Abelmoschus manihot*) leaves from the Cook Islands, Fiji, Samoa, Tonga and Vanuatu ('Nauru' biotype') (DAFF 2013a) and tomato fruit from the Netherlands ('B biotype') (Biosecurity Australia 2003). This assessment builds on the previous assessments. However, there are differences in horticultural practices, commodity type and pest prevalence between *Capsicum* spp. fruit from the assessed Pacific Island countries and the previously assessed commodity/country pathways. These differences make it necessary to reassess the likelihood that exotic *B. tabaci* complex whiteflies will be imported into Australia with fresh *Capsicum* spp. fruit (capsicums and chillies) from the assessed Pacific Island countries.

The likelihood of distribution of the *B. tabaci* complex has been previously assessed for the import pathways of island cabbage leaves from the Cook Islands, Fiji, Samoa, Tonga and Vanuatu and tomato fruit from the Netherlands. These previous assessments rated the likelihood of distribution of *B. tabaci* complex as Moderate. *Capsicum* spp. fruit from the assessed Pacific Island countries are expected to be distributed throughout Australia for sale, and disposed of, in a similar way to island cabbage leaves and tomato fruit.

Whitefly eggs, larvae and puparia could be distributed with the fruit. Most fruit waste is disposed of via municipal waste facilities and if whiteflies were present in such waste they are unlikely to have opportunities to transfer to a suitable host. Most life stages are immobile and unlikely to disperse to new hosts. Immature life stages are unlikely to complete development on fruit discarded in the environment or domestic compost systems. First instar nymphs, as well as adults that emerge from puparia during distribution, are mobile and could disperse short distances from the fruit to search for another host. Suitable host plants, including cucumber, eggplant, tomato, hibiscus, lantana and squash are common and widely distributed in many parts of Australia. Therefore, the likelihood of distribution for exotic *B. tabaci* complex species for *Capsicum* spp. fruit from the assessed Pacific Island countries is considered to be similar to the previous assessments.

The likelihoods of establishment and spread of exotic *B. tabaci* complex species in Australia and the consequences they may cause are considered to be similar to those previously assessed for island cabbage leaves from the Cook Islands, Fiji, Samoa, Tonga and Vanuatu and tomato fruit from the Netherlands. These likelihoods relate specifically to events that occur in Australia and are principally independent of the commodity import pathway. Therefore, the rating for the overall consequences of the *B. tabaci* complex on the previously assessed commodities have been adopted for the *Capsicum* spp. fruit from the assessed Pacific Island countries pathway.

The department has reviewed recent literature – for example Wongnikong et al. (2020), Guo et al. (2021), Hopkinson et al. (2020), Hu et al. (2014), Kanakala and Ghanim (2019), Kedar, Saini and Kumaranag (2018), Malumphy, Eyre and Anderson (2017) and Sequeira and Reid (2019) – and no new information has been identified that would significantly change the previously assessed risk ratings for distribution, establishment, spread and consequences as set out for *B. tabaci* in the existing policies.

The risk scenario of biosecurity concern considered here is the presence of exotic *B. tabaci* complex species on imported fresh *Capsicum* spp. fruit, particularly eggs, larvae and puparia.

4.2.1 Likelihood of entry

The likelihood of entry is considered in 2 parts, the likelihood of importation and the likelihood of distribution, which consider pre-border and post-border issues, respectively.

Likelihood of importation

The likelihood that exotic *B. tabaci* complex whiteflies will arrive in Australia with the importation of *Capsicum* spp. fruit from the assessed Pacific Island countries where these pests are present is assessed as High.

The following information provides supporting evidence for this assessment.

Bemisia tabaci sensu latu is present in the assessed Pacific Island countries and may be present on *Capsicum* spp. fruit.

- Species of the *B. tabaci* complex are present in Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu (de Barro, Liebregts & Carver 1998). The species status of populations in these countries has not been resolved.
- *Capsicum* spp. have been recorded as hosts of the *B. tabaci* complex in the assessed Pacific Island countries (de Barro, Liebregts & Carver 1998).
- Whiteflies are mainly associated with the leaves of host plants but can be present on fruit and stems. Exotic *B. tabaci* complex whiteflies may be present on exported *Capsicum* spp. fruit.
- Eggs, larvae and puparia are likely to remain on the fruit after harvest. The first instar crawler is the only mobile larval stage. Within a few days, it locates a suitable feeding location where it undergoes its first moult, losing its legs in the process (CABI EPPO 2003). It is sessile for the remaining 3 nymphal stages, the last of which is a puparium in which metamorphosis into the adult occurs (CABI EPPO 2003).
- Adult whiteflies are less likely to stay on the fruit after harvest, as they are active fliers, and will typically fly off when disturbed.
- Internationally *B. tabaci* complex whiteflies are regularly intercepted on capsicums and chillies in trade. The European Union reported intercepting *B. tabaci* in consignments of imported fresh *Capsicum annuum* and *C. frutescens* fruit in August 2020 (EUROPHYT 2020).

Bemisia tabaci complex whiteflies are likely to be difficult to remove from *Capsicum* spp. fruit throughout the export chain.

- *Bemisia tabaci* larvae may be difficult to detect on the fruit surface during quality assessments in the packing house, particularly if they are sheltering around the calyx.
- *Bemisia tabaci* nymphs are 0.3 to 0.6mm in length (CABI 2021) and creamy white to light green in colour (Mau & Martin Kessing 2007). The puparium is around 0.7mm in length. It lies flat on the surface of the host plant (CABI 2021). Their small size and cryptic colouring can make them difficult to detect.
- The adult whiteflies are around 1 mm in length, with a pale-yellow body and 2 pairs of white wings (Mau & Martin Kessing 2007), so would be more readily detected if they were present in a consignment of fruit packed for export.

Bemisia tabaci complex whiteflies may survive postharvest processes and transit to Australia.

- Postharvest practices such as washing, may not dislodge sessile larvae and puparia from the fruit.
- Whitefly development occurs at temperatures between 10°C and 32°C, with an optimum of 27°C (Mau & Martin Kessing 2007). While low temperatures may slow development, typical conditions experienced in transit (either air freight or by sea) are unlikely to significantly affect the viability of whiteflies present on fruit.

Whiteflies of the *B. tabaci* complex are present in Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu, and are associated with *Capsicum* spp. fruit. The potential for larvae to be present on imported *Capsicum* spp. fruit, the difficulty of detecting immature life stages on the fruit during harvesting and packing house procedures, and the history of interceptions on *Capsicum* spp. fruit in trade, support a likelihood estimate for importation of exotic *B. tabaci* complex species on *Capsicum* spp. fruit from the assessed Pacific Island countries of High.

Likelihood of distribution

As indicated, the likelihood of distribution for exotic *B. tabaci* complex whiteflies is being based on the previous assessments for island cabbage leaves from the Cook Islands, Fiji, Samoa, Tonga and Vanuatu and tomato fruit from the Netherlands. Therefore, the same rating of Moderate has been adopted for the likelihood of distribution for exotic *B. tabaci* complex whiteflies for *Capsicum* spp. fruit from the assessed Pacific Island countries.

Overall likelihood of entry

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

The likelihood that exotic *B. tabaci* complex whiteflies will arrive in Australia with the importation of fresh *Capsicum* spp. fruit from any of the assessed Pacific Island countries where these species are present, and be distributed in a viable state to a susceptible host, is assessed as Moderate.

4.2.2 Likelihood of establishment and spread

The likelihoods of establishment and spread for exotic *B. tabaci* complex whiteflies are independent of the import pathway, and are considered similar to the previously assessed pathways of island cabbage leaves from the Cook Islands, Fiji, Samoa, Tonga and Vanuatu (DAFF 2013a) and tomato fruit from the Netherlands (Biosecurity Australia 2003). The ratings of the previous assessments are:

Likelihood of establishment:	High
Likelihood of spread:	High

4.2.3 Overall likelihood of entry, establishment and spread

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

The overall likelihood that exotic *B. tabaci* complex species will enter Australia as a result of trade in fresh *Capsicum* spp. fruit from any of the assessed Pacific Island countries where these species are present, be distributed in a viable state to a susceptible host, establish in Australia and subsequently spread within Australia is assessed as Moderate.

4.2.4 Consequences

The potential consequences of the entry, establishment and spread of exotic *B. tabaci* complex species are considered similar to the previously assessed pathways of island cabbage leaves from the Cook Islands, Fiji, Samoa, Tonga and Vanuatu (DAFF 2013a) and tomato fruit from the Netherlands (Biosecurity Australia 2003). The rating for overall consequences from the previous assessments is 'Moderate'. Therefore, the overall consequences of exotic *B. tabaci* complex species for the *Capsicum* spp. fruit from the assessed Pacific Island countries pathway are also assessed as Moderate.

4.2.5 Unrestricted risk estimate

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

Unrestricted risk estimate for *B. tabaci* complex	
Overall likelihood of entry, establishment and spread	Moderate
Consequences	Moderate
Unrestricted risk	Moderate

The unrestricted risk estimate for exotic *B. tabaci* complex species on *Capsicum* spp. fruit from the assessed Pacific Island countries has been assessed as Moderate, which does not achieve the ALOP for Australia. Therefore, specific risk management measures are required for this pest on this pathway.

4.3 Mealybugs

Planococcus minor (EP, WA), *Pseudococcus jackbeardsleyi* (EP)

Two mealybug species were identified that are quarantine pests for all of or parts of Australia on the pathway for fresh *Capsicum* spp. fruit from the assessed Pacific Island countries: *Planococcus minor* and *Pseudococcus jackbeardsleyi* (Table 4.2).

Planococcus minor is not present in Western Australia and is a pest of regional quarantine concern for that state.

Table 4.2 Quarantine mealybugs for fresh *Capsicum* spp. fruit from Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu

Pest	In mealybugs Group PRA	Quarantine pest	On *Capsicum* spp. fruit pathway	Likelihood of entry
Planococcus minor	Yes	Yes (WA)	Yes	Moderate
Pseudococcus jackbeardsleyi	Yes	Yes	Yes	Moderate

WA: Pest of biosecurity concern for Western Australia.

The indicative likelihood of entry for all mealybugs is assessed in the mealybug Group PRA as Moderate (DAWR 2019). *Planococcus minor* is present in Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu, where it has been reported on chillies and capsicums (Williams & Watson 1988b). *Pseudococcus jackbeardsleyi* is present in Papua New Guinea, and *Capsicum annuum* is reported as a host (Williams 2004). General packing house procedures and transportation are not expected to reliably eliminate these mealybugs on the pathway. After assessment of the pathway-specific factors (Section 2.2.7) for *Capsicum* spp. fruit from Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu, the likelihood of entry estimate of Moderate was verified as appropriate for these quarantine mealybugs (Table 4.3).

Table 4.3 Risk estimates for quarantine mealybugs

Risk component	Rating for quarantine mealybugs
Likelihood of entry (importation x distribution)	Moderate (High x Moderate)
Likelihood of establishment	High (a)
Likelihood of spread	High (a)
Overall likelihood of entry, establishment and spread	Moderate
Consequences	Low (a)
Unrestricted risk	**Low**

(a): risk estimates adopted from the mealybugs Group PRA (DAWR 2019).

The indicative unrestricted risk estimate for mealybugs is Low, which does not achieve the ALOP for Australia, as assessed in the mealybugs Group PRA (Table 4.3).

This indicative unrestricted risk estimate is considered to be applicable for the quarantine mealybug species present on the fresh *Capsicum* spp. fruit from Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu pathway. Therefore, specific risk management measures are required for the quarantine mealybugs to achieve the ALOP for Australia.

The conclusion of this risk assessment, which is based on the mealybug Group PRA, applies to all other phytophagous quarantine mealybugs on the fresh *Capsicum* spp. fruit from Fiji, Papua New

Guinea, Samoa, Solomon Islands, Tonga and Vanuatu pathway, irrespective of their specific identification in this document.

4.4 Thrips

***Scirtothrips dorsalis* (GP, RA), *Thrips palmi* (GP, RA, SA, WA), *Thrips tabaci* (GP, RA)**

Three thrips species have been identified as quarantine pests and/or regulated articles for Australia on the pathway for fresh *Capsicum* spp. fruit from the assessed Pacific Island countries: *Scirtothrips dorsalis*, *Thrips palmi* and *Thrips tabaci* (Table 4.4).

Thrips palmi is not present in South Australia and is assessed as a regional quarantine pest for that state. *Thrips palmi* is present but not widely distributed in Western Australia, and is assessed as a regional quarantine pest for all areas of Western Australia outside the Ord River Irrigation Area (Shire of Wyndham-East Kimberley).

The indicative likelihood of entry for all thrips is assessed in the thrips Group PRA as Moderate (DAWR 2017). *Scirtothrips dorsalis* is present in Papua New Guinea and Solomon Islands (Dickey et al. 2015). *Thrips palmi* is present in Fiji (Biosecurity Authority of Fiji 2015), Papua New Guinea (CABI 2021) and Samoa (Waterhouse & Norris 1987). *Thrips tabaci* is present in Fiji, Papua New Guinea and Solomon Islands (CABI 2021).

These thrips are associated with *Capsicum* spp. fruit (CABI 2010; Kumar, Seal & Kakkar 2017). Standard packing house processes and transportation are not expected to eliminate these thrips from the pathway. After assessment of relevant pathway-specific factors (see Section 2.2.7) for fresh *Capsicum* spp. fruit from the assessed Pacific Island countries, the likelihood of entry of Moderate, as assessed in the thrips Group PRA, was verified as appropriate for these thrips (Table 4.4).

Table 4.4 Quarantine and regulated thrips species for *Capsicum* spp. fruit from the assessed Pacific Island countries

Pest	In thrips Group PRA	Quarantine pest	Regulated thrips	On *Capsicum* spp. fruit pathway	Likelihood of entry for thrips
Scirtothrips dorsalis	Yes	No	Yes	Yes	Moderate
Thrips palmi	Yes	Yes (SA, WA)	Yes	Yes	Moderate
Thrips tabaci	Yes	No	Yes	Yes	Moderate

SA: Pest of biosecurity concern for South Australia. **WA:** Pest of biosecurity concern for Western Australia.

As assessed in the thrips Group PRA, the indicative unrestricted risk estimate for thrips is Low (Table 4.5), which does not achieve the ALOP for Australia. This indicative unrestricted risk estimate is considered to be applicable for the quarantine thrips species associated with the *Capsicum* spp. fruit from the assessed Pacific Island countries pathway. Therefore, specific risk management measures are required for quarantine thrips on this pathway.

A summary of the risk assessment for quarantine thrips is presented in Table 4.5 for convenience.

Table 4.5 Risk estimates for quarantine thrips

Risk component	Rating for quarantine thrips
Likelihood of entry (importation x distribution)	Moderate (High x Moderate)
Likelihood of establishment	High (a)
Likelihood of spread	High (a)
Overall likelihood of entry, establishment and spread	Moderate
Consequences	Low (a)
Unrestricted risk	**Low**

(a): risk estimates adopted from the thrips Group PRA (DAWR 2017).

Scirtothrips dorsalis, *T. palmi* and *T. tabaci* are also identified as regulated articles, because they are capable of harbouring and spreading (vectoring) emerging orthotospoviruses that are quarantine pests for Australia, as detailed in the thrips Group PRA (DAWR 2017).

A Regulated Article is defined by the IPPC as 'any plant, plant product, storage place, packaging conveyance, container, soil and any other organisms, object or material capable of harbouring or spreading pests, deemed to require phytosanitary measures, particularly where international transportation is involved' (FAO 2019). For simplicity, thrips identified as regulated articles are referred to as 'regulated thrips'.

A summary of the risk assessment for quarantine orthotospoviruses transmitted by thrips is presented in Table 4.6.

Table 4.6 Risk estimates for emerging quarantine orthotospoviruses vectored by regulated thrips

Risk component	Rating for emerging quarantine orthotospoviruses
Likelihood of entry (importation x distribution)	Low (Moderate x Moderate)
Likelihood of establishment	Moderate (a)
Likelihood of spread	High (a)
Overall likelihood of entry, establishment and spread	Low
Consequences	Moderate (a)
Unrestricted risk	**Low**

(a): risk estimates for orthotospoviruses adopted from the thrips Group PRA (DAWR 2017).

As assessed in the thrips Group PRA, the unrestricted risk estimate for emerging quarantine orthotospoviruses transmitted by regulated thrips is Low (Table 4.6), which does not achieve the ALOP for Australia.

This unrestricted risk estimate is considered to be applicable for the emerging orthotospoviruses known to be vectored by the thrips species associated with the *Capsicum* spp. fruit from the assessed Pacific Island countries pathway. Therefore, specific risk management measures are required for the regulated thrips to mitigate the risks posed by emerging quarantine orthotospoviruses.

This risk assessment, which is based on the thrips Group PRA, applies to all phytophagous quarantine thrips and regulated thrips on the *Capsicum* spp. fruit from the assessed Pacific Island countries pathway, irrespective of the species identification in this document.

4.5 Pest risk assessment conclusions

Table 4.7 Summary of unrestricted risk estimates for quarantine pests and regulated articles associated with fresh *Capsicum* spp. fruit from Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu

Pest name	Likelihood of						Consequences	URE
	Entry			Establishment	Spread	EES		
	Importation	Distribution	**Overall**					
Fruit flies [Diptera: Tephritidae]								
Bactrocera dorsalis (EP)	High	High	**High**	High	High	High	High	**High**
Bactrocera facialis (EP)	High	High	**High**	High	High	High	High	**High**
Bactrocera kirki	High	High	**High**	High	High	High	High	**High**
Bactrocera passiflorae (EP)	High	High	**High**	High	High	High	High	**High**
Bactrocera trivialis	High	High	**High**	High	High	High	High	**High**
Bactrocera xanthodes	High	High	**High**	High	High	High	High	**High**
Zeugodacus cucurbitae (EP)	High	High	**High**	High	High	High	High	**High**
Whiteflies								
Bemisia tabaci complex (EP)	High	Moderate	**Moderate**	High	High	Moderate	Moderate	**Moderate**
Mealybugs [Hemiptera: Pseudococcidae]								
Planococcus minor (GP, WA)	High	Moderate	**Moderate**	High	High	Moderate	Low	**Low**
Pseudococcus jackbeardsleyi (GP)	High	Moderate	**Moderate**	High	High	Moderate	Low	**Low**
Thrips [Thysanoptera: Thripidae]								
Thrips palmi (GP, SA, WA)	High	Moderate	**Moderate**	High	High	Moderate	Low	**Low**
Orthotospoviruses [Bunyavirales: Tospoviridae] vectored by regulated thrips (*Scirtothrips dorsalis*, *Thrips palmi* and *Thrips tabaci*)								
Listed in the thrips group PRA (GP)	Moderate	Moderate	**Low**	Moderate	High	Low	Moderate	**Low**

EP: Species has been assessed previously and import policy already exists. **GP**: Species has been assessed previously in a group PRA, which is adopted for this assessment. **SA**: Regional quarantine pest for South Australia. **WA**: Regional quarantine pest for Western Australia. **EES**: Overall likelihood of entry, establishment and spread. **URE**: Unrestricted risk estimate.

4.6 Summary of assessment of quarantine pests of concern

This section provides a summary of the assessment of quarantine pests and regulated articles of biosecurity concern as also shown in Figure 17.

The pest categorisation process (Appendix A) identified 82 pests associated with fresh *Capsicum* spp. fruit in Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu. Of these 82 pests:

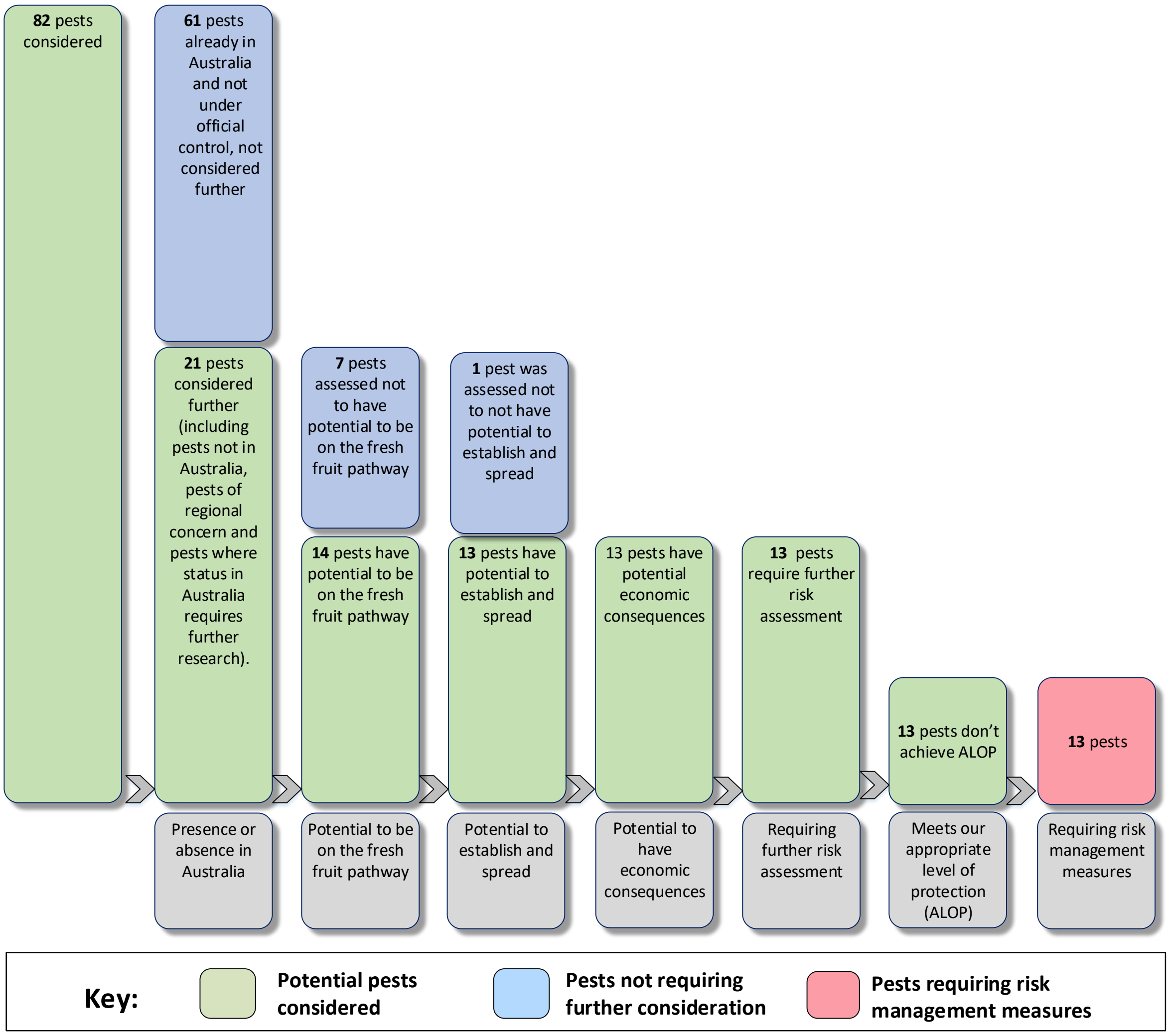
- 61 pests are already present in Australia, and not under official control, and therefore were not considered further
- 7 of the remaining 21 pests were assessed as not having potential to be on the fresh *Capsicum* spp. fruit pathway, and therefore were not considered further
- 1 of the remaining 14 pests was assessed as not having the potential to establish and spread in Australia, and therefore was not considered further.

The outcome of the above process left 13 pests that required further consideration, in the form of a pest risk assessment. Pest risk assessments for these 13 pests were subsequently completed, with outcomes as described below.

- The estimated unrestricted risks for the 13 pests were assessed as not achieving the ALOP for Australia, and thus specific risk management measures are required for these pests on this pathway. These pests are:
    - Oriental fruit fly (*Bactrocera dorsalis*)
    - Tropical fruit fly (*Bactrocera facialis*)
    - Fruit fly (*Bactrocera kirki*)
    - Fijian fruit fly (*Bactrocera passiflorae*)
    - New Guinea fruit fly (*Bactrocera trivialis*)
    - Pacific fruit fly (*Bactrocera xanthodes*)
    - Melon fly (*Zeugodacus cucurbitae*)
    - Whiteflies (*Bemisia tabaci* complex)
    - Pacific mealybug (*Planococcus minor*)
    - Jack Beardsley mealybug (*Pseudococcus jackbeardsleyi*)
    - Chilli thrips (*Scirtothrips dorsalis*)
    - Melon thrips (*Thrips palmi*)
    - Onion thrips (*Thrips tabaci*)

Scirtothrips dorsalis, *T. palmi* and *T. tabaci* were identified as regulated thrips due to their potential to introduce emerging quarantine orthotospoviruses into Australia. *Thrips palmi* is also recognised as a regional quarantine pest for South Australia and Western Australia.

Figure 17 Overview of the PRA decision process for fresh *Capsicum* spp. fruit from Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu



5 Pest risk management

This chapter provides information on the management of quarantine pests and regulated thrips identified as having an unrestricted risk level that does not achieve the appropriate level of protection (ALOP) for Australia. The recommended risk management measures for these pests are described in this chapter. This chapter also describes the operational system that is required for the maintenance and verification of the phytosanitary status of fresh *Capsicum* spp. fruit from Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu for export to Australia.

5.1 Pest risk management measures and phytosanitary procedures

Pest risk management evaluates and selects options for measures to reduce the risk of entry, establishment or spread of quarantine pests and regulated thrips for Australia, where they have been assessed to have an unrestricted risk level that does not achieve the ALOP for Australia. In calculating the unrestricted risk estimate, general commercial production practices in Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu have been considered, including the post-harvest procedures and the packing of fruit (as described in Chapter 3: Commercial production practices for *Capsicum* spp.).

In addition to the general commercial production systems and packing house operations for *Capsicum* spp., specific pest risk management measures are recommended to achieve the ALOP for Australia.

In this chapter, the department has recommended risk management measures and phytosanitary procedures that are to be applied to consignments of fresh *Capsicum* spp. fruit sourced from Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu. Finalisation of import conditions may be undertaken with input from the Australian states and territories as appropriate.

5.1.1 Pest risk management for quarantine pests and regulated thrips

The pest risk analysis process identified the quarantine pests and regulated thrips listed in Table 5.1as having unrestricted risks that do not achieve the ALOP for Australia. Therefore, risk management measures are required to manage the biosecurity risks posed by these pests.

The recommended measures are listed in Table 5.1.

Table 5.1 Risk management measures recommended for quarantine pests and regulated thrips associated with fresh *Capsicum* spp. fruit from Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu

Pest	Common name	Measures
Fruit flies		
Bactrocera dorsalis [EP] *Bactrocera facialis* [EP] *Bactrocera kirki* *Bactrocera passiflorae* [EP] *Bactrocera trivialis* *Bactrocera xanthodes* [EP] *Zeugodacus cucurbitae* [EP]	Oriental fruit fly Tropical fruit fly Fruit fly Fiji fruit fly New Guinea fruit fly Pacific fruit fly Melon fly	Area freedom **a** OR Fruit treatment considered to be effective against all life stages of these fruit fly species (for example, irradiation, high temperature forced air treatment). OR Conditional non-host status for specific *Capsicum* spp. varieties
Whiteflies		
Bemisia tabaci complex [EP]	Whitefly	Pre-export visual inspection and, if found, remedial action **b** OR Pre-export methyl bromide fumigation
Mealybugs		
Planococcus minor [GP, WA] *Pseudococcus jackbeardsleyi* [GP]	Pacific mealybug Jack Beardsley mealybug	Pre-export visual inspection and, if found, remedial action **b** OR Pre-export methyl bromide fumigation
Thrips		
Scirtothrips dorsalis [GP, RA] *Thrips palmi* [GP, RA, SA, WA] *Thrips tabaci* [GP, RA]	Chilli thrips Melon thrips Onion thrips	Pre-export visual inspection and, if found, remedial action **b** OR Pre-export methyl bromide fumigation

a: Area freedom may include pest free areas, pest free places of production or pest free production sites. **b:** Remedial action (depending on the location of the inspection) may include treatment of the consignment to ensure that the pest is no longer viable, or withdrawal of the consignment from export to Australia. **EP** Species has been assessed previously and import policy already exists. **RA**: regulated article, refer to Section 4.4 for definition of a regulated article. **SA**: Pest of biosecurity concern for South Australia. **WA** Pest of quarantine concern for Western Australia.

5.1.2 Risk management measures for quarantine pests and regulated thrips

This final report recommends that when the following risk management measures are applied, the restricted risk for all identified quarantine pests and regulated articles will achieve the ALOP for Australia. These measures are:

- For fruit flies:
  - area freedom (including pest free areas, pest free places of production or pest free production sites), or
  - fruit treatment considered to be effective against all life stages of fruit flies present in the exporting country, or
  - conditional non-host status for specific *Capsicum* spp. varieties and specific fruit fly species.

- For whiteflies, mealybugs and thrips:
  - pre-export visual inspection, and if found, remedial action, or
  - pre-export methyl bromide fumigation

Management for fruit flies

To manage the risk posed by *B. dorsalis*, *B. facialis*, *B. kirki*, *B. passiflorae*, *B. trivialis*, *B. xanthodes* and *Z. cucurbitae*, the department recommends a range of potential management options, including area freedom, fruit treatment considered to be effective against all life stages of fruit flies present in the exporting country, or conditional non host status. The objective of each of the recommended measures is to reduce the risk associated with these fruit fly species to achieve the ALOP for Australia.

A number of phytosanitary treatments are available to eliminate fruit flies, including heat treatments, cold treatments and irradiation (Armstrong 1997). However, many of these treatments may not be suitable for all fresh *Capsicum* spp. fruit varieties (for example high temperature forced air) or are not currently available in the assessed countries (such as gamma irradiation).

Recommended measure 1: Area freedom

The requirements for establishing and maintaining pest free areas are set out in ISPM 4: *Requirements for the establishment of pest free areas* (FAO 2021b), and more specifically for fruit flies, in ISPM 26: *Establishment of pest free areas for fruit flies (Tephritidae)* (FAO 2021i). The requirements for establishing and maintaining pest free places of production and pest free production sites are defined in ISPM 10: *Requirements for the establishment of pest free places of production and pest free production sites* (FAO 2021e).

Monitoring and trapping of fruit flies in the specified export farms and packing houses would be required, consistent with the procedures recommended in ISPM 26. In the event of the detection of any fruit fly species of economic importance in the identified pest free area, pest free place of production or pest free production site, the exporting country's NPPO would be required to notify the department within 48 hours of detection. The department would then assess the pest species, number of flies and specific information on individual flies detected and the circumstances of the detection, before advising the exporting country's NPPO of any action to be taken. If fruit flies were detected during pre-export inspection or during on-arrival inspection, trade under the area freedom pathway would be suspended immediately, pending the outcome of an investigation.

Should any of the assessed Pacific Island countries wish to use area freedom as a measure to manage the risk posed by fruit flies, the country's NPPO will be required to provide a submission to the department for its consideration. The submission must fulfil requirements set out in ISPM 4 (FAO 2021b), ISPM 10 (FAO 2021e) and ISPM 26 (FAO 2021i), and will be subject to approval by the department.

Recommended measure 2: Fruit treatment effective against all life stages of fruit flies

For fresh *Capsicum* spp. fruit sourced from outside the recognised fruit fly pest free areas, places of production or production sites, or where area freedom status has been suspended, an appropriate pre-export phytosanitary treatment recognised and approved by the department for management of fruit flies must be undertaken. Should Pacific Island countries wish to use an appropriate phytosanitary treatment, the NPPO will need to provide Australia with a treatment submission demonstrating efficacy of the proposed treatment for approval by the department.

Recommended measure 3: Conditional non host status for specific Capsicum spp. varieties

There is significant variability in host susceptibility to fruit flies depending on the pest species present and the type of *Capsicum* spp. fruit involved. Research has been undertaken in some Pacific Island countries to ascertain host susceptibility to fruit flies (Allwood & Tora 1998; Heimoana et al. 1997a; Leweniqila & Ralulu 2001). While *Capsicum* spp. broadly are recognised as fruit fly hosts, some chilli varieties have been demonstrated to be non-hosts of some fruit flies.

The Biosecurity Authority of Fiji has requested recognition of conditional non-host status for 3 chilli varieties: bird's eye, red fire and hot rod. This measure is based on studies conducted by Allwood and Tora (1998) and Leweniqila and Ralulu (2001) that tested chilli fruit at different stages of maturity for susceptibility to *B. passiflorae* and *B. xanthodes*, which are the 2 fruit flies of economic importance present in Fiji's horticultural production areas.

In these studies, no fruit of these chilli varieties, at any stage of maturity, were found to be susceptible to infestation by *B. passiflorae* and *B. xanthodes*. However, under the Bilateral Quarantine Agreement with New Zealand, exports for each of these 3 varieties are restricted to fruit at specific stages of maturity, which had the highest statistical confidence based on the number of fruit tested. Therefore, exported red fire chillies must only be at the mature green stage, hot rod chillies must be at the whitish to yellow stage of maturity, while bird's eye chillies must be at the ripe (red) stage of maturity. Export consignments must clearly identify the type of chilli, and the stage they were harvested and packed. This measure has been successfully used by Fiji for export to New Zealand for many years.

Should any of the assessed Pacific Island countries wish to use conditional non-host status as a measure to manage the risk posed by fruit flies, the NPPO of the Pacific Island country would need to submit a proposal to the department for consideration and an export protocol will need to be agreed before trade can commence. This is to ensure the components of the conditional non-host status measure, which may include use of approved seed, segregation of different varieties in the field, ensuring fruit are consistent with expected varietal characteristics, harvesting fruit at specific stage of maturity, secured storage and packaging following harvest and pest monitoring and surveillance, are applied and the conditional non-host status is maintained.

Management for whitefly, mealybugs and regulated thrips

To manage the risk posed by *P. minor*, *P. jackbeardsleyi*, *S. dorsalis*, *T. palmi* and *T. tabaci* and the *B. tabaci* complex, the department recommends either pre-export visual inspection, and if found, remedial action, or methyl bromide fumigation. The objective of the recommended measure is to reduce the risk associate with these pests to achieve the ALOP for Australia.

Recommended measure: Pre-export visual inspection and, if found, remedial action

All consignments of *Capsicum* spp. fruit for export to Australia must be subject to pre-export phytosanitary inspection by the NPPO of the exporting country to ensure that the fruit are free of *B. tabaci* complex whiteflies, the mealybugs *P. minor* and *P. jackbeardsleyi*, and thrips *S. dorsalis*, *T. palmi* and *T. tabaci*.

Pre-export visual inspection must be undertaken by the NPPO of the exporting country in accordance with ISPM 23: *Guidelines for inspection* (FAO 2021h) and consistent with the principles of ISPM 31: *Methodologies for sampling consignments* (FAO 2021g). Export consignments found to contain any of these pests must be subject to remedial action. Remedial action may include withdrawing the consignment from export to Australia, or if available, application of an approved treatment to ensure that the pest is no longer viable.

Recommended measure: Pre-export methyl bromide fumigation

Consignments of *Capsicum* spp. fruit for export to Australia may be subject to pre-export methyl bromide fumigation to ensure that the fruit are free of whiteflies of the *B. tabaci* complex, the mealybugs *P. minor* and *P. jackbeardsleyi*, and thrips *S. dorsalis*, *T. palmi* and *T. tabaci*. This measure will reduce the risks associated with these pests to a level that achieves the ALOP for Australia.

It is recommended that where fumigation with methyl bromide is used, it must be carried out according to the specifications below:

- 32g/m^3 for 2 hours at a fruit pulp temperature of 21 °C or greater at not more than 50% chamber load, or
- 40g/m^3 for 2 hours at a fruit pulp temperature of 16 °C or greater at not more than 50% chamber load, or
- 48g/m^3 for 2 hours at a fruit pulp temperature of 11 °C or greater at not more than 50% chamber load.

5.1.3 Consideration of alternative measures

Consistent with the principle of equivalence detailed in ISPM 11: *Pest risk analysis for quarantine pests* (FAO 2021f), the department will consider any alternative measure proposed by an NPPO, providing that it demonstrably manages the target pest to achieve the ALOP for Australia. Evaluation of such measures will require a technical submission from the NPPO that details the proposed measures, including suitable information to support claims of efficacy, for consideration by the department.

5.2 Operational system for the maintenance and verification of phytosanitary status

A system of operational procedures is necessary to maintain and verify the phytosanitary status of fresh *Capsicum* spp. fruit from Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu. This is to ensure that the recommended risk management measures have been met and are maintained.

5.2.1 A system of traceability to production sites

The objectives of this recommended procedure are to ensure that:

- *Capsicum* spp. fruit are sourced only from registered farms located in Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu producing commercial export-quality fruit.
- Farms from which *Capsicum* spp. fruit are sourced can be identified, so investigation and corrective action can be targeted, rather than applied to all contributing export properties, in the event that live pests/viable pests are intercepted.
- Where *Capsicum* spp. fruit is grown in an approved pest-free area, pest free place of production or pest free production site, it can be verified that all fruit was sourced from that area and produced and exported under the conditions for that pathway.
- Where *Capsicum* spp. fruit is exported under conditional non-host status for fruit flies, it can be verified that all fruit has been produced and exported under the conditions for that pathway.

Export production sites are registered with the exporting country's NPPO before commencement of each harvest season. The list of registered production sites must be kept by the NPPO. NPPOs must ensure that *Capsicum* spp. fruit for export to Australia can be traced back to registered commercial export farms in their respective countries. NPPOs are required to ensure the registered production sites are suitably equipped and have a system in place to carry out the specified phytosanitary activities. NPPOs are responsible for ensuring that export growers are aware of pests of biosecurity concern to Australia and the required risk management measures. Records of NPPO audits will be made available to the department upon request.

5.2.2 Registration of packing houses and auditing of procedures

The objectives of this recommended procedure are to ensure that:

- Commercially grown export quality *Capsicum* spp. fruit are sourced only from packing houses that are approved by the exporting country's NPPO.

Export packing houses must be registered with the exporting country's NPPO before the commencement of harvest each season. The list of registered packing houses must be kept by the exporting country's NPPO. The exporting country's NPPO is required to ensure that the registered packing houses are suitably equipped and have a system in place to carry out the specified phytosanitary activities. Records of the exporting country's NPPO packing house audits must be made available to the department on request.

5.2.3 Registration of treatment providers and auditing of procedures

The objectives of this recommended procedure are to ensure that:

- Commercially grown export quality *Capsicum* spp. are treated by treatment providers that have been approved by the exporting country's NPPO.

In circumstances where fruit undergo treatment prior to export, this process must be undertaken by treatment providers that have been registered with and audited by the exporting country's NPPO for that purpose. Records of the exporting country's NPPO registration requirements and audits are to be made available to the department upon request.

The approval of treatment providers by the exporting country's NPPO must include verification that suitable systems are in place to ensure compliance with the treatment requirements. This may include:

- documented procedures to ensure *Capsicum* spp. are appropriately treated and safeguarded post-treatment
- staff training to ensure compliance with procedures
- record-keeping procedures
- suitability of facilities and equipment
- compliance with the exporting country's NPPO's system of oversight of treatment application.

Following review of the regulatory oversight provided by the exporting country's NPPO and the type of treatment, the department may request to provide approval of the treatment facility. Site visits may be required as part of this approval process. Once the department has assurance that the treatment can be applied accurately and consistently, the department will publish the import conditions on BICON.

5.2.4 Packaging, labelling and containers

The objectives of this recommended procedure are to ensure that:

- *Capsicum* spp. fruit intended for export to Australia, and associated packaging, are not contaminated by quarantine pests or regulated articles (as defined in ISPM 5*: Glossary of phytosanitary terms* (FAO 2021c)).
- Unprocessed packing material, which is not permitted, as it may vector other pests not associated with *Capsicum* spp. fruit, is not imported with the fruit.
- All wood material associated with the consignment-used in packaging and transport of *Capsicum* spp. fruit must comply with the department's import requirements, as published on BICON.
- Secure packaging is used for export of *Capsicum* spp. fruit to Australia to prevent re-infestation during storage and transport and prevent escape of pests during clearance procedures on arrival in Australia. To make consignments insect proof and secure, at least 1 of the following packaging options must be used:
  - **integral cartons**: produce may be packed in integral (fully enclosed) cartons (packages) with boxes having no ventilation holes and lids tightly fixed to the bases
  - **ventilation holes of cartons covered**: cartons (packages) with ventilation holes must have the holes covered/sealed with a mesh/screen of no more than 1.6mm pore size and not less than 0.16mm strand thickness. Alternatively, the vent holes could be taped over
  - **polythene liners**: vented cartons (packages) with sealed polythene liners/bags within are acceptable (folded polythene bags are acceptable)

  - **meshed or shrink wrapped pallets or Unit Loading Devices (ULDs)**: ULDs transporting cartons with open ventilation holes/gaps, or palletised cartons with ventilation holes/gaps must be fully covered or wrapped with polythene/plastic/foil sheet or mesh/screen of no more than 1.6 mm diameter pore size and not less than 0.16mm strand thickness
  - **produce transported in fully enclosed containers**: cartons (packages) with holes as loose boxes or on pallets may be transported in fully enclosed containers. Enclosed containers include 6-sided container with solid sides, or ULDs with tarpaulin sides that have no holes or gaps. The container must be transported to the inspection point intact.
- the packaged *Capsicum* spp. fruit are labelled with sufficient identifying information for purposes of traceability, including (if applicable):
  - the source farm reference number
  - packing house registration reference/number
  - the treatment facility name/number and treatment identification number.

Export packing houses and treatment providers (where applicable) must ensure packaging and labelling are appropriate to maintain the phytosanitary status of the export consignments.

5.2.5 Specific conditions for storage and movement

The objective of this recommended procedure is to ensure that the quarantine integrity of *Capsicum* spp. fruit is maintained during storage and movement.

Capsicum spp. fruit for export to Australia that have been treated and/or inspected by the exporting country NPPO must be kept secure and segregated at all times from any fruit for domestic or other markets, and from untreated/uninspected product, to prevent mixing or cross-contamination.

5.2.6 Freedom from trash

The objective of this recommended procedure is to ensure that fresh *Capsicum* spp. fruit packed for export to Australia are free from trash (for example, loose stem and leaf material, seeds, soil, animal matter/parts or other extraneous material) and foreign matter.

Freedom from trash will be confirmed by the inspection procedures. Export lots or consignments found to contain trash or foreign matter must be withdrawn from export unless approved remedial action such as reconditioning is available and applied to the export consignment, and then re-inspected.

5.2.7 Pre-export phytosanitary inspection and certification

The objective of this recommended procedure is to ensure that Australia’s import requirements have been met. All consignments of *Capsicum* spp. fruit for export to Australia must be inspected by the exporting country NPPO and found free of pests of biosecurity concern for Australia. Pre-export visual inspection must be undertaken by the exporting country regulatory officials in accordance with ISPM 23: *Guidelines for inspection* (FAO 2021h) and consistent with the principles of ISPM 31: *Methodologies for sampling of consignments* (FAO 2021j).

All consignments must be inspected in accordance with official procedures for all visually detectable quarantine pests and regulated articles (including soil and trash) using random samples of 600 units per phytosanitary certificate, or equivalent, as per ISPM 31: *Methodologies for sampling consignments* (FAO 2021j). One unit is considered to be a single chilli or capsicum fruit.

A phytosanitary certificate must be issued for each consignment upon completion of pre-export inspection and treatment (if applicable) to verify that the required risk management measures have been undertaken prior to export and the consignment meets Australia's import requirements.

Each phytosanitary certificate must include:

– a description of the consignment (including traceability information);
– details of disinfestation treatments (if applicable), which includes date, concentration, temperature, duration, and/or attached fumigation certificate (as appropriate);
– details of fruit variety and maturity status (if applicable)
– any other statements that may be required such as identification of the consignment as being sourced from a recognised pest free area, pest free place of production or pest free production site.

5.2.8 Phytosanitary inspection by the Department of Agriculture, Water and the Environment

The objectives of this recommended procedure are to ensure that:

- consignments comply with Australian import requirements
- consignments are as described on the phytosanitary certificate
- quarantine integrity has been maintained.

On arrival in Australia, the department will:

– assess documentation to verify that the consignment is as described on the phytosanitary certificate, that required phytosanitary actions have been undertaken, and that product security has been maintained
– verify that the biosecurity status of the consignments of *Capsicum* spp. fruit from Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu meet Australia's import conditions. When inspecting consignments, the department will use random samples of 600 units, or equivalent, per phytosanitary certificate and inspection methods suitable for the commodity.

5.2.9 Remedial action(s) for non-compliance

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

- any quarantine pest or regulated article, including trash, is addressed by remedial action, as appropriate
- non-compliance with import requirements is addressed, as appropriate.

Any consignment that fails to meet Australia's import requirements will be subject to suitable remedial treatment where an effective treatment is available and biosecurity risks associated with applying the treatment can be effectively managed, or the imported consignment will be exported or destroyed.

Other actions, including partial or complete suspension of the import pathway, may be taken depending on the identity and/or importance of the pest intercepted, for example, fruit flies of biosecurity concern, or pests for which area freedom is established.

In the event that fresh *Capsicum* spp. fruit consignments from the assessed Pacific Island countries are repeatedly non-compliant, the department may require enhanced risk management measures, including mandatory phytosanitary treatment. The department reserves the right to suspend imports (either all imports, or imports from specific pathways) and conduct an audit of the risk management systems. Imports will be allowed to recommence only when the department is satisfied that appropriate corrective action has been undertaken.

5.3 Uncategorised pests

If an organism that has not been categorised in this review, including contaminant pests, is detected on fresh *Capsicum* spp. fruit on arrival in Australia, it will require assessment by the department to determine its quarantine status and whether phytosanitary action is required.

Assessment will also be required if the detected species was categorised as not likely to be on the import pathway. If the detected species was categorised as being on the pathway but assessed as having an unrestricted risk that achieves the ALOP for Australia, then it may require reassessment. The detection of any species of biosecurity concern not already identified in this risk analysis may result in remedial action and/or temporary suspension of trade while a review is conducted to ensure that existing measures continue to provide the ALOP for Australia.

5.4 Review of processes

5.4.1 Verification of protocol

Prior to or during the first season of trade, the department will verify the implementation of the required import requirements including registration, operational procedures and treatment providers, where applicable. For example, for measures conducted pre-export, the department may require information about standard operating procedures (SOPs). This may involve representatives from the department visiting areas in Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu that produce *Capsicum* spp. fruit for export to Australia.

5.4.2 Review of policy

The department will review the import policy after a suitable volume of trade has been achieved to ensure import requirements continue to be appropriate to the biosecurity risk of the pathway. In addition, the department reserves the right to review the import policy as deemed necessary, including if there is reason to believe that the pest or phytosanitary status in Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga or Vanuatu has changed, or where alternative risk management or compliance-based intervention options become available.

The exporting country's NPPO must inform the department immediately on detection of any newly identified pests or diseases of *Capsicum* spp. fruit in their respective countries that may be of potential biosecurity concern to Australia, or when the phytosanitary status of a pest has changed, in accordance with ISPM 8: *Determination of pest status in an area* (FAO 2021d).

5.5 Meeting Australia's food laws

Imported food for human consumption must comply with the requirements of the *Imported Food Control Act 1992,* as well as Australian state and territory food laws. Among other things, these laws require all food, including imported food, to meet the standards set out in the Australia New Zealand Food Standards Code (the Code).

The department administers the *Imported Food Control Act 1992.* This legislation provides for the inspection and control of imported food using a risk-based border inspection program, the Imported Food Inspection Scheme. More information on this inspection scheme, including the testing of imported food, is available from the department's website at: awe.gov.au/biosecurity-trade/import/goods/food/inspection-compliance/inspection-scheme.

Food Standards Australia New Zealand (FSANZ) is responsible for developing and maintaining the Code, including Standard 1.4.2– Agvet chemicals. This standard is available on the Federal Register of Legislation (legislation.gov.au) or through the FSANZ website (foodstandards.gov.au/code/Pages/default.aspx).

Standard 1.4.2 and Schedules 20 and 21 of the Code set out the maximum residue limits (MRLs) and extraneous residue limits (ERLs) for agricultural or veterinary chemicals that are permitted in food, including imported food.

Standard 1.1.1 of the Code specifies that a food must not have, as an ingredient or a component, a detectable amount of an agricultural and veterinary chemical, or a metabolite or a degradation product of the agricultural and veterinary chemical, unless expressly permitted by the Code.

6 Conclusion

The findings of this final risk analysis for fresh *Capsicum* spp. fruit from Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu are based on a comprehensive scientific analysis of relevant literature, and other avenues of enquiry.

The Department of Agriculture, Water and the Environment considers that the risk management measures recommended in this report will provide an appropriate level of protection against the quarantine pests and regulated articles identified as associated with the trade of fresh *Capsicum* spp. (chillies and capsicums) from Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu.

Appendix A: Initiation and categorisation for pests of fresh *Capsicum* spp. fruit from Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu

The table identifies pests that have the potential to be present on *Capsicum* spp. grown in Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu using general commercial production and packing procedures, and to be imported into Australia.

The purpose of pest categorisation is to ascertain which of these pests require detailed assessment in order to determine whether phytosanitary measures are appropriate. The steps in the pest categorisation process are considered sequentially. The assessment terminates at 'Yes' for the third column (presence within Australia), except for pests that are present, but under official control and/or regional quarantine pests. In cases where this does not apply, assessment terminates at the first 'No' in any of the following columns.

In the final column of the table (column 7) the acronyms 'EP', 'SA' and 'WA' are used. The acronym EP (existing policy) is used for pests that had previously been assessed by Australia and for which import policy exists. The acronyms 'SA' (South Australia) and 'WA' (Western Australia) are used to identify organisms that have been recorded in some regions of Australia, but due to interstate quarantine regulations, are considered regional quarantine pests for South Australia and Western Australia.

The *Final group pest risk analysis for thrips and orthotospoviruses on fresh fruit, vegetable, cut-flower and foliage imports* (DAWR 2017) and the *Final group pest risk analysis for mealybugs and viruses they transmit on fresh fruit, vegetable, cut-flower and foliage imports* (DAWR 2019) have been applied in this risk analysis. Application of group policy involves identification of up to 3 species of each relevant group associated with the commodity pathway. However, if any other quarantine pests or regulated articles not included in this risk analysis and/or in the relevant group policies is detected at pre-export or on arrival in Australia, the relevant group policy will also apply.

Details of the method used in this risk analysis are given in Chapter 2: Method for pest risk analysis.

This is not a comprehensive list of all pests associated with the entire *Capsicum* spp. plant, and it does not include soil-borne pests and pathogens, or wood-borers, root pests and secondary pests, as these are not directly related to the export pathway of fresh fruit. Other pests that may occasionally be detected in trade, which are not specifically associated with *Capsicum* spp. fruit are not considered here. Any such contaminant pests detected at the border are managed under existing standard operational procedures. It is important to note that any quarantine pests detected during on-arrival phytosanitary inspections will be actioned appropriately, even if they have not been assessed in this report.

The department is aware of the recent changes in fungal nomenclature concerning the separate naming of sexual/asexual states of fungi. However, as the nomenclature for these fungi is in a phase of transition and many priorities of names are still to be resolved, this report uses the generally accepted names and provides alternatively used names as synonyms, where required.

Pest	Present in Pacific Island countries	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
ARTHROPODS						
Coleoptera						
Henosepilachna vigintioctopunctata (Fabricius, 1775) [Coccinellidae] 28-spotted ladybird	Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga, Vanuatu (Richards 1983; Waterhouse & Norris 1987).	Yes. Recorded in NSW, NT, Qld and WA (Richards 1983; Waterhouse & Norris 1987).	Assessment not required	Assessment not required	Assessment not required	No
Diptera						
Atherigona orientalis (Schiner, 1868) Synonym: *Atherigona excisa* (Thomson, 1869) [Muscidae] Pepper fruit fly	Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga, Vanuatu (Pont 1991).	Yes. Present in NSW, Qld and WA (Pont 1991).	Assessment not required	Assessment not required	Assessment not required	No
Bactrocera bryoniae (Tryon, 1927) [Tephritidae] Fruit fly	Papua New Guinea (Leblanc, Vueti & Allwood 2013).	Yes. Present in NSW, NT, Qld and WA (PHA 2018).	Assessment not required	Assessment not required	Assessment not required	No
Bactrocera dorsalis (Hendel, 1912) [Tephritidae] Oriental fruit fly	Papua New Guinea (reported as *Bactrocera papayae*) (Leblanc et al. 2012).	No. Eradicated from mainland Australia. An incursion in Far North Queensland (under the name of *Bactrocera papayae*) was eradicated in 1999 and has been detected and eradicated from the Torres Strait islands a number of times (Cantrell, Chadwick & Cahill 2002).	Yes. *Capsicum annuum* is a host (White & Elson-Harris 1994). Not commonly a pest of chilli in Papua New Guinea (NAQIA 2018 pers. comm.), but it has been reported in *Capsicum* sp. in Papua New Guinea (Leblanc et al. 2012).	Yes. *Bactorcera dorsalis* is a highly polyphagous invasive pest that has readily established and become widespread in many countries (Leblanc, Vargas & Putoa 2013). *Bactrocera dorsalis* has the potential to establish and spread in Australia as sutiable hosts and environments are available. It has previoulsy established in areas of Australia (North Queensland and Torres Strait islands) before being eradicated.	Yes. *Bactrocera dorsalis* has the potential for economic consequences in Australia. This species is highly polyphagous, feeding on over 150 plant hosts (Allwood et al. 1999), and causes damage to many fruit crops including citrus, mango, papaya, lychee, chilli and tomato (Leblanc et al. 2012). Consequences include crop losses and could have a significant impact on access to export markets where this pest is not present.	Yes (EP)

Pest	Present in Pacific Island countries	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Bactrocera facialis (Coquillett, 1909) [Tephritidae] Tropical fruit fly	Tonga (Leblanc et al. 2012).	Not known to occur	Yes. Recorded on chilli in Tonga (Leblanc et al. 2012). Capsicum (bell pepper) is a host (Litsinger et al. 1991).	Yes. This species has yet to spread beyond Tonga (Litsinger et al. 1991), but suitable hosts are widely available in Australia and parts of Australia have similar climatic conditions to Tonga where this pest is currently established.	Yes. Potentially a major pest species (Drew, Hooper & Bateman 1982). This fruit fly attacks a large number of plant hosts, including many of economic importance to Australia such as citrus, peach and tomato (Litsinger et al. 1991). Losses of up to 100% of capsicum fruit and up to 97% of chillies have been reported in Tonga (Allwood & Leblanc 1997).	Yes (EP)
Bactrocera kirki (Froggatt, 1910) [Tephritidae] Fruit fly	Fiji, Samoa, Tonga (Leblanc et al. 2012; White & Elson-Harris 1994). Distribution in Fiji is restricted to the island of Rotuma (Tora Vueti 2000).	Not known to occur	Yes. *Capsicum frutescens* is a host (Drew 1989). This species was also reared on capsicum (*C. annuum* var. *grossum*) in a laboratory study in Tonga (Litsinger et al. 1991). *Bactrocera kirki* is not considered to be on the pathway from Fiji, as within Fiji, *B. kirki* is only found on the island of Rotuma, which is more than 500km from the main production areas. Movement of fresh goods from Rotuma is regulated.	Yes. This is a polyphagous species recorded from more than 40 host species in at least 19 plant families (Leblanc et al. 2012). Hosts such as mango, papaya, avocado, citrus and tomato (PHA 2018) are widely available in Australia. It occurs in a number of Pacific Island countries in environments similar to parts of Australia, suggesting a potential for establishment and spread.	Yes. This species is a potential pest of commercial crops grown in Australia such as limes, oranges, mandarin, mango, peach and pineapple (White & Elson-Harris 1994). *Bactrocera kirki* is responsible for significant damage in guava crops in Samoa, causing up to 99% fruit loss (Allwood & Leblanc 1997).	Yes

Pest	Present in Pacific Island countries	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Bactrocera passiflorae (Froggatt, 1911) [Tephritidae] Fijian fruit fly	Fiji (Leblanc et al. 2012), Tonga (Heimoana et al. 1997b). Records from the Tongan archipelago (Niuatoputapu and Niuaf'ou islands) are likely to be the undescribed *B. passiflorae* (sp. nr.) (Leblanc et al. 2012), which has a more restricted host range, and has not been reported on *Capsicum* spp.	Not known to occur	Yes. This species has been recorded on chillies in Fiji (Hinckley 1965a). However, some chilli varieties have been demonstrated to be conditional non-hosts (Heimoana et al. 1997a).	Yes. This species could establish in parts of Australia as it has a broad host range. Suitable host plants are common in many areas.	Yes. This species is a serious economic pest in Fiji. It has been recorded on nearly 50 plant hosts in the Pacific region, including many citrus varieties, mango, avocado, coffee and cashew (Leblanc et al. 2012). Losses of up to 60% of cumquat fruit, 40–90 % of guava and 20–25% of mango fruit have been reported in Fiji (Allwood & Leblanc 1997)	Yes (EP)
Bactrocera simulata (Malloch, 1939) [Tephritidae] Fruit fly	Papua New Guinea (Bougainville), Solomon Islands (Leblanc et al. 2012). Old records from Vanuatu are likely to be misidentifications (Allwood et al. 1997).	Not known to occur	No. A single report of this species attacking chillies in the Santa Cruz islands (remote islands in the far east of the Solomon Islands archipelago) (Waterhouse 1993) is considered dubious and not confirmed by host surveys (Leblanc, Vueti & Allwood 2013). Not reported to be a pest of economic significance in the Solomon Islands, where it is common (Hollingsworth et al. 2003), so unlikely to be associated with commercially produced *Capsicum* spp. fruit.	Assessment not required	Assessment not required	No

Pest	Present in Pacific Island countries	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Bactrocera trivialis (Drew, 1971) [Tephritidae] New Guinea fruit fly	Papua New Guinea (Leblanc et al. 2001).	Not established in mainland Australia. There are occasional detections in the Torres Strait islands, and subsequently eradicated under the Torrs Strait fruit fly eradication program (PHA 2018).	Yes. Chilli is a host (PHA 2018). Recorded from tabasco chilli (*C. frutescens*) in Papua New Guinea (Leblanc et al. 2001).	Yes. This species could potentially establish and spread in tropical areas of northern Australia where the climatic conditions are similar to that in the regions where the pest is currently established. This species is polyphagous and recorded on hosts from 10 families (PHA 2018), including commercial hosts grown in Australia such as mango, orange, grapefruit, peach and guava (White & Elson-Harris 1994).	Yes. Considered to be a pest of economic significance in Papua New Guinea (Tenakanai 1997), but reported to typically only cause limited damage compared to other fruit fly species (Leblanc et al. 2001).	Yes
Bactrocera xanthodes (Broun, 1904) [Tephritidae] Pacific fruit fly	Fiji, Samoa, Tonga (Leblanc et al. 2012). Old records from Vanuatu are misidentifications (Allwood et al. 1997).	Not known to occur	Yes. There is a record of this species being reared on capsicum (*C. annuum*) in a laboratory study in Tonga (Litsinger et al. 1991). However, Leblanc *et al*. (2012) considers the host association reported by Litsinger (1991) to be a dubious host record, as *B. xanthodes* was not detected in *C. annuum* fruit in intensive field host surveys undertaken to confirm host status (Leblanc et al. 2012).	Yes. This is a polyphagous pest, and hosts are widely available in Australia. Hosts include capsicum, citrus, papaya, tomato and watermelon (White & Elson-Harris 1994).	Yes. This species is associated with a number of economically important hosts. It has the potential to become a very serious pest in areas where extensive horticulture is undertaken (Drew, Hooper & Bateman 1982). In papaya crop losses of up to 37% have been reported (Allwood & Leblanc 1997).	Yes

Pest	Present in Pacific Island countries	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Liriomyza sativae (Blanchard, 1938) [Agromyzidae] Vegetable leaf miner	Papua New Guinea, Samoa, Vanuatu (Blacket et al. 2015; CABI 2021).	Yes. Present in Torres Strait and limited in distribution on mainland Australia to Cape York Peninsula (Blacket et al. 2015; IPPC 2017). Declared organism (Prohibited - s12) for WA (Government of Western Australia 2020).	No. *Capsicum* is a host (Waterhouse & Norris 1987), but this species is not associated with the fruit. Eggs are oviposited into the leaves below the epidermis (Waterhouse & Norris 1987). The pest is unlikely to be present on *Capsicum* spp. fruit packed for export.	Assessment not required	Assessment not required	No
Liriomyza trifolii (Burgess, 1880) [Agromyzidae] Serpentine leaf miner	Fiji, Solomon Islands (PestNet 2021), Samoa, Tonga (Waterhouse & Norris 1987).	Yes. Present in Qld (restricted to the Far Northern Biosecurity Zone 1) and WA (IPPC 2021). *Liriomyza trifolii* is currently considered to be present, not widely distributed and under regional official control in Qld and WA (IPPC 2021).	No. Capsicum is a host (Waterhouse & Norris 1987), but this species is not associated with the fruit. Eggs are oviposited into the leaves below the epidermis. Larvae feed within the leaves, with a preference for the palisade cells in the mesophyll (Waterhouse & Norris 1987). The pest is unlikely to be present on *Capsicum* spp. fruit packed for export.	Assessment not required	Assessment not required	No

Pest	Present in Pacific Island countries	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Zeugodacus cucurbitae (Coquillett, 1899) Synonym: *Bactrocera cucurbitae* (Coquillett, 1899) [Tephritidae] Melon fly	Papua New Guinea, Solomon Islands (Leblanc et al. 2012; White & Elson-Harris 1994).	No records found for mainland Australia. There are occasional outbreaks in the Torres Strait Protected Zone (CSIRO 2004), which has an established fruit fly eradication program.	Yes. *Capsicum* spp. are hosts (Dhillon et al. 2005; Vayssières, Rey & Traoré 2007). Field infestations of capsicums and chillies have been reported in Hawaii, Japan, Tanzania, Benin, Burkina Faso and Mali (McQuate, Liquido & Nakamichi 2017). This species has not been reported infesting *Capsicum* spp. in Papua New Guinea or Solomon Islands, where *Z. cucurbitae* is present, however the possibility of infestation cannot be discounted.	Yes. *Zeugodacus cucurbitae* is primarily a pest of cucurbitaceous crops and it has been reported to damage 81 host plant species (Allwood et al. 1999; Dhillon et al. 2005; FDACS 2017). Its host range includes pawpaw, guava, mango, pear, strawberry, avocado, citrus, squash, cucumber and watermelon (White & Elson-Harris 1994). It is widely distributed across Asia, Africa and Oceania (PHA 2018). It's hosts, and geographic distribution of this pest suggests that it could establish and spread in Australia.	Yes. This species is a very serious pest of cucurbit crops (White & Elson-Harris 1994), many of which are commercially grown in Australia. It can cause up to 100 per cent damage, depending on the cucurbit species and the season (Dhillon et al. 2005).	Yes (EP)

Pest	Present in Pacific Island countries	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Hemiptera						
Aleurodicus dispersus (Russell, 1965) [Aleyrodidae] Spiralling whitefly	Fiji, Papua New Guinea, Samoa, Tonga (Botha, Hardie & Power 2000; Waterhouse & Norris 1989).	Yes. Present in NT (Chin et al. 2011) and Qld (Carver & Reid 1996). Declared organism (Prohibited - s12) for WA (Government of Western Australia 2020).	No. Spiralling whiteflies are usually found on the underside of leaves (Nasruddin & Stocks 2014). In heavy infestations they may also be found on the upper leaf surface, as well as the fruit of some host plants (Botha, Hardie & Power 2000). The presence of flocculent white waxy deposits produced by the nymphs, as well as excreted honeydew and associated sooty mould mean affected fruit is easily visible and unlikely to be harvested for export.	Assessment not required	Assessment not required	No
Aleurothrixus trachoides (Back, 1912) Synonym: *Aleurotrachelus trachoides* (Back, 1912) [Aleyrodidae] Pepper whitefly	Fiji (Wilson and Evenhuis 2011), Papua New Guinea, Tonga (Malumphy & Reid 2017), Solomon Islands (QDAF 2019).	No records found on mainland Australia. Present in Torres Strait (Boigu Island) (QDAF 2019)	No. *Capsicum* spp. are recorded as hosts (Evans 2007), although this species feeds on leaves and young shoots. Fruit of some hosts may also be attacked (Malumphy & Reid 2017), but their presence would be readily apparent due to the presence of large amounts of white waxy material. Affected fruit is unlikely to be exported.	Assessment not required	Assessment not required	No

Pest	Present in Pacific Island countries	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Aonidiella aurantii (Maskell, 1879) [Diaspididae] Red scale	Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga, Vanuatu (Williams & Watson 1988a).	Yes. Recorded in NSW, NT, Qld, SA, Vic. and WA (ALA 2021; Donaldson & Tsang 2019).	Assessment not required	Assessment not required	Assessment not required	No
Aphis craccivora (Koch, 1854) [Aphididae] Groundnut aphid	Fiji (CABI 2021; Hinckley 1965b), Papua New Guinea, Samoa, Solomon Islands (CABI 2021), Tonga (CABI 2021; Carver, Hart & Wellings 1993).	Yes. Widespread in Australia (CABI 2021; Gutierrez et al. 1974).	Assessment not required	Assessment not required	Assessment not required	No
Aphis gossypii Glover, 1877 [Aphididae] Cotton aphid	Fiji, Samoa, Tonga, Vanuatu (Carver, Hart & Wellings 1993; Stout 1982).	Yes. Recorded in NSW, NT, Qld, SA, Tas., Vic. and WA (Hollis & Eastop 2014).	Assessment not required	Assessment not required	Assessment not required	No
Aphis nerii Boyer de Fonscolombe, 1841 [Aphididae] Sweet pepper aphid	Fiji, Samoa, Solomon Islands and Vanatu (Carver, Hart & Wellings 1993).	Yes. Recorded in ACT, Qld, SA Vic. and WA (Brumley 2020; CABI 2021).	Assessment not required	Assessment not required	Assessment not required	No
Aphis spiraecola Patch, 1914 [Aphididae] Spirea aphid	Fiji, Papua New Guinea, Vanuatu (CABI 2021).	Yes. Recorded in NSW, Qld, SA, Tas., Vic. and WA (Brumley 2020; CABI 2021; Government of Western Australia 2020).	Assessment not required	Assessment not required	Assessment not required	No
Aspidiotus destructor Signoret, 1869 [Diaspididae] Coconut scale	Fiji, Papua New Guinea, Samoa, Solomon Islands, Vanuatu (García Morales et al. 2021; Williams & Watson 1988a).	Yes. NSW, NT, Qld and WA (Donaldson & Tsang 2019; Poole 2010).	Assessment not required	Assessment not required	Assessment not required	No

Pest	Present in Pacific Island countries	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Bemisia tabaci (Gennadius, 1889) complex [Aleyrodidae] Whitefly	Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu (de Barro, Liebregts & Carver 1998). The species status of populations in these countries has not been resolved.	No. At least 3 species (AUS1, AUS II and MEAM 1) are known to be present in Australia, but most complex species remain absent from Australia.	Yes. Recorded on an unspecified *Capsicum* sp. in the Pacific (as 'Nauru' biotype) (de Barro, Liebregts & Carver 1998). *Bemisia tabaci* adults and nymphs are phloem feeders, typically found on the leaves of host plants (CABI 2021). However, pest interception records indicate species of the *B. tabaci* complex can be present on fresh chillies and capsicums fruit in international trade (EUROPHYT 2020).	Yes. Some *B. tabaci* complex whiteflies are highly invasive (Guo et al. 2021), and many species have wide geographical distribution ranges. Hosts of *B. tabaci* whiteflies in Pacific Island countries include broccoli, cucumber, tomato, pumpkin, sweet potato, lantana, sowthistle and dwarf poinsettia (de Barro, Liebregts & Carver 1998), which are common in many parts of Australia.	Yes. *Bemisia tabaci* complex whiteflies feed on many plant hosts of economic importance, directly causing damage by feeding on plant hosts, which can result in irreversible physiological disorders. In addition, indirect damage can be caused by vectoring of begomoviruses, and honeydew contamination, which encourages growth of sooty mould (de Barro, Liebregts & Carver 1998).	Yes (EP)
Coccus hesperidum Linnaeus, 1758 [Coccidae] Brown soft scale	Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga, Vanuatu (Ben-Dov 1993; Williams & Watson 1990).	Yes. Recorded in NSW, NT, Qld, SA, Tas., Vic. and WA (CSIRO 2004; Smith, Beattie & Broadley 1997).	Assessment not required	Assessment not required	Assessment not required	No
Hemiberlesia lataniae (Signoret, 1869) Synonym: *Abgrallaspis lataniaei* (Signoret, 1869) [Diaspididae] Latania scale	Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga, Vanuatu (Williams & Watson 1988a).	Yes. Recorded in NSW, Qld and WA (Donaldson & Tsang 2019).	Assessment not required	Assessment not required	Assessment not required	No
Icerya seychellarum (Westwood, 1855) [Monophlebidae] Seychelles fluted scale	Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga, Vanuatu (Beardsley 1966; Lever 1945; Williams & Watson 1990).	Yes. Recorded in Qld, NT (Unruh & Gullan 2008) and WA (Poole 2010).	Assessment not required	Assessment not required	Assessment not required	No

Pest	Present in Pacific Island countries	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Maconellicoccus hirsutus (Green, 1908) [Pseudococcidae] Pink hibiscus mealybug	Fiji (Hodgson & Lagowska 2011), Papua New Guinea, Tonga (Ben-Dov 1994).	Yes. Recorded in Qld, NT, SA and WA (Ben-Dov 1994).	Assessment not required	Assessment not required	Assessment not required	No
Myzus persicae (Sulzer, 1776) [Aphididae] Green peach aphid	Fiji, Solomon Islands, Tonga (CABI 2021).	Yes. Recorded in NSW, NT, Qld, SA, Tas., Vic. and WA (CABI 2021; Edwards et al. 2008).	Assessment not required	Assessment not required	Assessment not required	No
Nezara viridula (Linnaeus, 1758) [Pentatomidae] Green vegetable bug	Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga (Waterhouse & Norris 1987).	Yes. Recorded in NSW, NT, Qld, SA, Tas., Vic. and WA (ALA 2021).	Assessment not required	Assessment not required	Assessment not required	No
Parasaissetia nigra (Nietner, 1861) [Coccidae] Nigra scale	Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga, Vanuatu (García Morales et al. 2021; Williams & Watson 1990).	Yes. Recorded in NSW, NT, Qld, Vic. and WA (CSIRO 2004).	Assessment not required	Assessment not required	Assessment not required	No
Phenacoccus parvus Morrison, 1924 [Pseudococcidae] Lantana mealybug	Fiji (Hodgson & Lagowska 2011), Samoa, Vanuatu (Williams & Watson 1988b).	Yes. Recorded in NT, Qld and WA (CSIRO 2004).	Assessment not required	Assessment not required	Assessment not required	No
Pinnaspis strachani (Cooley, 1899) [Diaspididae] Hibiscus snow scale	Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga, Vanuatu (Williams & Watson 1990).	Yes. Recorded in SA (Brookes 1964), NT, Qld and WA (Poole 2010).	Assessment not required	Assessment not required	Assessment not required	No

Pest	Present in Pacific Island countries	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Planococcus minor (Maskell, 1897) Synonym: *Planococcus pacificus* Cox, 1981 [Pseudococcidae] Pacific mealybug	Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga, Vanuatu (Ben-Dov 1994; Williams & Watson 1988b).	Yes. Recorded in NSW, NT, Qld and SA (CSIRO 2004). Declared organism (Prohibited - s12) for WA (Government of Western Australia 2020).	Yes. Recorded on *Capsicum* spp. plants in the Pacific Islands (Williams & Watson 1988b). This species can be spread via trade of many fruit commodities (Francis, Kairo & Roda 2012; Venette & Davis 2004), so could be present on exported fresh *Capsicum* spp. fruit.	Yes. This species is polyphagous and has a high reproductive rate, and has successfully established in a number of countries following its introduction (Francis, Kairo & Roda 2012). It has already established in eastern Australia.	Yes. This species is a serious pest in some countries. It can affect crops such as banana, citrus, cocoa, coffee, corn, grape, mango, potato and soybean (Venette & Davis 2004).	Yes. Mealybug Group PRA applied (DAWR 2019)
Pseudaulacaspis pentagona (Targioni Tozzetti, 1886) [Diaspididae] White peach scale	Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga, Vanuatu (García Morales et al. 2021; Williams & Watson 1988a).	Yes. Recorded in NSW and Qld (CABI 2021; García Morales et al. 2021). Declared organism (Prohibited - s12) for WA (Government of Western Australia 2020).	No. Reported on *Capsicum* spp. plants in Fiji, Papua New Guinea, Solomon Islands and Tonga (Williams & Watson 1988a). No reports of *P. pentagona* infesting *Capsicum* spp. fruit have been identified, and this species is considered unlikely to be associated with exported *Capsicum* spp. fruit. This species typically infests the bark and stems of host plants and is often found in large numbers on the bottom of stems or trunks. The leaves and fruit are not usually colonised (Tsatsia & Jackson 2017).	Assessment not required	Assessment not required	No

Pest	Present in Pacific Island countries	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Pseudococcus jackbeardsleyi (Gimpel & Miller, 1996) [Pseudococcidae] Jack Beardsley mealybug	Papua New Guinea (Muniappan et al. 2009).	Yes. Present in the Torres Strait and restricted to the regulated quarantine zone in the northern part of Cape York Peninsula, mainland Australia. There is legislation in place to prevent the spread of this species (QDAF 2020). Regulated in Qld (Restricted matter – s21 and s38) (Queensland Government 2020).	Yes. *Capsicum annuum* is reported as a host (Williams 2004). Feeds on the exterior of fruit and leaves of host plants (Williams & Watson 1988b).	Yes. Feeds on a wide variety of plant hosts, including citrus, capsicum, banana, tomato and hibiscus (QDAF 2020). It is widely distributed over both tropical and temperate regions and has established in northern Australia (QDAF 2020). The host range and geographic distribution of this pest suggest that there are suitable environments for this pest to establish and spread in Australia.	Yes. This species has a wide host range including citrus, capsicum, banana, tomato, orchids, pepper and hibiscus, so could potentially have economic impacts on horticultural production (QDAF 2020).	Yes. Mealybug Group PRA applied (DAWR 2019)
Pulvinaria psidii Maskell, 1893 [Coccidae] Mango scale	Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga, Vanuatu (Ben-Dov 1993; García Morales et al. 2021; Williams & Watson 1990).	Yes. Recorded in NSW, NT, Qld (CSIRO 2004) and WA (Poole 2010).	Assessment not required	Assessment not required	Assessment not required	No
Pulvinaria urbicola Cockerell, 1893 [Coccidae] Urbicola soft scale	Fiji, Papua New Guinea, Samoa, Solomon Islands, Vanuatu (García Morales et al. 2021; Williams & Watson 1990).	Yes. Recorded in NT, Qld (CSIRO 2004) and WA (Government of Western Australia 2020).	Assessment not required	Assessment not required	Assessment not required	No

Pest	Present in Pacific Island countries	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Russellaspis pustulans (Cockerell, 1892) Synonym: *Asterolecanium pustulans* (Cockerell, 1892) [Asterolecaniidae] Oleander pit scale	Fiji, Papua New Guinea, Samoa (Williams & Watson 1990).	Not known to occur	No. This species attacks twigs, branches and leaves, and has been reported on the fruit of some hosts (Abd-Rabou, Ahmed & Badary 2012). A specimen was collected from a chilli plant in Kiribati in the 1970s (Williams & Watson 1990), but no other records on *Capsicum* spp. are known. Therefore, not considered likely to be associated with *Capsicum* spp. fruit.	Assessment not required	Assessment not required	No
Saissetia coffeae (Walker, 1852) [Coccidae] Brown scale	Fiji, Papua New Guinea, Solomon Islands, Tonga, Vanuatu (García Morales et al. 2021; Williams & Watson 1990).	Yes. Recorded in NSW, NT, Qld, SA, Vic. and WA (García Morales et al. 2021).	Assessment not required	Assessment not required	Assessment not required	No
Trialeurodes vaporariorum Westwood, 1856 [Aleyrodidae] Greenhouse whitefly	Papua New Guinea (CABI 2021).	Yes. Recorded in NSW, NT, Qld, SA, Tas., Vic. and WA (CABI 2021; CSIRO 2004; Plant Health Australia 2020).	Assessment not required	Assessment not required	Assessment not required	No
Lepidoptera						
Agrotis ipsilon (Hufnagel, 1766) [Noctuidae] Black cutworm	Fiji, Papua New Guinea, Samoa (CABI 2021), Tonga (PestNet 2021).	Yes. Recorded in NSW, Qld, Tas and WA (CABI 2021).	Assessment not required	Assessment not required	Assessment not required	No
Chrysodeixis eriosoma (Doubleday, 1843) [Noctuidae] Green looper caterpillar	Fiji, Papua New Guinea, Samoa, Tonga (CABI 2021; Stout 1982).	Yes. Recorded in NSW, Qld, Tas. (CSIRO 2004) and WA (Government of Western Australia 2020).	Assessment not required	Assessment not required	Assessment not required	No

Pest	Present in Pacific Island countries	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Eudocima phalonia (Linnaeus 1763) Synonym: *Eudocima fullonia* (Clerck, 1764) [Noctuidae] Fruit piercing moth	Fiji, Papua New Guinea, Samoa, Tonga, Vanuatu (Waterhouse & Norris 1987).	Yes. Recorded in NSW, NT, Qld (CSIRO 2004) and WA (Government of Western Australia 2020).	Assessment not required	Assessment not required	Assessment not required	No
Helicoverpa armigera (Hübner, 1808) [Noctuidae] Cotton bollworm	Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga, Vanuatu (Waterhouse & Norris 1987).	Yes. Widespread in Australia (ALA 2021).	Assessment not required	Assessment not required	Assessment not required	No
Helicoverpa assulta (Guenée, 1852) Synonym: *Heliothis assulta* Guenée, 1852 [Noctuidae] Oriental tobacco budworm	Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga, Vanuatu (CABI 2021; Stout 1982).	Yes. Widespread in Australia (ALA 2021; CABI 2021).	Assessment not required	Assessment not required	Assessment not required	No
Spodoptera frugiperda (J.E. Smith, 1797) [Noctuidae] Fall armyworm	PNG (CABI 2021), Solomon Islands (under official control) (CABI 2021) .	Yes. Widespread in Australia (CABI 2021; IPPC 2020; Spafford 2020).	Assessment not required	Assessment not required	Assessment not required	No
Phthorimaea operculella (Zeller 1873) [Gelechiidae] Potato tuber moth	Fiji and Papua New Guinea (CABI 2021).	Yes. Widespread in Australia (CABI 2021).	Assessment not required	Assessment not required	Assessment not required	No
Spodoptera litura (Fabricius, 1775) [Noctuidae] Taro armyworm	Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga, Vanuatu (Stout 1982; Waterhouse & Norris 1987).	Yes. Recorded in NSW, NT, Qld, Tas. and WA (Common 1990; CSIRO 2004).	Assessment not required	Assessment not required	Assessment not required	No
Mesostigmata						
Amblyseius largoensis (Muma, 1955) [Phytoseiidae] Predatory mite	Fiji, Papua New Guinea , Vanuatu (Phytoseiidae of New Zealand 2008)	Yes. Recorded in NT, Qld, SA (ALA 2021) and WA (Government of Western Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No

Pest	Present in Pacific Island countries	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Thysanoptera						
Scirtothrips dorsalis (Hood 1919) [Thripidae] Chilli thrips	Papua New Guinea, Solomon Islands (Dickey et al. 2015). This species is known to be a virus vector. While thrips-vectored orthotospoviruses are not known to be present in the assessed countries (Davis & Ruabete 2010), only limited testing has been done.	Yes. Recorded in NSW, NT, Qld (CSIRO 2004) and WA (Government of Western Australia 2020).	Yes. *Capsicum* spp. are hosts. Pupae of *S. dorsalis* can be present under the calyces of fruit (Kumar, Seal & Kakkar 2017).	Yes. Not applicable to vector as *S. dorsalis* has already established in Australia. However, the emerging quarantine orthotospoviruses vectored by this thrips have potential for establishment and spread.	Yes. Not applicable to vector. However, emerging quarantine orthotospoviruses vectored by this thrips have potential for consequences.	Yes. Thrips Group PRA applied (DAWR 2017).
Thrips palmi Karny, 1925 [Thripidae] Melon thrips	Fiji (Biosecurity Authority of Fiji 2015), Papua New Guinea (CABI 2021), Samoa (Waterhouse & Norris 1987). This species is known to be a virus vector. While thrips-vectored orthotospoviruses are not known to be present in the assessed countries (Davis & Ruabete 2010), only limited testing has been done.	Yes. Recorded in NSW, NT, Qld (Plant Health Australia 2020) and WA (Government of Western Australia 2020). Regulated pest in NT (DPIR 2018), SA (PIRSA 2017) and WA (Government of Western Australia 2020). Not recognised as a regional pest in NT for *Capsicum* spp. fruit imports as there are no international first points of entry within the declared protected area. Existing domestic controls will manage the risks associated with this pest.	Yes. These thrips are usually associated with new growth and developing fruit but may be present under the calyx of mature fruit (CABI 2021).	Yes. This species is already established in parts of Australia and has a broad host range including tomato, melons, citrus and cucumber (CABI 2021), suggesting potential for establishment and spread to other parts of Australia. In addition, the emerging quarantine orthotospoviruses vectored by this thrips have potential for establishment and spread.	Yes. This species attacks a wide range of plants, including cotton, melons, cucumber, eggplant, capsicum and beans (Waterhouse & Norris 1987). Emerging quarantine orthotospoviruses vectored by this thrips also have potential for consequences.	Yes (SA, WA). Thrips Group PRA applied (DAWR 2017).

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Thrips tabaci Lindeman, 1889 [Thripidae] Onion thrips	Fiji, Papua New Guinea, Solomon Islands (CABI 2021). This species is known to be a virus vector. While thrips-vectored orthotospoviruses are not known to be present in the assessed countries (Davis & Ruabete 2010), only limited testing has been done.	Yes. NSW, NT, Qld, SA, Tas., Vic. and WA (CABI 2021).	Yes. These thrips are usually associated with new growth and developing fruit but may be present under the calyx of mature fruit (CABI 2021).	Yes. Not applicable to the vector as *T. tabaci* has already established in Australia. However, the emerging quarantine orthotospoviruses vectored by this thrips have potential for establishment and spread.	Yes. Not applicable to vector. However, emerging quarantine orthotospoviruses vectored by this thrips have potential for consequences.	Yes. Thrips Group PRA applied (DAWR 2017).
Trombidiformes						
Polyphagotarsonemus latus (Banks, 1904) [Tarsonemidae] Broad mite	Fiji, Papua New Guinea, Samoa, Solomon Islands, Tonga, Vanuatu (Stout 1982; Waterhouse & Norris 1987).	Yes. Recorded in NSW, NT, Qld and WA (CSIRO 2004).	Assessment not required	Assessment not required	Assessment not required	No
Tetranychus urticae Koch, 1836 Synonym: *Tetranychus telarius* (Linnaeus, 1758) [Tetranychidae] Two-spotted spider mite	Papua New Guinea, Solomon Islands (CABI 2021).	Yes. NSW, NT, Qld, SA, Tas, Vic, WA (Miller 1966; Plant Health Australia 2020).	Assessment not required	Assessment not required	Assessment not required	No
BACTERIA						
Clavibacter michiganensis subsp. *michiganensis* (Smith 1910) Davis *et al.* Synonym: *Corynebacterium michiganensis* (Smith) Jensen [Actinomycetales: Microbacteriaceae] Bacterial canker	Fiji (as *Corynebacterium michiganense*) (Dingley, Fullerton & McKenzie 1981), Tonga (CABI 2021).	Yes. Widespread in Australia (CABI 2021).	Assessment not required	Assessment not required	Assessment not required	No

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Pectobacterium carotovorum subsp. *carotovorum* (Jones, 1901) Hauben et al. 1999 Synonym: *Erwinia caratovora* subsp. *caratovora* (Jones, 1901) Bergey et al. 1923 [Enterobacteriales: Enterobacteriaceae] Fruit rot	Fiji (as *Erwinia caratovora* var. *caratovora*) (Dingley, Fullerton & McKenzie 1981), Papua New Guinea (CABI 2021).	Yes. Recorded in NSW, NT, Qld, Tas, Vic and WA (CABI 2021).	Assessment not required	Assessment not required	Assessment not required	No
Ralstonia solanacearum (Smith 1896) Yabuuchi *et al.* species complex [Burkholderiales: Burkholderiaceae] Bacterial wilt	Fiji, Papua New Guinea, Samoa, Tonga, Vanuatu (CABI 2021; Dingley, Fullerton & McKenzie 1981; Jeong et al. 2007; McKenzie 1989).	Yes. Bacterial wilt complex species in Australia include *R. solanacearum* (Hong et al. 2012) and *R. pseudosolanacearum* (Safni et al. 2014). Recorded in NSW, NT and Qld (Cook & Sequeira 1994; Pitkethley 1998). Declared organism (Prohibited - s12) for WA (Government of Western Australia 2020). No specific domestic movement controls in place for this pest.	Assessment not required	Assessment not required	Assessment not required	No
Xanthomonas euvesicatoria Jones et al. Synonym: *Xanthomonas campestris* pv. *vesicatoria* (Doidge) Dye type A [Xanthomonadales: Xanthomonadaceae] Bacterial spot	Fiji, Tonga (Dingley, Fullerton & McKenzie 1981; Firman 1972), Solomon Islands (McKenzie & Jackson 1986).	Yes. Recorded in NSW, NT, Qld and WA (Plant Health Australia 2020; Roach et al. 2018; Shivas 1989).	Assessment not required	Assessment not required	Assessment not required	No

Pest	Present in Pacific Island countries	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
CHROMALVEOLATA						
Globisporangium irregulare (Buisman) Uzuhashi, Tojo & Kakish. Synonym: *Pythium irregulare* Buisman [Peronosporales: Pythiaceae] Dieback	Fiji (Dingley, Fullerton & McKenzie 1981), Papua New Guinea, Vanuatu (McKenzie 1989).	Yes. Recorded in NSW, Qld, SA, Tas., Vic. and WA (Cook & Dubé 1989; Davison et al. 2003; Letham 1995; Sampson & Walker 1982; Shivas 1989; Simmonds 1966).	Assessment not required	Assessment not required	Assessment not required	No
FUNGI						
Alternaria alternata (Fr.) Keissl. [Pleosporales: Pleosporaceae] Leaf spot	Tonga (Dingley, Fullerton & McKenzie 1981), Vanuatu (McKenzie 1989).	Yes. Recorded in NSW, Qld, SA, Tas., Vic. and WA (Barkat et al. 2016; Cook & Dubé 1989; Sampson & Walker 1982; Shivas 1989)	Assessment not required	Assessment not required	Assessment not required	No
Athelia rolfsii (Curzi) Tu & Kimbrough [Atheliales: Atheliaceae] Root rot	Fiji, Samoa, Tonga (Dingley, Fullerton & McKenzie 1981), Papua New Guinea (Farr & Rossman 2018), Solomon Islands (McKenzie & Jackson 1986), Vanuatu (McKenzie 1989).	Yes. Recorded in NSW, Qld, SA and WA (Cook & Dubé 1989; Letham 1995; Shivas 1989; Simmonds 1966).	Assessment not required	Assessment not required	Assessment not required	No
Cercospora physalidis Ellis Synonym: *Cercospora capsici* Heald & FA Wolf [Capnodiales: Mycosphaerellaceae] Frog eye leaf spot	Fiji, Samoa, Tonga (Dingley, Fullerton & McKenzie 1981), Solomon Islands (McKenzie & Jackson 1986), Vanuatu (McKenzie 1989).	Yes. Recorded in NT, Qld and WA (Plant Health Australia 2020).	Assessment not required	Assessment not required	Assessment not required	No

Pest	Present in Pacific Island countries	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Choanephora cucurbitarum (Berk. & Ravenel) Thaxt. [Mucorales: Choanephoraceae] Fruit rot	Fiji, Tonga (Dingley, Fullerton & McKenzie 1981), Samoa (CABI 2021), Solomon Islands (McKenzie & Jackson 1986), Papua New Guinea, Vanuatu (McKenzie 1989).	Yes. Recorded in NSW, NT and Qld (CABI 2021). No specific domestic movement controls in place for this pest.	Assessment not required	Assessment not required	Assessment not required	No
Colletotrichum truncatum (Schwein.) Andrus & WD Moore Synonym: *Colletotrichum capsici* (Syd.) EJ Butler & Bisby [Glomerellales: Glomerellaceae] Anthracnose	Fiji, Tonga (Dingley, Fullerton & McKenzie 1981), Papua New Guinea, Samoa (CABI 2021), Solomon Islands (McKenzie & Jackson 1986), Vanuatu (McKenzie 1989).	Yes. Recorded in NSW, NT, Qld and WA (Plant Health Australia 2020).	Assessment not required	Assessment not required	Assessment not required	No
Colletotrichum dematium (Pers.) Grove [Glomerellales: Glomerellaceae] Anthracnose	Fiji, Samoa (Dingley, Fullerton & McKenzie 1981), Papua New Guinea (Farr & Rossman 2018), Solomon Islands (McKenzie & Jackson 1986), Vanuatu (McKenzie 1989).	Yes. Recorded in NSW, NT, Qld, SA, Tas. and Vic. (Plant Health Australia 2020). No specific domestic movement controls in place for this pest.	Assessment not required	Assessment not required	Assessment not required	No

Pest	Present in Pacific Island countries	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Corticium koleroga (Cooke) Höhn. Synonym: *Pellicularia koleroga* Cooke [Corticiales: Corticiaceae] White thread blight	Fiji (as *Pellicularia koleroga*) (Firman 1972), Papua New Guinea, Samoa (CABI 2021), Vanuatu (as *P. koleroga*) (McKenzie 1989).	Not known to occur	No. Although recorded on *C. annuum* in Fiji (Firman 1972), this fungus typically infects foliage, twigs and branches of woody plants (Lourd & Alves 1987). It is easily recognised by external white mycelial threads that cause necrosis and dieback of affected twigs and leaves (Benchimol et al. 2001). Infected plants are unlikely to produce export-quality fruit. Fruit infected with this disease would have visible symptoms and likely be removed at harvest or during pre-export handling.	Assessment not required	Assessment not required	No
Diaporthe capsici Punithalingham Anamorph: *Phomopsis capsici* (Magnaghi) Sacc. [Diaporthales: Diaporthaceae] Fruit rot	Fiji (as *Phomopsis capsici*) (Firman 1972), Solomon Islands (McKenzie & Jackson 1986), Tonga (Dingley, Fullerton & McKenzie 1981).	Yes. Present in Australia (Simmonds 1966; Udayanga et al. 2011). No specific domestic movement controls in place for this pest.	Assessment not required	Assessment not required	Assessment not required	No

Pest	Present in Pacific Island countries	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Diaporthe phaseolorum (Cooke & Ellis) Sacc. [Diaporthales: Diaporthaceae] Fruit rot	Fiji, Tonga (Dingley, Fullerton & McKenzie 1981), Papua New Guinea (Farr & Rossman 2018). Old records on *Capsicum* spp. are likely to be referring to *D. capsici*. Dingley, Fullerton and McKenzie (1981) considered Firman (1972) report of *Phomopsis capsici* to be the conidial state of *D. phaseolorum*.	Yes. Present in Australia (Udayanga et al. 2011). Recorded in Qld (Simmonds 1966). No specific domestic movement controls in place for this pest.	Assessment not required	Assessment not required	Assessment not required	No
Fusarium concolor Reinking [Hypocreales: Nectriaceae] Crown rot	Papua New Guinea (Farr & Rossman 2018), Solomon Islands (McKenzie & Jackson 1986), Vanuatu (McKenzie 1989).	Yes. Recorded in NSW, Tas. and WA (Plant Health Australia 2020; Sampson & Walker 1982)	Assessment not required	Assessment not required	Assessment not required	No
Fusarium incarnatum (Roberge) Sacc. Synonyms: *Fusarium semitectum* Berk. & Ravenel [Hypocreales: Nectriaceae] Fruit rot	Fiji (Dingley, Fullerton & McKenzie 1981), Papua New Guinea (Farr & Rossman 2018).	Yes. Recorded in NSW, NT, Qld, SA, Tas., Vic. and WA (Plant Health Australia 2020)	Assessment not required	Assessment not required	Assessment not required	No
Glomerella cingulata (Stoneman) Spaulding & H Schrenk [Glomerellales: Glomerellaceae] Anthracnose	Fiji (Firman 1972), Papua New Guinea (Farr & Rossman 2018), Samoa, Tonga (Dingley, Fullerton & McKenzie 1981), Solomon Islands (McKenzie & Jackson 1986), Vanuatu (McKenzie 1989).	Yes. Recorded in NSW, Qld, SA, Tas., Vic. and WA (Cook & Dubé 1989; Cunnington 2003; Hyde & Alcorn 1993; Letham 1995; Sampson & Walker 1982; Shivas 1989).	Assessment not required	Assessment not required	Assessment not required	No

Pest	Present in Pacific Island countries	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Lasiodiplodia theobromae (Pat.) Griffon & Maubl. [Botryosphaeriales: Botryosphaeriaceae] Fruit rot	Fiji, Samoa, Tonga (Dingley, Fullerton & McKenzie 1981), Papua New Guinea, Solomon Islands (Farr & Rossman 2018).	Yes. Recorded in NSW, Qld and WA (Government of Western Australia 2020; Hyde & Alcorn 1993; Qiu et al. 2011).	Assessment not required	Assessment not required	Assessment not required	No
Leveillula taurica (Lév.) G Arnaud [Erysiphales: Erysiphaceae] Powdery mildew	Fiji (Firman 1972), Solomon Islands (McKenzie & Jackson 1986), Tonga (Dingley, Fullerton & McKenzie 1981), Papua New Guinea (Farr & Rossman 2018).	Yes. Recorded in Qld, SA, Vic. and WA (Cook & Dubé 1989; Cunnington 2003; Shivas 1989; Simmonds 1966).	Assessment not required	Assessment not required	Assessment not required	No
Nigrospora sphaerica (Sacc.) E.W. Mason [Xylariales: Apiosporaceae] Leaf spot	Fiji, Tonga (Dingley, Fullerton & McKenzie 1981), Papua New Guinea (Farr & Rossman 2018), Vanuatu (McKenzie 1989).	Yes. Recorded in NSW, Qld and WA (Plant Health Australia 2020).	Assessment not required	Assessment not required	Assessment not required	No
Rhizoctonia solani J.G. Kühn Synonym: *Thanatephorus cucumeris* (A.B. Frank) Donk [Cantharellales: Ceratobasidiaceae] Fruit rot	Fiji (as *Corticium solani*)(Firman 1972), Papua New Guinea, Solomon Islands (Farr & Rossman 2018), Samoa (as *Thanatephorus cucumeris*) (Dingley, Fullerton & McKenzie 1981), Vanuatu (McKenzie 1989).	Yes. Recorded in NSW, Qld, SA, Tas., Vic. and WA (Cook & Dubé 1989; Cunnington 2003; Letham 1995; Sampson & Walker 1982; Shivas 1989; Simmonds 1966).	Assessment no required	Assessment not required	Assessment not required	No
Sclerotinia sclerotiorum (Lib.) de Bary [Helotiales: Sclerotiniaceae] Cottony soft rot	Fiji, Samoa (CABI 2021).	Yes. Recorded in NSW, Qld, SA, Tas., Vic. and WA (CABI 2021; Ekins et al. 2011; Mu et al. 2018).	Assessment no required	Assessment not required	Assessment not required	No

Pest	Present in Pacific Island countries	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
VIRUSES						
Chilli veinal mottle virus (ChiVMV) [Potyviridae: Potyvirus] Chilli veinal mottle	Papua New Guinea (CABI 2021; Davis et al. 2002).	Not known to occur	No. Chilli veinal mottle virus is associated with chilli (Chandrakant 2015), with varying levels of disease incidence and resistance depending on the variety (Chandrakant 2015). The virus has been detected in leaves and sepals of chillies and is transmitted by aphid vectors, grafting and mechanical sap (Chandrakant 2015; Shah et al. 2008). Infected plants produce deformed fruit with fruit symptoms including surface roughness, twisting and malformation (Chandrakant 2015; Prakash et al. 2002). Fruit symptoms are visible and would likely be discarded during harvesting, grading and packing. This virus is not seed transmissible (Chandrakant 2015).	Assessment not required	Assessment not required	No
Cucumber mosaic virus (CMV) [Bromoviridae: Cucomovirus] Cucumber mosaic	Fiji (Davis & Ruabete 2010), Solomon Islands (Davis & Tsatsia 2009), Samoa (Davis et al. 2006), Tonga (Davis, Brown & Pone 1996), Vanuatu (Davis et al. 2006).	Yes. Recorded in NSW, Qld, SA, Tas., Vic. and WA (Büchen-Osmond et al. 1988).	Assessment not required	Assessment not required	Assessment not required	No

Pest	Present in Pacific Island countries	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Potato virus Y (PVY) [Potyviridae: Potyvirus]	Papua New Guinea (Pearson & Grisoni 2002), Samoa (Davis et al. 2006).	Yes. Recorded in NSW, SA, Tas., Vic. and WA (Büchen-Osmond et al. 1988). No specific domestic movement controls in place for this pest.	Assessment not required	Assessment not required	Assessment not required	No
Tobacco mosaic virus (TMV) [Virgaviridae: Tobamovirus] Tobacco mosaic	Fiji, Tonga (Davis & Ruabete 2010), Samoa (Davis et al. 2006), Solomon Islands (Davis & Tsatsia 2009).	Yes. Recorded in NSW, Qld, SA, Tas., Vic. and WA (Büchen-Osmond et al. 1988).	Assessment not required	Assessment not required	Assessment not required	No
Tomato mosaic virus (ToMV) [Virgaviridae: Tobamovirus] Tomato mosaic virus	Solomon Islands, Tonga (Davis & Ruabete 2010).	Yes. Recorded in ACT, NSW, Qld, SA, Tas., Vic. and WA (Büchen-Osmond et al. 1988).	Assessment not required	Assessment not required	Assessment not required	No
Tomato spotted wilt virus (TSWV) [Bunyaviridae: Tospovirus] Tomato spotted wilt	Papua New Guinea (CABI 2021).	Yes. Widespread in Australia (CABI 2021).	Assessment not required	Assessment not required	Assessment not required	No
Zucchini yellow mosaic virus (ZYMV) [Potyviridae: Potyvirus] Zucchini yellow mosaic virus	Papua New Guinea (Maina et al. 2019).	Yes. Recorded in WA, NT, Qld and NSW (Maina et al. 2019).	Assessment not required	Assessment not required	Assessment not required	No

Appendix B: Issues raised in stakeholder comments

This section outlines key technical issues raised by stakeholders during consultation on the draft report, and the department's responses. Additional information on other issues commonly raised by stakeholders, which may be outside the scope of this technical report, is available on the department's website.

Comment 1: Clarification and recommended review of the pest status of *Colletotrichum dematium* in Australia (page 82 of the draft report)

The department has reviewed the assessment for the presence of *Colletotrichum dematium* in Australia. After consideration of stakeholder comments and further analysis of the literature on taxonomy and the re-identification of Australian isolates, the department concluded that the evidence does not support a change in pest status.

The Australian Plant Pest Database (APPD) (Plant Health Australia 2020) lists 83 records of *C. dematium*, collected from a wide range of plant families and species. It is acknowledged that molecular studies have subsequently revised the definition of *C. dematium*, so historical records need to be treated with caution. Damm *et al*. (2009) notes that strains historically identified as *C. dematium* could be assigned to 12 different species. As reported by Shivas et al. (2016), 2 of the Australian records have subsequently been reassigned to *C. chlorophyti* and *C. tolfieldiae*, although many more are yet to be confirmed. Based on the revised description by Damm *et al*. (2009), the true *C. dematium* is recognised as being present in Australia (Shivas et al. 2016).

Colletotrichum dematium was assessed in the draft report as being present in all states and territories but it is feasible that *C. dematium* may be absent from Western Australia. It is acknowledged that the isolate collected from Western Australia in 1967, which is listed as *C. dematium* in the Australian Plant Pest Database (Plant Health Australia 2020), has subsequently been reidentified as *C. tolfieldiae* by Shivas *et al*. (2016). The Atlas of Living Australia (ALA 2021) has at least 1 other record of *C. dematium* in Western Australia, with a specimen collected in 2015 deposited in the Western Australian Herbarium (record number AAM 10670). In addition, APPD lists around 40 unidentified *Colletotrichum* specimens collected in Western Australia that require verification.

The department has also reviewed the potential pathway association of *C. dematium* and whether interstate movement controls are appropriate to prevent the introduction of *C. dematium* from infested areas to other areas in Australia.

Colletotrichum dematium is a saprophytic fungus associated with a wide plant host range, present on stems, twigs, leaves, fruit and roots. Infection with *Colletotrichum* spp. can result in the formation of necrotic lesions on the surfaces of fruit, leaves, stems and flowers. However, infected tissues can remain externally symptomless for a period, with healthy-looking fruit subsequently deteriorating in postharvest storage (Cannon et al. 2012). It is noted that domestic movement of host plant material, including nursery stock plants, as well as fresh fruit and vegetables, only requires visual inspection of each consignment on arrival, which is not considered an adequate measure to prevent entry of *C. dematium* from all host pathways into Western Australia. Consequently, *C. dematium* is not considered to be under 'official control' for Western Australia.

Comment 2: Recommended review of the pest status of *Diaporthe capsici* for consideration as a regional pest for Western Australia (page 83 of the draft report)

The department has reviewed the assessment for the presence of *Diaporthe capsici* (Anamorph *Phomopsis capsici*) in Australia and the information presented to support its absence from Western Australia. After consideration of stakeholder comments and further review of the literature, the department concluded that the evidence does not support a change in pest status.

Diaporthe/Phomopsis spp. are endophytes and saprobes that can become pathogenic under conducive conditions. Some species identified as pathogens of crops have also been isolated as endophytes from healthy tissues of the same hosts, and as saprobes from dead material (Udayanga et al. 2011). *Diaporthe capsici* infection is most likely to occur in damaged fruit (Shen et al. 2010), particularly those also affected by *Colletotrichum* spp. infection, with disease development promoted by warm and wet conditions (Rodeva, Stoyanova & Pandeva 2009).

Diaporthe capsici infection is reported to cause dieback, plant wilt and fruit rot symptoms in *Capsicum* species (Rodeva, Stoyanova & Pandeva 2009), while tomato and eggplant fruit have also been shown to be susceptible experimentally (Shen et al. 2010). However, there is very limited information on the association of *D. capsici* with *Capsicum* spp. plants in the field, or with other hosts such as tomato and eggplant (Shen et al. 2010). It is considered likely that it survives endophytically on hosts without any symptoms but can become pathogenic under conducive conditions.

It is noted that domestic movement of host plant material, including nursery stock plants, as well as fresh fruit and vegetables, only requires visual inspection of each consignment on arrival, which is not considered an adequate measure to prevent entry of *D. capsici* from all host pathways into Western Australia. Consequently, *D. capsici* is not considered to be under 'official control' for Western Australia.

Comment 3: Recommended review of pest status of Potato Virus Y to include assessment of exotic strains (page 87 of the draft report)

The department has reviewed the assessment for the presence of Potato Virus Y (PVY) in Australia and the information presented on potentially exotic strains. After consideration of stakeholder comments and further review of the literature, the department concluded that the evidence does not support a change in pest status.

Potato virus Y (PVY) is a Potyvirus that affects plants in the Solanaceae family, including economically important crops like potato, tomato and capsicum, as well as weeds such as black nightshade (*Solanum nigrum*). PVY has long been divided into 3 parental non-recombinant 'strain groups', PVY^C, PVY^N and PVY^O, each containing a number of isolates and strains. Recombination between these PVY lineages can also occur, with up to 36 additional recombinant strains defined (Rodriguez-Rodriguez et al. 2020).

Potato Virus Y is transmitted by a number of aphid species in a non-persistent manner (Persley 2016). It can also be mechanically transmitted in the field through leaf-to-leaf contact, or transfer of infective sap on machinery or equipment (Coutts & Jones 2015). Potato Virus Y is not reported to be seed transmissible in *Capsicum* spp. (Green & Kim 1991), although there have been occasional reports suggesting seed transmission in other hosts such as eggplant and black nightshade (EFSA PLH Panel (EFSA Panel on Plant Health) et al. 2020).

There is little evidence to indicate that recombinant strains possess novel biological properties compared to their parental strains. Variation between strains in their impact on potato and tomato plants has been shown to depend more on the host cultivar and growing conditions than on the infecting virus population and new recombinant isolates (EFSA PLH Panel (EFSA Panel on Plant Health) et al. 2020), and this is likely to also be the case in *Capsicum* species.

Capsicum spp. can be infected by isolates belonging to all 3 parental strain groups (PVY^C, PVY^N and PVY^O) (EFSA PLH Panel (EFSA Panel on Plant Health) et al. 2020), although there is variability in host range between PVY isolates in those strain groups. It has been demonstrated that many isolates reported from capsicum and tomato are not capable of infecting potato (Gebre Selassie et al. 1985; Thomas et al. 1989).

Various systems for differentiating strains in *Capsicum* spp. have been proposed. Gebre Selassie et al. (1985) tested PVY isolates from France against specific *Capsicum* spp. cultivars and identified 3 distinct pathotypes (designated PVY-0, PVY-1, PVY-1-2) among the isolates. A similar system using an expanded range of differential cultivars was used to categorise Australian PVY isolates in *Capsicum* spp., and also found 3 distinct pathotype strains were present (Thomas et al. 1989). The Gebre Selassie system for classifying PVY strains in *Capsicum* spp. is now commonly used in plant breeding to indicate host resistance to particular PVY pathotypes (Pasko, Gil Ortega & Luis Arteaga 1996).

Potato Virus Y is present in Australia and has been recorded in New South Wales, Queensland, South Australia, Tasmania, Victoria and Western Australia. Isolates from all the strain groups (PVY^C, PVY^N and PVY^O), as well as the recombinant strain PVY^{NTN}, have been reported in Australia (Coutts & Jones 2015; Kehoe & Jones 2016; Rodriguez-Rodriguez et al. 2020). It is acknowledged that PVY^{NTN} is absent from Tasmania and Western Australia (Rodriguez-Rodriguez et al. 2020).

Potato Virus Y is the most widespread and economically important virus present in Queensland's *Capsicum* spp. production (Thomas et al. 1989), and it is likely to be present in all production areas in Queensland (Thomas et al. 1989). All the major PVY pathotype groups in *Capsicum* spp. have been reported in Australia (Thomas et al. 1989) and several strains capable of overcoming host resistance are known to be present (Persley 2016).

Potato Virus Y on *C. annuum* in Samoa and Papua New Guinea was first reported in surveys in the late 1970s and early 1980s, but the strains present were not identified. No evidence of further research to determine which strains are present has been found. The Pacific Islands, and to a lesser extent Papua New Guinea, are relatively isolated geographically, so the successful establishment of new virus strains via introductions of infected planting materials or virus-vectoring aphids is likely to be infrequent. As a result, the genetic diversity of PVY in Papua New Guinea and Samoa is likely to be limited.

While there are isolates that are absent from Australia, genetic variability alone does not provide sufficient justification for regulation of different strains. Consistent with ISPM 11 (FAO 2021f), to regulate a pest below the species level, for example a strain, it must be demonstrated that factors such as differences in virulence, host range or vector relationships between exotic and domestic strains are significant enough to affect the pest risk (FAO 2021f). Given that all the major pathotype groups have already been recorded in Australia (Thomas et al. 1989) and can be managed by use of resistant plant varieties, the likelihood of introducing other strains with significantly greater economic impacts is considered to be unlikely.

Additionally, fresh *Capsicum* spp. fruit imported for human consumption would not provide a likely transmission pathway for introduction of exotic strains of PVY. While it is feasible that symptomless infected fruit could be imported if it enters the export supply chain, vectoring from aphid feeding on, or mechanical transmission from, such fruit after importation is considered to be extremely unlikely to occur.

Comment 4: Clarification and recommended review of potential pathway association of *Pseudaulacaspis pentagona* on *Capsicum* spp. fruit (page 73 of the draft report).

The department has reviewed previous assessments of the pathway association of *P. pentagona* on *Capsicum* spp. fruit. A further analysis of the evidence presented and of other literature over the last decade supports the assessment that *P. pentagona* is not associated with *Capsicum* spp. fruit.

The department has reviewed the references cited in previous assessments, and besides the reference to papaya fruit in Hawaii (Follett 2006), other sources only refer to infestation of 'fruit trees', not the fruit specifically. It is acknowledged that *P. pentagona* does have an association with peach fruit and kiwifruit fruit (Malumphy et al. 2016), but there is no evidence *P. pentagona* is likely to be found on *Capsicum* spp. fruit. While *Capsicum* spp. are recognised in host lists for *P. pentagona* (for example García Morales (2021), Mamet (1943) and Miller and Davidson (2005)), no primary reports that discuss the association with *P. pentagona* have been identified.

Given the lack of primary evidence for association with *Capsicum* spp. fruit, *P. pentagona* is not considered likely to be on the import pathway and the review has not resulted in a change to the assessment. *Pseudaulacaspis pentagona* is still recognised as a regional quarantine pest for Western Australia and will be actioned accordingly if detected during on-arrival inspection. This is consistent with existing controls for *P. pentagona* on capsicums and chillies brought into Western Australia from other Australian states and territories. Interceptions of this species on imported *Capsicum* spp. fruit may trigger reassessment of the pathway association.

Comment 5: There may be exotic strains of *Helicoverpa armigera* (cotton bollworm) and *Spodoptera frugiperda* (fall armyworm) that may introduce pesticide resistance genes (page 76 of the draft report).

Both *Helicoverpa armigera* and *Spodoptera frugiperda* are present in Australia and are not recognised as being under official control and therefore do not meet the criteria for a quarantine pest.

Consistent with ISPM 11 (FAO 2021f), the department regulates pests at the species level unless there is evidence that factors such as differences in virulence, host range or vector relationships are significant enough to affect pest risk. Typically, pesticide resistance would not be considered a significant difference, as endemic populations are also likely to develop resistance if exposed to the same chemicals.

Helicoverpa armigera readily develops resistance in response to selection pressure from exposure to pesticides. Populations within Australia have evolved resistance to a number of chemical groups including pyrethroids (including Fenvalerate and Bifenthrin), carbamate (Methomyl), oxadiazine (Indoxacarb) and organophosphates (including profenofos and methyl parathion) (Bird 2018; GRDC 2018).

Despite only being present in Australia since early 2020, *S. frugiperda* is already showing variability in sensitivity to insecticides between geographically segregated populations (GRDC 2021).

Exotic ‘strains’ of *H. armigera* and *S. frugiperda* are not expected to have a significantly different impact to the existing populations in Australia. Therefore, there is insufficient justification for further consideration of these species in the assessment.

Glossary

Term or abbreviation	Definition
Additional declaration	A statement that is required by an importing country to be entered on a phytosanitary certificate and which provides specific additional information on a consignment in relation to regulated pests (FAO 2021c).
Appropriate level of protection (ALOP)	The level of protection deemed appropriate by the Member establishing a sanitary or phytosanitary measure to protect human, animal or plant life or health within its territory (WTO 1995).
Appropriate level of protection (ALOP) for Australia	The *Biosecurity Act 2015* defines the appropriate level of protection (or ALOP) for Australia as a high level of sanitary and phytosanitary protection aimed at reducing biosecurity risks to very low, but not to zero.
Area	An officially defined country, part of a country or all or parts of several countries (FAO 2021c).
Area of low pest prevalence	An area, whether all of a country, part of a country, or all parts of several countries, as identified by the competent authorities, in which a specific pest occurs at low levels and which is subject to effective surveillance, control or eradication measures (FAO 2021c).
Arthropod	The largest phylum of animals, including the insects, arachnids and crustaceans.
Asexual reproduction	The development of new individual from a single cell or group of cells in the absence of meiosis.
Australian territory	Australian territory as referenced in the *Biosecurity Act 2015* refers to Australia, Christmas Island and Cocos (Keeling) Islands.
Biosecurity	The prevention of the entry, establishment or spread of unwanted pests and infectious disease agents to protect human, animal or plant health or life, and the environment.
Biosecurity measures	The *Biosecurity Act 2015* defines biosecurity measures as measures to manage any of the following: biosecurity risk, the risk of contagion of a listed human disease, the risk of listed human diseases entering, emerging, establishing themselves or spreading in Australian territory, and biosecurity emergencies and human biosecurity emergencies.
Biosecurity import risk analysis (BIRA)	The *Biosecurity Act 2015* defines a BIRA as an evaluation of the level of biosecurity risk associated with particular goods, or a particular class of goods, that may be imported, or proposed to be imported, into Australian territory, including, if necessary, the identification of conditions that must be met to manage the level of biosecurity risk associated with the goods, or the class of goods, to a level that achieves the ALOP for Australia. The risk analysis process is regulated under legislation.
Biosecurity risk	The *Biosecurity Act 2015* refers to biosecurity risk as the likelihood of a disease or pest entering, establishing or spreading in Australian territory, and the potential for the disease or pest causing harm to human, animal or plant health, the environment, economic or community activities.
Calyx	A collective term referring to all of the sepals in a flower.
Consignment	A quantity of plants, plant products or other articles being moved from 1 country to another and covered, when required, by a single phytosanitary certificate (a consignment may be composed of 1 or more commodities or lots) (FAO 2021c).
Control (of a pest)	Suppression, containment or eradication of a pest population (FAO 2021c).
Crawler	Intermediate mobile nymph stage of certain Arthropods.
The department	The Department of Agriculture, Water and the Environment.
Endangered area	An area where ecological factors favour the establishment of a pest whose presence in the area will result in economically important loss (FAO 2021c).

Term or abbreviation	Definition
Endemic	Belonging to, native to, or prevalent in a particular geography, area or environment.
Endophyte	An organism, usually a fungus or bacterium, that lives within a plant for all or part of its lifecycle without causing disease to the host plant.
Entry (of a pest)	Movement of a pest into an area where it is not yet present, or present but not widely distributed and being officially controlled (FAO 2021c).
Establishment (of a pest)	Perpetuation, for the foreseeable future, of a pest within an area after entry (FAO 2021c).
Fresh	Living; not dried, deep-frozen or otherwise conserved (FAO 2021c).
Fumigation	A method of pest control that completely fills an area with gaseous pesticides to suffocate or poison the pests within.
Genus	A taxonomic category ranking below a family and above a species and generally consisting of a group of species exhibiting similar characteristics. In taxonomic nomenclature the genus name is used, either alone or followed by a Latin adjective or epithet, to form the name of a species.
Goods	The *Biosecurity Act 2015* defines goods as an animal, a plant (whether moveable or not), a sample or specimen of a disease agent, a pest, mail or any other article, substance or thing (including, but not limited to, any kind of moveable property).
Host	An organism that harbours a parasite, mutual partner, or commensal partner, typically providing nourishment and shelter.
Host range	Species capable, under natural conditions, of sustaining a specific pest or other organism (FAO 2021c).
Import permit	Official document authorising importation of a commodity in accordance with specified phytosanitary import requirements (FAO 2021c).
Infection	The internal 'endophytic' colonisation of a plant, or plant organ, and is generally associated with the development of disease symptoms as the integrity of cells and/or biological processes are disrupted.
Infestation (of a commodity)	Presence in a commodity of a living pest of the plant or plant product concerned. Infestation includes infection (FAO 2021c).
Inspection	Official visual examination of plants, plant products or other regulated articles to determine if pests are present or to determine compliance with phytosanitary regulations (FAO 2021c).
Intended use	Declared purpose for which plants, plant products, or other regulated articles are imported, produced or used (FAO 2021c).
Interception (of a pest)	The detection of a pest during inspection or testing of an imported consignment (FAO 2021c).
International Plant Protection Convention (IPPC)	The IPPC is an international plant health agreement, established in 1952, that aims to protect cultivated and wild plants by preventing the introduction and spread of pests. The IPPC provides an international framework for plant protection that includes developing International Standards for Phytosanitary Measures (ISPMs) for safeguarding plant resources.
International Standard for Phytosanitary Measures (ISPM)	An international standard adopted by the Conference of the Food and Agriculture Organization, the Interim Commission on Phytosanitary Measures or the Commission on Phytosanitary Measures, established under the IPPC (FAO 2019).
Introduction (of a pest)	The entry of a pest resulting in its establishment (FAO 2021c).
Larva	A juvenile form of animal with indirect development, undergoing metamorphosis (for example, insects or amphibians).

Term or abbreviation	Definition
Lot	A number of units of a single commodity, identifiable by its homogeneity of composition, origin et cetera, forming part of a consignment (FAO 2021c). Within this report a 'lot' refers to a quantity of fruit of a single variety, harvested from a single production site during a single pick and packed at 1 time.
Mature fruit	Commercial maturity is the start of the ripening process. The ripening process will then continue and provide a product that is acceptable to consumers. Maturity assessments include colour, starch, index, soluble solids content, flesh firmness, acidity, and ethylene production rate.
National Plant Protection Organization (NPPO)	Official service established by a government to discharge the functions specified by the IPPC (FAO 2021c).
Nymph	The immature form of some insect species that undergoes incomplete metamorphosis. It is not to be confused with larva, as its overall form is already that of the adult.
Official control	The active enforcement of mandatory phytosanitary regulations and the application of mandatory phytosanitary procedures with the objective of eradication or containment of quarantine pests or for the management of regulated non-quarantine pests (FAO 2021c).
Pathogen	A biological agent that can cause disease to its host.
Pathogenic	Causing disease in a host
Pathotype	A distinct variety of an organism that causes disease in specific range of hosts
Pathway	Any means that allows the entry or spread of a pest (FAO 2021c).
Pest	Any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products (FAO 2021c).
Pest categorisation	The process for determining whether a pest has or has not the characteristics of a quarantine pest or those of a regulated non-quarantine pest (FAO 2021c).
Pest free area (PFA)	An area in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained (FAO 2021c).
Pest free place of production	Place of production in which a specific pest does not occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained for a defined period (FAO 2021c).
Pest free production site	A production site in which a specific pest is absent, as demonstrated by scientific evidence, and in which, where appropriate, this condition is being officially maintained for a defined period (FAO 2021c).
Pest risk analysis (PRA)	The process of evaluating biological or other scientific and economic evidence to determine whether an organism is a pest, whether it should be regulated, and the strength of any phytosanitary measures to be taken against it (FAO 2021c).
Pest risk assessment (for quarantine pests)	Evaluation of the probability of the introduction and spread of a pest and of the magnitude of the associated potential economic consequences (FAO 2021c).
Pest risk assessment (for regulated non-quarantine pests)	Evaluation of the probability that a pest in plants for planting affects the intended use of those plants with an economically unacceptable impact (FAO 2021c).
Pest risk management (for quarantine pests)	Evaluation and selection of options to reduce the risk of introduction and spread of a pest (FAO 2021c).
Pest risk management (for regulated non-quarantine pests)	Evaluation and selection of options to reduce the risk that a pest in plants for planting causes an economically unacceptable impact on the intended use of those plants (FAO 2021c).
Pest status (in an area)	Presence or absence, at the present time, of a pest in an area, including where appropriate its distribution, as officially determined using expert judgement on the basis of current and historical pest records and other information (FAO 2021c).

Term or abbreviation	Definition
Phytosanitary certificate	An official paper document or its official electronic equivalent, consistent with the model of certificates of the IPPC, attesting that a consignment meets phytosanitary import requirements (FAO 2021c).
Phytosanitary certification	Use of phytosanitary procedures leading to the issue of a phytosanitary certificate (FAO 2021c).
Phytosanitary measure	Phytosanitary relates to the health of plants. Any legislation, regulation or official procedure having the purpose to prevent the introduction and/or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests (FAO 2021c). In this risk analysis the term 'phytosanitary measure' and 'risk management measure' may be used interchangeably.
Phytosanitary procedure	Any official method for implementing phytosanitary measures including the performance of inspections, tests, surveillance or treatments in connection with regulated pests (FAO 2021c).
Phytosanitary regulation	Official rule to prevent the introduction and/or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests, including establishment of procedures for phytosanitary certification (FAO 2021c).
Polyphagous	Feeding on a relatively large number of hosts from different plant family and/or genera.
PRA area	Area in relation to which a pest risk analysis is conducted (FAO 2021c).
Production site	In this report, a production site is a continuous planting of *Capsicum* spp. plants treated as a single unit for pest management purposes. If a property is subdivided into 1 or more units for pest management purposes, then each unit is a production site.
Quarantine	Official confinement of regulated articles for observation and research or for further inspection, testing or treatment (FAO 2021c).
Quarantine pest	A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled (FAO 2021c).
Regulated article	Any plant, plant product, storage place, packaging, conveyance, container, soil and any other organism, object or material capable of harbouring or spreading pests, deemed to require phytosanitary measures, particularly where international transportation is involved (FAO 2021c).
Regulated non-quarantine pest	A non-quarantine pest whose presence in plants for planting affects the intended use of those plants with an economically unacceptable impact and which is therefore regulated within the territory of the importing contracting party (FAO 2021c).
Regulated pest	A quarantine pest or a regulated non-quarantine pest (FAO 2021c).
Restricted risk	Restricted risk is the risk estimate when risk management measures are applied.
Risk analysis	Refers to the technical or scientific process for assessing the level of biosecurity risk associated with the goods, or the class of goods, and if necessary, the identification of conditions that must be met to manage the level of biosecurity risk associated with the goods, or class of goods to a level that achieves the ALOP for Australia.
Risk management measure	Are conditions that must be met to manage the level of biosecurity risk associated with the goods or the class of goods, to a level that achieves the ALOP for Australia. In this risk analysis, the term 'risk management measure' and 'phytosanitary measure' may be used interchangeably.
Saprobe/Saprophyte	An organism deriving its nourishment from dead organic matter.
Spread (of a pest)	Expansion of the geographical distribution of a pest within an area (FAO 2021c).
SPS Agreement	WTO Agreement on the Application of Sanitary and Phytosanitary Measures.

Term or abbreviation	Definition
Stakeholders	Government agencies, individuals, community or industry groups or organizations, whether in Australia or overseas, including the proponent/applicant for a specific proposal, who have an interest in the policy issues.
Surveillance	An official process which collects and records data on pest occurrence or absence by surveying, monitoring or other procedures (FAO 2021c).
Systems approach(es)	The integration of different risk management measures, at least 2 of which act independently, and which cumulatively achieve the appropriate level of protection against regulated pests.
Trash	Soil, splinters, twigs, leaves and other plant material, other than fruit as defined in the scope of this risk analysis. For example, stem and leaf material, seeds, soil, animal matter/parts or other extraneous material
Treatment	Official procedure for the killing, inactivation or removal of pests, or for rendering pests infertile or for devitalisation (FAO 2021c).
Unrestricted risk	Unrestricted risk estimates apply in the absence of risk management measures.
Vector	An organism that does not cause disease itself, but which causes infection by conveying pathogens from 1 host to another.
Viable	Alive, able to germinate or capable of growth.

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All web links in references were accessible and active on 24 November 2021.

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