



Australian Government  
Department of Agriculture,  
Fisheries and Forestry

# Passionfruit from Vietnam: biosecurity import requirements draft report

July 2023



© Commonwealth of Australia July 2023

### **Ownership of intellectual property rights**

Unless otherwise noted, copyright (and any other intellectual property rights) in this publication is owned by the Commonwealth of Australia (referred to as the Commonwealth).

### **Creative Commons licence**

All material in this publication is licensed under a [Creative Commons Attribution 4.0 International Licence](https://creativecommons.org/licenses/by/4.0/) except content supplied by third parties, logos and the Commonwealth Coat of Arms.



### **Cataloguing data**

This publication (and any material sourced from it) should be attributed as: DAFF July 2023, *Passionfruit from Vietnam: biosecurity import requirements draft report*, Department of Agriculture, Fisheries and Forestry, Canberra, CC BY 4.0.

This publication is available at [agriculture.gov.au/about/publications](https://agriculture.gov.au/about/publications).

Department of Agriculture, Fisheries and Forestry  
GPO Box 858 Canberra ACT 2601

Telephone 1800 900 090

Web [agriculture.gov.au](https://agriculture.gov.au)

Email: [plantstakeholders@agriculture.gov.au](mailto:plantstakeholders@agriculture.gov.au)

### **Disclaimer**

The Australian Government acting through the Department of Agriculture, Fisheries and Forestry has exercised due care and skill in preparing and compiling the information and data in this publication. Notwithstanding, the Department of Agriculture, Fisheries and Forestry, its employees and advisers disclaim all liability, including liability for negligence and for any loss, damage, injury, expense or cost incurred by any person as a result of accessing, using or relying upon any of the information or data in this publication to the maximum extent permitted by law.

### **Acknowledgement of Country**

We acknowledge the Traditional Custodians of Australia and their continuing connection to land and sea, waters, environment and community. We pay our respects to the Traditional Custodians of the lands we live and work on, their culture, and their Elders past and present.

### **Stakeholder submissions on draft reports**

This draft report has been issued to give all interested parties an opportunity to comment on relevant technical biosecurity issues, with supporting rationale. A final report will then be produced taking into consideration any comments received.

Submissions should be sent to the Department of Agriculture, Fisheries and Forestry following the conditions specified within the related Biosecurity Advice, which is available at: [agriculture.gov.au/biosecurity-trade/policy/risk-analysis/memos](https://agriculture.gov.au/biosecurity-trade/policy/risk-analysis/memos).

## Contents

<b>Summary .....</b>	<b>vii</b>
<b>1 Introduction.....</b>	<b>1</b>
1.1 Australia’s biosecurity policy framework .....	1
1.2 This risk analysis .....	1
<b>2 Commercial production practices for passionfruit in Vietnam.....</b>	<b>8</b>
2.1 Considerations used in estimating unrestricted risk.....	8
2.2 Production areas of passionfruit .....	8
2.3 Climate in production areas .....	10
2.4 Pre-harvest .....	11
2.5 Harvesting and handling procedures .....	18
2.6 Post-harvest .....	18
2.7 Export capability.....	21
<b>3 Pest risk assessments for quarantine pests .....</b>	<b>22</b>
3.1 Summary of outcomes of pest initiation and categorisation.....	22
3.2 Pests requiring further pest risk assessment .....	22
3.3 Overview of pest risk assessment .....	23
3.4 Fruit flies.....	25
3.5 Mealybugs .....	32
3.6 Scale insects .....	34
3.7 Spider mite .....	36
3.8 Thrips.....	42
3.9 Pest risk assessment conclusions .....	44
<b>4 Pest risk management .....</b>	<b>47</b>
4.1 Pest risk management measures and phytosanitary procedures.....	47
4.2 Operational system for the assurance, maintenance and verification of phytosanitary status .....	51
4.3 Uncategorised pests.....	55
4.4 Review of processes .....	55
4.5 Meeting Australia’s food laws.....	56
<b>5 Conclusion .....</b>	<b>57</b>
<b>Appendix A: Method for pest risk analysis .....</b>	<b>58</b>
<b>Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam .....</b>	<b>71</b>
<b>Glossary, acronyms and abbreviations .....</b>	<b>121</b>
<b>References .....</b>	<b>126</b>

## Figures

Figure 1.1 Diagram of passionfruit morphology .....	2
Figure 1.2 Process flow diagram for conducting a risk analysis and implementing trade.....	5
Figure 2.1 Mean monthly minimum and maximum temperatures and mean monthly rainfall in the main production areas of passionfruit in Vietnam.....	11
Figure 2.2 Passionfruit seedlings growing in a nursery.....	12
Figure 2.3 Trellis supports for passionfruit plants in Vietnam .....	14
Figure 2.4 Harvesting of passionfruit .....	18
Figure 2.5 Passionfruit packing house processes.....	19
Figure 2.6 Summary of operational steps for passionfruit grown in Vietnam for export.....	20
Figure 3.1 Overview of the PRA decision process for passionfruit from Vietnam .....	46
Figure A.1 Decision rules for determining the impact score for each direct and indirect criterion, based on the <i>level of impact</i> and the <i>magnitude of impact</i> .....	66

## Tables

Table 2.1 Production area of passionfruit in Vietnam in 2019 .....	10
Table 2.2 Example of a fertiliser regime for passionfruit in Vietnam .....	14
Table 2.3 Examples of pest management options for passionfruit in Vietnam .....	17
Table 3.1 Quarantine pests and regulated articles potentially associated with passionfruit from Vietnam, and requiring further pest risk assessment .....	23
Table 3.2 Quarantine mealybug species for passionfruit from Vietnam .....	32
Table 3.3 Risk estimates for quarantine mealybugs .....	32
Table 3.4 Quarantine scale insect species for passionfruit from Vietnam.....	34
Table 3.5 Risk estimates for quarantine scale insects.....	34
Table 3.6 Quarantine and regulated thrips species for passionfruit from Vietnam .....	42
Table 3.7 Risk estimates for quarantine thrips .....	42
Table 3.8 Risk estimates for emerging quarantine orthospoviruses vectored by regulated thrips ..	43
Table 3.9 Pest risk assessment conclusions for pests, and pest groups, associated with the pathway of passionfruit from Vietnam .....	45
Table 4.1 Proposed risk management measures for quarantine pests and regulated articles potentially associated with passionfruit from Vietnam .....	48
Table A.1 Nomenclature of likelihoods .....	62
Table A.2 Matrix of rules for combining likelihoods .....	63
Table A.3 Decision rules for determining the overall consequence rating for each pest.....	67
Table A.4 Risk estimation matrix.....	67

## Maps

Map 1 Map of Australia.....	vi
-----------------------------	----

Table of contents

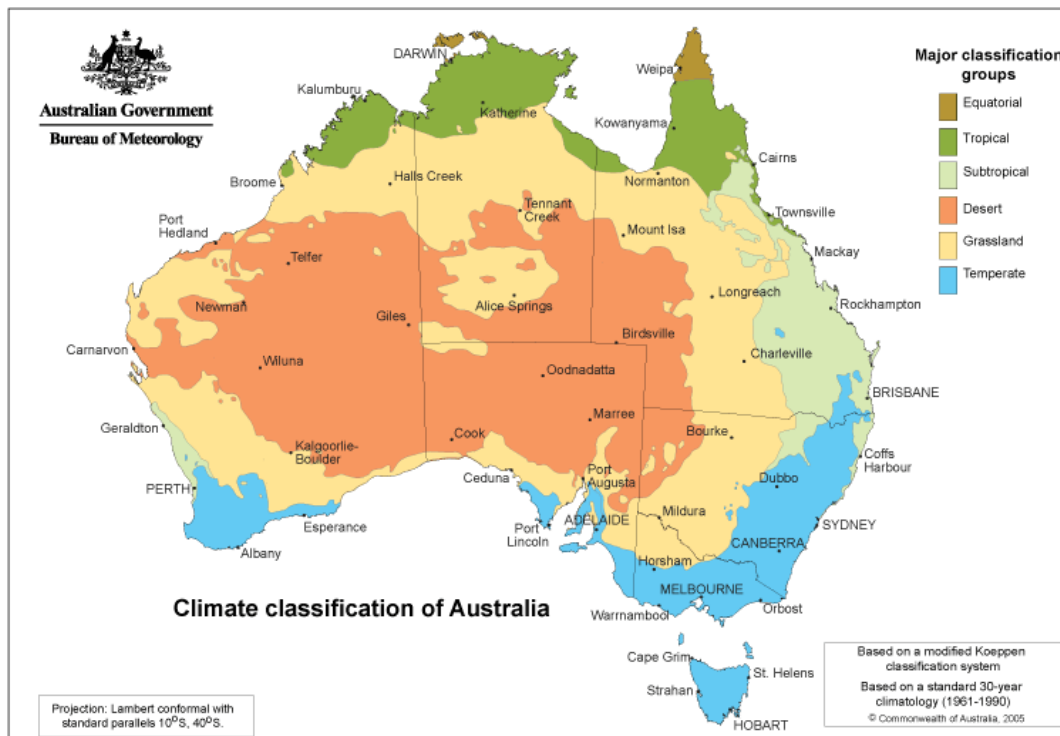
Map 2 A guide to Australia’s bio-climatic zones .....	vi
Map 3 The main passionfruit growing provinces within regions of Vietnam .....	9

Maps

Map 1 Map of Australia



Map 2 A guide to Australia's bio-climatic zones



## Summary

The Australian Government Department of Agriculture, Fisheries and Forestry (the department) has prepared this draft report to assess the proposal by Vietnam for market access to Australia for fresh passionfruit for human consumption.

Australia currently permits the importation of passionfruit from New Zealand for human consumption, provided Australian biosecurity import conditions are met.

This draft report determines that the importation of commercially produced passionfruit to Australia from all commercial production areas of Vietnam can be permitted, subject to a range of biosecurity requirements.

This draft report contains details of plant pests that are of biosecurity concern to Australia and are potentially associated with the importation of fresh passionfruit from Vietnam. The term 'pests' includes both arthropod pests and pathogens. This report also contains risk assessments for the identified quarantine pests and regulated articles, and, where required, proposed risk management measures to reduce the biosecurity risk to an acceptable level, that is, to achieve the appropriate level of protection (ALOP) for Australia.

Eleven 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*), melon fly (*Zeugodacus cucurbitae*) and pumpkin fruit fly (*Zeugodacus tau*)
- mealybugs: Pacific mealybug (*Planococcus minor*) and mango mealybug (*Rastrococcus invadens*)
- scale insects: dictyospermum scale (*Chrysomphalus dictyospermi*), mulberry scale (*Pseudaulacaspis pentagona*) and West Indian red scale (*Selenaspidus articulatus*)
- spider mite: *Tetranychus piercei*
- thrips: melon thrips (*Thrips palmi*) and chilli thrips (*Scirtothrips dorsalis*).

Of these 11 pests:

- ten are quarantine pests, including melon thrips, which was also identified as a regulated article as it is capable of harbouring and spreading emerging orthospoviruses that are quarantine pests for Australia
- one is a non-quarantine pest (chilli thrips) but is identified as a regulated article as it is capable of harbouring and spreading quarantine orthospoviruses.

The identified pests are the same, or of the same pest groups, as those associated with other horticultural commodities that have been analysed previously by the department.

The proposed risk management measures take account of regional differences in pest distribution within Australia. Four pests requiring risk management measures, *Planococcus minor*, *Chrysomphalus dictyospermi*, *Pseudaulacaspis pentagona* and *Thrips palmi*, have been identified as regional quarantine pests for Western Australia, and *Thrips palmi* has also been identified as a regional quarantine pest for South Australia. These pests are considered regional quarantine pests as interstate quarantine regulations and enforcement are in place to prevent the introduction and distribution of these pests into the respective jurisdictions.

Summary

In this draft report the department proposes a range of risk management measures, combined with operational systems, to reduce the risks posed by the 11 identified pests to achieve the ALOP for Australia. The proposed measures are:

- for fruit flies:
  - pest free areas, pest free places of production or pest free production sites; or
  - fruit treatment considered to be effective against fruit flies such as irradiation
- for mealybugs, scale insects, spider mite and thrips:
  - pre-export visual inspection, and if found, remedial action.

This draft report has been published on the department website to allow interested parties to provide comments and submissions within the specified consultation period.



# 1 Introduction

## 1.1 Australia's biosecurity policy framework

Australia's biosecurity policies aim to protect Australia against the risks that may arise from exotic pests 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 proposed 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 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 website at [agriculture.gov.au/biosecurity-trade/policy/risk-analysis/guidelines](http://agriculture.gov.au/biosecurity-trade/policy/risk-analysis/guidelines).

## 1.2 This risk analysis

### 1.2.1 Background

Vietnam's Plant Protection Department (PPD) within the Ministry of Agriculture and Rural Development (MARD) formally requested market access to Australia for passionfruit for human consumption in a submission received in June 2016. This submission provided information on the pests associated with passionfruit in Vietnam, including the plant parts affected. Information was also provided on the standard commercial production practices for passionfruit in Vietnam.

On 30 August 2022, the department notified stakeholders of the decision to progress a request for market access for passionfruit from Vietnam as a review of biosecurity import requirements. This analysis is conducted in accordance with the *Biosecurity Act 2015*.

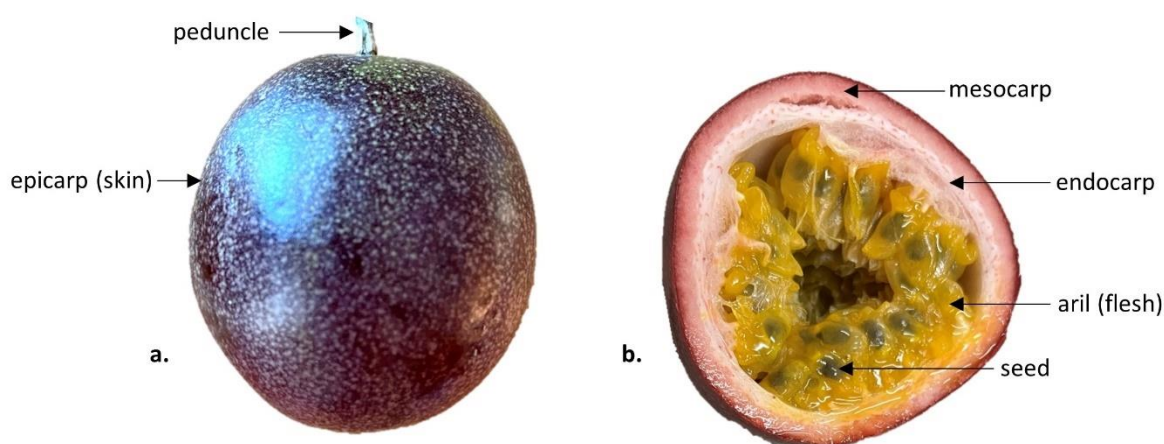
In November 2022, officers from the department visited production areas for passionfruit from Vietnam. The objective of this visit was to observe commercial production, pest management and other export practices.

### 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 passionfruit (*Passiflora edulis*) from Vietnam, produced using standard commercial production practices as described in Chapter 2, for human consumption in Australia.

In this risk analysis, passionfruit are defined as the entire fruit with the skin, flesh, seeds, and potentially a small portion of the peduncle (Figure 1.1). This risk analysis covers all cultivars of commercially produced passionfruit from all production regions in Vietnam.

Figure 1.1 Diagram of passionfruit morphology



a. External morphology of the mature passionfruit. b. Internal morphology of the mature passionfruit.

### 1.2.3 Existing policy

#### International policy

Import policy exists for fresh passionfruit from New Zealand. Australia has import policies for the following horticultural commodities from Vietnam: longan (DAWR 2019b), dragon fruit (DAWR 2017c), lychees (DAFF 2013) and mangoes (DAWR 2015).

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

A preliminary assessment has identified that the potential pests of biosecurity concern for passionfruit from Vietnam are the same, or of the same pest groups, as those associated with these and other horticultural commodities that have been assessed previously by the department, and for which risk management measures are established.

The department has reviewed all the pests and pest groups previously identified in existing policies and, where relevant, the information in those assessments has been considered in this risk analysis. The department has also reviewed the latest scientific literature and other

information and, where relevant, the department has included this new information in this risk analysis.

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 2017a).

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 2019a).

The biosecurity risk posed by soft and hard scale insects was previously assessed for all countries in the *Final group pest risk analysis for soft and hard scale insects on fresh fruit, vegetable, cut-flower and foliage imports* (scales Group PRA) (DAWE 2021).

These Group policies are applicable for the passionfruit from Vietnam pathway. The department has determined that the information in these Group policies 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. 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/arrangements. 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 passionfruit from Vietnam that are assessed in this risk analysis, other organisms may arrive with the imported commodity. These organisms may include pests considered not to be associated with the fruit pathway, pests of other crops, or predators and parasitoids of arthropods. The department considers these organisms to be contaminating pests ('contaminants') that could pose sanitary (to human or animal life or health) or phytosanitary (to plant life or health) risks. 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 a verification process on arrival in Australia. The department will investigate whether any pest identified through import verification processes may be of biosecurity concern to Australia and may thus require remedial action.

#### **1.2.5 Consultation**

On 30 August 2022, the department notified stakeholders, in Biosecurity Advice 2022/P08, of the commencement of a review of biosecurity import requirements to assess a proposal by Vietnam for market access to Australia for passionfruit for human consumption.

Prior to, and following the announcement of this decision, the department engaged with the Australian passionfruit industry – Passionfruit Australia Inc.

The department has also consulted with the government of Vietnam and Australian state and territory governments during the preparation of this report.

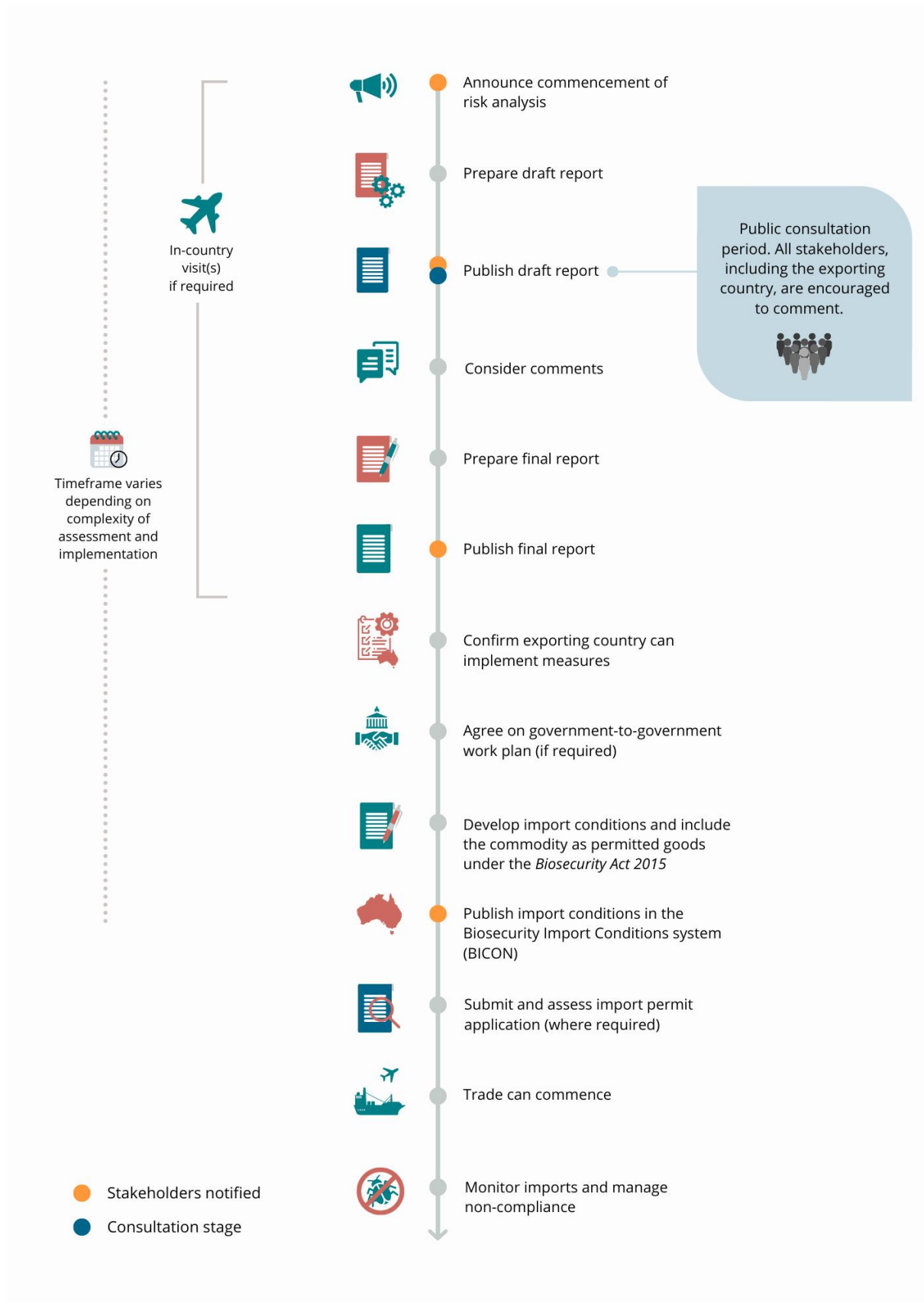
### **1.2.6 Overview of this pest risk analysis**

A pest risk analysis (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'. A pest is 'any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products' (FAO 2023). This definition is also applied in the *Biosecurity Act 2015*.

The department conducted this PRA in accordance with Australia's method for pest risk analysis (Appendix A), which is consistent with the International Standards for Phytosanitary Measures (ISPMs), including ISPM 2: *Framework for pest risk analysis* (FAO 2019b) and ISPM 11: *Pest risk analysis for quarantine pests* (FAO 2019c), and the WTO Agreement on the Application of Sanitary and Phytosanitary Measures (the SPS Agreement) (WTO 1995).

A summary of the process used by the department to conduct a risk analysis is provided in Figure 1.2.

Figure 1.2 Process flow diagram for conducting a risk analysis and implementing trade



The PRA was conducted in the following 3 consecutive stages:

- 1) Initiation—identification of:
  - the pathway being assessed in the risk analysis
  - the pest(s) that have potential to be associated with the pathway and are of biosecurity concern and should be considered for analysis in relation to the identified PRA area.
- 2) Pest risk assessment—this was conducted in 2 sequential steps:
  - 2a. Pest categorisation: examination of each pest identified in stage 1 to determine whether they are a quarantine pest and require further pest risk assessment.
  - 2b. Further pest risk assessment: evaluation of the likelihoods of the introduction (entry and establishment) and spread, and the magnitude of the potential consequences of the quarantine pest(s). The combination of the likelihoods and consequences gives an overall estimate of the biosecurity risk of the pest, known as the unrestricted risk estimate (URE).
- 3) Pest risk management—the process of identifying and proposing/recommending required phytosanitary measures to reduce the biosecurity risk to achieve the ALOP for Australia where the URE is determined as not achieving the ALOP for Australia. Restricted risk is estimated with these phytosanitary measure(s) applied.

A phytosanitary measure is ‘any legislation, regulation or official procedure having the purpose to prevent the introduction or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests’ (FAO 2023).

For further information on the:

- method for PRA see: Appendix A
- terms used in this risk analysis see: Glossary, acronyms and abbreviations at the end of this report
- pathway being assessed in this risk analysis see: section 1.2.2
- initiation and pest categorisation see: Appendix B
- commercial production practices of passionfruit in Vietnam and its export capability see: Chapter 2
- pest risk assessments for pests/pest groups identified in Appendix B as requiring further pest risk assessment see: Chapter 3
- risk management measures for pests/pest groups assessed in Chapter 3 as not achieving the ALOP for Australia see: Chapter 4.

### **1.2.7 Next steps**

The department has notified the proposer, the registered stakeholders, and the WTO-Secretariat about the release of this draft report.

This draft report gives stakeholders an opportunity to comment on the department’s review and proposed measures, and to draw attention to any scientific, technical or other gaps in the data, or misinterpretations or errors.

Introduction

The department will consider submissions received on the draft report and may consult further with stakeholders. The department will revise the report as appropriate and then prepare a final report, taking into account stakeholder comments.

The final report will be published on the department website along with a notice advising stakeholders of the release. The department will also notify the proposer, 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.

The biosecurity requirements recommended in the final report will form the basis of the conditions published on BICON, and for any import permits subsequently issued.

Should the final report recommend importation be permitted, Vietnam must be able to demonstrate to the department that processes and procedures are in place to implement the agreed risk management measures prior to publication of import conditions on BICON. This will ensure safe trade in passionfruit from Vietnam.

## 2 Commercial production practices for passionfruit in Vietnam

This chapter provides information on the pre-harvest, harvest and post-harvest practices considered to be standard practices in Vietnam for the production of passionfruit for export. It also outlines the export capability of Vietnam.

### 2.1 Considerations used in estimating unrestricted risk

Vietnam provided a technical market access submission and additional information to Australia that included information on commercial production practices of passionfruit in Vietnam.

In November 2022, the department visited passionfruit producing areas in the provinces of Gia Lai and Son La, and passionfruit packing houses in these provinces and Ho Chi Minh City. The department's observations during the visit, and additional information provided during and after the visit, confirmed the production, harvest, processing and packing procedures described in this chapter as standard commercial production practices for passionfruit for export.

The information provided by Vietnam and gathered by the department during the visit has been supplemented with data from published literature and other sources and has been taken into consideration when estimating the unrestricted risks of pests that may be associated with import of this commodity.

In estimating the likelihood of pest introduction, it was considered that the pre-harvest, harvest and post-harvest production practices for passionfruit, as described in this chapter, are implemented by all growers and packing houses for all varieties of passionfruit produced for export.

### 2.2 Production areas of passionfruit

Commercial production of passionfruit in Vietnam occurs predominantly in the Central Highlands (provinces of Gia Lai, Dak Nong, Dak Lak, Kon Tum and Lam Dong), the North West region (provinces of Hoa Binh and Son La), the North East region (provinces of Ha Giang, Cao Bang and Lang Son), and the North Central Coast region (province of Nghe An) (MARD 2016, 2021). These production areas are identified in Map 3.

The commercial production of passionfruit in Vietnam is a relatively new and expanding industry that commenced in 2007 (MARD 2016). The total area planted to passionfruit in 2019 was 10,500 ha, with around 70% of plantings occurring in the Central Highlands region (Table 2.1) (MARD 2021).

The area grown to passionfruit continues to increase as the industry grows (MARD 2016). Production of passionfruit per hectare has also increased in recent years due to improvements and efficiencies in production methods (MARD 2016).



Map 3 The main passionfruit growing provinces within regions of Vietnam



Source: Adapted from OnTheWorldMap (2023)

**Table 2.1 Production area of passionfruit in Vietnam in 2019**

<b>Regions (Provinces)</b>	<b>Production area (ha)</b>
North East and North West regions (Hoa Binh, Son La, Cao Bang, Ha Giang and Lang Son provinces)	2,494
North Central Coast region (Nghe An province)	385
Central Highlands region (Gia Lai, Lam Dong, Dak Nong, Dak Lak and Kon Tum provinces)	7,351
Other provinces	270
<b>Total</b>	<b>10,500</b>

### 2.3 Climate in production areas

Vietnam has both tropical and temperate climate zones, with central and southern parts of the country experiencing a tropical climate, and northern parts experiencing a temperate climate (World Bank Group 2021). There is a rainy season in the north and south from May to October and in the central regions from September to January. The rainy seasons correspond to the annual monsoon effect (World Bank Group 2021).

Northern parts of the country have mean monthly temperatures ranging from 17°C to 36°C, whereas southern parts experience a narrower mean monthly temperature range of 23°C to 35°C (World Weather Online 2023). The annual mean rainfall in Vietnam ranges from approximately 1,700 to 1,900 mm (World Bank Group 2021).

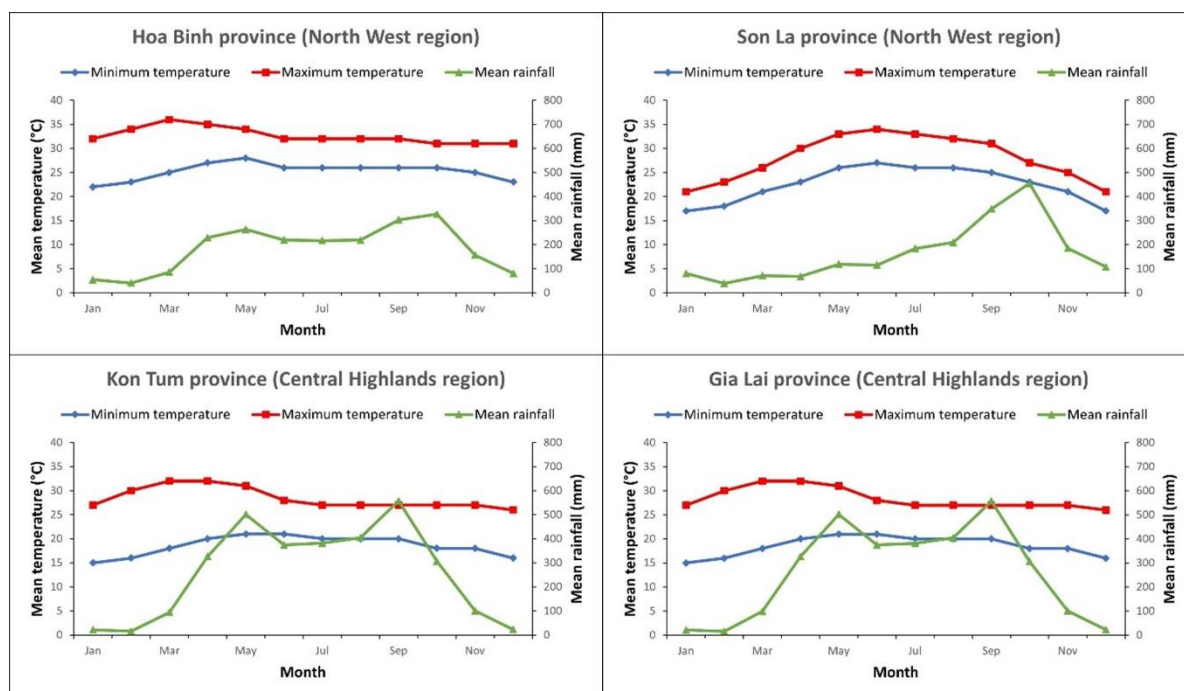
The North East and North West regions include areas with elevations of 2,000 m to 3,000 m above sea level. These regions have a rainy season from April to September, with most rain occurring from June to August and drought often occurring during November to April (MARD 2021).

The North Central Coast region has a tropical monsoon climate with a hot, humid summer with abundant rainfall and a cold winter with little rainfall. Annual rainfall in the North Central Coast region ranges from 1,200 mm to 2,000 mm, with 123 to 152 rainy days per year (MARD 2021).

The Central Highlands region consists of a series of fertile plateaus, ranging from 500 m to 1,500 m above sea level, surrounded by high mountain ranges. This region has a dry season and a rainy season (MARD 2021).

Figure 2.1 summarises the mean monthly minimum and maximum temperatures, and mean monthly rainfall in some of the main passionfruit production areas.

**Figure 2.1 Mean monthly minimum and maximum temperatures and mean monthly rainfall in the main production areas of passionfruit in Vietnam**



Mean monthly minimum (—◆—) and maximum (—■—) temperatures (°C) and mean monthly rainfall (millimetres) (—▲—) in provinces of Vietnam. Source: World Weather Online (2023)

## 2.4 Pre-harvest

### 2.4.1 Cultivars

The passionfruit plant is a member of the family Passifloraceae. It is a short-lived perennial, shallow-rooted and woody, self-climbing vine. The leaves are alternate, oval-shaped when young, and develop into deeply 3-lobed, approximately 7.5 cm to 20 cm in length when mature (Morton 1987). The young stems, tendrils and leaves may be tinged with red or purple. A single flower is borne at each node on new growth. Each flower, which contains both male and female parts, is 5 cm to 7.5 cm wide and is composed of 5 petals, 5 sepals and 5 anthers (Bailey et al. 2021; Morton 1987).

After pollination, the ovum, located below the 3-pointed stigma, grows into the fruit (Figure 1.1). The fruit is round to ovoid (Bailey et al. 2021; Morton 1987). Botanically the fruit is a berry, filled with black seeds that are covered by membranous orange pulpy sacs (arils), all surrounded by a white pith (Bailey et al. 2021) and a tough outer rind (Bailey et al. 2021). When mature, the rind ranges in colour from green to yellow, red or purple and is smooth and waxy in appearance (Bailey et al. 2021; Morton 1987).

The main cultivar of passionfruit that is currently grown in Vietnam is Dai Nong 1, which is a hybrid of yellow and purple passionfruit varieties. This cultivar, also known as the Tainung no. 1 cultivar, was developed by the Taiwan Agricultural Research Institute (Chang et al. 2017). It is reddish-purple when ripe, has low acidity, a fragrant aroma, and a smooth, glossy skin (Chang et al. 2017). Dai Nong 1 accounts for 95% of commercially grown passionfruit in Vietnam (MARD 2021).

Further cultivars are being trialled for potential commercial production. Yellow passionfruit are also grown, but these are largely used as a rootstock for grafting Dai Nong 1 plants or for producing fruit for the Vietnamese market.

## 2.4.2 Cultivation practices

### Production of seedlings

Passionfruit seedlings for commercial planting are grown, from disease-free seed or as grafted plants, in nurseries accredited by Vietnam's Crop Production Department within MARD (Figure 2.2).

The Dai Nong 1 variety is generally grafted onto a yellow passionfruit rootstock, which provides improved vigour and disease resistance. The rootstock may be grown from seed or cuttings. To provide protection from harmful insects, especially virus vectors, the parent plants for production of the grafting buds, and seeds and cuttings for rootstocks are maintained in insect-proof facilities (MARD 2023). Disease screening - for example, testing for viruses by reverse transcriptase polymerase chain reaction and polymerase chain reaction methods - is conducted prior to the seedlings being released from the nursery for planting on farms (MARD 2023).

Since 2021, all passionfruit seedlings have been produced in Vietnam (MARD 2023). Prior to 2021, nurseries sourced passionfruit seed and seedlings from within Vietnam and through importation from Taiwan (Chang et al. 2017). Seedlings previously sourced from Taiwan required strict pathogen testing at the nursery in Taiwan prior to export (Chang et al. 2017; Red Pine International 2023), as well as clearance through quarantine on arrival in Vietnam (MARD 2014).

Figure 2.2 Passionfruit seedlings growing in a nursery



Source: MARD (2016)

## **Planting**

### *Land preparation*

Passionfruit can be grown on any terrain. The plant prefers soil that is porous and rich in organic matter, such as a red basalt soil. Soils that are too acidic or too alkaline impact plant growth and development.

Land preparation prior to planting involves removal of weeds, raking and levelling the area, and creation of drainage ditches to minimise soil erosion. Holes are dug for planting of new seedlings and plastic matting may be laid down prior to planting (MARD 2021).

In areas of steep terrain, passionfruit are planted along contour lines, in combination with other plants that assist in preventing soil erosion.

### *Planting techniques and timing*

Each passionfruit seedling is placed into a hole, the roots are covered with soil, and the plant is watered. Poles and other support materials are placed around the seedling to prevent wind damage.

Depending on the soil type, topographical location and the cropping intensity, passionfruit may be planted with a density of 850 plants/ha (3 m x 4 m) to 1,660 plants/ha (3 m x 2 m) (MARD 2021).

While passionfruit can be planted year-round in Vietnam, the predominant time for planting is at the start of the rainy season in the respective region (MARD 2016).

## **Plant management**

### *Plant growth and production*

Passionfruit plants are grown on a trellis, 1.8 m to 2.0 m in height, with cross wires to support the growing vines (Figure 2.3). The trellis enhances flowering and fruiting through provision of increased light exposure for the plant. It also allows for an increase in the canopy surface to reduce disease development.

Passionfruit plants commence cropping when approximately 6 months of age and become full-bearing within 18 months (Dirou 2004). The productive life of a passionfruit plant is approximately 3 to 4 years (Dirou 2004), but plants are usually replaced in Vietnam when they are 2 years old. This practice maintains farms with optimal plant vigour and productivity (Chang et al. 2017).

### *Fertilisation*

Fertiliser applications of nitrogen, phosphorus and potassium are applied during the planting period and regularly throughout the year (MARD 2021). An example of a fertiliser regime is provided in Table 2.2.



**Figure 2.3 Trellis supports for passionfruit plants in Vietnam**



**Table 2.2 Example of a fertiliser regime for passionfruit in Vietnam**

Phase	Fertiliser	Frequency
Pre-planting	Animal compost or microbial organic fertiliser Phosphorus and limestone powder	One application
1-6 months	Nitrogen/Phosphorus/Potassium	Nitrogen and Potassium are applied 20 days after planting, and then every 15 days. Phosphorus is separately applied twice, 60 days and 150 days after planting.
7 months onwards	Nitrogen/Phosphorus/Potassium Other foliar fertilisers containing Calcium, Magnesium, Sulfur, Boron, Molybdenum, and Iron are also applied to support the growth, development, flowering and fruiting of the passionfruit plant.	Nitrogen and Potassium are applied 20 times/year, every 15-20 days. Phosphorus is applied 3 times every 3-6 months.

Source: MARD (2016)

### *Pruning, weeding and mulching*

Pruning of passionfruit plants is conducted for selection and training of the main vines, for establishing an optimal plant structure, to enhance the growth, flowering and fruiting of each plant, and to reduce development of diseases. Pruning of young plants involves both canopy and layer management. Leaves near the base of the plant are removed when the plant is approximately 1 m in height (MARD 2016). When the plant is approximately 20 cm to 40 cm

beneath the top platform of the trellis, pruning is conducted to retain only 5 to 6 main branches. Later pruning ensures 4 to 5 vines from each main branch are retained (MARD 2016). Once the plant covers the entire trellis, vines are either pulled down or pulled across to cover the cross wires.

Once the passionfruit plant is fully established, pruning is conducted to remove:

- thick vines
- dead vines affected by pests
- covered vines that exhibit poor flowering and fruiting
- abnormally growing vines, including those that are too long
- old vines that produced fruit in the previous season
- yellow, old and pest-affected leaves
- leaves near large fruit
- leaves on vines without fruits.

Pruning is done using sharp, clean tools and discarded leaves and vines are removed from the farms.

Weeds around the base of the passionfruit plants are removed manually to mitigate harm to the roots and prevent competition and disease development. Mulch may also be applied around the base of the plants to maintain humidity and prevent weed growth.

#### *Irrigation*

A shallow root system enables the passionfruit plant to avoid waterlogging during the rainy season. Irrigation is not required during periods of high rainfall; supplementary irrigation is often required during the dry season.

### **2.4.3 Pest management**

Each province in Vietnam is serviced by government staff from the Crop Production Department and PPD for management of data and statistics, pest surveillance and monitoring, and pest management guidance. At the province level, local PPD officers play an important role in educating and regulating the nurseries, farms and packing houses. The local PPD officers conduct regular surveys of passionfruit farms, on at least a monthly basis (MARD 2023). Officers focus on key pests and diseases, and provide recommendations for pest management practices (MARD 2021).

The main pests reported to be of concern during production of passionfruit in Vietnam are fruit flies, scale insects, thrips, mites, nematodes, fungi, bacteria and viruses.

Biological products containing beneficial organisms such as *Trichoderma* spp., *Streptomyces* spp. and *Bacillus* spp., and saponins and alkaloids, are applied separately, or together with fertilisers, to control fungi and nematodes. Garlic and chilli sprays may be used as pest deterrents. Chemical pesticides are used only when required. Examples of pest management options for different pests of passionfruit in Vietnam are presented in Table 2.3.

To minimise the incidence of viral diseases in passionfruit farms, the common commercial practice is to use disease free planting material and sterilised tools and conduct regular inspection and removal of any plants displaying poor vigour or disease symptoms, including curl, mosaic and/or yellowing of leaves (Chang et al. 2017; Lo, Lou & Huang 2023; PPD 2021). In addition, potential insect vectors are controlled (PPD 2021). After 2 years of growth, passionfruit plants are usually replaced. This strategy is effective in suppressing any disease incidence and maintaining productivity.



**Table 2.3 Examples of pest management options for passionfruit in Vietnam**

<b>Pest/pest group</b>	<b>Management method</b>	<b>Timing of application</b>
Fruit flies	Methyl eugenol traps are used for pest surveillance Protein baits are applied when fruit flies are detected	As required
Scales	Insecticides: abamectin, abamectin + petroleum oil, emamectin benzoate, pymetrozine, spirotetramat, thiamethoxam, imidacloprid, matrine, eucalyptol, deltamethrin, acephate, propargite or sulfur	As required
Thrips	Yellow sticky traps Insecticides: abamectin, matrine, acephate or propargite	As required
Fungi (leaves, branches and fruit)	Fungicides: dimethomorph + mancozeb, propineb, difenoconazole, fosetyl aluminium, azoxystrobin, mancozeb, chlorothalonil, mandipropamid + chlorothalonil, matrine or mancozeb + metalaxyl-M Biological agent: <i>Bacillus</i> spp.	Applied when buds grow or at the beginning of the rainy season. When the weather is favourable for fungal growth, another application may be conducted 7-10 days after the first application. To prevent resistance, different active constituents are applied for any subsequent applications.
Fungi (soil-borne)	Fungicides: phosphoric acid, fosetyl-aluminium, mancozeb or metalaxyl Biological agents: <i>Trichoderma</i> spp. or <i>Bacillus</i> spp.	Applied once or twice each year, at the beginning or at the end of the rainy season, by spraying to the base of the plant or directly to fungi-affected spots.  Chemical pesticides are not applied to the places where bio-products have been applied. Chemicals are used at least 20 days before bio-products.
Bacteria, Phytoplasmas & Viruses	Use of disease-free planting material Control of vectors Removal of infected plants	As required, or after approximately 2 years.
Nematodes	Nematicides: clinoptilolite, abamectin or chitosan Biological agents: <i>Streptomyces lydicus</i> or <i>Purpureocillium lilacinum</i>	On detection of nematodes
Mites	Infested shoots are removed. Miticides: abamectin, abamectin + petroleum oil, emamectin benzoate or mineral oil	If there is a high population density of mites, a rotational application of pesticides may be sprayed to leaves and other parts of passionfruit plants. A second application may be required if mites are found 3-5 days after the initial application.

Source: MARD (2016)

## 2.5 Harvesting and handling procedures

Multiple harvests of passionfruit from individual plants occur through the year, depending on the climate and vine productivity. In the northern provinces, harvesting can occur year-round, but the main harvesting season is from May to December. In the southern provinces, harvesting of passionfruit occurs year-round (MARD 2021).

Harvesting commences when the green fruit start to change colour indicating maturity. Harvesting is done manually, with the passionfruit being hand-snapped from the vine. Passionfruit are harvested into buckets or bags, which are then consolidated into crates or large bags (Figure 2.4), labelled with the farm name or identification number, and transported to the packing house in sealed trucks for further processing.

Passionfruit are highly perishable and are susceptible to moisture loss after harvest, leading to diminished quality, including wrinkling of the fruit surface (Kishore et al. 2011; Yumbya et al. 2014). As a result, passionfruit are transported to the packing house as soon as possible after harvest.

Figure 2.4 Harvesting of passionfruit



Harvested passionfruit being collected into a. crates and b. buckets. Source: MARD (2021)

## 2.6 Post-harvest

### 2.6.1 Packing house processes

There are a number of packing houses in Vietnam that process and pack passionfruit for export.

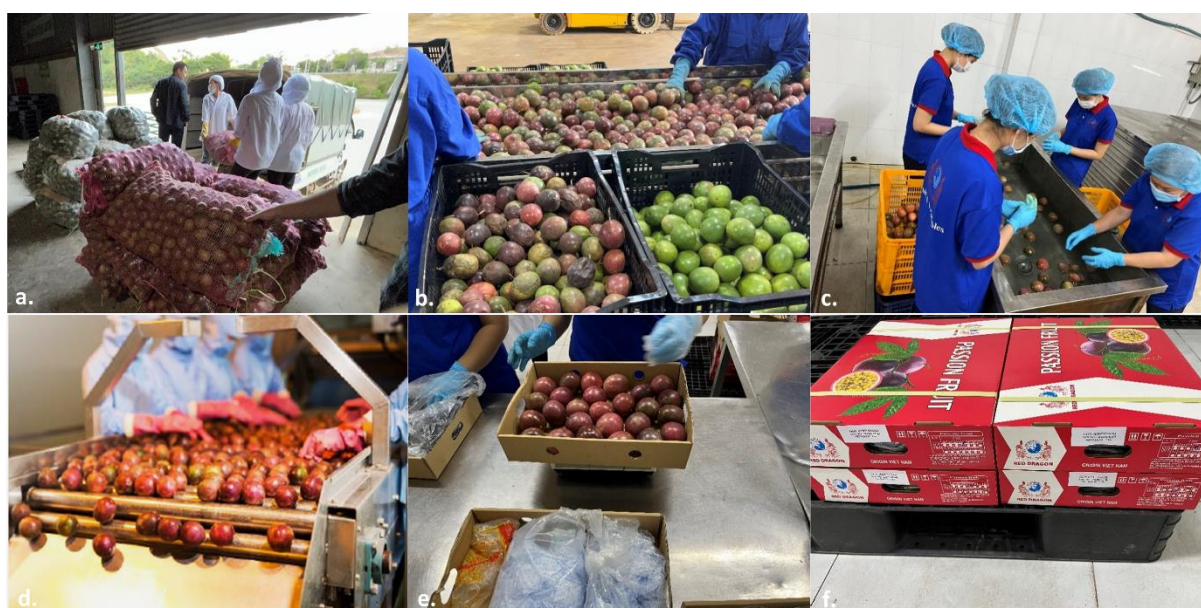
The processing steps for passionfruit at the packing house (Figure 2.5) involve:

- 1) unloading of harvested fruit from trucks and storing in the packing house holding area prior to processing
- 2) initial visual sorting and grading of fruit for size, quality and maturity, and removal of damaged or diseased fruit
- 3) removal of peduncles from fruit using scissors, snips or a sharp blade
- 4) brushing fruit to remove trash on fruit surface
- 5) washing fruit in water
- 6) washing fruit in 100-200 ppm chlorine for at least 1 minute

- 7) rinsing fruit in water
- 8) drying fruit with fans
- 9) final visual quality checks of fruit
- 10) weighing and packing of fruit into perforated bags in tray lined cardboard cartons or polythene wrapped trays
- 11) cold storage of packed fruit
- 12) dispatch.

The brushing, washing, rinsing and drying steps may be carried out manually and/or by machine. The passionfruit may undergo further disinfestation treatment prior to export, if required by the importing country (MARD 2016).

Figure 2.5 Passionfruit packing house processes



a. Harvested passionfruit arrive at the packing house. b. Passionfruit undergo initial sorting and grading. c. Passionfruit are washed. d. Passionfruit undergo further quality checks. e. Passionfruit are packed into boxes. f. Packed passionfruit ready for storage and dispatch.

### 2.6.2 Phytosanitary inspection

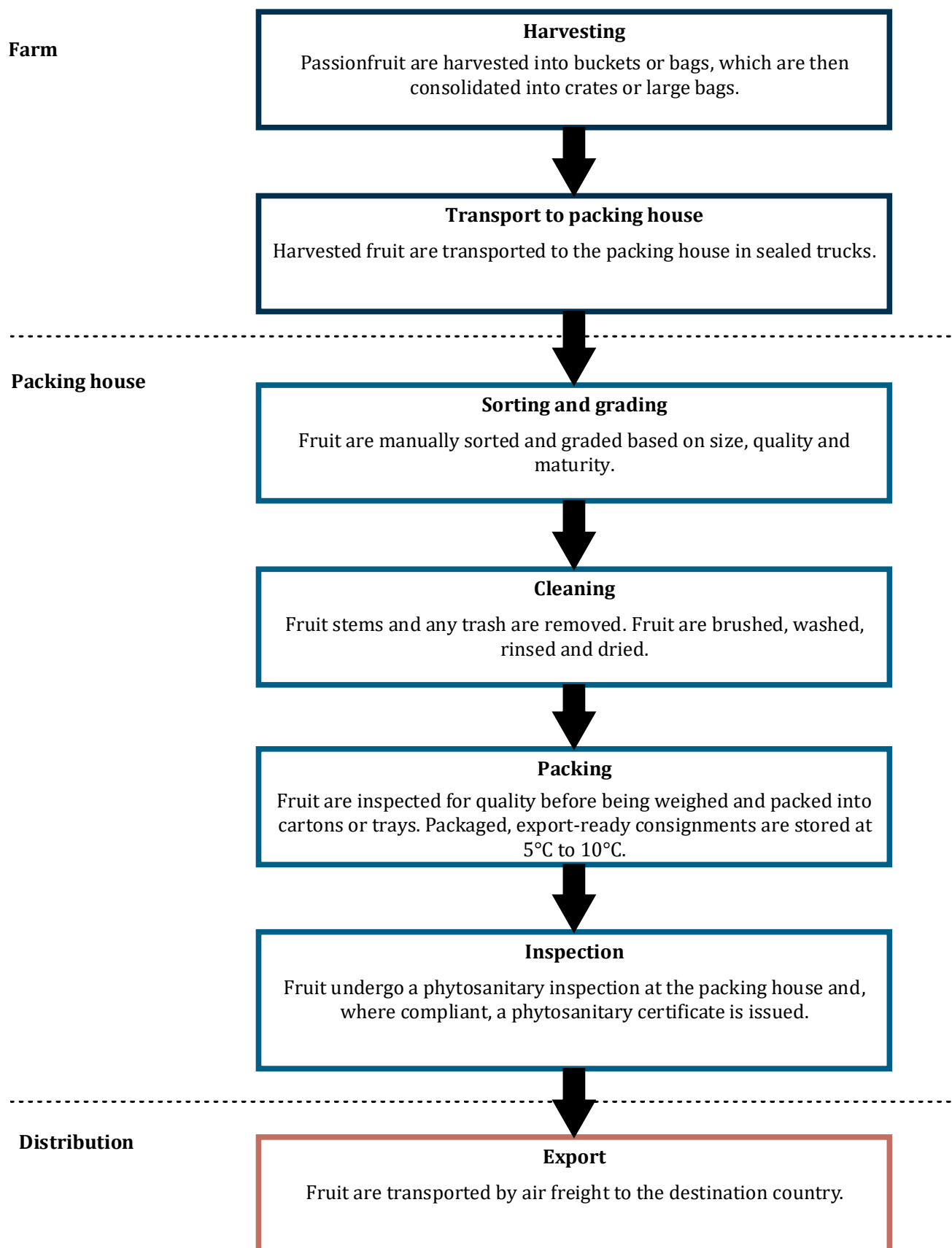
Phytosanitary inspection is performed by PPD inspection officers at a dedicated area in the packing house. PPD inspection officers randomly inspect a sample of fruit. If the consignment is found free of pests and meets the requirements of the importing country, it is issued with a phytosanitary certificate.

### 2.6.3 Transport

Export consignments are loaded into sealed trucks and transported directly to the airport. Shelf life of passionfruit varies from 1 week for fully-ripe fruit to 3 to 5 weeks for partially ripe fruit (Kader 1999). Recommended conditions during storage and transit are a temperature of 5°C to 10°C (Bao Long Foods 2023; Kader 1999) and humidity of up to 95% (Bao Long Foods 2023).

A summary of the operational steps for passionfruit grown in Vietnam for export is provided in Figure 2.6.

Figure 2.6 Summary of operational steps for passionfruit grown in Vietnam for export



## **2.7 Export capability**

### **2.7.1 Production statistics**

In 2019, Vietnam produced 222,200 tonnes of passionfruit from a total production area of 10,500 ha (MARD 2021). Due to the high economic value of passionfruit in Vietnam, the acreage and yields per hectare continue to increase.

### **2.7.2 Export statistics**

Vietnam exports fresh passionfruit to a range of markets including China, the Netherlands, the United Arab Emirates, France, Germany, Switzerland, Spain, Singapore, Hong Kong and the Republic of Korea (MARD 2021). In 2019, the volume of fresh passionfruit exported from Vietnam totalled approximately 3,300 tonnes (MARD 2021). As a relatively new and expanding industry in Vietnam, there is potential for significant increases in passionfruit exports.

### **2.7.3 Export season**

Export of passionfruit from Vietnam occurs year-round, with peak availability from April to September (Nafoods 2021).

### **3 Pest risk assessments for quarantine pests**

#### **3.1 Summary of outcomes of pest initiation and categorisation**

The initiation process (Appendix B) identified 113 pests as being associated with passionfruit in Vietnam.

Of these 113 pests, the pest categorisation process (Appendix B) identified:

- 74 pests as already present in Australia and not under official control, and therefore not requiring further assessment
- 28 pests as not having potential to enter on the commercially produced passionfruit from Vietnam pathway, and therefore not requiring further assessment

The remaining 11 pests were assessed as having potential to establish, spread and cause consequences in Australia, and therefore require further pest risk assessment.

In applying the Group PRAs, 2 thrips, 2 mealybugs and 3 scale insects were identified on the import pathway and listed in the pest categorisation (Appendix B). The application of the Group PRAs to this risk analysis is outlined in Appendix A in section A2.7.

#### **3.2 Pests requiring further pest risk assessment**

The 11 pests, associated with commercially produced passionfruit for export from Vietnam, identified as requiring further pest risk assessment are listed in Table 3.1.

Of these 11 pests:

- 10 are quarantine pests and 1 is a regulated article for Australia as it can vector emerging quarantine orthospoviruses
- 1 of the 10 quarantine pests is also a regulated article as it can vector emerging quarantine orthospoviruses
- 4 of the quarantine pests are regional quarantine pests as, whilst they have been recorded in some regions of Australia, interstate quarantine regulations are in place and enforced.



**Table 3.1 Quarantine pests and regulated articles potentially associated with passionfruit from Vietnam, and requiring further pest risk assessment**

Pest/pest group	Scientific name	Common name	Policy status/region
Fruit flies [Diptera: Tephritidae]	<i>Bactrocera dorsalis</i>	Oriental fruit fly	EP
	<i>Zeugodacus cucurbitae</i>	Melon fly	EP
	<i>Zeugodacus tau</i>	Pumpkin fruit fly	EP
Mealybugs [Hemiptera: Pseudococcidae]	<i>Planococcus minor</i>	Pacific mealybug	GP, WA
	<i>Rastrococcus invadens</i>	Mango mealybug	GP
Scale insects [Hemiptera: Diaspididae]	<i>Chrysomphalus dictyospermi</i>	Dictyospermum scale	GP, WA
	<i>Pseudaulacaspis pentagona</i>	Mulberry scale	GP, WA
	<i>Selenaspidus articulatus</i>	West Indian red scale	GP
Spider mite [Acariformes: Tetranychidae]	<i>Tetranychus piercei</i>		
Thrips [Thysanoptera: Thripidae]	<i>Scirtothrips dorsalis</i>	Chilli thrips	GP, RA
	<i>Thrips palmi</i> <sup>a</sup>	Melon thrips	GP, SA, WA

**a:** Quarantine thrips species that is also identified as a regulated article for Australia as it vectors emerging quarantine orthotospoviruses. **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. **WA:** Regional quarantine pest for Western Australia. **SA:** Regional quarantine pest for South Australia.

### 3.3 Overview of pest risk assessment

This chapter assesses, for each of the pests, or pest groups identified in Table 3.1, the likelihoods of entry, establishment and spread, and the magnitude of the associated potential consequences these species may cause if they were to enter, establish and spread in Australia.

All of the pests or pest groups in Table 3.1 have been assessed previously by the department. Where appropriate, the outcomes of the 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' is used to identify species assessed previously and for which import policy already exists. The process relating to the adoption of outcomes from previous assessments is outlined in Appendix A in section A2.6.

The biosecurity risk posed by thrips and the orthotospoviruses they transmit was previously assessed for all countries in the thrips Group PRA (DAWR 2017a), which has been applied to this assessment of passionfruit from Vietnam.

The biosecurity risk posed by mealybugs and the viruses they transmit was previously assessed for all countries in the mealybugs Group PRA (DAWR 2019a), which has been applied to this assessment of passionfruit from Vietnam.

The biosecurity risk posed by soft and hard scale insects was previously assessed for all countries in the scales Group PRA (DAWE 2021), which has been applied to this assessment of passionfruit from Vietnam.

The acronym 'GP' is used to identify species assessed previously in a Group PRA and for which a Group PRA was applied. The application of the Group PRAs to this risk analysis is outlined in

Appendix A in section A2.7. A summary of assessment from the Group PRAs is presented for the relevant pests and/or regulated thrips in this chapter for convenience.

A summary of the likelihood, consequence and URE ratings obtained in each pest risk assessment is provided in Table 3.9. An overview of the decision process at the initiation, pest categorisation and pest risk assessment stages of this PRA is presented diagrammatically in Figure 3.1.



### 3.4 Fruit flies

#### ***Bactrocera dorsalis* (EP), *Zeugodacus cucurbitae* (EP) and *Zeugodacus tau* (EP)**

*Bactrocera dorsalis* (Oriental fruit fly), *Zeugodacus cucurbitae* (melon fly) and *Z. tau* (pumpkin fruit fly) belong to the Tephritidae family, a group of fruit flies considered to be amongst the most damaging pests of horticultural crops (White & Elson-Harris 1994). These species are serious pests of a range of commercial fruit crops in parts of Asia (White & Elson-Harris 1994), and all 3 species are present in Vietnam (Drew & Romig 2013; Leblanc et al. 2018).

*Bactrocera dorsalis*, *Z. cucurbitae* and *Z. tau* are not reported in Australia and therefore are quarantine pests for all of Australia.

*Bactrocera invadens* (Drew, Tsuruta & White), *B. papayae* Drew & Hancock and *B. philippinensis* Drew & Hancock have been synonymised with *B. dorsalis* (Schutze et al. 2014). References to these previously accepted species are now considered to be references to *B. dorsalis*, and this is reflected in the assessment of fruit flies for passionfruit from Vietnam.

On the basis of phylogenetic relationship analysis, *Bactrocera cucurbitae* and *B. tau* have been placed in the genus *Zeugodacus* (De Meyer et al. 2015; Doorenweerd et al. 2018; Plant Health Australia 2023; Virgilio et al. 2015). Current and past literature refers to these species under both the former (*B. cucurbitae* and *B. tau*) and current (*Z. cucurbitae* and *Z. tau*) scientific names. This assessment uses the currently accepted names of *Z. cucurbitae* and *Z. tau*.

*Bactrocera dorsalis*, *Z. cucurbitae* and *Z. tau* have been grouped together in this assessment as they have common biological characteristics and behaviours, and are considered to pose similar biosecurity risks. In this assessment, the term 'fruit flies' is used to refer to these 3 species as a group. The scientific name is used when the information relates to a specific species.

Tephritid fruit flies have 4 life stages: egg, larva, pupa and adult. Adult females lay eggs in clutches under the skin of host fruits. Once the eggs hatch, the larvae feed on the flesh of the host fruit. On reaching maturity, the fruit fly larvae usually leave the fruit, drop to the ground and pupate in the soil under the host plant (Christenson & Foote 1960). Tephritid fruit flies can produce several generations each year, depending primarily on temperature. Adults begin mating within 1 to 2 weeks following emergence, and may live from 1 to 3 months, or up to 12 months in cool conditions (Christenson & Foote 1960). The major dispersal mechanism of tephritid flies is by human-mediated activities through transportation of infested fruit (Louzeiro et al. 2021; Putulan et al. 2004). However, dispersal by adult flight is also possible (Fletcher 1989; Qureshi et al. 1975).

All 3 species of fruit flies have been assessed previously in the policies for mangoes from Taiwan (Biosecurity Australia 2006) and India (Biosecurity Australia 2008, 2011). Other fresh fruit policies that have assessed one or more of these 3 species include lychees from Taiwan and Vietnam (DAFF 2013), mangoes from Indonesia, Thailand and Vietnam (DAWR 2015), dragon fruit from Indonesia (DAWR 2018), longan fruit from Vietnam (DAWR 2019b) and fresh jujubes from China (Department of Agriculture 2020). In these policies, the UREs for *B. dorsalis* and *Z. cucurbitae* did not achieve the ALOP for Australia and specific risk management measures were required for *B. dorsalis* and *Z. cucurbitae* on those pathways. In the previous policies that assessed *Z. tau*, mango and longan fruit were not considered hosts for *Z. tau*. The assessment

outcomes for *Z. tau* therefore did achieve the ALOP for Australia and specific risk management measures were not required for *Z. tau* on those pathways.

The assessment for *B. dorsalis*, *Z. cucurbitae* and *Z. tau* for passionfruit from Vietnam builds on the previous assessments for *B. dorsalis* and/or *Z. cucurbitae*. Previous assessments for *Z. tau* were not considered relevant as the fruits assessed (mango and longan) were determined to be non-hosts for *Z. tau*, whereas passionfruit is a recorded host for *Z. tau*.

There may be differences in commercial production practices, climatic conditions, fruit biology and pest prevalence between the previously assessed commodity/country pathways and passionfruit from Vietnam. These potential differences make it necessary to re-assess the likelihood that these assessed fruit flies will arrive in Australia in a viable state with the importation of passionfruit from Vietnam.

The assessments of *B. dorsalis* and/or *Z. cucurbitae* on the lychees from Taiwan and Vietnam, mangoes from Indonesia, Thailand and Vietnam, dragon fruit from Indonesia, longan fruit from Vietnam and fresh jujubes from China pathways rated the likelihood of distribution of these fruit fly species as High. Passionfruit from Vietnam are expected to be distributed in Australia in a similar way to these previously assessed pathways.

It is expected that once passionfruit arrives in Australia from Vietnam, they will be distributed to various destinations throughout Australia for wholesale and retail sale. Most fruit waste would likely be disposed of via municipal waste facilities reducing the risk of fruit flies distributing to a host. However, small quantities may be discarded in the environment. Any fruit flies present in discarded passionfruit may disperse to new hosts, as adult fruit flies are highly mobile and could fly to nearby host plants. Fruit flies have wide host ranges and there will likely be hosts present year-round in Australia. On this basis, the same rating of High for the likelihood of distribution of these fruit flies in previous assessments is adopted for the passionfruit from Vietnam pathway.

The likelihoods of establishment and spread of fruit flies in Australia from the passionfruit from Vietnam pathway have been assessed as similar to those of the previous assessments of High and High, respectively. Those likelihoods relate specifically to events that occur in Australia and are essentially independent of the import pathway. The consequences of the entry, establishment and spread of fruit flies in Australia are also independent of the import pathway and have been assessed as being similar to those previous risk assessments of High. The existing ratings for the likelihoods of establishment and spread, and the rating for the overall consequences for *B. dorsalis* and/or *Z. cucurbitae* in previous assessments have been adopted for *B. dorsalis*, *Z. cucurbitae* and *Z. tau* on the passionfruit from Vietnam pathway.

In addition, the department has reviewed the latest literature – for example, Follett, Haynes and Dominiak (2021); Huang et al. (2020b); Li et al. (2020); Louzeiro et al. (2021); Michel et al. (2021); Zeng et al. (2018). No new information has been identified that would significantly change the risk ratings for distribution, establishment, spread and consequences as set out for *B. dorsalis* and/or *Z. cucurbitae* in the existing policies.

The risk scenario of biosecurity concern considered here is that eggs or larvae of *B. dorsalis*, *Z. cucurbitae* and *Z. tau* may be present within passionfruit imported from Vietnam and may successfully develop and emerge as adults in Australia.

### 3.4.1 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 *B. dorsalis*, *Z. cucurbitae* and *Z. tau* will arrive in Australia in a viable state with the importation of passionfruit from Vietnam is assessed as **High**.

The likelihood of importation is assessed as High because *B. dorsalis*, *Z. cucurbitae* and *Z. tau* are present in Vietnam and are likely to be present in passionfruit production areas. There is evidence of *B. dorsalis*, *Z. cucurbitae* and *Z. tau* infesting passionfruit under field conditions. Both immature and mature passionfruit are prone to fruit fly infestation. Infested immature fruit tend to develop signs of injury, and wither and drop from the vine. However, fruit fly infestation of mature passionfruit may not be visibly evident at harvest. Cold temperatures during storage and transport of passionfruit may delay or temporarily halt development, and may affect survival of immature stages of fruit flies within passionfruit. However, due to its highly perishable nature, storage and transport period of passionfruit is likely to be short. The development of surviving immature stages of fruit flies may recommence when favourable temperatures are reinstated.

The following information provides supporting evidence for this assessment.

*Bactrocera dorsalis*, *Z. cucurbitae* and *Z. tau* are present in Vietnam.

- *Bactrocera dorsalis*, *Z. cucurbitae* and *Z. tau* are present and widespread in Vietnam (Dien, Huy & Dung 2021; Drew & Romig 2013; Thuy 1998). Areas where one or more of these fruit fly species are present include in Ba Be, Me Linh, Tam Dao (Leblanc et al. 2018), Tuyen Quang and Phu Tho (Shi, Kerdelhué & Ye 2014) in northern Vietnam, Bach Ma in central Vietnam (Leblanc et al. 2018), the Mekong Delta in southern Vietnam (Dien, Huy & Dung 2021) and Binh Duong, Dong Nai, and Binh Thuan in south-eastern Vietnam (Thuy, Duc & Vu 2000).
- A trapping survey for adult fruit flies was conducted in Vietnam in 2015 and 2017 whereby individual traps were maintained for 3 to 5 days at 220 sites in forest reserves and national parks. *Bactrocera dorsalis* was the predominant species trapped in areas of northern Vietnam, central Vietnam and southern Vietnam (Leblanc et al. 2018). *Zeugodacus tau* and *Z. cucurbitae* also occurred in all 3 areas of Vietnam but at lower levels compared to *B. dorsalis* (Leblanc et al. 2018).

Biotic and abiotic factors in Vietnam will support fruit fly populations in passionfruit production areas.

- A wide variety of tropical fruits are grown in Vietnam, and overlapping harvest times provide a continuous source of suitable host material for the development of multiple fruit fly generations throughout the year (Thuy, Duc & Vu 2000).
- Fruit fly populations have been positively correlated with high rainfall and temperature (Allwood & Drew 1997; Bess & Haramoto 1961; Hasyim, Muryati & de Kogel 2008; Hossain et al. 2019; Win et al. 2014).
  - In a field survey of a dragon fruit growing area in southern Vietnam in 2016 to 2018, higher numbers of adult fruit fly species, including *B. dorsalis* were caught in methyl eugenol traps in the wet periods, from March to September, with population peaks in May to June (Hien et al. 2020).

- Similarly, in a field survey conducted in 2005 of a passionfruit growing area in nearby Thailand, the number of *Z. tau* adult males caught in traps peaked in July, with the population showing a significant positive correlation with high rainfall and high temperatures (Hasyim, Muryati & de Kogel 2008).
- Temperatures and rainfall in areas of Vietnam are conducive to fruit fly survival and development.
  - Vietnam experiences a rainy season (World Bank Group 2021) and above average annual precipitation (1,700 to 1,900 mm) (TheGlobalEconomy.com 2018; World Bank Group 2021).
  - The northern region has mean monthly temperatures ranging from 17°C to 36°C. The southern region experiences a narrower mean monthly temperature range of 23°C to 35°C (World Weather Online 2023).

Passionfruit is a host for *B. dorsalis*, *Z. cucurbitae* and *Z. tau*, although there is evidence that morphological and physiological attributes of passionfruit may affect fruit fly oviposition, development and survival.

- Passionfruit is a host for *B. dorsalis* (Leblanc, Vueti & Allwood 2013; Steiner 1955; Vargas et al. 2012), *Z. cucurbitae* (Aye & Thaug 2002; Tsuruta et al. 1997) and *Z. tau* (Hasyim, Muryati & de Kogel 2008; Suputa et al. 2010) under field conditions.
- Passionfruit is grown and harvested year-round in Vietnam (MARD 2016). Both immature passionfruit with a soft rind and mature, ripe passionfruit with a hardened rind are attractive to ovipositing female fruit flies (Steiner 1955).
- However, there is evidence that the thick skin of passionfruit provides some resistance to oviposition by, and development of, tephritid fruit flies.
  - Steiner, in Christenson and Foote (1960), observed unspecified fruit flies penetrating extremely hard-skinned fruits such as passionfruit with their ovipositor; however, this required a prolonged effort.
  - Subhagan, Dhalin and Kumar (2020) indicated that while fruit fly oviposition scars were present on ripening passionfruit, they generally did not contain living larvae of *Bactrocera* spp.
  - Yang et al. (2023) reported that oviposition of *B. dorsalis*, *Z. cucurbitae* and *Z. tau* eggs into the mesocarp of passionfruit induced the passionfruit to naturally release hydrogen cyanide. Exposure of the fruit fly eggs to this toxin stopped embryonic development, resulting in death of the eggs (Yang et al. 2023). Of 131 field-collected passionfruit samples showing oviposition puncture sites, Yang et al. (2023) reported 130 samples contained eggs of *B. dorsalis*, *Z. cucurbitae* and/or *Z. tau*, but produced no larvae. Only 1 sample contained larvae, which were raised until adult emergence and identified as *B. dorsalis*.
- Resistance to fruit fly oviposition and development may lessen as the fruit ripens. Morton (1987) indicated that cyanogenic glycoside, the precursor of toxic hydrogen cyanide (Yang et al. 2023), is present in the pulp at all stages of development of the passionfruit, but is highest in very young unripe fruits and lowest in fallen, wrinkled fruits - the latter being so low that it is of no toxicological significance. This suggests that mature passionfruit around harvest may be more likely to support fruit fly development than immature passionfruit.

While immature fruit injured by fruit fly may be removed from the pathway, mature passionfruit infested by fruit fly larvae or eggs may not be detected during harvest and post-harvest processing.

- Passionfruit injured by fruit fly oviposition in the immature fruit stage develop a small woody crater around the puncture site as they ripen, causing disfigurement of the outer appearance of the fruit (Akamine et al. 1974).
- Immature passionfruit injured by fruit fly oviposition are likely to shrivel and fall from the vine. However, if fruit are well developed when injured by ovipositing fruit flies, the passionfruit may grow to maturity (Akamine et al. 1974).
- Ovipositional punctures by fruit flies may provide an entrance point for various other decay organisms, resulting in further damage and decomposition of the punctured passionfruit (Bess & Haramoto 1961).
- Passionfruit showing visible signs of fruit fly infestation are likely to be detected and removed during standard commercial grading and packing processes.
- However, ripe passionfruit infested by fruit flies shortly prior to harvest may not develop visible signs of infestation by the time they enter the packing house. Under experimental conditions, ripe passionfruit infested by *B. dorsalis* up to 14 days prior to harvest could not be distinguished from uninfested fruit at the time of harvest (Moquet & Delatte 2021). Therefore, infested passionfruit may remain undetected during harvest and post-harvest procedures and may be packed for export.

Short term storage and transit of fruit at cold temperatures is likely to affect survival and halt development of immature stages of fruit flies in passionfruit. However, any surviving fruit flies are likely to recommence development when fruit are no longer stored at cold temperatures.

- The optimum storage conditions for passionfruit, providing a storage life of up to 5 weeks, are a temperature between 5°C to 10°C and a relative humidity of 90% to 95% (Kader 1999). Chilling injury to the fruit occurs at temperatures below 5°C (Kader 1999).
- Due to the relatively short shelf life of up to 5 weeks, passionfruit are likely to be imported into Australia by air freight as soon as possible after harvest to maximise fruit quality and commercial shelf life. As a result, fruit may only be maintained at cold temperatures for short periods.
- Temperatures between 5°C and 10°C are likely to halt development and may affect survival of fruit flies in infested passionfruit.
  - The development time of fruit flies is inversely dependent on temperature, with development time increasing at lower ambient temperature (Duyck, Sterlin & Quilici 2004; Fletcher 1989; Mkiga & Mwatawala 2015).
  - Mkiga and Mwatawala (2015) estimated the lower developmental thresholds for eggs and larvae of *Z. cucurbitae* to be 15.8°C and 13.4°C, respectively.
  - Danjuma et al. (2014) reported a strong and positive linear relationship between temperature and developmental rate in *B. dorsalis* (as *B. papayae*), with lower development thresholds of 12.1°C and 10.5°C for eggs and larvae, respectively.
  - Michel et al. (2021) showed that eggs of *B. dorsalis* do not hatch when held at a constant temperature of 10°C. Similarly, Ahn, Choi and Huang (2022) reported that eggs of *Z. cucurbitae* did not develop into larvae when subjected to a constant temperature of 12.0°C.

- Fruit flies have been shown to survive short term cold shocks at temperatures at or below the optimum storage temperature of 5°C to 10°C.
  - Huang et al. (2020b) studied the impact of short term (12-hour) low temperature treatments on the growth and development of *Z. tau* and *Z. cucurbitae*. Eggs and larvae were cold-shocked for 12 hours at one of the treatment temperatures (8°C, 6°C, 4°C, 2°C, 0°C, -2°C and -4°C), followed by direct transfer to a controlled temperature of 24°C. The developmental period of each life stage for both species increased gradually with a decrease in the 12-hour cold shock temperature from 8°C to -2°C. The -4°C treatment was the only treatment resulting in 100% mortality of eggs and larvae of *Z. tau* and *Z. cucurbitae*.
- The temperatures for optimum cold storage of passionfruit (Kader 1999) are higher than cold disinfestation treatment temperatures for tephritid fruit flies.
  - Cold disinfestation treatment schedules against fruit flies, including *B. dorsalis*, *Z. cucurbitae* and *Z. tau*, in various fruit commodities, require core fruit temperatures to be maintained between  $\leq -0.55^{\circ}\text{C}$  to 1.67°C for between 11 and 24 days, with the temperature and duration dependent on the fruit species and the target fruit fly pests (Dohino et al. 2017).
  - Cold treatment schedules for *B. dorsalis*, *Z. cucurbitae* and/or *Z. tau* in the USDA Treatment Manual range from 0°C for 12 days to 1.67°C for 22 days (USDA 2016).
- The proposed storage and transport temperatures for passionfruit indicate that fruit flies may not be able to develop during this time and that there may be some mortality. However, upon reaching temperatures capable of supporting development, such as in retail settings, the surviving eggs and larvae in fruit may be able to continue and complete development.

For the reasons outlined, the likelihood of importation of *B. dorsalis*, *Z. cucurbitae* and *Z. tau* on imported passionfruit from Vietnam is assessed as High.

### Likelihood of distribution

The likelihood that *B. dorsalis*, *Z. cucurbitae* and *Z. tau* will be distributed within Australia in a viable state, as a result of the processing, sale or disposal of passionfruit from Vietnam, and subsequently transfer to a susceptible part of a host, is likely to be similar to *B. dorsalis* and/or *Z. cucurbitae* on previously assessed pathways. The same rating of **High** for the likelihood of distribution for *B. dorsalis* and/or *Z. cucurbitae* on the previously assessed pathways is adopted for *B. dorsalis*, *Z. cucurbitae* and *Z. tau* on the passionfruit from Vietnam pathway.

### Likelihood of entry

The likelihood of entry is determined as **High** by combining the re-assessed likelihood of importation of High with the adopted likelihood of distribution of High, using the matrix of rules in Table A.2.

#### 3.4.2 Likelihoods of establishment and spread

The likelihoods of establishment and spread for *B. dorsalis*, *Z. cucurbitae* and *Z. tau* are independent of the import pathway and are considered similar to those in previously assessed pathways.

Based on the existing import policies for *B. dorsalis* and/or *Z. cucurbitae*, the likelihoods of establishment and spread for *B. dorsalis*, *Z. cucurbitae* and *Z. tau* are assessed as **High** and **High**, respectively.

### 3.4.3 Overall likelihood of entry, establishment and spread

The overall likelihood of entry, establishment and spread is determined by combining the individual likelihoods of entry, of establishment and of spread using the matrix of rules in Table A.2.

The overall likelihood that *B. dorsalis*, *Z. cucurbitae* and *Z. tau* will enter Australia as a result of trade in passionfruit from Vietnam, be distributed in a viable state to a susceptible part of a host, establish in Australia and subsequently spread within Australia is assessed as **High**.

### 3.4.4 Consequences

The potential consequences of the entry, establishment and spread of *B. dorsalis*, *Z. cucurbitae* and *Z. tau* in Australia are similar to those in the previously assessed pathways. The overall consequences for *B. dorsalis* and/or *Z. cucurbitae* in the previous assessments were assessed as High. The overall consequences for *B. dorsalis*, *Z. cucurbitae* and *Z. tau* on the passionfruit from Vietnam pathway are also assessed as **High**.

### 3.4.5 Unrestricted risk estimate

Unrestricted risk is the result of combining the overall likelihood of entry, establishment and spread with the outcome of overall consequences. The likelihood and consequences are combined using the risk estimation matrix in Table A.4.

---

<b>Unrestricted risk estimate for <i>B. dorsalis</i>, <i>Z. cucurbitae</i> and <i>Z. tau</i></b>	
Overall likelihood of entry, establishment and spread	High
Consequences	High
Unrestricted risk	<b>High</b>

---

The URE for *B. dorsalis*, *Z. cucurbitae* and *Z. tau* on the passionfruit from Vietnam pathway is assessed as **High**, which does not achieve the ALOP for Australia. Therefore, specific risk management measures are required for *B. dorsalis*, *Z. cucurbitae* and *Z. tau* on this pathway.

### 3.5 Mealybugs

#### *Planococcus minor* (GP, WA) and *Rastrococcus invadens* (GP)

Two mealybug species were identified on the passionfruit from Vietnam pathway as quarantine pests for Australia, *Planococcus minor* (Pacific mealybug) and *Rastrococcus invadens* (mango mealybug) (Table 3.2).

*Rastrococcus invadens* is not known to be present in Australia and is a quarantine pest for all of Australia. *Planococcus minor* is not present in Western Australia and is assessed as a regional quarantine pest for that state.

The indicative likelihood of entry for all quarantine mealybugs is assessed in the mealybugs Group PRA as Moderate (DAWR 2019a). *Planococcus minor* and *Rastrococcus invadens* are present in Vietnam and passionfruit is reported as a host of these pests (Nébié et al. 2018; Spodek et al. 2018; Williams & Watson 1988). Standard packing house processes and transportation are not expected to eliminate these mealybugs from the pathway. After assessment of relevant pathway-specific factors (sections A2.6 and A2.7) for passionfruit from Vietnam, the likelihood of entry of Moderate was verified as appropriate for these mealybug species on this pathway (Table 3.2).

**Table 3.2 Quarantine mealybug species for passionfruit from Vietnam**

Pest	In mealybugs Group PRA	Quarantine pest	On passionfruit pathway	Likelihood of entry
<i>Planococcus minor</i>	Yes	Yes (WA)	Yes	Moderate
<i>Rastrococcus invadens</i>	Yes	Yes	Yes	Moderate

**WA:** Regional quarantine pest for Western Australia.

A summary of the risk assessment for quarantine mealybugs is presented in Table 3.3 for convenience.

**Table 3.3 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
Likelihood of spread	High
Overall likelihood of entry, establishment and spread	Moderate
Consequences	Low
<b>Unrestricted risk</b>	<b>Low</b>

As assessed in the mealybugs Group PRA, the indicative URE for mealybugs is Low (Table 3.3) which does not achieve the ALOP for Australia. This indicative URE is considered to be applicable for all quarantine mealybugs present on the passionfruit from Vietnam pathway. Therefore, specific risk management measures are required for the quarantine mealybugs on this pathway.

In the mealybugs Group PRA, viruses of biosecurity concern transmitted by mealybugs were assessed to have an 'indicative' URE of 'Very Low' for plant import pathways, including the fresh



fruit pathway. This is because mealybugs can only transmit viruses for a short period of time (semi-persistent transmission) and these viruses also have a limited host range compared to their mealybug vectors. These biological factors make it very unlikely for the viruses vectored by mealybugs on imported fresh fruit to be transmitted to a suitable host plant in Australia. The URE of 'Very Low' achieves the ALOP for Australia, therefore, no specific risk management measures are required for the viruses transmitted by mealybugs on this pathway.

This risk assessment, which is based on the mealybugs Group PRA, applies to all quarantine mealybugs on the passionfruit from Vietnam pathway, irrespective of their specific identification in this document. This is explained in section A2.7.

### 3.6 Scale insects

#### ***Chrysomphalus dictyospermi* (GP, WA), *Pseudaulacaspis pentagona* (GP, WA) and *Selenaspidus articulatus* (GP)**

Three scale insect species on the passionfruit from Vietnam pathway, *Chrysomphalus dictyospermi* (dictyospermum scale), *Pseudaulacaspis pentagona* (mulberry scale) and *Selenaspidus articulatus* (west Indian red scale), were identified as quarantine pests for Australia (Table 3.4).

*Selenaspidus articulatus* is not known to be present in Australia and is a quarantine pest for all of Australia. *Chrysomphalus dictyospermi* and *Pseudaulacaspis pentagona* are not present in Western Australia and are assessed as regional quarantine pests for that state.

The indicative likelihood of entry for these scale insect species is assessed in the scales Group PRA as Moderate (DAWE 2021). *Chrysomphalus dictyospermi*, *Pseudaulacaspis pentagona* and *Selenaspidus articulatus* are present in Vietnam and passionfruit is reported as a host of these pests (García Morales et al. 2022; Nakahara 1982). Standard packing house processes and transportation are not expected to eliminate these scale insect species from the passionfruit from Vietnam pathway. After assessment of relevant pathway-specific factors (sections A2.6 and A2.7) for passionfruit from Vietnam, the likelihood of entry of Moderate was verified as appropriate for these scale insect species on this pathway (Table 3.4).

**Table 3.4 Quarantine scale insect species for passionfruit from Vietnam**

<b>Pest</b>	<b>In scales Group PRA</b>	<b>Quarantine pest</b>	<b>On passionfruit pathway</b>	<b>Likelihood of entry</b>
<i>Chrysomphalus dictyospermi</i>	Yes	Yes (WA)	Yes	Moderate
<i>Pseudaulacaspis pentagona</i>	Yes	Yes (WA)	Yes	Moderate
<i>Selenaspidus articulatus</i>	Yes	Yes	Yes	Moderate

**WA:** Regional quarantine pest for Western Australia.

A summary of the risk assessment for quarantine scales is presented in Table 3.5 for convenience.

**Table 3.5 Risk estimates for quarantine scale insects**

<b>Risk component</b>	<b>Rating for quarantine scales</b>
Likelihood of entry (importation x distribution)	Moderate (High x Moderate)
Likelihood of establishment	High
Likelihood of spread	High
Overall likelihood of entry, establishment and spread	Moderate
Consequences	Low
<b>Unrestricted risk</b>	<b>Low</b>

As assessed in the scale insects Group PRA, the indicative URE for hard scale insects is Low (Table 3.5) which does not achieve the ALOP for Australia. This indicative URE is considered to be applicable for the quarantine hard scale insects present on the passionfruit from Vietnam pathway. Therefore, specific risk management measures are required for the quarantine hard scale insect pests on this pathway.

This risk assessment, which is based on the scale insects Group PRA, applies to all quarantine scale insects on the passionfruit from Vietnam pathway, irrespective of their specific identification in this document. This is explained in section A2.7.

### 3.7 Spider mite

*Tetranychus piercei* belongs to the family Tetranychidae, which includes over 1,300 species (Migeon & Dorkeld 2023) in around 70 genera (Krantz & Walter 2009). The family has commonly been referred to as 'spider mites' due to their habit of producing copious silken webbing on host plants (Walter & Proctor 2013).

*Tetranychus* is one of the largest genera of Tetranychidae, representing more than 100 known species, and is considered one of the most economically important genera of mites (Seeman & Beard 2011; Walter 2006).

*Tetranychus piercei* has not been reported in Australia, and is a quarantine pest for Australia.

*Tetranychus piercei* is a tropical and warm sub-tropical pest and has been recorded in at least 14 countries in East and Southeast Asia and Australasia (Papua New Guinea). This pest has been recorded on more than 91 host species, including species from the families Convolvulaceae, Cucurbitaceae, Euphorbiaceae and Fabaceae (Migeon & Dorkeld 2022; NAPPO 2014). The major host plant species include banana, bean, cassava, eggplant, mulberry, papaya, passionfruit, peach, sweet potato and a range of ornamentals (Walter 2006).

*Tetranychus piercei* can develop and reproduce across a wide range of temperatures. Temperatures between 26°C to 32°C appear the most suitable for growth, survival and reproduction of *T. piercei*. The threshold temperature for complete development of a female has been estimated at 10.7°C (Fu et al. 2002).

Most spider mites, including *T. piercei*, have a similar life cycle that includes 5 life stages: egg, larva, protonymph, deutonymph and adult (Crooker 1985; Jeppson, Keifer & Baker 1975). The 3 immature stages are each followed by an intervening period of quiescence, during which moulting takes place (Crooker 1985).

Fertile eggs are laid by both unmated and mated females of *T. piercei*. Unmated females produce only male eggs and lay an average of 80 eggs during their first 27 days of life, whereas mated females produce up to 150 eggs, which may be male or female (Gutierrez, Helle & Bolland 1979). Adult females are on average 0.5 mm long and 0.3 mm wide, and larger than adult males that are on average 0.3 mm long and 0.17 mm wide (Zhang & Fu 2004a).

Spider mites disperse and exploit new feeding sites very quickly, thereby causing severe damage to agricultural and horticultural crops, and often leading to economic losses (Flechtmann & Knihinicki 2002). Spider mites primarily feed on the leaves of host plants, concentrating their activities near leaf veins. During feeding, they insert their style-like mouthparts (chelicerae) into the parenchyma cells to suck the cell contents into their body by a 'pharyngeal pump' (Botha, Bennington & Poole 2014). This results in discolouration of leaf tissue, with typical symptoms including yellow spots on the upper side of the leaf. Stippling can also occur around leaf veins or entire leaves, causing stunted and deformed growth (Botha, Bennington & Poole 2014). Mite damage to leaves can alter plant and fruit development, change the sugar content and flavour of the fruit, cause aesthetic injury and downgrade fruit quality (Botha, Bennington & Poole 2014; Fonte et al. 2020).

Motile immature stages and adults of *T. piercei* feed and form webbing on plant parts and can reduce crop yields (Ullah, Gotoh & Lim 2014). For example, on banana plants, *T. piercei* causes

small brown spots on leaves, initially on the under surface. High populations result in entire leaves turning reddish brown underneath and yellow above, and then the leaves turning necrotic and dry (Fu et al. 2002).

Although there is only limited evidence of *T. piercei* feeding on fruit, spider mites are known to move from leaves to fruit when populations become high (Botha, Bennington & Poole 2014; Fonte et al. 2020; McMurtry 1985). Live spider mites are also regularly intercepted on imported fruit commodities at the Australian border (Brake, Crowe & Russell 2003).

Various tetranychid mites have been previously assessed by the department, and import policies for tetranychid mites already exist (Biosecurity Australia 2010b, a; DAFF 2012, 2022; DAWE 2020; DAWR 2017b; Department of Agriculture 2019). *Tetranychus piercei* has similar biological characteristics to 2 of those spider mite species - *T. pacificus* and *T. turkestanii* - including highly polyphagous habits and distribution across a range of different climates (Bolland, Gutierrez & Flechtmann 1998; Fu et al. 2002; Praslička & Huszár 2004). *Tetranychus pacificus* and *T. turkestanii* were assessed in the final import risk analysis report for stone fruit from California, Idaho, Oregon and Washington (stone fruit from the USA) (Biosecurity Australia 2010b).

Based on their similarities, outcomes of the previous risk assessment for *T. pacificus* and *T. turkestanii* on stone fruit from the USA (Biosecurity Australia 2010b) have been reviewed in this risk assessment for *T. piercei* on passionfruit from Vietnam. Where the risk profile is assessed as comparable to those previously assessed situations, outcomes of previous risk assessments have been adopted in this assessment. For each of the risk components, the comparisons and bases for adopting previous assessments for spider mites on stone fruit from the USA, or for assessing the risk of spider mites specifically for passionfruit from Vietnam, are outlined below.

There are differences in commercial production practices, climatic conditions, fruit biology and pest prevalence between the previously assessed USA stone fruit pathway and passionfruit from Vietnam. These differences make it necessary to assess the likelihood that *T. piercei* will arrive in Australia in a viable state with the importation of passionfruit from Vietnam.

The assessment of spider mites on stone fruit from the USA (Biosecurity Australia 2010b) rated the likelihood of distribution as Moderate. Passionfruit are expected to be distributed in Australia, as a result of the processing, sale or disposal of the imported produce, in a similar way to stone fruit from the USA. Fruit that are unmarketable are likely to be disposed of as municipal waste, from where it is unlikely that *T. piercei* will be distributed into the environment. However, fruit waste may also be deposited as litter into urban or peri-urban situations and areas of natural vegetation. *Tetranychus piercei* is polyphagous and can infest a wide range of agricultural and horticultural crops and hosts found in domestic gardens and urban environments as amenity plants or weeds. The time of year when importation occurs will not affect the likelihood of distribution for *T. piercei*. On the basis outlined, the likelihood of distribution of Moderate previously assessed for spider mites on the stone fruit from the USA pathway has been adopted for *T. piercei* on the passionfruit from Vietnam pathway.

The likelihoods of establishment and spread of *T. piercei* in Australia on the passionfruit from Vietnam pathway have been assessed as similar to those of the previous assessment of High and High, respectively, for spider mites on stone fruit from the USA. Those likelihoods relate specifically to events that occur in Australia and are independent of the import pathway. The

consequences of entry, establishment and spread of *T. piercei* in Australia are also independent of the import pathway and have been assessed as being similar to the previous risk assessment of Low. The existing ratings for the likelihoods of establishment and spread, and the rating for the overall consequences for spider mites in the previous assessment for USA stone fruit have been adopted for *T. piercei* on the passionfruit from Vietnam pathway.

In addition, the department has reviewed the latest literature – for example, (Fonte et al. 2020; Kaur 2022; Kaur & Zalom 2018; Migeon & Dorkeld 2023; Pan et al. 2019; Yu et al. 2021; Zhang et al. 2020). No new information has been identified that would significantly change the risk ratings for distribution, establishment, spread or consequences as set out for spider mites in the existing policy for USA stone fruit.

The risk scenario of biosecurity concern considered here is the potential presence of adults, juveniles or eggs of *T. piercei* on passionfruit from Vietnam imported into Australia.

### 3.7.1 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 *T. piercei* will arrive in Australia in a viable state with the importation of passionfruit from Vietnam is assessed as **High**.

The likelihood of importation is assessed as High because *T. piercei* is present in Vietnam, and the passionfruit plant is known to be a host for this spider mite. Although *T. piercei* is mainly associated with foliage, it may be present on the fruit at harvest if the infestation level is high. Pest management practices in the orchard are likely to reduce numbers of *T. piercei* on passionfruit plants and reduce the risk of fruit infestation. Harvest and post-harvest processes are likely to reduce, but not eliminate, infestation on the fruit given their small size and cryptic habits. If spider mites are present in packed fruit, they are likely to survive conditions during storage and transportation to Australia.

The following information provides supporting evidence for this assessment.

*Tetranychus piercei* is present in Vietnam and is a pest of passionfruit.

- *Tetranychus piercei* is present in Vietnam (Bolland, Gutierrez & Flechtmann 1998; Walter 2006).
- Passionfruit are grown commercially mainly in tropical and sub-tropical climates of Vietnam (MARD 2016), and such climates are suitable for the survival and development of *T. piercei* (Crooker 1985; Jeppson, Keifer & Baker 1975).
- *Tetranychus piercei* is recorded as a pest of passionfruit (Walter 2006).

Although spider mites like *T. piercei* mainly feed on leaves, they can be found on fruit.

- Spider mites primarily feed on leaves of host plants, concentrating their activities near leaf veins. Severe infestations can result in mites moving from the leaves to feed on the fruit, which can cause damage such as scars to fruit (Bolland, Gutierrez & Flechtmann 1998; Botha, Bennington & Poole 2014; Fonte et al. 2020).

Pest management practices in the orchard are likely to reduce numbers of *T. piercei* on passionfruit plants and reduce the risk of fruit infestation.

- Spider mite populations can rapidly increase, particularly in hot and dry conditions (UC IPM 2011).
- Vietnamese farmers manage *T. piercei* in passionfruit orchards under the guidance of government plant protection officers (MARD 2016).
- Vietnamese farmers regularly monitor *T. piercei* and other pests and apply relevant pesticides, as necessary. These practices are likely to reduce the risk of *T. piercei* being on fruit (MARD 2016).

Harvest and post-harvest processes are unlikely to remove all *T. piercei* from the fruit.

- *Tetranychus piercei* is almost microscopic and may not be detected during harvest, packing and inspection processes. Adult females and males are around 0.5 mm and 0.3 mm long, respectively, and eggs are about 0.1 mm in diameter (Zhang & Fu 2004b, a).
- Post-harvest processes in the packing house, such as brushing and washing, would remove a number of *T. piercei* on the surface of the fruit. However, some *T. piercei* may survive these processes.
- Inactive juvenile stages, known as chrysalis stages, could anchor on the fruit surface (Childers & Fasulo 1995) and may not be removed during packing house processes.

*Tetranychus piercei* on fruit may survive temperatures during storage and while in transit from Vietnam to Australia.

- Due to the fruit's relatively short shelf life (Kader 1999), passionfruit are likely to be stored for only short periods in Vietnam prior to export, and be transported to Australia by air freight to maximise the quality and shelf life of the fruit.
- The recommended temperature for storage and transport of passionfruit is between 5°C and 10°C (Kader 1999).
- Development of *T. piercei* would slow or cease at temperatures between 5°C and 10°C as the threshold temperature for complete development of female *T. piercei* has been estimated at 10.7°C (Fu et al. 2002).
- Although data on survival of *T. piercei* at low temperatures could not be found, it is likely that the species could survive short periods of time while fruit are stored at cold temperatures.
  - Spider mites are tolerant of cold temperatures, and this attribute is considered to be a major contributor to their successful spread (White, Bale & Hayward 2018).
  - In the closely related species *T. urticae*, temperatures between 5°C and 10°C for 2 hours are sufficient to induce physiological cold responses to enable survival of females (White, Bale & Hayward 2018).

*Tetranychus piercei* may be able to enter diapause to survive low temperatures during storage and transportation.

- Spider mites can enter diapause to survive low temperatures such as during winter (Suzuki et al. 2015).
- *Tetranychus* species have been shown to diapause as adult females (Botha, Bennington & Poole 2014).



For the reasons outlined, the likelihood that *T. piercei* will arrive in Australia in a viable state with the importation of passionfruit from Vietnam is assessed as High.

### **Likelihood of distribution**

The likelihood that *T. piercei* will be distributed within Australia in a viable state as a result of the processing, sale or disposal of passionfruit from Vietnam and subsequently transfer to a susceptible part of a host, is likely to be similar to the spider mite species previously assessed on stone fruit from the USA (Biosecurity Australia 2010b). The same rating of Moderate for the likelihood of distribution for spider mite species in the previous assessment is adopted for *T. piercei* for passionfruit from Vietnam.

### **Likelihood of entry**

The likelihood of entry is determined as **Moderate** by combining the likelihood of importation of High with the adopted likelihood of distribution of Moderate, using the matrix of rules shown in Table A.2.

#### **3.7.2 Likelihoods of establishment and spread**

The likelihoods of establishment and spread for *T. piercei* in Australia are independent of the import pathway and are considered to be similar to those for spider mites on stone fruit from the USA (Biosecurity Australia 2010b).

Based on the existing import policy for stone fruit from the USA (Biosecurity Australia 2010b), the likelihoods of establishment and spread for *T. piercei* are assessed as **High** and **High** respectively.

#### **3.7.3 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 in Table A.2.

The overall likelihood that *T. piercei* will enter Australia as a result of trade in passionfruit from Vietnam, be distributed in a viable state to a susceptible part of a host, establish in Australia and subsequently spread within Australia is assessed as **Moderate**.

#### **3.7.4 Consequences**

The potential consequences of the entry, establishment and spread of *T. piercei* in Australia are similar to those in the previous assessments for spider mites on stone fruit from the USA (Biosecurity Australia 2010b). The overall consequences for spider mites in the previous assessment were assessed as Low. The overall consequences for *T. piercei* on the passionfruit from Vietnam pathway are also assessed as **Low**.

#### **3.7.5 Unrestricted risk estimate**

Unrestricted risk is the result of combining the overall likelihood of entry, establishment and spread with the outcome of overall consequences. The likelihood and consequences are combined using the risk estimation matrix in Table A.4.

Passionfruit from Vietnam: biosecurity import requirements draft report  
Pest risk assessments for quarantine pests

---

<b>Unrestricted risk estimate for <i>T. piercei</i></b>	
Overall likelihood of entry, establishment and spread	Moderate
Consequences	Low
<b>Unrestricted risk</b>	<b>Low</b>

---

The URE for *T. piercei* on the passionfruit from Vietnam pathway is assessed as **Low**, which does not achieve the ALOP for Australia. Therefore, specific risk management measures are required for these spider mites on the passionfruit from Vietnam pathway.

### 3.8 Thrips

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

Two thrips species on the passionfruit from Vietnam pathway, *Scirtothrips dorsalis* (chilli thrips) and *Thrips palmi* (melon thrips), were identified as quarantine pests and/or regulated articles for Australia (Table 3.6).

*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).

*Scirtothrips dorsalis* is present in Australia and is not under official control, therefore is not a quarantine pest for Australia.

However, *Scirtothrips dorsalis*, as well as *Thrips palmi* are identified as regulated articles because they are capable of harbouring and spreading (vectoring) emerging orthospoviruses that are quarantine pests for Australia, as detailed in the thrips Group PRA (DAWR 2017a).

A regulated article is defined by the IPPC as 'any plant, plant product, storage place, packaging, conveyance, container, soil and any other organism, object or material capable of harbouring or spreading pests, deemed to require phytosanitary measures, particularly where international transportation is involved' (FAO 2023). For simplicity, thrips identified as a regulated article are also referred to as 'regulated thrips'.

The indicative likelihood of entry for all quarantine thrips and regulated thrips is assessed in the thrips Group PRA as Moderate (DAWR 2017a). *Scirtothrips dorsalis* and *Thrips palmi* are present in Vietnam and are associated with passionfruit (Hung 2009; PPD 2017). Standard packing house processes and transportation are not expected to eliminate these thrips species on the passionfruit from Vietnam pathway. After assessment of relevant pathway-specific factors (sections A2.6 and A2.7) for passionfruit from Vietnam, the likelihood of entry of Moderate was verified as appropriate for these thrips species on this pathway (Table 3.6).

**Table 3.6 Quarantine and regulated thrips species for passionfruit from Vietnam**

<b>Pest</b>	<b>In thrips Group PRA</b>	<b>Quarantine pest</b>	<b>Regulated thrips</b>	<b>On passionfruit pathway</b>	<b>Likelihood of entry</b>
<i>Scirtothrips dorsalis</i>	Yes	No	Yes	Yes	Moderate
<i>Thrips palmi</i>	Yes	Yes (SA, WA)	Yes	Yes	Moderate

**SA:** Regional quarantine pest for South Australia **WA:** Regional quarantine pest for Western Australia.

A summary of the risk assessment for the quarantine thrips is presented in Table 3.7 for convenience.

**Table 3.7 Risk estimates for quarantine thrips**

<b>Risk component</b>	<b>Rating for quarantine thrips</b>
Likelihood of entry (importation x distribution)	Moderate (High x Moderate)
Likelihood of establishment	High
Likelihood of spread	High

Passionfruit from Vietnam: biosecurity import requirements draft report  
Pest risk assessments for quarantine pests

Overall likelihood of entry, establishment and spread	Moderate
Consequences	Low
<b>Unrestricted risk</b>	<b>Low</b>

As assessed in the thrips Group PRA, the indicative URE for thrips is Low (Table 3.7) which does not achieve the ALOP for Australia. This indicative URE is considered to be applicable for the quarantine thrips species present on the passionfruit from Vietnam pathway. Therefore, specific risk management measures are required for quarantine thrips on this pathway.

As the thrips species *Scirtothrips dorsalis* and *Thrips palmi* vector orthospoviruses that are quarantine pests for Australia, a summary of the risk assessment for quarantine orthospoviruses transmitted by these thrips is presented in Table 3.8 for convenience.

**Table 3.8 Risk estimates for emerging quarantine orthospoviruses vectored by regulated thrips**

Risk component	Rating for emerging quarantine orthospoviruses (a)
Likelihood of entry (importation x distribution)	Low (Moderate x Moderate)
Likelihood of establishment	Moderate
Likelihood of spread	High
Overall likelihood of entry, establishment and spread	Low
Consequences	Moderate
<b>Unrestricted risk</b>	<b>Low</b>

a: Risk estimates for orthospoviruses adopted from the thrips Group PRA (DAWR 2017a).

As assessed in the thrips Group PRA, the URE for emerging quarantine orthospoviruses transmitted by regulated thrips is Low (Table 3.8), which does not achieve the ALOP for Australia.

This URE is considered to be applicable for the emerging orthospoviruses known to be vectored by the thrips species present on the passionfruit from Vietnam pathway. Therefore, specific risk management measures are required for the regulated thrips to mitigate the risks posed by emerging quarantine orthospoviruses in order to achieve the ALOP for Australia.

This risk assessment, which is based on the thrips Group PRA, applies to all phytophagous quarantine thrips and regulated thrips on the passionfruit from Vietnam pathway, irrespective of their specific identification in this document. This is explained in section A2.7.

### 3.9 Pest risk assessment conclusions

Likelihood ratings and the consequences estimate for individual quarantine pests and regulated articles are set out in Table 3.9.

Of the 11 pests for which a further pest risk assessment was conducted:

- The UREs for the 10 quarantine 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*)
  - melon fly (*Zeugodacus cucurbitae*)
  - pumpkin fruit fly (*Zeugodacus tau*)
  - Pacific mealybug (*Planococcus minor*)
  - mango mealybug (*Rastrococcus invadens*)
  - dictyospermum scale (*Chrysomphalus dictyospermi*)
  - mulberry scale (*Pseudaulacaspis pentagona*)
  - West Indian red scale (*Selenaspidus articulatus*)
  - spider mite (*Tetranychus piercei*)
  - melon thrips (*Thrips palmi*).
- An additional thrips species, chilli thrips (*Scirtothrips dorsalis*), and the regional quarantine thrips species melon thrips were identified as regulated articles for Australia due to their potential to introduce emerging quarantine orthospoviruses into Australia. The URE for quarantine orthospoviruses transmitted by thrips was assessed in the thrips Group PRA (DAWR 2017a) as not achieving the ALOP for Australia, and thus specific risk management measures are required for these regulated articles on this pathway.

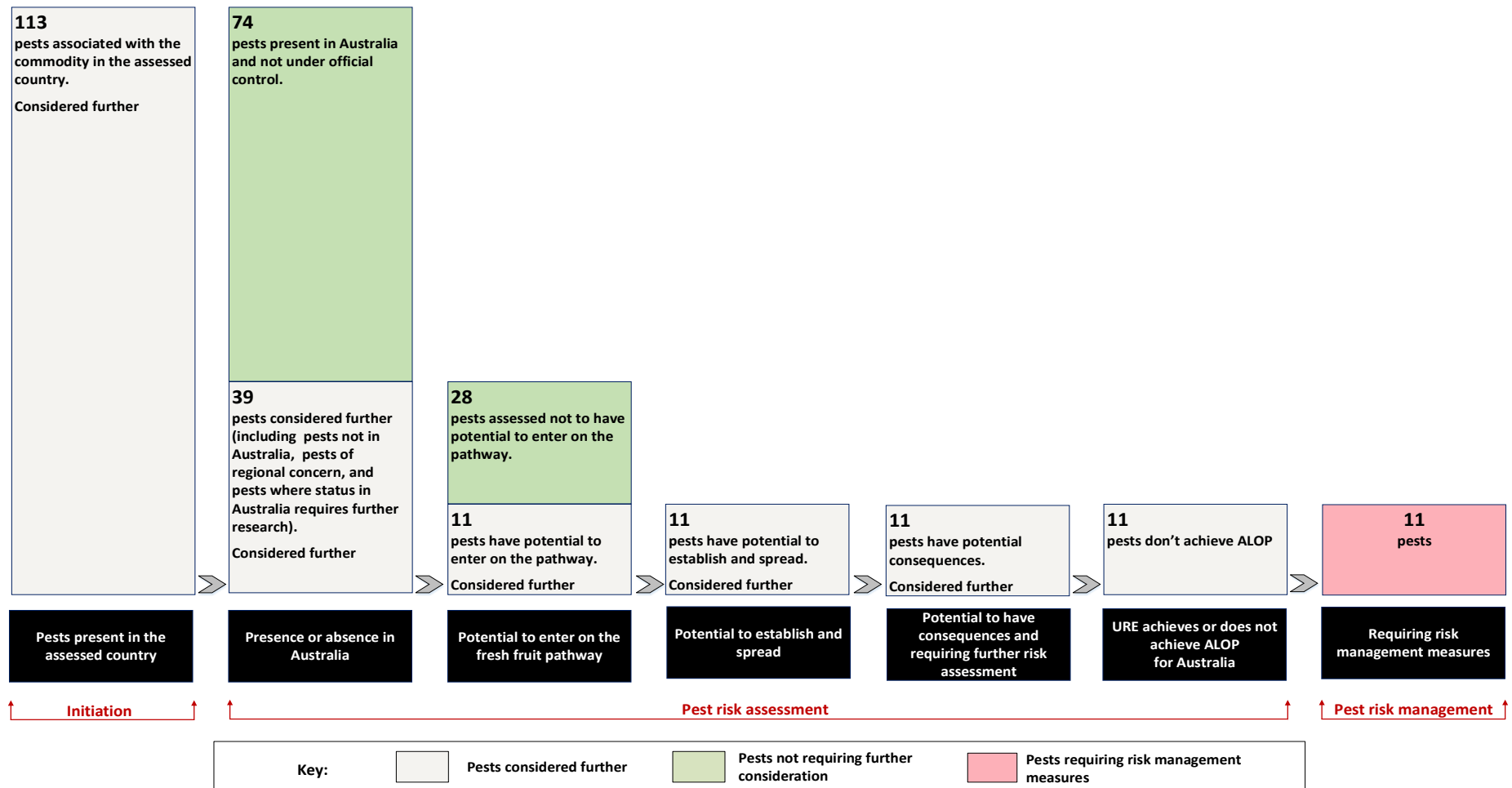
An overview of the decision process at the initiation, pest categorisation and pest risk assessment stages of the pest risk analysis for passionfruit from Vietnam is presented in Figure 3.1.

**Table 3.9 Pest risk assessment conclusions for pests, and pest groups, associated with the pathway of passionfruit from Vietnam**

Pest name	Likelihood of						Consequences	URE
	Importation	Distribution	Entry	Establishment	Spread	EES		
<b>Fruit flies (Diptera: Tephritidae)</b>								
<i>Bactrocera dorsalis</i> (EP)	High	High	<b>High</b>	High	High	High	High	<b>High</b>
<i>Zeugodacus cucurbitae</i> (EP)	High	High	<b>High</b>	High	High	High	High	<b>High</b>
<i>Zeugodacus tau</i> (EP)	High	High	<b>High</b>	High	High	High	High	<b>High</b>
<b>Mealybugs [Hemiptera: Pseudococcidae]</b>								
<i>Planococcus minor</i> (GP, WA)	High	Moderate	<b>Moderate</b>	High	High	Moderate	Low	<b>Low</b>
<i>Rastrococcus invadens</i> (GP)	High	Moderate	<b>Moderate</b>	High	High	Moderate	Low	<b>Low</b>
<b>Scale insects (Hemiptera: Diaspididae)</b>								
<i>Chrysomphalus dictyospermi</i> (GP, WA)	High	Moderate	<b>Moderate</b>	High	High	Moderate	Low	<b>Low</b>
<i>Pseudaulacaspis pentagona</i> (GP, WA)	High	Moderate	<b>Moderate</b>	High	High	Moderate	Low	<b>Low</b>
<i>Selenaspis articulatus</i> (GP)	High	Moderate	<b>Moderate</b>	High	High	Moderate	Low	<b>Low</b>
<b>Spider mite [Acariformes: Tetranychidae]</b>								
<i>Tetranychus piercei</i>	High	Moderate	<b>Moderate</b>	High	High	Moderate	Low	<b>Low</b>
<b>Thrips [Thysanoptera: Thripidae]</b>								
<i>Scirtothrips dorsalis</i> (GP, RA)	High	Moderate	<b>Moderate</b>	N/A	N/A	N/A	N/A	<b>N/A</b>
<i>Thrips palmi</i> (GP, SA, WA) <b>a</b>	High	Moderate	<b>Moderate</b>	High	High	Moderate	Low	<b>Low</b>
<b>Orthospoviruses [Bunyavirales: Tospoviridae] vectored by <i>Thrips palmi</i> and <i>Scirtothrips dorsalis</i></b>								
Listed in the thrips group PRA (GP)	Moderate	Moderate	<b>Low</b>	Moderate	High	Low	Moderate	<b>Low</b>

**a:** Quarantine thrips species that is also identified as a regulated article for Australia as it vectors emerging quarantine orthospoviruses. This table also presents the risk estimates for these viruses from the thrips Group PRA (DAWR 2017a). **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. **WA:** Regional quarantine pest for Western Australia. **SA:** Regional quarantine pest for South Australia. **EES:** Overall likelihood of entry, establishment and spread. **URE:** Unrestricted risk estimate.

Figure 3.1 Overview of the PRA decision process for passionfruit from Vietnam





## 4 Pest risk management

Pest risk management evaluates and selects options for measures for quarantine pests and regulated articles identified, in Chapter 3, as having a URE that does not achieve the ALOP for Australia. This chapter proposes specific risk management measures for those quarantine pests and regulated articles (section 4.1). It also proposes an operational system for the assurance, maintenance and verification of phytosanitary status (section 4.2). Both specific risk management measures (section 4.1) and the operational system (section 4.2) are required to reduce the risk of introduction of these quarantine pests and regulated articles to achieve the ALOP for Australia. These measures are in addition to existing commercial production practices for passionfruit in Vietnam, as described in Chapter 2, as these practices have been considered in assessing the URE.

### 4.1 Pest risk management measures and phytosanitary procedures

This section describes the proposed risk management measures for the 10 quarantine pests (1 of which is also a regulated article) and 1 regulated article assessed, in Chapter 3, as having a URE that does not achieve the ALOP for Australia.

Historical trade and pest interception data of other similar pathways, as described in section 4.1.1, have been considered in determining the appropriate risk management measures for the importation of passionfruit from Vietnam.

#### 4.1.1 Analysis of pest interception data

Australia currently allows the import of fresh passionfruit from New Zealand. Between 2017 and 2022, New Zealand exported approximately 2.5 tonnes of passionfruit to Australia. Approximately 7.1% of consignments required remedial action for quarantine pests including mites.

Vietnam has access to the Australian market for imported fresh fruit that present a similar risk pathway to passionfruit, including dragon fruit, longans, lychees and mangoes.

Between 2017 and 2022, Vietnam exported approximately 4,664 tonnes of dragon fruit to Australia. Approximately 4.4% of consignments required remedial action for quarantine pests including mites, beetles, aphids, mealybugs, scale insects, fungi and weed seeds.

Between 2019 and 2022, Vietnam exported approximately 242 tonnes of longans to Australia. Approximately 2.0% of consignments required remedial action for unidentified plant material.

Between 2015 and 2022, Vietnam exported approximately 387 tonnes of lychees to Australia. Approximately 22.2% of consignments required remedial action for quarantine pests including sucking bugs, mealybugs, snails and mites. Most of these non-compliant consignments occurred during initial years of trade in lychees between 2015 and 2018.

Between 2016 and 2022, Vietnam exported approximately 589 tonnes of mangoes to Australia. Approximately 3.5% of consignments required remedial action for quarantine pests including mealybugs and scale insects.

#### 4.1.2 Risk management measures for quarantine pests and regulated articles associated with passionfruit from Vietnam

Proposed specific risk management measures for the 10 quarantine pests (1 of which is also a regulated article) and 1 regulated article associated with passionfruit from Vietnam are listed in Table 4.1.

**Table 4.1 Proposed risk management measures for quarantine pests and regulated articles potentially associated with passionfruit from Vietnam**

Pest/pest group	Scientific name	Common name	Measures
Fruit flies [Diptera: Tephritidae]	<i>Bactrocera dorsalis</i> [EP]	Oriental fruit fly	PFA, PFPP or PFPS <b>a</b> OR Fruit treatment known to be effective against fruit fly species such as irradiation
	<i>Zeugodacus cucurbitae</i> [EP]	Melon fly	
	<i>Zeugodacus tau</i> [EP]	Pumpkin fruit fly	
Mealybugs [Hemiptera: Pseudococcidae]	<i>Planococcus minor</i> [GP, WA]	Pacific mealybug	Pre-export visual inspection and, if found, remedial action <b>b</b>
	<i>Rastrococcus invadens</i> [GP]	Mango mealybug	
Scale insects [Hemiptera: Diaspididae]	<i>Chrysomphalus dictyospermi</i> [GP, WA]	Dictyospermum scale	Pre-export visual inspection and, if found, remedial action <b>b</b>
	<i>Pseudaulacaspis pentagona</i> [GP, WA]	Mulberry scale	
	<i>Selenaspis articulatus</i> [GP]	West Indian red scale	
Spider mite [Acariformes: Tetranychidae]	<i>Tetranychus piercei</i>		Pre-export visual inspection and, if found, remedial action <b>b</b>
Thrips [Thysanoptera: Thripidae]	<i>Scirtothrips dorsalis</i> [GP, RA]	Chilli thrips	Pre-export visual inspection and, if found, remedial action <b>b</b>
	<i>Thrips palmi</i> [GP, SA, WA] <b>c</b>	Melon thrips	

**a:** PFA is pest free areas, PFPP is pest free places of production or PFPS is pest free production sites. **b:** Remedial action may include treatment of the consignment to ensure that the pest is no longer viable or withdrawal of the consignment from export to Australia. **c:** Quarantine thrips species that is also identified as a regulated article for Australia as it vectors emerging quarantine orthospoviruses assessed in the thrips Group PRA (DAWR 2017a) as posing an unrestricted risk that does not achieve the ALOP for Australia. **EP:** Species has been assessed previously and import policy already exists.

**RA:** Regulated article. **GP:** Species has been assessed previously in a Group PRA, and the Group PRA has been applied.

**SA:** Regional quarantine pest for South Australia. **WA:** Regional quarantine pest for Western Australia.

The department proposes the following specific risk management measures for the identified quarantine pests and regulated articles:

- for fruit flies
  - pest free areas, pest free places of production or pest free production sites, or
  - fruit treatment considered to be effective against fruit flies (such as irradiation)
- for mealybugs, scale insects, spider mite and thrips
  - pre-export visual inspection and, if detected, remedial action.

### Measures for fruit flies

For the fruit flies *B. dorsalis*, *Z. cucurbitae* and *Z. tau* the department proposes the options of pest free areas, pest free places of production or pest free production sites, or fruit treatment considered to be effective against all life stages associated with passionfruit such as irradiation. The objective of each proposed measure is to reduce the risk associated with these fruit fly species to achieve the ALOP for Australia when applied in combination with the operational system outlined in section 4.2.

#### *Proposed measure 1: Pest free areas, pest free places of production or pest free production sites*

The requirements for establishing pest free areas (PFA) are set out in ISPM 4: *Requirements for the establishment of pest free areas* (FAO 2017) and, more specifically, ISPM 26: *Establishment of pest free areas for fruit flies (Tephritidae)* (FAO 2018). The requirements for establishing pest free places of production (PFPP) and pest free production sites (PFPS) are set out in ISPM 10: *Requirements for the establishment of pest free places of production and pest free production sites* (FAO 2016a).

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 (FAO 2018). In the event of the detection of any fruit fly species of economic importance in the identified PFA, PFPP or PFPS, Vietnam's PPD 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, such as life stage, sex and gravidity of females, and the circumstances of the detection before advising PPD of any action to be taken. If fruit flies were detected during pre-export inspection or during on-arrival inspection, trade under the PFA, PFPP or PFPS pathway would be suspended immediately, pending the outcome of an investigation.

Should Vietnam wish to use PFA, PFPP or PFPS as a measure to manage the risk posed by fruit flies, PPD would need to provide a submission demonstrating the establishment of these to the department. The submission demonstrating PFA must fulfil requirements as set out in ISPM 4 (FAO 2017) and ISPM 26 (FAO 2018), and the submission demonstrating PFPP or PFPS must fulfil requirements as set out in ISPM 10 (FAO 2016a). The submission is subject to approval by the department.

#### *Proposed measure 2: Fruit treatment*

Fruit treatment known to be effective against fruit flies, such as irradiation, applied pre-export may be used as a phytosanitary measure for *B. dorsalis*, *Z. cucurbitae* and *Z. tau*.

The department considers irradiation to be an effective treatment for *B. dorsalis*, *Z. cucurbitae* and *Z. tau* on the passionfruit from Vietnam pathway. The requirements for using irradiation as a phytosanitary measure are set out in ISPM 18: *Guidelines for the use of irradiation as a phytosanitary measure* (FAO 2019a). Irradiation is recognised as an effective method for pest risk management when performed in approved facilities and at specific dose rates recognised as effective for target pest groups. Food Standards Australia New Zealand permits irradiation dose rates up to a maximum of 1,000 gray for quarantine purposes for fresh fruits and vegetables including passionfruit (FSANZ 2021).

The department proposes a treatment schedule of 150 gray minimum absorbed dose, consistent with ISPM 28 Annex 7: *Irradiation treatment for fruit flies of the family Tephritidae (generic)* (FAO 2021) for *B. dorsalis*, *Z. cucurbitae* and *Z. tau*.

The use of irradiation as a phytosanitary measure is subject to the department's approval of the irradiation facilities identified by PPD. Should Vietnam wish to use irradiation as a phytosanitary measure, PPD would need to provide a submission to the department. The submission must fulfil requirements as set out in ISPM 18 (FAO 2019a).

The department recognises other treatments, such as cold, heat (e.g., vapour heat treatment) or fumigation, may also be effective treatments against *B. dorsalis*, *Z. cucurbitae* and *Z. tau* on the passionfruit from Vietnam pathway. The use of any such treatment option is subject to its approval by the department as an efficacious measure against *B. dorsalis*, *Z. cucurbitae* and *Z. tau*. Should Vietnam wish to propose a treatment option, PPD would need to provide a submission, which includes suitable information to support the claimed efficacy of the treatment to manage *B. dorsalis*, *Z. cucurbitae* and *Z. tau* on the passionfruit from Vietnam pathway, for consideration by the department.

#### **Measures for mealybugs, scale insects, spider mite and thrips**

The department proposes the option of pre-export visual inspection and, if found, remedial action for the species of mealybugs, scale insects, spider mite and thrips on the passionfruit from Vietnam pathway. The method used for visual inspection must be able to detect all life stages of these pests, for example by using visual aids such as hand lens, where necessary. The inspection should be consistent with ISPM 23: *Guidelines for inspection* (FAO 2019d) and ISPM 31: *Methodologies for sampling of consignments* (FAO 2016b) and provide a 95% level of confidence that infestation greater than 0.5% will be detected. The objective of this proposed measure is to reduce the risk associated with these pests to achieve the ALOP for Australia when applied in combination with the operational system outlined in section 4.2.

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

All passionfruit consignments for export to Australia must be inspected by PPD in accordance with ISPM 23 (FAO 2019d) and ISPM 31 (FAO 2016b). The inspection technique must be capable of detecting all life stages of these pests. Each consignment must be found free of the mealybugs *Planococcus minor* and *Rastrococcus invadens*, the scale insects *Chrysomphalus dictyospermi*, *Pseudaulacaspis pentagona* and *Selenaspidus articulatus*, the spider mite *Tetranychus piercei* and the thrips *Scirtothrips dorsalis* and *Thrips palmi*. This requirement also applies to any other quarantine or regulated mealybugs, scale insects or thrips not specifically identified in this import risk analysis. Export consignments found to contain any of these pests must be subjected to remedial action. Remedial action may include withdrawing the consignment from export to Australia, or application of an approved treatment to ensure that the pest is no longer viable.

#### **4.1.3 Consideration of alternative measures**

Consistent with the principle of equivalence detailed in ISPM 11: *Pest risk analysis for quarantine pests* (FAO 2019c), the department will consider any alternative measure proposed by PPD. Alternative measures must demonstrably manage the target pest(s) to achieve the ALOP for Australia. Evaluation of any such measure will require a technical submission from PPD that

details the proposed measure, including suitable information to support the claimed efficacy, for consideration by the department.

## **4.2 Operational system for the assurance, maintenance and verification of phytosanitary status**

A system of operational procedures is necessary to ensure proposed specific risk management measures (section 4.1) are effectively applied, the phytosanitary status of passionfruit from Vietnam is maintained, and these can be verified.

### **4.2.1 A system of traceability to source farms**

The objectives of this proposed procedure are to ensure that:

- passionfruit are sourced only from farms producing commercial quality fruit
- farms from which passionfruit are sourced can be identified, so that any investigation and corrective action can be targeted in the event that pests of biosecurity concern to Australia are intercepted
- where passionfruit is grown/produced in an approved PFA, PFPP or PFPS, it can be verified that all fruit were sourced from the approved area, place or site and produced and exported under the conditions for that pathway.

PPD must establish a system to enable traceability to where passionfruit for export to Australia are sourced. PPD must ensure that export passionfruit growers are aware of pests of biosecurity concern for Australia and have systems in place to produce export quality fruit that meet Australia's requirements.

Where a pest risk management measure involving pest monitoring and controls during production and at harvest (such as PFA, PFPP, PFPS or systems approach) is used, export farms must be registered with PPD before commencement of each harvest season. Records of registered farms and PPD audits must be kept by PPD and must be made available to the department upon request.

### **4.2.2 Registration of packing houses and treatment providers, and auditing of procedures**

The objectives of this proposed procedure are to ensure that:

- commercial quality passionfruit are sourced only from packing houses that are approved by PPD
- where applicable, treatment providers are approved by PPD and capable of applying a treatment that suitably manages the target pests.

Passionfruit export packing houses are registered with PPD before the commencement of each harvest season. PPD 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. The list of registered packing houses and records of PPD audits must be kept by PPD and must be made available to the department upon request.

In circumstances where passionfruit undergo pre-export treatment, this process must be undertaken by treatment providers that have been registered with and audited by PPD for that

purpose. Records of PPD registration requirements and audits must be made available to the department upon request.

The approval of treatment providers by PPD must include verification that suitable systems are in place to ensure compliance with treatment requirements. This may include:

- documented procedures to ensure passionfruit are appropriately treated and safeguarded post treatment
- staff training to ensure compliance with procedures
- record-keeping procedures
- suitability of facilities and equipment
- PPD's system of oversight of treatment application.

The department provides final approval of facilities, following review of regulatory oversight provided by PPD and the capability demonstrated by the facility. Site visits may be required for the department to have assurance that treatment can be applied accurately and consistently.

#### 4.2.3 Packaging, labelling and containers

The objectives of this proposed procedure are to ensure that:

- passionfruit 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 2023))
- unprocessed packaging material is not imported with passionfruit from Vietnam. Unprocessed packaging material is not permitted as it may vector pests identified as not being on the pathway, or pests not known to be associated with passionfruit
- all wood material associated with the consignment used in packaging and transport of passionfruit complies with the department's import requirements, as published on BICON
- secure packaging is used for export of passionfruit from Vietnam to Australia, to prevent re-infestation during storage and transport and prevent escape of pests during clearance procedures on arrival in Australia. Packaging must meet Australia's secure packaging options published on BICON
- consignments are made insect proof and secure, by using at least one of the following secure consignment options:
  - **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 1.6 mm pore size and not less than 0.16 mm strand thickness. Alternatively, the vent holes may 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 Load Devices (ULDs):** ULDs transporting cartons with open ventilation holes/gaps, or palletised cartons with ventilation holes/gaps must be fully covered or wrapped with polyethylene/plastic/foil sheet or mesh/screen of no more than 1.6 mm diameter pore size and not less than 0.16 mm 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 containers with solid sides, or ULDs with tarpaulin sides that have no holes or gaps. The container must be transported to the inspection point intact
- packaged passionfruit from Vietnam must be labelled with sufficient identification for the purposes of traceability. This may include:
  - for treated product: the treatment facility name/number and treatment identification reference/number
  - for passionfruit where the measures include pre-harvest controls/freedom: the export farm reference/number
  - for passionfruit where phytosanitary measures are applied at the packing house: the packing house reference/number
- where applicable, packaged passionfruit from Vietnam that has undergone irradiation treatment is labelled with a statement that the passionfruit has been treated with ionising radiation.

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

#### 4.2.4 Specific conditions for storage and movement

The objective of this proposed procedure is to ensure that the quarantine integrity of the passionfruit is maintained during storage and movement.

Treated and/or inspected passionfruit for export to Australia must be kept secure and segregated at all times from any fruit for domestic or other markets, and from untreated/un-inspected product, to prevent mixing or cross-contamination. The area set aside for goods to Australia must be clearly identified with signage.

#### 4.2.5 Freedom from trash

The objective of this proposed procedure is to ensure that passionfruit for export 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.

#### 4.2.6 Pre-export phytosanitary inspection and certification by PPD

The objective of these proposed procedures is to ensure that Australia's import conditions have been met. All consignments of passionfruit from Vietnam for export to Australia must be inspected by PPD and found free of pests of biosecurity concern for Australia. Pre-export visual inspection must be undertaken by PPD in accordance with ISPM 23: *Guidelines for inspection* (FAO 2019d) and consistent with the principles of ISPM 31: *Methodologies for sampling of consignments* (FAO 2016b). Any netting or artificial wrapping material must be removed during the inspection.



All consignments must be inspected prior to export in accordance with official procedures for all visually-detectable quarantine pests and regulated articles (including trash). Sampling and inspection methods should be consistent with ISPM 23 (FAO 2019d) and ISPM 31 (FAO 2016b) and provide a 95% level of confidence that infestation greater than 0.5% will be detected. For a consignment equal to or greater than 1,000 units (one unit being a single passionfruit), this is equivalent to a 600-unit sample randomly selected across the consignment. Any netting or artificial wrapping material must be removed during the inspection.

A phytosanitary certificate must be issued for each consignment upon completion of pre-export inspection and treatment to certify that the required risk management measures have been undertaken prior to export and that 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 required) which includes approved facility name and address, date of treatment and, where irradiation is used, absorbed dose (target and measured)
- additional declarations 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.

Some treatments (such as irradiation) may also require treatment certificates that accompany the phytosanitary certificate. BICON will describe when treatment certificates are required.

#### **4.2.7 Phytosanitary inspection by the Department of Agriculture, Fisheries and Forestry**

The objectives of this proposed 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 consignments of passionfruit from Vietnam meet Australia's import requirements. When inspecting consignments, the department will randomly sample 600 units, or equivalent, per phytosanitary certificate and apply an inspection method suitable for the commodity.

#### **4.2.8 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 for the identified biosecurity risks. Where an effective treatment is not available, 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 economic importance, or pests for which PFAs, PFPPs or PFPSs are established.

In the event that consignments of passionfruit from Vietnam 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 to 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.

### **4.3 Uncategorised pests**

If an organism that has not been categorised, including a contaminant pest, is detected on passionfruit on arrival in Australia, it will require assessment by the department to determine its quarantine status and whether phytosanitary action is required.

Assessment is also required if the detected species was categorised as not having the potential 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 pests of biosecurity concern not already identified in the analysis may result in remedial action and/or temporary suspension of trade while a review is conducted to ensure that existing measures continue to provide the ALOP for Australia.

### **4.4 Review of processes**

#### **4.4.1 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. This may involve representatives from the department visiting areas in Vietnam that produce passionfruit for export to Australia.

#### **4.4.2 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 manage the biosecurity risk of the pathway. In addition, the department reserves the right to review the import policy as deemed necessary. This may include if there is reason to believe that the pest or phytosanitary status in Vietnam has changed, or where alternative risk management or compliance-based intervention options become available.

PPD must inform the department immediately on the detection of any new pests of passionfruit in Vietnam that might be of potential biosecurity concern to Australia.

## 4.5 Meeting Australia's food laws

In addition to meeting Australia's biosecurity 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).

Food Standards Australia New Zealand (FSANZ) is responsible for developing and maintaining the Code. The Code is available at [foodstandards.gov.au/code/Pages/default.aspx](http://foodstandards.gov.au/code/Pages/default.aspx).

The department administers the *Imported Food Control Act 1992* which supports the inspection and testing of imported food to verify its safety and compliance with Australia's food standards, including the Code. This is undertaken through a risk-based border inspection program, the Imported Food Inspection Scheme. More information about this scheme is available at [agriculture.gov.au/biosecurity-trade/import/goods/food/inspection-testing/ifis](http://agriculture.gov.au/biosecurity-trade/import/goods/food/inspection-testing/ifis).

Standards 1.1.1, 1.1.2 and 1.4.4 of the Code specify that a food for sale must not consist of, or have as an ingredient or a component, a prohibited or restricted plant or fungus; unless expressly permitted by the Code. The prohibited and restricted plants and fungi are listed in Schedules 23 and 24 of the Code, respectively.

Standard 1.4.2 and Schedules 20, 21 and 22 of the Code set out the maximum residue limits and extraneous residue limits for agricultural or veterinary chemicals that are permitted in foods for sale, 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 agvet chemical, or a metabolite or a degradation product of the agvet chemical; unless expressly permitted by the Code.

Certain imported food, including some minimally processed horticulture products, must be covered by a food safety management certificate to be imported into Australia. The certificate provides evidence that a food has been produced through a food safety management system. This system must have appropriate controls in place to manage food safety hazards. More information about the foods that require a food safety management certificate and how to comply is available at [agriculture.gov.au/biosecurity-trade/import/goods/food/lodge/safety-management-certificates](http://agriculture.gov.au/biosecurity-trade/import/goods/food/lodge/safety-management-certificates).

## 5 Conclusion

This draft risk analysis report was conducted to assess the proposal by Vietnam's PPD for market access to Australia for passionfruit for human consumption.

The risk analysis was conducted in accordance with Australia's method for pest risk analysis (Appendix A), which is consistent with the International Standards for Phytosanitary Measures (ISPMs), including ISPM 2: *Framework for pest risk analysis* (FAO 2019b) and ISPM 11: *Pest risk analysis for quarantine pests* (FAO 2019c), and the WTO Agreement on the Application of Sanitary and Phytosanitary Measures (WTO 1995).

In conclusion, this draft report proposes that the importation of commercially produced passionfruit to Australia from all commercial production areas of Vietnam can be permitted, subject to a range of biosecurity requirements outlined in Chapter 4.

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

The department considers that the risk management measures proposed in this report will provide an appropriate level of protection against the quarantine pests and regulated articles identified as associated with the trade of passionfruit from Vietnam.

All fresh fruit, including passionfruit from Vietnam, have been determined by the Director of Biosecurity to be conditionally non-prohibited goods under s174 of the *Biosecurity Act 2015*. Conditionally non-prohibited goods cannot be brought or imported into Australia unless they meet specific import conditions.

This report, upon its finalisation, provides the basis for import conditions for passionfruit from Vietnam for human consumption. The import conditions will be communicated on BICON. The publication of import conditions on BICON is subject to Vietnam being able to demonstrate that processes and procedures are in place to implement the required risk management measures.

## Appendix A: Method for pest risk analysis

This section sets out the method for the pest risk analysis (PRA) used by the department. This method is consistent with the International Standards for Phytosanitary Measures (ISPMs), including ISPM 2: *Framework for pest risk analysis* (FAO 2019b) and ISPM 11: *Pest risk analysis for quarantine pests* (FAO 2019c) and the WTO Agreement on the Application of Sanitary and Phytosanitary Measures (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 2023). A pest is 'any species, strain or biotype of plant, animal, or pathogenic agent, injurious to plants or plant products' (FAO 2023). 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 2023).

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

Unrestricted risk is estimated taking into account, where applicable, the existing commercial production practices of the exporting country and procedures that occur on arrival in Australia. These procedures include verification by the department 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 or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests' (FAO 2023).

A PRA is conducted in 3 consecutive stages: initiation (A1), pest risk assessment (A2) and pest risk management (A3).

### A1 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.

A pathway is 'any means that allows the entry or spread of a pest' (FAO 2023). For this risk analysis, the 'pathway' being assessed is defined in Chapter 1 (section 1.2.2).

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 based on 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.

According to ISPM 11 (FAO 2019c), the PRA process may be initiated as a result of:

- the identification of a pathway that presents a potential pest hazard. For example, international trade is requested for a commodity not previously imported into the country or a commodity from a new area or new country of origin
- the identification of a pest that may require phytosanitary measures. For example, a new pest risk is identified by scientific research, a pest is repeatedly intercepted, a request is made to import an organism, or an organism is identified as a vector of other pests
- the review or revision of a policy. For example, a country's decision is taken to review phytosanitary regulations, requirements or operations or a new treatment or loss of a treatment system, a new process, or new information impacts on an earlier decision.

The basis for the initiation of this risk analysis is defined in Chapter 1 (section 1.2.1).

The primary elements in the initiation stage are:

- identity of the pests
- potential association of each pest with the pathway being assessed.

The identity of the pests is presented at species level by the species' scientific name in most instances, but a lower taxonomic level may be 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.

The potential association of each pest with the pathway being assessed considers information on:

- association of the pest with the host plant/commodity and
- the presence or absence of the pest in the exporting country/region relevant to the pathway being assessed.

## A2 Stage 2: Pest risk assessment

The process for pest risk assessment includes 2 sequential steps:

- pest categorisation (A2.1)
- further pest risk assessment, which includes evaluation of the likelihoods of the introduction (entry and establishment) and spread of a pest (A2.2), and evaluation of the magnitude of the associated potential consequences (A2.3).

### A2.1 Pest categorisation

Pest categorisation examines the pests identified in the initiation stage (A1) to determine which of these pests meet the definition of a quarantine pest and require further pest risk assessment.

ISPM 11 (FAO 2019c) states that '*The opportunity to eliminate an organism or organisms from consideration before in-depth examination is undertaken is a valuable characteristic of the categorisation process. An advantage of pest categorisation is that it can be done with relatively little information; however information should be sufficient to adequately carry out the categorisation*'. In line with ISPM 11, the department utilises the pest categorisation step to screen out some pests from further consideration where appropriate. For each pest that is not present in Australia, or is present but under official control, the department assesses its potential to enter (importation and distribution) on the pathway being assessed and, if having

potential to enter, its potential to establish and spread in the PRA area. For a pest to cause economic consequences, the pest will need to enter, establish and spread in the PRA area. Therefore, pests that do not have potential to enter on the pathway being assessed, or have potential to enter but do not have potential to establish and spread in the PRA area, are not considered further. The potential for economic consequences is then assessed for pests that have potential to enter, establish and spread in the PRA area. Further pest risk assessments are then undertaken for pests that have potential to cause economic consequences, i.e., pests that meet the criteria for a quarantine pest.

Pest categorisation uses the following primary elements to identify the quarantine pests and to screen out some pests from further consideration where appropriate for the pathway being assessed:

- presence or absence and regulatory status in the PRA area
- potential for entry, establishment and spread in the PRA area
- potential for economic consequences in the PRA area.

## **A2.2 Assessment of the likelihood of entry, establishment and spread**

ISPM 11 (FAO 2019c) provides details of how to assess the ‘probability of entry’, ‘probability of establishment’ and ‘probability of spread’ of a pest. The SPS Agreement (WTO 1995) uses the term ‘likelihood’ rather than ‘probability’ for these estimates. In qualitative PRAs, the department uses the term ‘likelihood’ as the descriptor. The use of the term ‘probability’ is limited to the direct quotation of ISPM definitions.

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

### **A2.2.1 Likelihood of entry**

The likelihood of entry describes the likelihood that a quarantine pest will enter Australia when a given commodity is imported, be distributed in a viable state in the PRA area and subsequently be transferred to a host.

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 in a viable state when a given commodity is imported
- **Likelihood of distribution**— the likelihood that the pest will be distributed in a viable state, 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:

- likelihood of the pest being associated with the pathway at origin
  - prevalence 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 along each pathway



- seasonal timing of imports
- pest management, cultural and commercial procedures applied at the place of origin (for example, application of plant protection products, handling, culling, and grading)
- likelihood of survival of the pest during transport or storage
  - speed and conditions of transport and duration and conditions of storage compared with the duration of the life cycle of the pest
  - vulnerability of the life-stages of the pest during transport or storage
  - prevalence 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
- likelihood of pest surviving existing pest management procedures.

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

#### **A2.2.2 Likelihood of establishment**

Establishment is defined as the 'perpetuation for the foreseeable future, of a pest within an area after entry' (FAO 2023). 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 suitable hosts, alternate hosts and vectors in the PRA areas
  - prevalence of hosts and alternate hosts in the PRA area
  - whether hosts and alternate hosts occur within sufficient geographic proximity to allow the pest to complete its life cycle
  - whether there are other plant species, which could prove to be suitable hosts in the absence of usual host species
  - whether a vector, if needed for dispersal of the pest, is already present in the PRA area or likely to be introduced
- suitability of environment in the PRA area

- factors in the environment in the PRA area (for example, suitability of climate, soil, pest and host competition) that are critical to the development of the pest, its host and if applicable its vector, and to their ability to survive periods of climatic stress and complete their life cycles
- cultural practices and control measures in the PRA area that may influence the ability of the pest to establish
- other characteristics of the pest
  - reproductive strategy of the pest and method of pest survival
  - potential for adaptation of the pest
  - minimum population needed for establishment.

### A2.2.3 Likelihood of spread

Spread is defined as ‘the expansion of the geographical distribution of a pest within an area’ (FAO 2023). 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.

### A2.2.4 Assigning likelihoods for entry, establishment and spread

Likelihoods are assigned to each step of entry, establishment and spread. Six qualitative likelihood descriptors are used: High; Moderate; Low; Very Low; Extremely Low; and Negligible. Definitions for these descriptors and their indicative ranges are given in Table A.1. The indicative ranges are only provided to illustrate the boundaries of the descriptors and are not used beyond this purpose in qualitative PRAs. These indicative ranges provide guidance to the risk analyst and promote consistency between different pest risk assessments.

**Table A.1 Nomenclature of likelihoods**

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

### A2.2.5 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 A.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 a descriptor of Low is assigned for the likelihood of importation, Moderate for the likelihood of distribution, High for the likelihood of establishment and Very Low for the likelihood of spread, then the likelihood of importation of Low and the likelihood of distribution of Moderate 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 A.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 one year's trade. This is a convenient value for the analysis that is relatively easy to estimate and allows for expert consideration of seasonal variations in pest presence, incidence and behaviour to be taken into account. The consideration of the likelihood of entry, establishment and spread and subsequent consequences takes into account events that might happen over a number of years even though only one year's volume of trade is being considered. This

difference reflects biological and ecological facts, for example where a pest or disease may establish in the year of import but spread may take many years.

The use of a one year volume of trade has been taken into account when setting up the matrix that is used to estimate the risk and therefore any policy based on this analysis does not simply apply to one year of trade. Policy decisions that are based on the department's method that uses the estimated volume of one year's trade are consistent with Australia's policy on appropriate level of protection and meet the Australian Government's requirement for ongoing quarantine protection. 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 substantial volume of trade will occur.

### **A2.3 Assessment of potential consequences**

In estimating the potential consequences of a pest if the pest were to enter, establish and spread in Australia, the department uses a 2-step process. In the first step, a qualitative descriptor of the impact is assigned to each of the direct and indirect criteria in terms of the *level of impact* and the *magnitude of impact*. The second step involves combining the impacts for each of the criteria to obtain an 'overall consequences' estimation.

#### **Step 1: Assessing direct and indirect impacts**

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

- the life or health of plants and plant products  
This may include pest impacts on the life or health of the plants and production effects (yield or quality) either at harvest or during storage.
  - Where applicable, pest impacts on the life or health of humans or of animals and animal products may also be considered.
- other aspects of the environment.

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

- eradication and control  
This may include pest impacts on new or modified eradication, control, surveillance or monitoring and compensation strategies or programs.
- domestic trade  
This may include pest impacts on domestic trade or industry, including changes in domestic consumer demand for a product resulting from quality changes and effects on other industries supplying inputs to, or using outputs from, directly affected industries.
- international trade  
This may include pest impacts on international trade, including loss of markets, meeting new technical requirements to enter or maintain markets and changes in international consumer demand for a product resulting from quality changes.
- non-commercial and environment

This may include pest impacts on the community and environment, including reduced tourism, reduced rural and regional economic viability, loss of social amenity, and any 'side effects' of control measures.

For each of these direct and indirect criteria, the level of impact is 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 impact at each of these geographic levels is described using 4 categories, defined as:

- **Unlikely to be discernible**—pest impact is not usually distinguishable from normal day-to-day variation in the criterion
- **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.

Each individual direct or indirect impact is given an impact score (A–G) using the decision rules in Figure A.1. This is done by determining which of the shaded cells with bold font in Figure A.1 correspond to the level and magnitude of the particular impact.

The following are considered during this process:

- At each geographic level below 'National', an impact more serious than 'Minor significance' is considered at least 'Minor significance' at the level above. For example, a 'Significant' impact at the state or territory level is considered equivalent to at least a 'Minor significance' impact at the national level.
- If the impact of a pest at a given level is in multiple states or territories, districts or regions or local areas, it is considered to represent at least the same magnitude of impact at the next highest geographic level. For example, a 'Minor significance' impact in multiple states or territories represents a 'Minor significance' impact at the national level.
- The geographic distribution of an impact does not necessarily determine the impact. For example, an outbreak could occur on one orchard/farm, but the impact could potentially still be considered at a state or national level.

Figure A.1 Decision rules for determining the impact score for each direct and indirect criterion, based on the *level of impact* and the *magnitude of impact*

Impact score	G	Major significance	-	-	-
	F	Significant	Major significance or equal to at least 'Significant' at National level	-	-
	E	Minor significance	Significant or equal to at least 'Minor significance' at National level	Major significance or equal to at least 'Significant' at Regional level	-
	D	Unlikely to be discernible	Minor significance	Significant or equal to at least 'Minor significance' at Regional level	Major significance or equal to at least 'significant' at District level
	C	-	Unlikely to be discernible	Minor significance	Significant or equal to at least 'Minor significance' at District level
	B	-	-	Unlikely to be discernible	Minor significance
	A	-	-	-	Unlikely to be discernible
		National	Regional	District	Local
Geographic level					

For each criterion:

- the *level of impact* is estimated over 4 geographic levels: local, district, regional and national
- the *magnitude of impact* at each of the 4 geographic levels is described using 4 categories: unlikely to be discernible, minor significance, significant and major significance
- an impact score (A–G) is assigned by determining which of the shaded cells with bold font correspond to the level and magnitude of impact.

## Step 2: Combining direct and indirect impacts

The overall consequence for each pest or each group of pests is achieved by combining the impact scores (A–G) for each direct and indirect criterion using the decision rules in Table A.3. These rules are mutually exclusive, and are assessed in numerical order until one applies. For example, if the first rule does not apply, the second rule is considered, and so on.

**Table A.3 Decision rules for determining the overall consequence rating for each pest**

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

#### A2.4 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 each group of pests. This is determined by using a risk estimation matrix (Table A.4) to combine the estimates of the likelihood of entry, establishment and spread and the overall consequences of pest establishment and spread.

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 give a Low rating.

**Table A.4 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

## **A2.5 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 A.4 marked ‘Very Low risk’ represents the ALOP for Australia.

## **A2.6 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 for the likelihood of importation and the likelihood of distribution is considered on a case-by-case basis by comparing factors relevant to the pathway being assessed 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 in the exporting country/region. For assessment of the likelihood of distribution of a pest the factors considered/compared include the commodity type, the ways the imported produce will be distributed within Australia as a result of the processing, sale or disposal of the imported produce, and 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 for the pathway being assessed to be comparable to those assigned in the previous assessment(s), and there is no new information to suggest that the ratings assigned in the previous assessment(s) have changed.

The likelihoods of establishment and of spread of a pest species in the PRA area will be comparable between risk assessments, regardless of the import pathway through which the pest has entered the PRA area. This is because these likelihoods relate specifically to conditions and events that occur in the PRA area, and are independent of the import pathway. Similarly, the estimate of potential consequences associated with a pest species is also independent of the import pathway. Therefore, the likelihoods of establishment and of spread of a pest, and the estimate of potential consequences, are directly comparable between assessments. If there is no new information available that would significantly change the ratings for establishment or spread or the consequences the pests may cause, the ratings assigned in the previous assessments for these components may be adopted with confidence.

## **A2.7 Application of Group PRAs to this risk analysis**

The Group PRAs that were applied to this risk analysis are:

- the *Final group pest risk analysis for thrips and orthospoviruses on fresh fruit, vegetable, cut-flower and foliage imports* (thrips Group PRA) (DAWR 2017a).
- 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 2019a).



- the *Final group pest risk analysis for soft and hard scale insects on fresh fruit, vegetable, cut-flower and foliage imports* (scales Group PRA) (DAWE 2021).

The Group PRA approach is consistent with relevant international standards and requirements—including ISPM 2: *Framework for Pest Risk Analysis* (FAO 2019b), ISPM 11: *Pest Risk Analysis for Quarantine Pests* (FAO 2019c) and the SPS Agreement (WTO 1995). ISPM 2 states that ‘Specific organisms may be analysed individually, or in groups where individual species share common biological characteristics.’

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 A2.6. 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 A2.6, 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, unless there is specific evidence to suggest otherwise, 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 (the URE) may change.

Application of Group policy involves identification of up to 3 species of each relevant group associated with the import pathway. However, if any other quarantine pests or regulated articles not included in this risk analysis and/or in the relevant group policies are detected at pre-export or on arrival in Australia, the relevant Group policy will also apply.

### **A3 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 proposed/recommended phytosanitary measures (or combination of measures) is evaluated, using the same approach as used to evaluate the unrestricted risk. This ensures the restricted risk for the relevant pest or pests achieves the ALOP for Australia.

ISPM 11 (FAO 2019c) 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.

## Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

The pest categorisation table does not represent a comprehensive list of all the pests associated with the entire passionfruit plant, grown in Vietnam. Reference to soil-borne nematodes, soil-borne pathogens, wood-borer pests, root pests or pathogens, and secondary pests has not been made, as they are not directly related to the export pathway passionfruit and would be addressed by Australia's current approach to contaminating pests.

The steps in the initiation and categorisation processes are considered sequentially, with the assessment terminating at 'Yes' for column 3 (except for pests that are present, but under official control and/or pests of regional concern), or at the first 'No' for columns 4, 5, 6 or 7. In the final column of the table (column 8) the acronyms 'EP', 'GP' and 'RA' are used. The acronym 'EP' (existing policy) is used for pests that have been assessed by Australia and for which a policy exists. The acronym 'GP' (Group policy) is used for pests that have been assessed by Australia in a Group policy. The acronym 'RA' (regulated article) is used for pests that are known to vector pathogens of biosecurity concern and are therefore regulated articles. The acronym for the state or territory for which regional pest status is considered, such as 'WA' (Western Australia) or 'SA' (South Australia), is used to identify organisms that have been recorded in some regions of Australia, and due to interstate quarantine regulations are considered regional quarantine pests.

*The Final group pest risk analysis for thrips and orthospoviruses on fresh fruit, vegetable, cut-flower and foliage imports (DAWR 2017a), the Final group pest risk analysis for mealybugs and the viruses they transmit on fresh fruit, vegetable, cut-flower and foliage imports (DAWR 2019a) and the Final group pest risk analysis for soft and hard scale insects on fresh fruit, vegetable, cut-flower and foliage imports (DAWE 2021) 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 are detected at pre-export or on-arrival in Australia, the relevant Group policy will also apply.*

The department is aware of the recent changes in fungal nomenclature which ended the separate naming of different states of fungi with a pleomorphic life cycle. 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. The department is also aware of the changes in nomenclature of arthropod species based on the latest morphological and molecular reviews. As official lists of accepted fungus and arthropod names become available, these accepted names will be adopted.

A detailed description of the method used for a pest risk analysis is provided in Appendix A.

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
<b>ARTHROPODS</b>							
<b>Coleoptera</b>							
<i>Araecerus fasciculatus</i> (De Geer, 1775) Synonyms: <i>Araecerus coffeae</i> (Fabricius, 1801) <i>Anthribus coffeae</i> (Fabricius, 1801) [Anthribidae] Coffee bean weevil	Yes (Alba-Alejandre, Alba-Tercedor & Vega 2018)	Yes. NSW, NT, Qld, Vic. (recorded as <i>Araecerus coffeae</i> ) (APPD 2022), WA (Government of Western Australia 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Aulacophora flavomarginata</i> Duvivier, 1884 [Anthribidae] Pumpkin beetle	Yes (MARD 2016)	No records found	No. <i>Aulacophora flavomarginata</i> has been reported in Vietnam on the leaves of passionfruit plants (MARD 2016). Adults lay eggs in the soil and the hatching larvae burrow into the soil and feed primarily on plant roots. The adults feed on leaves, but may also cause damage to flowers and small fruits (Tsatsia & Jackson 2017). Adults are strong fliers and quickly disperse when disturbed (Tsatsia & Jackson 2017) and therefore are unlikely to	Assessment not required	Assessment not required	Assessment not required	No

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
			remain on the fruit during harvesting and packing house practices.				
<i>Hypomeces squamosus</i> (Fabricius, 1792) [Curculionidae]	Yes (PPD 2009)	No records found	No. <i>Hypomeces squamosus</i> is associated with passionfruit (Zhang et al. 2022), however, adults feed on the leaves and larvae feed on the roots of host plants (Ong & Farid 2017; Thu et al. 2010).	Assessment not required	Assessment not required	Assessment not required	No
<i>Phyllotreta striolata</i> (Fabricius, 1803) [Chrysomelidae] Cabbage flea beetle	Yes (MARD 2016)	No records found	No. <i>Phyllotreta striolata</i> has been reported in Vietnam on the leaves of passionfruit (MARD 2016). Adults feed on the leaves and larvae feed on the roots of host plants, primarily crucifers (Mason, Alford & Kuhar 2020).	Assessment not required	Assessment not required	Assessment not required	No
<b>Diptera</b>							
<i>Bactrocera dorsalis</i> (Hendel, 1912) Synonyms: <i>Bactrocera invadens</i> (Drew, Tsuruta & White, 2005), <i>B. papayae</i> Drew & Hancock, 1994 and <i>B.</i>	Yes (Drew & Hancock 1994; Drew & Romig 2013; Thuy 1998; Thuy, Duc & Vu 2000)	Absent: pest eradicated (Hancock et al. 2000)	Yes. <i>Passiflora edulis</i> is described as either a field host (Steiner 1955; Vargas et al. 2007; Vargas et al. 2012) or a conditional host (Moquet & Delatte 2021) for <i>B. dorsalis</i> . In a	Yes. <i>Bactrocera dorsalis</i> is highly polyphagous (McQuate & Liquido 2017) and suitable hosts are available in Australia. Passionfruit will be	Yes. This highly polyphagous species can infest more than 470 individual plant taxa across 78 plant families (McQuate &	Yes. <i>Bactrocera dorsalis</i> is highly polyphagous and a major pest of avocado, citrus, and mango (CABI	Yes (EP)

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
<i>philippinensis</i> Drew & Hancock, 1994 have been synonymised with <i>B. dorsalis</i> (Schutze et al. 2014; Schutze et al. 2015). [Tephritidae] Oriental fruit fly			small field survey, no flies emerged from 105 ripe field-collected passionfruit; however, 10% of mature, intact fruit were infested by <i>B. dorsalis</i> under laboratory conditions (Moquet & Delatte 2021). Mature, infested fruits were visually indistinguishable from non-infested (control) samples over a test period of 14 days (Moquet & Delatte 2021), indicating potential for import of passionfruit infested by <i>B. dorsalis</i> .	distributed across Australia for sale and could potentially carry fruit fly eggs and larvae. At temperatures between 20-25°C, <i>B. dorsalis</i> is able to complete development from egg to pupa in less than 10 days (Michel et al. 2021), which is within the expected shelf life of whole passionfruit (10-23 days) (Yumbya et al. 2014). Viable immature stages that could potentially be present in imported passionfruit could pupate, develop into adults, and disperse to new hosts available in Australia.	Liquido 2017). Since 1990, <i>B. dorsalis</i> has spread to a further 70 countries (Zeng et al. 2018). It is distributed across sub-Saharan Africa, Asia and several islands in Oceania including Papua New Guinea and Hawaii (CABI 2023; Vargas, Pinero & Leblanc 2015; White & Elson-Harris 1992), which have similar climates to parts of Australia. Its host range and geographic distribution suggest that <i>B. dorsalis</i> could establish and spread in Australia.	2022; Follett, Haynes & Dominiak 2021), all of which are grown commercially in Australia, and are of economic importance. A detection of Oriental fruit fly (then known as papaya fruit fly) near Cairns in 1995 cost \$33.5 million and took nearly 4 years to eradicate. The estimated cost to industry at that time was \$100 million (Cantrell, Chadwick & Cahill 2002).	
<i>Bactrocera latifrons</i> (Hendel, 1915)	Yes (Drew & Romig 2013; Thuy 1998)	No records found	No. <i>Bactrocera latifrons</i> is a polyphagous species	Assessment not required	Assessment not required	Assessment not required	No

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
<p>Synonyms:  <i>Chaetodacus antennalis</i> Shiraki, 1933; <i>Chaetodacus latifrons</i> Hendel, 1915; <i>Dacus parvulus</i> Hendel, 1912  [Tephritidae]  Solanum fruit fly</p>			that predominantly infests fruits of the families Solanaceae and Cucurbitaceae (McQuate & Liquido 2013). The family Passifloraceae is reported as a host for <i>B. latifrons</i> (McQuate & Liquido 2013, 2017; PHA 2018). However, only 2 records of infestation have been found: <i>B. latifrons</i> is reported in 2 samples of <i>Passiflora foetida</i> in a survey of fruit flies in southeast Asia (Allwood et al. 1999), and an interception of viable larvae in <i>Passiflora</i> sp. occurred at Hawaii airport (McQuate & Liquido 2013). No record was found in the literature of <i>B. latifrons</i> infesting <i>Passiflora edulis</i> .				
<p><i>Liriomyza huidobrensis</i> (Blanchard, 1926)  [Agromyzidae]  Serpentine leaf miner</p>	Yes (Andersen, Tran & Nordhus 2008; Weintraub et al. 2017)	Yes. Under official control (Regional) for WA (IPPC 2021a). Present in NSW, Qld (IPPC 2021a), Vic (Agriculture Victoria 2022).	No. Although <i>L. huidobrensis</i> is associated with passionfruit (Kahinga, Gichuki & Waiganjo 2017), it is a leaf miner;	Assessment not required	Assessment not required	Assessment not required	No

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
			larvae feed and develop in the leaves of the host plant (Weintraub et al. 2017). Fruit is not considered a pathway for spread of leafminers; harvesting and packing house practices will remove any adults on fruit and remove leaf material that could be infested (Plant Health Australia 2022).				
<i>Liriomyza sativae</i> Blanchard, 1938 [Agromyzidae] Vegetable leaf miner	Yes (Andersen, Tran & Nordhus 2008; Hofsvang et al. 2005; Mujica et al. 2016)	Yes. Under official control (National). Present with restricted distribution in Qld (IPPC 2017).	No. Although <i>L. sativae</i> is associated with passionfruit (Mujica et al. 2016), it is a leaf miner; larvae feed and develop in the leaves of the host plant (Mujica et al. 2016). Fruit is not considered a pathway for spread of leafminers; harvesting and packing house practices will remove adults and remove leaf material that could be infested (Burgess, Ridland & Pirtle 2020).	Assessment not required	Assessment not required	Assessment not required	No



Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
<p><i>Zeugodacus cucurbitae</i> (Coquillett, 1899)  Synonym: <i>Bactrocera cucurbitae</i> (Coquillett, 1899)  [Tephritidae]  Melon fly</p>	<p>Yes (Drew &amp; Romig 2013; Thuy 1998; Thuy, Duc &amp; Vu 2000)</p>	<p>No records found</p>	<p>Yes. <i>Passiflora edulis</i> is a host for <i>Z. cucurbitae</i> (Aye &amp; Thaug 2002; Steiner 1955; Tsuruta et al. 1997). <i>Zeugodacus cucurbitae</i> generally oviposits into immature fruit with a tender rind, but may also oviposit into more developed fruit (Akamine et al. 1974). Small, undeveloped infested fruit tend to shrivel and drop from the vine whereas more developed fruit may continue to maturity, with scarring developing at oviposition sites (Akamine et al. 1974).</p>	<p>Yes. <i>Zeugodacus cucurbitae</i> is polyphagous (Dhillon et al. 2005) and suitable hosts are available in Australia. Passionfruit will be distributed across Australia for sale and could potentially carry fruit fly eggs and larvae. Viable immature stages that could potentially be present in imported passionfruit could pupate, develop into adults, and disperse to new hosts available in Australia.</p>	<p>Yes. <i>Zeugodacus cucurbitae</i> has spread from its native range of India through southeastern and east Asia (Weems, Heppner &amp; Fasulo 2018) to many Pacific Islands, including Hawaii, and to Africa (De Meyer et al. 2015). Some of these areas have similar climates to parts of Australia. In some regions there have been multiple introductions, eradications and subsequent re-introductions (Kakinohana et al. 1997; Mitchell 1980; Wong et al. 1989). Its wide host range (predominantly cucurbits) (Allwood et al. 1999) and</p>	<p>Yes. <i>Zeugodacus cucurbitae</i> damages over 81 plant species (Dhillon et al. 2005). It is a major pest of cucurbitaceous crops, which are commercial crops of economic importance for Australia. <i>Zeugodacus cucurbitae</i> may cause up to 100% damage depending upon the cucurbit species and the season (Dhillon et al. 2005).</p>	<p>Yes (EP)</p>

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
					geographic distribution suggest that <i>Z. cucurbitae</i> could establish and spread in Australia.		
<i>Zeugodacus tau</i> (Walker, 1849) Synonym: <i>Dacus hageni</i> Meijere, 1911 [Tephritidae] Pumpkin fruit fly	Yes (Drew & Romig 2013; Shi, Kerdelhué & Ye 2014; Thuy & Ye 2014; Thuy, Duc & Vu 2000)	No records found	Yes. The fruit of <i>Passiflora edulis</i> is a host for <i>Z. tau</i> (Hasyim, Muryati & de Kogel 2008). Adult females lay eggs under the skin of fruit; emerging larvae feed on the flesh, causing fruit to rot and drop (Li et al. 2020).	Yes. <i>Zeugodacus tau</i> is polyphagous (Ahmad & Vasudha 2019) and suitable hosts are available in Australia. Passionfruit will be distributed across Australia for sale and could potentially carry fruit fly eggs and larvae. Viable immature stages that could potentially be present in imported passionfruit could pupate and develop into adults and disperse to new hosts available in Australia.	Yes. <i>Zeugodacus tau</i> was first described from southeastern China. and has since spread throughout tropical and subtropical Asia and the South Pacific region (Shi, Kerdelhué & Ye 2014). Some of these regions have similar climates to parts of Australia. Its wide host range (predominantly cucurbits) (Allwood et al. 1999) and geographic distribution suggest that <i>Z. tau</i> could establish	Yes. <i>Zeugodacus tau</i> has been reported to infest 62 plant species across more than 20 families (Ahmad & Vasudha 2019), including several crop species (predominantly cucurbits), which are commercial crops of economic importance for Australia. Fruit loss caused by <i>Z. tau</i> in agricultural crops is estimated to be as high as 40%	Yes (EP)

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
					and spread in Australia.	of production (Hasyim, Muryati & de Kogel 2008; Jaleel, Lu & He 2018). Like <i>Z. cucurbitae</i> , <i>Z. tau</i> is considered an economically important pest, based on similarities in host range and population growth capacity (Yang, Carey & Dowell 1994).	
<b>Hemiptera</b>							
<i>Aonidiella aurantii</i> (Maskell, 1879) [Diaspididae] California red scale	Yes (García Morales et al. 2022)	Yes. NSW, NT, Qld, SA, Tas., Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Aleurocanthus woglumi</i> Ashby, 1915 [Aleyrodidae]	Yes (CABI 2022; MARD 2016)	No records found	No. <i>Aleurocanthus woglumi</i> is associated with <i>Passiflora edulis</i> (Dietz & Zetek 1920) and has been reported in Vietnam on the leaves and stems (MARD 2016). Adults lay eggs	Assessment not required	Assessment not required	Assessment not required	No

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
			on the undersides of leaves (Nguyen, Hamon & Fasulo 2010) and nymphs feed on leaves throughout their development (Enkerlin 1976). Adult whiteflies are very active and easily disturbed, and therefore are unlikely to remain on the fruit during harvesting and packing house practices. However, if any life stages are present on harvested fruit, they would likely be removed during packing house processes such as brushing and washing.				
<i>Aphis craccivora</i> Koch, 1854 [Aphididae] Cowpea aphid	Yes (Waterhouse 1993)	Yes. NSW, Qld, SA, Vic., WA (ALA 2022; APPD 2022). As a potential vector of the potyviruses <i>East Asian Passiflora virus</i> , <i>Passiflora mottle virus</i> and <i>Telosma mosaic virus</i> (which are not known to occur in Australia but are present in Vietnam) (Do et al. 2021; Gadhav et al. 2020c; Ha et al. 2008a),	No. <i>Aphis craccivora</i> is associated with passionfruit (Garc�ez et al. 2015; Nantale et al. 2014). Aphids feed on phloem of leaves, stems (Capinera 2018; Nalam et al. 2021), buds or roots (Mahr 2022) of plants. <i>Aphis craccivora</i> is unlikely to feed on mature fruit. However, if any life stages are	Assessment not required	Assessment not required	Assessment not required	No

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
		the potential for <i>A. craccivora</i> to enter on the pathway needs to be assessed.	present on harvested fruit, they would likely be removed during packing house processes such as brushing and washing.				
<i>Aphis fabae</i> Scopoli, 1763 Synonyms: <i>Anuraphis cynariella</i> ; <i>Aphis abietaria</i> ; <i>Aphis acanthi</i> [Aphididae] Black bean aphid; Bean aphid	Yes (PPD 2021)	No records found	No. <i>Aphis fabae</i> has been reported as a pest of <i>Passiflora edulis</i> (PPD 2021). Aphids feed on phloem of leaves, stems (Capinera 2018; Nalam et al. 2021), buds or roots (Mahr 2022) of plants. They are unlikely to feed on mature fruit. However, if any life stages are present on harvested fruit, they would likely be removed during packing house processes such as brushing and washing.	Assessment not required	Assessment not required	Assessment not required	No
<i>Aphis gossypii</i> Glover, 1877 [Aphididae] Cotton aphid	Yes (MARD 2016)	Yes. NSW, NT, Qld, SA, Tas., Vic., WA (APPD 2022). As a potential vector of the potyviruses <i>East Asian Passiflora virus</i> , <i>Passiflora mottle virus</i> and <i>Telosma mosaic virus</i> (which are not known to occur in	No. <i>Aphis gossypii</i> has been reported in Vietnam on the leaves of passionfruit (MARD 2016). Aphids feed on phloem of leaves, stems (Capinera 2018; Nalam et al. 2021), buds or roots (Mahr 2022) of plants. They are unlikely	Assessment not required	Assessment not required	Assessment not required	No

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway			Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution	Potential for establishment and spread		
		Australia but are present in Vietnam) (Do et al. 2021; Gadhave et al. 2020c; Ha et al. 2008a), the potential for <i>A. gossypii</i> to enter on the pathway needs to be assessed.	to feed on mature fruit. However, if any life stages are present on harvested fruit, they would likely be removed during packing house processes such as brushing and washing.				
<i>Aphis spiraecola</i> Patch, 1914 [Aphididae] Spirea aphid	Yes (MARD 2016)	Yes. NSW, Qld, SA, Tas., Vic., WA (APPD 2022).  As a potential vector of the potyviruses <i>East Asian Passiflora virus</i> , <i>Passiflora mottle virus</i> and <i>Telosma mosaic virus</i> (which are not known to occur in Australia but are present in Vietnam) (Do et al. 2021; Gadhave et al. 2020c; Ha et al. 2008a), the potential for <i>A. spiraecola</i> to enter on the pathway needs to be assessed.	No. <i>Aphis spiraecola</i> has been reported in Vietnam on the young leaves of passionfruit (MARD 2016). Aphids feed on phloem of leaves, stems (Capinera 2018; Nalam et al. 2021), buds or roots (Mahr 2022) of plants. They are unlikely to feed on mature fruit. However, if any life stages are present on harvested fruit, they would likely be removed during packing house processes such as brushing and washing.	Assessment not required	Assessment not required	Assessment not required	No
<i>Aspidiotus destructor</i> Signoret, 1869 [Diaspididae] Coconut scale	Yes (García Morales et al. 2022)	Yes. NSW, NT, Qld, Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
<i>Aspidiotus nerii</i> Bouche, 1833 [Diaspididae] Oleander scale	Yes (García Morales et al. 2022)	Yes. NSW, NT, Qld, SA, Vic., WA (ABRS 2022; APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Bemisia tabaci</i> species complex Gennadius, 1889 Synonym: <i>Bemisia argentifolii</i> Bellows, Perring, Gill & Hendrick, 1994 [Aleyrodidae] Silverleaf whitefly Tobacco whitefly	Yes (Götz & Winter 2016)	Yes, but only some members of the complex. At least three species (AUS1, AUS II and MEAM 1) are known to be present in Australia. Most species in the complex remain absent from Australia. The <i>B. tabaci</i> complex is a known vector for begomoviruses, several of which are quarantine pests of concern for Australia (Fiallo-Olivé et al. 2020). Therefore, the <i>B. tabaci</i> complex, including those known to be present in Australia, are regulated articles for Australia.	No. <i>Passiflora edulis</i> is a host for <i>B. tabaci</i> (Li et al. 2011). <i>Bemisia tabaci</i> feeds on leaves and stems (Gangwar & Gangwar 2018) of host plants. The species is unlikely to feed on mature fruit. However, if present on harvested fruit, it would likely be removed during packing house processes such as brushing and washing. In addition, adult whiteflies are very active and easily disturbed, and therefore are unlikely to remain on harvested fruit.	Assessment not required	Assessment not required	Assessment not required	No
<i>Chrysomphalus dictyospermi</i> (Morgan, 1889) [Diaspididae] Dictyospermum scale	Yes (García Morales et al. 2022)	Yes. Under official control (Regional) for WA (Government of Western Australia 2022). Present in NSW, NT, Qld (APPD 2022).	Yes. <i>Chrysomphalus dictyospermi</i> is polyphagous and has been reported as a pest of <i>Passiflora</i> spp. (Miller & Davidson 2005; Watson 2022). <i>Chrysomphalus</i>	Yes. <i>Chrysomphalus dictyospermi</i> is polyphagous (Miller & Davidson 2005; Watson 2022) and suitable hosts are available in Australia. Imported	Yes. Assessed in the scale group PRA (DAWE 2021)	Yes. Assessed in the scale group PRA (DAWE 2021)	Yes (GP)

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required	
			Potential for importation	Potential for distribution				
			<i>dictyospermi</i> feeds on the upper surface of leaves and can also infest the underside of leaves, branches and fruit (Miller & Davidson 2005; Watson 2022).	passionfruit will be distributed across Western Australia for sale and could potentially carry <i>C. dictyospermi</i> . <i>Chrysomphalus dictyospermi</i> present on discarded passionfruit fruit waste could potentially disperse to a new host within close proximity.				
<i>Coccis hesperidum</i> Linnaeus, 1758 Synonym: <i>Coccus patellaeformi</i> Curtis, 1843 [Coccidae] Brown soft scale	Yes (García Morales et al. 2022; PPD 2010a)	Yes. ACT, NSW, NT, Qld, SA, Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No	
<i>Hyperomyzus lactucae</i> (Linnaeus, 1758) [Aphididae] Currant-lettuce aphid; Sowthistle aphid; Currant-sowthistle aphid	Yes (PPD 2021)	Yes. ACT, NSW, Qld, SA, Tas., Vic., WA (Brumley 2020). As a potential vector of the potyvirus <i>East Asian Passiflora virus</i> , (which is not known to be present in Australia but is present in Vietnam) (Iwai et al. 2006; Omatsu et al. 2004;	No. <i>Hyperomyzus lactucae</i> has been associated with passionfruit (Omatsu et al. 2004). Aphids feed on phloem of leaves, stems (Capinera 2018; Nalam et al. 2021), buds or roots (Mahr 2022) of plants. <i>Hyperomyzus lactucae</i> is unlikely to	Assessment not required	Assessment not required	Assessment not required	No	



Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
		PPD 2021), the potential for <i>H. lactucae</i> to enter on the pathway needs to be assessed.	feed on mature fruit. However, if any life stages are present on harvested fruit, they would likely be removed during packing house processes such as brushing and washing.				
<i>Icerya purchasi</i> Maskell, 1879 [Monophlebidae] Cottony cushion scale	Yes (García Morales et al. 2022)	Yes. NSW, Qld, SA, Tas., Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Leptoglossus gonagra</i> (Fabricius, 1775) Synonym: <i>Leptoglossus australis</i> Fabricius, 1775 [Coreidae] Passionvine bug	Yes (PPD 2010b)	Yes. NSW, NT, Qld, WA (ABRS 2022; Government of Western Australia 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Maconellicoccus hirsutus</i> (Green, 1908) Synonyms: <i>Phenacoccus hirsutus</i> Green, 1908; <i>Phenacoccus glomeratus</i> Green, 1922 [Pseudococcidae]	Yes (García Morales et al. 2022)	Yes. NT, Qld, Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
Grape mealybug							
<i>Macrosiphum euphorbiae</i> (Thomas, 1878) [Aphididae] Potato aphid	Yes (Kim et al. 2016)	Yes. NSW, NT, Qld, Tas., Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Megymenum brevicorne</i> (Fabricius, 1787) Synonym: <i>Cimex brevicornis</i> Fabricius, 1787 [Dinidoridae] Shield bug	Yes (Waterhouse 1993)	No records found	No. <i>Megymenum brevicorne</i> has been reported to feed on <i>Passiflora quadrangularis</i> (Miller 1929). This pest feeds on stems and fruit of host plants. Eggs are laid in chains on leaves and stems of host plants (Miller 1929). Shield bug nymphs and adults are easily disturbed and are highly unlikely to be found on commercially produced and processed passionfruit as they will not remain on fruit during the harvest, sorting and packing processes.	Assessment not required	Assessment not required	Assessment not required	No
<i>Myzus persicae</i> (Sulzer, 1776) Synonym: <i>Myzus (Nectarosiphon)</i>	Yes (Waterhouse 1993)	Yes. NSW, NT, Qld, Tas., Vic., WA (APPD 2022). As a potential vector of the potyviruses, <i>East</i>	No. <i>Passiflora edulis</i> is a host for <i>Myzus persicae</i> (Joy & Sherin 2016). Aphids feed on phloem	Assessment not required	Assessment not required	Assessment not required	No

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
<i>persicae</i> (Sulzer, 1776) [Aphididae] Green peach aphid		<i>Asian Passiflora virus</i> , <i>Passiflora mottle virus</i> and <i>Telosma mosaic virus</i> (which are not known occur in Australia but are present in Vietnam) (Do et al. 2021; Gadhav et al. 2020c; Ha et al. 2008a), the potential for <i>M. persicae</i> to enter on the pathway needs to be assessed.	of leaves, stems (Capinera 2018; Nalam et al. 2021), buds or roots (Mahr 2022) of plants. They are unlikely to feed on mature fruit. However, if any life stages are present on harvested fruit, they would likely be removed during packing house processes such as brushing and washing.				
<i>Nezara viridula</i> (Linnaeus, 1758) [Pentatomidae] Green vegetable bug	Yes (Lam, Lam & Lan 2015; Waterhouse 1993)	Yes. ACT, NSW, Qld, Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Parasaissetia nigra</i> (Nietner, 1861) Synonym: <i>Lecanium nigrum</i> Nietner, 1861 [Coccidae] Pomegranate scale	Yes (García Morales et al. 2022)	Yes. NSW, NT, Qld, SA, Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Parlatoria proteus</i> (Curtis, 1843) Synonym: <i>Parlatoria selenipedii</i> Signoret, 1869 [Diaspididae]	Yes (García Morales et al. 2022)	Yes. NSW, NT, Qld, SA, WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
Orchid parlatoria scale							
<i>Phenacoccus solenopsis</i> (Tinsley, 1898) [Pseudococcidae] Solenopsis mealybug	Yes (García Morales et al. 2022)	Yes. Qld, NT, WA (APPD 2023; Government of Western Australia 2023)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Pinnaspis strachani</i> (Cooley, 1899) Synonym: <i>Pinnaspis temporaria</i> Ferris, 1942 [Diaspididae] Cotton white scale	Yes (García Morales et al. 2022)	Yes. NSW, NT, Qld, WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Planococcus citri</i> (Risso, 1813) [Pseudococcidae] Citrus mealybug	Yes (García Morales et al. 2022)	Yes. ACT, NSW, NT, Qld, SA, Tas., Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Planococcus minor</i> Maskell, 1897 Synonym: <i>Planococcus pacificus</i> Cox, 1981 [Pseudococcidae] Pacific mealybug	Yes (García Morales et al. 2022)	Yes. Under official control (Regional) for WA (Government of Western Australia 2022). Present in NSW, NT, Qld, SA, Vic. (APPD 2022).	Yes. <i>Planococcus minor</i> has been reported on <i>Passiflora</i> spp. (Roda et al. 2013; Williams & Watson 1988). This species has been intercepted via trade of many commodities (Venette & Davis 2004) and could be present on	Yes. <i>Planococcus minor</i> is polyphagous (DAWR 2019a) and suitable hosts are available in Australia. Imported passionfruit will be distributed across Western Australia and could potentially carry	Yes. Assessed in the mealybug Group PRA (DAWR 2019a)	Yes. Assessed in the mealybug Group PRA (DAWR 2019a)	Yes (GP)

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
			imported fresh passionfruit.	<i>P. minor. Planococcus minor</i> present on discarded passionfruit fruit waste could potentially disperse to a new host within close proximity.			
<i>Plautia affinis</i> (Dallas, 1851) [Pentatomidae] Green Stink Bug	Yes (MARD 2016)	Yes. NSW, NT, Qld, Tas., Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Pseudococcus longispinus</i> (Targioni Tozzetti, 1867) Synonym: <i>Dactylopius longispinus</i> (Targioni Tozzetti, 1867) [Pseudococcidae] Longtailed mealybug	Yes (García Morales et al. 2022)	Yes. ACT, NSW, Qld, SA, Tas., Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Pseudaulacaspis pentagona</i> (Targioni Tozzetti, 1886) [Diaspididae] Mulberry scale	Yes (García Morales et al. 2022; Suh 2015)	Yes. Under official control (Regional) for WA (Government of Western Australia 2022). Present in NSW, Qld (APPD 2022).	Yes. <i>Pseudaulacaspis pentagona</i> is a pest of <i>Passiflora edulis</i> (Crause 1990). This pest is found mainly on stems and fruits, and occasionally on leaves and roots, affecting host plants during the seedling, vegetative, flowering	Yes. <i>Pseudaulacaspis pentagona</i> is polyphagous (DAWE 2021) and suitable hosts are available in Australia. Imported passionfruit will be distributed across Western Australia for sale and could potentially carry	Yes. Assessed in the scale Group PRA (DAWE 2021)	Yes. Assessed in the scale Group PRA (DAWE 2021)	Yes (GP)

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
			and fruiting stages (Watson 2022).	<i>P. pentagona</i> . <i>Pseudaulacaspis pentagona</i> present on discarded passionfruit fruit waste could potentially disperse to a new host within close proximity.			
<i>Rastrococcus invadens</i> Williams, 1986 [Pseudococcidae] Mango mealybug	Yes (García Morales et al. 2022; PPD 2009; Williams 2004)	No records found	Yes. <i>Rastrococcus invadens</i> is polyphagous and <i>Passiflora</i> spp. have been reported as hosts (García Morales et al. 2022; Nébié et al. 2018). <i>Rastrococcus invadens</i> has been reported on the buds, fruit and leaves of its hosts (Agouké, Agricola & Bokonon-Ganta 1988; Peña & Mohyuddin 1997). Due to its smaller size, it is possible that <i>R. invadens</i> on passionfruit may remain undetected and be present on the pathway.	Yes. <i>Rastrococcus invadens</i> is polyphagous (García Morales et al. 2022; Nébié et al. 2018) and suitable hosts are available in Australia. Imported passionfruit will be distributed across Australia for sale and could potentially carry <i>R. invadens</i> . <i>Rastrococcus invadens</i> present on discarded passionfruit fruit waste could potentially disperse to a new host within close proximity.	Yes. Assessed in the mealybug Group PRA (DAWR 2019a)	Yes. Assessed in the mealybug Group PRA (DAWR 2019a)	Yes (GP)

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
<i>Saissetia coffeae</i> (Walker, 1852) Synonym: <i>Chermes anthurii</i> Boisduval, 1867 [Coccidae] Hemispherical scale	Yes (García Morales et al. 2022)	Yes. ACT, NSW, NT, Qld, SA, Tas., Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Selenaspilus articulatus</i> (Morgan, 1889) [Diaspididae] West Indian red scale	Yes (Suh 2016)	Absent: pest records (Mamet 1958) are considered invalid.	Yes. <i>Selenaspilus articulatus</i> is polyphagous (Martins et al. 2022) and has been reported as a pest of <i>Passiflora edulis</i> (Carlos & Bartra 1974). It can be found on both sides of leaves, with a preference for upper leaf surfaces, and occasionally on fruits and pods of host plants (Watson 2022).	Yes. <i>Selenaspilus articulatus</i> is polyphagous (Martins et al. 2022) and suitable hosts are available in Australia. Imported passionfruit will be distributed across Australia for sale and could potentially carry <i>S. articulatus</i> . <i>Selenaspilus articulatus</i> present on discarded passionfruit fruit waste could potentially disperse to a new host within close proximity.	Yes. Assessed in the scale group PRA (DAWE 2021).	Yes. Assessed in the scale group PRA (DAWE 2021).	Yes (GP)
<i>Toxoptera aurantii</i> (Boyer de Fonscolombe, 1841)	Yes (Nguyen et al. 2019)	Yes. NSW, NT, Qld, Tas., Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
[Aphididae] Black citrus aphid							
<i>Toxoptera citricida</i> (Kirkaldy, 1907) Synonym: <i>Toxoptera citricidus</i> (Kirkaldy, 1907)	Yes (EPPO 1994)	Yes. NSW, Qld, SA, Tas., Vic., WA (ABRS 2022; APPD 2022; Hollis & Eastop 2005)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
[Aphididae] Black citrus aphid							
<b>Lepidoptera</b>							
<i>Chrysodeixis eriosoma</i> (Doubleday, 1843)	Yes (Waterhouse 1993)	Yes. NSW, NT, Qld, Tas., Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
[Noctuidae] Green looper							
<i>Eudocima fullonia</i> Clerck, 1874	Yes (MARD 2016)	Yes. NSW, NT Qld, Vic., WA (ALA 2023; APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
[Noctuidae] Fruit-piercing moth							
<i>Spodoptera frugiperda</i> (Smith and Abbot, 1797) Synonym: <i>Phalaena frugiperda</i> (Smith, 1797)	Yes (Dao et al. 2020)	Yes. NSW, NT, Qld, Tas., Vic., WA (IPPC 2021b)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
[Noctuidae] Fall armyworm							



Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
<i>Zeuzera coffeae</i> Nietner, 1861 Synonym: <i>Zeuzera roriczyana</i> Walker, 1862 [Cossidae] Coffee carpenter	Yes (Thu et al. 2010)	No records found	No. <i>Zeuzera coffeae</i> is a polyphagous pest that has been reported on <i>Passiflora edulis</i> in Asia (Waterhouse 1993). <i>Zeuzera coffeae</i> damages the plant stem. Adults lay eggs on the stem; larvae burrow inside the stem and excavate tunnels, before pupating in tunnels (Mannakkara 2006; Thu et al. 2010).	Assessment not required	Assessment not required	Assessment not required	No
<b>Thysanoptera</b>							
<i>Haplothrips gowdeyi</i> (Franklin, 1908) Synonym: <i>Anothrips gowdeyi</i> (Franklin, 1908) [Phlaeothripidae] Gold-tipped tubular thrips	Yes (MARD 2016)	Yes. NSW, NT, Qld, WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Heliothrips haemorrhoidalis</i> (Bouché, 1833) [Thripidae] Greenhouse thrips	Yes (Waterhouse 1993)	Yes. NSW, NT, Qld, SA, Tas., Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Scirtothrips dorsalis</i> Hood, 1919	Yes (PPD 2017)	Yes. NSW, NT, Qld, WA (APPD 2022). <i>Scirtothrips</i>	Yes. <i>Scirtothrips dorsalis</i> has been reported as a	Yes. <i>Scirtothrips dorsalis</i> has a wide	Not applicable to vector. However,	Not applicable to vector.	Yes (GP, RA)

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
[Thripidae] Synonym: <i>Scirtothrips padmae</i> Ramakrishna 1942 Oriental tea thrips Chilli thrips		<i>dorsalis</i> was previously assessed in the thrips Group PRA as a vector of quarantine orthotospoviruses. Therefore, it is a regulated article for Australia (DAWR 2017a).	pest of <i>Passiflora edulis</i> (Greenlife Industry Australia 2021; NPDN 2022). It usually feeds externally on leaves and flowers of host plants. However, fruit may also be damaged with scars and deformities due to feeding injury (CABI 2022). <i>Scirtothrips</i> spp. are routinely intercepted on horticultural products at the Australian border (DAWR 2017a).	host range including crop plants and ornamentals (CABI 2022), and many hosts are available in Australia. Imported passionfruit will be distributed across Australia for sale and could potentially carry <i>S. dorsalis</i> . <i>Scirtothrips dorsalis</i> present on discarded passionfruit fruit waste could potentially disperse to a new host within close proximity.	the emerging quarantine orthotospoviruses vectored by this thrips have potential for establishment and spread (DAWR 2017a).	However, the emerging quarantine orthotospoviruses vectored by this thrips have potential for consequences (DAWR 2017a).	
<i>Thrips hawaiiensis</i> (Morgan, 1913) Hawaiian flower thrips Synonym: <i>Euthrips hawaiiensis</i> (Morgan, 1913) [Thripidae] Hawaiian flower thrips	Yes (MARD 2016)	Yes. NSW, NT, Qld, Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Thrips palmi</i> (Karny, 1925)	Yes (Hung 2009)	Yes. Under official control (Regional) for SA (PIRSA 2022) and WA (Government of Western	Yes. Bermudez (2014) listed <i>P. edulis</i> as a host of <i>T. palmi</i> . It usually feeds externally on	Yes. <i>Thrips palmi</i> is a polyphagous species that attacks many hosts in the	Yes. Assessed in the thrips Group	Yes. Assessed in the thrips	Yes (GP)

Department of Agriculture, Fisheries and Forestry

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
Synonyms: <i>Thrips clarus</i> (Moulton, 1928); <i>Thrips gossypicola</i> (Priesner, 1939) [Thripidae] Melon thrips		Australia 2022). Present in NSW, NT and Qld (APPD 2022).	leaves and flowers of host plants. However, <i>T. palmi</i> is routinely intercepted on horticultural products at the Australian border (DAWR 2017a).	Cucurbitaceae, Solanaceae and Fabaceae families (CABI 2022; Young & Zhang 1998), and many hosts are available in Australia. Imported passionfruit will be distributed across South Australia and Western Australia for sale and could potentially carry <i>T. palmi</i> . <i>Thrips palmi</i> present on discarded passionfruit fruit waste could potentially disperse to a new host within close proximity.	PRA (DAWR 2017a)	Group PRA (DAWR 2017a)	
<b>Trombidiformes</b>							
<i>Brevipalpus phoenicis</i> (Geijskes, 1936)  [Tenuipalpidae] Red and black flat mite	Yes (Zhang 2021)	Yes. NSW, NT, WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Oligonychus coffeae</i> (Nietner, 1861) [Tetranychidae]	Yes (Vacante 2016)	Yes. NSW, NT, Qld, WA (APPD 2022; Botha,	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
Tea red spider mite		Bennington & Poole 2014)					
<i>Panonychus citri</i> (McGregor, 1916) [Tetranychidae] Citrus red mite	Yes (CABI 2022; Huyen et al. 2017)	Yes. Under official control (Regional) for WA (Government of Western Australia 2022). Present in NSW (NSW DPI 2017).	No. <i>Panonychus citri</i> has a wide host range of about 90 different species across 30 plant families (NSW DPI 2017). Although passionfruit is listed as a host for <i>P. citri</i> in some publications (NSW DPI 2017; Practical Action 2003), no evidence could be found indicating that <i>P. citri</i> is a pest of passionfruit in Vietnam or other countries.	Assessment not required	Assessment not required	Assessment not required	No
<i>Polyphagotarsonemus latus</i> (Banks, 1904) [Tarsonemidae] Broad mite	Yes (PPD 2010b)	Yes. NSW, NT, Qld, SA, Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Tetranychus marianae</i> McGregor, 1950 [Tetranychidae] Mariana mite	Yes (Migeon & Dorkeld 2022)	Yes. NT, Qld, WA (APPD 2022; Government of Western Australia 2022; Seeman & Beard 2011)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Tetranychus piercei</i> McGregor, 1950	Yes (Bolland, Gutierrez & Flechtmann 1998)	No records found	Yes. <i>Tetranychus piercei</i> has been reported as a pest of <i>Passiflora edulis</i>	Yes. <i>Tetranychus piercei</i> is polyphagous	Yes. This pest has the potential to establish and	Yes. <i>Tetranychus piercei</i> is	Yes

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
<p>Synonym:  <i>Tetranychus manihotis</i> Flechmann, 1981  [Tetranychidae]</p>			<p>(Bolland, Gutierrez &amp; Flechtmann 1998; Walter 2006).  <i>Tetranychus</i> spp. are generally found on the leaves. However, at levels of high infestation they can also be found on fruit of hosts (Meck, Walgenbach &amp; Kennedy 2012).</p>	<p>(Bolland, Gutierrez &amp; Flechtmann 1998) and suitable hosts of this mite are available in Australia. Imported passionfruit will be distributed across Australia for sale and could potentially carry <i>T. piercei</i>. <i>Tetranychus piercei</i> present on discarded passionfruit fruit waste could potentially disperse to a new host within close proximity (Kennedy &amp; Smitley 1985).</p>	<p>spread in Australia as suitable hosts and environments are available. <i>Tetranychus piercei</i> is polyphagous. Hosts include passionfruit, banana, peach, papaya, eggplant cassia and pandanus (Bolland, Gutierrez &amp; Flechtmann 1998; Masaki 2001). Hosts of <i>T. piercei</i> are grown across Australia. This mite occurs in tropical and warm subtropical regions, and similar climates are found in some parts of Australia (Bolland, Gutierrez &amp; Flechtmann 1998).</p>	<p>polyphagous with horticultural crop hosts including passionfruit, banana, peach, papaya and eggplant (Bolland, Gutierrez &amp; Flechtmann 1998). <i>Tetranychus piercei</i> is reported as causing severe damage to bananas in southern China (Fu et al. 2002).</p>	

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
<i>Tetranychus urticae</i> Koch, 1836 Synonym: <i>Tetranychus telarius</i> Linnaeus, 1758 [Tetranychidae] Two-spotted spider mite	Yes (Hinomoto et al. 2007; Migeon & Dorkeld 2022)	Yes. NSW, NT, Qld, SA, Tas., Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<b>BACTERIA</b>							
<i>Pseudomonas syringae</i> pv. <i>passiflorae</i> (Reid 1938) Young et al. 1978 Synonym: <i>Pseudomonas passiflorae</i> (Reid 1938) Burkholder 1948 [Pseudomonadales: Pseudomonadaceae] Grease spot	Yes (Red Pine International 2019)	Yes. WA (Doepel 1965; Government of Western Australia 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Pseudomonas syringae</i> pv. <i>syringae</i> van Hall 1902 [Pseudomonadales: Pseudomonadaceae]	Yes (Red Pine International 2019)	Yes. ACT, NSW, NT, Qld, SA, Tas., Vic., WA (APPD 2022; Government of Western Australia 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
<i>Ralstonia solanacearum</i> (Smith 1896) Yabuuchi et al., 1995 [Burkholderiales: Burkholderiaceae] Bacterial wilt	Yes (Burgess et al. 2008)	Yes. NSW, NT, Qld, SA, Vic. (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<b>CHROMALVEOLATA</b>							
<i>Phytophthora cinnamomi</i> Rands [Peronosporales: Peronosporaceae]	Yes (PPD 2010b)	Yes. ACT, NSW, NT, Qld, SA, Tas., Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Phytophthora drechsleri</i> Tucker [Peronosporales: Peronosporaceae]	Yes (Jung et al. 2020)	Yes. NSW, Qld, SA, Tas., Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Phytophthora nicotianae</i> Breda de Haan [Peronosporales: Peronosporaceae] Fruit Rot	Yes (MARD 2016)	Yes. NSW, NT, Qld, SA, Tas., Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Phytophthora vexans</i> (de Bary) Abad, de Cock, Bala, Robideau, Lodhi & Lévesque Synonym: <i>Pythium vexans</i> de Bary	Yes (Thao et al. 2020)	Yes. NSW, Qld, Vic., WA (APPD 2022; Government of Western Australia 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
[Peronosporales: Pythiaceae]							
<i>Pythium aphanidermatum</i> (Edson) Fitzp	Yes (Luong et al. 2010)	Yes. NSW, NT, Qld, Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
[Peronosporales: Pythiaceae] Damping-off							
<i>Pythium irregulare</i> Buisman	Yes. (EPPO 2022)	Yes. NSW, Qld, Tas., Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
[Peronosporales: Pythiaceae]							
<b>FUNGI</b>							
<i>Aspergillus niger</i> Tiegh. [Eurotiales: Trichocomaceae]	Yes (Burgess & Burgess 2009)	Yes. NSW, NT, Qld, SA, Vic., WA (APPD 2022; Government of Western Australia 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Alternaria alternata</i> (Fr.) Keissl. [Pleosporales: Pleosporaceae] Alternaria leaf spot	Yes (Le et al. 2000; PPD 2010a)	Yes. ACT, NSW, NT, Qld, SA, Tas., Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Alternaria passiflorae</i> J.H. Simmonds [Pleosporales: Pleosporaceae] Brown spot	Yes (National Agricultural Extension Center 2021)	Yes. NSW, Qld, Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No



Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
<i>Athelia rolfsii</i> (Curzi) C. C. Tu & Kimbr. Synonym: <i>Sclerotium rolfsii</i> Sacc. [Atheliales: Atheliaceae]	Yes (Le et al. 2012)	Yes. NSW, NT, Qld, SA, Tas., Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Botrytis cinerea</i> Pers [Helotiales: Screotiniaceae] Grey mould	Yes (Danse et al. 2007)	Yes. NSW, Qld, SA, Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Ceratocystis fimbriata</i> (Ellis & Halst.) Sacc. [Microscales: Ceratocystidaceae]	Yes (Tran et al. 2019)	No. <i>Ceratocystis fimbriata</i> has several apparently host specialised strains known as 'types', 'races', or forms (Baker et al. 2003; Harrington 2000; Vogelzang & Scott 1990). <i>Ceratocystis fimbriata</i> isolates reported in Australia are all from <i>Syngonium</i> (APPD 2022).	No. There is only one report from Brazil of <i>C. fimbriata</i> causing fruit rot in passionfruit (Firmino et al. 2013). There are no other reports of <i>C. fimbriata</i> on <i>Passiflora edulis</i> or causing fruit rot in passionfruit in Vietnam. In a laboratory pathogenicity test, a fungal spore isolate of <i>C. fimbriata</i> from passionflower, injected into passionfruit, produced visible degradation of the outer fruit shell after 96 hours	Assessment not required	Assessment not required	Assessment not required	No

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
			at 25°C (Firmino et al. 2016). Due to the visible symptoms and rapid degradation, diseased fruits are unlikely to be harvested, or are likely to be removed during the sorting and packing processes.				
<i>Cladosporium cladosporioides</i> (Fresen.) De Vries [Capnodiales: Cladosporiaceae] Black mould	Yes (Alexandrova et al. 2018)	Yes. ACT, NSW, NT Qld, SA, Tas., Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Cladosporium herbarum</i> (Pers.) Link [Capnodiales: Cladosporiaceae]	Yes (PPD 2010a)	Yes. NSW, Qld, SA, Tas., Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Cladosporium oxysporum</i> Berk. & M.A. Curtis [Capnodiales: Cladosporiaceae]	Yes (Le et al. 2000)	Yes. NSW, NT, Qld, Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Colletotrichum gloeosporioides</i> (Penz.) Penz. & Sacc. Synonym: <i>Glomerella cingulata</i> (Stoneman) Spauld & H Schrenk	Yes (Nguyen et al. 2009)	Yes. NSW, NT, Qld, SA, Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
[Glomerellales: Glomerellaceae] Anthracnose							
<i>Colletotrichum karsti</i> You L. Yang, Zuo Y. Liu, K.D. Hyde & L. Cai.	Yes (Damm et al. 2012)	Yes. NSW, Qld, Vic. (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
[Glomerellales: Glomerellaceae] Anthracnose							
<i>Colletotrichum truncatum</i> (Schwein.) Andrus & WD Moore Synonym: <i>Colletotrichum capsici</i> (Syd.) EJ Butler & Bisby	Yes (PPD 2010a)	Yes. NSW, NT, Qld, WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
[Glomerellales: Glomerellaceae] Anthracnose							
<i>Curvularia lunata</i> (Wakk.) Boedijin	Yes (Le et al. 2000)	Yes. ACT, NSW, NT, Qld, Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
[Pleosporales: Pleosporaceae]							
<i>Fusarium avenaceum</i> (Fr.) Sacc. Synonym: <i>Gibberella</i> <i>avenacea</i> R.J. Cook	Yes (Red Pine International 2019)	Yes. NSW, NT, Qld, Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
[Hypocreales: Nectriaceae]							
<i>Fusarium fujikuroi</i> Nirenberg <i>F. fujikuroi</i> is part of a species complex Synonyms: <i>Gibberella fujikuroi</i> (Sawada) <i>Wollenw.</i>	Yes. As part of the <i>Gibberella fujikuroi</i> species complex on rice (Wulff et al. 2010)	Yes. Qld (Liew et al. 2016)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
[Hypocreales: Nectriaceae]							
<i>Fusarium graminearum</i> Schwabe Synonyms: <i>Gibberella zeae</i> (Schwein.) Petch <i>Gibberella saubinetii</i> (Durieu & Mont.) Sacc.	Yes (Red Pine International 2019)	Yes. NSW, Qld, SA, Tas., Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
[Hypocreales: Nectriaceae]							
<i>Fusarium incarnatum</i> (Desm.) Sacc. Synonyms: <i>Fusarium semitectum</i> Berk. & Ravenel; <i>Fusarium pallidoroseum</i> Cooke	Yes (Le et al. 2000)	Yes. NSW, Qld, SA, Tas., Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
[Hypocreales:							

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
Nectriaceae]							
<i>Fusarium lateritium</i> Nees Synonym: <i>Gibberella baccata</i> (Wallr.) Sacc. [Hypocreales: Nectriaceae]	Yes (Le et al. 2000)	Yes. NSW, Qld, SA, Tas., Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Fusarium oxysporum</i> Schltld. [Hypocreales: Nectriaceae]	Yes (MARD 2016)	Yes. ACT, NSW, NT, Qld, SA, Tas., Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Fusarium proliferatum</i> (Matsush.) Nirenberg [Hypocreales: Nectriaceae]	Yes (Phan et al. 2021)	Yes. NSW, NT, Qld, SA, Tas., Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Fusarium solani</i> (Mart.) Sacc. [Hypocreales: Nectriaceae]	Yes (Thuy et al. 2013).	Yes. ACT, NSW, NT, Qld, SA, Tas., Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Lasiodiplodia theobromae</i> (Pat) Griffon & Maubl. Synonym: <i>Botryosphaeria rhodina</i> (Berk. & M.A. Curtis) Arx	Yes (MARD 2016)	Yes. NSW, NT, Qld, SA, Tas., Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
[Botryosphaerales: Botryosphaeriaceae]							
<i>Penicillium digitatum</i> Sacc. Synonym: <i>Monilia digitata</i> Pers. [Eurotiales: Trichocomaceae]	Yes (Whittle 1992)	Yes. NSW, Qld, SA, Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Penicillium italicum</i> Wehmer [Eurotiales: Trichocomaceae] Blue mould	Yes (Whittle 1992)	Yes. NSW, Qld, SA, Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Rhizoctonia solani</i> J.G. Kühn Synonym: <i>Thanatephorus cucumeris</i> (A.B. Frank) Donk [Cantharellales: Ceratobasidiaceae]	Yes (PPD 2010b)	Yes. ACT, NSW, NT, Qld, SA, Tas., Vic., WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Rhizopus stolonifer</i> (Ehrenb.) Vuill. Synonym: <i>Mucor stolonifer</i> Ehrenb. [Mucorales: Mucoraceae]	Yes (Ngoc et al. 2018)	Yes. NSW, NT, Qld, Tas., Vic., WA (APPD 2022; Yuan et al. 2009)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
<p><i>Sclerotinia sclerotiorum</i> (Lib.) de Bary</p> <p>Synonyms: <i>Hymenoscyphus sclerotiorum</i> (Lib.) W. Phillips; <i>Whetzelinia sclerotiorum</i> (Lib.) Korf &amp; Dumont</p> <p>[Helotiales: Sclerotiniaceae]</p>	Yes (Trinh et al. 2012)	Yes. NSW, Qld, SA, Tas., Vic., WA (Plant Health Australia 2021)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<p><i>Septoria passifloricola</i> Punith.</p> <p>Synonym: <i>Septoria passiflorae</i> Louw</p> <p>[Capnodiales: Mycosphaerellaceae]</p>	Yes (Red Pine International 2019)	Yes. NSW, QLD, WA (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<b>PHYTOPLASMAS</b>							
<p>'<i>Candidatus</i> Phytoplasma asteris' Lee et al. 2004 [16SrI]</p>	Yes (Hoat et al. 2015)	Absent: pest records invalid (EPP0 2022)	Yes. While no records have been found of ' <i>Candidatus</i> Phytoplasma asteris' on passionfruit in Vietnam, passionfruit has been reported as a host for ' <i>Candidatus</i> Phytoplasma asteris' (CABI Invasive Species Compendium 2021).	No. Passionfruit from Vietnam will likely be distributed throughout Australia for retail sale. The end use is human consumption and some infected fruit may be discarded into the environment. Phytoplasmas may be transmitted by	Assessment not required	Assessment not required	No

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
				phloem-feeding leafhoppers, planthoppers and psyllids (Weintraub & Beanland 2006), and by grafting and dodder (El-Banna et al. 2015). Phloem-feeding, leafhoppers, planthoppers and psyllids are unlikely to feed on infected passionfruit waste should it be discarded into the environment. While there is evidence for seed transmission of <i>Candidatus</i> Phytoplasma asteris' in sandalwood (Kirdat et al. 2022), no records have been found for seed transmission of <i>'Candidatus</i> Phytoplasma asteris' in passionfruit.			
<i>'Candidatus</i> Phytoplasma aurantifolia' Zreik et al. 1995 [16SrII]	Yes (Hoat et al. 2015)	No. Previously recorded in Australia as present as <i>'Candidatus</i> Phytoplasma aurantifolia' (Lee, Wylie & Jones 2010; Saqib et al.	Yes. While no records have been found of <i>'Candidatus</i> Phytoplasma aurantifolia' on	No. Passionfruit from Vietnam will likely be distributed throughout Australia for retail sale. The	Assessment not required	Assessment not required	No



Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
		2005a; Streten & Gibb 2006; Tairo, Jones & Valkonen 2006). However, these may be misidentifications of 'Candidatus Phytoplasma australasia' (Bertaccini et al. 2022), although other authors consider 'Candidatus Phytoplasma australasia' should be abolished due to similarities with 'Candidatus Phytoplasma aurantifolia' (Wei & Zhao 2022).	passionfruit in Vietnam, passionfruit has been reported as a host for 'Candidatus Phytoplasma aurantifolia' in Uganda (Arocha et al. 2009).	end use is human consumption and some infected fruit may be discarded into the environment. Phytoplasmas may be transmitted by phloem-feeding leafhoppers, planthoppers and psyllids (Weintraub & Beanland 2006), and by grafting and dodder (El-Banna et al. 2015). (Satta, Paltrinieri & Bertaccini 2019). Phloem-feeding, leafhoppers, planthoppers and psyllids are unlikely to feed on infected passionfruit waste should it be discarded into the environment. While there is evidence for seed transmission of 16SrII group phytoplasmas (Satta 2017), no records have been found for seed transmission of			

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
				' <i>Candidatus</i> Phytoplasma aurantifolia' in passionfruit.			
<b>VIRUSES</b>							
<i>Bean common mosaic virus</i> (BCMV) [Potyviridae: Potyvirus]	Yes (Gadhav et al. 2020a; Ha et al. 2008b)	Yes. NSW, NT, Qld, SA, Tas., Vic., (APPD 2022); WA (Saqib et al. 2005b)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Cotton leaf curl Multan virus</i> (CLCUMV) [Geminiviridae: Begomovirus]	Yes (Tang, He & Zhou 2020)	No records found	Yes. <i>Cotton leaf curl Multan virus</i> is part of a complex that causes cotton leaf curl disease (Briddon 2003; Rahman et al. 2017). While no records have been found of CLCUMV on passionfruit in Vietnam, CLCUMV is associated with passionfruit in Yunnan province, China (Tang, He & Zhou 2020), a region adjoining Vietnam. Infection, with symptoms of leaf curling and dark green, swollen veins (Tang, He & Zhou 2020) is systemic (Geering 2006); in cotton, symptoms may	No. Passionfruit from Vietnam will likely be distributed throughout Australia for retail sale. The end use is human consumption and some infected fruit may be discarded into the environment. CLCUMV is not known to be seedborne, seed transmitted (Rahman et al. 2017; Varma 1963) or mechanically transmitted (Varma 1963).	Assessment not required	Assessment not required	No

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required	
			Potential for importation	Potential for distribution				
			<p>take 3-4 weeks to appear following inoculation (Singh, Sohi &amp; Mann 1997) and may become mild or absent in cooler weather (PHA 2015).</p> <p>As this virus infects plants systemically, there is a possibility of the virus being present in fruit.</p> <p>Fruit harvested from infected plants may not show obvious symptoms, therefore, they may not be removed during harvest and post-harvest processes and potentially be exported.</p>	<p>CLCUMV is transmitted by <i>Bemisia tabaci</i> (Chen et al. 2019; Tang, He &amp; Zhou 2020) in a persistent and circulative manner (Chen et al. 2019). <i>Bemisia tabaci</i> is a leaf-sap feeder that infests leaves, stems (Li et al. 2021) and buds (Alegbejo &amp; Banwo 2005) of host plants. It is unlikely to feed on infected passionfruit waste should it be discarded into the environment.</p>				
<p><i>Cowpea aphid-borne mosaic virus</i> (CABMV) [Potyviridae: Potyvirus]</p>	Yes (Manyangarirwa, Sibiya & Mortensen 2010)	Yes. Qld, WA, NT (APPD 2022; Behncken & Maleevsky 1977; Coutts et al. 2011)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No	
<p><i>Cucumber mosaic virus</i> (CMV) [Bromoviridae: Cucumovirus]</p>	Yes (Kiritani & Su 1999)	Yes. NSW, Qld, SA, Tas., Vic., WA (Büchen-Osmond et al. 1988)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No	

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
<i>East Asian Passiflora virus</i> (EAPV) [Potyviridae: Potyvirus]	Yes (Do et al. 2021)	No records found	Yes. <i>East Asian Passiflora virus</i> is a causal pathogen of passionfruit woodiness disease (Do et al. 2021). In experimental studies, foliar symptoms on passionfruit plants were evident 1 month after inoculation (Do et al. 2021). Affected fruit exhibit size reduction, malformation and woodiness (Do et al. 2021) or may be dappled or faded (Iwai et al. 2006). As this virus infects passionfruit plants systemically (Chong et al. 2018; Iwai et al. 2006), there is a possibility of the virus being present in fruit. Fruit harvested from infected plants may not show obvious symptoms, therefore, infected fruit may not be removed during harvest and post-harvest processes and could potentially be exported.	No. Passionfruit from Vietnam will likely be distributed throughout Australia for retail sale. The end use is human consumption and some infected fruit may be discarded into the environment. EAPV is not seedborne (Iwai et al. 1996) or seed transmitted (Omatsu et al. 2004). It can be mechanically transmitted from passionfruit to a different host plant by abrasive technique inoculation using infected sap (Iwai et al. 2006). Mechanical transmission from fruit for human consumption is unlikely. EAPV has been shown experimentally to be transmitted by	Assessment not required	Assessment not required	No

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
				aphids ( <i>Aphis gossypii</i> , <i>Hyperomyzus lactucae</i> and <i>Myzus persicae</i> ) to healthy passionfruit plants of hybrid cultivar (Iwai et al. 1996; Omatsu et al. 2004). Aphids feed on phloem of leaves, stems (Capinera 2018; Nalam et al. 2021), buds or roots (Mahr 2022) of plants. They are unlikely to feed on infected passionfruit waste should it be discarded into the environment.			
<i>Euphorbia leaf curl virus</i> (EuLCV) [Geminiviridae: Begomovirus]	Yes (Hoa et al. 2014)	No records found	Yes. <i>Euphorbia leaf curl virus</i> is associated with passionfruit in Vietnam (Hoa et al. 2014). Striped concaves have been observed on the surface of immature passionfruit produced from diseased plants; diseased plants may become symptomless in	No. Passionfruit from Vietnam will likely be distributed throughout Australia for retail sale. The end use is human consumption and some infected fruit may be discarded into the environment.	Assessment not required	Assessment not required	No

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required	
			Potential for importation	Potential for distribution				
			<p>warmer weather (Cheng et al. 2014).</p> <p>As this virus infects plants systemically (Wu, Zulfiqar &amp; Huang 2010), there is a possibility of the virus being present in fruit.</p> <p>Fruit harvested from infected plants may not show obvious symptoms, therefore, infected fruit may not be removed during harvest and post-harvest processes and could potentially be exported.</p>	<p>There are no records found of this virus being seedborne or seed-transmitted in passionfruit.</p> <p>EuLCV is transmitted by <i>Bemisia tabaci</i> (Wu, Zulfiqar &amp; Huang 2010) and transmission of begomoviruses occurs in a persistent, circulative manner (Inoue-Nagata, Lima &amp; Gilbertson 2016).</p> <p><i>Bemisia tabaci</i> is a leaf-sap feeder that infests leaves, stems (Li et al. 2021) and buds (Alegbejo &amp; Banwo 2005) of host plants. It is unlikely to feed on infected passionfruit waste should it be discarded into the environment.</p>				
<i>Papaya leaf curl China virus</i> (PaLCuCNV)	Yes (Ha 2007)	No records found	Yes. While no records have been found of PaLCuCNV on passionfruit in Vietnam, PaLCuCNV is associated	No. Passionfruit from Vietnam will likely be distributed throughout Australia for retail sale. The	Assessment not required	Assessment not required	No	

Department of Agriculture, Fisheries and Forestry

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
[Geminiviridae: Begomovirus]			with passionfruit in Jiangxi province, China (Huang et al. 2020a) and the virus has been reported infecting <i>Carica papaya</i> in Guangxi province, China (Wang, Xie & Zhou 2004), a region adjoining Vietnam. An efficient vector of PaLCuCNV in China, the Middle East-Asia Minor 1 species of <i>B. tabaci</i> , is abundant in northern Vietnam (Götz & Winter 2016) where passionfruit are grown (Guo et al. 2015; Hang 2018).  As this virus infects plants systemically (Zhang et al. 2010), there is a possibility of the virus being present in fruit.  Fruit harvested from infected passionfruit plants may not show obvious symptoms (Huang et al. 2020a), therefore, infected fruit may not be removed	end use is human consumption and some infected fruit may be discarded into the environment.  There are no records found of this virus being seedborne or seed-transmitted in passionfruit.  PaLCuCNV is transmitted by <i>Bemisia tabaci</i> (Guo et al. 2015) and transmission of begomoviruses occurs in a persistent, circulative manner (Inoue-Nagata, Lima & Gilbertson 2016). <i>Bemisia tabaci</i> is a leaf-sap feeder that infests leaves, stems (Li et al. 2021) and buds (Alegbejo & Banwo 2005) of host plants. It is unlikely to feed on infected passionfruit waste should it be			

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
			during harvest and post-harvest processes and could potentially be exported.	discarded into the environment.			
<i>Papaya leaf curl Guandong virus</i> (PaLCuGDV) [Geminiviridae: Begomovirus]	Yes. However, uncertainty exists on the virus name as Hoa et al. (2014) refer to the virus in Vietnam as <i>Papaya leaf curl virus</i> with an ambiguous citation to Cheng et al. (2011), which is considered to be the reference to Cheng et al. (2014) indicating the name of the virus as <i>Papaya leaf curl Guandong virus</i> , since renamed to <i>Papaya leaf curl Guandong virus</i> (ICTV 2022).	No records found	Yes. <i>Papaya leaf curl Guandong virus</i> is associated with passionfruit in Vietnam (Hoa et al. 2014). Evidence as to the visible symptoms of PaLCuGDV on the fruit of passionfruit is ambiguous (Cheng et al. 2014). Infected, symptomless passionfruit may be exported.	No. Passionfruit from Vietnam will likely be distributed throughout Australia for retail sale. The end use is human consumption; some infected fruit may be discarded into the environment. There are no records found of this virus being seedborne or seed-transmitted in passionfruit. Yang et al. (2013) reported transmission of PaLCuGDV in <i>Nicotiana tabacum</i> by <i>Bemisia tabaci</i> . Transmission of begomoviruses by <i>B. tabaci</i> occurs in a persistent, circulative manner (Inoue-Nagata, Lima & Gilbertson 2016). <i>Bemisia tabaci</i> is a	Assessment not required	Assessment not required	No



Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
				leaf-sap feeder that infests leaves, stems (Li et al. 2021) and buds (Alegbejo & Banwo 2005) of host plants. It is unlikely to feed on infected passionfruit waste should it be discarded into the environment.			
<i>Passiflora mottle virus</i> (PaMoV) Passionfruit Vietnam virus (PVNV) [Potyviridae: Potyvirus]	Yes (Do et al. 2021)	No records found	Yes. <i>Passiflora mottle virus</i> is the main cause of passionfruit woodiness disease in Vietnam (Do et al. 2021). Infection of <i>Passiflora edulis</i> f. <i>flavicarpa</i> (yellow passionfruit) by <i>Passiflora mottle virus</i> produces small, distorted woody fruits with pale green skin (Do et al. 2021). As this virus infects plants systemically (Do et al. 2021), there is a possibility of the virus being present in fruit. Fruit harvested from infected passionfruit plants may not show obvious symptoms	No. Passionfruit from Vietnam will likely be distributed throughout Australia for retail sale. The end use is human consumption and some infected fruit may be discarded into the environment. PaMoV is not seedborne or seed-transmitted in passionfruit (Chang 1992). PaMoV has been shown experimentally to be transmitted by aphids (Chang 1992). Aphids feed on	Assessment not required	Assessment not required	No

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
			(Chang 1992), therefore, infected fruit may not be removed during harvest and post-harvest processes and potentially be exported.	phloem of leaves, stems (Capinera 2018; Nalam et al. 2021), buds or roots (Mahr 2022) of plants. They are unlikely to feed on infected passionfruit waste should it be discarded into the environment.			
<i>Soybean mosaic virus</i> (SMV) [Potyviridae: Potyvirus]	Yes (Thu et al. 2014)	Yes (APPD 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Telosma mosaic virus</i> (TelMV) [Potyviridae: Potyvirus]	Yes (Do et al. 2021; Gadhave et al. 2020a; Ha et al. 2008a)	No records found	Yes. <i>Telosma mosaic virus</i> is associated with passionfruit in Vietnam (Do et al. 2021). Infection by TelMV presents as mosaic skin on green fruit (Chiemsombat, Prammanee & Pipattanawong 2014); fruit development is adversely affected, with reduced fruit length, thickness and weight (Chen et al. 2018). Viral infection on leaves is evident 21 days after	No. Passionfruit from Vietnam will likely be distributed throughout Australia for retail sale. The end use is human consumption and some infected fruit may be discarded into the environment. There are no records found of this virus being seedborne or seed-transmitted in passionfruit.	Assessment not required	Assessment not required	No

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
			infection (Chiemsombat, Prammanee & Pipattanawong 2014). Infected, symptomless mature passionfruit may be exported.	Potyviruses are transmitted by aphids and transmission occurs in a non-persistent manner (Gadhav et al. 2020b). Aphids feed on phloem of leaves, stems (Capinera 2018; Nalam et al. 2021), buds or roots (Mahr 2022) of plants. They are unlikely to feed on infected passionfruit waste should it be discarded into the environment.			
<i>Tobacco mosaic virus</i> (TMV) [Virgaviridae: Tobamovirus]	Yes (MARD 2010)	Yes. NSW, Qld, SA, Tas., Vic., WA (Büchen-Osmond et al. 1988)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Tomato ringspot virus</i> (ToRSV) [Secoviridae: Nepovirus]	Yes (MARD 2010)	Absent: pest eradicated (IPPC 2013)	Yes. <i>Tomato ringspot virus</i> is associated with <i>Passiflora edulis</i> (Koenig & Fribourg 1986).	No. There is a single, historic report of ToRSV on passionfruit in Peru (Koenig & Fribourg 1986). While ToRSV has been identified on tomato in Vietnam (MARD	Assessment not required	Assessment not required	No

Passionfruit from Vietnam: biosecurity import requirements draft report  
Appendix B: Initiation and categorisation for pests of passionfruit from Vietnam

Pest	Present in Vietnam	Present within Australia	Potential to enter on pathway		Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
			Potential for importation	Potential for distribution			
					2010), no record of ToRSV has been found on passionfruit in Vietnam.		
<i>Turnip mosaic virus</i> (TuMV) [Potyviridae: Potyvirus]	Yes (Gadhav et al. 2020a; Ha et al. 2008a)	Yes. ACT, NSW, Qld, SA, Tas., Vic., WA (Büchen-Osmond et al. 1988)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Zucchini yellow mosaic virus</i> (ZYMV) [Potyviridae: Potyvirus]	Yes (Gadhav et al. 2020a)	Yes. NSW, NT, Qld, WA (Maina et al. 2019)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No

## Glossary, acronyms and abbreviations

Term or abbreviation	Definition
ACT	Australian Capital Territory
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 or regulated articles (FAO 2023).
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 <i>Biosecurity Act 2015</i> 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 2023).
Area of low pest prevalence	An area, whether all of a country, part of a country, or all or parts of several countries, as identified by the competent authorities, in which a specific pest is present at low levels and which is subject to effective surveillance or control (FAO 2023).
Aril	A fleshy and usually brightly coloured and edible covering that surrounds the seed
Arthropod	The largest phylum of animals, including the insects, arachnids and crustaceans.
Australian territory	Australian territory as referenced in the <i>Biosecurity Act 2015</i> refers to Australia, Christmas Island and Cocos (Keeling) Islands and any external Territory to which that provision extends.
BA	Biosecurity Advice
BICON	Australia's Biosecurity Import Conditions system <a href="http://bicon.agriculture.gov.au/BiconWeb4.0">bicon.agriculture.gov.au/BiconWeb4.0</a>
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 import risk analysis (BIRA)	The <i>Biosecurity Act 2015</i> 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 measures	The <i>Biosecurity Act 2015</i> 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 risk	The <i>Biosecurity Act 2015</i> 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.
Consignment	A quantity of plants, plant products or other articles being moved from one country to another and covered, when required, by a single phytosanitary certificate (a consignment may be composed of one or more commodities or lots) (FAO 2023).
Control (of a pest)	Suppression, containment or eradication of a pest population (FAO 2023).

<b>Term or abbreviation</b>	<b>Definition</b>
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 2023).
Endemic	Belonging to, native to, or prevalent in a particular geography, area or environment.
Endocarp	The inside layer of the fruit, which directly surrounds the seeds
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 2023).
EP	Existing policy. This denotes that a pest species has previously been assessed in another policy published by the department.
Epicarp	The outermost layer of the fruit
Establishment (of a pest)	Perpetuation, for the foreseeable future, of a pest within an area after entry (FAO 2023).
FAO	Food and Agriculture Organization of the United Nations
Fresh	Living; not dried, deep-frozen or otherwise conserved (FAO 2023).
FSANZ	Food Standards Australia New Zealand ( <a href="http://foodstandards.gov.au/Pages/default.aspx">foodstandards.gov.au/Pages/default.aspx</a> ) and the Australia New Zealand Food Standards Code ( <a href="http://foodstandards.gov.au/code/Pages/default.aspx">foodstandards.gov.au/code/Pages/default.aspx</a> )
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 <i>Biosecurity Act 2015</i> 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).
GP	Group policy. This refers to the <i>Final group pest risk analysis for thrips and orthospoviruses on fresh fruit, vegetable, cut-flower and foliage imports</i> (thrips Group PRA) (DAWR 2017a), the <i>Final group pest risk analysis for mealybugs and the viruses they transmit on fresh fruit, vegetable, cut-flower and foliage imports</i> (mealybugs Group PRA) (DAWR 2019a) and the <i>Final group pest risk analysis for soft and hard scale insects on fresh fruit, vegetable, cut-flower and foliage imports</i> (scales Group PRA) (DAWE 2021).
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 2023).
Import permit	Official document authorising importation of a commodity in accordance with specified phytosanitary import requirements (FAO 2023).
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 2023).
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 2023).
Intended use	Declared purpose for which plants, plant products or other articles are imported, produced or used (FAO 2023).

<b>Term or abbreviation</b>	<b>Definition</b>
Interception (of a pest)	The detection of a pest during inspection or testing of an imported consignment (FAO 2023).
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 2023).
Introduction (of a pest)	The entry of a pest resulting in its establishment (FAO 2023).
Larva	A juvenile form of animal with indirect development, undergoing metamorphosis (for example, insects or amphibians).
Lot	A number of units of a single commodity, identifiable by its homogeneity of composition, origin et cetera, forming part of a consignment (FAO 2023). 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 one time.
MARD	Ministry of Agriculture and Rural Development
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.
Mesocarp	The fleshy layer of a fruit between the epicarp and endocarp
National Plant Protection Organization (NPPO)	Official service established by a government to discharge the functions specified by the IPPC (FAO 2023).
NSW	The state of New South Wales in Australia.
NT	The Northern Territory of Australia.
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 2023).
Pathogen	A biological agent that can cause disease to its host.
Pathway	Any means that allows the entry or spread of a pest (FAO 2023).
PPD	Plant Protection Department
Peduncle	A flower stalk bearing either a cluster or a solitary flower, which develops into fruit
Pest	Any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products (FAO 2023).
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 2023).
Pest free area (PFA)	An area in which a specific pest is absent as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained (FAO 2023).

<b>Term or abbreviation</b>	<b>Definition</b>
Pest free place of production (PFPP)	Place of production 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 2023).
Pest free production site (PFPS)	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 2023).
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 2023).
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 2023).
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 2023).
Pest risk management (for quarantine pests)	Evaluation and selection of options to reduce the risk of introduction and spread of a pest (FAO 2023).
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 2023).
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 2023).
Phytosanitary certificate	An official paper document or its official electronic equivalent, consistent with the model certificates of the IPPC, attesting that a consignment meets phytosanitary import requirements (FAO 2023).
Phytosanitary certification	Use of phytosanitary procedures leading to the issue of a phytosanitary certificate (FAO 2023).
Phytosanitary measure	Phytosanitary relates to the health of plants. Any legislation, regulation or official procedure having the purpose to prevent the introduction or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests (FAO 2023). 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 2023).
Phytosanitary regulation	Official rule to prevent the introduction or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests, including establishment of procedures for phytosanitary certification (FAO 2023).
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 2023).
Production site	In this report, a production site is a continuous planting of passionfruit plants treated as a single unit for pest management purposes. If a property is subdivided into one or more units for pest management purposes, then each unit is a production site.
Qld	The state of Queensland in Australia.
Quarantine	Official confinement of regulated articles, pests or beneficial organisms for inspection, testing, treatment, observation or research (FAO 2023).



<b>Term or abbreviation</b>	<b>Definition</b>
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 2023).
Regulated article (RA)	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 2023).
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 2023).
Regulated pest	A quarantine pest or a regulated non-quarantine pest (FAO 2023).
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	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.
SA	The state of South Australia.
Spread (of a pest)	Expansion of the geographical distribution of a pest within an area (FAO 2023).
SPS Agreement	WTO Agreement on the Application of Sanitary and Phytosanitary Measures.
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 presence or absence by survey, monitoring or other procedures (FAO 2023).
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.
Tas.	The state of Tasmania in Australia.
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 (as a phytosanitary measure)	Official procedure for killing, inactivating, removing, rendering infertile or devitalising regulated pests (FAO 2023).
Unrestricted risk	Unrestricted risk estimates apply in the absence of risk management measures.
Vector	In this report, a vector is an organism that is capable of harbouring and spreading a pest from one host to another.
Viable	Alive, able to germinate or capable of growth and/or development.
Vic.	The state of Victoria in Australia.
WA	The state of Western Australia.
WTO	World Trade Organization

## References

All web links in references were accessible and active on week of 26 June 2023.

ABRS 2022, 'Australian Faunal Directory', Australian Biological Resources Study (ABRS), Canberra, Australia, available at <https://biodiversity.org.au/afd/home>, accessed 2022.

Agoukéké, D, Agricola, U & Bokonon-Ganta, HA 1988, '*Rastrococcus invadens* Williams (Hemiptera: Pseudococcidae), a serious exotic pest of fruit trees and other plants in West Africa', *Bulletin of Entomological Research*, vol. 78, pp. 695-702.

Agriculture Victoria 2022, *Exotic Liriomyza leafminers*, Melbourne, Victoria.

Ahmad, MA & Vasudha, A 2019, 'Recorded host plants of *Zeugodacus (Zeugodacus) tau* (Walker) (Tephritidae: Dacinae: Dacini)', *Shodh Samagam*, vol. 2, no. 4, pp. 302-13. (193kb)

Ahn, JJ, Choi, KS & Huang, YB 2022, 'Thermal effects on the development of *Zeugodacus cucurbitae* (Coquillett) (Diptera: Tephritidae) and model validation', *Phytoparasitica*, vol. 50, no. 3, DOI 10.1007/s12600-022-00985-5.

Akamine, EK, Aragaki, M, Beaumont, JH, Hamilton, RA, Nishida, T, Sherman, GD, Shoji, K, Storey, WB, Martinez, AP, Yee, WYJ, Onsdorff, T & Shaw, TN 1974, *Passion fruit culture in Hawaii*, AEC-345, University of Hawaii.

ALA 2022, 'Atlas of Living Australia (ALA)', Commonwealth Scientific and Industrial Research Organisation (CSIRO), Canberra, Australia, available at <https://www.ala.org.au/>, accessed 2022.

-- -- 2023, 'Atlas of Living Australia (ALA)', Commonwealth Scientific and Industrial Research Organisation (CSIRO), Canberra, Australia, available at <https://www.ala.org.au/>, accessed 2023.

Alba-Alejandre, I, Alba-Tercedor, J & Vega, FE 2018, 'Micro-CT to document the coffee bean weevil, *Araecerus fasciculatus* (Coleoptera: Anthribidae), inside field-collected coffee berries (*Coffea canephora*)', *Insects*, vol. 9, 100, <https://doi.org/10.3390/insects9030100>.

Alegbejo, MD & Banwo, OO 2005, 'Host plants of *Bemisia tabaci* Genn. in northern Nigeria', *Journal of Plant Protection Research*, vol. 45, no. 2, pp. 93-8.

Alexandrova, AV, Aldobaeva, II, Kalashnikova, KA & Kuznetsov, AN 2018, 'Influence of environmental factors on the structure of soil microfungi of Vietnamese tropical forests', *Contemporary Problems of Ecology*, vol. 11, no. 5, pp. 472-83.

Allwood, AJ, Chinajariyawong, A, Drew, RAI, Hamacek, EL, Hancock, DL, Hengsawad, C, Jipanin, JC, Jirasurat, M, Kong Krong, C, Kritsaneepaiboon, S, Leong, CTS & Vijaysegaran, S 1999, 'Host plant records for fruit flies (Diptera: Tephritidae) in Southeast Asia', *Raffles Bulletin of Zoology*, vol. Supplement No 7, pp. 1-92.

Allwood, AJ & Drew, RAI, (eds) 1997, *Management of fruit flies in the Pacific: a regional symposium, Nadi, Fiji 28-31 October, 1996*, Australian Centre for International Agricultural Research (ACIAR), Canberra.

Andersen, A, Tran, TTA & Nordhus, E 2008, 'Distribution and importance of polyphagous *Liriomyza* species (Diptera, Agromyzidae) in vegetables in Vietnam', *Norwegian Journal of Entomology*, vol. 55, no. 2, pp. 149-64.

APPD 2022, 'Australian Plant Pest Database, online database', available at <https://www.appd.net.au/>, accessed 2022.

-- -- 2023, 'Australian Plant Pest Database, online database', Plant Health Australia, available at <https://www.appd.net.au/>, accessed 2023.

Arocha, Y, Echodu, R, Talengera, D, Muhangi, J, Rockefeller, E, Asher, O, Nakacwa, R, Serugga, R, Gumisiriza, G, Tripathi, J, Kabuye, D, Otipa, M, Vutseme, K, Lukanda, M & Boa, E 2009,

- 'Occurrence of '*Candidatus* Phytoplasma aurantifolia' (16SrII group) in cassava and four other species in Uganda', *Plant Pathology*, vol. 58, p. 390.
- Aye, TT & Thaug, M 2002, 'Study on the occurrence of fruit flies in Yezin area', *Journal of Agricultural, Forestry, Livestock and Fishery Sciences*, vol. (August), pp. 36-43.
- Bailey, M, Sarkhosh, A, Rezazadeh, A, Anderson, J, Chambers, A & Crane, J 2021, *The passion fruit in Florida*, HS1406, University of Florida, IFAS Extension, available at <https://doi.org/10.32473/edis-hs1406-2021>.
- Baker, CJ, Harrington, TC, Krauss, U & Alfenas, AC 2003, 'Genetic variability and host specialization in the Latin American Clade of *Ceratocystis fimbriata*', *Phytopathology*, vol. 93, no. 10, pp. 1274-84.
- Bao Long Foods 2023, 'Fresh export passion fruit', Gia Lai Province, Vietnam, available at <https://baolongfoods.com/san-pham/fresh-export-passion-fruit/?lang=en>.
- Behncken, GM & Maleevsky, L 1977, 'Detection of Cowpea aphid-borne mosaic virus in Queensland', *Australian Journal of Experimental Agriculture and Animal Husbandry*, vol. 17, pp. 674-8.
- Bermudez, RL 2014, 'Evaluación de la capacidad de depredación de la especie de *Stratiolaelaps* sp. (Acari: Laelapidae) en poblaciones de *Thrips palmi* karny (Thysanoptera: Thripidae)', Masters in Agricultural Sciences Thesis, University of National Colombia.
- Bertaccini, A, Arocha-Rosete, Y, Contaldo, N, Duduk, B, Fiore, N, Montano, HG, Kube, M, Kuo, CH, Martini, M, Oshima, K, Quaglino, F, Schneider, B, Wei, W & Zamorano, A 2022, 'Revision of the '*Candidatus* Phytoplasma' species description guidelines', *International Journal of Systematic and Evolutionary Microbiology*, vol. 72, no. 4, pp. 1-16.
- Bess, HA & Haramoto, FH 1961, *Contributions to the biology and ecology of the oriental fruit fly, Dacus dorsalis Hendel (Diptera: Tephritidae)*, in Hawaii, Technical Bulletin No. 44, Hawaii Agricultural Experiment Station, University of Hawaii, Hawaii.
- Biosecurity Australia 2006, *Policy for the importation of fresh mangoes (Mangifera indica L.) from Taiwan*, Biosecurity Australia, Department of Agriculture, Fisheries and Forestry, Canberra, available at <https://www.agriculture.gov.au/biosecurity-trade/policy/risk-analysis/plant/mangoes-taiwan>.
- -- 2008, *Final import risk analysis report for fresh mango fruit from India*, Biosecurity Australia, Department of Agriculture, Fisheries and Forestry, Canberra, available at <https://www.agriculture.gov.au/biosecurity-trade/policy/risk-analysis/plant/mangoes-from-india>.
- -- 2010a, *Final import risk analysis report for fresh apple fruit from the People's Republic of China*, Biosecurity Australia, Department of Agriculture, Fisheries and Forestry, Canberra, available at <https://www.agriculture.gov.au/biosecurity-trade/policy/risk-analysis/plant/apples-china>.
- -- 2010b, *Final import risk analysis report for fresh stone fruit from California, Idaho, Oregon and Washington*, Biosecurity Australia, Department of Agriculture, Fisheries and Forestry, Canberra, available at <https://www.agriculture.gov.au/biosecurity-trade/policy/risk-analysis/plant/stonefruit-usa> (pdf 1.4 mb).
- -- 2011, *Revised conditions for importing fresh mango fruit from India, final report*, Department of Agriculture, Fisheries and Forestry, Canberra, available at <https://www.agriculture.gov.au/biosecurity-trade/policy/risk-analysis/plant/mangoes-from-india>.
- Bolland, HR, Gutierrez, J & Flechtmann, CHW 1998, *World catalogue of the spider mite family (Acari: Tetranychidae)*, Brill, Boston.

- Botha, J, Bennington, J & Poole, M 2014, *Spider mite pests of Western Australian plants*, Government of Western Australia, Perth, Western Australia.
- Brake, VM, Crowe, B & Russell, S 2003, 'Fresh produce imports: a quarantine perspective', *Australian Postharvest Horticulture Conference, Brisbane, Queensland, Australia, 1-3 October 2003*, Australian Quarantine and Inspection Service, Canberra, pp. 1-2.
- Briddon, RW 2003, 'Cotton leaf curl disease, a multicomponent begomovirus complex', *Molecular Plant Pathology*, vol. 4, no. 6, pp. 427-34.
- Brumley, C 2020, 'A checklist and host catalogue of the aphids (Hemiptera: Aphididae) held in the Australian National Insect Collection', *Zootaxa*, vol. 4728, no. 4, pp. 575-600.
- Büchen-Osmond, C, Crabtree, K, Gibbs, AJ & McLean, G, (eds) 1988, *Viruses of plants in Australia: descriptions and lists from the VIDE database*, The Australian National University Research School of Biological Sciences, Canberra.
- Burgess, LW & Burgess, JS 2009, 'Capacity building in plant pathology: soilborne diseases in Vietnam, 1993-2009', *Australasian Plant Pathology*, vol. 38, pp. 325-33.
- Burgess, LW, Knight, TE, Tesoriero, L & Phan, HT 2008, *ACIAR Monograph No. 129: diagnostic manual for plant diseases in Vietnam*, Australian Centre for International Agricultural Research (ACIAR), Canberra, Australia.
- Burgess, R, Ridland, P & Pirtle, E 2020, *Liriomyza sativae contingency plan*, MT16004, Horticulture Innovation, Australia.
- CABI 2022, 'Crop Protection Compendium', CAB International, Wallingford, UK, available at <http://www.cabi.org/cpc/>, accessed 2022.
- -- 2023, 'CABI Compendium: Invasive Species', CAB International, Wallingford, UK, available at <https://www.cabidigitallibrary.org/product/qi>, accessed 2023.
- CABI Invasive Species Compendium 2021, '*Candidatus Phytoplasma asteris* (yellow disease phytoplasmas)', available at <https://www.cabi.org/isc/datasheet/7642>.
- Cantrell, BK, Chadwick, B & Cahill, A 2002, *Fruit fly fighters: eradication of the papaya fruit fly*, CSIRO Publishing, Collingwood.
- Capinera, JL 2018, *Melon aphid or cotton aphid, Aphis gossypii Glover (Insecta: Hemiptera: Aphididae)*, EENY-173, Institute of Food and Agricultural Sciences Extension, University of Florida, Gainesville, Florida, USA, available at <http://edis.ifas.ufl.edu/in330>.
- Carlos, E & Bartra, P 1974, 'Biología de *Selenaspidus articulatus* Morgan y sus principales controladores biológicos' (Biology of *Selenaspidus articulatus* Morgan and main forms of biological control), *Revista Peruana de Entomología*, vol. 17, no. 1, pp. 60-8.
- Chang, CA 1992, 'Characterization and comparison of passionfruit mottle virus, a newly recognized potyvirus, with passionfruit woodiness virus', *Phytopathology*, vol. 82, pp. 1358-63.
- Chang, CA, Huang, LC, Chen, YC, Lin, YY, Lu, HC & Lin, YD 2017, 'A review of the research and control of passionfruit virus diseases in Taiwan', *Journal of Plant Medicine*, vol. 59, no. 3, DOI 10.6716/JPM.201709\_59(3).0001.
- Chen, S, Yu, N, Yang, S, Zhong, B & Lan, H 2018, 'Identification of *Telosma* mosaic virus infection in *Passiflora edulis* and its impact on phytochemical contents', *Virology Journal*, vol. 15, 168, <https://doi.org/10.1186/s12985-018-1084-6>.
- Chen, T, Saeed, Q, He, Z & Lu, L 2019, 'Transmission efficiency of *Cotton leaf curl Multan virus* by three cryptic species of *Bemisia tabaci* complex in cotton cultivars', *PeerJ*, vol. 7, e7788, DOI 10.7717/peerj.7788.

## References

- Cheng, YH, Deng, TC, Chen, CC, Chiang, CH & Chang, CA 2014, 'First report of *Euphorbia leaf curl virus* and *Papaya leaf curl Guangdong virus* on passion fruit in Taiwan', *Plant Disease*, vol. 98, no. 12, p. 1746.
- Cheng, YH, Deng, TC, Chen, CC, Liao, JY, Chang, CA & Chiang, CH 2011, 'First report of *Pepper mottle virus* in bell pepper in Taiwan', *Plant Disease*, vol. 95, no. 5, p. 617.
- Chiemsombat, P, Prammanee, S & Pipattanawong, N 2014, 'Occurrence of *Telosma mosaic virus* causing passion fruit severe mosaic disease in Thailand and immunostrip test for rapid virus detection', *Crop Protection*, vol. 63, pp. 41-7.
- Childers, CC & Fasulo, TR 1995, *Citrus red mite*, ENY 817, Department of Entomology and Nematology, UF/IFAS Extension, Florida, USA.
- Chong, Y, Cheng, Y, Cheng, H, Huang, Y & Yeh, S 2018, 'The virus causing passionfruit woodiness disease in Taiwan is reclassified as *East Asian passiflora virus*', *Journal of General Plant Pathology*, vol. 84, pp. 208-20.
- Christenson, LD & Foote, RH 1960, 'Biology of fruit flies', *Annual Review of Entomology*, vol. 5, pp. 171-92.
- Coutts, BA, Kehoe, MA, Webster, CG, Wylie, SJ & Jones, RAC 2011, 'Indigenous and introduced potyviruses of legumes and *Passiflora* spp. from Australia: biological properties and comparison of coat protein nucleotide sequences', *Archives of Virology*, vol. 156, no. 10, pp. 1757-74.
- Crause, C 1990, 'The white peach scale, *Pseudaulacaspis pentagona* (Targioni-Tozzetti) (Homoptera: Diaspididae), a pest of economic importance on granadilla', *Acta Horticulturae*, vol. 275, pp. 655-62.
- Crooker, A 1985, 'Embryonic and juvenile development', in *Spider mites: their biology, natural enemies and control*, vol. 1A, Helle, W & Sabelis, MW (eds), Elsevier Science Publishers B.V., Amsterdam.
- DAFF 2012, *Final report for the non-regulated analysis of existing policy for fresh mangosteen fruit from Indonesia*, Department of Agriculture, Fisheries and Forestry, Canberra, available at <https://www.agriculture.gov.au/biosecurity-trade/policy/risk-analysis/plant/mangosteens-indonesia>.
- -- 2013, *Final report for the non-regulated analysis of existing policy for fresh lychee fruit from Taiwan and Vietnam*, Department of Agriculture, Fisheries and Forestry, Canberra, available at <https://www.agriculture.gov.au/biosecurity-trade/policy/risk-analysis/memos/2013/ba2013-07-final-lychees-taiwan-vietnam>.
- -- 2022, *Final report for the review of biosecurity import requirements for fresh apple fruit from the Pacific Northwest states of the United States of America*, Department of Agriculture, Fisheries and Forestry, Canberra.
- Damm, U, Cannon, PF, Woudenberg, JHC, Johnston, PR, Weir, BS, Tan, YP, Shivas, RG & Crous, PW 2012, 'The *Colletotrichum boninense* species complex', *Studies in Mycology*, vol. 73, no. 1, pp. 1-36.
- Danjuma, S, Thaochan, N, Permkam, S & Satasook, C 2014, 'Effect of temperature on the development and survival of immature stages of the carambola fruit fly, *Bactrocera carambolae*, and the Asian papaya fruit fly, *Bactrocera papayae*, reared on guava diet', *Journal of Insect Science*, vol. 14, no. 126, DOI 10.1093/jis/14.1.126.
- Danse, MG, García, N, Peeters, F, Huong, TM & Luyen, CH 2007, *Report on fieldwork for 'sustainable flowers in Vietnam', part two, Dalat 26 February- 3 March 2007*, Project code 4043400, The Netherlands, available at <https://edepot.wur.nl/18598>.



## References

Dao, TH, Nguyen, VL, Phạm, VL, Wyckhuys, KAG, Nguyễn, TT, Trần, TTH, Phạm, DT & Nguyễn, ĐV 2020, 'First record of fall armyworm *Spodoptera frugiperda* (J.E. Smith), (Lepidoptera: Noctuidae) on maize in Vietnam', *Zootaxa*, vol. 4772, no. 2, pp. 396-400.

DAWE 2020, *Final report for the review of biosecurity import requirements for fresh strawberry fruit from Japan*, Department of Agriculture, Water and the Environment, Canberra, ACT, available at <https://www.agriculture.gov.au/biosecurity-trade/policy/risk-analysis/plant/strawberries-from-japan>.

-- -- 2021, *Final group pest risk analysis for soft and hard scale insects on fresh fruit, vegetable, cut-flower and foliage imports*, Department of Agriculture, Water and the Environment, Canberra, available at <https://www.agriculture.gov.au/biosecurity-trade/policy/risk-analysis/group-pest-risk-analyses/scales>.

DAWR 2015, *Final report for the non-regulated analysis of existing policy for fresh mango fruit from Indonesia, Thailand and Vietnam*, Australian Government Department of Agriculture and Water Resources, Canberra, available at <https://www.agriculture.gov.au/biosecurity-trade/policy/risk-analysis/plant/mango-indonesia-thailand-vietnam> (pdf 3.6 mb).

-- -- 2017a, *Final group pest risk analysis for thrips and orthotospoviruses on fresh fruit, vegetable, cut-flower and foliage imports*, Department of Agriculture and Water Resources, Canberra, available at <https://www.agriculture.gov.au/biosecurity-trade/policy/risk-analysis/group-pest-risk-analyses/group-pra-thrips-orthotospoviruses/final-report>.

-- -- 2017b, *Final report for the non-regulated analysis of existing policy for fresh strawberry fruit from the Republic of Korea*, Department of Agriculture and Water Resources, Canberra, available at <https://www.agriculture.gov.au/biosecurity-trade/policy/risk-analysis/plant/strawberries-from-korea/final-report>.

-- -- 2017c, *Final report for the review of biosecurity import requirements for fresh dragon fruit from Vietnam*, Department of Agriculture and Water Resources, Canberra, Australia, available at <https://www.agriculture.gov.au/biosecurity-trade/policy/risk-analysis/plant/dragon-fruit-from-vietnam/final-report>.

-- -- 2018, *Final report for the review of biosecurity import requirements for fresh dragon fruit from Indonesia*, Department of Agriculture and Water Resources, Canberra, Australia, available at <https://www.agriculture.gov.au/biosecurity-trade/policy/risk-analysis/plant/dragon-fruit-indonesia>.

-- -- 2019a, *Final group pest risk analysis for mealybugs and the viruses they transmit on fresh fruit, vegetable, cut-flower and foliage imports*, Department of Agriculture and Water Resources, Canberra, available at <https://www.agriculture.gov.au/biosecurity-trade/policy/risk-analysis/group-pest-risk-analyses/mealybugs/final-report>.

-- -- 2019b, *Final report for the review of biosecurity import requirements for fresh longan fruit from Vietnam*, Australian Government Department of Agriculture and Water Resources, Canberra, Australia, available at <https://www.agriculture.gov.au/biosecurity-trade/policy/risk-analysis/plant/longans-from-vietnam>.

De Meyer, M, Delatte, H, Mwatawala, M, Quilici, S, Vayssieres, JF & Virgilio, M 2015, 'A review of the current knowledge on *Zeugodacus cucurbitae* (Coquillett) (Diptera, Tephritidae) in Africa, with a list of species included in *Zeugodacus*', *ZooKeys*, vol. 540, pp. 539-57.

Department of Agriculture 2019, *Final report for the review of biosecurity import requirements for fresh avocados from Chile*, Department of Agriculture, Canberra, available at <https://www.agriculture.gov.au/biosecurity-trade/policy/risk-analysis/plant/avocado-from-chile>.

-- -- 2020, *Final report for the review of biosecurity import requirements for fresh Chinese jujube fruit from China*, Department of Agriculture, Canberra, available at

<https://www.agriculture.gov.au/biosecurity-trade/policy/risk-analysis/plant/jujubes-from-china>.

Dhillon, MK, Singh, R, Naresh, JS & Sharma, HC 2005, 'The melon fruit fly, *Bactrocera cucurbitae*: a review of its biology and management', *Journal of Insect Science*, vol. 5, no. 1, 40, <https://doi.org/10.1093/jis/5.1.40>.

Dien, LQ, Huy, DTN & Dung, TN 2021, 'Differences and similarities of *Bactrocera carambolae* and *Bactrocera tau* in the Mekong Delta of Vietnam based on polymorphism of Mtdna', *Natural Volatiles and Essential Oils*, vol. 8, no. 5, pp. 3610-21.

Dietz, HF & Zetek, J 1920, *The black fly of citrus and other subtropical plants*, United States Department of Agriculture, Washington, D.C.

Dirou, JF 2004, 'Passionfruit growing: what you need to know', *Agnote*, vol. 1, no. 82, 3rd edition, pp. 1-2.

Do, DH, Chong, YH, Ha, VC, Cheng, HW, Chen, YK, Bui, TNL, Nguyen, TBN & Yeh, SD 2021, 'Characterization and detection of Passiflora mottle virus and two other potyviruses causing passionfruit woodiness disease in Vietnam', *Phytopathology*, vol. 111, no. 9, pp. 1675-85.

Doepel, RF 1965, 'Grease spot of passion fruit', *Journal of the Department of Agriculture, Western Australia, Series 4*, vol. 6, no. 5, p. 291.

Dohino, T, Hallman, GJ, Grout, TG, Clarke, AR, Follett, PA, Cugala, DR, Minh Tu, D, Murdita, W, Hernandez, E, Pereira, R & Myers, SW 2017, 'Phytosanitary treatments against *Bactrocera dorsalis* (Diptera: Tephritidae): Current situation and future prospects', *Commodity Treatment and Quarantine Entomology*, vol. 110, no. 1, pp. 67-79.

Doorenweerd, C, Leblanc, L, Norrbom, AL, San Jose, M & Rubinoff, D 2018, 'A global checklist of the 932 fruit fly species in the tribe Dacini (Diptera, Tephritidae)', *ZooKeys*, vol. 730, pp. 17-54.

Drew, RAI & Hancock, DL 1994, 'The *Bactrocera dorsalis* complex of fruit flies (Diptera: Tephritidae: Dacinae) in Asia', *Bulletin of Entomological Research*, vol. Suppl. 2, pp. 1-68.

Drew, RAI & Romig, MC 2013, *Tropical fruit flies (Tephritidae: Dacinae) of South-East Asia: Indomalaya to North-West Australasia*, CAB International, Wallingford, UK.

Duyck, PF, Sterlin, JF & Quilici, S 2004, 'Survival and development of different life stages of *Bactrocera zonata* (Diptera: Tephritidae) reared at five constant temperatures compared to other fruit fly species', *Bulletin of Entomological Research*, vol. 94, pp. 89-93.

El-Banna, OM, Toima, NI, Youssef, SA & Shalaby, AA 2015, 'Molecular and electron microscope evidence for an association of phytoplasma with citrus witches broom disease', *International Journal of Scientific and Engineering Research*, vol. 6, no. 6, pp. 127-34.

Enkerlin, DS 1976, 'Some aspects of the citrus blackfly (*Aleurocanthus woglumi* Ashby) in Mexico', *Proceedings of the Tall Timbers Conference on Ecological Animal Control by Habitat Management, Florida, 1976*, Tall Timbers Research Station, University of Florida, Tallahassee, pp. 65-76.

EPPO 1994, *EPPO distribution list for *Toxoptera citricidus**, EPPO Global Database, 1994/159, EPPO Reporting Service.

-- -- 2022, 'EPPO Global Database', European and Mediterranean Plant Protection Organization (EPPO), available at <https://gd.eppo.int/>, accessed 2022.

FAO 2016a, *International Standards for Phytosanitary Measures (ISPM) no. 10: Requirements for the establishment of pest free places of production and pest free production sites*, Secretariat of the International Plant Protection Convention, Food and Agriculture Organization of the United Nations, Rome, Italy, available at <https://www.ippc.int/en/core-activities/standards-setting/ispms/>.

## References

- -- 2016b, *International Standards for Phytosanitary Measures (ISPM) no. 31: Methodologies for sampling of consignments*, Secretariat of the International Plant Protection Convention, Food and Agriculture Organization of the United Nations, Rome, Italy, available at <https://www.ippc.int/en/core-activities/standards-setting/ispms/>.
- -- 2017, *International Standards for Phytosanitary Measures (ISPM) no. 4: Requirements for the establishment of pest free areas*, Secretariat of the International Plant Protection Convention, Food and Agriculture Organization of the United Nations, Rome, Italy, available at <https://www.ippc.int/en/core-activities/standards-setting/ispms/>.
- -- 2018, *International Standards for Phytosanitary Measures (ISPM) no. 26: Establishment of pest free areas for fruit flies (Tephritidae)*, Secretariat of the International Plant Protection Convention, Food and Agriculture Organization of the United Nations, Rome, Italy, available at <https://www.ippc.int/en/core-activities/standards-setting/ispms/>.
- -- 2019a, *International Standard for Phytosanitary Measures (ISPM) no. 18: Guidelines for the use of irradiation as a phytosanitary measure*, Secretariat of the International Plant Protection Convention, Food and Agriculture Organization of the United Nations, Rome, Italy, available at <https://www.ippc.int/en/core-activities/standards-setting/ispms/>.
- -- 2019b, *International Standards for Phytosanitary Measures (ISPM) no. 2: Framework for pest risk analysis*, Secretariat of the International Plant Protection Convention, Food and Agriculture Organization of the United Nations, Rome, Italy, available at <https://www.ippc.int/en/core-activities/standards-setting/ispms/>.
- -- 2019c, *International Standards for Phytosanitary Measures (ISPM) no. 11: Pest risk analysis for quarantine pests*, Secretariat of the International Plant Protection Convention, Food and Agriculture Organization (FAO) of the United Nations, Rome, Italy, available at <https://www.ippc.int/en/core-activities/standards-setting/ispms/>.
- -- 2019d, *International Standards for Phytosanitary Measures (ISPM) no. 23: Guidelines for inspection*, Secretariat of the International Plant Protection Convention, Food and Agriculture Organization of the United Nations, Rome, Italy, available at <https://www.ippc.int/en/core-activities/standards-setting/ispms/>.
- -- 2021, *International Standards for Phytosanitary Measures (ISPM) no. 28 Annex 07 (2009): Irradiation treatment for fruit flies of the family Tephritidae (generic)*, Secretariat of the International Plant Protection Convention, Food and Agriculture Organization of the United Nations, Rome, Italy, available at <https://www.ippc.int/en/core-activities/standards-setting/ispms/>.
- -- 2023, *International Standards for Phytosanitary Measures (ISPM) no. 5: Glossary of phytosanitary terms*, Secretariat of the International Plant Protection Convention, Food and Agriculture Organization of the United Nations, Rome, Italy, available at <https://www.ippc.int/en/core-activities/standards-setting/ispms/>.
- Fiallo-Olivé, E, Pan, LL, Liu, SS & Navas-Castillo, J 2020, 'Transmission of begomoviruses and other whitefly-borne viruses: dependence on the vector species', *Phytopathology*, vol. 110, pp. 10-7.
- Firmino, AC, Fischer, IH, Antonio, GL, De Novaes, QS, Júnior, HJT & Furtado, EL 2016, 'Characterization of *Ceratocystis fimbriata* from passion fruits', *Arquivos do Instituto Biológico*, vol. 83, e0982014, DOI 10.1590/1808-1657000982014.
- Firmino, AC, Novaes, QS, Tozze, HJ, Jr, Sobrinho, GGR, Santos, A, Bezerra, JL & Furtado, EL 2013, 'First report of *Ceratocystis fimbriata* causing fruit-rot of *Passiflora edulis* in Brazil', *New Disease Reports*, vol. 27, no. 4, <http://dx.doi.org/10.5197/j.2044-0588.2013.027.004>.



## References

- Flechtmann, CHW & Knihinicki, DK 2002, 'New species and new record of *Tetranychus* Dufour from Australia, with a key to the major groups in this genus based on females (Acari: Prostigmata: Tetranychidae)', *Australian Journal of Entomology*, vol. 41, pp. 118-27.
- Fletcher, BS 1989, 'Movements of tephritid fruit flies', in *Fruit flies, their biology, natural enemies and control. Vol. 3B*, Robinson, AS & Hooper, G (eds), Elsevier Science Publishers B.V., Amsterdam.
- Follett, PA, Haynes, FEM & Dominiak, BC 2021, 'Host suitability index for polyphagous tephritid fruit flies', *Journal of Economic Entomology*, vol. 114, no. 3, pp. 1021-34.
- Fonte, A, Garcerá, C, Tena, A & Chueca, P 2020, 'CitrusVol validation for the adjustment of spray volume in treatments against *Tetranychus urticae* in clementines', *Agronomy*, vol. 10, 32, DOI 10.3390/agronomy10010032.
- FSANZ 2021, *Amendment No. 201 (Application A1193 – irradiation as a phytosanitary measure for all fresh fruit and vegetables) Variation*, FSC 142, Commonwealth of Australia, available at <https://www.foodstandards.gov.au/code/changes/gazette/Pages/Amendment%20No201.aspx>.
- Fu, YH, Zhang, F, Peng, Z, Lui, K & Jin, Q 2002, 'The effects of temperature on the development and reproduction of *Tetranychus piercei* McGregor (Acari: Tetranychidae) in banana', *Systematic and Applied Acarology*, vol. 7, pp. 69-76.
- Gadhve, KR, Gautam, S, Rasmussen, DA & Srinivasan, R 2020a, 'Aphid transmission of *Potyvirus*: the largest plant-infecting RNA virus genus', *Viruses*, vol. 12, no. 7 (suppl.), pp. S1-57.
- -- 2020b, 'Aphid transmission of *Potyvirus*: the largest plant-infecting RNA virus genus', *Viruses*, vol. 12, no. 7, pp. 773-95.
- -- 2020c, 'Aphid transmission of *Potyvirus*: the largest plant-infecting RNA virus genus', *Viruses*, vol. 12, no. 7, 773, DOI 10.3390/v12070773.
- Gangwar, RK & Gangwar, C 2018, 'Lifecycle, distribution, nature of damage and economic importance of Whitefly, *Bemisia tabaci* (Gennadius)', *Acta Scientific Agriculture*, vol. 2, no. 4, pp. 36-9.
- Garcêz, RM, Chaves, ALR, Eiras, M, Meletti, LMM, Filho, JA, da Silva, LA & Colariccio, A 2015, 'Survey of aphid population in a yellow passion fruit crop and its relationship on the spread *Cowpea aphid-borne mosaic virus* in a subtropical region of Brazil', *SpringerPlus*, vol. 4, 537, DOI 10.1186/s40064-015-1263-5.
- García Morales, M, Denno, BD, Miller, DR, Miller, GL, Ben-Dov, Y & Hardy, NB 2022, 'ScaleNet: A literature-based model of scale insect biology and systematics', available at <http://scalenet.info/>, accessed 2022.
- Geering, ADW 2006, 'Cotton leaf curl (*Cotton leaf curl Multan virus* and others) updated on 2/23/2010', PaDIL, available at <https://www.padil.gov.au/pests-and-diseases/pest/136662>.
- Götz, M & Winter, S 2016, 'Diversity of *Bemisia tabaci* in Thailand and Vietnam and indications of species replacement', *Journal of Asia-Pacific Entomology*, vol. 19, no. 2, pp. 537-43.
- Government of Western Australia 2022, 'Western Australia Organism List (WAOL)', Department of Primary Industries and Regional Development, Perth, Western Australia, available at <https://www.agric.wa.gov.au/bam/western-australian-organism-list-waol>, accessed 2022.
- -- 2023, 'Western Australia Organism List (WAOL)', Department of Primary Industries and Regional Development, Perth (WA) Australia, available at <https://www.agric.wa.gov.au/bam/western-australian-organism-list-waol>, accessed 2023.
- Greenlife Industry Australia 2021, *Chilli thrips (Scirtothrips dorsalis): an emerging endemic plant pest*, Pest Technical Factsheet, Hort Innovation, Australian Government.

- Guo, T, Guo, Q, Cui, XY, Liu, YQ, Hu, J & Liu, SS 2015, 'Comparison of transmission of *Papaya leaf curl China virus* among four cryptic species of the whitefly *Bemisia tabaci* complex', *Scientific Reports*, vol. 5, DOI 10.1038/srep15432.
- Gutierrez, J, Helle, W & Bolland, HR 1979, 'Etude d'une souche de *Tetranychus piercei* (Acariens: Tetranychidae), d'Indonésie: redescription, caryotype et reproduction', *Entomologische Berichten*, vol. 39, no. 6, pp. 88-94.
- Ha, C, Coombs, S, Reville, PA, Harding, RA, Vu, M & Dale, JL 2008a, 'Design and application of two novel degenerate primer pairs for the detection and complete genomic characterization of potyviruses', *Archives of Virology*, vol. 153, no. 1, pp. 25-36.
- Ha, C, Reville, P, Harding, RM, Vu, M & Dale, JL 2008b, 'Identification and sequence analysis of potyviruses infecting crops in Vietnam', *Archives of Virology*, vol. 153, pp. 45-60.
- Ha, CV 2007, 'Detection and identification of potyviruses and geminiviruses in Vietnam', Doctor of Philosophy Thesis, Queensland University of Technology.
- Hancock, DL, Hamacek, E, Lloyd, AC & Elson-Harris, MM 2000, *The distribution and host plants of fruit flies (Diptera: Tephritidae) in Australia*, Department of Primary Industries, Brisbane.
- Hang, T 2018, 'Moc Chau people grow passion fruit for export', *The Voice of Vietnam - VOV World*, available at <https://vovworld.vn/en-US/society/moc-chau-people-grow-passion-fruit-for-export-698614.vov>.
- Harrington, TC 2000, 'Host specialization and speciation in the American wilt pathogen *Ceratocystis fimbriata*', *Fitopatologia Brasileira*, vol. 25 (suppl.), pp. 262-3.
- Hasyim, A, Muryati & de Kogel, WJ 2008, 'Population fluctuation of adult males of the fruit fly, *Bactrocera tau* Walker (Diptera: Tephritidae) in passion fruit orchards in relation to abiotic factors and sanitation', *Indonesian Journal of Agricultural Science*, vol. 9, no. 1, pp. 29-33.
- Hien, NTT, Trang, VTT, Thanh, VV, Lien, HK, Thang, DĐ, Xuyen, LT & Pereira, R 2020, 'Fruit fly area-wide integrated pest management in dragon fruit in Binh Thuan Province, Viet Nam', in *Area-wide management of fruit fly pests*, Pérez-Staples, D, Díaz-Fleischer, F, Montoya, P & Vera, MT (eds), CRC Press, Boca Raton (FL) USA.
- Hinomoto, N, Tran, DP, Pham, AT, Le, TBN, Tajima, R, Ohashi, K, Osakabe, M & Takafuji, A 2007, 'Identification of spider mites (Acari: Tetranychidae) by DNA sequences: a case study in northern Vietnam', *International Journal of Acarology*, vol. 33, no. 1, pp. 53-60.
- Hoa, NV, Hieu, NT, Hanh, TTM, Uyen, DTK & Dien, LQ 2014, 'Emerging infectious diseases and insect pests of dragon fruit, passionfruit, citrus, longan', paper presented at Workshop on Increasing Production and Market Access for Tropical Fruit in Southeast Asia, Southern Horticultural Research Institute (SOFRI), Long Dihn, Chau Thanh, Tien Giang, Viet Nam, 13-17 October.
- Hoat, TX, Quan, MV, Anh, DTL, Cuong, NN, Vuong, PT, Alvarez, E, Nguyen, TTD, Wyckhuys, K, Paltrinieri, S, Pardo, JM, Mejia, JF, Thanh, ND, Dickinson, M, Duong, CA, Kumarsaringhe, NC & Bertaccini, A 2015, 'Phytoplasma diseases on major crops in Vietnam', *Phytopathogenic Mollicutes*, vol. 5, pp. 69-70.
- Hofsvang, T, Snøan, B, Andersen, A, Heggen, H & Anh, LN 2005, '*Liriomyza sativae* (Diptera: Agromyzidae), an invasive species in South-East Asia: studies on its biology in northern Vietnam', *International Journal of Pest Management*, vol. 51, no. 1, pp. 71-80.
- Hollis, D & Eastop, VF 2005, *Superfamily Aphidoidea*, Australian Faunal Directory, Australian Biological Resources Study.
- Hossain, MA, Leblanc, L, Momen, M, Bari, MA & Khan, SA 2019, 'Seasonal abundance of economically important fruit flies (Diptera: Tephritidae: Dacinae) in Bangladesh, in relation to

abiotic factors and host plants', *Proceedings of the Hawaiian Entomological Society*, vol. 51, no. 2, pp. 25-37.

Huang, A, Ding, M, Cao, M, Zhang, S, Zhong, L & Wang, Y 2020a, 'First report of Papaya Leaf Curl China Virus on passion fruit in China', *APS Publications*, vol. 104, no. 4, p. 1265.

Huang, Y, Gu, X, Peng, X, Tao, M, Peng, L, Chen, G & Zhang, X 2020b, 'Effect of short-term low temperature on the growth, development, and reproduction of *Bactrocera tau* (Diptera: Tephritidae) and *Bactrocera cucurbitae*', *Journal of Economic Entomology*, vol. 113, no. 5, pp. 2141-9.

Hung, HQ 2009, 'Study on natural enemies of insect pests attacking vegetables, beans, orange fruit trees in Hanoi, Vietnam', *Journal of ISSAAS [International Society for Southeast Asian Agricultural Sciences](Philippines)*, vol. 15, no. 1, p. 214. (Abstract only)

Huyen, LT, Tung, ND, Lan, DH, Chi, CV, De Clercq, P & Dinh, NV 2017, 'Life table parameters and development of *Neoseiulus longispinosus* (Acari: Phytoseiidae) reared on citrus red mite, *Panonychus citri* (Acari: Tetranychidae) at different temperatures', *Systematic & Applied Acarology*, vol. 22, no. 9, pp. 1316-26.

ICTV 2022, 'ICTV Taxonomic Information', International Committee on Taxonomy of Viruses (ICTV), London, United Kingdom, available at <https://talk.ictvonline.org/taxonomy/>, accessed 2022.

Inoue-Nagata, AK, Lima, MF & Gilbertson, RL 2016, 'A review of geminivirus (begomovirus) diseases in vegetables and other crops in Brazil: current status and approaches for management', *Horticultura Brasileira*, vol. 34, no. 1, pp. 8-18.

IPPC 2013, *Absence of Tomato ringspot virus from Australia*, AUS-58/3, IPPC, Rome, Italy, available at <https://www.ippc.int/en/countries/australia/pestreports/2013/08/absence-of-tomato-ringspot-virus-from-australia/>.

-- -- 2017, *Detection of Liriomyza sativae in Far North Queensland*, AUS-80/1, Food and Agriculture Organization of the United Nations, available at <https://www.ippc.int/en/countries/australia/pestreports/2017/04/detection-of-liriomyza-sativae-in-far-north-queensland/>.

-- -- 2021a, *Liriomyza huidobrensis (serpentine leafminer) in New South Wales and Queensland*, AUS-103/3, International Plant Protection Convention, Food and Agriculture Organization of the United Nations, available at <https://www.ippc.int/en/countries/australia/pestreports/2021/07/liriomyza-huidobrensis-in-new-south-wales-and-queensland/>.

-- -- 2021b, *Spodoptera frugiperda (fall armyworm) detections Australia*, AUS-101/1, International Plant Protection Convention (IPPC), Rome, Italy, available at <https://www.ippc.int/en/countries/australia/pestreports/2021/05/spodoptera-frugiperda-fall-armyworm-detections-australia/>.

Iwai, H, Ohmori, T, Kurokawa, Y, Muta, T & Arai, K 1996, 'New record of passionfruit woodiness virus in Japan', *Annals of the Phytopathological Society of Japan*, vol. 62, pp. 459-65.

Iwai, H, Yamashita, Y, Nishi, N & Nakamura, M 2006, 'The potyvirus associated with the dappled fruit of *Passiflora edulis* in Kagoshima prefecture, Japan is the third strain of the proposed new species East Asian *Passiflora* virus (EAPV) phylogenetically distinguished from strains of *Passion fruit woodiness virus*', *Archives of Virology*, vol. 151, pp. 811-8.

Jaleel, W, Lu, L & He, Y 2018, 'Biology, taxonomy, and IPM strategies of *Bactrocera tau* Walker and complex species (Diptera, Tephritidae) in Asia: a comprehensive review', *Environmental Science and Pollution Research*, vol. 25, pp. 19346-61.

- Jeppson, LR, Keifer, HH & Baker, EW 1975, *Mites injurious to economic plants*, University of California, Berkeley.
- Joy, PP & Sherin, CG 2016, 'Insect pests of passion fruit (*Passiflora edulis*) and their management', in *Insect pests management of fruit crops*, Kerala Agricultural University, Kerala, India.
- Jung, T, Scanu, B, Brasier, MC, Webber, J, Milenković, I, Corcobado, T, Tomšovský, M, Pánek, M, Bakonyi, J, Maia, C, Bačová, A, Raco, M, Rees, H, Pérez-Sierra, A & Horta Jung, M 2020, 'A survey in natural forest ecosystems of Vietnam reveals high diversity of both new and described *Phytophthora* taxa including *P. ramorum*', *Forests*, vol. 11.
- Kader, AA 1999, 'Passionfruit. Recommendations for maintaining postharvest quality', *Fruit Produce Facts English*, University of California, Davis (CA) USA, available at [https://postharvest.ucdavis.edu/Commodity\\_Resources/Fact\\_Sheets/Datastores/Fruit\\_English/?uid=43&ds=798](https://postharvest.ucdavis.edu/Commodity_Resources/Fact_Sheets/Datastores/Fruit_English/?uid=43&ds=798).
- Kahinga, JN, Gichuki, PM & Waiganjo, MM 2017, 'Managing passionfruit leafminer in the context of integrated-pest-management in the highland of central Kenya', *The 11th JKUAT Scientific, Technological and Industrialization Conference Proceedings, Juja, Kenya, November 2016*.
- Kakinohana, H, Hiroyuki, K, Kohama, KK, Taniguchi, M, Nakamori, H, Tanahara, A & Sokei, Y 1997, 'Eradication of the melon fly, *Bactrocera cucurbitae* Coquillett, by mass release of sterile flies in Okinawa Prefecture, Japan', *JARQ*, vol. 31, pp. 91-100.
- Kaur, N 2022, 'Vegetable crop pests-Spider mite', in *Pacific Northwest Insect Management Handbook*, Kaur, N (ed), Oregon State University, Oregon, USA.
- Kaur, P & Zalom, FG 2018, 'Development of two-spotted spider mite, *Tetranychus urticae* Koch, at different temperatures', *Agricultural Research*, vol. 55, no. 1, pp. 172-4.
- Kennedy, GG & Smitley, DR 1985, 'Dispersal', in *Spider mites: their biology, natural enemies and control*, vol. 1A, Helle, W & Sabelis, MW (eds), Elsevier Science Publisher, Amsterdam, Netherlands.
- Kim, J, Cha, DJ, Kwon, M & Maharjan, R 2016, 'Potato virus Y (PVY) detection in a single aphid by one-step RT-PCR with boiling technique', *Entomological Research*, vol. 46, no. 4, pp. 278-85.
- Kirdat, K, Tiwarekar, B, Swetha, P, Padma, S, Thorat, V, Manjula, KN, Kavya, N, Sundararaj, R & Yadav, A 2022, 'Nested real-time PCR assessment of vertical transmission of sandalwood spike phytoplasma ('*Ca. Phytoplasma asteris*')', *Biology*, vol. 11, pp. 1-14.
- Kiritani, K & Su, H 1999, 'Papaya ring spot, banana bunchy top, and citrus greening in the Asia and Pacific region: occurrence and control strategy', *Japan Agricultural Research Quarterly*, vol. 33, pp. 23-30.
- Kishore, K, Pathak, KA, Shukla, R & Bharali, R 2011, 'Effect of storage temperature on physico-chemical and sensory attributes of purple passion fruit (*Passiflora edulis* Sims)', *Journal of Food Science and Technology*, vol. 48, no. 4, pp. 484-8.
- Koenig, R & Fribourg, CE 1986, 'Natural occurrence of tomato ringspot virus in *Passiflora edulis* from Peru', *Plant Disease*, vol. 70, pp. 244-5.
- Krantz, GW & Walter, DE 2009, *A manual of Acarology*, Krantz, GW & Walter, DE (eds), Texas Tech University Press, Lubbock, Texas.
- Lam, TTN, Lam, TX & Lan, TN 2015, 'Polymorphism of the southern green stink bug *Nezara viridula* Linnaeus, 1758 (Hemiptera: Pentatomidae) in Vietnam', *Biological Forum An International Journal*, vol. 7, no. 1, pp. 276-81.
- Le, CN, Mendes, R, Kruijt, M & Raaijmakers, JM 2012, 'Genetic and phenotypic diversity of *Sclerotium rolfsii* in groundnut fields in central Vietnam', *Plant Disease*, vol. 96, pp. 389-97.



## References

- Le, VT, Nguyen, N, Nguyen, DD, Dang, TKT, Nguyen, CT, Dang, VHM, Chau, NH & Trinh, NL 2000, 'Quality assurance system for dragon fruit', *ACIAR Proceedings Series, Ho Chi Minh City, 9-12 November 1999*, ACIAR, pp. 101-14.
- Leblanc, L, Doorenweerd, C, San Jose, M, Pham, HT & Rubinoff, D 2018, 'Descriptions of four new species of *Bactrocera* and new country records highlight the high biodiversity of fruit flies in Vietnam (Diptera, Tephritidae, Dacinae)', *ZooKeys*, vol. 797, pp. 81-115.
- Leblanc, L, Vueti, ET & Allwood, AJ 2013, 'Host plant records for fruit flies (Diptera: Tephritidae: Dacini) in the Pacific Islands: 2. Infestation statistics on economic hosts', *Proceedings of the Hawaiian Entomological Society*, vol. 45, pp. 83-117.
- Lee, E, Wylie, SJ & Jones, MGK 2010, 'First report of '*Candidatus* Phytoplasma aurantifolia' associated with severe stunting and necrosis on the invasive weed *Pelargonium capitatum* in Western Australia', *Plant Disease*, vol. 94, no. 10, p. 1264.
- Li, SJ, Xue, X, Ahmed, MZ, Ren, SX, Du, YZ, Wu, JH, Cuthbertson, AGS & Qiu, BL 2011, 'Host plants and natural enemies of *Bemisia tabaci* (Hemiptera: Aleyrodidae) in China', *Insect Science*, vol. 18, pp. 101-20.
- Li, X, Yang, H, Hu, K & Wang, J 2020, 'Temporal dynamics of *Bactrocera (Zeugodacus) tau* (Diptera: Tephritidae) adults in north Jiangxi, a subtropical area of China revealed by eight years of trapping with cue lure', *Journal of Asia-Pacific Entomology*, vol. 23, pp. 1-6.
- Li, Y, Mbata, GN, Punnuri, S, Simmons, AM & Shapiro-Ilan, DI 2021, '*Bemisia tabaci* on vegetables in the southern United States: incidence, impact, and management', *Insects*, vol. 12, 198, <https://doi.org/10.3390/insects12030198>.
- Liew, ECY, Laurence, MH, Pearce, CA, Shivas, RG, Johnson, GI, Tan, YP, Edwards, J, Perry, S, Cooke, AW & Summerell, BA 2016, 'Review of *Fusarium* species isolated in association with mango malformation in Australia', *Australasian Plant Pathology*, vol. 45, <https://link.springer.com/article/10.1007/s13313-016-0454-z>.
- Lo, H, Lou, L & Huang, T 2023, 'Establishment of integrated propagation system on grafting plantlets of passion fruit (*Passiflora edulis*)', *HortScience*, vol. 58, no. 2, pp. 170-7.
- Louzeiro, LRF, Souza-Filho, MF, Raga, A & Gislotti, LJ 2021, 'Incidence of frugivorous flies (Tephritidae and Lonchaeidae), fruit losses and the dispersal of flies through the transportation of fresh fruit', *Journal of Asia-Pacific Entomology*, vol. 24, pp. 50-60.
- Luong, TM, Huynh, LMT, Hoang, HMT, Tesoriero, LA, Burgess, LW, Phan, HT & Davies, P 2010, 'First report of Pythium root rot of chrysanthemum in Vietnam and control with metalaxyl drench', *Australasian Plant Disease Notes*, vol. 5, pp. 51-4.
- Mahr, S 2022, 'Aphids, in-depth', University of Wisconsin, Madison (WI) USA, available at <https://hort.extension.wisc.edu/articles/aphids-2/>.
- Maina, S, Barbetti, MJ, Edwards, OR, Minemba, D, Areke, MW & Jones, RAC 2019, 'Zucchini yellow mosaic virus genomic sequences from Papua New Guinea: lack of genetic connectivity with northern Australian or East Timorese genomes, and new recombination findings', *Plant Disease*, vol. 103, pp. 1326-36.
- Mamet, JR 1958, 'The *Selenaspidus* complex (Homoptera: Coccoidea)', *Annales du Musée Royal du Congo Belge, Zoologiques, Miscellanea Zoologica, Tervuren*, vol. 4, pp. 361-429.
- Mannakkara, A 2006, 'Red stem borer, *Zeuzera coffeae* (Lepidoptera: Cossidae): emerging threats to forest plantation in Sri Lanka', *The Sri Lanka Forester*, vol. 29, pp. 61-7.
- Manyangarirwa, W, Sibiyi, J & Mortensen, CN 2010, 'Seed-borne viruses detected on farm-retained seeds from smallholder farmers in Zimbabwe, Burkina Faso, Bangladesh and Vietnam', *RUFORUM Second Biennial Conference, Entebbe, Uganda, 20-24 September 2010*, RUFORUM, pp. 1063-9.

## References

- MARD 2010, *Report of pest risk analysis on importation of fresh tomato fruits (*Lycopersicon esculentum* L.) from republic of Korea into Vietnam*, Ministry of Agriculture and Rural Development, Hanoi, Vietnam.
- -- 2014, *On procedures for plant quarantine for import, export, transit and post-import of articles subject to plant quarantine*, No. 33/2014/TT-BNNPTNT, Ministry of Agriculture and Rural Development (MARD), Hanoi, Vietnam.
- -- 2016, *Technical market access submission, export of Vietnam passion fruit (*Passiflora edulis* Sims)*, Ministry of Agriculture and Rural Development (MARD), Hanoi, Vietnam.
- -- 2021, *Detailed information for passion fruit export from Vietnam to Australia*, Ministry of Agriculture and Rural Development, Vietnam.
- -- 2023, *Information on passion fruit as requested by DAFF*, Ministry of Agriculture and Rural Development (MARD), Hanoi, Vietnam.
- Martins, DS, Wolff, VRS, Culik, MP, Santos, BC, Fornazier, MJ & Ventura, JA 2022, 'Diversity, distribution and host plants of armored scale insects (Hemiptera: Diaspididae) in Espírito Santo, Brazil', *Biota Neotropica*, vol. 22, no. 2, e20211248, DOI 10.1590/1676-0611-BN-2021-1248.
- Masaki, M 2001, 'Note on some tetranychid mites on Thai plants intercepted at Narita airport in Japan' (in Japanese), *Research Bulletin of the Plant Protection Service, Japan*, vol. 37, pp. 111-6.
- Mason, J, Alford, AM & Kuhar, TP 2020, 'Flea beetle (Coleoptera: Chrysomelidae) populations, effects of feeding injury, and efficacy of insecticide treatments on eggplant and cabbage in southwest Virginia', *Journal of Economic Entomology*, vol. 113, no. 2, pp. 887-95.
- McMurtry, JA 1985, 'Citrus', in *Spider mites: their biology, natural enemies and control*, vol. 1B, Helle, W & Sabelis, MW (eds), Elsevier Science Publishers B.V., Amsterdam.
- McQuate, GT & Liquidó, NJ 2013, 'Annotated world bibliography of host fruits of *Bactrocera latifrons* (Hendel) (Diptera:Tephritidae)', *Insecta Mundi*, vol. 0289, available at <http://digitalcommons.unl.edu/insectamundi/792>.
- -- 2017, 'Host plants of invasive tephritid fruit fly species of economic importance', *International Journal of Plant Biology & Research*, vol. 5, no. 4, p. 1072.
- Meck, ED, Walgenbach, JF & Kennedy, GG 2012, 'Association of *Tetranychus urticae* (Acari: Tetranychidae) feeding and gold fleck damage on tomato fruit', *Crop Protection*, vol. 42, pp. 24-9.
- Michel, ADK, Fiaboe, KKM, Kekeunou, S, Nanga, SN, Kuate, AF, Tonnang, HEZ, Gnanvossou, D & Hanna, R 2021, 'Temperature-based phenology model to predict the development, survival, and reproduction of the oriental fruit fly *Bactrocera dorsalis*', *Journal of Thermal Biology*, vol. 97, 102877, <https://doi.org/10.1016/j.jtherbio.2021.102877>.
- Migeon, A & Dorkeld, F 2022, 'Spider Mites Web: a comprehensive database for the Tetranychidae', available at <http://www1.montpellier.inra.fr/CBGP/spmweb>, accessed 2022.
- -- 2023, 'Spider Mites Web: a comprehensive database for the Tetranychidae', available at <http://www1.montpellier.inra.fr/CBGP/spmweb>, accessed 2023.
- Miller, DR & Davidson, JA 2005, *Armored scale insect pests of trees and shrubs (Hemiptera: Diaspididae)*, Cornell University Press, Ithaca & London.
- Miller, PW 1929, '*Megymenum brevicorne* F. Pentatomidae. (Hemiptera-Heteroptera) a minor pest of *Cucurbitaceae* and *Passifloraceae*', *The Malayan Agricultural Journal*, vol. 17, no. 12, pp. 421-59.
- Mitchell, WC 1980, 'Verification of the absence of oriental fruit and melon fruit fly following an eradication program in the Mariana Islands', *Proceedings, Hawaiian Entomological Society*, vol. XXIII, no. 2, pp. 239-43.

- Mkiga, AM & Mwatawala, MW 2015, 'Developmental biology of *Zeugodacus cucurbitae* (Diptera: Tephritidae) in three cucurbitaceous hosts at different temperature regimes', *Journal of Insect Science*, vol. 15, no. 1, 160, DOI 10.1093/jisesa/iev141.
- Moquet, L & Delatte, H 2021, 'Host status of *Citrus hystrix*, *Citrus aurantifolia*, *Passiflora edulis* and *Litchi chinensis* for *Bactrocera dorsalis* (Tephritidae, Diptera) on Réunion Island', *Fruits*, vol. 76, no. 6, pp. 310-6.
- Morton, J 1987, 'Passionfruit: *Passiflora edulis* Sims', in *Fruits of warm climates*, J.F. Morton, Miami, USA.
- Mujica, N, Alvites, D, Carhuapoma, P & Kroschel, J 2016, 'Vegetable leafminer, *Liriomyza sativae* (Blanchard 1938)', in *Pest distribution and risk atlas for Africa. Potential global and regional distribution and abundance of agricultural and horticultural pests and associated biocontrol agents under current and future climates*, Kroschel, J, Mujica, N, Carhuapoma, P & Sporleder, M (eds), International Potato Center (CIP), Lima (Peru), available at <https://cipotato.org/riskatlasforafrica/liriomyza-sativae/>.
- Nafods 2021, *Nafods catalogue 2022*, Nafods Group JSC, Vietnam.
- Nakahara, S 1982, *Checklist of the armored scales (Homoptera: Diaspididae) of the conterminous United States*, United States Department of Agriculture, Hoboken.
- Nalam, VJ, Han, J, Pitt, WJ, Acharya, SR & Nachappa, P 2021, 'Location, location, location: feeding site affects aphid performance by altering access and quality of nutrients', *PLoS ONE*, vol. 16, no. 2, e0245380, <https://doi.org/10.1371/journal.pone.0245380>.
- Nantale, MN, Sseruwagi, P, Karungi, J & Ochwo-Ssemakula, M 2014, 'Aphid transmission and alternate hosts of *Passiflora chlorotic mottle virus* in Uganda', paper presented at 4th Biennial RUFORUM Conference, Maputo, Mozambique, 19-25 July.
- NAPPO 2014, 'Morphological identification of spider mites (Tetranychidae) affecting imported fruits', North American Plant Protection Organization, Ottawa, Ontario, Canada, available at [https://nappo.org/application/files/3515/8322/7229/DP\\_03\\_Tetranychidae-e.pdf](https://nappo.org/application/files/3515/8322/7229/DP_03_Tetranychidae-e.pdf) (pdf 1125 kb).
- National Agricultural Extension Center 2021, *Symptoms, arising characteristics and harmful effects of some major pests and diseases on passion fruit trees (part 1)*, National Agricultural Extension Center.
- Nébié, K, Nacro, S, Otaidobiga, LC & Somda, I 2018, 'Host plants of the mango mealybug *Rastrococcus invadens* Williams (Homoptera: Pseudococcidae) in Western Burkina Faso', *International Journal of Agriculture and Environmental Research*, vol. 4, no. 4, pp. 891-901.
- Ngoc, NK, Phong Nguyen, NV, An, PTM, Woolf, AB & Fullerton, RA 2018, 'Effect of storage temperatures on postharvest diseases of dragon fruit (*Hylocereus undatus* Haw.) in the Mekong Delta Region, Vietnam', *Acta Horticulturae*, vol. 1213, pp. 453-60.
- Nguyen, R, Hamon, AB & Fasulo, TR 2010, *Citrus blackfly, Aleurocanthus woglumi* Ashby (Insecta: Hemiptera: Aleyrodidae), EENY-042, University of Florida, IFAS Extension, available at <https://edis.ifas.ufl.edu/in199>.
- Nguyen, THP, Säll, T, Bryngelsson, T & Liljeroth, E 2009, 'Variation among *Colletotrichum gloeosporioides* isolates from infected coffee berries at different locations in Vietnam', *Plant Pathology*, vol. 58, pp. 898-909.
- Nguyen, VT, Nguyen, VL, Le, TH & Bui, THY 2019, *Investigation of pest composition and natural enemies on passion fruit in Vietnam in the period 2015 - 2016* (in Vietnamese), 8 (105), Vietnam Agricultural Science and Technology Magazine, Vietnam.
- NPDN 2022, *Chilli thrips, Scirtothrips dorsalis*, National Plant Diagnostic Network, USDA APHIS PPQ, USA.

## References

- NSW DPI 2017, *Citrus red mite (primefact 1477), second edition*, NSW Department of Primary Industries, Orange, available at <https://www.dpi.nsw.gov.au/components/module/accordion/agriculture/horticulture/content/insects-diseases-disorders-and-biosecurity/insect-pest-factsheets/citrus-red-mite>.
- Omatsu, N, Iwai, H, Setokuchi, O & Arai, K 2004, 'Immigrating aphid species and their importance as vectors of passionfruit woodiness virus in the fields of Amami Oshima Island, Japan', *Memoirs of the Faculty of Agriculture Kagoshima University*, vol. 39, pp. 1-5.
- Ong, SP & Farid, AM 2017, *Plant pests: the leaf-feeding beetles*, FRIM Technical Information No. 76, Malaysia.
- OnTheWorldMap 2023, 'Vietnam province map', Ontheworldmap.com, available at <https://ontheworldmap.com/vietnam/vietnam-province-map.html>.
- Pan, D, Dou, W, Yuan, GR, Zhou, QH & Wang, JJ 2019, 'Monitoring the resistance of the citrus red mite (Acari: Tetranychidae) to four acaricides in different citrus orchards in china', *Journal of Economic Entomology*, vol. 113, no. 2, pp. 918-23.
- Peña, JE & Mohyuddin, AI 1997, 'Insect pests', in *The mango: botany, production and uses*, Litz, RE (ed), CAB International, Wallingford.
- PHA 2015, *Cotton leaf curl disease*, Technical fact sheet, Plant Health Australia, Australia.
- -- 2018, *The Australian handbook for the identification of fruit flies version 3.1*, Plant Health Australia, Canberra, Australia.
- Phan, LTK, Tran, TM, Audenaert, K, Jacxsens, L & Eeckhout, M 2021, 'Contamination of *Fusarium proliferatum* and *Aspergillus flavus* in the rice chain linked to crop seasons, cultivation regions, and traditional agricultural practices in Mekong Delta, Vietnam', *Foods*, vol. 10, 2064, DOI 10.3390/foods10092064.
- PIRSA 2022, *Plant quarantine standard: South Australia*, Version 17.3, Primary Industries and Regions, South Australia (PIRSA), Adelaide (SA) Australia, available at [https://www.pir.sa.gov.au/biosecurity/plant\\_health](https://www.pir.sa.gov.au/biosecurity/plant_health).
- Plant Health Australia 2021, 'Australian Plant Pest Database, online database', available at <http://www.planthealthaustralia.com.au/resources/australian-plant-pest-database/>, accessed 2021.
- -- 2022, *Fact sheet: Serpentine leafminer*, Plant Health Australia, Australia.
- -- 2023, 'Fruit Fly ID Australia', Plant Health Australia, Canberra, Australia, available at <https://www.fruitflyidentification.org.au/>, accessed 2023.
- PPD 2009, *A proposal to export mangoes (Mangnifera indica L.) from Vietnam to Australia*, Plant Protection Department (PPD), Ministry of Agriculture and Rural Development, Vietnam (pdf 511 kb).
- -- 2010a, *A proposal to export dragon fruit (Hylocereus undatus) from Vietnam to Australia*, Plant Protection Department (PPD), Ministry of Agriculture and Rural Development, Vietnam (pdf 761 kb).
- -- 2010b, *A proposal to export lychee fruit (Litchi chinensis Sonn) from Vietnam to Australia*, Plant Protection Department, Ministry of Agriculture and Rural Development, Vietnam (pdf 725 kb).
- -- 2017, *Technical market access submission: export of Vietnam longan fruit (Dimocarpus longan Lour.)*, Plant Protection Department (PPD), Ministry of Agriculture and Rural Development, Vietnam.
- -- 2021, *Technical Process: prevention of harmful viruses (Leimon)*, Plant Protection Department, Ministry of Agriculture and Rural Development, Hanoi, Vietnam.



## References

- Practical Action 2003, *Passion fruit cultivation*, The Schumacher Centre for Technology and Development, Bourton on Dunsmore, Rugby, UK.
- Praslička, J & Huszár, J 2004, 'Influence of temperature and host plants on the development and fecundity of the spider mite *Tetranychus urticae* (Acarina: Tetranychidae)', *Plant Protection Science*, vol. 40, no. 4, pp. 141-4.
- Putulan, D, Sar, S, Drew, RAI, Raghu, S & Clarke, AR 2004, 'Fruit and vegetable movement on domestic flights in Papua New Guinea and the risk of spreading pest fruit-flies (Diptera: Tephritidae)', *International Journal of Pest Management*, vol. 50, no. 1, pp. 17-22.
- Qureshi, ZA, Ashraf, M, Bughio, AR & Siddiqui, QH 1975, 'Population fluctuation and dispersal studies of the fruit fly, *Dacus zonatus* Saunders', *Proceedings of the symposium on the sterility principle for insect control jointly organised by the International Atomic Energy Agency and the Food and Agriculture Organization of the United Nations, Innsbruck, 22-26 July 1974*, pp. 201-7.
- Rahman, M, Khan, AQ, Rahmat, Z, Iqbal, MA & Zafar, Y 2017, 'Genetics and genomics of cotton leaf curl disease, its viral causal agents and whitefly vector: a way forward to sustain cotton fiber security', *Frontiers in Plant Science*, vol. 8, 1157, DOI 10.3389/fpls.2017.01157.
- Red Pine International 2019, 'Passion fruit disease and prevention of passion fruit disease', *Passion fruit tree, Agriculture engineering, Vietnam*, available at <https://redpineinternational.vn/ky-thuat-nong-nghiep/benh-hai-chanh-day/>.
- -- 2023, 'Taiwan red pine cao tun - red pine passion fruit variety', Taiwan, available at <https://redpineinternational.vn/san-pham/giong-chanh-day-red-pine-cao-tun-dai-loan/>.
- Roda, A, Francis, A, Kairo, MTK & Culik, M 2013, '*Planococcus minor* (Hemiptera: Pseudococcidae): bioecology, survey and mitigation strategies', in *Potential invasive pests of agricultural crops*, Peña, J (ed), CABI.
- Saqib, M, Bayliss, KL, Dell, B, Hardf, GE & Jones, MGK 2005a, 'First record of a phytoplasma-associated disease of chickpea (*Cicer arietinum*) in Australia', *Australasian Plant Pathology*, vol. 34, no. 3, pp. 425-6.
- Saqib, M, Jones, RAC, Cayford, B & Jones, MGK 2005b, 'First report of *Bean common mosaic virus* in Western Australia', *Plant Pathology*, vol. 54, no. 4, p. 563.
- Satta, E 2017, 'Studies on phytoplasma seed transmission in different biological systems', PhD in Agricultural, Environmental and Food Sciences and Technologies Thesis, University of Bologna.
- Satta, E, Paltrinieri, S & Bertaccini, A 2019, 'Phytoplasma transmission by seed', in *Phytoplasmas: plant pathogenic bacteria - II: transmission and management of Phytoplasma - associated diseases*, Bertaccini, A, Weintraub, PG, Rao, GP & Mori, N (eds), Springer Nature Singapore Pte Ltd, Singapore.
- Schutze, MK, Aketarawong, N, Amornsak, W, Armstrong, KF, Augustinos, AA, Barr, N, Bo, W, Bourtzis, K, Boykin, LM, Cáceres, C, Cameron, SL, Chapman, TA, Chinvinijkul, S, Chomic, A, de Meyer, M, Drosopoulou, E, Englezou, A, Ekesi, S, Gariou-Papalexiou, A, Geib, SM, Hailstones, D, Hasanuzzaman, M, Haymer, D, Hee, AKW, Hendrichs, J, Jessup, A, Ji, Q, Khamis, FM, Krosch, MN, Leblanc, L, Mahmood, K, Malacrida, AR, Mavragani-Tsipidou, P, Mwatawala, M, Nishida, R, Ono, H, Reyes, J, Rubinoff, D, Sanjose, M, Shelly, TE, Spikachar, S, Tan, KH, Thanaphum, S, Haq, I, Vijaysegaran, S, Wee, SL, Yesmin, F, Zacharopoulou, A & Clarke, AR 2014, 'Synonymization of key pest species within the *Bactrocera dorsalis* species complex (Diptera: Tephritidae): taxonomic changes based on a review of 20 years of integrative morphological, molecular, cytogenetic, behavioural and chemoecological data', *Systematic Entomology*, vol. 40, no. 2, pp. 456-71.
- Schutze, MK, Mahmood, K, Pavasovic, A, Bo, W, Newman, J, Clarke, AR, Krosch, MN & Cameron, SL 2015, 'One and the same: integrative taxonomic evidence that *Bactrocera invadens* (Diptera: Tephritidae) is the same species as the Orientaly fruit fly *Bactrocera dorsalis*', *Systematic Entomology*, vol. 40, no. 2, pp. 472-86.

- Seeman, OD & Beard, JJ 2011, 'Identification of exotic pest and Australian native and naturalised species of *Tetranychus* (Acari: Tetranychidae)', *Zootaxa*, vol. 2961, pp. 1-72.
- Shi, W, Kerdelhué, C & Ye, H 2014, 'Genetic structure and colonization history of the fruit fly *Bactrocera tau* (Diptera: Tephritidae) in China and Southeast Asia', *Journal of Economic Entomology*, vol. 107, no. 3, pp. 1256-65.
- Singh, J, Sohi, AS & Mann, HS 1997, 'Screening of cotton germplasm against cotton leaf curl viral disease using its vector *Bemisia tabaci* (Genn.)', *Journal of Research Punjab Agricultural University*, vol. 34, no. 3, pp. 294-8.
- Spodek, M, Ben-Dov, Y, Mondaca, L, Protasov, A, Erel, E & Mendel, Z 2018, 'The cotton mealybug, *Phenacoccus solenopsis* Tinsley (Hemiptera: Pseudococcidae) in Israel: pest status, host plants and natural enemies', *Phytoparasitica*, vol. 46, pp. 45-55.
- Steiner, LF 1955, 'Fruit fly control with bait sprays in relation to passion fruit production', *Hawaiian Entomological Society Proceedings*, vol. 15, no. 3, pp. 601-7.
- Streten, C & Gibb, KS 2006, 'Phytoplasma diseases in sub-tropical and tropical Australia', *Australasian Plant Pathology*, vol. 35, pp. 129-46.
- Subhagan, SR, Dhalin, D & Kumar, AK 2020, 'Dipteran flies in *Passiflora* L. (Passifloraceae): a comprehensive review', *Journal of Entomology and Zoology Studies*, vol. 8, no. 4, pp. 2325-30.
- Suh, SJ 2015, 'New records of armored scale insects, *Pseudulacaspis* MacGillivray (Hemiptera: Diaspididae), in Korea', *Insecta Mundi*, vol. 0403, pp. 1-8.
- -- 2016, 'Armoured scale insects (Hemiptera: Diaspididae) intercepted at the ports of entry in the Republic of Korea over the last 20 years', *Bulletin OEPP/EPPO Bulletin*, vol. 46, no. 2, pp. 313-31.
- Suputa, Trisyono, YA, Martono, E & Siwi, SS 2010, 'Update on the host range of difference species of fruit flies in Indonesia', *Jurnal Perlindungan Tanaman Indonesia*, vol. 16, no. 2, pp. 62-75.
- Suzuki, T, Wang, CH, Gotoh, T, Amano, H & Ohyama, K 2015, 'Deoxidant-induced anoxia as a physical measure for controlling spider mites (Acari: Tetranychidae)', *Experimental and Applied Acarology*, vol. 65, no. 3, pp. 293-305.
- Tairo, F, Jones, RAC & Valkonen, JPT 2006, 'Phytoplasma from little leaf disease affected sweetpotato in Western Australia: detection and phylogeny', *Annals of Applied Biology*, vol. 149, pp. 9-14.
- Tang, Y, He, Z & Zhou, G 2020, '*Passiflora edulis* is a new host of Cotton leaf curl Multan virus-betasatellite complex in China', *Canadian Journal of Plant Pathology*, vol. 42, no. 4, pp. 493-8.
- Thao, LD, Hien, LT, Liem, NV, Thanh, HM, Khanh, TN, Binh, VTP, Trang, TTT, Anh, PT & Tu, TT 2020, 'First report of *Phytophthium vexans* causing root rot disease on durian in Vietnam', *New Disease Reports*, vol. 41, no. 2, <http://dx.doi.org/10.5197/j.2044-0588.2020.041.002>.
- TheGlobalEconomy.com 2018, 'Precipitation - Country rankings', TheGlobalEconomy.com, available at <https://www.theglobaleconomy.com/rankings/precipitation/>.
- Thu, LTM, Son, LV, Ha, CH & Mau, CH 2014, 'Development of RNAi-based vector aims at creating antiviral soybean plants in Vietnam', *International Journal of Bioscience, Biochemistry and Bioinformatics*, vol. 4, no. 3, pp. 208-11.
- Thu, PQ, Griffiths, MW, Pegg, GS, McDonald, JM, Wylie, FR, King, J & Lawson, SA 2010, *Healthy plantations: a field guide to pests and pathogens of Acacia, Eucalyptus and Pinus in Vietnam*, Department of Employment, Economic Development and Innovation, Queensland, Australia.
- Thuy, NN 1998, 'Fruit fly problem in south Vietnam', *FAO/IAEA International Conference on area-wide control of insect pests, Penang, Malaysia, 1 June 1998*, International Atomic Energy Agency, Vienna, Austria.

## References

- Thuy, NN, Duc, HT & Vu, NH 2000, 'Preliminary results on a fruit fly investigation in the South of Vietnam', *Proceedings of the 19th Association of South-East Asian Nations (ASEAN) and 1st Asia-Pacific Economic Cooperation (APEC) Postharvest Technology Seminar, Ho Chi Minh City, Vietnam, 9-12 November 1999*, Australian Centre for International Agricultural Research, p. 736.
- Thuy, TTT, Chi, NTM, Yen, NT, Anh, LTN, Te, LL & De Waele, D 2013, 'Fungi associated with black pepper plants in Quang Tri province (Vietnam), and interaction between *Meloidogyne incognita* and *Fusarium solani*', *Archives of Phytopathology and Plant Protection*, vol. 46, no. 4, pp. 470-82.
- Tran, H, Van, HN, Muniappan, R, Amrine, J, Naidu, R, Gilbertson, R & Sidhu, J 2019, 'Integrated pest management of longan (Sapindales: Sapindaceae) in Vietnam', *Journal of Integrated Pest Management*, vol. 10, no. 1.
- Trinh, HX, Quan, MV, Groenewald, JZ & Burgess, LW 2012, 'First report of stub dieback of poinsettia (*Euphorbia pulcherrima*) caused by *Sclerotinia sclerotiorum* in Vietnam', *Australasian Plant Disease Notes*, vol. 7, no. 1, pp. 55-7.
- Tsatsia, H & Jackson, G 2017, *Pumpkin beetle*, Pacific pests, pathogens & weeds - fact sheets, Australian Centre for International Agricultural Research.
- Tsuruta, K, White, IM, Bandara, HMJ, Rajapakse, H, Sundaraperuma, SAH, Kahawatta, SBMUC & Rajapakse, GBJP 1997, 'A preliminary notes on the host-plants of fruit flies of the tribe Dacini (Diptera: Tephritidae) in Sri Lanka', *Esakia*, vol. 37, pp. 149-60.
- UC IPM 2011, *Spider mites: integrated pest management for home gardeners and landscape professionals*, 7405, University of California Statewide Integrated Pest Management Program, California, USA.
- Ullah, MS, Gotoh, T & Lim, UT 2014, 'Life history parameters of three phytophagous spider mites, *Tetranychus piercei*, *T. truncatus* and *T. bambusae* (Acari: Tetranychidae)', *Journal of Asia-Pacific Entomology*, vol. 17, pp. 767-73.
- USDA 2016, *USDA treatment manual*, USA, United States Department of Agriculture, available at [https://www.aphis.usda.gov/import\\_export/plants/manuals/ports/downloads/treatment.pdf](https://www.aphis.usda.gov/import_export/plants/manuals/ports/downloads/treatment.pdf).
- Vacante, V 2016, *The handbook of mites of economic plants: identification, bio-ecology and control*, CABI, Croydon, UK.
- Vargas, RI, Leblanc, L, Putoa, R & Eitam, A 2007, 'Impact of introduction of *Bactrocera dorsalis* (Diptera: Tephritidae) and classical biological control releases of *Fopius aricanus* (Hymenoptera: Braconidae) on economically important fruit flies in French Polynesia', *Journal of Economic Entomology*, vol. 100, no. 3, pp. 670-9.
- Vargas, RI, Leblanc, L, Putoa, R & Piñero, JC 2012, 'Population dynamics of three *Bactrocera* spp. fruit flies (Diptera: Tephritidae) and two introduced natural enemies, *Fopius arisanus* (Sonan) and *Diachasmimorpha longicaudata* (Ashmead) (Hymenoptera: Braconidae), after an invasion by *Bactrocera dorsalis* (Hendel) in Tahiti', *Biological Control*, vol. 60, no. 2, pp. 199-206.
- Vargas, RI, Pinero, JC & Leblanc, L 2015, 'An overview of pest species of *Bactrocera* fruit flies (Diptera: Tephritidae) and the integration of biopesticides with other biological approaches for their management with a focus on the Pacific region', *Insects*, vol. 6, pp. 297-318.
- Varma, PM 1963, 'Transmission of plant viruses by whiteflies', *Bulletin of the National Institute of Sciences of India*, vol. 24, pp. 11-33.
- Venette, RC & Davis, EE 2004, *Mini risk assessment: passionvine mealybug: *Planococcus minor* (Maskell) [Pseudococcidae: Hemiptera]*, University of Minnesota, St Paul, Minnesota.
- Virgilio, M, Jordaens, K, Verwimp, C, White, I & De Meyer, M 2015, 'Higher phylogeny of frugivorous flies (Diptera, Tephritidae, Dacini): localised partition conflicts and a novel generic classification', *Molecular Phylogenetics and Evolution*, vol. 85, pp. 171-9.

- Vogelzang, BK & Scott, ES 1990, '*Ceratocystis fimbriata*, causal agent of basal rot of *Syngonium* cultivars, and host range studies of isolates of *C. fimbriata* in Australia', *Australasian Plant Pathology*, vol. 19, no. 3, pp. 82-9.
- Walter, DE 2006, *Invasive mite identification: Tools for quarantine and plant protection*, United States Department of Agriculture (USDA) & Colorado State University, available at <http://www.lucidcentral.org/keys/v3/mites>.
- Walter, DE & Proctor, HC 2013, *Mites: ecology, evolution and behaviour*, 2nd edn, Springer, Dordrecht, The Netherlands.
- Wang, X, Xie, Y & Zhou, X 2004, 'Molecular characterization of two distinct begomoviruses from papaya in China', *Virus Genes*, vol. 29, no. 3, pp. 303-9.
- Waterhouse, DF 1993, *The major arthropod pests and weeds of agriculture in Southeast Asia: distribution, importance and origin*, Monograph No. 21, Australian Centre for International Agricultural Research (ACIAR), Canberra.
- Watson, GW 2022, *Arthropods of Economic Importance: Diaspididae of the World 2.0*, Universiteit van Amsterdam, the Netherlands.
- Weems, HV, Heppner, JB & Fasulo, TR 2018, 'Melon fly, *Bactrocera cucurbitae* (Coquillett) (Insecta: Diptera: Tephritidae)', *Featured Creatures*, University of Florida, Florida, USA, available at [http://entnemdept.ufl.edu/creatures/fruit/tropical/melon\\_fly.htm](http://entnemdept.ufl.edu/creatures/fruit/tropical/melon_fly.htm).
- Wei, W & Zhao, Y 2022, 'Phytoplasma taxonomy: nomenclature, classification, and identification', *Biology*, vol. 11, 1119, <https://doi.org/10.3390/biology11081119>.
- Weintraub, PG & Beanland, L 2006, 'Insect vectors of phytoplasmas', *Annual Review of Entomology*, vol. 51, pp. 91-111.
- Weintraub, PG, Scheffer, SJ, Visser, D, Valladares, G, Corrêa, AS, Shepard, MB, Rauf, A, Murphy, ST, Mujica, N, MacVean, C, Kroschel, J, Kishinevsky, M, Joshi, RC, Johansen, NS, Hallett, RH, Civelek, HS, Chen, B & Metzler, HB 2017, 'The invasive *Liriomyza huidobrensis* (Diptera: Agromyzidae): understanding its pest status and management globally', *Journal of Insect Science*, vol. 17, no. 1, DOI 10.1093/jisesa/iew121.
- White, IM & Elson-Harris, MM 1992, *Fruit flies of economic significance: their identification and bionomics*, CAB International, Wallingford, UK.
- -- 1994, *Fruit flies of economic significance: their identification and bionomics*, CAB International and ACIAR, Wallingford, UK.
- White, N, Bale, JS & Hayward, SAL 2018, 'Life-history changes in the cold tolerance of the two-spot spider mite *Tetranychus urticae*: applications in pest control and establishment risk assessment', *Physiological Entomology*, vol. 43, no. 4, pp. 334-45.
- Whittle, AM 1992, 'Diseases and pests of citrus in Viet Nam', *FAO Plant Protection Bulletin*, vol. 40, no. 3, pp. 75-81.
- Williams, DJ 2004, *Mealybugs of Southern Asia*, Natural History Museum and Southdene, Kuala Lumpur.
- Williams, DJ & Watson, GW 1988, *The scale insects of the tropical South Pacific region: part 2. The mealybugs (Pseudococcidae)*, CAB International, Wallingford.
- Win, NZ, Mi, KM, Win, KK, Park, J & Park, JK 2014, 'Occurrence of fruit flies (Diptera: Tephritidae) in fruit orchards from Myanmar', *Korean Journal of Applied Entomology*, vol. 53, no. 4, pp. 323-9.
- Wong, TTY, Cunningham, RT, McInnis, DO & Gilmore, JE 1989, 'Seasonal distribution and abundance of *Dacus cucurbitae* (Diptera: Tephritidae) in Rota, Commonwealth of the Northern Mariana Islands', *Environmental Entomology*, vol. 18, no. 6, pp. 1079-82.



- World Bank Group 2021, *Climate risk country profile: Vietnam (2021)*, World Bank Group, Washington DC, USA.
- World Weather Online 2023, 'Vietnam weather', Zoomash Ltd, available at <https://www.worldweatheronline.com/vietnam-weather.aspx>.
- WTO 1995, *Agreement on the application of sanitary and phytosanitary measures*, World Trade Organization, Geneva, available at [https://www.wto.org/english/docs\\_e/legal\\_e/15-sps.pdf](https://www.wto.org/english/docs_e/legal_e/15-sps.pdf) (pdf 91 kb).
- Wu, J, Zulficar, A & Huang, C 2010, 'Infectivity of Euphorbia leaf curl virus and interaction with Tomato yellow leaf curl China betasatellite', *Archives of Virology*, vol. 156, no. 3, pp. 517-21.
- Wulff, EG, Sørensen, JL, Lübeck, M, Nielsen, KF, Thrane, U & Torp, J 2010, 'Fusarium spp. associated with rice Bakanae: ecology, genetic diversity, pathogenicity and toxigenicity', *Environmental Microbiology*, vol. 12, no. 3, pp. 649-57.
- Yang, C, Zheng, L, Wu, Z & Xie, L 2013, 'Papaya leaf curl Guangdong virus and Ageratum yellow vein virus associated with leaf curl disease of tobacco in China', *Journal of Phytopathology*, vol. 161, pp. 201-4.
- Yang, J, Zheng, L, Liao, Y, Fu, Y, Zeng, D, Chen, W & Wu, W 2023, 'HCN-induced embryo arrest: passion fruit as an ecological trap for fruit flies', *Pest Management Science*, <https://doi.org/10.1002/ps.7396> [epub ahead of print], accessed 02 March 2023.
- Yang, P, Carey, JR & Dowell, RV 1994, 'Host-specific demographic studies of wild *Bactrocera tau* (Walker) (Diptera: Tephritidae)', *Pan-Pacific Entomologist*, vol. 70, no. 3, pp. 253-8.
- Young, GR & Zhang, L 1998, 'IPM of melon thrips, *Thrips palmi* Karny (Thysanoptera: Thripidae), on eggplant in the top end of the Northern Territory', *Proceedings of the Sixth Workshop for Tropical Agricultural Entomologists, Darwin, Australia, 11-15 May 1998*, Department of Primary Industry and Fisheries, Darwin, pp. 101-11.
- Yu, H, Li, R, Wang, X, Yue, Y, Liu, S, Xing, R & Li, P 2021, 'Field experiment effect on citrus spider mite *Panonychus citri* of venom from jellyfish *Nemopilema nomurai*: the potential use of jellyfish in agriculture', *Toxins*, vol. 13, 411, DOI 10.3390/toxins13060411.
- Yuan, Z, Metcalf, D, Buntain, M, Williams, W & Pan, C 2009, *Survey of blueberry diseases in Tasmania*, Department of Primary Industries and Water, Tasmania.
- Yumbya, P, Ambuko, J, Shibairo, S & Owino, WO 2014, 'Effect of modified atmosphere packaging on the shelf life and postharvest quality of purple passion fruit (*Passiflora edulis* Sims)', *Journal of Postharvest Technology*, vol. 2, no. 1, pp. 25-36.
- Zeng, Y, Reddy, GVP, Li, Z, Qin, Y, Wang, Y, Pan, X, Jiang, F, Gao, F & Zhao, ZH 2018, 'Global distribution and invasion pattern of oriental fruit fly, *Bactrocera dorsalis* (Diptera: Tephritidae)', *Journal of Applied Entomology*, vol. 143, no. 3, pp. 165-76.
- Zhang, F & Fu, YH 2004a, 'The occurrence and preventative of *Tetranychus piercei* McGregor in Hainan' (in Chinese), *South China Fruits*, vol. 6, pp. 44-7.
- -- 2004b, 'The occurrence of banana leaf mite and its control' (in Chinese), *South China Fruits*, vol. 6, pp. 44-7.
- Zhang, H, Ma, X, Qian, Y & Zhou, X 2010, 'Molecular characterization and infectivity of papaya leaf curl China virus infecting tomato in China', *Journal of Zhejiang University-SCIENCE B (Biomedicine & Biotechnology)*, vol. 11, no. 2, pp. 109-14.
- Zhang, Z, Xiao, L, Feng, H, Cheng, Z & Gao, L 2022, 'Investigation and identification of diseases and pests of passion fruit in Hainan and the damages', *Chinese Journal of Tropical Crops*, vol. 43, no. 10, pp. 2114-21. (Abstract only)

References

Zhang, ZQ 2021, 'Tenuipalpidae of Southeast Asia', *Mites in ASEAN countries*, Systematic & Applied Acarology Society, available at <http://www.acarology.org/asean/content/Tenuipalpidae.htm>.

Zhang, ZY, Ali, MW, Saqib, HA, Liu, SX, Yang, X, Li, Q & Zhang, H 2020, 'A shift pattern of bacterial communities across the life stages of the citrus red mite, *Panonychus citri*', *Frontiers in Microbiology*, vol. 11, 1620, DOI 10.3389/fmicb.2020.01620.