



Australian Government
Department of Agriculture,
Fisheries and Forestry

Pomelo fruit from Vietnam: biosecurity import requirements draft report

April 2024



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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/risk-analysis/memos.

Contents

Summary	vii
1 Introduction.....	1
1.1 Australia’s biosecurity policy framework	1
1.2 This risk analysis	1
2 Commercial production practices for pomelo fruit in Vietnam	8
2.1 Considerations used in estimating unrestricted risk.....	8
2.2 Production areas of pomelo fruit	8
2.3 Climate in production areas	10
2.4 Registration of exporting orchards and packing houses	12
2.5 Pre-harvest	13
2.6 Harvesting and handling procedures	20
2.7 Postharvest.....	20
2.8 Production and Export	25
3 Pest risk assessments for quarantine pests	26
3.1 Summary of outcomes of pest initiation and categorisation.....	26
3.2 Pests requiring further pest risk assessment	26
3.3 Overview of pest risk assessment	27
3.4 Asian citrus psyllid	29
3.5 False spider mites.....	31
3.6 Fruit flies.....	39
3.7 Mealybugs	46
3.8 Scales	48
3.9 Spider mites.....	50
3.10 Thrips.....	52
3.11 Brown rot	54
3.12 Citrus canker.....	64
3.13 Citrus scab	71
3.14 Pest risk assessment conclusions	76
4 Pest risk management	81
4.1 Pest risk management measures and phytosanitary procedures.....	81
4.2 Operational system for the assurance, maintenance and verification of phytosanitary status	87
4.3 Uncategorised pests.....	91
4.4 Review of processes	91
4.5 Meeting Australia’s food laws	92

5 Conclusion	93
Appendix A: Method for pest risk analysis	94
Appendix B: Initiation and categorisation for pests of pomelo fruit from Vietnam.....	107
Glossary, acronyms and abbreviations	168
References	174

Figures

Figure 1.1 Diagram of pomelo fruit 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 regions of pomelo in Vietnam	12
Figure 2.2 Examples of pomelo varieties grown in Vietnam.....	13
Figure 2.3 Propagation of grafted rootstock and orchard management of pomelo in Vietnam.....	15
Figure 2.4 Pomelo orchards and fruit transportation in Vietnam.....	17
Figure 2.5 Receival of pomelo fruit into packing house and washing of fruit.....	21
Figure 2.6 Preparation of fruit for packing, and packed fruit.	22
Figure 2.7 Summary of operational steps for pomelo fruit produced in Vietnam for export	24
Figure 3.1 Overview of the PRA decision process for pomelo fruit from Vietnam	80
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>	102

Tables

Table 2.1 Characteristics of some of the main pomelo fruit varieties grown in Vietnam	14
Table 2.2 Examples of pest management options for pomelo in Vietnam	19
Table 2.3 Pomelo fruit production in the different agricultural regions of Vietnam in 2014 and 2020.....	25
Table 3.1 Quarantine pests and regulated articles potentially associated with pomelo fruit from Vietnam, and requiring further pest risk assessment	26
Table 3.2 Risk estimates for <i>Diaphorina citri</i> on the Rutaceae fruit pathway	29
Table 3.3 Risk estimates for <i>Candidatus Liberibacter asiaticus</i> vectored by <i>Diaphorina citri</i> if known vectors are present or absent in Australia	30
Table 3.4 Quarantine mealybug species for pomelo fruit from Vietnam	46
Table 3.5 Risk estimates for quarantine mealybugs	46
Table 3.6 Quarantine scale insect species for pomelo fruit from Vietnam	48
Table 3.7 Risk estimates for quarantine scale insects.....	48
Table 3.8 Quarantine spider mite species for pomelo fruit from Vietnam.....	51
Table 3.9 Risk estimates for quarantine spider mites	51

Table 3.10 Thrips species identified as quarantine pests and/or regulated articles for pomelo fruit from Vietnam	52
Table 3.11 Risk estimates for emerging quarantine orthospoviruses vectored by thrips.....	52
Table 3.12 Pest risk assessment conclusions for pests, and pest groups, associated with the pathway of pomelo fruit from Vietnam	78
Table 4.1 Proposed risk management measures for quarantine pests and regulated articles potentially associated with pomelo fruit from Vietnam	82
Table A.1 Nomenclature of likelihoods	98
Table A.2 Matrix of rules for combining likelihoods	99
Table A.3 Decision rules for determining the overall consequence rating for each pest	103
Table A.4 Risk estimation matrix.....	103

Maps

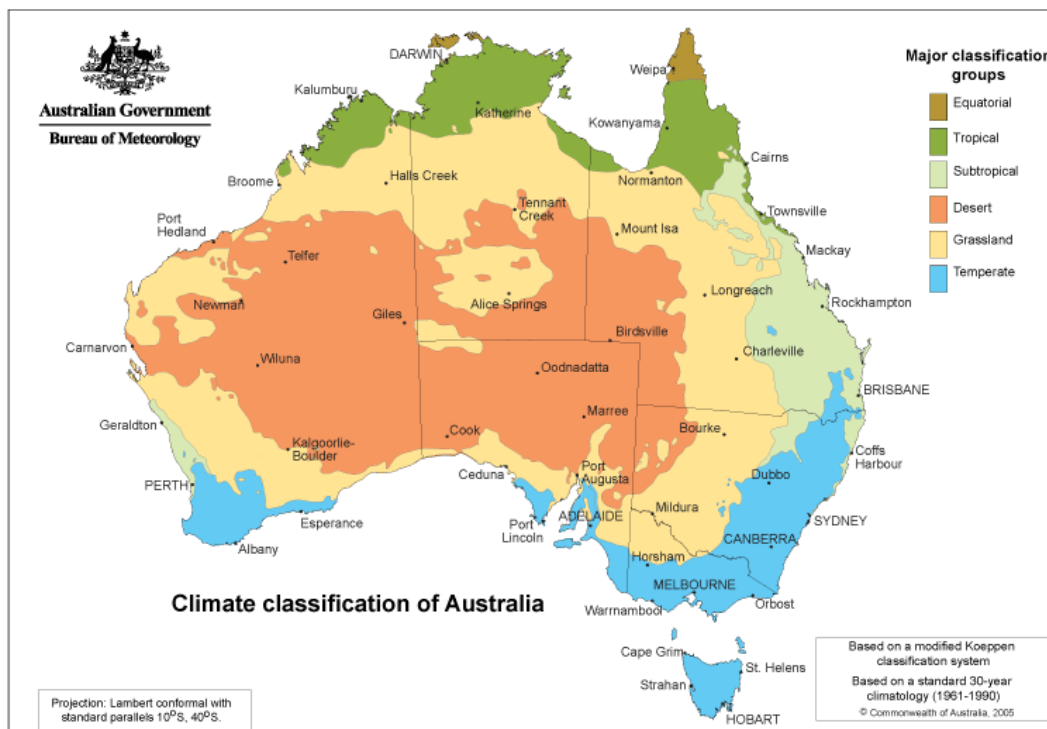
Map 1 Map of Australia.....	vi
Map 2 A guide to Australia's bio-climatic zones	vi
Map 3 Main provinces within regions that produce pomelo in Vietnam	10

Pomelo fruit from Vietnam: biosecurity import requirements draft report
Maps of Australia

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 pomelo fruit for human consumption.

Australia currently permits the importation of pomelo fruit from the USA, Israel, Spain and New Zealand for human consumption, provided Australian biosecurity import conditions are met.

This draft report determines that the importation of commercially produced pomelo fruit 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 pomelo fruit 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.

Nineteen 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:

- psyllid: Asian citrus psyllid (*Diaphorina citri*)
- false spider mites: *Brevipalpus phoenicis* species complex
- fruit flies: carambola fruit fly (*Bactrocera carambolae*), guava fruit fly (*Bactrocera correcta*), Oriental fruit fly (*Bactrocera dorsalis*), peach fruit fly (*Bactrocera zonata*), melon fly (*Zeugodacus cucurbitae*) and pumpkin fruit fly (*Zeugodacus tau*)
- mealybugs: cocoa mealybug (*Exallomochlus hispidus*), coffee mealybug (*Planococcus lilacinus*) and fruit tree mealybug (*Rastrococcus invadens*)
- scale insects: tropical grey chaff scale (*Parlatoria cinerea*), black parlatoria scale (*Parlatoria ziziphi*) and mulberry scale (*Pseudaulacaspis pentagona*)
- spider mites: citrus red mite (*Panonychus citri*) and Kanzawa spider mite (*Tetranychus kanzawai*)
- thrips: chilli thrips (*Scirtothrips dorsalis*) and onion thrips (*Thrips tabaci*)
- bacterium: citrus canker (*Xanthomonas citri* subsp. *citri*).

Of these 19 pests:

- 17 are quarantine pests, including Asian citrus psyllid and false spider mites, which were also identified as regulated articles as they are capable of vectoring pathogens that are quarantine pests for Australia. However, there are no reports of the quarantine viruses vectored by false spider mites being present in Vietnam. Therefore, the regulated article aspect of false spider mites is not applicable to pomelo fruit from Vietnam pathway.
- 2 are non-quarantine pests (chilli thrips and onion thrips) but are identified as regulated articles as they are capable of harbouring and spreading quarantine orthotospoviruses.

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.

Summary

The proposed risk management measures take account of regional differences in pest distribution within Australia. Three pests requiring risk management measures, *Panonychus citri*, *Pseudaulacaspis pentagona* and *Tetranychus kanzawai*, have been identified as regional quarantine pests for Western 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 Western Australia.

In this draft report the department proposes a range of risk management measures, combined with operational systems, to reduce the risks posed by the 19 identified species to achieve the ALOP for Australia. The proposed measures are:

- for Asian citrus psyllid:
 - pest free areas, pest free places of production or pest free production sites; or
 - a systems approach considered to be effective in mitigating the risk of this psyllid on pomelo fruit, and approved by the department; or
 - fruit treatment considered to be effective against psyllids, such as methyl bromide fumigation
- 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 false spider mites, mealybugs, scale insects, spider mite and thrips:
 - pre-export visual inspection, and if found, remedial action
- for citrus canker:
 - a systems approach considered to be effective in mitigating the risk of this pathogen on pomelo fruit, and approved by the department.

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 Australia's 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's website at 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 pomelo fruit for human consumption in a submission received in May 2022. This submission provided information on the pests associated with pomelo fruit in Vietnam, including the plant parts affected. Information was also provided on the standard commercial production practices for pomelo fruit in Vietnam.

On 28 July 2023, the department notified stakeholders of the decision to progress a request for market access for pomelo fruit from Vietnam as a review of biosecurity import requirements. This analysis is conducted in accordance with the *Biosecurity Act 2015*.

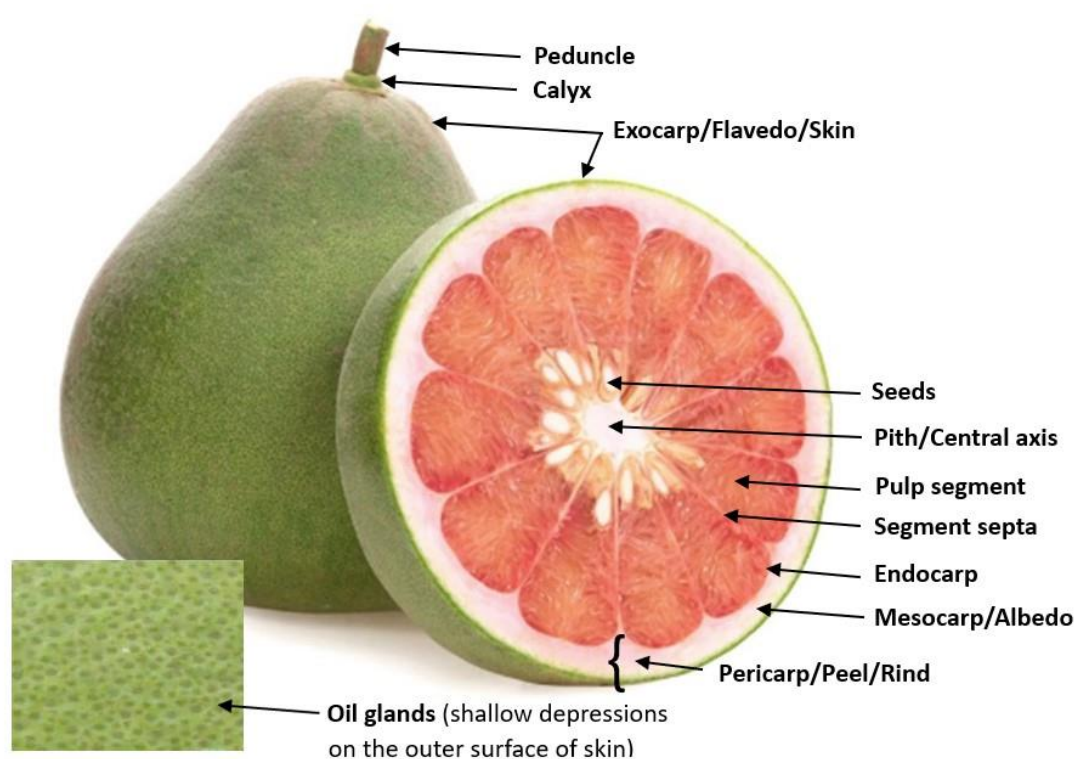
In October/November 2022, officers from the department visited production areas for pomelo fruit from Vietnam. The objective of this visit was to observe commercial production, pest management and other export practices.

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 pomelo fruit (*Citrus maxima*) from Vietnam, produced using standard commercial production practices as described in Chapter 2, for human consumption in Australia.

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

Figure 1.1 Diagram of pomelo fruit morphology



Source: adapted from Sadka et al. (2019)

1.2.3 Existing policy

International policy

Australia currently permits fresh pomelo fruit imports from the USA, Israel, Spain and New Zealand. Australia has import policies for the following horticultural commodities from Vietnam: passionfruit (DAFF 2024), longan (DAWR 2019c), dragon fruit (DAWR 2017b), mangoes (DAWR 2015) and lychees (DAFF 2013).

The biosecurity import conditions for these commodity pathways, except passionfruit which was not finalised at the time of publication, can be found in the Biosecurity Import Conditions (BICON) database on the department website at bicon.agriculture.gov.au/BiconWeb4.0.

A preliminary assessment has identified that the potential pests of biosecurity concern for pomelo fruit 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 2021a).

The biosecurity risk posed by the spider mites has been re-assessed by the department in the recently released *Draft report for a review of pest risk assessments for spider mites (Acari: Trombidiformes: Tetranychidae)* (spider mites draft Group PRA) (DAFF 2023a).

The Group policies for thrips, mealybugs and scales and the draft Group policy for spider mites are applicable for the pomelo fruit from Vietnam pathway. The department has determined that the information in these Group policies and draft Group policy can be adopted for the species under consideration in this risk analysis. The draft Group policy for spider mites and its adoption is further explained in Chapter 3 (Section 3.3 and Section 3.8).

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 pomelo 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 28 July 2023, the department notified stakeholders, in Biosecurity Advice 2023-P05, of the commencement of a review of biosecurity import requirements to assess a proposal by Vietnam for market access to Australia for pomelo fruit for human consumption.

Prior to, and following the announcement of this decision, the department engaged with Australian pomelo growers, and more broadly, the Australian citrus industry.

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

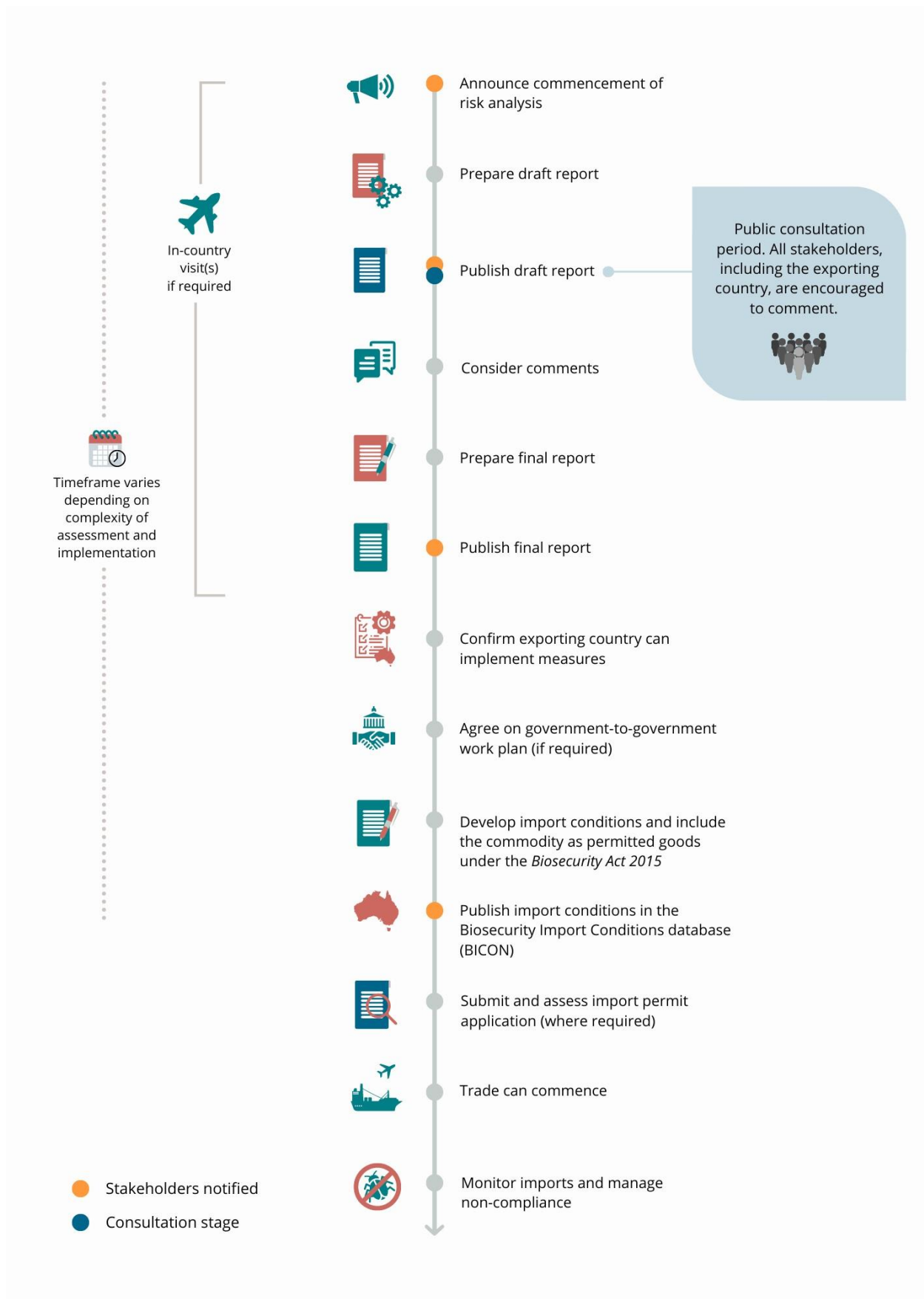
A pest risk analysis (PRA) is 'the process of evaluating biological or other scientific and economic evidence to determine whether an organism is a pest, whether it should be regulated, and the strength of any phytosanitary measures to be taken against it'. A pest is 'any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products' (FAO 2023a). 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 2019a) and ISPM 11: *Pest risk analysis for quarantine pests* (FAO 2019b), 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.

Introduction

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 it is a quarantine pest and requires further pest risk assessment.
 - 2b. Further pest risk assessment: evaluation of the likelihoods of the introduction (entry and establishment) and spread, and 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 2023a).

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 pomelo 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.

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.

Introduction

The final report will be published on the department's website along with a notice advising stakeholders of the release. The department will also notify the 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 pomelo fruit from Vietnam.

2 Commercial production practices for pomelo fruit in Vietnam

This chapter provides information on the pre-harvest, harvest and postharvest practices considered to be standard practices in Vietnam for the production of pomelo fruit for export. It also outlines the pomelo fruit production and export capacity of Vietnam.

2.1 Considerations used in estimating unrestricted risk

Vietnam provided a technical market access submission to Australia in May 2022 that included information on commercial production practices of pomelo in Vietnam.

In October/November 2022, the department officials visited a pomelo fruit producing area in Ben Tre province in the Mekong Delta region, and pomelo fruit packing houses in this province 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 pomelo fruit 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 fresh pomelo fruit from Vietnam.

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

2.2 Production areas of pomelo fruit

Pomelo is grown throughout Vietnam; however, the fruit is not grown commercially above elevations of 400 m above sea level (MARD 2022c). Commercial pomelo production is largely located in the Mekong Delta, northern midlands and mountainous (comprising North East and North West regions), South East and Red River Delta regions. The location of these production regions and the main production provinces within these regions are identified in Map 3.

The total area under pomelo commercial production has increased in recent years from approximately 50,000 ha in 2015 to 105,000 ha in 2020 (MARD 2022c), with pomelo grown across 31,926 ha, 30,558 ha, 16,297 ha and 12,664 ha respectively in the Mekong Delta, Northern Midlands and Mountainous, South East and Red River Delta regions (MARD 2022c). In 2020, pomelo was also grown across 12,965 ha and 1,393 ha in the North Central Coast and South Central Coast regions, and Central Highlands region, respectively (MARD 2022c).

Mekong River Delta region: This is a part of the Mekong Basin delta and covers an area of about 4 million hectares. The topography is typically low elevation, with most production areas at 3 to 5 m above sea level (Anh et al. 2018; MARD 2022c). As the Mekong Delta's average elevation is less than 2 m (Brown 2016), production also occurs on elevated beds in lower lying areas where frequent saltwater intrusion can be problematic for production. An integrated system of irrigation, dykes and levees are required to stabilize agricultural production and prevent

excessive flooding or saltwater intrusion (Quang 2013; Quang & Jansson 2008; Torell & Salamanca 2003).

North Central Coast: This region is divided between lowlands along the coast and upland areas. The topography of the coastal plains is typically low elevation, and some areas are only 0.2 m above sea level. Compared with other regions in Vietnam, the North Central Coast experiences a much higher proportion of extreme weather conditions due to its complex topography with mountains and a long coastline (Tran et al. 2022).

Northern Midlands and Mountainous region: This region comprises the midlands of the mountainous North East and North West regions, where numerous peaks in these ranges exceed an elevation of 2,000 m. The limestone highlands transition down to hilly lands, which is typical of the midland country where pomelo is mainly grown (MARD 2022c).

Red River Delta region: This region has a relatively flat terrain consisting mainly of flood plains with a dense system of rivers. During the monsoon season, flooding of estuaries often occurs. In the dry season (October to April) water flow in the rivers is substantially reduced (MARD 2022c). An integrated system of irrigation, dykes and levees are required to stabilize agricultural production and prevent excessive flooding or saltwater intrusion (Devienne 2006; Tu, van Gelder & Thub 2013).

South Central Coast: This region has a diverse topography with mountain ranges and hills extending along the entire border with the Central Highlands, which descend to hills and coastal plains (Dinh & Toan 2022). Due to the topography, the retention capacity of rivers and streams in the region is limited, with flooding occurring during the wet season, followed by an extended dry period (Dinh & Toan 2022).

South East region: This region has a diverse and complex topography including mountains, upland hills and lowland plains. Numerous peaks in the mountain ranges exceed an elevation of 1,500 m and the upland hilly regions comprise small valleys with rainfed agriculture. The lowland plains are characterised by meandering rivers along which irrigated crops are cultivated (Gobin et al. 2020). Commercial production of pomelo occurs primarily in the lowland plains.

Map 3 Main provinces within regions that produce pomelo in Vietnam



Source: Adapted from OnTheWorldMap (2023)

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 relatively narrower mean monthly temperature range of 23°C to 35°C (World Weather Online 2023b). The annual mean rainfall in Vietnam ranges from approximately 1,700–1,900 mm (World Bank Group 2021).

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

The Red River Delta experiences winters characterized as being cold with frequent light rainfall and minimal sunlight while summers are hot, rainy with few dry days. Mean annual temperatures in the coastal areas are around 23°C in which the coldest month has a mean temperature of 16°C to 17°C and the hottest month has a mean temperature of 28°C to 30°C. Average annual rainfall in coastal areas is approximately 1,600–1,700 mm (MARD 2022c).

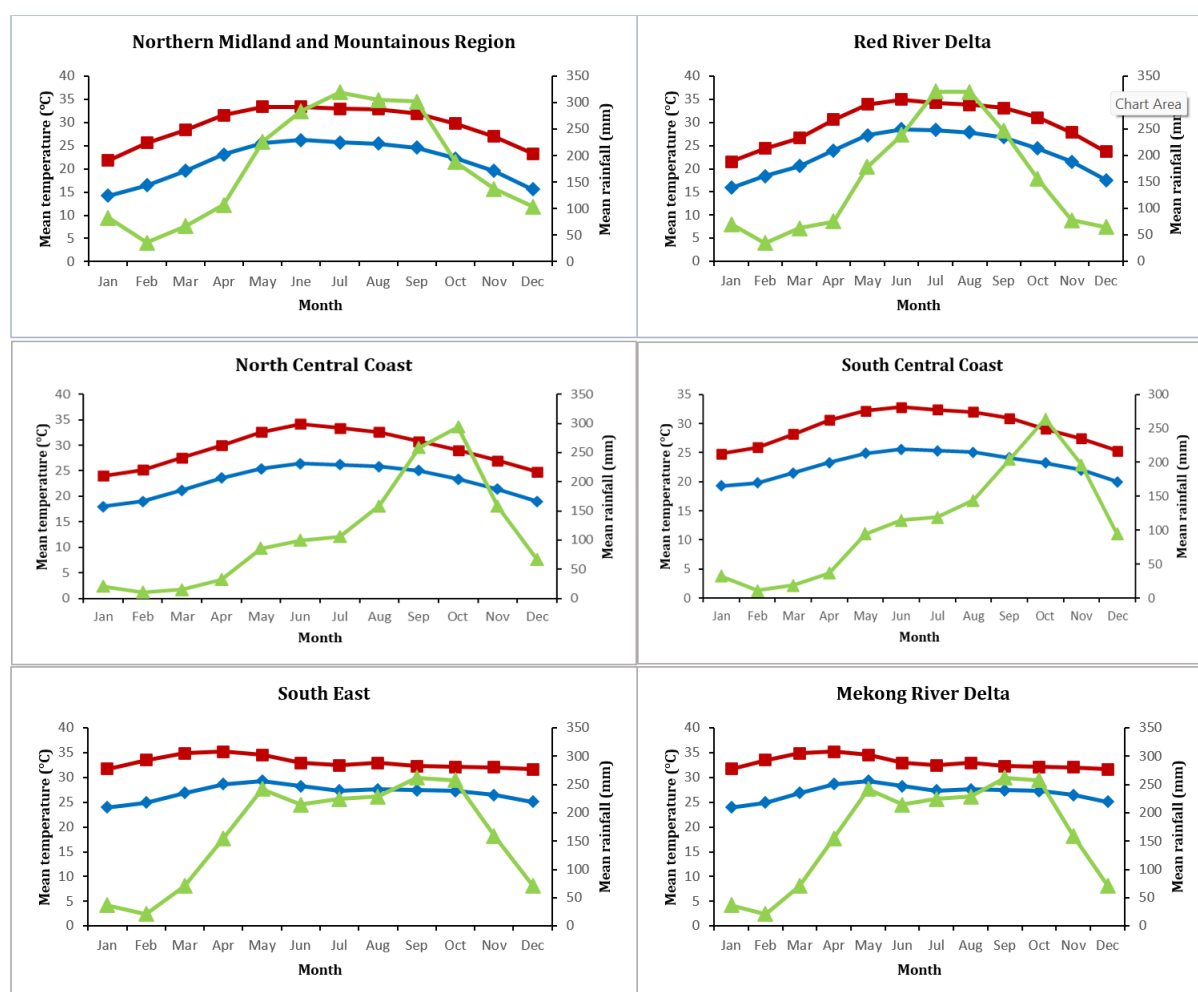
The North Central Coast region has a tropical monsoon climate with a hot, humid summer with abundant rainfall and a cold winter with little rainfall. Annual rainfall in the North Central Coast region ranges from 1,200–2,000 mm, with 123 to 152 rainy days per year (MARD 2021a). In recent years, negligible rainfall during the dry season (December to August) has increased reliance on irrigation for food production.

The South Central Coast region is affected by the tropical monsoon climate with high temperatures and humidity, and includes some of the most arid (Ninh Thuan province and Binh Thuan province) as well as some of wettest (Da Nang, parts of Quang Nam province and Quang Ngai province) climates in Vietnam (Dinh & Toan 2022; Truong, Dat & Huan 2022). The weather has two distinct seasons: a rainy season from September to November and a dry season from December to August.

The climate of the Mekong River Delta and South East regions are strongly influenced by the southwest monsoon. These regions are characterised by high temperatures year-round, with a mean annual temperature in coastal areas around 27°C. Average annual rainfall in coastal areas is approximately 1,500–2,500 mm with the rainy season occurring between May and November (MARD 2022c).

Figure 2.1 presents the average maximum and minimum temperatures and rainfall by month in the six major pomelo producing regions of Vietnam.

Figure 2.1 Mean monthly minimum and maximum temperatures and mean monthly rainfall in the main production regions of pomelo in Vietnam



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

2.4 Registration of exporting orchards and packing houses

Commercial orchards growing pomelo for export and packing houses processing pomelo fruit for export are required to register with MARD, which issues growing area codes and export packing house codes for exporting orchards and packing houses, respectively. These growing area codes and the export packing house codes must be included in the packaging and labels for exported products (Nhan Dan 2023; Vietnamese Government 2023).

Registered orchards must apply VietGAP standards. VietGAP is a system used to maintain an acceptable level of orchard hygiene and safe and effective pest management, with records maintained for the use of approved pesticides (MARD 2022b; Vietnamese Government 2023). Export registration of a packing house requires the facility to meet the requirements of the importing country and ensure traceability of all products processed in the facility (MARD 2022b).

2.5 Pre-harvest

2.5.1 Cultivars

Pomelo trees have a wide canopy. Their leaves are ovate to elliptical and larger than the leaves of other species in the citrus group. Pomelo trees flower all year round, but mainly between March and May. Each inflorescence in the axillary leaves consists of 7 to 10 large, white, and very fragrant flowers. Ripe pomelo fruit are large with a diameter of 15–30 cm and weight of 0.8–2.0 kg, with a range of skin and pulp colours, depending on variety (MARD 2022c). Characteristics of some of the main pomelo fruit varieties grown in Vietnam are shown in Figure 2.2 and Table 2.1.

Figure 2.2 Examples of pomelo varieties grown in Vietnam



Pomelo fruit varieties: (a) Luan Van; (b) Doan Hung; (c) Duong La Cam; (d) Da Xahn; (e) Nam Roi; (f) Dien. Source: MARD (2022c); Royal Green Trees (2022); VNUA (2022b)

Table 2.1 Characteristics of some of the main pomelo fruit varieties grown in Vietnam

Variety	Fruit weight (kg)	Fruit shape	Colour		Main production regions
			Exocarp (skin)	Pulp segments	
Da Xanh	1.8–2.0	Round	Green	Pinkish red	Mekong Delta
Dien	0.8–1.0	Round	Yellowish orange	Yellowish green	Red River Delta, Northern Midlands
Doan Hung	0.7–1.0	Round	Yellow	Ivory white	Red River Delta, Northern Midlands
Duong La Cam	0.8–1.2	Piriform	Yellowish green	Pale yellow	Southeast
Duong Chin Som	0.8–1.2	Round	Greenish yellow	Pale yellow	Red River Delta
Hoa Binh	0.8–1.0	Round	Greenish yellow	Pale yellow to ivory white	Northern Midlands
Hoang	1.5–2.0	Piriform	Greenish yellow	pale yellow to pearl white	Red River Delta, Northern Midlands
Luan Van	1.0–1.2	Ellipsoid	Reddish-pink	Reddish pink	North Central Coast
Nam Roi	1.4–1.8	Piriform	Greenish yellow	Pale yellow	Mekong Delta
Phuc Trach	1.0–1.2	Round	Yellowish green	Pale pink to white pulp	North Central Coast
Que Duong	1.2–1.5	Round	Yellow	Yellow	Red River Delta, Northern Midlands
Tan Lac	1.2–1.5	Round	Yellowish green	Pinkish red	Red River Delta, Northern Midlands
Tan Trieu	1.0–1.2	Round	Green	Pinkish red	Southeast
Thanh Tra	0,7–1.0	Piriform	Yellow	Pale yellow to ivory white	North Central Coast
5 Roi	1.5–1.8	Piriform	Greenish yellow	Pale yellow	Mekong Delta

Source: MARD (2022c); Royal Green Trees (2022); VNUA (2022b, 2022a)

2.5.2 Cultivation practices

Disease-free nursery stock

Commercial orchards only plant certified disease-free grafted trees that are propagated at nurseries accredited by Vietnam's Crop Production Department, as shown in Figure 2.3. Pomelo trees are propagated by grafting disease free scions onto nursery grown rootstocks that have been selected for disease resistance, vigour, and varietal quality traits. The production of certified disease-free citrus plant material in Vietnam is supervised by the Plant Protection Research Institute (MARD 2017). The process involves testing of plant material using molecular methods such as PCR and ELISA, and a 3-level screen house system before supplying for production.

For newly established pomelo orchards, suitable site selection, use of certified disease-free scions grafted onto *Phytophthora* disease-resistant rootstock, vector control, and pest and

disease management are important to the overall success of an integrated management approach against important diseases such as citrus greening and tristeza of citrus (MARD 2017).

Orchard design

An earth mound of approximating 40–60 cm high and 80–100 cm in diameter is prepared about 2 to 4 weeks prior to planting. Mounds comprise soil mixed with compost and limestone powder. At the time of planting, a hole is dug into the centre of the mound where an additional 200 g of diammonium phosphate fertiliser and a thin layer of soil is added prior to the grafted plant being planted.

The recommended average planting (grid) distance is 4–5 m x 5–6 m (equivalent to planting density of about 350 to 500 plants/ha). Wind breaks (e.g., high Chinese hibiscus, mango or coconut plants) are planted around the orchard perimeter, in east and southwest directions to provide protection to the young growing plants from prevailing high winds (MARD 2021b).

Figure 2.3 Propagation of grafted rootstock and orchard management of pomelo in Vietnam



Seedling propagation and orchard management: (a)–(b) pomelo seedlings propagated within insect proof greenhouses; (c) young pomelo trees planted; (d) new commercial pomelo orchard; (e) use of plastic sheeting to manage weed growth around trunk of pomelo trees. Source: MARD (2022b)

Irrigation

Pomelo trees need adequate moisture levels in the root zone, especially during seedling growth, flowering, and fruiting (MARD 2021b). Drainage ditches and rings of raised earth are used to help control the amount of water that reaches and remains near each tree. It is recommended to allow soils to become relatively dry leading into flowering to reduce the number of flower buds formed per branch and effectively increase fruit size at harvest. Pomelo trees can defoliate in response to unfavourable soil conditions, where soils have been allowed to become excessively dry or waterlogged for an extended period. Pomelo orchards often require irrigation during the dry season (MARD 2021b).

Application of fertiliser

Depending on the stage of growth and development of pomelo trees, the following fertiliser application program is generally adopted for pomelo production.

For trees at 1 to 3 years of age, phosphorus and diammonium phosphate fertilisers are applied to the base of trees. Nitrogen fertiliser (e.g., urea) is applied at the rate of 10–20 g per tree every 1 to 2 months (MARD 2001, 2021b, 2022c, b).

For mature pomelo trees, fertiliser is applied:

- 4 weeks before flowering – nitrogen, phosphorus and potassium fertilisers
- after fruiting – nitrogen, phosphorus and potassium fertilisers
- during fruit development – nitrogen and potassium fertilisers
- 1 month prior to harvest – potassium fertiliser
- after harvest – nitrogen, phosphorus, and an organic fertiliser.

In addition, 0.5–1.0 kg of calcium fertiliser is also applied per tree after harvest, before flowering and after fruit set (MARD 2021b, 2022c, b).

Organic fertiliser is progressively replacing or supplementing chemical fertilisers in Vietnam. Organic fertiliser is applied at the rate of 15–30 kg per tree per year to mature pomelo trees. Limestone powder is also used to assist control of pathogens. In addition, compost is applied together with phosphorous and nitrogenous fertilisers.

Figure 2.4 Pomelo orchards and fruit transportation in Vietnam



Pomelo orchards and transportation: (a) flowering (developing fruitlet [ovary] at base of flower; (b) poles supporting branches bearing Nam Roi pomelo; (c) harvesting pomelo fruit; (d) pomelo fruit ready for road and (e) river transport. Source: MARD (2022b); VNUA (2022b, 2022a)

Pruning and tree management

Creating a tree with an open centre gives high yields and long-term production. A canopy management program involving pruning to enable lateral branches to develop, and then selecting around 3 strong, straight branches to grow from the main stem, forms the basis of an

open canopy. With this program, the tree will have a balanced canopy after 3 years. Mature trees are pruned annually following harvest. This involves removing branches that have produced fruit, branches that show disease symptoms or are weak in appearance, and branches growing back into the canopy, which would not bear fruit. Overhanging branches are also removed while the tree is bearing fruit. Bamboo or timber poles are often used in pomelo orchards to support fruit bearing branches (Figure 2.4b).

Pruning equipment is sterilised by soaking equipment in a 10% sodium hypochlorite (NaOCl) solution for a minimum of 30 minutes, or wiping with, or dipping equipment into 90% alcohol (MARD 2001).

Weed suppression is important during plant growth to avoid competition (MARD 2023b). The soil surface is largely kept free of weeds around the root zone during growth of young trees (Figure 2.3c), and mulching (e.g., rice straw) is also used to retain moisture during the dry season. Mulches or plastic sheeting (Figure 2.3e) are used for mature trees to suppress weeds and retain moisture.

Pomelo fruit yield

In Vietnam, average pomelo fruit yield is around 12.5 tonne/ha, depending on the variety, soil condition and cultivation methods. Pomelo trees begin to produce flowers in about 5 years from planting and are most productive at about 10 years old. The fruit production declines after 20 years. Each tree can produce 200 to 300 fruit annually.

2.5.3 Pest management

Each province in Vietnam is serviced by staff from the Crop Production Department and PPD for general agronomic and pest management guidance. Pomelo growers receive advice on agronomic techniques to improve the productivity of their orchards. This includes pruning techniques, fertiliser and water use, safe and effective use of approved pesticides, and general farm hygiene. The local PPD officers conduct regular pest surveys of pomelo farms, on at least a monthly basis (MARD 2023b). Officers focus on key pests and diseases, and provide recommendations for pest management practices (MARD 2021a). Orchard sanitation is also frequently carried out under guidance of local PPD officers.

Local PPD officers also play an important role in educating and regulating the nurseries and packing houses. Commercial pomelo growers in Vietnam are increasingly achieving VietGAP and Global GAP certification, which covers production processes, food safety, sustainable agriculture, and soil and environmental protection.

Integrated pest management is increasingly adopted by pomelo growers in Vietnam. Trees are inoculated with the antagonistic fungus *Trichoderma* spp. which can reduce disease incidence caused by pathogens such as *Phytophthora palmivora*, *Rhizoctonia solani*, *Fusarium* spp., *Sclerotium rolfsii* and *Pythium* spp. (Ha 2010). Biocontrol agents such as the entomophagous fungi, *Beauveria bassiana* and *Metarhizium* spp., are reported to have high effectiveness against selected pests, including *Toxoptera citricidus* (black citrus aphid) and *Diaphorina citri* (Asian citrus psyllid) (Loc et al. 2010).

Biopesticides formulated from different plant extracts are also used with some success. Neem (*Azadirachta indica*) oil and mineral oil sprays are effectively used as part of integrated pest management programs to manage aphids, whiteflies, mealybugs, scale insects, false spider mites,

spider mites, psyllids and thrips (Ha 2010). Bagging of developing fruit (after fruit set) is practised on some farms, contributing to risk mitigation of fruit flies and lepidopteran pest species (MARD 2001, 2022c, b; Xia et al. 2019).

Arthropod pest populations are monitored using yellow sticky or light traps, which allows strategic use of chemical insecticides when population levels exceed the threshold limit established for a local production area or province (MARD 2021b). Pheromone traps and protein hydrolysate baits are used to manage fruit fly populations (MARD 2022c, b). Fungicides are used in a preventative manner to reduce potential damage and yield losses caused by fungal diseases. These fungicides are applied at growth stages when trees are most susceptible to infection, or when prevailing weather is conducive to the development and spread of inoculum (MARD 2021b).

Examples of pest management techniques for pomelo in Vietnam are listed in Table 2.2.

Table 2.2 Examples of pest management options for pomelo in Vietnam

Pest/pathogen	Management method
Citrus fruit borer (<i>Citripestis sagittiferella</i>)	Collect and dispose of all infested fruit. Cover (bagging) fruit after fruit setting, combined with removal of damaged and inferior quality fruit. Strategic release of <i>Trichogramma</i> parasitic wasps at the time of egg laying. Apply petroleum oil spray.
Citrus leafminer (<i>Phyllocnistis citrella</i>)	Prune trees to achieve more uniform young leaf flushes. Preventative spray program: spray entire surface of young leaves with lambda-cyhalothrin, methomyl, profenofos or thiamethoxam.
Citrus rind borer (<i>Prays endocarpa</i>)	Collect and dispose of infested fruit. Cover (bagging) fruit after fruit setting, combined with removal of damaged and inferior quality fruit. Preventative spray program: apply mineral oils or insecticide treatment to young fruit, 2 times, 5 to 7 days apart.
Fruit flies (<i>Bactrocera</i> spp. and <i>Zeugodacus</i> spp.)	Integrated pest management program, including cultural practices (e.g., bagging fruit, orchard hygiene), use of sticky traps for monitoring, pheromone/insecticide traps for mass trapping, and protein bait/insecticide sprays.
Long-horned beetle (<i>Chelidonium argentatum</i>)	After harvest, whitewash (hydrated lime mixed with water) is applied by brush to the trunk and exposed lower branches to kill eggs. Insecticide solution (fenitrothion or methidathion) injected into visible holes, which are then sealed.
Fruit tree mealybug (<i>Rastrococcus invadens</i>)	Pruning and removing infested shoots. Preventative spray program: foliar treatment of cypermethrin or etofenprox applied to young leaves when mealybug numbers increase.
Chilli thrips (<i>Scirtothrips dorsalis</i>)	Preventative spray program: foliar treatment containing insecticide (abamectin, emamectin benzoate, imidacloprid or pymetrozine), applied when threshold levels are reached.
Citrus red mite (<i>Panonychus citri</i>)	Preventative spray program. Foliar treatment containing fenpyroximate or propargite applied every 5 to 7 days when mite threshold levels are reached.
Asian citrus psyllid (<i>Diaphorina citri</i>)	Cultural practices (orchard hygiene, pest monitoring, trees pruned to open centre), insecticide/cover spray options less toxic to beneficial mites and insects, integrated with strategic foliar application of mineral oils or insecticides (buprofezin, cypermethrin, methidathion, imidacloprid or fenvalerate/dimethoate).
Kanzawa spider mite (<i>Tetranychus kanzawai</i>)	Cultural practices (orchard hygiene, pest monitoring, good irrigation, trees pruned to open centre), insecticide/cover spray options less toxic to beneficial mites and insects, integrated with strategic foliar application of mineral oils or insecticides (abamectin, acrinathrin, diafenthiuron, fenpyroximate, hexythiazox or propargite).
<i>Phytophthora citrophthora</i>	Collect and dispose of fallen and diseased fruit. Bordeaux solution (calcium hydroxide, copper sulfate) sprayed onto tree trunks, branches and foliage. Foliar sprays of other fungicides include fosetyl aluminium, difenoconazole/propiconazole or metalaxyl M/mancozeb.

Citrus canker (<i>Xanthomonas citri</i> subsp. <i>citri</i>)	Use disease-free plant material. Remove and dispose of infected branches on detection. Apply foliar spray of fungicides containing copper hydroxide or copper oxychloride every 2 weeks from flower bud development through to fruit ripening.
Citrus greening, Huanglongbing (<i>Candidatus Liberibacter asiaticus</i>)	Provincial establishment of pathogen-free nursery system and IPM in orchards: cultivation of healthy citrus plant material, management of insect vector (<i>Diaphorina citri</i>) and its host plants.
Tristeza of citrus (<i>Citrus tristeza closterovirus</i> [CTV])	Provincial establishment of pathogen-free nursery system and IPM in orchards: cultivation of healthy citrus plant material, management of insect vectors (<i>Aphis gossypii</i> , <i>Myzus persicae</i> , <i>Toxoptera citricidus</i>) and their host plants.

Source: Loc (2021); MARD (2001, 2021b, 2022b); Thai and Sang (2017); Trung, Hong and Vien (2005)

2.6 Harvesting and handling procedures

The range of growing locations, climates and varieties enable pomelo fruit to be harvested all year round, with a peak season from September to the end of November for early ripening varieties, from November to the end of December for normal ripening varieties, and from January to February for late ripening varieties (MARD 2022c). Pomelo fruit are hand-harvested 6 to 7 months after flowering, preferably on cool days without extreme sunlight, fog or rain (MARD 2022c). Fruit are harvested using clean snips and secateurs and placed into buckets, bags or wheeled carts (Figure 2.4c), which are then taken to a primary collection point such as the edge of the orchard.

Harvested fruit are usually pre-sorted in the orchard by hand on tarpaulins and export quality fruit are selected based on size and quality (no damage or marks). Export quality fruit destined for the packing house are packed into crates lined with paper to protect them from damage. Crates of harvested pomelo fruit are transported directly to the packing house.

There are two ways of transportation from orchard to packing house. Where pomelo orchards are easily accessible, trucks (Figure 2.4d) transport pomelo fruit directly from orchards to packing houses for processing and packing. Where pomelo orchards cannot be easily accessed, boats (Figure 2.4e) or small vehicles may be used to transport the pomelo fruit to a location where a larger vehicle has access to load the fruit or, for small vehicles, to the packing house directly (MARD 2022c).

2.7 Postharvest

2.7.1 Packing house processes

There are many packing houses in Vietnam that process and pack pomelo fruit for export.

The processing steps for export quality pomelo fruit at the packing house (Figure 2.5, Figure 2.6) involve:

- unloading of transported fruit, preliminary inspection of fruit, and storing of fruit in the packing house receival area prior to further processing
- initial visual sorting and grading of fruit for size, quality and maturity, and removal of any damaged or blemished fruit, including fruit with visible signs of insect and mite damage, or visible symptoms of disease
- initial washing of fruit in a clean water bath

- disinfection – treatment of fruit for approximately 5 minutes in a water bath containing 200 ppm chlorine solution, which is replaced after treatment of approximately 3 t of fruit (Figure 2.5c)
- rinsing of fruit under high pressure water spray or in a water bath (Figure 2.5d)
- fan-forced-air drying and brushing of fruit
- coating of fruit in a natural or synthetic polyethylene wax solution, followed by drying
- moving fruit into a secure packing area
- final visual quality checks of fruit
- weighing and placing of individual fruit in a foam net and/or meshed bag and then packing into lined cardboard boxes (6 to 8 fruit per box)
- cold storage of packed fruit until they are transported to the port of export
- despatch.

Figure 2.5 Receival of pomelo fruit into packing house and washing of fruit



Packing house processes: (a) bulk receipt of pomelo fruit into packing house; (b) initial inspection prior to washing; (c) chlorine disinfection in a turbulent water bath; (d) final wash rinse using pressure sprays. Source: Chánh Thu Fruits (2023); MARD (2022c); Vietpacking (2023)

The washing, disinfection and drying steps may be carried out manually and/or by machine. A mechanised pressure spray or dip system is used to apply a wax solution coating to pomelo fruit. The pomelo fruit may undergo further disinfestation/disinfection treatment prior to export, if required by the importing country (MARD 2022c).

Fresh fruit of Da Xanh and Nam Roi varieties have a postharvest shelf life of up to 6 months when appropriately handled and stored at 2°C to 8°C and 85 to 95% relative humidity (Chánh Thu Fruits 2023; Viet Quality 2022). The optimal storage conditions for other pomelo fruit varieties may vary due to variation in susceptibility to chilling injury when held at low temperatures for a prolonged period.

Figure 2.6 Preparation of fruit for packing, and packed fruit.



Packing house processes: (a) covering pomelo fruit with protective netting; (b) packed cartons contain 6 to 8 pomelo fruit.
Source: Hoa Lac 24/7 (Hanoi); Kinh Te Nong Thon – Rural Economic Magazine (Hanoi)

2.7.2 Phytosanitary inspection

Phytosanitary inspection is performed by PPD inspection officers at a dedicated area in the packing house or treatment facility. 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.

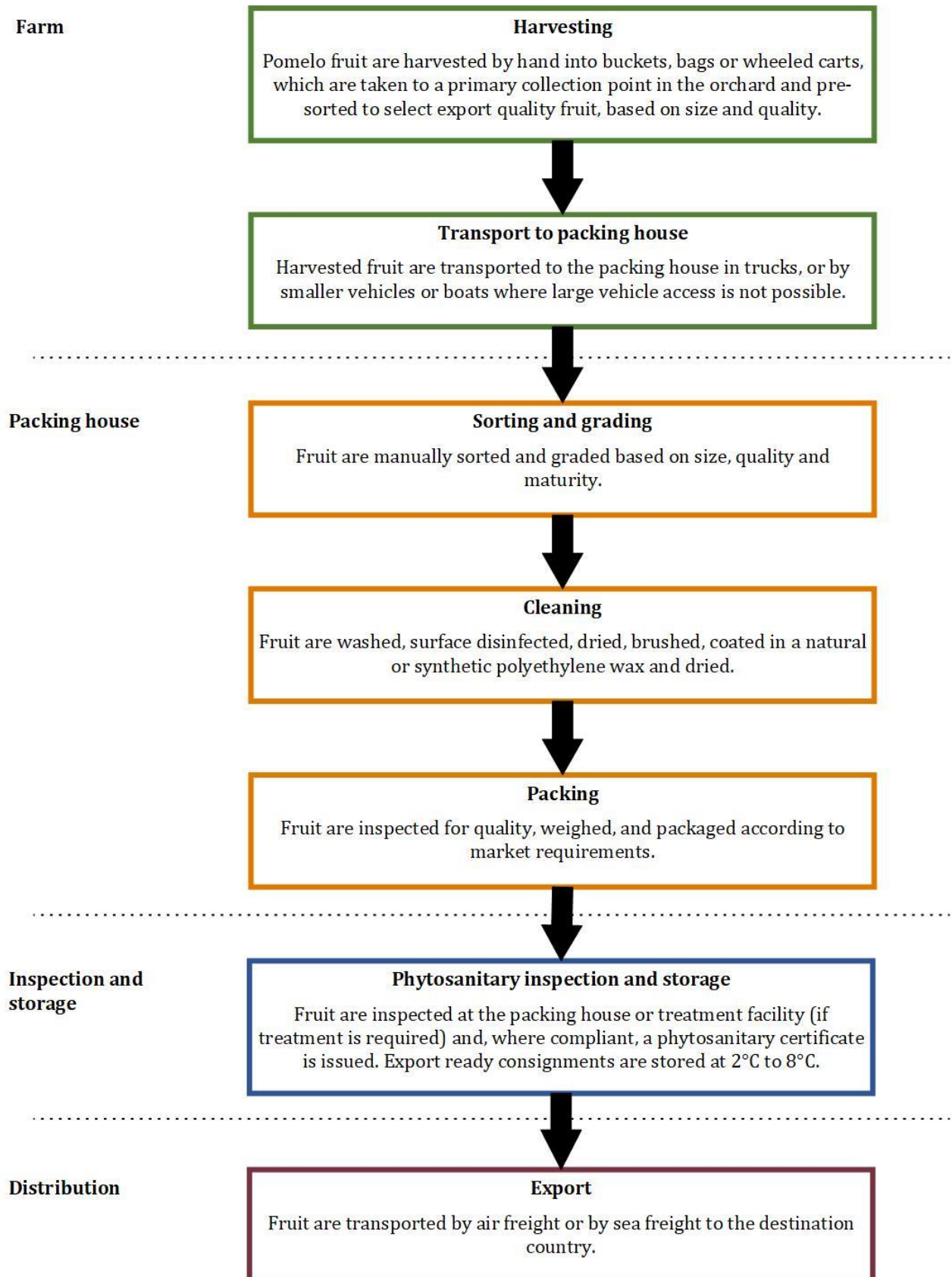
2.7.3 Transport

Export consignments are loaded into trucks, sealed and transported directly to the airport or seaport.

Recommended conditions during storage and transit are a temperature of 2°C to 8°C and relative humidity of 85 to 95% (Viet Quality 2022).

A summary of the operational steps for pomelo fruit produced in Vietnam for export is provided in Figure 2.7.

Figure 2.7 Summary of operational steps for pomelo fruit produced in Vietnam for export



2.8 Production and Export

2.8.1 Production statistics

Total pomelo fruit production in Vietnam increased from 184,669 t in 2014 to 903,197 t in 2020 (MARD 2022c). Production in tonnes for the different regions is shown in Table 2.3 below.

Table 2.3 Pomelo fruit production in the different agricultural regions of Vietnam in 2014 and 2020

Production Region	Pomelo fruit production (tonnes)	
	2014	2020
Mekong Delta	32,382	329,193
Northern midlands and mountainous	6,241	204,457
Red River Delta	75,921	165,314
South East	31,821	99,855
North Central Coast	34,589	91,218
South Central Coast	2,177	9,166
Central Highlands	1,540	3,994
Total	184,669	903,197

2.8.2 Export statistics

The major export markets for fresh pomelo fruit from Vietnam are the USA, the European Union and Hong Kong, with exports also to mainland China, Canada, Chile, Japan, Kuwait, Malaysia, Oman, Russia, Singapore, United Arab Emirates and United Kingdom (MARD 2022c). Annual export volume is approximately 5,000 t. Varieties that are currently exported include Dien and Tan Lac, which are mainly produced in the Red River Delta and Northern Midlands production regions, and Nam Roi and Da Xanh, which are mainly produced in the Mekong Delta production region (MARD 2022c).

2.8.3 Export season

Pomelo fruit are harvested all year round in Vietnam, with a peak season from September to February (MARD 2022c, b). Although it is expected that exports to Australia would primarily occur during peak production periods, exports could occur throughout the year (MARD 2022c).

3 Pest risk assessments for quarantine pests

3.1 Summary of outcomes of pest initiation and categorisation

The initiation process (Appendix B) identified 116 pests as being associated with pomelo fruit in Vietnam.

Of these 116 pests, the pest categorisation process (Appendix B) identified:

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

The remaining 21 pests were assessed as having potential to establish, spread and cause consequences in Australia, and therefore requiring further pest risk assessment.

In applying the Group PRAs, 2 thrips, 3 mealybugs, 2 spider mites 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 21 pests associated with commercially produced pomelo fruit for export from Vietnam, identified as requiring further pest risk assessment are listed in

Table 3.1.

Of these 21 pests:

- 19 are quarantine pests
 - 2 of the 19 quarantine pests are also regulated articles for Australia as they can vector quarantine pathogens
 - 3 of the 19 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
- 2 are regulated articles for Australia as they can vector quarantine viruses.

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

Pest/pest group	Scientific name	Common name	Policy status/region
Asian citrus psyllid [Hemiptera: Liviidae]	<i>Diaphorina citri</i> a	Asian citrus psyllid	EP
False spider mite [Acariformes: Tenuipalpidae]	<i>Brevipalpus phoenicis</i> species complex a		EP
Fruit flies [Diptera: Tephritidae]	<i>Bactrocera carambolae</i>	carambola fruit fly	EP
	<i>Bactrocera correcta</i>	guava fruit fly	EP
	<i>Bactrocera dorsalis</i>	Oriental fruit fly	EP

Pest/pest group	Scientific name	Common name	Policy status/region
	<i>Bactrocera zonata</i>	peach fruit fly	EP
	<i>Zeugodacus cucurbitae</i>	melon fly	EP
	<i>Zeugodacus tau</i>	pumpkin fruit fly	EP
Mealybugs [Hemiptera: Pseudococcidae]	<i>Exallomochlus hispidus</i>	cocoa mealybug	GP
	<i>Planococcus lilacinus</i>	coffee mealybug	GP
	<i>Rastrococcus invadens</i>	fruit tree mealybug	GP
Scale insects [Hemiptera: Diaspididae]	<i>Parlatoria cinerea</i>	tropical grey chaff scale	GP
	<i>Parlatoria ziziphi</i>	black parlatoria scale	GP
	<i>Pseudaulacaspis pentagona</i>	mulberry scale	GP, WA
Spider mite [Acariformes: Tetranychidae]	<i>Panonychus citri</i>	citrus red mite	DGP, WA
	<i>Tetranychus kanzawai</i>	Kanzawa spider mite	DGP, WA
Thrips [Thysanoptera: Thripidae]	<i>Scirtothrips dorsalis</i>	chilli thrips	GP, RA
	<i>Thrips tabaci</i>	onion thrips	GP, RA
Bacterium [Xanthomonadales: Xanthomonadaceae]	<i>Xanthomonas citri</i> subsp. <i>citri</i>	citrus canker	EP
Chromalveolata [Peronosporales: Peronosporaceae]	<i>Phytophthora mekongensis</i>	brown rot	
Fungus [Myriangiales: Elsinoaceae]	<i>Elsinoë fawcettii</i>	citrus scab	EP

a: Quarantine pest species that is also identified as a regulated article for Australia as it vectors quarantine pathogens. **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. **DGP:** Species has been assessed previously in a draft Group PRA, and the draft Group PRA has been applied. **RA:** Regulated article. **WA:** Regional quarantine pest for Western Australia.

3.3 Overview of pest risk assessment

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

All of the pest groups and most of the 21 identified pests 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 pomelo fruit 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 pomelo fruit from Vietnam.

The biosecurity risk posed by soft and hard scale insects was previously assessed for all countries in the scales Group PRA (DAWE 2021a), which has been applied to this assessment of pomelo fruit 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 quarantine pests and/or regulated articles in this chapter for convenience.

The biosecurity risk posed by the spider mites has been re-assessed by the department in the recently released *Draft report for a review of pest risk assessments for spider mites (Acari: Trombidiformes: Tetranychidae)* (draft spider mite review) (DAFF 2023a). The approach used in the draft spider mite review is consistent with that applied to the Group PRAs for thrips (DAWR 2017a), mealybugs (DAWR 2019a) and scale insects (DAWE 2021a). Therefore, the draft spider mite review is regarded as a draft Group PRA (acronym DGP) for spider mites. A summary of assessment from the draft Group PRA for spider mites is presented in this chapter (Section 3.9) for convenience.

A summary of the likelihood, consequence and URE ratings obtained in each pest risk assessment is provided in Table 3.12. 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 Overview of the PRA decision process for pomelo from Vietnam.

3.4 Asian citrus psyllid

Diaphorina citri (EP, RA)

The biosecurity risks posed by *Diaphorina citri* and the bacteria it can vector have been previously assessed by the department in the *Final pest risk analysis report for 'Candidatus Liberibacter species' and their vectors associated with Rutaceae* (DAFF 2011). This pest risk analysis assessed the unrestricted risk for *D. citri* on the fresh fruit pathway and for bacteria vectored by *D. citri* as not achieving the ALOP for Australia. Therefore, *D. citri* requires specific risk management measures on fresh fruit pathways.

Diaphorina citri belongs to the family Liviidae in the order Hemiptera and is exclusively associated with the Rutaceae family (CABI 2024; EFSA Panel on Plant Health et al. 2021). Most of its major hosts are commercial citrus varieties such as sweet oranges, lemons, rough lemon, mandarins, pomelo, sour orange, grapefruit and limes (Aubert 1990; CABI 2024; Tsai & Liu 2000).

In Vietnam, *D. citri* is associated with pomelo (MARD 2022b, c) and the pest can vector 'Candidatus Liberibacter asiaticus', the causal agent of Huanglongbing (citrus greening disease), which results in damaging symptoms (Bové 2006). Infected leaves show a mottled or blotchy appearance at the initial stage and the yellowing spreads to other parts of the tree, followed by dieback. Infected trees senesce within 3–5 years (Bové 2006; CABI 2024; Tsai & Liu 2000).

Management of citrus greening requires an increased effort to manage the vector, including increased insecticide applications (Grafton-Cardwell et al. 2006; Grafton-Cardwell, Stelinski & Stansly 2013), and the removal of infected trees (Gottwald 2010), significantly increasing the cost of production.

The department has reviewed the latest literature—for example, Bové (2006); CABI (2024); EFSA Panel on Plant Health et al. (2021); Grafton-Cardwell, Stelinski and Stansly (2013); MPI NZ (2022). No new information has been identified that would change the unrestricted risk from that of the previous assessment for *D. citri* on imported fruit and 'Ca. L. asiaticus' vectored by *D. citri* (DAFF 2011).

Therefore, the following unrestricted risks previously estimated for *D. citri* on imported fruit (Table 3.2) and 'Ca. L. asiaticus' vectored by *D. citri* (Table 3.3) have been adopted in the current risk analysis.

Table 3.2 Risk estimates for *Diaphorina citri* on the Rutaceae fruit pathway

Risk component	Rating for quarantine Asian citrus psyllid
Likelihood of entry (importation x distribution)	Moderate (Moderate x High)
Likelihood of establishment	High
Likelihood of spread	High
Overall likelihood of entry, establishment and spread	Moderate
Consequences	High
Unrestricted risk	High

Table 3.3 Risk estimates for '*Candidatus Liberibacter asiaticus*' vectored by *Diaphorina citri* if known vectors are present or absent in Australia

Risk component	Rating for '<i>Candidatus Liberibacter asiaticus</i>' vectored by Asian citrus psyllid if known vectors are present in Australia	Rating for '<i>Candidatus Liberibacter asiaticus</i>' vectored by Asian citrus psyllid if known vectors are absent in Australia
Likelihood of entry (importation x distribution)	Moderate (Moderate x High)	Moderate (Moderate x High)
Likelihood of establishment	High	High
Likelihood of spread	High	Very low
Overall likelihood of entry, establishment and spread	Moderate	Very low
Consequences	High	High
Unrestricted risk	High	Low

The URE for *D. citri* on the pomelo fruit from Vietnam pathway is assessed as **High**, which does not achieve the ALOP for Australia. The UREs for '*Ca. L. asiaticus*' vectored by *D. citri* on the pomelo fruit from Vietnam pathway are assessed as **Low** or **High**, which do not achieve the ALOP for Australia. Therefore, specific risk management measures are required for *D. citri* on this pathway.

3.5 False spider mites

***Brevipalpus phoenicis* species complex (EP)**

Historically, *Brevipalpus phoenicis* was reported in Australia (APPD 2023; Smiley & Gerson 1995). However, Beard et al. (2015) showed that *B. phoenicis* is a complex of at least 8 species, with *B. papayensis* and *B. yothersi* the only 2 species in the complex present in Australia. Therefore, the *B. phoenicis* species complex is identified as a quarantine pest for Australia.

Brevipalpus phoenicis is reported in Vietnam (PPD 2010b; Zhang 2021) and surrounding countries (CABI 2023a; DOA Thailand 2005). Because it is not clear which species in the complex are present in Vietnam, the *B. phoenicis* species complex present in Vietnam is considered to be of biosecurity concern to Australia.

The *B. phoenicis* species complex is also identified as a regulated article for Australia as it is known to vector economically important cileviruses and dichorhaviruses, including citrus leprosis viruses, passionfruit green spot virus and coffee ringspot virus (Ferreira et al. 2020; Freitas Astúa et al. 2018; Kitajima, Chagas & Rodrigues 2003; Kitajima et al. 2020; Nunes et al. 2018), some of which have been assessed as quarantine pests for Australia. However, there is no report of citrus leprosis viruses, passionfruit green spot virus or coffee ringspot virus being present in Vietnam (Ramos-González et al. 2020), and therefore the risk associated with the vector component of *B. phoenicis* species complex is not assessed here. In line with Section 4.4.2, the department will assess the risk associated with the vector component of *B. phoenicis* species complex for pomelo from Vietnam pathway if there is information to suggest that the status of quarantine viruses vectored by this species complex in Vietnam has changed.

The *B. phoenicis* species complex belongs to the family Tenuipalpidae. Tenuipalpid mites superficially appear very similar to spider mites, although they lack the ability to produce silk webbing, and are therefore commonly referred to as false spider mites or flat mites (Childers & Denmark 2011). Species in the complex are reported from many parts of the world including Africa, Asia, Europe, South America and the USA (Beard et al. 2015).

The eggs of *B. phoenicis* are approximately 0.1 mm long, oval and bright red (Hill 2008). The eggs are laid on the underside of leaves or in young bark crevices (Hill 2008). Eggs adhere to any surface and are difficult to remove from the plant (Childers & Rodrigues 2011; Haramoto 1969). Eggs hatch after about 10 days (Hill 2008).

The larva, protonymph and deutonymph stages of *B. phoenicis* are all active stages that feed and disperse (Martin Kessing & Mau 1992). There is a dormant immobile stage called a chrysalis between each of the life stages (Childers & Rodrigues 2011). The adult is also active, approximately 0.3 mm long, and predominantly female, with males being rare (Haramoto 1969). The species reproduces asexually via parthenogenesis producing only female progeny (Martin Kessing & Mau 1992).

The life cycle of the mite is approximately 6 weeks (Hill 2008). However, the duration of the life cycle is dependent on temperature, with laboratory studies recording egg to adult development from 18 days at 30°C, to 50 days at 20°C (Haramoto 1969; Martin Kessing & Mau 1992).

The species feeds predominantly on leaves (Gupta 1985; Hill 2008) but will move to feed on other parts of the host plant, including fruit, when population densities are high (Haramoto

1969). Feeding causes chlorosis, blistering, bronzing or necrotic areas on host tissues, which subsequently impacts plant growth and development (Childers, French & Rodrigues 2003).

Brevipalpus phoenicis is polyphagous and has been recorded on a number of fruit, vegetable and ornamental species, including important crops such as citrus, passionfruit, tea, stone fruit, grapes, coffee, rubber, papaya, squash, persimmon and guava (Childers, Rodrigues & Webourn 2003; Hill 2008).

Pomelo is reported as a host for *B. phoenicis* in Africa and Asia (Childers, Rodrigues & Webourn 2003; Maity & Mondal 2023). *Brevipalpus phoenicis* has also been reported on citrus in the USA (Florida and Texas), Mexico, Cuba, Trinidad, Argentina, Brazil, Venezuela, Aden, Ethiopia, Egypt, Spain, Syria, India, and the Philippines (Alves, Casarin & Omoto 2005; Knorr & Denmark 1970; Rodrigues et al. 2000).

The risk scenario of biosecurity concern is that the eggs, larvae, nymphs or adults of the *B. phoenicis* species complex may be present on the pomelo fruit from Vietnam pathway, which may result in the establishment and spread of this pest in Australia.

3.5.1 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. phoenicis* species complex will arrive in Australia in a viable state with the importation of pomelo fruit from Vietnam is assessed as: **High**.

The likelihood of importation is assessed as High because *B. phoenicis* species complex is present in Vietnam and pomelo is a host. Although false spider mites are mainly leaf feeders, they can be found on fruit when pest populations are high. Commercial production practices in the orchard and in the packing house may reduce the risk of *B. phoenicis* species complex being present on fruit. However, some life stages may not be removed and present on fruit packed for export and could survive storage and transport conditions.

The following information provides supporting evidence for this assessment.

Brevipalpus phoenicis species complex is reported in Vietnam and is a pest of pomelo.

- *Brevipalpus phoenicis* has been reported in Vietnam (PPD 2010b; Zhang 2021). It is not clear which species in the *B. phoenicis* species complex are present in Vietnam. Due to this uncertainty, it is considered that the *B. phoenicis* species complex present in Vietnam is of biosecurity concern to Australia until information that suggests otherwise becomes available.
- Pomelo is reported as a host for *B. phoenicis* (Childers, Rodrigues & Webourn 2003; Maity & Mondal 2023; New Zealand Ministry for Primary Industries 2022).
- Pomelo fruit is grown commercially in tropical and sub-tropical climates of Vietnam (MARD 2022c), and such climates in Vietnam are suitable for the survival and development of *B. phoenicis* (Haramoto 1969; Hill 2008).

Although *B. phoenicis* generally feeds on leaves, they can be found on host fruit.

- *Brevipalpus phoenicis* feeds predominantly on leaves (Hill 2008), however may move to feed on other parts of the host plant, including fruit, when population densities are high (Haramoto 1969).
- *Brevipalpus phoenicis* has been reported on the fruits of citrus (Ferreira et al. 2020; Kaur et al. 2020; Knorr & Denmark 1970; Nickel 1958; Rodrigues et al. 2000), passionfruit (Childers, Rodrigues & Webourn 2003; Kitajima, Rezende & Rodrigues 2003), papaya (Haramoto 1969) and guava (Rivero et al. 2010).

Pest management practices in the orchard are likely to reduce mite numbers on pomelo plants and reduce the risk of fruit infestation.

- Vietnamese farmers regularly monitor mites and other pests and apply relevant pesticides, as necessary, under the guidance of government plant protection officers (MARD 2016, 2022c). These practices are likely to reduce the risk of *B. phoenicis* species complex being on fruit (MARD 2016, 2022c).

Harvest and postharvest processes are unlikely to remove all mites from the fruit.

- Life stages of *B. phoenicis* are almost microscopic and may not be detected during postharvest processes. Adults are approximately 0.3 mm long, and eggs are about 0.1 mm in diameter (Haramoto 1969).
- Postharvest processes in the packing house, such as washing, drying and waxing, would remove a number of mites on the surface of the fruit. However, some mites may survive these processes and remain on the fruit (Childers & Rodrigues 2011).
- Inactive juvenile stages, known as chrysalis stages, could anchor on the fruit surface (Childers & Rodrigues 2011) and may not be removed during packing house processes.

Adults and immature stages on fruit may survive cold temperatures during storage and while in transit from Vietnam to Australia.

- Pomelo fruit are likely to be imported into Australia soon after harvest to maximise fruit quality and commercial shelf life. Fruit may be exported via either sea freight taking 20 to 30 days or air freight taking up to several days, during which fruit will be maintained at cold temperatures.
- The main export varieties of pomelo fruit are generally stored and transported at temperatures of 2°C to 8°C and a relative humidity of 85 to 95%, in order to maintain the quality of fresh fruit for up to 6 months (Chánh Thu Fruits 2023; Viet Quality 2022).
- There is no evidence to suggest that these storage and transport conditions are lethal to *B. phoenicis*. Larvae and adult females of *B. phoenicis* have been shown to survive temperatures as low as 10°C for up to one week and 23 days, respectively (Haramoto 1969). Although high mortality rates of larvae and adult females were recorded at 10°C, some survived and, when returned to a more favourable temperature of 25°C, larvae continued development and adults were able to produce eggs (Haramoto 1969).

For the reasons outlined, the likelihood that *B. phoenicis* will arrive in Australia in a viable state with the importation of pomelo fruit from Vietnam is assessed as **High**.

Likelihood of distribution

The likelihood that *B. phoenicis* species complex will be distributed within Australia in a viable state as a result of processing, sale or disposal of pomelo fruit from Vietnam, and subsequently transfer to a susceptible part of a host is assessed as: **Moderate**.

The likelihood of distribution is assessed as Moderate because *B. phoenicis* species complex may survive storage and transport conditions prior to sale. Any mites on fruit are most likely to enter the external environment through the disposal of fruit waste. The species complex is polyphagous and several host plants are widely available in Australia. However, transfer of false spider mites to a host in Australia is likely to be moderated by their limited mobility and survival capacity on discarded fruit waste.

The following information provides supporting evidence for this assessment.

Pomelo fruit imported from Vietnam will be distributed throughout Australia for retail sale. Prior to sale, fruit are likely to be stored and transported at cold temperatures for a short period of time, and any mites on fruit in transit are likely to survive.

- Pomelo fruit would be distributed for sale to various destinations in Australia. They may be distributed through large fresh produce wholesale markets and then to supermarkets or other sellers, or directly to smaller retailers and then to consumers. Prior to sale, fruit will likely be stored and transported at the recommended temperature between 2°C to 8°C (Chánh Thu Fruits 2023; Viet Quality 2022).
- Mites that are on pomelo fruit may survive during storage and transport as there is evidence that life stages of *B. phoenicis* have some cold tolerance capacity.
- *Brevipalpus phoenicis* larvae and adult females can survive at 10°C for up to one week and 23 days, respectively (Haramoto 1969). When returned to a more favourable temperature of 25°C, larvae continued development and females were able to produce eggs.

False spider mites are most likely to enter the external environment through the disposal of fruit waste. Although most pomelo fruit waste will likely be discarded into managed waste systems, some fruit waste may be discarded into the environment near a suitable host.

Brevipalpus phoenicis species complex has a wide range of hosts and several hosts are widely available in Australia. However, their life stages have limited capacity to transfer to a new host.

- Most fruit waste would likely be disposed of via municipal waste facilities (Pickin et al. 2022) where host plants are generally not available.
- However, consumers may discard small quantities of fruit waste in a variety of urban, rural and natural environments. Some of this waste could be discarded near suitable host plants.
- The *B. phoenicis* species complex is polyphagous, feeding on many fruit, vegetable and ornamental host plants, including citrus, passionfruit, tea, stone fruit, grapes, coffee, rubber, papaya, squash, persimmon, guava, clematis, oleander, geranium and azalea (Childers, Rodrigues & Webourn 2003; Hill 2008). Many host plants are widely available in Australia.
- False spider mites have limited capacity to move to a new host as they can only crawl short distances (Alves, Casarin & Omoto 2005; Haramoto 1969). False spider mites also have limited wind dispersal capacity as they lack the ability to produce silk (Childers & Denmark 2011), unlike spider mites which can disperse using silk threads (Bell et al. 2005).
- Transfer to a new host is further limited as life stages cannot live without food for more than 3 days, and they are vulnerable to death by desiccation and predation (Childers & Rodrigues 2011; Haramoto 1969).

For the reasons outlined, the likelihood that *B. phoenicis* species complex will be distributed within Australia in a viable state as a result of processing, sale or disposal of pomelo fruit from Vietnam, and subsequently transfer to a susceptible part of a host is assessed as **Moderate**.

Likelihood of entry

The likelihood of entry is determined by combining the likelihood of importation with the likelihood of distribution using the matrix of rules shown in Table A.2.

The likelihood that *B. phoenicis* species complex will enter Australia as a result of trade in pomelo fruit from Vietnam and be distributed in a viable state to a susceptible part of a host is assessed as: **Moderate**.

3.5.2 Likelihood of establishment

The likelihood that *B. phoenicis* species complex will establish within Australia, based on a comparison of factors in the source and destination areas that affect pest survival and reproduction, is assessed as: **High**.

The likelihood of establishment is assessed as High because hosts are widely available. Species in the complex are found throughout the world, including in Australia, and many parts of Australia have climates that are likely to be suitable for establishment. *Brevipalpus phoenicis* species complex reproduces asexually and can develop rapidly under suitable conditions, which would be likely to assist establishment.

The following information provides supporting evidence for this assessment.

Host plant species of the *B. phoenicis* species complex are widely available in Australia.

- *Brevipalpus phoenicis* is polyphagous and has been recorded on many fruit, vegetable and ornamental host plants, including citrus, passionfruit, tea, stone fruit, grapes, coffee, rubber, papaya, squash, persimmon, guava, clematis, oleander, geranium and azalea (Childers, Rodrigues & Webourn 2003; Hill 2008).
- Many of these hosts are widely grown in Australia, including in home gardens, parks and commercial farms.

Many areas of Australia are likely to be suitable for *B. phoenicis* species complex.

- Species in the *B. phoenicis* species complex are found throughout the world including Africa, Asia, Europe, South America and the USA (Denmark 2018).
- The two species in the complex that are present in Australia, *B. papayensis* and *B. yothersi*, have been reported from many parts of Australia (Akyazi, Ueckermann & Liburd 2017; APPD 2023; Beard et al. 2015).
- Australia is likely to have suitable climates and environments to enable establishment of other species in the complex.

Brevipalpus phoenicis species complex reproduces asexually and can develop rapidly, which would be likely to assist establishment.

- *Brevipalpus phoenicis* reproduces asexually via parthenogenesis (Martin Kessing & Mau 1992) and therefore, a single adult female is sufficient to lead to establishment of a new population in an area.
- *Brevipalpus phoenicis* can develop rapidly and undergo many generations per year under suitable conditions (Haramoto 1969; Kennedy et al. 1996).

For the reasons outlined, the likelihood that *B. phoenicis* species complex will establish within Australia is assessed as **High**.

3.5.3 Likelihood of spread

The likelihood that *B. phoenicis* species complex will spread within Australia, based on a comparison of factors in the source and destination areas that affect the expansion of the geographic distribution of the pest is assessed as: **High**.

The likelihood of spread is assessed as High because hosts are widely available in Australia. Although larvae, nymphs and adults are active, they are unable to move long distances naturally. However, mites can be spread over long distances via human-assisted movement, including trade, of infested plants or plant parts.

The following information provides supporting evidence for this assessment.

Host plant species of *B. phoenicis* species complex are widely available in Australia.

- *Brevipalpus phoenicis* is polyphagous and has been recorded on a number of species including citrus, passionfruit, tea, stone fruit, grapes, coffee, rubber, papaya, squash, persimmon, guava, clematis, oleander, geranium and azalea (Childers, Rodrigues & Webourn 2003; Hill 2008).
- Many of these hosts are widely grown in Australia, including in home gardens, parks and commercial farms, which would assist spread.

Spread via active movement will be limited, but human-mediated movement of infested plants and plant parts may facilitate spread over long distances.

- Although false spider mite larvae, nymphs and adults have legs and can crawl, they have limited capacity to actively move to new hosts. Laboratory experiments using closely spaced plants showed low levels of active dispersal of *B. phoenicis* adults from heavily infested plants to uninfested plants (Haramoto 1969).
- False spider mites also have limited wind dispersal capacity as they lack the ability to produce silk (Childers & Denmark 2011), unlike spider mites which can disperse in the wind using silk threads (Bell et al. 2005).
 - Laboratory and field studies of *B. phoenicis* on citrus reported low levels of wind dispersal of adults to new host plants, even at wind speeds of 30 to 40 km per hour (Alves, Casarin & Omoto 2005).
 - Haramoto (1969) recorded successful dispersal of *B. phoenicis* adults to new host plants, up to 15 m downwind of infested papaya plants.
- Human-mediated movement of infested host plants, plant parts and propagative material could facilitate spread of these mites over long distances within Australia.

For the reasons outlined, the likelihood that *B. phoenicis* species complex will spread within Australia is assessed as **High**.

3.5.4 Overall likelihood of entry, establishment and spread

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

The overall likelihood that *B. phoenicis* species complex will enter Australia as a result of trade in pomelo fruit 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**.

3.5.5 Consequences

The potential consequences of the establishment of *B. phoenicis* species complex in Australia has been estimated according to the methods described in Figure A.1.

Based on the decision rules described in Table A.3, that is, where the potential consequences of a pest with respect to one or more criteria are 'D', the overall consequences are estimated to be **Low**.

Criterion	Estimate and rationale
Direct	
The life or health of plants and plant products	<p>D – Significant at the district level</p> <p>False spider mites in the <i>B. phoenicis</i> species complex feed on many plants including fruit trees, vegetable crops and ornamentals (Childers, Rodrigues & Webourn 2003; Hill 2008). Hosts such as citrus, passionfruit, stone fruit and grapes are widely grown and economically important crops in Australia. False spider mites feed on leaves, soft twigs and fruits (Gupta 1985; Haramoto 1969; Hill 2008; Vacante 2010), causing chlorosis, blistering, bronzing or necrotic areas on the infested host tissues, subsequently impacting plant growth and development (Childers, French & Rodrigues 2003). Establishment and spread of <i>B. phoenicis</i> species complex in Australia could potentially impact production and profitability of various crops.</p> <p>The <i>B. phoenicis</i> species complex is known to transmit cileviruses and dichorhavirus, including citrus leprosis viruses, passionfruit green spot virus and coffee ringspot virus (Ferreira et al. 2020; Freitas Astúa et al. 2018; Kitajima et al. 2020) (Kitajima, Rezende & Rodrigues 2003; Nunes et al. 2018). These viruses are not reported to be present in Vietnam.</p>
Other aspects of the environment	<p>B – Minor significance at the local level</p> <p>The introduction of <i>B. phoenicis</i> species complex may have a minor impact on native mite species by competing for the same or similar resources. The <i>B. phoenicis</i> species complex is not likely to reduce abundance of keystone plant species, or plant species that are major components of ecosystems.</p>
Indirect	
Eradication, control	<p>D – Significant at the district level</p> <p>It is expected that efforts would be required to contain and possibly eradicate an incursion of the <i>B. phoenicis</i> species complex within Australia. It is likely that eradicating <i>B. phoenicis</i> species complex could be difficult due to their wide host range and the commonly delayed period to detection.</p> <p>Where eradication is not considered feasible, efforts would be required to control and manage the species complex on an ongoing basis. Control of false spider mites usually involves cultural, physical, biological and chemical control methods. Existing control practices for other species of mites on citrus crops may also control <i>B. phoenicis</i> in Australian orchards. The introduction of an exotic false spider mite in a cropping system will likely require initial investigation and ongoing additional research to determine what modifications to existing pest management regimes are required, and to evaluate their effectiveness.</p> <p>The indirect effects of eradication or control as a result of the introduction of false spider mites may include a large increase in costs for containment, eradication and control at the local level. Containment and eradication activities are costly and would also cause significant disruption to agribusiness at the district level. The costs associated with the initial response to an incursion and ongoing control of the introduced false spider mites, including any additional research requirement, would be expected to be of minor significance at the regional level.</p>
Domestic trade	<p>C – Minor significance at the district level</p> <p>An incursion of <i>B. phoenicis</i> species complex could lead to a moderate reduction of trade or loss of domestic markets at the local level. Biosecurity measures would likely be enforced to prevent the movement of infested plant material out of the initial incursion area, which would have significant economic impact on host crop industries and business at the local level.</p>

Criterion	Estimate and rationale
	The introduction of a new pest to a district would be likely to disrupt intra- and/or interstate trade due to biosecurity restrictions on the domestic movement of affected commodities. This would be expected to be of minor significance at the district level.
International trade	<p>C – Minor significance at the district level</p> <p>Many countries require phytosanitary measures to mitigate the risk posed by their tenuipalpid quarantine species. Should exotic species within the <i>B. phoenicis</i> species complex become established on host crops grown for export markets, Australia's trading partners may impose phytosanitary measures, resulting in additional export costs and/or disruption to the existing trade. The impact would be expected to threaten economic viability through a moderate reduction and/or disruption of trade and export markets at the local level and have a minor impact on affected industries at the district level. Resources would also be required to support affected industries in regaining market access or in implementing the additional phytosanitary measures.</p>
Non-commercial and environmental	<p>B – Minor significance at the local level</p> <p>Any additional usage of chemical sprays may affect the environment. However, this is unlikely to impact on the environment to any greater extent than already occurs due to control measures for other pests.</p>

3.5.6 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 shown in Table A.4.

Unrestricted risk estimate for <i>B. phoenicis</i> species complex	
Overall likelihood of entry, establishment and spread	Moderate
Consequences	Low
Unrestricted risk	Low

The URE for *B. phoenicis* species complex on the pomelo fruit from Vietnam pathway is assessed as **Low**, which does not achieve the ALOP for Australia. Therefore, specific risk management measures are required for *B. phoenicis* species complex on this pathway.

3.6 Fruit flies

***Bactrocera carambolae* (EP), *Bactrocera correcta* (EP), *Bactrocera dorsalis* (EP), *Bactrocera zonata* (EP), *Zeugodacus cucurbitae* (EP) and *Zeugodacus tau* (EP)**

Bactrocera carambolae (carambola fruit fly), *B. correcta* (guava fruit fly), *B. dorsalis* (Oriental fruit fly), *B. zonata* (peach fruit fly), *Zeugodacus cucurbitae* (melon fly) and *Z. tau* (pumpkin fruit fly) belong to the Tephritidae family. These fruit flies are considered to be amongst the most damaging pests of horticultural crops, including in parts of Asia (Peña 1998; White & Elson-Harris 1994).

Bactrocera carambolae, *B. correcta*, *B. dorsalis*, *B. zonata*, *Z. cucurbitae* and *Z. tau* have not been reported in Australia; therefore, they are quarantine pests for all of Australia.

On the basis of phylogenetic relationship analysis, *Bactrocera cucurbitae* and *B. tau* have been proposed to be placed in the genus *Zeugodacus* (De Meyer et al. 2015; Virgilio et al. 2015). The literature refers to these species under both the former (*B. cucurbitae* and *B. tau*) and current (*Z. cucurbitae* and *Z. tau*) scientific names. This document uses the currently accepted names of *Z. cucurbitae* and *Z. tau*.

Bactrocera carambolae, *B. correcta*, *B. dorsalis*, *B. zonata*, *Z. cucurbitae* and *Z. tau* have been grouped together in this assessment as they have common biological characteristics and are considered to pose similar risks. In this assessment, the term 'fruit flies' is used to refer to these six 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, larvae usually leave the fruit, drop to the ground, and pupate in the soil beneath the host plant (Christenson & Foote 1960). 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).

Tephritid fruit flies can produce several generations each year, depending primarily on temperature and host plant availability (Fletcher 1987; Liu & Ye 2009; Liu et al. 2019; Vargas et al. 2000). The optimal temperature for development of most tephritid fruit flies is 25°C to 30°C (Danjuma et al. 2014; Dhillon et al. 2005; Liu & Ye 2009; Michel et al. 2021; Vargas et al. 2000). Low survival rates are generally observed at temperatures of 15°C or below and 35°C or above for all developmental stages of tephritid fruit flies (Brévault & Quilici 2003; Duyck & Quilici 2002; Duyck, Sterlin & Quilici 2004; Rwomushana et al. 2008).

The major dispersal mechanism of tephritid fruit flies is by human-mediated activities through transportation of infested fruit (Louzeiro et al. 2021; Putulan et al. 2004). Dispersal by adult flight is also effective, as they actively search for food and hosts to lay eggs (Kausar et al. 2022; Win et al. 2014).

All 6 species of fruit flies have been assessed previously in existing policies. *Bactrocera carambolae* has been assessed for fresh pomegranate whole fruit and extracted arils from India (DAWE 2020), table grapes from India 2016 (DAWR 2016b) and mango fruit from Indonesia, Thailand and Vietnam (DAWR 2015). *Bactrocera correcta* has been assessed for jujubes from

China (Department of Agriculture 2020) and nectarines from China (DAWR 2016a). *Bactrocera dorsalis* has been assessed for passionfruit from Vietnam (DAFF 2024), capsicums from Pacific Island countries 2021 (DAWE 2021b), fresh pomegranate whole fruit and extracted arils from India (DAWE 2020), dates from Middle East and North Africa 2019 (DAWR 2019b) and mango fruit from Indonesia, Thailand and Vietnam (DAWR 2015). *Bactrocera zonata* has been assessed for okra from India 2023 (DAFF 2023d), fresh pomegranate whole fruit and extracted arils from India (DAWE 2020), dates from Middle East and North Africa 2019 (DAWR 2019b) and mango fruit from Indonesia, Thailand and Vietnam (DAWR 2015). *Zeugodacus cucurbitae* has been assessed for passionfruit from Vietnam (DAFF 2024), okra from India (DAFF 2023d) and capsicums from Pacific Island countries 2021 (DAWE 2021b). *Zeugodacus tau* has been assessed for passionfruit from Vietnam (DAFF 2024). In those policies, the UREs for *B. carambolae*, *B. correcta*, *B. dorsalis*, *B. zonata*, *Z. cucurbitae* and *Z. tau* did not achieve the ALOP for Australia. Therefore, specific risk management measures are required for these 6 species of fruit flies on those pathways.

However, there may be differences in the commercial production practices, climatic conditions, fruit biology and/or pest prevalence between the previously assessed commodity/country pathways, and pomelo fruit from Vietnam. These potential differences make it necessary to re-assess the likelihood that *B. carambolae*, *B. correcta*, *B. dorsalis*, *B. zonata*, *Z. cucurbitae* and *Z. tau* will arrive in Australia in a viable state on the pomelo fruit from Vietnam pathway.

Previous assessments for *B. carambolae*, *B. correcta*, *B. dorsalis*, *B. zonata*, *Z. cucurbitae* and *Z. tau* in the existing policies rated the likelihood of distribution as High.

Pomelo fruit from Vietnam are expected to be distributed in Australia in a similar way to the previously assessed commodity/country pathways. It is expected that once pomelo fruit arrive in Australia from Vietnam, they will be distributed to various destinations throughout Australia for 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 urban, rural and natural environments. Any fruit flies present in discarded pomelo fruit may develop and disperse to new hosts, as adult fruit flies are highly mobile and could fly to 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 for *B. carambolae*, *B. correcta*, *B. dorsalis*, *B. zonata*, *Z. cucurbitae* and *Z. tau* in previous assessments is adopted for the pomelo fruit from Vietnam pathway.

The likelihoods of establishment and spread of *B. carambolae*, *B. correcta*, *B. dorsalis*, *B. zonata*, *Z. cucurbitae* and *Z. tau* in Australia from the pomelo fruit from Vietnam pathway have also 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 these 6 species 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. carambolae*, *B. correcta*, *B. dorsalis*, *B. zonata*, *Z. cucurbitae* and *Z. tau* in previous assessments have been adopted for the pomelo fruit from Vietnam pathway.

In addition, the department has reviewed the latest literature—for example, Follett, Haynes and Dominiak (2021); Huang et al. (2020); 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. carambolae*, *B. correcta*, *B. dorsalis*, *B. zonata*, *Z. cucurbitae* and *Z. tau* in the existing policies.

The risk scenario of biosecurity concern is that eggs and/or larvae of *B. carambolae*, *B. correcta*, *B. dorsalis*, *B. zonata*, *Z. cucurbitae* and *Z. tau* may be present within pomelo fruit imported from Vietnam, which may result in the establishment and spread of these pests in Australia.

3.6.1 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. carambolae*, *B. correcta*, *B. dorsalis*, *B. zonata*, *Z. cucurbitae* and *Z. tau* will arrive in Australia in a viable state with the importation of pomelo fruit from Vietnam is assessed as: **High**.

The likelihood of importation is assessed as High because *B. carambolae*, *B. correcta*, *B. dorsalis*, *B. zonata*, *Z. cucurbitae* and *Z. tau* are present in pomelo fruit production areas in Vietnam. These fruit flies can infest pomelo fruit under field conditions, with both immature and mature pomelo fruit prone to infestation. Infested immature fruit tend to develop fungal infections around sting punctures, causing fruit to rot and drop from the plant. However, infestation of mature pomelo fruit, especially closer to the harvest, may not be readily visible during harvest and packing house processes, which could lead to infested fruit being packed for export. Cold temperatures during storage and transport of pomelo fruit may delay or temporarily halt development and may affect survival of immature stages of fruit flies within pomelo fruit. However, 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 carambolae, *B. correcta*, *B. dorsalis*, *B. zonata*, *Z. cucurbitae* and *Z. tau* are present in Vietnam, including in commercial pomelo production areas.

- *Bactrocera carambolae*, *B. correcta*, *B. dorsalis*, *B. zonata*, *Z. cucurbitae* and *Z. tau* are widespread in Vietnam, including in areas where pomelo is commercially grown (Dien, Huy & Dung 2021; Drew & Romig 2013; Hà 2014; Phạm 2013a; 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 in areas of northern, central and southeast Vietnam (Leblanc et al. 2018). *Zeugodacus cucurbitae* and *Z. tau* were also trapped in all 3 regions of Vietnam, but at lower levels compared to *B. dorsalis* and *B. carambolae*.

Bactrocera correcta was only collected from central and southeast regions (Leblanc et al. 2018).

Biotic and abiotic factors in Vietnam are likely to positively influence fruit fly populations.

- 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), which are characteristic of Vietnam's climate (TheGlobalEconomy.com 2018; World Bank Group 2021; World Weather Online 2023a).
 - 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* and *B. correcta*, were trapped during 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 trapped peaked in July, with the population showing a significant positive correlation with high rainfall and high temperatures (Hasyim, Muryati & de Kogel 2008).

Pomelo fruit is a host, with immature and ripening/ripe pomelo fruit the most susceptible stages to fruit fly infestation. Although infested immature fruit are likely to rot and drop from the plant, ripening or ripe fruit may contain fruit fly eggs and/or larvae at harvest.

- Pomelo is a host for *B. carambolae* (MPI 2021; Thongjua & Thongjua 2017), *B. correcta* (He, Xu & Chen 2023; Thongjua & Thongjua 2017), *B. dorsalis* (Dao et al. 2019; He, Xu & Chen 2023; PPD 2016), *B. zonata* (MPI 2021), *Z. cucurbitae* (PPD 2009; USDA 2020a; Xia et al. 2020), and *Z. tau* (Ahmad & Vasudha 2019; Xia et al. 2020).
- In general, fruit flies preferentially infest young citrus fruit when the skin is soft and less resistant to oviposition by female flies (Ahn, Choi & Huang 2022; Rattanpal et al. 2019).
- Infestation of young fruit can lead to rotting by fungi and bacteria infecting fruit through puncture (sting) holes in the fruit skin and internal feeding by larvae, resulting in premature fruit fall (Cayol et al. 1994; Rattanpal et al. 2019; Smith, Beattie & Broadley 1997).
- As citrus fruit mature, the skin (exocarp) hardens, and they become less susceptible to fruit fly infestation (Dias et al. 2018; Muthuthantri 2013).
- However, ripening or ripe citrus fruit, including pomelo, become more susceptible to fruit fly infestation again from the colour break stage (4 to 6 weeks prior to harvest for pomelo) until harvest, as the skin softens sufficiently for penetration of the ovipositor of the adult female (Muthuthantri 2013).

Commercial production practices would reduce the risk of fruit fly infestation of pomelo fruit.

- Vietnamese growers manage fruit flies in pomelo orchards under the guidance of government plant protection officers (MARD 2022c).
- Fruit flies are managed in pomelo orchards using cultural practices (e.g., bagging fruit and orchard hygiene), sticky and/or pheromone traps for monitoring and/or mass trapping, and protein baiting and insecticide sprays (MARD 2021b, 2022c) for controlling fruit flies.
- Fallen fruit are collected and disposed of by various ways, including deep burial or burning (MARD 2021b, 2022c).
- Collectively, these practices would reduce the risk of fruit fly infestation in pomelo orchards.

Pomelo fruit with clear signs of infestation would be detected and removed during harvest and/or postharvest processes. However, fruit with early stages of infestation may not be detected and may be packed for export.

- Infested pomelo fruit showing clear symptoms of distortion and/or rotting would be removed during harvest or postharvest practices.
- Fruit that have been oviposited in just prior to harvest may not show evident signs of infestation as oviposition stings on the fruit surface and early larval feeding can be difficult to detect (Cantrell, Chadwick & Cahill 2002; Putulan et al. 2004). As a result, newly infested fruit may be packed for export.

Short term storage and transit of pomelo fruit at cold temperatures is likely to halt development and may cause some mortality of immature stages of fruit flies in fruit. However, surviving eggs and/or larvae are likely to recommence development when fruit are no longer stored at cold temperatures.

- Storage conditions for pomelo fruit, providing a shelf life of up to 6 months, are at temperature between 2°C to 8°C, and a relative humidity of 85 to 95% (Chánh Thu Fruits 2023; Viet Quality 2022).
- Pomelo fruit are likely to be imported into Australia soon after harvest to maximise fruit quality and commercial shelf life. Fruit may be exported via sea freight taking 20 to 30 days or air freight taking up to several days, and fruit will be maintained at cold temperatures during transit.
- Temperatures between 2°C and 8°C are likely to halt development of fruit flies in infested pomelo fruit.
 - 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).
 - A strong and positive linear relationship was reported 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 (Danjuma et al. 2014). At 10°C, Michel et al. (2021) reported no eggs of *B. dorsalis* hatched.
 - The lower developmental thresholds for eggs and larvae of *Z. cucurbitae* were 15.8°C and 13.4°C, respectively (Mkiga & Mwatawala 2015).
 - The lower developmental thresholds for *B. correcta* were estimated to be 8.5°C and 7.6°C for egg and larval stages, respectively (Liu & Ye 2009).
 - The lower developmental thresholds for eggs and larvae of *B. zonata* were reported to be 12.7°C and 12.6°C, respectively (Duyck, Sterlin & Quilici 2004).
- Temperatures between 2°C and 8°C may result in at least some mortality of fruit fly eggs and/or larvae in fruit.
 - These temperatures are at or above typical cold disinfestation treatment temperatures for many tropical fruit fly species (Dohino et al. 2017; USDA 2016).
 - Levels of mortality of fruit fly eggs and/or larvae during storage and transport to Australia would depend on the temperature and duration of storage and transit. Fruit fly mortality levels would be higher for fruit that are cold stored for a period of time prior to export or fruit that are exported via sea freight. In contrast, fruit fly mortality levels would likely be lower for fruit that are exported via air freight shortly after harvest.

- The proposed storage and transport temperatures for pomelo fruit indicate that fruit flies may not be able to develop and that some mortality of eggs and larvae may occur. However, upon reaching temperatures capable of supporting development, surviving eggs and larvae that may be present in fruit are likely to continue and complete development.

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

Likelihood of distribution

The likelihood that the assessed *B. carambolae*, *B. correcta*, *B. dorsalis*, *B. zonata*, *Z. cucurbitae* and *Z. tau* will be distributed within Australia in a viable state as a result of the processing, sale or disposal of pomelo fruit from Vietnam, and subsequently transfer to a susceptible part of a host is likely to be similar to these 6 species of fruit flies on previously assessed pathways. The same rating of **High** for the likelihood of distribution for *B. carambolae*, *B. correcta*, *B. dorsalis*, *B. zonata*, *Z. cucurbitae* and *Z. tau* in previous assessments is adopted for pomelo fruit from Vietnam.

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.

3.6.2 Likelihoods of establishment and spread

The likelihoods of establishment and spread for the assessed *B. carambolae*, *B. correcta*, *B. dorsalis*, *B. zonata*, *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. carambolae*, *B. correcta*, *B. dorsalis*, *B. zonata*, *Z. cucurbitae* and *Z. tau*, the likelihoods of establishment and spread are assessed as **High** and **High**, respectively.

3.6.3 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. carambolae*, *B. correcta*, *B. dorsalis*, *B. zonata*, *Z. cucurbitae* and *Z. tau* will enter Australia as a result of trade in pomelo fruit 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**.

3.6.4 Consequences

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

3.6.5 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 shown in Table A.4.

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

The URE for *B. carambolae*, *B. correcta*, *B. dorsalis*, *B. zonata*, *Z. cucurbitae* and *Z. tau* on the pomelo fruit from Vietnam pathway is assessed as **High**, which does not achieve the ALOP for Australia. Therefore, specific risk management measures are required for these 6 species of fruit flies on this pathway.

3.7 Mealybugs

Exallomochlus hispidus (GP), *Planococcus lilacinus* (GP) and *Rastrococcus invadens* (GP)

Three mealybug species were identified on the pomelo fruit from Vietnam pathway as quarantine pests for Australia: *Exallomochlus hispidus* (cocoa mealybug), *Planococcus lilacinus* (coffee mealybug) and *Rastrococcus invadens* (fruit tree mealybug) (Table 3.4).

The indicative likelihood of entry for all quarantine mealybugs is assessed in the mealybugs Group PRA as Moderate (DAWR 2019a). *Exallomochlus hispidus*, *P. lilacinus* and *R. invadens* are reported from Vietnam and are associated with pomelo fruit (CABI 2023b; Indarwatmi et al. 2021; Le et al. 2018; Williams 2004). Standard packing house processes and transportation are not expected to eliminate these mealybugs on the pathway. After assessment of relevant pathway-specific factors (sections A2.6 and A2.7) for pomelo fruit from Vietnam, the likelihood of entry of Moderate was verified as appropriate for these mealybug species on this pathway (Table 3.4).

Table 3.4 Quarantine mealybug species for pomelo fruit from Vietnam

Pest	In mealybugs Group PRA	Quarantine pest	On pomelo fruit pathway	Likelihood of entry
<i>Exallomochlus hispidus</i>	Yes	Yes	Yes	Moderate
<i>Planococcus lilacinus</i>	Yes	Yes	Yes	Moderate
<i>Rastrococcus invadens</i>	Yes	Yes	Yes	Moderate

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

Table 3.5 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
Unrestricted risk	Low

As assessed in the mealybugs Group PRA, the indicative URE for mealybugs is **Low** (Table 3.5) which does not achieve the ALOP for Australia. This indicative URE is considered to be applicable for the quarantine mealybugs species present on the pomelo fruit 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 pomelo fruit from Vietnam pathway, irrespective of their specific identification in this document. This is explained in section A2.7.

3.8 Scales

***Parlatoria cinerea* (GP), *Parlatoria ziziphi* (GP) and *Pseudaulacaspis pentagona* (GP, WA)**

Three scale insect species on the pomelo fruit from Vietnam pathway, *Parlatoria cinerea* (tropical grey chaff scale), *Parlatoria ziziphi* (black parlatoria scale) and *Pseudaulacaspis pentagona* (mulberry scale), were identified as quarantine pests for Australia (Table 3.6).

Parlatoria cinerea and *P. ziziphi* are not known to be present in Australia and are quarantine pests for all of Australia. *Pseudaulacaspis pentagona* 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 hard scale species is assessed in the scales Group PRA as Moderate (DAWE 2021a). *Parlatoria cinerea*, *P. ziziphi* and *P. pentagona* are reported from Vietnam and are associated with pomelo fruit (Dao et al. 2018; García Morales et al. 2023; Leathers 2016). Standard packing house processes and transportation are not expected to eliminate these scale species on the pomelo fruit from Vietnam pathway. After assessment of relevant pathway-specific factors (sections A2.6 and A2.7) for pomelo fruit from Vietnam, the likelihood of entry of Moderate was verified as appropriate for these scale species on this pathway (Table 3.6).

Table 3.6 Quarantine scale insect species for pomelo fruit from Vietnam

Pest	In scales Group PRA	Quarantine pest	On pomelo fruit pathway	Likelihood of entry
<i>Parlatoria cinerea</i>	Yes	Yes	Yes	Moderate
<i>Parlatoria ziziphi</i>	Yes	Yes	Yes	Moderate
<i>Pseudaulacaspis pentagona</i>	Yes	Yes (WA)	Yes	Moderate

WA: Regional quarantine pest for Western Australia.

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

Table 3.7 Risk estimates for quarantine scale insects

Risk component	Rating for quarantine scales
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
Unrestricted risk	Low

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

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

3.9 Spider mites

***Panonychus citri* (DGP, WA) and *Tetranychus kanzawai* (DGP, WA)**

Two spider mite species on the pomelo from Vietnam pathway: *Panonychus citri* and *Tetranychus kanzawai* were identified as regional quarantine pests for Western Australia as they are not present in that state (Table 3.8).

Panonychus citri and *T. kanzawai* belong to the family Tetranychidae. All members of Tetranychidae are commonly referred to as spider mites or tetranychids.

The biosecurity risk posed by spider mites has been re-assessed by the department in the recently released a *Draft report for a review of pest risk assessments for spider mites (Acari: Trombidiformes: Tetranychidae)* (draft spider mite review) (DAFF 2023a). The draft spider mite review examines and evaluates all previous pest risk assessments conducted by the department on species of Tetranychidae. The draft spider mite review concludes that those spider mite species share several biological characteristics relevant to biosecurity risk and are expected to pose similar risk, including having similar likelihoods of entry, establishment and spread, and causing comparable overall consequences. The draft spider mite review proposes that a likelihood rating of High for establishment, a likelihood rating of High for spread and an estimate of Low for overall consequences are appropriate for all spider mite species previously assessed by the department. These ratings could also be applied to other spider mite species in future assessments unless counter evidence is available. The draft report also proposes an indicative likelihood rating of High for importation (pathway specific) and an indicative likelihood rating of Moderate for distribution (pathway and/or species specific) for all spider mite species in future assessments. This means factors relevant to likelihood for importation and likelihood for distribution should be examined to determine whether the indicative rating can be verified. This approach is consistent with that applied to the Group PRAs for thrips (DAWR 2017a), mealybugs (DAWR 2019a) and scale insects (DAWE 2021a). Therefore, the draft spider mite review is regarded as a draft Group PRA (DGP) for spider mites. When completed, the *Final report for a review of pest risk assessments for spider mites (Acari: Trombidiformes: Tetranychidae)*, hereafter referred to as ‘final spider mites review’, will be regarded as the department’s Group policy for spider mites.

This pest risk assessment adopts the proposals of the ‘draft spider mites review’, noting that any updates required to be included in the ‘final spider mites review’ will also be included in the pest risk assessment for spider mites in the final report for pomelo fruit from Vietnam.

The indicative likelihood of entry for all quarantine spider mites is proposed in the ‘draft spider mites review’ as Moderate (High for importation, Moderate for distribution) (DAFF 2023a). *Panonychus citri* and *T. kanzawai* are reported from Vietnam and are associated with the fruit of pomelo (MARD 2022b, c; Migeon & Dorkeld 2023; Phạm 2013a; PPD 2016; Vacante 2015; Whittle 1992). Standard packing house processes are not expected to eliminate these spider mites on the pathway, and the storage and transport conditions are not lethal to these pests. After assessment of relevant pathway-specific factors (sections A2.6 and A2.7) for pomelo from Vietnam, the indicative likelihood of entry of Moderate was verified as appropriate for these spider mite species on this pathway (Table 3.8).

Table 3.8 Quarantine spider mite species for pomelo from Vietnam

Pest	In 'draft spider mites review'	Quarantine pest	On pomelo pathway	Likelihood of entry
<i>Panonychus citri</i>	Yes	Yes (WA)	Yes	Moderate
<i>Tetranychus kanzawai</i>	Yes	Yes (WA)	Yes	Moderate

WA: Regional quarantine pest for Western Australia.

A summary of the risk assessment for quarantine spider mites is presented in Table 3.9 for convenience.

Table 3.9 Risk estimates for quarantine spider mites

Risk component	Rating for quarantine spider mites
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
Unrestricted risk	Low

As assessed in the 'draft spider mites review', the indicative URE for quarantine spider mites is **Low** (Table 3.9) which does not achieve the ALOP for Australia. This indicative URE is considered to be applicable for the quarantine spider mite species present on the pomelo fruit from Vietnam pathway. Therefore, specific risk management measures are required for the quarantine spider mites on this pathway.

3.10 Thrips

Scirtothrips dorsalis (GP, RA) and *Thrips tabaci* (GP, RA)

Two thrips species were identified on the pomelo fruit from Vietnam pathway as regulated articles for Australia: *Scirtothrips dorsalis* (chilli thrips) and *Thrips tabaci* (onion thrips) (Table 3.10).

Scirtothrips dorsalis and *T. tabaci* are present in Australia and are not under official control and, therefore, are not quarantine pests for Australia.

However, *S. dorsalis* and *T. tabaci* are identified as regulated articles for Australia 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 2023a).

The indicative likelihood of entry for all quarantine thrips and all thrips that were identified as regulated articles, is assessed in the thrips Group PRA as Moderate (DAWR 2017a). *Scirtothrips dorsalis* and *T. tabaci* are reported from Vietnam and are associated with citrus, including pomelo (Atakan, Pehlivan & Kiminsu 2016; CABI 2023b; Capinera 2020; DPIRD 2021; Kerns, Wright & Loghry 2001; MARD 2022b, c; Toyota 1972). Standard packing house processes and transportation are not expected to eliminate these thrips species on the pomelo from Vietnam pathway. After assessment of relevant pathway-specific factors (section A2.6 and A2.7) for pomelo from Vietnam, the likelihood of entry of Moderate was verified as appropriate for these thrips species on this pathway (Table 3.10).

Table 3.10 Thrips species identified as quarantine pests and/or regulated articles for pomelo from Vietnam

Pest	In thrips Group PRA	Quarantine pest	Regulated article	On pomelo pathway	Likelihood of entry
<i>Scirtothrips dorsalis</i>	Yes	No	Yes	Yes	Moderate
<i>Thrips tabaci</i>	Yes	No	Yes	Yes	Moderate

As *S. dorsalis* and *T. tabaci* 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 3.11 for convenience.

Table 3.11 Risk estimates for emerging quarantine orthospoviruses vectored by 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

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

Consequences	Moderate
Unrestricted risk	Low

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 thrips is **Low** (Table 3.11), 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 pomelo from Vietnam pathway. Therefore, specific risk management measures are required for these thrips species 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 all thrips identified as regulated articles on the pomelo from Vietnam pathway, irrespective of their specific identification in this document. This is explained in section A2.7.

3.11 Brown rot

Phytophthora mekongensis

Phytophthora mekongensis was isolated from diseased pomelo fruit and roots in Vietnam in 2012; however, it was only formally described as a new species of *Phytophthora* in 2017 (Cacciola et al. 2017). *Phytophthora mekongensis* is not known to occur in Australia; therefore, it is a quarantine pest for all of Australia.

Phytophthora is a genus of water-associated fungi-like microorganisms (oomycetes) that actively grow and reproduce in a moist environment (Erwin & Ribeiro 1996). The genus belongs to the family Peronosporaceae, and contains a large number of species, which are currently divided into 14 different clades (taxonomic groups) (Brasier et al. 2022). *Phytophthora mekongensis* has been assigned to *Phytophthora* clade 2a (Puglisi et al. 2017). Most *Phytophthora* species are plant pathogens.

Phytophthora species produce up to five different life stages: mycelia, sporangia, zoospores, chlamydospores and oospores (Erwin & Ribeiro 1996).

Mycelia grow inside the host, infecting plant tissues and acquiring nutrients from dead or dying cells (Hardham 2007).

Sporangia and zoospores are asexual structures that are only produced under ideal conditions; for example, in the presence of free water or very high humidity, and optimum temperature. Sporangia emerge from sporangiophores that develop on mycelia (Van Tran et al. 2023). In some species of *Phytophthora*, the sporangia may be easily dislodged (caducous), whereas in others they remain attached to the hyphae (non-caducous) (Judelson & Blanco 2005). When mature, sporangia can germinate directly and form hyphae, or indirectly and form zoospores (Erwin & Ribeiro 1996; Hardham 2007). Indirect germination (also known as zoosporogenesis) is dependent on ambient temperature, with low temperatures promoting the release of zoospores (Judelson & Blanco 2005; Situ et al. 2022). Both direct and indirect germination require the sporangia to be immersed in an aqueous environment (Judelson & Blanco 2005; Situ et al. 2022), and even slight desiccation reduces their viability (Cohen et al. 1974).

Zoospores are the only motile spore produced by *Phytophthora* and the most important type of infectious propagule for initiation of disease (Judelson & Blanco 2005; Widmer 2009). Zoospores are flagellated wall-less cells with the outer surface covered by a plasma membrane, and they are highly vulnerable to dehydration (Erwin & Ribeiro 1996; Hardham 2007). They disperse passively through water and moist soil, or actively for 35–50cm through propulsion with the flagella (Erwin & Ribeiro 1996; Irwin, Cahill & Drenth 1995; Judelson & Blanco 2005). Zoospores are attracted to a variety of signals from host plants; for example, chemical, electrical field and physical features (Situ et al. 2022). However, not all these responses are host-specific, which may result in the zoospores encysting on a non-host plant where infection cannot progress (Hardham 2007; Judelson & Blanco 2005). Upon contact, the zoospores adhere to the surface and lose their flagella, forming a cyst (Erwin & Ribeiro 1996; Hardham 2007).

Chlamydospores are also asexual spores but formed in host tissues from mycelium, generally when conditions for growth are unfavourable.

Oospores are sexually produced spores generated from mycelium that are released into the soil when infected plant tissues break down. Oospores have thick cell walls, are resistant to desiccation, and are able to remain dormant in soil for up to several years (Erwin & Ribeiro 1996; Hardham 2007; Situ et al. 2022).

Although oospores and chlamydospores are important survival structures, some species of *Phytophthora* do not produce these structures (Chen et al. 2022; Erwin & Ribeiro 1996). *Phytophthora mekongensis* is not reported to produce either oospores or chlamydospores (Puglisi et al. 2017).

Some species of *Phytophthora* such as *P. sojae* are highly host specific; other species, such as *P. cinnamomi* and *P. nicotianae*, can infect a wide range of hosts (Rahman et al. 2014; Roy & Grünwald 2014).

In Vietnam, *Phytophthora mekongensis* causes brown rot on pomelo fruit (Puglisi et al. 2017), root rot of pomelo, sweet orange (*Citrus sinensis*) and lime (*C. aurantiifolia*) (Puglisi et al. 2017; Van Tran et al. 2023), and stem gummosis on sweet orange (Van Tran et al. 2023). In addition, laboratory studies have shown that grapefruit (*C. paradisi*), bergamot (*C. bergamia*) (Puglisi et al. 2017), sweet orange and lime (Van Tran et al. 2023) are susceptible to *P. mekongensis* fruit rot, while pomelo, sweet orange and citrange (*Citrus sinensis* × *Poncirus trifoliata*) are susceptible to stem gummosis (Puglisi et al. 2017).

The risk scenario of biosecurity concern is that fresh pomelo fruit from Vietnam may be infected with *P. mekongensis*, which may result in the establishment and spread of this pathogen in Australia.

3.11.1 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 *P. mekongensis* will arrive in Australia in a viable state with the importation of pomelo from Vietnam is assessed as: **Low**.

The likelihood of importation is assessed as Low because *P. mekongensis* is associated with pomelo in Vietnam, although pest management and packing house practices would reduce the likelihood of *P. mekongensis* being present in pomelo fruit for export. Symptoms on fruit are visible, and symptomatic fruit are likely to be removed during harvest, grading and sorting. Fruit with early stages of brown rot infection may not be detected during harvest and postharvest processes. However, pathogen numbers and viability are likely to be reduced by pressure washing and disinfection at the packing house. *Phytophthora mekongensis* could survive postharvest storage and transport conditions.

The following information provides supporting evidence for this assessment.

Phytophthora mekongensis is present in Vietnam and is associated with pomelo fruit.

- *Phytophthora mekongensis* was only described in 2017 after being first detected during tropical fruit disease surveys in 2012 as brown rot symptoms on commercially produced

pomelo fruit in the Vinh Long province of the Mekong Delta region in southern Vietnam (Puglisi et al. 2017).

- *Phytophthora mekongensis* is known to be present in northern and southern citrus production areas of Vietnam (Puglisi et al. 2017; Van Tran et al. 2023).
 - In southern Vietnam, it has been isolated from the Vinh Long, Dong Thap and Ben Tre provinces in the Mekong River Delta region (Puglisi et al. 2017).
 - *Phytophthora mekongensis* appears to be less prevalent in northern Vietnam having only been isolated from the Tuyen Quang and Yen Bai provinces in the Red River Delta region (Van Tran et al. 2023).
 - Because *P. mekongensis* has only been described in 2017, it may also be present in other pomelo production areas of Vietnam.
- Pomelo has been reported as the main host of *P. mekongensis*, with disease symptoms in the field including root rot and fruit brown rot (Cacciola et al. 2017; Puglisi et al. 2017; Van Tran et al. 2023).

Pest monitoring and management are likely to limit *P. mekongensis* disease incidence in commercial orchards.

- Orchards producing pomelo fruit for export are monitored each month for pests and diseases by the Vietnam Plant Protection Sub Department (PPSD) (MARD 2023a).
- If symptoms of *P. mekongensis* infection are detected in the orchard, control methods including pruning and disposal of infected plant material are generally undertaken (MARD 2001), which reduces the likelihood of further spread throughout the tree canopy.
- Fungicides are applied to manage *Phytophthora* species in orchards, as detailed in Chapter 2 of this report. This management practice will likely also reduce *P. mekongensis*-associated disease incidence.

Infected fruit exhibiting visible symptoms are likely to be detected and removed during harvest and packing house processes. Some fruit may not exhibit symptoms at the time of harvest, and therefore could escape detection. However, washing and disinfection processes in the packing house will reduce numbers and viability of any pathogens present.

- Fruit express symptoms 5 to 6 days after infection (Puglisi et al. 2017). Symptoms include a light brown leathery rind decay with white mycelia forming especially in humid conditions (Puglisi et al. 2017). These symptoms are visible and therefore, infected fruit are likely to be detected and removed during harvest, sorting and grading processes.
- Pomelo fruit with early stages of infection by *P. mekongensis* may not show visible symptoms at the time of harvest and/or during sorting and grading and therefore may not be detected.
- However, fruit for export are washed, disinfected with sodium hypochlorite solution and dried (MARD 2022c) (and pers. comm.) as outlined in Chapter 2 of this report. These procedures are likely to reduce numbers and viability of pathogens, including *P. mekongensis*, that may be present on the fruit surface (Hong et al. 2003).

Phytophthora mekongensis is likely to survive fruit storage and transport conditions.

- Pomelo fruit are stored and transported at temperatures of 2°C to 8°C and a relative humidity of 85 to 95%.

- The minimum temperature for growth of *P. mekongensis* was reported to be 8°C to 12°C (Puglisi et al. 2017). Thus, little or no growth would be expected to occur at storage and transport temperatures.
- Although there is currently no information available on survival of *P. mekongensis* under these conditions, this pathogen is likely to survive these conditions based on information for other *Phytophthora* species.
 - Other clade 2a species that stopped growing when held at 4°C for 5 to 7 days were able to recover when the temperature increased to 20°C (Dang et al. 2021).
 - Mycelium of *P. cinnamomi* were able to survive for 16 days at a temperature of 1.4°C (Benson 1982).
 - Exposure to a temperature of -5°C for up to 24 hours had no effect on survival of hyphae of *P. ramorum* (Browning et al. 2008).
- Desiccation has been reported as the primary factor limiting sporangia survival in *Phytophthora* species (Modesto et al. 2016). High relative humidity levels (85 to 95%) maintained during storage and transport are unlikely to impact survival of *P. mekongensis*, based on the information available for other *Phytophthora* species.
 - Survival of *P. ramorum* isolates was unaffected at relative humidities of 81% and 93% (Browning et al. 2008); however, complete mortality occurred within 8 hours at an exposure to a relative humidity of 41% at 20°C.
 - Sporangia of *P. infestans* lose their viability in 1 to 3 hrs in dry air (20 to 40% RH) and in 5 to 18 hrs in moist air (50 to 80% RH) at temperatures above 20°C (Ridings & Alfieri 1972).

For the reasons outlined, the likelihood that *P. mekongensis* will arrive in Australia in a viable state with the importation of pomelo from Vietnam is assessed as Low.

Likelihood of distribution

The likelihood that *P. mekongensis* will be distributed within Australia in a viable state as a result of processing, sale or disposal of pomelo from Vietnam, and subsequently transfer to a susceptible part of a host is assessed as: **Very Low**.

The likelihood of distribution is assessed as Very Low because pomelo fruit are intended for human consumption, and most pomelo fruit waste will be disposed of in managed waste systems. A small amount of fruit waste may potentially be discarded in the environment where host plants may be present. However, movement of the pathogen from fruit waste to a suitable host requires water. Survival/viability of *Phytophthora* species is limited by environmental factors and competition from other microorganisms. Further, the identified hosts of *P. mekongensis* are limited to a few *Citrus* species, which would likely reduce the opportunity to transfer.

The following information provides supporting evidence for this assessment.

The end use of pomelo fruit is for human consumption; therefore, the fruit will be distributed throughout Australia for retail sale. Fruit showing symptoms of *P. mekongensis* infection are likely to be removed from distribution, but some fruit may show no or mild symptoms and may be distributed and sold.

- Imported pomelo fruit are intended for human consumption and would be distributed throughout Australia. The major population centres are likely to receive most imported fruit.
- If viable inoculum was present on imported pomelo fruit, growth would likely resume once they are exposed to higher temperatures that support growth.
- Any infected fruit showing symptoms are likely to be removed from distribution and disposed of in managed waste systems. Potential transfer of the pathogen to suitable hosts from managed waste systems is likely to be negligible.
- However, some pomelo fruit infected with *P. mekongensis* may show no or mild symptoms at the time of distribution for retail sale.

Most fruit waste would be discarded via municipal waste facilities, but some may be discarded in the environment where suitable hosts are present.

- Most of the fruit, except the rind, seeds and internal membranes, will be consumed. Fruit waste is likely to be discarded into municipal waste systems (Pickin et al. 2022). Potential transfer of the pathogen to suitable hosts from municipal waste systems is likely to be negligible.
- However, some fruit waste may be discarded into a variety of environments, which may contain suitable host plants.

Known host plants of *P. mekongensis* are present in Australia and thus available for transfer of this pathogen. However, the major host, pomelo, is not widely grown.

- The known hosts of *P. mekongensis* are restricted to the Rutaceae family (Puglisi et al. 2017; Van Tran et al. 2023).
 - Pomelo is reported to be the primary field host (Puglisi et al. 2017).
 - Other field hosts include sweet orange and lime (Puglisi et al. 2017; Van Tran et al. 2023).
 - Laboratory studies have shown that grapefruit, bergamot (Puglisi et al. 2017), sweet orange and lime (Van Tran et al. 2023) are susceptible to *P. mekongensis* infection.
 - Several of these host plants are grown throughout Australia on commercial farms and in home gardens.
- Pomelo, the main host of *P. mekongensis*, has a limited distribution, with most commercial production in Far North Queensland. Small scale production also occurs in the Murray Valley in New South Wales and Victoria, the Riverland in South Australia, and in the Northern Territory.
- Pomelo is not commonly grown in home gardens in Australia.

Movement of *P. mekongensis* from fruit waste to a suitable host is limited by the requirement of water, and survival is limited by environmental factors and competition from other microorganisms.

- *Phytophthora* is spread naturally by water, for example via irrigation water, heavy rain or flooding. It can also be moved by human and animal activities (Pegg et al. 2023; Redondo et al. 2018).
- *Phytophthora mekongensis* produces only short-lived reproductive structures: mycelia, sporangia and zoospores. Longer-living survival structures, oospores and chlamydospores, which are found in other *Phytophthora* species, have not been reported to be produced by *P. mekongensis* (Puglisi et al. 2017).

- Zoospores, mycelia and sporangia have limited energy reserves and are vulnerable to desiccation and solar radiation (Judelson & Blanco 2005), which could reduce the viability of the pathogen in the environment.
 - There are no reports available on the viability of *P. mekongensis* zoospores. Survival of zoospores of other *Phytophthora* species varies and depends on the species (Hwang & Ko 1978; Porter & Johnson 2004; Quitugua & Trujillo 1998) and environmental conditions (Kong & Hong 2014; Kong et al. 2009; Peries & Fernando 1966). Zoospores of the closely related species *P. colocasiae* are reported to remain viable for at least 107 days in soil (Quitugua & Trujillo 1998); however, zoospores of another closely related species, *P. meadii*, are viable for less than 24 hours (Peries & Fernando 1966).
 - Similarly, no reports are available on the viability of mycelia and sporangia of *P. mekongensis*; however, mycelia and sporangia of *P. meadii* are reported to remain viable for up to 3 weeks (Liyanage & Wheeler 1991).
 - Solar radiation is reported to rapidly reduce the viability of sporangia of *Phytophthora* species such as *P. infestans* (Mizubuti, Aylor & Fry 2000; Porter & Johnson 2004). One hour of exposure on a sunny day reduced the viability of sporangia of *P. infestans* by 95% (Mizubuti, Aylor & Fry 2000).
 - In a study of the effect of various doses of UV light on survival of *P. citrophthora*, *P. capsici* and *P. nicotianae*, zoospores were found to be more sensitive than hyphae (Banihashemi, MacDonald & Lagunas-Solar 2010).
- *Phytophthora* species are highly vulnerable to antagonistic microorganisms, which can proliferate more rapidly and suppress growth directly and indirectly through parasitism, production of antibiotic substances, and competition (Drenth & Sendall 2001; Erwin & Ribeiro 1996; Picard, Tirilly & Benhamou 2000).

For the reasons outlined, the likelihood that *P. mekongensis* will be distributed within Australia in a viable state as a result of processing, sale or disposal of pomelo from Vietnam, and subsequently transfer to a susceptible part of a host is assessed as Very Low.

Likelihood of entry

The likelihood of entry is determined by combining the likelihood of importation with the likelihood of distribution using the matrix of rules shown in Table A.2.

The likelihood that *P. mekongensis* will enter Australia as a result of trade in pomelo from Vietnam and be distributed in a viable state to a susceptible part of a host is assessed as: **Very Low**.

3.11.2 Likelihood of establishment

The likelihood that *P. mekongensis* will establish within Australia, based on a comparison of factors in the source and destination areas that affect pest survival and reproduction, is assessed as: **Moderate**.

The likelihood of establishment is assessed as Moderate because hosts are available in various parts of Australia, although the main host, pomelo, is not widely grown in Australia. The most favourable environments for establishment are available in tropical areas of Australia. However, suitable environments may also occur in sub-tropical and temperate areas. Active stages of *Phytophthora* are highly vulnerable to the environmental conditions outside host plant tissue, and to antagonistic microorganisms, which will reduce their ability to establish.

The following information provides supporting evidence for this assessment.

Hosts of *P. mekongensis* are present in many parts of Australia.

- *Phytophthora mekongensis* has only been recorded infecting hosts within the Rutaceae family. This includes pomelo, sweet orange and lime under field conditions, and grapefruit, bergamot and citrange under laboratory conditions (Puglisi et al. 2017; Van Tran et al. 2023).
- Pomeles are commercially grown mainly in Far North Queensland, with small scale production in the Murray Valley in New South Wales and Victoria, the Riverland in South Australia, and the Northern Territory. Pomelo is a relatively minor commercial *Citrus* species in Australia, with approximately 1,000 t produced in 2022 (Citrus Australia pers. comm, 2023).
- Other citrus hosts such as sweet orange and lime are more significant commercial crops in Australia, with major growing areas situated in New South Wales, Queensland, Victoria, South Australia and Western Australia (Citrus Australia 2021; Hardy et al. 2010; Plant Health Australia 2015).
- Although pomelo is not commonly grown in home gardens, other citrus hosts such as sweet orange and lime are commonly found in home gardens.

Climates that are most favourable for establishment of *P. mekongensis* occur in northern tropical regions of Australia, although other parts of Australia may also be suitable for establishment of *P. mekongensis*.

- Climatic conditions similar to those in the Mekong River and Red River Delta regions in Vietnam, where this pathogen is prevalent, occur in Australia.
 - Northern coastal parts of Western Australia, Queensland and the Northern Territory have a tropical climate with climatic conditions most similar to the regions in Vietnam where this pathogen is present (Bureau of Meteorology 2023; MARD 2022c), and thus likely to be most favourable for establishment of *P. mekongensis*.
- Susceptible citrus hosts are also grown in subtropical and temperate areas of Australia. While the climatic conditions in these areas may not be optimal for the growth of *P. mekongensis*, it is not known if *P. mekongensis* could establish in these areas as cold temperatures during winter could impact growth and survival.
- Excessive irrigation and rainfall increase disease severity (Erwin & Ribeiro 1996). Northern coastal parts of Australia experience monsoonal rainfalls, and many commercial citrus production areas depend on irrigation – conditions in such areas are likely to support establishment of *P. mekongensis*.

Active stages of *Phytophthora* are highly vulnerable to the environment outside host plant tissue, and to antagonistic microorganisms, which will reduce their ability to establish within Australia.

- Zoospores, sporangia and mycelia of *Phytophthora* are short-lived and vulnerable to desiccation and solar radiation (Banihashemi, MacDonald & Lagunas-Solar 2010; Judelson & Blanco 2005).
- *Phytophthora* species are highly vulnerable to antagonistic microorganisms, which can proliferate more rapidly and suppress growth directly and indirectly through parasitism, production of antibiotic substances, and competition (Drenth & Sendall 2001; Erwin & Ribeiro 1996; Picard, Tirilly & Benhamou 2000).

For the reasons outlined, the likelihood that *P. mekongensis* will establish within Australia is assessed as Moderate.

3.11.3 Likelihood of spread

The likelihood that *P. mekongensis* will spread within Australia, based on a comparison of factors in the source and destination areas that affect the expansion of the geographic distribution of the pest is assessed as: **Low**.

The likelihood of spread is assessed as Low because *P. mekongensis* has a reportedly limited range of hosts. It can spread by natural means, such as water, or by human assisted movement of infected plants or contaminated material. The climate in some parts of Australia will favour the spread of *P. mekongensis*. However, climatic conditions in other parts of Australia may not be favourable and could limit the spread of this pathogen. In addition, *P. mekongensis* is not reported to produce survival structures, oospores and chlamydospores, which will also limit spread.

The following information provides supporting evidence for this assessment.

Phytophthora mekongensis can spread naturally and through human activities.

- *Phytophthora* can be spread naturally by water, over short distances via subsurface movement, and long distances via irrigation systems, rivers and streams (Orlikowski et al. 2009; Stamler et al. 2016; Zappia et al. 2014).
- Many Australian citrus production areas are located along or in close proximity to rivers (RIRDC 2010) and irrigation channels, or on floodplains, which would support dispersal of *P. mekongensis* propagules.
- *Phytophthora* can also be spread through the movement of contaminated soil, clothing, equipment or infected plant material by humans, and by animals, such as herbivorous vertebrates and insects (Erwin & Ribeiro 1996).
- However, oospores and chlamydospores, structures important for *Phytophthora* survival and spread (Erwin & Ribeiro 1996), are not reported to be produced by *P. mekongensis* (Puglisi et al. 2017), moderating the likelihood of spread compared to other *Phytophthora* species.
- In addition, the relatively limited range of hosts in the family Rutaceae would also limit spread of *P. mekongensis*.

Spread of *P. mekongensis* may be limited to areas where climatic conditions are suitable for growth and survival.

- Vast areas across Australia have drier and more temperate climates that differ greatly from the predominantly tropical climates in Vietnam known to be suitable for the growth and survival of *P. mekongensis*. Seventy percent of the Australian mainland is considered either arid or semi-arid, receiving annual rainfalls of <250 mm and 250–350 mm respectively (DCCEE 2021). As a result, the spread of *P. mekongensis* in these areas may be limited.

For the reasons outlined, the likelihood that *P. mekongensis* will spread within Australia is assessed as Low.

3.11.4 Overall likelihood of entry, establishment and spread

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

The overall likelihood that *P. mekongensis* will enter Australia as a result of trade in pomelo 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: **Very Low**.

3.11.5 Consequences

The potential consequences of the establishment of *P. mekongensis* in Australia have been estimated according to the methods described in Figure A.1.

Based on the decision rules described in Table A.3, that is, where the potential consequences of a pest with respect to one or more criteria are 'D', the overall consequences are estimated to be **Low**.

Criterion	Estimate and rationale
Direct	
The life or health of plants and plant products	<p>D – Significant at the district level</p> <p>Pomelo is the main host of <i>P. mekongensis</i>. Sweet orange and lime were also identified as susceptible to root rot and stem gummosis; however, reports suggest that these <i>Citrus</i> species are not as susceptible as pomelo to <i>P. mekongensis</i> (Van Tran et al. 2023). A laboratory study reported that grapefruit, bergamot and citrange were also susceptible (Puglisi et al. 2017). The only published record of disease incidence reported around 10% of pomelo fruit with symptoms of brown rot due to infection by this pathogen in the Mekong River Delta region of Vietnam during surveys in 2012 (Puglisi et al. 2017).</p> <p>The Australian citrus industry is the primary industry affected by <i>P. mekongensis</i>. Pomelo production in Australia is currently expanding, with an estimated annual production of 1,000 t (Citrus Australia, pers. Comm. 2023). However, production volumes of sweet orange and lime are more substantial. For the year ending June 2023, the production value of fresh Australian oranges was \$439.1 million, and limes were worth \$47.6 million (based on 31% of the combined lemon/lime production value of \$153.7 million) (Horticulture Innovation Australia 2022).</p> <p>Australia has native species of citrus, however there is currently no evidence that <i>P. mekongensis</i> will affect hosts other than the reported species above.</p>
Other aspects of the environment	<p>A – Indiscernible at the local level</p> <p>There are currently no known direct consequences of <i>P. mekongensis</i> on other aspects of the natural environment.</p>
Indirect	
Eradication, control	<p>D – Significant at the district level</p> <p>Eradication of soil-borne <i>Phytophthora</i> would be costly and difficult. Eradication efforts would likely require the destruction of infected or potentially infected plant material and a period free of host plants, noting that available literature indicates that <i>P. mekongensis</i> is limited to hosts belonging to the Rutaceae family (Puglisi et al. 2017; Van Tran et al. 2023).</p> <p>The use of disease-free planting material is the primary disease control method for pathogens including <i>Phytophthora</i> (Erwin & Ribeiro 1996). Rootstocks with varying degrees of resistance/susceptibility to <i>Phytophthora</i> root and collar rots are available in the National Citrus Repository Program (AusCitrus 2023), which could be utilised to minimise impact. Changeover of plants from susceptible to resistant rootstocks will incur additional costs to the citrus industry.</p> <p>There are many fungicides registered for use on citrus for <i>Phytophthora</i> (APVMA 2023); however, the use to control this pathogen will add to the cost of production.</p>

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

Criterion	Estimate and rationale
	The cultural practices already applied in Australia to manage <i>P. citrophthora</i> and <i>P. nicotianae</i> in citrus, such as use of mounded soil beds for maximum drainage, treatment of soil before planting, and controlled irrigation may also contribute to the control of <i>P. mekongensis</i> .
Domestic trade	D – Significant at the district level Australian states and territories have their own domestic biosecurity restrictions for pests of concern for their jurisdictions. When an exotic pest is detected and its distribution is limited in area, the Subcommittee on Domestic Quarantine and Market Access (SDQMA) can restrict intra- and/or inter-state movement of affected commodities to prevent the pest's spread (SDQMA 2014). The presence of <i>P. mekongensis</i> in commercial production areas is likely to result in interstate trade restrictions on citrus host propagative material and may also include citrus host fruit at least in the initial stage. This will require industry adjustment at the district level.
International trade	D – Significant at the district level Australia currently has market access for citrus fruit to many countries including the USA, EU, New Zealand, China and Japan, and for nursery stock to a number of countries. Currently none of these countries regulate for <i>P. mekongensis</i> , however several regulate for <i>P. palmivora</i> and/or <i>P. citrophthora</i> (DAFF 2023c). The presence of <i>P. mekongensis</i> in Australia may impact current and/or potential future trade of host commodities. Producers of citrus nursery stock may be required to provide assurance to international trading partners that the host commodities for export are free of <i>P. mekongensis</i> . These will incur additional cost as it may require extensive systems to provide assurance of pest freedom.
Non-commercial and environmental	A – Indiscernible at the local level Fungicides are commonly applied in agriculture throughout Australia to control many fungal diseases. Additional usage of fungicides to control <i>P. mekongensis</i> in the event of it entering Australia, is unlikely to have a significant environmental impact.

3.11.6 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 shown in Table A.4.

Unrestricted risk estimate for <i>Phytophthora mekongensis</i>	
Overall likelihood of entry, establishment and spread	Very Low
Consequences	Low
Unrestricted risk	Negligible

The URE for *P. mekongensis* on the pomelo fruit from Vietnam pathway is assessed as **Negligible**, which achieves the ALOP for Australia. Therefore, specific risk management measures are not required for *P. mekongensis* on this pathway.

3.12 Citrus canker

Xanthomonas citri subsp. *citri* (EP)

Citrus canker is a plant disease caused by two similar but taxonomically distinct bacteria, *Xanthomonas citri* subsp. *citri* and *Xanthomonas fuscans* subsp. *aurantifolii*. *Xanthomonas fuscans* subsp. *aurantifolii* is reported to be present only in South America (Fonseca et al. 2019; Patané et al. 2019). There is no evidence for the presence of *X. fuscans* subsp. *aurantifolii* in Vietnam, therefore, only *X. citri* subsp. *citri* is included in this risk assessment.

Australia is free from *X. citri* subsp. *citri* (IPPC 2021) and, therefore, *X. citri* subsp. *citri* is a quarantine pest for Australia. *Xanthomonas citri* subsp. *citri* was previously detected in the Northern Territory, Queensland (Torres Strait) and Western Australia (Broadbent 1992; Broadbent et al. 1992; Broadbent et al. 1995; DPIRD 2019; Gambley et al. 2009; Jones 1991; Northern Territory Government 2022). These incursions have all been eradicated (IPPC 2021).

Citrus canker is classified into 3 distinct types: A, B and C (Civerolo 1984; Patané et al. 2019). *Xanthomonas citri* subsp. *citri* causes citrus canker A. This type is reported to have originated in Asia (Campos et al. 2022; Fawcett & Jenkins 1933; Patané et al. 2019) and has now spread to other parts of the world (CABI 2023a).

Citrus canker A, also known as Asiatic citrus canker, is further subdivided into 3 strains or variants; citrus canker A, citrus canker A* and citrus canker A^w (Wellington), with these strains differentiated by host specificity (Ngoc et al. 2010; Patané et al. 2019). Citrus canker A affects a wide range of *Citrus* species and causes the greatest economic damage of all three strains (Patané et al. 2019). The host range of citrus canker A* is restricted to Mexican lime (*Citrus aurantifolia*), Tahitian lime (*C. latifolia*), alemow (*C. macrophylla*) and grapefruit (*C. paradisi*) (Vernière et al. 1998). Citrus canker A^w infects Mexican lime and alemow only (Patané et al. 2019; Sun et al. 2000; Sun et al. 2004).

Citrus canker A primarily affects plants within the Rutaceae family, particularly within the *Citrus* genus (Business Queensland 2021; Civerolo 1984; Gottwald 2002; Government of Queensland 2019; Licciardello et al. 2022). The most susceptible hosts for *X. citri* subsp. *citri* are grapefruit, sweet oranges (Hamlin, Pineapple and Navel varieties), Mexican limes, lemons (*C. limon*) and trifoliate orange and their hybrids that are used for rootstocks (Goto 1992; Gottwald 2002). Pomelo is reported to be susceptible to Citrus canker A (Goto 1992; Gottwald 2002; Trung 1991).

The citrus canker A strain is the only strain reported to be present in Vietnam (Ngoc et al. 2009). Citrus canker was reported in Vietnam as early as 1920 (Reinking 1921). Canker symptoms were rated as severe on pomelo and lime in the survey throughout Ho Chi Minh City (formerly Saigon), and the Ben Cat and Thu Dau Mot regions, despite the survey being conducted in an extended dry season (May) (Reinking 1921). Citrus canker has since been reported multiple times in Vietnam (Bové et al. 1996; Chau & Hong 2007; Garnsey et al. 1979; Hong 1998; Trung 1991; Vernière et al. 2014; Whittle 1992). The pathogen is now considered to be widespread in Vietnam.

All plant parts, including leaves, stems and fruit, are susceptible to infection by *X. citri* subsp. *citri*. Natural infection is most likely when plant tissues are young and still growing, as resistance of plant tissues to citrus canker increases with maturity (Canteros 1992; Graham et al. 1992b;

Koizumi 1972). Leaves are most susceptible when they have grown to two-thirds of their maximum size (Graham et al. 1992a). Fruit are most susceptible to infection in the first 90 days after petal fall. Infections of fruit that occur after this period result in small, inconspicuous pustules only (Civerolo 1984; Gottwald & Graham 2000). Infections can also occur through wounds, such as those caused by mechanical damage, or through pests such as the citrus leafminer (Chagas et al. 2001; Goto 1962; Koizumi & Kuhara 1982; Serizawa, Inoue & Goto 1969).

Xanthomonas citri subsp. *citri* has been assessed previously in the existing policy for fresh Unshu mandarin from Japan (Biosecurity Australia 2009). In that policy, the URE for *X. citri* subsp. *citri* was assessed as Low, which does not achieve the ALOP for Australia. Therefore, specific risk management measures are required for *X. citri* subsp. *citri* on that pathway.

However, there may be differences in the commercial production practices, climatic conditions, *Citrus* species susceptibility and pest prevalence between the previously assessed pathway for Unshu mandarin from Japan and pomelo from Vietnam. These potential differences make it necessary to re-assess the likelihood that *X. citri* subsp. *citri* will arrive in Australia in a viable state on the pomelo from Vietnam pathway.

The previous assessment for *X. citri* subsp. *citri* in the existing policy for fresh Unshu mandarin from Japan rated the likelihood of distribution as Very Low.

The likelihood that *X. citri* subsp. *citri* will be distributed within Australia in a viable state as a result of the processing, sale or disposal of pomelo fruit from Vietnam and subsequently transfer to a susceptible part of a host, is likely to be similar to that previously assessed on the fresh Unshu mandarin from Japan pathway. Pomelo fruit from Vietnam will be imported for human consumption and will likely be distributed throughout Australia for wholesale and retail trade. Fruit arriving at sale points that are unmarketable are likely to be removed from further distribution and discarded into managed waste systems. Potential transfer of this pathogen to suitable host plants from managed waste systems is likely to be negligible. However, some fruit carrying citrus canker but not showing symptoms and sold to customers may be disposed of as waste into urban, peri-urban, or areas of natural vegetation in proximity to suitable host plants. Hosts of *X. citri* subsp. *citri* primarily belong to the Rutaceae family (e.g., *Citrus*, *Fortunella*, and *Poncirus* spp.), which are grown extensively throughout Australia. However, the infection of a host may be unlikely to occur because several conditions are required to coincide: climatic conditions suitable for release of bacteria from an infected fruit, the presence of host tissue at a development stage receptive to infection (or alternatively tissue with fresh wounds), and successful transfer of sufficient inoculum to a susceptible host (Biosecurity Australia 2009; Gottwald 2002; USDA 2020a). On this basis, the same rating of Very Low for the likelihood of distribution for *X. citri* subsp. *citri* in the assessment for fresh Unshu mandarin from Japan is adopted for the pomelo from Vietnam pathway.

The likelihoods of establishment and spread of *X. citri* subsp. *citri* in Australia from the pomelo from Vietnam pathway have also been assessed as similar to those of the previous assessment for fresh Unshu mandarin from Japan 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 *X. citri* subsp. *citri* in Australia are also independent of the import pathway and have been assessed as being similar to

those previous risk assessments for fresh Unshu mandarin from Japan of High. The existing ratings for the likelihoods of establishment and spread, and the rating for the overall consequences for *X. citri* subsp. *citri* in previous assessment for fresh Unshu mandarin from Japan have been adopted for the pomelo from Vietnam pathway.

In addition, the department has reviewed the subsequent, including latest literature – for example, Bellanger, Dereeper and Koebnik (2022); Canteros, Gochez and Moschini (2017); Cubero et al. (2011); Fu et al. (2020); Ibrahim et al. (2016); Kang et al. (2014); Luo et al. (2020); Malamud et al. (2013); Picchi et al. (2016); Redondo et al. (2015) and Sumares et al. (2016). No new information has been identified that would significantly change the risk ratings for distribution, establishment, spread and consequences as set out for *X. citri* subsp. *citri* in the existing policy.

The risk scenario of biosecurity concern is that *X. citri* subsp. *citri* may be present on fresh pomelo fruit imported from Vietnam, which may result in the establishment and spread of this pathogen in Australia.

3.12.1 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 *X. citri* subsp. *citri* will arrive in Australia in a viable state with the importation of pomelo from Vietnam is assessed as: **Low**.

The likelihood of importation is assessed as Low because, although *Xanthomonas citri* subsp. *citri* is present in Vietnam, commercial pomelo production practices, including sourcing of disease-free nursery stock for planting and regular monitoring and control of pests in orchards, are likely to reduce disease incidence and severity. Any infected fruit with visible symptoms are likely to be detected and discarded, but fruit with no or mild symptoms may be packed for export. However, numbers and viability of pathogens, including *X. citri* subsp. *citri* are likely to be reduced by washing and disinfection with chlorine-based sanitisers in the packing house. *Xanthomonas citri* subsp. *citri* could survive postharvest storage and transport conditions.

The following information provides supporting evidence for this assessment.

Xanthomonas citri subsp. *citri* is present in pomelo production areas of Vietnam and pomelo is a susceptible host of this pathogen.

- Pomelo is reported to be a susceptible host for *X. citri* subsp. *citri* (Gottwald 2002; Trung 1991).
- In northern Vietnam, the disease is reported to be frequently severe on sweet oranges (Trung 1991; Whittle 1992).
- In southern Vietnam, citrus canker is described as widespread (Reinking 1921) and prevalent (Chau & Hong 2007; Hong 1998), with sweet orange and pomelo the most common hosts (Vernière et al. 2014).
- A 2006 survey in Vietnam reported *X. citri* subsp. *citri* from commercial pomelo orchards in both northern and southern regions (Vernière et al. 2014).

Climatic conditions in citrus production areas of Vietnam are conducive for growth and development of *X. citri* subsp. *citri*.

- Citrus canker is most prevalent in countries that have high temperatures and heavy rainfall accompanied by wind, coinciding with flushes of new growth (Das 2003; Ference et al. 2018; Koizumi 1985; Peltier 1926; Reinking 1921).
 - The ideal temperature for growth of *X. citri* subsp. *citri* in host tissue is 30°C (Peltier 1926), with active growth in the temperature range of 20°C to 36°C (Koizumi 1985; Peltier 1920).
 - Free water, via rain, dew or certain irrigation methods, is necessary for the multiplication and release of bacteria from the canker lesion (Koizumi 1985).
 - Free water is also necessary for the bacterium to penetrate host tissue and initiate infection. A minimum wet period of 20 minutes on the surface of host material is reported to be required for infection (Peltier 1926).
 - Strong winds accompanying heavy rainfall promote increased disease severity, both through stomatal infection and via wind-associated wounds (Das 2003; Gottwald et al. 2009; Koizumi 1985).
- Areas of Vietnam where pomelo is grown typically have a tropical climate, characterised by high temperatures and high rainfall.
 - The Mekong Delta and Southeast production regions in the south of Vietnam are tropical, with average daily temperatures between 26°C and 29°C all year round. The Red River Delta and North Midland and Mountainous production regions in northern Vietnam experience more subtropical conditions, with average daily temperatures in summer ranging from 22.5°C to 27.5°C (McSweeney, New & Lizcano 2010).
 - Annual rainfall in Vietnam ranges from 1,200 to 3,000 mm, with many regions increasingly experiencing extreme weather events (Le Toan et al. 2021).
 - Coastal areas are vulnerable to Pacific tropical cyclones or typhoons (McSweeney, New & Lizcano 2010), which supports the prevalence of citrus canker in those areas.

Existing in-field controls would reduce the level of inoculum and incidence of disease in pomelo orchards, reducing the risk of fruit being infected. Infected fruit showing visible symptoms are likely to be detected and discarded prior to and at harvest. However, fruit that were infected close to harvest and showing no or mild symptoms, may be harvested.

- Commercial orchards source disease-free material for planting (MARD 2013, 2022b). However, these plants may become infected post-planting if disease inoculum moves into the orchard.
- Pests and diseases, including citrus canker, are monitored at least monthly in commercial orchards by Plant Protection Sub Department (PPSD) (MARD 2023a) and control measures are applied when necessary.
- A prevention program involving application of copper-based and other pesticide products is generally used in conjunction with cultural practices to manage spread of the disease in infected orchards (MARD 2021b, 2022c).
- Infection of fruit is generally associated with severe infection within the tree canopy (leaves and branches) (Gottwald 2002; NSW DPI 2017a). If trees become infected, diseased branches and fruit are removed and appropriately disposed of when environmental conditions are least favourable to pathogen spread (MARD 2001). Thus, the disease is generally detected and managed when it first appears in the canopy, which reduces the likelihood of fruit infection.

- Fruit infected at its early development stage typically produce detectable pustules and are therefore likely to be removed prior to harvest.
- However, fruit infected at a later stage of development (more than 90 days after petal fall) may only develop smaller, less visible pustules (Civerolo 1984; Gottwald & Graham 2000). In addition, symptoms may take up to 60 days to appear under unfavourable conditions (Gottwald 2002; Loucks 1930; Peltier 1920). As a result, fruit with no or mild symptoms may be harvested.

Postharvest processes are likely to detect and remove any infected fruit showing symptoms. Infected fruit with no or mild symptoms may not be detected. Washing and disinfection processes in the packing house will reduce numbers and viability of any pathogens present.

- Harvested fruit are usually pre-sorted by hand in the orchard. Export quality fruit are selected based on size and quality, with damaged or marked fruit rejected. Any fruit with visible disease symptoms are likely to be discarded.
- On arrival at the packing house, the fruit are subjected to an initial visual inspection and sorting and grading process. Any fruit with damage, visible blemishes, or visible disease symptoms will be removed.
- Infected fruit showing no or mild symptoms may not be detected. However, a number of processes at the packing house such as washing, disinfecting, drying and waxing will assist in reducing inoculum and viability of any bacteria present on the surface of pomelo fruit.
 - Washing fruit in water prior to treating with chlorine is reported to significantly reduce populations of *X. citri* subsp. *citri* when compared to treatment of fruit with chlorine-based solutions alone (Al-Saleh & Ibrahim 2010; Gottwald et al. 2009). Al-Saleh (2010) reported a reduction in populations of *X. citri* subsp. *citri* of approximately 50% on both grapefruit and mandarin when washed in water prior to treatment with chlorine, compared to fruits treated with chlorine alone.
 - Chlorine-based sanitisers have been shown to reduce populations and viability of *X. citri* subsp. *citri* on both naturally and artificially contaminated fruit (Al-Saleh & Ibrahim 2010; Behlau et al. 2021; Gottwald et al. 2009; Redondo et al. 2015; Stapleton 1987). Behlau et al. (2021) recorded a reduction of approximately 75% of viable *X. citri* subsp. *citri* bacteria in artificially inoculated fruit when compared to the untreated control, while in naturally (orchard) infected fruit, populations of *X. citri* subsp. *citri* were reduced by an average of 87% compared to the untreated control. Behlau et al. (2021) noted that, although packing house treatments such as washing with sodium hypochlorite solution were not able to eliminate viable populations of *X. citri* subsp. *citri* on fruit surfaces, the infective potential of the remaining bacteria was insignificant.
- Fruit undergoes a final visual quality inspection prior to packing. Any fruit showing visible signs of infection are likely to be removed as part of this process.
- Collectively, these packing house processes will reduce the risk of infected fruit being packed for export.

The pathogen may survive conditions during postharvest storage and transport to Australia.

- Pomelo fruit from Vietnam are expected to be stored and transported at temperatures of 2°C to 8°C and 85 to 95% relative humidity.
- Temperatures of 5°C are reported to inhibit growth of, but not kill, *X. citri* subsp. *citri* (Koizumi 1985; Peltier 1920).

- *Xanthomonas citri* subsp. *citri* has been demonstrated to remain viable for up to 100 days on fruit stored at 5°C (Bonn et al. 2010), although the population decreased over time (Bonn et al. 2010; Gottwald et al. 2009).
- Pomelo fruit from Vietnam may be exported to Australia via either air freight, taking up to several days, or via sea freight, taking around 20 to 30 days. *Xanthomonas citri* subsp. *citri* on fruit may survive this duration of transport to Australia.
- Viable *X. citri* subsp. *citri* bacteria have been detected on imported fresh citrus fruit (EFSA PLH Panel 2014b; Golmohammadi et al. 2007; Ibrahim et al. 2016), including on citrus fruit imported into the European Union from Vietnam (EUROPHYT 2023).

For the reasons outlined above, the likelihood that *X. citri* subsp. *citri* will arrive in Australia in a viable state with the importation of pomelo fruit from Vietnam is assessed as Low.

Likelihood of distribution

The likelihood that the assessed *X. citri* subsp. *citri* will be distributed within Australia in a viable state as a result of the processing, sale or disposal of pomelo from Vietnam, and subsequently transfer to a susceptible part of a host is likely to be similar to *X. citri* subsp. *citri* previously assessed on the Unshu mandarin from Japan pathway. The same rating of **Very Low** for the likelihood of distribution for *X. citri* subsp. *citri* in the previous assessment is adopted for pomelo from Vietnam.

Likelihood of entry

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

3.12.2 Likelihoods of establishment and spread

The likelihoods of establishment and spread for *X. citri* subsp. *citri* is independent of the import pathway and are considered similar to those in the previously assessed pathway.

Based on the existing import policy for fresh Unshu mandarin from Japan (Biosecurity Australia 2009) for *X. citri* subsp. *citri*, the likelihoods of establishment and spread are assessed as **High** and **High**, respectively.

3.12.3 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 *X. citri* subsp. *citri* will enter Australia as a result of trade in pomelo 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 **Very Low**.

3.12.4 Consequences

The potential consequences of the entry, establishment and spread of *X. citri* subsp. *citri* in Australia are similar to those in the previous assessment for citrus canker on the fresh Unshu mandarin from Japan pathway. The overall consequences in the previous assessment were

assessed as High. The overall consequences for *X. citri* subsp. *citri* on the pomelo from Vietnam pathway are also assessed as **High**.

3.12.5 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 shown in Table A.4.

Unrestricted risk estimate for <i>Xanthomonas citri</i> subsp. <i>citri</i>	
Overall likelihood of entry, establishment and spread	Very Low
Consequences	High
Unrestricted risk	Low

The URE for *X. citri* subsp. *citri* on the fresh pomelo from Vietnam pathway is assessed as **Low**, which does not achieve the ALOP for Australia. Therefore, specific risk management measures are required for *X. citri* subsp. *citri* on this pathway.

3.13 Citrus scab

Elsinoë fawcettii (EP)

Citrus scab is caused by *Elsinoë fawcettii* (Hou et al. 2014). The previously described *S. fawcettii* var. *scabiosa* is now considered to be a pathotype of *E. fawcettii* and is no longer a valid name (Timmer, Garnsey & Graham 2000). Pomelo is a host of *E. fawcettii* (Gopal et al. 2014; Winston, Bowman & Bach 1925).

The congeneric *E. australis* causes scab in sweet orange (Hou et al. 2014), but it is not known to be present in Vietnam (Gopal et al. 2014) and therefore this species is not included in this risk assessment.

Several *E. fawcettii* pathotypes have been identified worldwide, distinguished by host range and genetics (Hou et al. 2014; Hyun et al. 2009). The Tryon's and lemon pathotypes are present in Australia, but have a restricted distribution within New South Wales, Northern Territory and Queensland (Hyun et al. 2009; Miles et al. 2015; Tan et al. 1996). Many pathotypes are not known to be present in Australia, such as 'SRGC' (satsuma, rough lemon, grapefruit, clementine), 'Florida broad host range' (FBHR), 'Florida narrow host range' (FNHR), and 'Jingeul' (Hyun et al. 2009), and other unnamed pathotypes more recently identified in China (Hou et al. 2014). Exotic pathotypes of *E. fawcettii* are quarantine pests for Australia.

Reported hosts of *E. fawcettii* that are present in Australia include lemon, sweet orange, sour orange (*C. aurantium*), mandarin (*C. reticulata*), Rangpur lime (*C. limonia*), bergamot, finger lime (*C. australasica*) and tangerine (*C. reticulata*) (APPD 2023; Donovan, Barkley & Hardy 2009; Hyun et al. 2009; Jeffress et al. 2020; Miles et al. 2015; Queensland Government Department of Agriculture and Fisheries 2013; Tan et al. 1996; Timmer et al. 1996).

Elsinoë fawcettii is present in both northern and southern Vietnam (Hong 1998; Trung 1991; Whittle 1992), where citrus scab is a disease of economic importance in citrus (Chau & Hong 2007; Duc, Tuyen & Hao 2001). There is no information available on the pathotypes that are present in Vietnam; however, in neighbouring China, isolates of *E. fawcettii* from pomelo were found to be the FBHR pathotype (Hou et al. 2014).

This risk assessment is conducted for exotic pathotypes of *E. fawcettii* and assumes that pathotypes of *E. fawcettii* present in Vietnam and associated with pomelo include exotic pathotype(s) for Australia.

Elsinoë fawcettii has been assessed previously in the existing policies for Persian limes from Mexico (DAFF 2023b) and for Tahitian limes from the Pacific Islands (DAWR 2018). In those policies, the URE for *E. fawcettii* was assessed as Negligible and Very Low, respectively, which achieves the ALOP for Australia. Therefore, no specific risk management measures are required for *E. fawcettii* on those pathways.

However, there may be differences in the pest prevalence and standard commercial production practices (such as in-field pest management and packing house processes) between the lime production areas in Mexico and the Pacific Islands, and pomelo from Vietnam. These potential differences make it necessary to re-assess the likelihood that *E. fawcettii* will arrive in Australia in a viable state on the pomelo from Vietnam pathway.

Previous assessments for *E. fawcettii* in the existing policies for limes from Mexico, and the Pacific Islands, both rated the likelihood of distribution as Low. Pomelo from Vietnam are expected to be distributed in Australia in a similar way to the limes from Mexico and the Pacific Islands pathways. Opportunities for *E. fawcettii* present on infected pomelo fruit from Vietnam to be distributed to the vicinity of suitable host plants are likely to be similar to the previous assessments. The specific conditions required to initiate spore dispersal from the scab pustules and the poor survival of *E. fawcettii* conidia are not reported to significantly differ between pathotypes. While there may be some variability in the host ranges of different *E. fawcettii* pathotypes, the likelihood of the pathogen being transferred to a suitable host will not significantly differ from the previous assessments. It is acknowledged that the availability of suitable hosts could potentially be greater if a pathotype with a broader host range was imported with pomelo fruit from Vietnam. However, this is not considered to significantly increase the probability of successful transmission. On this basis, the same rating of Low for the likelihood of distribution for *E. fawcettii* in the previous assessments for limes from Mexico and the Pacific Islands is adopted for the pomelo from Vietnam pathway.

The likelihoods of establishment and spread of *E. fawcettii* in Australia from the pomelo from Vietnam pathway have also been assessed as similar to those of the previous assessments for limes from Mexico, and the Pacific Islands, of Moderate and Moderate, respectively. Those likelihoods relate specifically to events that occur in Australia and are essentially independent of the import pathway. There is no information to suggest that different pathotypes vary in their capacity to establish and spread in regions with drier climates. Many citrus types have wide distributions around Australia so while there may be some variability in the host ranges of different pathotypes, that is unlikely to significantly affect the likelihood of spread. Therefore, the existing ratings of Moderate for both the likelihoods of establishment and spread have been adopted for the pomelo fruit from Vietnam pathway.

The consequences of the entry, establishment and spread of *E. fawcettii* in Australia are also independent of the import pathway. The consequences of pathotype(s) from pomelo fruit from Vietnam is not expected to differ significantly from that of the previous assessment for lime fruit from Mexico and the Pacific Islands pathways. Therefore, the rating for the overall consequences of Low for *E. fawcettii* in the previous assessments for lime fruit from Mexico and the Pacific Islands has also been adopted for the pomelo from Vietnam pathway.

In addition, the department has reviewed the recent literature – for example, Choi et al. (2020); Elliott et al. (2023); Komuta, Sakoda and Fujiwara (2019); Shin et al. (2021) and Ujat et al. (2023). No new information has been identified that would significantly change the risk ratings for distribution, establishment, spread and consequences as set out for *E. fawcettii* in the existing policies.

The risk scenario of biosecurity concern is that exotic pathotypes of *E. fawcettii* may be present on fresh pomelo fruit imported from Vietnam, which may result in the establishment and spread of this pathogen in Australia.

3.13.1 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 *E. fawcettii* will arrive in Australia in a viable state with the importation of pomelo from Vietnam is assessed as: **Low**.

The likelihood of importation is assessed as Low because citrus scab is prevalent in Vietnam. However, standard commercial production practices such as application of fungicides and removal and disposal of diseased plant material would reduce incidence of citrus scab in orchards. In addition, infection of fruit typically occurs in the early stages of development (Chung 2011b; EFSA Panel 2017; Hou et al. 2014) and generally express highly visible symptoms as they mature and are therefore not likely to be harvested. Although mature fruit are more resistant to infection, they may still become infected and show no or mild symptoms at harvest and therefore may not be detected and excluded from harvest or export (Gopal et al. 2014; Timmer, Garnsey & Graham 2000; Tsatsia & Jackson 2017). Packing house practices including sorting, grading and quality inspection would remove any infected fruit that show symptoms at the time of packing but fruit with no or mild symptoms may not be detected and removed. Packing house practices, including washing, drying and disinfection, are likely to reduce the viability of *E. fawcettii* that may be present on the fruit.

The following information provides supporting evidence for this assessment.

Elsinoë fawcettii is prevalent in citrus production areas of Vietnam, pomelo is a known host, and fruit can be infected.

- *Elsinoë fawcettii* is prevalent in Vietnam (Chau & Hong 2007). In southern Vietnam, it has been reported in the Mekong Delta region (Duc, Tuyen & Hao 2001; Hong 1998). In northern Vietnam, it has also been reported as present (Trung 1991; Whittle 1992).
- Pomelo is susceptible to *E. fawcettii* and fruit can be infected (Chung 2011b; Gopal et al. 2014; Thuan 2017). Isolates were confirmed from pomelo fruit as *E. fawcettii* in neighbouring China (Hou et al. 2014). In a survey in southern China in the early 1900s, scab symptoms on pomelo were described as being severe at times, primarily on leaves, but also on the fruit (Reinking 1921).

Pest monitoring and control practices are likely to reduce disease incidence in commercial orchards.

- Pests and diseases are monitored in the orchards by the Vietnam Plant Protection Sub Department (PPSD) at least monthly (MARD 2023a). Regular monitoring is likely to detect citrus scab as symptoms are typically highly visible.
- Fungicide sprays and cultural controls, such as removal and disposal of diseased plant material, are used to manage citrus scab in orchards, as outlined in Chapter 2 of this report.

Fruit that are infected at an early stage of development are highly likely to develop visible symptoms and be removed prior to or during harvest. However, mature fruit that are infected closer to harvest may develop no or mild symptoms, and therefore may not be excluded from harvest.

- *Elsinoë fawcettii* primarily affects young plant tissue, with tissue becoming more resistant as they mature (Gottwald 1995; Tsatsia & Jackson 2017).

- Infection of host plants is usually initiated during the spring flush when young host tissue is available and the weather conditions are conducive to release and transfer of inoculum, and germination (Chung 2011b).
- Fruit are most susceptible to infection until they are around 3 cm in diameter (Tsatsia & Jackson 2017), or for about 6 to 8 weeks after petal fall (Chung 2011b; Timmer, Garnsey & Graham 2000).
- Symptoms may be evident on fruit from approximately 7 days after infection, and present as rough spots. As infected fruit develop and the rind tissue expands, these spots develop into raised warty pustules (Chung 2011b; EPPO 2023), which are readily visible.
- As pomelo fruit take about 5 to 6 months to mature ready for harvest, fruit that are infected at an early stage are highly likely to develop visible symptoms prior to harvest. These fruit are likely to be excluded from harvest.
- When mature fruit are infected by *E. fawcettii*, they exhibit lesions that are relatively flatter and smaller than those of young fruit (Chung 2011b; Gopal et al. 2014; Timmer, Garnsey & Graham 2000). They may also exhibit no obvious symptoms. Fruit showing no or mild symptoms may not be excluded from harvest.

Commercial packing house practices will reduce the likelihood of infected fruit being packed and exported. Although infected fruit with no or mild symptoms may not be detected, packing house practices will reduce the viability of any *E. fawcettii* present on the fruit.

- Visibly symptomatic fruit are likely to be removed during the sorting, grading and quality inspection processes at the packing house, reducing the likelihood of infected fruit being packed and exported.
- Infected fruit showing no or mild symptoms may not be detected in the packing house and may be packed for export.
- However, postharvest processes, particularly washing, surface disinfection and air drying are likely to reduce the viability of pathogens, including *E. fawcettii* propagules, that may be present on the fruit surface (Stapleton 1986, 1987; USDA-APHIS 2016). Stapleton (1986) observed a reduction in total fungal numbers of 81-100% following treatment of lime fruit with NaOCl at concentrations ranging from 50 to 900 ppm, while Stapleton (1987) observed a reduction in hyphal fungi of 99-100% following treatment of lime fruit with NaOCl at concentrations of 180 to 900 ppm.

For the reasons outlined, the likelihood that *E. fawcettii* will arrive in Australia in a viable state with the importation of pomelo from Vietnam is assessed as Low.

Likelihood of distribution

The likelihood that *E. fawcettii* will be distributed within Australia in a viable state as a result of the processing, sale or disposal of pomelo from Vietnam, and subsequently transfer to a susceptible part of a host is likely to be similar to *E. fawcettii* on previously assessed pathways for limes from Mexico and the Pacific Islands. The same rating of **Low** for the likelihood of distribution for *E. fawcettii* in these previous assessments is adopted for pomelo from Vietnam.

Likelihood of entry

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

3.13.2 Likelihoods of establishment and spread

The likelihoods of establishment and spread for *E. fawcettii* are independent of the import pathway and are considered similar to those in the previously assessed pathways for limes from Mexico and the Pacific Islands.

Based on the existing import policies for *E. fawcettii*, the likelihoods of establishment and spread are assessed as **Moderate** and **Moderate**, respectively.

3.13.3 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 *E. fawcettii* will enter Australia as a result of trade in pomelo 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 **Very Low**.

3.13.4 Consequences

The potential consequences of the entry, establishment and spread of *E. fawcettii* in Australia are similar to those in the previously assessed pathways for limes from Mexico, and the Pacific Islands. The overall consequences in the previous assessments were assessed as Low. The overall consequences for *E. fawcettii* on the pomelo from Vietnam pathway are also assessed as **Low**.

3.13.5 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 shown in Table A.4.

Unrestricted risk estimate for <i>Elsinoë fawcettii</i>	
Overall likelihood of entry, establishment and spread	Very Low
Consequences	Low
Unrestricted risk	Negligible

The URE for *E. fawcettii* on the pomelo from Vietnam pathway is assessed as **Negligible**, which achieves the ALOP for Australia. Therefore, specific risk management measures are not required for *E. fawcettii* on this pathway.

3.14 Pest risk assessment conclusions

Likelihood ratings and the consequences estimate for individual quarantine pests and regulated articles are set out in Table 3.12.

Of the 21 pests for which a further pest risk assessment was conducted:

- The UREs for 17 quarantine pests and 2 regulated articles 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:
 - Asian citrus psyllid (*Diaphorina citri*)
 - false spider mites (*Brevipalpus phoenicis* species complex)
 - carambola fruit fly (*Bactrocera carambolae*)
 - guava fruit fly (*Bactrocera correcta*)
 - Oriental fruit fly (*Bactrocera dorsalis*)
 - peach fruit fly (*Bactrocera zonata*)
 - melon fly (*Zeugodacus cucurbitae*)
 - pumpkin fruit fly (*Zeugodacus tau*)
 - cocoa mealybug (*Exallomochlus hispidus*)
 - coffee mealybug (*Planococcus lilacinus*)
 - fruit tree mealybug (*Rastrococcus invadens*)
 - tropical grey chaff scale (*Parlatoria cinerea*)
 - black parlatoria scale (*Parlatoria ziziphi*)
 - mulberry scale (*Pseudaulacaspis pentagona*)
 - citrus red mite (*Panonychus citri*)
 - Kanzawa spider mite (*Tetranychus kanzawai*)
 - chilli thrips (*Scirtothrips dorsalis*)
 - onion thrips (*Thrips tabaci*)
 - citrus canker (*Xanthomonas citri* subsp. *citri*)
- The 2 thrips species, onion thrips (*Thrips tabaci*) and chilli thrips (*Scirtothrips dorsalis*), while present in Australia, were identified as regulated articles for Australia due to their potential to introduce emerging quarantine orthotospoviruses into Australia. The URE for quarantine orthotospoviruses 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.
- *Brevipalpus phoenicis* species complex is a regulated article for Australia due to its potential to introduce viruses of quarantine concern into Australia. However, there are no reports of these viruses being present in Vietnam; therefore, the risks associated with the vector component of *B. phoenicis* species complex is not assessed in this report.
- *Diaphorina citri* is a regulated article for Australia due to its potential to introduce bacteria of quarantine concern to Australia.

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

Pomelo fruit from Vietnam: biosecurity import requirements draft report

Pest risk assessments for quarantine pests

Table 3.12 Pest risk assessment conclusions for pests, and pest groups, associated with the pathway of pomelo from Vietnam

Pest name	Likelihood of						Consequences	URE
	Importation	Distribution	Entry	Establishment	Spread	EES		
Asian citrus psyllid								
[Hemiptera: Liviidae]								
<i>Diaphorina citri</i> (EP, RA) a	Moderate	High	Moderate	High	High	Moderate	High	High
False spider mite								
[Acariformes: Tenuipalpidae]								
<i>Brevipalpus phoenicis</i> species complex (EP) a	High	Moderate	Moderate	High	High	Moderate	Low	Low
Fruit flies (Diptera: Tephritidae)								
<i>Bactrocera carambolae</i> (EP)	High	High	High	High	High	High	High	High
<i>Bactrocera correcta</i> (EP)	High	High	High	High	High	High	High	High
<i>Bactrocera dorsalis</i> (EP)	High	High	High	High	High	High	High	High
<i>Bactrocera zonata</i> (EP)	High	High	High	High	High	High	High	High
<i>Zeugodacus cucurbitae</i> (EP)	High	High	High	High	High	High	High	High
<i>Zeugodacus tau</i> (EP)	High	High	High	High	High	High	High	High
Mealybugs [Hemiptera: Pseudococcidae]								
<i>Exallomochlus hispidus</i> (GP)	High	Moderate	Moderate	High	High	Moderate	Low	Low
<i>Planococcus lilacinus</i> (GP)	High	Moderate	Moderate	High	High	Moderate	Low	Low
<i>Rastrococcus invadens</i> (GP)	High	Moderate	Moderate	High	High	Moderate	Low	Low
Scale insects (Hemiptera: Diaspididae)								
<i>Parlatoria cinerea</i> (GP)	High	Moderate	Moderate	High	High	Moderate	Low	Low
<i>Parlatoria ziziphi</i> (GP)	High	Moderate	Moderate	High	High	Moderate	Low	Low
<i>Pseudaulacaspis pentagona</i> (GP, WA)	High	Moderate	Moderate	High	High	Moderate	Low	Low
Spider mite [Acariformes: Tetranychidae]								
<i>Panonychus citri</i> (DGP, WA)	High	Moderate	Moderate	High	High	Moderate	Low	Low
<i>Tetranychus kanzawai</i> (DGP, WA)	High	Moderate	Moderate	High	High	Moderate	Low	Low

Pomelo fruit from Vietnam: biosecurity import requirements draft report

Pest risk assessments for quarantine pests

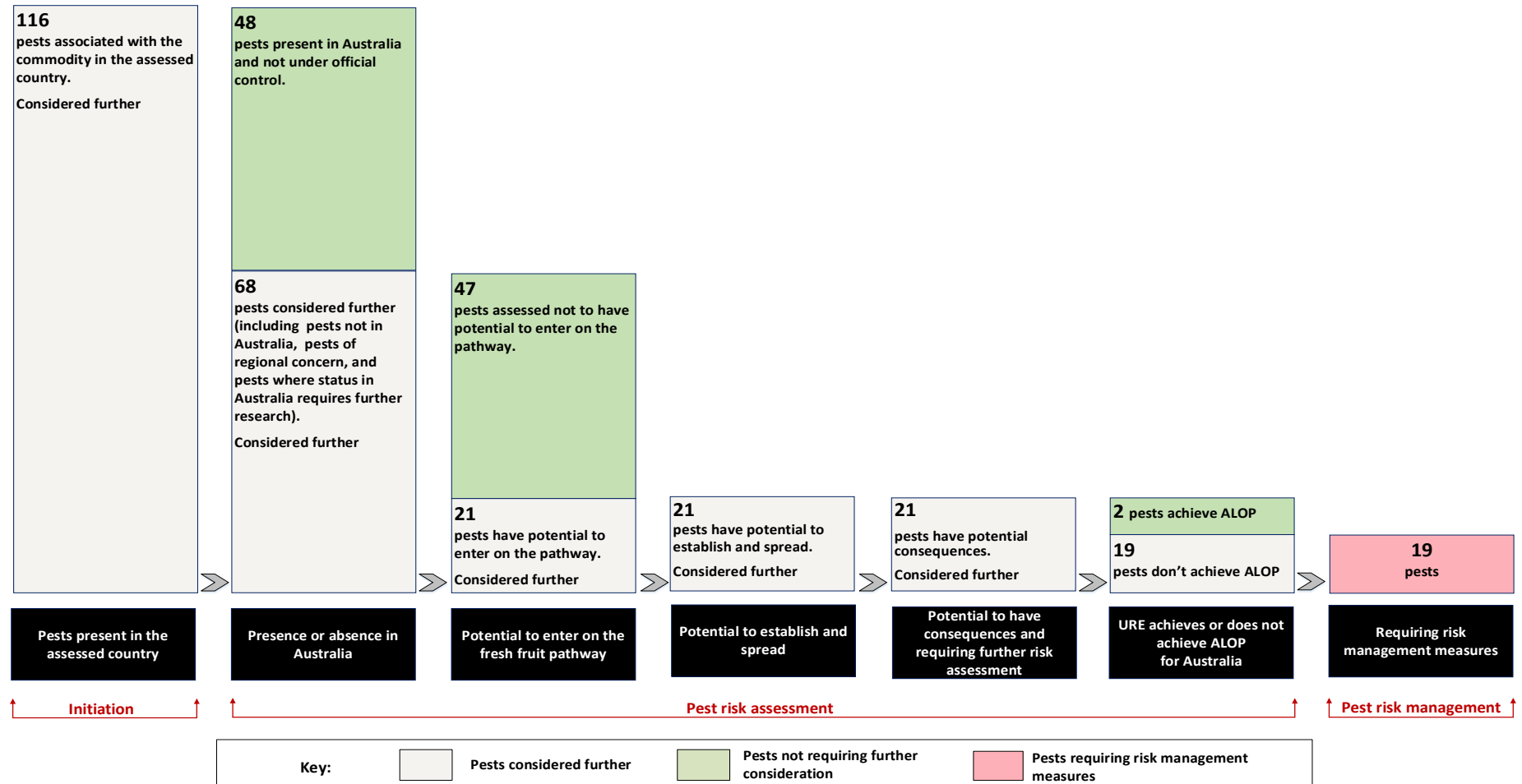
Pest name	Likelihood of						Consequences	URE
	Importation	Distribution	Entry	Establishment	Spread	EES		
Thrips [Thysanoptera: Thripidae]								
<i>Scirtothrips dorsalis</i> (GP, RA)	High	Moderate	Moderate	High	High	Moderate	Low	Low
<i>Thrips tabaci</i> (GP, RA)	High	Moderate	Moderate	High	High	Moderate	Low	Low
Bacteria [Xanthomonadales: Xanthomonadaceae]								
<i>Xanthomonas citri</i> subsp. <i>citri</i> (EP)	Low	Very Low	Very Low	High	High	Very Low	High	Low
Chromalveolata [Peronosporales: Peronosporaceae]								
<i>Phytophthora mekongensis</i>	Low	Very Low	Very Low	Moderate	Low	Very Low	Low	Negligible
Fungus [Myriangiales: Elsinoaceae]								
<i>Elsinoë fawcettii</i> (EP)	Low	Low	Very Low	Moderate	Moderate	Very Low	Low	Negligible
'Candidatus Liberibacter asiaticus' [Rhizobiales: Phyllobacteriaceae] vectored by <i>Diaphorina citri</i>								
If known vectors are present (DAFF 2011)	Moderate	High	Moderate	High	High	Moderate	High	High
If known vectors are absent (DAFF 2011)	Moderate	High	Moderate	High	Very Low	Very Low	High	Low
Orthotospoviruses [Bunyavirales: Tospoviridae] vectored by <i>Scirtothrips dorsalis</i> and <i>Thrips tabaci</i>								
Listed in the thrips group PRA (GP)	Moderate	Moderate	Low	Moderate	High	Low	Moderate	Low

a: Quarantine pest species that is also identified as a regulated article for Australia as it vectors quarantine pathogens. However, the risks associated with the vector aspect of *Brevipalpus phoenicis* species complex is not assessed in this document as there are no reports of these viruses being present in Vietnam. **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. **DGP:** Species has been assessed previously in a draft Group PRA, and the draft Group PRA has been applied. **RA:** Regulated article. This table also presents the risk estimates for the quarantine orthospoviruses vectored by thrips from the thrips Group PRA (DAWR 2017a). and for 'Candidatus Liberibacter asiaticus' vectored by *D. citri* from the PRA for 'Candidatus Liberibacter species' and their vectors associated with Rutaceae (DAFF 2011). **WA:** Regional quarantine pest for Western Australia. **EES:** Overall likelihood of entry, establishment and spread. **URE:** Unrestricted risk estimate.

Pomelo fruit from Vietnam: biosecurity import requirements draft report

Pest risk assessments for quarantine pests

Figure 3.1 Overview of the PRA decision process for pomelo 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. The specific risk management measures and the operational system are in addition to the commercial production practices for pomelo fruit 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 17 quarantine pests and 2 regulated articles assessed, in Chapter 3, as having a URE that does not achieve the ALOP for Australia.

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

4.1.1 Analysis of pest interception data

Australia currently allows imports of fresh pomelo fruit from Spain, Israel, USA and New Zealand. However, pomelo fruit have not been imported from Spain into Australia. During the period from 2015 to 2023, Israel exported approximately 1,277.6 t, the USA exported approximately 2,383.2 t and New Zealand exported approximately 13.7 t of pomelo fruit to Australia.

Approximately 11.9% of consignments from Israel and 14.7% of consignments from the USA required remedial action due to the detection of pests of biosecurity concern, most commonly mites. Other arthropod pests such as thrips and mealybugs, and an incidence of a common environmental fungus, *Cladosporium cladosporioides* were also detected in pomelo fruit imported from USA and Israel. These detections were all appropriately actioned.

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

Between 2017 and 2023, Vietnam exported approximately 6,519 t of dragon fruit to Australia. Forty-seven consignments, representing approximately 3.8% of consignments, required remedial action due to the detection of mites (family Acaridae), beetles (family Anthribidae), aphids (family Aphididae), mealybugs (family Pseudococcidae), scale insects (family Diaspididae), fungi and weed seeds of biosecurity concern.

Between 2019 and 2023, Vietnam exported approximately 287 t of longans to Australia. One consignment, representing approximately 1.5% of consignments, required remedial action for unidentified plant material of biosecurity concern.

Between 2015 and 2023, Vietnam exported approximately 472 t of lychees to Australia. Twenty-one consignments, representing approximately 21.2% of consignments, required remedial action due to the detection of sucking bugs (family Geocoridae), mealybugs (family Pseudococcidae), mites (family Phytoseiidae) and snails of biosecurity concern. Most of these non-compliant consignments occurred during initial years of trade in lychees between 2015 and 2018.

Between 2016 and 2023, Vietnam exported approximately 738 t of mangoes to Australia. Seven consignments, representing approximately 4.0% of consignments, required remedial action due to the detection of mealybugs (family Pseudococcidae) and scale insects (family Coccidae) of biosecurity concern.

It is important to note that a considerable proportion of pests detected were not able to be identified to species level. Those identified to genus, family, etc. containing species that are quarantine pests and/or regulated articles for Australia, were regarded as of biosecurity concern.

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

Proposed specific risk management measures for the 17 quarantine pests and 2 regulated articles associated with pomelo from Vietnam are listed in Table 4.1.

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

Pest/pest group	Scientific name	Common name	Measures
Psyllid [Hemiptera: Liviidae]	<i>Diaphorina citri</i> a (EP)	Asian citrus psyllid	PFA, PFPP or PFPS c OR Systems approach approved by the department OR Fruit treatment considered effective against psyllid
False spider mites [Acariformes: Tenuipalpidae]	<i>Brevipalpus phoenicis</i> species complex a (EP)		Pre-export visual inspection and, if found, remedial action b
Fruit flies [Diptera: Tephritidae]	<i>Bactrocera carambolae</i> (EP)	carambola fruit fly	PFA, PFPP or PFPS c OR Fruit treatment considered effective against all life stages of <i>B. carambolae</i> , <i>B. correcta</i> , <i>B. dorsalis</i> , <i>B. zonata</i> , <i>Z. cucurbitae</i> and <i>Z. tau</i>
	<i>Bactrocera correcta</i> (EP)	guava fruit fly	
	<i>Bactrocera dorsalis</i> (EP)	Oriental fruit fly	
	<i>Bactrocera zonata</i> (EP)	peach fruit fly	
	<i>Zeugodacus cucurbitae</i> (EP)	melon fly	
	<i>Zeugodacus tau</i> (EP)	pumpkin fruit fly	
Mealybugs [Hemiptera: Pseudococcidae]	<i>Exallomochlus hispidus</i> (GP)	cocoa mealybug	Pre-export visual inspection and, if found, remedial action b
	<i>Planococcus lilacinus</i> (GP)	coffee mealybug	
	<i>Rastrococcus invadens</i> (GP)	fruit tree mealybug	
Scale insects [Hemiptera: Diaspididae]	<i>Parlatoria cinerea</i> (GP)	tropical grey chaff scale	Pre-export visual inspection and, if found,

Pomelo fruit from Vietnam: biosecurity import requirements draft report

Pest risk management

Pest/pest group	Scientific name	Common name	Measures
	<i>Parlatoria ziziphi</i> (GP)	black parlatoria scale	remedial action b
	<i>Pseudaulacaspis pentagona</i> (GP, WA)	mulberry scale	
Spider mites [Trombidiformes: Tetranychidae]	<i>Panonychus citri</i> (DGP, WA)	citrus red mite	Pre-export visual inspection and, if found, remedial action b
	<i>Tetranychus kanzawai</i> (DGP, WA)	Kanzawa spider mite	
Thrips [Thysanoptera: Thripidae]	<i>Scirtothrips dorsalis</i> (GP, RA)	chilli thrips	Pre-export visual inspection and, if found, remedial action b
	<i>Thrips tabaci</i> (GP, RA)	onion thrips	
Bacterium [Xanthomonadales: Xanthomonadaceae]	<i>Xanthomonas citri</i> subsp. <i>citri</i> (EP)	citrus canker	Systems approach approved by the department

a: Quarantine pest species that is also identified as a regulated article for Australia as it vectors quarantine pathogens. However, the risks associated with the vector aspect of the *Brevipalpus phoenicis* species complex are not assessed in this document as there are no reports of the viruses vectored by this species complex being present in Vietnam. **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:** PFA is pest free areas, PFPP is pest free places of production or PFPS is pest free production sites. **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. **DGP:** Species has been assessed previously in a draft Group PRA, and the draft Group PRA has been applied. **WA:** Regional quarantine pest for Western Australia.

The Australian Government Department of Agriculture, Fisheries and Forestry (the department) proposes the following specific risk management measures for the identified quarantine pests and regulated articles:

- for Asian citrus psyllid
 - pest free areas, pest free places of production or pest free production sites, or
 - systems approach, or
 - fruit treatment considered to be effective against psyllid
- 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 false spider mites, mealybugs, scale insects, spider mites and thrips
 - pre-export visual inspection and, if detected, remedial action
- for citrus canker (*Xanthomonas citri* subsp. *citri*)
 - systems approach.

Measures for Asian citrus psyllid

For Asian citrus psyllid, *D. citri*, the department proposes the options of pest free areas, pest free places of production or pest free production sites; a systems approach; or a fruit treatment considered to be effective against all life stages associated with pomelo fruit, such as fumigation.

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 2017a) and, 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).

Should Vietnam wish to use PFA, PFPP or PFPS as a measure to manage the risk posed by *D. citri*, 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 2017a), and the submission demonstrating PFPP or PFPS must fulfil requirements as set out in ISPM 10 (FAO 2016a).

Proposed measure 2: Systems approach

A systems approach integrates different risk management measures, at least two of which act independently, which cumulatively achieve the required level of phytosanitary protection. The requirements of a systems approach are set out in ISPM 14: *The use of integrated measures in a systems approach for pest risk management* (FAO 2017b).

A systems approach could be based on a combination of monitoring, preventative and management measures in orchards, and harvest and postharvest processes. Should Vietnam wish to use a systems approach as a measure to manage the risk posed by *D. citri*, PPD will need to submit a proposal to the department for consideration.

The department proposes that the systems approach should include washing, brushing and waxing of fruit in approved packing houses.

Proposed measure 3: Fruit treatment

Fruit treatment known to be effective against *D. citri*, such as fumigation, applied pre-export may be used as a phytosanitary measure.

Fumigation (e.g. with methyl bromide) as a treatment is known to be effective against all life stages of psyllid and could be applied as a measure to manage the risk posed by psyllids associated with the importation of fruit. It is proposed that where methyl bromide fumigation of fruit is adopted, it must be completed in accordance with the relevant departmental standards.

Treatments for fruit, other than methyl bromide fumigation, will be considered on a case by case basis by the department if proposed by Vietnam. If an alternative fumigant is proposed to be used, the department would have to assess the efficacy of that fumigant to ensure it gives an equal level of protection to methyl bromide, prior to the acceptance of an alternative fumigant.

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

Measures for fruit flies

For the fruit flies *B. carambolae*, *B. correcta*, *B. dorsalis*, *B. zonata*, *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 pomelo fruit, 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 2017a) 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 orchards 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 2017a) 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. carambolae*, *B. correcta*, *B. dorsalis*, *B. zonata*, *Z. cucurbitae* and *Z. tau*.

The department considers irradiation to be an effective treatment for *B. carambolae*, *B. correcta*, *B. dorsalis*, *B. zonata*, *Z. cucurbitae* and *Z. tau* on the pomelo fruit 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 2023b). 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 pomelo fruit (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. carambolae*, *B. correcta*, *B. dorsalis*, *B. zonata*, *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 2023b).

The department recognises other treatments, such as cold, heat (e.g., vapour heat treatment) or fumigation, may also be effective treatments against *B. carambolae*, *B. correcta*, *B. dorsalis*, *B. zonata*, *Z. cucurbitae* and *Z. tau* on the pomelo fruit from Vietnam pathway. The use of any such treatment option is subject to its approval by the department as an efficacious measure against *B. carambolae*, *B. correcta*, *B. dorsalis*, *B. zonata*, *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. carambolae*, *B. correcta*, *B. dorsalis*, *B. zonata*, *Z. cucurbitae* and *Z. tau* on the pomelo fruit from Vietnam pathway, for consideration by the department.

Measures for mealybugs, scale insects, false spider mites, spider mites and thrips

The department proposes the option of pre-export visual inspection and, if found, remedial action for the species of mealybugs, scale insects, false spider mite, spider mites and thrips on the pomelo fruit 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 2019c) 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 pomelo fruit consignments for export to Australia must be inspected by PPD in accordance with ISPM 23 (FAO 2019c) 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 false spider mite *Brevipalpus phoenicis* species complex, mealybugs *Exallomochlus hispidus*, *Planococcus lilacinus* and *Rastrococcus invadens*, the scale insects *Parlatoria cinerea*, *Parlatoria ziziphi* and *Pseudaulacaspis pentagona*, the spider mites *Panonychus citri* and *Tetranychus kanzawai*, and the thrips *Scirtothrips dorsalis* and *Thrips tabaci*. 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.

Measure for citrus canker

For citrus canker, the department proposes that a systems approach could be used to reduce the risk of *X. citri* subsp. *citri* being imported to Australia with consignments of fresh pomelo fruit.

Proposed measure: Systems approach

Should Vietnam wish to use a systems approach as a measure to manage the risk posed by *X. citri* subsp. *citri*, PPD will need to submit a proposal to the department for consideration. The proposal would need to outline all components of the system and how these components would address the risks posed by *X. citri* subsp. *citri*. The department proposes that the following

components are considered for inclusion in such a systems approach: registration and auditing of orchards and packing houses; disease monitoring, prevention and management; harvest and packing house requirements; postharvest processes and/or treatments; inspection processes; and non-compliance arrangements.

4.1.3 Consideration of alternative measures

Consistent with the principle of equivalence detailed in ISPM 11: *Pest risk analysis for quarantine pests* (FAO 2019b), the department will consider any alternative measure proposed by PPD. Alternative measures must demonstrably manage the target pests 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 pomelo from Vietnam is maintained, and these can be verified.

4.2.1 A system of traceability to source orchards

The objectives of this proposed procedure are to ensure that:

- pomelo are sourced only from registered orchards producing commercial export quality fruit
- orchards from which pomelo 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 pomelo is grown/produced in an approved PFA, PFPP or PFPS, or under an approved systems approach, it can be verified that all fruit was 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 pomelo for export to Australia are sourced. PPD must ensure that export pomelo 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 orchards must be registered with PPD before commencement of each harvest season. Records of registered orchards 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 pomelo 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.

Packing houses must be registered with PPD before the commencement of each pomelo export 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 pomelo 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 pomelo 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:

- pomelo 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 2023a))
- unprocessed packaging material is not imported with pomelo 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 pomelo
- all wood material associated with the consignment used in packaging and transport of pomelo complies with the department's import requirements, as published on BICON
- secure packaging is used for export of pomelo 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 pomelo 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 pomelo produced using the systems approach to manage the risk of citrus canker: the orchard reference/number and the packing house reference/number
- where applicable, packaged pomelo from Vietnam that has undergone irradiation treatment is labelled with a statement that the pomelo 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 pomelo is maintained during storage and movement.

Treated and/or inspected pomelo 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 pomelo 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 exporting PPD

The objective of these proposed procedures is to ensure that Australia's import conditions have been met. All consignments of pomelo 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 2019c) 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 2019c) 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 pomelo fruit), 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 verification 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 pomelo 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 pomelo 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 Uncategorized pests

If an organism that has not been categorised, including a contaminant pest, is detected on pomelo 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 pomelo 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 pomelo 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, food imported for sale 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 be safe and 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.

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.

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.

5 Conclusion

This draft risk analysis report was conducted to assess the proposal by Vietnam for market access to Australia for pomelo fruit 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 2019a) and ISPM 11: *Pest risk analysis for quarantine pests* (FAO 2019b), 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 pomelo fruit to Australia from all commercial production areas of Vietnam 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 pomelo fruit from Vietnam.

All fresh fruit, including pomelo fruit 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 pomelo fruit 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 of Agriculture, Fisheries and Forestry (the department). This method is consistent with the International Standards for Phytosanitary Measures (ISPMs), including ISPM 2: *Framework for pest risk analysis* (FAO 2019a) and ISPM 11: *Pest risk analysis for quarantine pests* (FAO 2019b) 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 2023a). A pest is ‘any species, strain or biotype of plant, animal, or pathogenic agent, injurious to plants or plant products’ (FAO 2023a). 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 2023a).

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 2023a).

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 2023a). 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 2019b), 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 2019b) 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 2019b) 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 2023a). 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 2023a). 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	$0.7 < \text{to} \leq 1$
Moderate	The event would occur with an even likelihood	$0.3 < \text{to} \leq 0.7$
Low	The event would be unlikely to occur	$0.05 < \text{to} \leq 0.3$
Very Low	The event would be very unlikely to occur	$0.001 < \text{to} \leq 0.05$
Extremely Low	The event would be extremely unlikely to occur	$0.000001 < \text{to} \leq 0.001$
Negligible	The event would almost certainly not occur	$0 < \text{to} \leq 0.000001$

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
Geographic level					
National Regional District Local					

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 orthotospoviruses 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 2021a).
- the *Draft report for a review of pest risk assessments for spider mites (Acari: Trombidiformes: Tetranychidae)* (draft spider mite review) (DAFF 2023a).

The Group PRA approach is consistent with relevant international standards and requirements—including ISPM 2: *Framework for Pest Risk Analysis* (FAO 2019a), ISPM 11: *Pest Risk Analysis for Quarantine Pests* (FAO 2019b) 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 2019b) 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 pomelo fruit from Vietnam

The pest categorisation table does not represent a comprehensive list of all the pests associated with the entire pomelo 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 of pomelo 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', 'DGP' 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 'DGP' (draft Group policy) is used for pests that have been assessed by Australia in a draft 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), 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 orthotospoviruses 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 2021a) 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 *Draft report for a review of pest risk assessments for spider mites (Acari: Trombidiformes: Tetranychidae)* (draft Group PRA for spider mites) (DAFF 2023a) has also been applied in this risk analysis as explained in Chapter 3 (Section 3.3 and Section 3.8).

The department is aware of the 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.

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
ARTHROPODS							
Coleoptera							
<i>Adoretus sinicus</i> Burmeister, 1855 [Scarabaeidae] Chinese rose beetle	Yes (Phạm 2013a; Waterhouse 1993)	No records found	No. <i>Citrus</i> species are minor hosts of <i>A. sinicus</i> (Li, Wang & Waterhouse 1997; USDA 2020b). Adult beetles are defoliators. Eggs are laid in the soil (Habeck 1964), and the soil-dwelling larvae feed on the roots of host plants, and humus and detritus (CABI 2023b; Waterhouse 1997).	Assessment not required	Assessment not required	Assessment not required	No
<i>Anoplophora chinensis</i> (Forster, 1771) [Cerambycidae] Citrus long-horned beetle	Yes (Phạm 2013a; Waterhouse 1993)	No records found	No. Pomelo is a host of <i>A. chinensis</i> (MARD 2022b). Adult beetles feed on leaves, petioles and bark of host trees (Gyeltshen & Hodges 2018). Eggs are laid under the bark. Larvae feed on the green, sappy portion of the inner bark, and then tunnel into the trunk (Gyeltshen & Hodges 2018).	Assessment not required	Assessment not required	Assessment not required	No
<i>Chelidonium argentatum</i> (Dalman, 1817) Synonym(s): <i>Cerambyx argentatus</i> Dalman, 1817 [Cerambycidae]	Yes (Nguyen 2005; Phạm 2013a; Waterhouse 1993)	No records found	No. Pomelo is a known host of <i>C. argentatum</i> (MARD 2021b, 2022b). Adults feed on the flowers of host plants (Lin, Perissinotto & Clennell 2021). Eggs are laid on leaves and branches (FVRI 2017), while larvae bore into and primarily feed on the sapwood (Yingian 1958).	Assessment not required	Assessment not required	Assessment not required	No
<i>Clitea metallica</i> Chen, 1933	Yes (Dao et al. 2019; Phạm 2013a)	No records found	No. Larvae and adults of <i>C. metallica</i> feed almost exclusively	Assessment not required	Assessment not required	Assessment not required	No

Department of Agriculture, Fisheries and Forestry

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
Synonym(s): <i>Clitea citri</i> (Chujo, 1958) [Chrysomelidae] Citrus leaf beetle	2013a; Whittle 1992)		on leaves and tender shoots of <i>Citrus</i> species (Shang et al. 2019). This species is not associated with the fruit (Grousset et al. 2016).				
<i>Corigetus sieversi</i> Reitter, 1900 Synonym(s): <i>Platymycterus sieversi</i> (Reitter, 1900) [Curculionidae]	Yes (MARD 2022b)	No records found	No. Pomelo is a host of <i>C. sieversi</i> (MARD 2022a). Adults feed on young shoots and foliage, roots, flowers or buds of host plants (MARD 2022a). Eggs are laid on branches or leaves, and larvae burrow into the soil to feed on roots of host plants (FVRI 2017).	Assessment not required	Assessment not required	Assessment not required	No
<i>Hypomeces pulviger</i> (Herbst, 1795) Synonym(s): <i>Hypomeces squamosus</i> (Fabricius, 1792) [Curculionidae] Green weevil	Yes (Phạm 2013a, b; Waterhouse 1993)	No records found	No. Pomelo is a host of <i>H. pulviger</i> (MARD 2022b). Adults feed on leaves (Hill 2008; Ong & Farid 2017). Eggs are laid on branches or leaves, larvae burrow into the soil to feed on roots of host plants (FVRI 2017; Hill 2008; Plantwise 2023).	Assessment not required	Assessment not required	Assessment not required	No
<i>Nadezhdiella cantori</i> (Hope, 1843) [Cerambycidae] Black-grey citrus longicorn beetle	Yes (Dao et al. 2019; Phạm 2013a; Whittle 1992)	No records found	No. Pomelo is a known host of <i>N. cantori</i> (MARD 2021b, 2022b). Eggs are laid on the tree trunk and main branches (MARD 2021b). Adult beetles feed on flowers of host plants, while larvae bore into and primarily feed on sapwood (Wang & Zeng 2004).	Assessment not required	Assessment not required	Assessment not required	No
Diptera							

Appendix B: Initiation and categorisation for pests of pomelo fruit 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>Bactrocera carambolae</i> Drew & Hancock, 1994 [Tephritidae] Carambola fruit fly	Yes (Drew & Romig 2013; Phạm 2013a; PPD 2009)	No records found	Yes. <i>Bactrocera carambolae</i> is known to be associated with pomelo (Thongjua & Thongjua 2017). Tephritid fruit flies lay eggs under the fruit skin and larvae feed within the fruit (Fletcher 1989).	Yes. Pomelo fruit may be distributed across Australia. If there were viable eggs and larvae in fruit, they could potentially survive fruit storage and transport conditions and develop into adults. Adults are highly likely to find new hosts as they can fly and the species is polyphagous, with over 100 host plants including avocado, lemon, orange and mango (Marchioro 2016). Many hosts are widespread in Australia.	Yes. This species is highly polyphagous, feeding on over 100 host plants including avocado, lemon, mango and orange (Marchioro 2016). Many hosts are widespread in Australia. <i>Bactrocera carambolae</i> has established in areas with a wide range of climatic conditions (Marchioro 2016; van Sauers-Muller 2005), with similar climates occurring in Australia. Its wide host range and geographic distribution suggest that <i>B. carambolae</i> could establish and spread in Australia.	Yes. <i>Bactrocera carambolae</i> is a major economic pest of numerous fruit crops (Danjuma et al. 2014; Lemos et al. 2014; Marchioro 2016). The larvae cause premature fruit ripening, fruit rot and fruit drop (Allwood & Drew 1997; Radonjić, Hrnčić & Perović 2019). Consequences would include crop losses as well as quarantine restrictions on trade, both within Australia and internationally, to areas where this species is not present.	Yes (EP)
<i>Bactrocera correcta</i> (Bezzi, 1916) [Tephritidae] Guava fruit fly	Yes (Hà 2014; Phạm 2013a; PPD 2009)	No records found	Yes. <i>Bactrocera correcta</i> is known to be associated with pomelo (Allwood et al. 1999; Thongjua & Thongjua 2017). Tephritid fruit flies lay eggs under the fruit skin	Yes. Pomelo fruit may be distributed across Australia. If there were viable eggs and larvae in fruit, they could	Yes. This species has a wide range of hosts including pomelo, mandarin, mango and peach (CABI 2023b). Many	Yes. <i>Bactrocera correcta</i> is a pest of numerous tropical and subtropical fruit crops and can	Yes (EP)

Appendix B: Initiation and categorisation for pests of pomelo fruit 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 larvae feed within the fruit (Fletcher 1989).	potentially survive fruit storage and transport conditions and develop into adults. Adults are highly likely to find new hosts as they can fly and the species is polyphagous, with a wide range of hosts, including mandarin, mango and peach. Many hosts are widespread across Australia.	hosts are widespread across Australia. <i>Bactrocera correcta</i> is reported in China, Japan, India, Sri Lanka, Pakistan, and Thailand (Drew & Romig 2013), which have similar climates to parts of Australia. Its wide host range and geographic distribution suggest that <i>B. correcta</i> could establish and spread in Australia.	cause serious economic damage to fruit production (Liu, Yan & Ye 2013). Feeding by larvae causes premature fruit ripening, fruit rot and fruit drop (Allwood & Drew 1997; Radonjić, Hrnčić & Perović 2019). Jalaluddin et al. (1999) estimated losses of 60 to 80% for guava in India due to <i>B. correcta</i> , while Mondal et al. (2015) estimated losses of up to 90%.	
<i>Bactrocera dorsalis</i> (Hendel, 1912) Synonym(s): <i>Bactrocera invadens</i> Drew, Tsuruta & White, 2005; <i>Bactrocera papayae</i> Drew & Hancock, 1994 and <i>Bactrocera philippinensis</i> Drew & Hancock, 1994 have	Yes (Allwood & Drew 1997; Drew & Hancock 1994; Hoa et al. 2006; Waterhouse 1993)	No. Eradicated from mainland Australia (Hancock et al. 2000).	Yes. <i>Bactrocera dorsalis</i> is known to be associated with pomelo (Dao et al. 2019; Thongjua & Thongjua 2017; USDA 2020a). Tephritid fruit flies lay eggs under the fruit skin and larvae feed within the fruit (Fletcher 1989).	Yes. Pomelo fruit may be distributed across Australia. If there were viable eggs and larvae in fruit, they could potentially survive fruit storage and transport conditions and develop into adults. Adults are highly likely to find	Yes. This highly polyphagous species can infest more than 470 individual plant taxa across 78 plant families (McQuate & Liquido 2017). <i>Bactrocera dorsalis</i> is highly invasive, having spread rapidly around the world to 75	Yes. <i>Bactrocera dorsalis</i> is a major pest of many fruit species (CABI 2023b; Follett, Haynes & Dominiak 2021) which are grown commercially in Australia and are of economic importance. The	Yes (EP)

Department of Agriculture, Fisheries and Forestry

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
been synonymised with <i>B. dorsalis</i> [Tephritidae] Oriental fruit fly				new hosts as they can fly and the species is polyphagous, with a wide range of hosts, including avocado, citrus and mango (CABI 2023b; Follett, Haynes & Dominiak 2021). Many hosts are widespread across Australia.	countries (Zeng et al. 2018). It is distributed across sub-Saharan Africa, Asia and several islands in Oceania including Papua New Guinea and Hawaii (Adkins et al. 2015; CABI 2023b; White & Elson-Harris 1992), which have similar climates to parts of Australia. Its wide host range and geographic distribution suggest that <i>B. dorsalis</i> could establish and spread in Australia.	larvae cause premature fruit ripening, rot and drop (Allwood & Drew 1997; Radonjić, Hrnčić & Perović 2019). Significant indirect loss also could result from the loss of market access opportunities (Dohino et al. 2017; Heather & Hallman 2008). A detection of <i>B. dorsalis</i> (then recorded as <i>B. papaya</i>) near Cairns in 1995 cost A\$33.5 million to eradicate over four years. The estimated cost to industry at the time was \$100 million (Cantrell, Chadwick & Cahill 2002).	
<i>Bactrocera zonata</i> (Saunders, 1841) [Tephritidae]	Yes (Allwood & Drew 1997; Drew & Romig)	No records found	Yes. <i>Citrus</i> species are hosts of <i>B. zonata</i> (EPPO 2010, 2015; Plant Health Australia 2013). Tephritid fruit flies lay eggs under the fruit	Yes. Pomelo fruit may be distributed across Australia. If there were viable	Yes. This species is highly polyphagous, feeding on over 50 cultivated and wild	Yes. <i>Bactrocera zonata</i> is a serious economic pest of fruit in South and	Yes (EP)

Department of Agriculture, Fisheries and Forestry

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
Peach fruit fly	2013; Phạm 2013a)		skin and hatched larvae feed within the fruit (Fletcher 1989).	eggs and larvae in fruit, they could potentially survive fruit storage and transport conditions and develop into adults. Adults are highly likely to transfer to new hosts as they can fly and the species is polyphagous, with a wide range of hosts, including peach, guava, mango, apricot, fig and citrus (Alzubaidy 2000; EPPO 2015; Mahmoudi et al. 2017). Many hosts are widespread across Australia.	fruit-bearing plants, including peach, guava, mango, apricot, fig and citrus (Alzubaidy 2000; EPPO 2015; Mahmoudi et al. 2017). <i>Bactrocera zonata</i> has established in areas with a wide range of climatic conditions (Alzubaidy 2000), spreading across pan-tropical areas with a minimum developmental temperature of 13°C (Alzubaidy 2000; Duyck, Sterlin & Quilici 2004). Similar climates occur in parts of Australia. Its wide host range and geographic distribution across a range of climates suggest that <i>B. zonata</i> could establish and spread in Australia.	Southeast Asia (Alzubaidy 2000; Mahmoudi et al. 2017). The larvae cause premature fruit ripening, fruit rot and fruit drop (Allwood & Drew 1997; Radonjić, Hrnčić & Perović 2019). In heavy infestations, total crop losses have been reported (Alzubaidy 2000; Mahmoudi et al. 2017).	

Appendix B: Initiation and categorisation for pests of pomelo fruit 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>Zeugodacus cucurbitae</i> (Coquillett, 1849) Synonym(s): <i>Bactrocera cucurbitae</i> (Coquillett, 1899) [Tephritidae] Melon fly	Yes (Drew & Romig 2013; Hà 2014; Phạm 2013a; PPD 2016)	No records found	Yes. <i>Zeugodacus cucurbitae</i> is known to be associated with pomelo (Tan & Lee 1982; USDA 2020a; Xia et al. 2020). <i>Zeugodacus cucurbitae</i> generally lay eggs into immature fruit with a tender rind but may also lay eggs into more developed fruit (Akamine et al. 1974).	Yes. Pomelo fruit may be distributed across Australia. If there were viable eggs and larvae in fruit, they could potentially survive fruit storage and transport conditions and develop into adults. Adults are highly likely to transfer to new hosts, as they can fly and the species is polyphagous, with a wide range of hosts, including papaya, peach, pear and mango both cultivated and wild species (Dhillon et al. 2005). Many hosts are widespread across Australia.	Yes. This species has a wide host range of over 81 plant species (Dhillon et al. 2005), including cultivated and wild cucurbitaceous vegetables, beans, eggplant and fruit crops, including papaya, peach, pear and mango (Dhillon et al. 2005). <i>Zeugodacus cucurbitae</i> is distributed widely in temperate, tropical and sub-tropical regions of the world (Dhillon et al. 2005), with similar climates found throughout Australia. Its wide host range and geographic distribution across a range of climates suggest that <i>Z. cucurbitae</i> could establish and spread in Australia.	Yes. <i>Zeugodacus cucurbitae</i> is a major pest of cucurbit crops including melons and pumpkins, as well as beans, which are all commercial crops of economic importance to Australia. Host crops are widely grown in Australia and would be at risk of infestation. This pest may cause up to 100% damage depending upon the cucurbit species and the season (Dhillon et al. 2005).	Yes (EP)
<i>Zeugodacus tau</i> (Walker, 1849)	Yes (Drew & Romig 2013;	No records found	Yes. <i>Zeugodacus tau</i> is known to be associated with pomelo (Ahmad &	Yes. Pomelo fruit may be distributed	Yes. <i>Zeugodacus tau</i> has the potential to	Yes. <i>Zeugodacus tau</i> is a	Yes (EP)

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
Synonym(s): <i>Dacus hageni</i> Meijere, 1911 [Tephritidae] Pumpkin fruit fly	Hà 2014; Phạm 2013a) (Leblanc et al. 2018)		Vasudha 2019; Allwood et al. 1999; Xia et al. 2020). Tephritid fruit flies lay eggs under the fruit skin and hatched larvae feed within the fruit (Fletcher 1989).	across Australia. If there were viable eggs and larvae in fruit, they could potentially survive fruit storage and transport conditions and develop into adults. Adults are highly likely to transfer to new hosts as they can fly and the species is polyphagous, with a wide range of hosts, including several crop species (predominantly cucurbits, e.g., cucumber, gourd, luffa, pumpkin, squash) (Allwood et al. 1999), that are widespread across Australia.	establish and spread in Australia. <i>Zeugodacus tau</i> has been reported to infest 62 plant species across more than 20 families (Ahmad & Vasudha 2019), including Cucurbitaceae, Fabaceae, Myrtaceae, Rutaceae, Solanaceae and Vitaceae (Allwood et al. 1999; PHA 2018; Yong et al. 2017). <i>Zeugodacus tau</i> is reported to maintain its ability to feed and lay eggs under diverse situations (Huang et al. 2020). This species has spread from its native range in southeast China, throughout tropical and subtropical Asia, and the South Pacific region (Shi, Kerdelhué & Ye 2014), which have similar climates to	polyphagous fruit pest of economic importance in Asia (Yong et al. 2017) and a major economic pest on cucurbitaceous plants, tomatoes and other fleshy fruits (Huang et al. 2020). <i>Zeugodacus tau</i> has caused 21–34% and 21–32% yield losses of monkfruit (<i>Siraitia grosvenorii</i>) and butternut squash (<i>Cucurbita moschata</i>), respectively (Huang et al. 2020).	

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
					parts of Australia. Its wide host range and geographic distribution suggest that <i>Z. tau</i> could establish and spread in Australia.		
Hemiptera							
<i>Aleurocanthus woglumi</i> Ashby, 1915 [Aleyrodidae] Citrus blackfly	Yes (Phạm 2013a; PPD 2010b; Whittle 1992)	No. Recorded from Australian territories of Christmas and Cocos Islands (Bellis et al. 2004)	No. <i>Aleurocanthus woglumi</i> is known to be associated with pomelo (Oo et al. 2019; USDA 2020a). Eggs, nymphs and adults are associated with leaves of hosts (Enkerlin 1976; Hill 2008; Nguyen, Hamon & Fasulo 2010).	Assessment not required	Assessment not required	Assessment not required	No
<i>Aphis gossypii</i> Glover, 1877 [Aphididae] Cotton aphid	Yes (Phạm 2013a; PPD 2016)	Yes. NSW, NT, Qld, SA, Tas., Vic., WA (APPD 2023; Government of Western Australia 2023; Naumann 1993). 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	No. <i>Aphis gossypii</i> is known to be associated with citrus fruit (USDA 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 mature fruit. However, if any life stages are present on harvested fruit, they would likely be removed during packing house processes such as washing, forced air drying and surface disinfection.	Assessment not required	Assessment not required	Assessment not required	No

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
		present in Vietnam) (Do et al. 2021; Gadhav et al. 2020; Ha et al. 2008), the potential for <i>A. gossypii</i> to enter on the pathway needs to be assessed.					
<i>Aphis spiraecola</i> Patch, 1914 [Aphididae] Spirea aphid	Yes (MARD 2010; Phạm 2013a)	Yes. NSW, Qld, SA, Tas., Vic., WA (APPD 2023). 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. 2020; Ha et al. 2008), the potential for <i>A. spiraecola</i> to enter on the pathway needs to be assessed.	No. <i>Aphis spiraecola</i> is known to be associated with citrus fruit (USDA 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 mature fruit. However, if any life stages are present on harvested fruit, they would likely be removed during packing house processes such as washing, forced air drying and surface disinfection.	Assessment not required	Assessment not required	Assessment not required	No

Appendix B: Initiation and categorisation for pests of pomelo fruit 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>Bemisia giffardi</i> (Kotinsky, 1907) [Aleyrodidae] Giffard's whitefly	Yes (Dooley 2011)	Yes. NSW, Qld, SA, Vic. (ALA 2023; APPD 2023)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Bemisia tabaci</i> (Gennadius 1889) complex [Aleyrodidae] Silverleaf whitefly	Yes (Götz & Winter 2016; Phạm 2013a; Waterhouse 1993)	Yes. However, only three members of the <i>Bemisia tabaci</i> complex species (AUS1, AUS II and MEAM 1) are known to be present in Australia, while 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>Bemisia tabaci</i> is known to be associated with citrus (Evans 2007; USDA 2020b). Eggs are laid on the underside of leaves (Business Queensland 2018). <i>Bemisia tabaci</i> adults and nymphs feed on the phloem tissue in leaves and stems (McAuslane 2000) and are unlikely to feed on the fruit. In the unlikely event that whiteflies are on fruit, they are unlikely to remain on the fruit during harvesting and packing house practices.	Assessment not required	Assessment not required	Assessment not required	No

Appendix B: Initiation and categorisation for pests of pomelo fruit 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>Dialeurodes citri</i> (Ashmead, 1885) Synonym(s): <i>Aleyrodes citri</i> Ashmead, 1885 [Aleyrodidae] Citrus whitefly	Yes (Phạm 2013a; Whittle 1992)	No records found	<i>No. Dialeurodes citri</i> is known to be associated with citrus (Evans 2007; USDA 2020b). Eggs and nymphs are associated with leaves (CABI Compendium 2021; Fasulo & Weems 2014; Flint 2002). In the unlikely event that whiteflies are on fruit, they would be removed during harvest and packing house practices (MAF Biosecurity New Zealand 2009).	Assessment not required	Assessment not required	Assessment not required	No
<i>Diaphorina citri</i> Kuwayama, 1908 [Liviidae] Asian citrus psyllid	Yes (Phạm 2013a; Whittle 1992)	No. Previous detections have since been eradicated, as demonstrated by surveys (Bellis, Hollis & Jacobson 2005)	Yes. In Vietnam, <i>D. citri</i> is associated with pomelo (MARD 2022b, c). The unrestricted risk for <i>D. citri</i> , as a result of combining the overall likelihood of entry, establishment and spread with the outcome of overall consequences, on imported fruit pathways has been previously assessed as “high”, which does not achieve the ALOP for Australia (DAFF 2011).				
<i>Erthesina fullo</i> (Thunberg, 1783) [Pentatomidae] Yellow spotted stink bug	Yes (Grousset et al. 2016; Phạm 2013a)	No records found	No. Pomelo is a host of <i>E. fullo</i> (Mi et al. 2020). Adults and nymphs feed on young shoots, leaves and fruit of hosts, and eggs are typically laid on the undersides of leaves (Mi et al. 2020). Adults and nymphs are easily disturbed and are unlikely to remain on the fruit during harvest and packing house practices.	Assessment not required	Assessment not required	Assessment not required	No
<i>Exallomochlus hispidus</i> (Morrison, 1921) [Pseudococcidae]	Yes (García Morales et al. 2023; New Zealand)	No records found	Yes. <i>Exallomochlus hispidus</i> is known to be associated with pomelo (García Morales et al. 2023; Indarwatmi et al. 2021; Williams	Yes. Adults and immature stages have the capacity to survive low	Yes. Assessed in the mealybug group PRA (DAWR 2019a)	Yes. Assessed in the mealybug group PRA (DAWR 2019a)	Yes (GP)

Department of Agriculture, Fisheries and Forestry

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
Cocoa mealybug	Ministry for Primary Industries 2016)		2004). <i>Exallomochlus hispidus</i> may infest all parts of a host plant, including fruit. It is possible that <i>E. hispidus</i> on pomelo fruit may remain undetected and be present on the pathway.	temperatures during fruit storage and transport (DAWR 2019a). <i>Exallomochlus hispidus</i> has been recorded to feed on 41 host plants from 30 families in the Asian region (Indarwatmi et al. 2021). The host plants include, rambutan, sapodilla, soursop, mangosteen, lemon and ornamentals (Indarwatmi et al. 2021), many of which are available in Australia. <i>Exallomochlus hispidus</i> present on pomelo fruit could potentially disperse to a new host within close proximity as crawlers and early nymphal stages have the ability to crawl or be passively transferred to a host plant with the			

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
				assistance of wind (DAWR 2019a).			
<i>Halyomorpha halys</i> Stål, 1855 [Pentatomidae] Brown marmorated stink bug	Yes (Burne 2019; Konjević 2020)	No. Intercepted on cargo from international origins in NSW, Tas., Vic., WA (APPD 2023) Not established in Australia.	No. <i>Halyomorpha halys</i> is known to be associated with citrus (Burne 2019; Grousset et al. 2016). Eggs are laid on the undersides of leaves; adults and nymphs are sap suckers that are known to feed on citrus fruit (Gyeltshen, Bernon & Hodges 2010). However, they are present on fruit only for short periods. They are easily disturbed and are unlikely to remain on commercially produced, export quality fruit (Alcock 1971).	Assessment not required	Assessment not required	Assessment not required	No
<i>Leptocorisa acuta</i> (Thunberg, 1783) [Coreidae] Rice seed bug	Yes (Phạm 2013a; Waterhouse 1993)	Yes. NSW, NT, Qld, Tas. (APPD 2023); WA (DPIRD 2023)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Nezara viridula</i> (Linnaeus, 1758) [Pentatomidae] Green vegetable bug	Yes (Phạm 2013a, b; PPD 2010a)	Yes. NSW, NT, Qld, SA, Tas., Vic., WA (APPD 2023; Coombs 2004; Government of Western Australia 2023)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Parabemisia myricae</i> (Kuwana, 1927) [Aleyrodidae] Bayberry whitefly	Yes (Phạm 2013a; Waterhouse 1993)	Yes. Under official control (Regional) for WA (Government of Western Australia	No. <i>Parabemisia myricae</i> is known to be associated with pomelo; however, it feeds primarily on leaves (Ministry of Jihad-e-Agriculture 2014; New Zealand	Assessment not required	Assessment not required	Assessment not required	No

Department of Agriculture, Fisheries and Forestry

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
		2023). Qld (APPD 2023)	Ministry for Primary Industries 2022). Adults are reported to occasionally feed on fruit, which results in the presence of large amounts of honeydew and sooty mould (Rose, DeBach & Woolley 1981). Feeding damage on the fruit is visible, and therefore infested fruit are likely to be removed during packing house practices. Adult whiteflies are also active flyers and are unlikely to remain on fruit during harvest and packing house practices.				
<i>Parlatoria cinerea</i> Hadden in Doane & Hadden, 1909 [Diaspididae] Tropical grey chaff scale	Yes (Dao et al. 2018; García Morales et al. 2023)	No records found	Yes. <i>Parlatoria cinerea</i> is known to be associated with pomelo (Dao et al. 2018). This pest preferentially infests stems and branches but can occasionally be found externally on leaves and fruit (Dao et al. 2018; Watson 2022). Infested fruit are likely to be removed during harvest and packing house practices. However, it is possible that <i>P. cinerea</i> on pomelo fruit may remain undetected due to their small size and lack of apparent damage at the early stage of infestation.	Yes. <i>Parlatoria cinerea</i> has the capacity to survive fruit storage and transport conditions (DAWE 2021a). This pest has a broad host range, including other <i>Citrus</i> species, crab apple, grapes, gardenia, jasmine, mango, oleander, phalsa and viburnum (García Morales et al. 2023), with many hosts available in Australia. First instar crawlers of <i>P. cinerea</i> present on	Yes. Assessed in the scales group PRA (DAWE 2021a)	Yes. Assessed in the scales group PRA (DAWE 2021a)	Yes (GP)

Department of Agriculture, Fisheries and Forestry

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
				pomelo fruit could potentially transfer to a new host within close proximity as they have the ability to crawl or be passively transferred to a host plant with the assistance of wind (DAWE 2021a).			
<i>Parlatoria ziziphi</i> (Lucas, 1853) [Diaspididae] Black parlatoria scale	Yes (Dao et al. 2018; Phạm 2013a)	No. Three specimens of this pest were detected in NT during 1914–1915 (APPD 2023); however, with no further detection, <i>Parlatoria ziziphi</i> is considered absent from NT.	Yes. <i>Parlatoria ziziphi</i> has been recorded infesting twigs, leaves and fruit of pomelo (Dao et al. 2018). It is possible that <i>P. ziziphi</i> on pomelo fruit may remain undetected due to their small size and lack of apparent damage at the early stage of infestation.	Yes. <i>Parlatoria ziziphi</i> has the capacity to survive fruit storage and transport conditions (DAWE 2021a). This pest has a broad host range, including other <i>Citrus</i> species, asparagus, coconut, jasmine, jujube, rambutan and tea (García Morales et al. 2023), with many hosts available in Australia. First instar crawlers of <i>P. ziziphi</i> present on pomelo fruit could potentially disperse to a new host within close proximity as they have the ability	Yes. Assessed in the scales group PRA (DAWE 2021a)	Yes. Assessed in the scales group PRA (DAWE 2021a)	Yes (GP)

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
				to crawl or be passively transferred to a host plant with the assistance of wind (DAWE 2021a).			
<i>Planococcus lilacinus</i> (Cockerell, 1905) [Pseudococcidae] Coffee mealybug	Yes (New Zealand Ministry for Primary Industries 2016; Phạm 2013a; Trinh et al. 2015)	No records found	Yes. <i>Planococcus lilacinus</i> is known to be associated with pomelo (CABI 2023b; García Morales et al. 2023; Le et al. 2018), and affects all stages of host plants, including the root system (Business Queensland 2019b). It is possible that <i>P. lilacinus</i> on pomelo fruit may remain undetected and be present on the pathway.	Yes. <i>Planococcus lilacinus</i> has the capacity to survive fruit storage and transport conditions (DAWR 2019a). This pest has a broad host range that includes coffee, custard apple, coconut, cocoa and citrus (Business Queensland 2019b), with many hosts available in Australia. <i>Planococcus lilacinus</i> present on pomelo fruit could potentially transfer to a new host within close proximity as crawlers and early nymphal stages have the ability to crawl or be passively transferred to a host plant with the	Yes. Assessed in the mealybug group PRA (DAWR 2019a)	Yes. Assessed in the mealybug group PRA (DAWR 2019a)	Yes (GP)

Appendix B: Initiation and categorisation for pests of pomelo fruit 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>Pseudaulacaspis pentagona</i> (Targioni Tozzetti, 1886) [Diaspididae] Mulberry scale	Yes (MacLeod 2007; Phạm 2013a; Watson 2022)	Yes. Under official control (Regional) for WA (Government of Western Australia 2023). Qld, NSW (CABI 2023b).	Yes. <i>Pseudaulacaspis pentagona</i> is known to be associated with pomelo (García Morales et al. 2023; Leathers 2016; Morales-Rodriguez & McKenna 2019). <i>Pseudaulacaspis pentagona</i> sucks sap from the host plant, feeding primarily on the bark and occasionally on the leaves and fruit. Infested fruit are likely to be removed during harvest and packing house practices. However, it is possible that <i>P. pentagona</i> on pomelo fruit may remain undetected due to their small size.	assistance of wind (DAWR 2019a). Yes. <i>Pseudaulacaspis pentagona</i> has the capacity to survive fruit storage and transport conditions (DAWE 2021a). This species has a broad host range of crop plants and ornamentals, including other <i>Citrus</i> species, apple, capsicum, cotton, eggplant, geranium, grape, magnolia, mango, mulberry, oleander, okra, passionfruit, pear, pittosporum and plum (García Morales et al. 2023; Malumphy et al. 2016), many of which are available in Australia. First instar crawlers present on pomelo fruit could potentially transfer to a new host within close proximity as they have the ability	Yes. Assessed in the scales group PRA (DAWE 2021a)	Yes. Assessed in the scales group PRA (DAWE 2021a)	Yes (GP, WA)

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
				to crawl or be passively transferred to a host plant with the assistance of wind (DAWE 2021a).			
<i>Rastrococcus invadens</i> Williams, 1986 [Pseudococcidae] Fruit tree mealybug	Yes (García Morales et al. 2023; Phạm 2013a)	No records found	Yes. <i>Rastrococcus invadens</i> is known to be associated with pomelo (CABI 2023b; Williams 2004). This species has been reported to infest buds, fruit and leaves of its hosts (Agouunké, Agricola & Bokonon-Ganta 1988; Peña & Mohyuddin 1997). Infested fruit are likely to be removed during harvest and packing house practices. However, it is possible that <i>R. invadens</i> on pomelo fruit may remain undetected and be present on the pathway.	Yes. <i>Rastrococcus invadens</i> has the capacity to survive fruit storage and transport conditions (DAWR 2019a). <i>Rastrococcus invadens</i> has been recorded to feed on more than 40 host plants including <i>Citrus</i> species, passionfruit and banana (García Morales et al. 2023; Nébié et al. 2018), with many hosts available in Australia. <i>Rastrococcus invadens</i> present on pomelo fruit could potentially transfer to a new host within close proximity as crawlers and early nymphal stages have the ability to crawl	Yes. Assessed in the mealybug group PRA (DAWR 2019a)	Yes. Assessed in the mealybug group PRA (DAWR 2019a)	Yes (GP)

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
				or be passively transferred to a host plant with the assistance of wind (DAWR 2019a).			
<i>Rhynchocoris humeralis</i> (Thunberg, 1783) Synonym(s): <i>Rhynchocoris poseidon</i> Kirkaldy, 1909 [Pentatomidae] Spined fruit bug	Yes (Phạm 2013a; Whittle 1992)	No records found	No. <i>Rhynchocoris humeralis</i> is known to be associated with pomelo (MARD 2022c; Nguyen 2005; USDA 2020a). Eggs are laid in clusters on the upper surface of leaves (National Plant Protection Centre 2017). Adults and nymphs preferentially attack young shoots and young fruit (Plant Health Australia 2015). Damaged young fruit turn yellow, form callus tissue at the feeding site, and fall from the tree (Nguyen 2005). Adults and nymphs are easily disturbed and are unlikely to remain on the fruit during harvest and packing house practices.	Assessment not required	Assessment not required	Assessment not required	No
<i>Tessaratoma papillosa</i> (Drury, 1770) [Pentatomidae] Litchi stink bug	Yes (New Zealand Ministry for Primary Industries 2016; Pham 2016; Pham 2013a)	No records found	No. <i>Tessaratoma papillosa</i> is known to be associated with citrus (USDA 2020b). Adults and nymphs feed on the terminal shoots, flowers, twigs and fruit, and usually cause premature fruit drop (Peña, Sharp & Wysoki 2002). Eggs are laid in clusters on branches (Wu et al. 2020). Adults and nymphs are easily disturbed and are unlikely to	Assessment not required	Assessment not required	Assessment not required	No

Appendix B: Initiation and categorisation for pests of pomelo fruit 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 harvest and packing house practices.				
<i>Toxoptera aurantii</i> (Boyer de Fonscolombe, 1841) Synonym(s): <i>Aphis aurantii</i> (Boyer de Fonscolombe, 1841) [Aphididae] Brown citrus aphid	Yes (Phạm 2013a, b; Whittle 1992)	Yes. NSW, NT, Qld, Tas., Vic., WA (APPD 2023)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Toxoptera citricida</i> (Kirkaldy, 1907) Synonym(s): <i>Toxoptera citricidus</i> (Kirkaldy, 1907) [Aphididae] Black citrus aphid	Yes (Phạm 2013a; Waterhouse 1993)	Yes. NSW, Qld, SA, Tas., Vic., WA (ALA 2023; APPD 2023). However, this species is known to be a potential vector of <i>Citrus tristeza virus</i> (CTV) (CABI 2023b; Yokomi 2009a), which is present in Vietnam. Some strains of CTV are absent from Australia and are of quarantine concern, therefore an assessment is required for the potential for <i>T. citricida</i> to enter	No. <i>Toxoptera citricida</i> feeds on the leaves and stems of citrus plants and is not associated with mature fruit, so is unlikely to be present on pomelo fruit when it is harvested (CABI 2023b). If aphids were present on pomelo fruit, they would be removed during the packing house practices. Therefore, the pest is unlikely to be present on commercially produced, export quality pomelo fruit.	Assessment not required	Assessment not required	Assessment not required	No

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
		through this pathway.					
Lepidoptera							
<i>Achaea janata</i> (Linnaeus, 1758) [Erebidae] Castor semi-looper	Yes (Phạm 2013a; Waterhouse 1993)	Yes. NSW, NT, Qld, SA, Tas., Vic., WA (ALA 2023; APPD 2023)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Achaea serva</i> (Fabricius, 1775) [Erebidae] Fruit piercing moth	Yes (Pham et al. 2021)	Yes. NSW, NT, Qld (ALA 2023)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Adoxophyes privatana</i> Walker, 1863 [Tortricidae] Apple leaf curling moth	Yes (Phạm 2013a; Vang et al. 2013; Waterhouse 1993)	No records found	<i>No. Adoxophyes privatana</i> is known to be associated with pomelo (MARD 2022c). Larvae roll young citrus leaves together with silken threads to feed and pupate (Vang et al. 2013). Superficial damage to pomelo fruit may occur when the feeding nest is adjacent to fruit. However, larvae are very active and abandon their feeding site when disturbed (Meijerman & Ulenberg 2023). Damage to the skin is visible and likely to be detected during harvest and packing house practices.	Assessment not required	Assessment not required	Assessment not required	No
<i>Archips micaceana</i> Walker, 1863 [Tortricidae]	Yes (Phạm 2013a; Waterhouse 1993)	No records found	No. <i>Archips micaceana</i> is known to be associated with citrus (USDA 2020b). However, the larvae primarily feed on foliage (Sottikul	Assessment not required	Assessment not required	Assessment not required	No

Department of Agriculture, Fisheries and Forestry

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
Soyabean leafroller			1989). Superficial damage to fruit may occur when later larval instars feed inside rolled leaves adjacent to the fruit, or where they have webbed leaves to the fruit (USDA 2020b). Superficial larval damage to the exocarp is visible and likely to be detected during harvest and packing house practices.				
<i>Citripestis sagittiferella</i> Moore, 1891 [Pyralidae] Citrus fruit borer	Yes (EFSA Panel on Plant Health 2021; Grousset et al. 2016; Phạm 2013a; Whittle 1992)	No records found	No. <i>Citripestis sagittiferella</i> is known to be associated with pomelo (Biosecurity Queensland 2018; EFSA Panel on Plant Health 2021). Eggs are laid on the fruit at any stage of fruit development (EFSA Panel on Plant Health 2021). Young larvae (2.5 mm long) bore into the fruit rind, and then move into the flesh (EFSA Panel on Plant Health 2021; FERA 2013). After the first moult, larvae bore several holes of 2–3 mm in diameter where large amounts of drying sap and excrement can be readily detected (EFSA Panel on Plant Health 2021). This feeding activity may cause premature fruit drop, or spoilage (due to tunnels and frass), and allow the entry of pathogens, causing secondary rot in the fruit (CABI 2023b; FERA 2013). Generally, several larvae can infest an individual fruit, with an average of over 6 larvae/fruit recorded in	Assessment not required	Assessment not required	Assessment not required	No

Department of Agriculture, Fisheries and Forestry

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
			pomelo orchards in Indonesia (Marthana, Bagus & Susila 2018). Symptoms on fruit would be clearly evident, as larvae bore numerous cavities on the fruit surface, which are covered with excreta (USDA-APHIS 2017). Infested fruit would be removed during harvest and packing house practices. Eggs and newly hatched larvae on the surface of fruit would likely be removed during packing house practices, including washing, drying, and waxing of the fruit surface. Therefore, the pest is unlikely to be present on commercially produced, export quality pomelo fruit.				
<i>Conogethes punctiferalis</i> Guenée, 1854 Synonym(s): <i>Dichocrocis punctiferalis</i> (Guenée, 1854) [Crambidae] Yellow peach moth	Yes (New Zealand Ministry for Primary Industries 2016; Phạm 2013a; PPD 2017)	Yes. NSW, NT, Qld, WA (APPD 2023)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Cryptoblabes gnidiella</i> Millière, 1867 [Pyralidae] Honeydew moth	Yes (Nguyen & Ha 2020)	No records found	No. <i>Cryptoblabes gnidiella</i> is known to be associated with citrus (EPPO 2023; USDA 2020b) but is considered a secondary pest of citrus fruit (Silva & Mexia 1999). Adults are attracted to honeydew	Assessment not required	Assessment not required	Assessment not required	No

Department of Agriculture, Fisheries and Forestry

Appendix B: Initiation and categorisation for pests of pomelo fruit 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>excreted on the fruit surface by aphids, mealybugs or scale insects, or to sugar secretions of fruit injured by other insects, and lay eggs on fruit, branches or foliage (Abdel-Moaty, Hashim & Tadros 2017; Cocuzza et al. 2016; Dawidowicz & Rozwalka 2016; Molet 2016). Early larval stages feed on honeydew on the fruit surface (Avidov & Harpaz 1969; Cocuzza et al. 2016; Silva & Mexia 1999), and later stages burrow into the fruit rind using holes previously made by birds or other borers (Molet 2016). Infested fruit are typically smaller in size (Moore 2003), and larval feeding causes premature fruit yellowing and drop (Silva & Mexia 1999). Due to the obvious feeding damage, infested fruit are likely to be removed during harvest and packing house practices. Therefore, the pest is unlikely to be present on commercially produced, export quality pomelo fruit.</p>				
<i>Erebus ephesperis</i> (Hübner, 1823) [Erebidae] Owl moth	Yes (GBIF Secretariat 2022)	No records found	No. Adults of <i>E. ephesperis</i> are known to be associated with pomelo (Ngampongsai et al. 2005). Eggs and larvae are associated with non-citrus hosts (Holloway 2005b). The adults feed on citrus fruit at night (Sourakov & Chadd 2022)	Assessment not required	Assessment not required	Assessment not required	No

Department of Agriculture, Fisheries and Forestry

Appendix B: Initiation and categorisation for pests of pomelo fruit 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 are unlikely to be present when fruit is harvested. Therefore, this pest is unlikely to be present on commercially produced, export quality pomelo fruit (USDA 2020b).				
<i>Eublemma versicolor</i> (Walker, 1864) Synonym(s): <i>Autoba versicolor</i> Walker, 1864 [Noctuidae] Flower webber	Yes (Phạm 2013a)	Yes. Qld, NT, WA (ALA 2023; APPD 2023)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Eudocima phalonia</i> Linnaeus, 1763 Synonym(s): <i>Eudocima fullonia</i> (Clerck, 1874) [Noctuidae] Fruit-piercing moth	Yes (MARD 2016; Phạm 2013a)	Yes. NSW, NT, Qld, Vic., WA (ALA 2023; APPD 2023)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Eudocima salamina</i> (Cramer, 1777) [Noctuidae] Fruit-piercing moth	Yes (Phạm 2013a; PPD 2017; Van Mele 2000)	Yes. Under official control (Regional) for WA (Government of Western Australia 2023). NSW, NT, Qld, Vic. (ALA 2023; APPD 2023)	No. Adults of <i>E. salamina</i> are an occasional pest on pomelo (Ngampongsai et al. 2005). Eggs and larvae are associated with non-citrus hosts (Muniappan et al. 2012; QDAF 2012). Adults feed on citrus fruit at night (Leong & Kueh 2011) and are unlikely to be present when fruit are harvested. Therefore, this pest is unlikely to be present on commercially	Assessment not required	Assessment not required	Assessment not required	No

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
			produced, export quality pomelo fruit (USDA 2020b).				
<i>Euproctis fraterna</i> Moore, 1883 [Erebidae] Gypsy moth	Yes (Phạm 2013a; Robinson et al. 2023)	No records found	No. <i>Citrus</i> species are known hosts of <i>E. fraterna</i> (Robinson et al. 2023; USDA 2020b). Larvae feed on the leaves of host plants (Kuroko & Lewvanich 1993; Nizamani et al. 2016; Waterhouse 1993). There are no reports available indicating presence of this pest on commercially produced, export quality pomelo fruit.	Assessment not required	Assessment not required	Assessment not required	No
<i>Grammodes geometrica</i> (Fabricius, 1775) [Erebidae]	Yes (Phạm 2013a)	Yes. NT, Qld (ALA 2023)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Graphium agamemnon</i> Linnaeus, 1758 [Papilionidae] Green-spotted triangle	Yes (Phạm 2013a; Vu et al. 2008; Vu & Yuan 2003)	Yes. Qld (APPD 2023)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Homona coffearia</i> (Nietner, 1861) Synonym(s): <i>Tortrix coffearia</i> (Nietner, 1861) [Tortricidae] Camellia tortrix	Yes (Phạm 2013a, b; Whittle 1992)	No records found	No. <i>Citrus</i> species are known hosts of <i>H. coffearia</i> (Meijerman & Ulenberg 2023). <i>Homona coffearia</i> is a leafroller moth which constructs larval shelters by fastening two or more leaves together with silk (CABI 2023b). Eggs are laid on and larvae feed on	Assessment not required	Assessment not required	Assessment not required	No

Department of Agriculture, Fisheries and Forestry

Appendix B: Initiation and categorisation for pests of pomelo fruit 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>leaves (Cranham & Danthanarayana 1971; Kuroko & Lewvanich 1993; Meijerman & Ulenberg 2023; Waterhouse 1993). Pupation occurs in the folds of leaves (Meijerman & Ulenberg 2023). Fruit are not reported to be infested by this pest. Ripening pomelo fruit typically hang from tree branches well clear of the leaves. However, where leaves are adjacent to the fruit, late instar larvae feeding on these leaves may cause superficial damage to pomelo fruit (USDA 2020b). Mature larvae (25 mm in length) that may be present on the fruit surface will be highly visible and are likely to be removed during harvest and packing house practices. Therefore, this pest is unlikely to be present on commercially produced, export quality pomelo fruit.</p>				
<i>Hyposidra talaca</i> (Walker, 1860) [Geometridae] Black looper	Yes (Phạm 2013a; Robinson et al. 2023)	Yes. Under official control (Regional) for WA (Government of Western Australia 2023). NSW, Qld (ALA 2023; Herbison-Evans & Crossley 2022)	No. <i>Hyposidra talaca</i> is known to be associated with pomelo (Australian Faunal Directory 2022; Kemal, Watanasit & Kocak 2007). <i>Hyposidra talaca</i> lay eggs into cracks and crevices in the bark of trees (Holloway 1994; Roy et al. 2017). Larvae are defoliators and flower-feeders (Roy et al. 2017). There are no reports available to indicate that this pest is associated	Assessment not required	Assessment not required	Assessment not required	No

Department of Agriculture, Fisheries and Forestry

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
			with commercially produced, export quality pomelo fruit.				
<i>Mocis frugalis</i> (Fabricius, 1775) [Noctuidae] Sugarcane looper	Yes (Phạm 2013a; Pham & Le 2011; Zilli 2000)	Yes. NSW, NT, Qld, WA (ALA 2023)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Mocis undata</i> (Fabricius, 1775) [Erebidae] Brown striped semi-looper	Yes (Phạm 2013a)	No records found	No. Adults of <i>Mocis undata</i> are known to be associated with pomelo (Aiswarya & Abhilash 2022; Ngampongsai et al. 2005). Eggs and larvae are associated with non-citrus hosts (Holloway 2005a; USDA 2020b). The adults feed on citrus fruit at night (Leong & Kueh 2011; Ngampongsai et al. 2005) and are unlikely to be present when fruit are harvested. Therefore, this pest is unlikely to be present on commercially produced, export quality pomelo fruit (USDA 2020b).	Assessment not required	Assessment not required	Assessment not required	No
<i>Ophiura coronata</i> (Fabricius, 1775) [Erebidae] Fruit-piercing moth	Yes (Phạm 2013a; PPD 2017)	Yes. NSW, NT, Qld, WA (ALA 2023)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Orgyia postica</i> (Walker, 1855) Synonym(s): <i>Notolophus australis</i>	Yes (Phạm 2013a, b; PPD 2017)	No records found	No. <i>Citrus</i> species are known hosts of <i>O. postica</i> (Holloway 1999; Robinson et al. 2023). Females generally lay eggs in their cocoon (Sanchez & Laigo 1968), and hatched larvae feed on stamens and	Assessment not required	Assessment not required	Assessment not required	No

Department of Agriculture, Fisheries and Forestry

Appendix B: Initiation and categorisation for pests of pomelo fruit 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>posticus</i> (Walker, 1855) [Erebidae] Cocoa tussock moth			leaves (Duan & Hu 2021; Kuroko & Lewvanich 1993). There are no reports available to indicate that this pest is associated with commercially produced, export quality pomelo fruit.				
<i>Orotholassodes falsaria</i> (Prout, 1912) Synonym(s): <i>Thalassodes falsaria</i> Prout, 1912 [Geometridae]	Yes (PPD 2009)	No records found	No. <i>Citrus</i> species are known hosts of <i>O. falsaria</i> (Robinson et al. 2023). Larvae feed on foliage and adults feed on nectar (Robinson et al. 2001). There are no reports available to indicate that this pest is associated with commercially produced, export quality pomelo fruit.	Assessment not required	Assessment not required	Assessment not required	No
<i>Papilio demoleus</i> Linnaeus, 1758 Synonym(s): <i>Papilio (Princeps) demoleus</i> Linnaeus, 1758 [Papilionidae] Chequered swallowtail	Yes (Phạm 2013a; Pham & Le 2011; Waterhouse 1993)	Yes. NSW, NT, Qld, SA, Vic., WA (APPD 2023)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Papilio memnon</i> Linnaeus, 1758 [Papilionidae] Great Mormon	Yes (Phạm 2013a; Võ et al. 2020; Vu & Yuan 2003)	No records found	No. <i>Citrus</i> species, including pomelo, are known hosts of <i>P. memnon</i> (Komala, Wiyati & Suryanda 2018; Robinson et al. 2023). Eggs are laid on the leaf surface. Larvae feed on foliage and adults feed on nectar of flowers (Nguyen 2005).	Assessment not required	Assessment not required	Assessment not required	No

Department of Agriculture, Fisheries and Forestry

Appendix B: Initiation and categorisation for pests of pomelo fruit 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>Papilio polytes</i> Linnaeus, 1758 [Papilionidae] Common Mormon	Yes (Phạm 2013a; Vu & Yuan 2003; Waterhouse 1993)	No records found	No. Pomelo is a known host of <i>P. polytes</i> (MARD 2022b). Eggs are laid on the leaf surface. Larvae feed on foliage and adults feed on nectar of flowers (Islam et al. 2017; Nguyen 2005).	Assessment not required	Assessment not required	Assessment not required	No
<i>Papilio xuthus</i> Linnaeus, 1767 [Papilionidae] Asian swallowtail	Yes (Phạm 2013a; Vu 2014)	No records found	No. <i>Citrus</i> species, including pomelo, are known hosts of <i>P. xuthus</i> (Murata, Mori & Nishida 2011; Ohsugi, Nishida & Fukami 1985). Eggs are laid on the leaf surface. Larvae feed on leaves (Ohsugi, Nishida & Fukami 1985) and adults on the nectar of flowers (ALA 2023).	Assessment not required	Assessment not required	Assessment not required	No
<i>Parasa lepida</i> (Cramer, 1799) [Limacodidae] Nettle caterpillar	Yes (Phạm 2013a, b; PPD 2009)	No records found	No. <i>Citrus</i> species, including pomelo, are known hosts of <i>P. lepida</i> (CABI 2023b; Robinson et al. 2023). Eggs are laid and larvae feed on leaves of host plants (Kuroko & Lewvanich 1993). There are no reports available to indicate that this pest is associated with commercially produced, export quality pomelo fruit.	Assessment not required	Assessment not required	Assessment not required	No
<i>Phyllocnistis citrella</i> Stainton, 1856 [Gracillariidae] Citrus leafminer	Yes (Nguyen 2005; Phạm 2013a; Waterhouse 1993)	Yes. NSW, NT, Qld, SA, Vic., WA (ALA 2023; APPD 2023)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No

Appendix B: Initiation and categorisation for pests of pomelo fruit 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>Polyphagozerra coffeae</i> Nietner, 1861 Synonym(s): <i>Zeuzera coffeae</i> Nietner, 1861 [Cossidae] Red coffee borer	Yes (Phạm 2013a; PPD 2017)	No records found	No. <i>Citrus</i> species are known hosts of <i>P. coffeae</i> (Byrne & Moyle 2019; Robinson et al. 2023). <i>Polyphagozerra coffeae</i> is a borer of host trees. Eggs are laid on the branches of host plants, and larvae feed on the heartwood and pith (Byrne & Moyle 2019; Tavares et al. 2020).	Assessment not required	Assessment not required	Assessment not required	No
<i>Prays endocarpa</i> Meyrick, 1919 [Yponomeutidae] Citrus rind borer	Yes (Phạm 2013a; USDA 2020a; Vang et al. 2011)	No records found	No. <i>Prays endocarpa</i> primarily infests certain varieties of pomelo and other <i>Citrus</i> species (Robinson et al. 2023). <i>Prays endocarpa</i> is generally considered a minor pest of citrus (Areces-Berazain 2022), and it infests fruit during early stages of development (Vang et al. 2011; Vang, Son & Khanh 2018). Eggs are laid in the depression of oil glands on the rind of young citrus fruit, often before the petals have fallen (Areces-Berazain 2022; EFSA Panel on Plant Health 2008b). Larvae mine and develop in the rind of immature fruit, causing gall-like swellings (pocks) (EFSA Panel on Plant Health 2008b). Lignified tissue is formed around the entry point, which may extend to the pulp (Areces-Berazain 2022). Mature larvae are 5–7 mm in length, and exit the fruit to pupate on the sepal, leaves or trunk of the	Assessment not required	Assessment not required	Assessment not required	No

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
			host tree (CABI 2023b). Infestation of immature fruit causes fruit drop (USDA 2020a). Because eggs are laid during early stage of the fruit development and take only a few days to hatch, they are unlikely to be found on mature fruits (EFSA Panel on Plant Health 2008b). In the unlikely event that mature fruit are infested, the galls formed in the rind would be obvious, and fruit are likely to be removed during harvest and packing house practices (EFSA Panel on Plant Health 2008b).				
<i>Quasithosea obliquistriga</i> (Hering, 1931) [Limaecodidae]	Yes (GBIF Secretariat 2022; Holloway, Cock & de Chenon 1987; Ustjuzhanin & Kovtunovich 2009)	No records found	No. <i>Citrus</i> species, including pomelo, are known hosts of <i>Q. obliquistriga</i> (Robinson et al. 2023). Eggs are laid and larvae feed on leaves of host plants (Ustjuzhanin & Kovtunovich 2009). There are no reports available to indicate that this pest is associated with commercially produced, export quality pomelo fruit.	Assessment not required	Assessment not required	Assessment not required	No
<i>Spirama retorta</i> (Clerck, 1764) Synonym(s): <i>Speiredonia retorta</i> (Clerck, 1764) [Erebidae] Owlet-moth	Yes (Pham & Le 2011)	No records found	No. Adults of <i>S. retorta</i> are known to be associated with <i>Citrus</i> species (USDA 2020b). Eggs and larvae are associated with non-citrus hosts (Husain & Hasan 2020; Sajap, Wahab & Marsidi 1997). The adults feed on citrus fruit at night (Sourakov & Chadd 2022) and are	Assessment not required	Assessment not required	Assessment not required	No

Department of Agriculture, Fisheries and Forestry

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
			unlikely to be present when fruit are harvested. Therefore, this pest is unlikely to be present on commercially produced, export quality pomelo fruit (USDA 2020b).				
<i>Trigonodes hyppasia</i> (Cramer, 1779) [Erebidae] Triangles	Yes (Pham & Le 2011)	Yes. NSW, NT, Qld, Vic., WA (ALA 2023)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
Thysanoptera							
<i>Scirtothrips dorsalis</i> Hood, 1919 [Thripidae] Chilli thrips	Yes (Pham 2013a; PPD 2017)	Yes. NSW, NT, Qld, WA (Government of Western Australia 2023; Mound, Tree & Paris 2023). <i>Scirtothrips 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).	Yes. Pomelo is a known host of <i>S. dorsalis</i> (MARD 2022b, c). <i>Scirtothrips dorsalis</i> usually feeds externally on leaves and flowers of host plants. However, fruit may also be damaged with scarring and deformities due to feeding injury (CABI 2023b). <i>Scirtothrips</i> species are routinely intercepted on horticultural products at the Australian border (DAWR 2017a).	Yes. <i>Scirtothrips dorsalis</i> has the capacity to survive fruit storage and transport conditions. This pest has a wide host range including crop plants and ornamentals (CABI 2023b), and many hosts are available in Australia. <i>Scirtothrips dorsalis</i> on pomelo fruit could potentially disperse to a new host within close proximity.	Not applicable to vector. However, the emerging quarantine orthotospoviruses vectored by this thrips have potential for establishment and spread (DAWR 2017a).	Not applicable to vector. However, the emerging quarantine orthotospoviruses vectored by this thrips have potential for consequences (DAWR 2017a).	Yes (GP, RA)
<i>Thrips hawaiiensis</i> (Morgan, 1913)	Yes (New Zealand Ministry for	Yes. NSW, NT, Qld, Vic., WA (APPD	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No

Department of Agriculture, Fisheries and Forestry

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
Synonym(s): <i>Euthrips hawaiiensis</i> Morgan, 1913 [Thripidae] Hawaiian flower thrips	Primary Industries 2016; Phạm 2013a; Poushkova & Kasatkin 2020)	2023; Mound, Tree & Paris 2023)					
<i>Thrips tabaci</i> Lindeman, 1889 [Thripidae] Onion thrips	Yes (Phạm 2013a; PPD 2017)	Yes. NSW, NT, Qld, SA, Tas., Vic., WA (APPD 2023) <i>Thrips tabaci</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).	Yes. <i>Citrus</i> species are known hosts of <i>T. tabaci</i> (Atakan, Pehlivan & Kiminsu 2016; DPIRD 2021; Kerns, Wright & Loghry 2001). <i>Thrips tabaci</i> usually feeds externally on leaves and flowers of host plants. However, fruit may also be damaged with scarring and deformities due to feeding injury (CABI 2023b). <i>Thrips tabaci</i> is routinely intercepted on horticultural products at the Australian border (DAWR 2017a).	Yes. <i>Thrips tabaci</i> has the capacity to survive fruit storage and transport conditions. This pest has a wide host range with more than 140 plant species in over 40 families, including cultivated crops, ornamentals and weedy plants (Gill et al. 2015), and many hosts are available in Australia. Winged adult thrips exhibit highly dispersive behaviour (Loredo Varela & Fail 2022). Adults of <i>T. tabaci</i> present on pomelo fruit can therefore potentially disperse to a new host.	Not applicable to vector. However, the emerging quarantine orthotospoviruses vectored by this thrips have potential for establishment and spread (DAWR 2017a).	Not applicable to vector. However, the emerging quarantine orthotospoviruses vectored by this thrips have potential for consequences (DAWR 2017a).	Yes (GP, RA)
Trombidiformes							

Appendix B: Initiation and categorisation for pests of pomelo fruit 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>Brevipalpus phoenicis</i> species complex (Geijskes, 1939) [Tenuipalpidae] False spider mite	Yes (Zhang 2021). There are at least 8 species in the complex (Beard et al. 2015), but it is not known which of these species are present in Vietnam.	Yes. NSW, NT, SA, Qld, Vic., WA (APPD 2023; Womersley 1940), but only 2 species (<i>B. papayensis</i> and <i>B. yothersi</i>) are considered present (Beard et al. 2015).	Yes. <i>Brevipalpus phoenicis</i> is a polyphagous pest causing damage to leaves (Gupta 1985; Hill 2008) and fruit (Haramoto 1969; Vacante 2010). Pomelo is reported as a known host for <i>B. phoenicis</i> in Africa and Asia (Childers, Rodrigues & Webourn 2003; Maity & Mondal 2023). <i>Brevipalpus</i> species are routinely intercepted on horticultural products at the Australian border.	Yes. Pomelo fruit will be distributed throughout Australia for sale and could potentially carry mite adults, eggs, larvae and nymphs. <i>Brevipalpus phoenicis</i> is polyphagous (Childers, Rodrigues & Webourn 2003; UH-CTAHR Department of Entomology & Hawaii Department of Agriculture 2023) and suitable hosts are available in Australia. Adults, as well as viable immature stages potentially present on imported pomelo fruit could transfer to new hosts available in Australia (UH-CTAHR Department of Entomology & Hawaii Department of Agriculture 2023) although their	Yes. <i>Brevipalpus phoenicis</i> reproduces asexually via parthenogenesis and so individuals may reproduce readily on reaching a suitable host and establish if conditions are favourable. The species is polyphagous, which would facilitate natural spread, although the rate of spread would be slow due to its limited mobility. The pest could more rapidly spread to new regions via movement of infested plant material.	Yes. <i>Brevipalpus phoenicis</i> has been reported as a pest of a range of economically important crops, including citrus, grapes, passionfruit, papaya and <i>Prunus</i> species (Childers, Rodrigues & Webourn 2003; Hill 2008), which are grown commercially in Australia. Infestations can lead to reduced fruit production, damage to fruit and, in extreme cases, death of the host plant. This species can also vector viruses, including citrus leprosis viruses and passionfruit green spot virus, which can cause significant crop losses (Rodrigues & Childers 2013).	Yes (EP)

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
				capacity for dispersal is limited.		Although these viruses are not present in Vietnam or Australia, the presence of additional vectors may increase the potential for such viruses to become established if they were introduced.	
<i>Eutetranychus orientalis</i> (Klein, 1936) [Tetranychidae] Citrus brown mite	Yes (Beard 2018; New Zealand Ministry for Primary Industries 2016; WTO 2020)	Yes. NT, Qld, WA (ALA 2023; Government of Western Australia 2023; Walter, Halliday & Smith 1995)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Neoseiulus longispinosus</i> (Evans, 1952) [Phytoseiidae]	Yes (Huyen et al. 2017)	Yes. NT, Qld, WA (APPD 2023; Government of Western Australia 2023)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Oligonychus coffeae</i> (Nietner, 1861) [Tetranychidae] Tea red spider mite	Yes (Phạm 2013a, b; Vacante 2016)	Yes. NSW, NT, Qld (APPD 2023); WA (DPIRD 2023) (APPD 2023)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Panonychus citri</i> (McGregor, 1916)	Yes (Migeon & Dorkeld 2023;	Yes. Under official control (Regional) for WA	Yes. <i>Panonychus citri</i> is known to be associated with pomelo (MARD 2022b, c; Phạm 2013a). This	Yes. <i>Panonychus citri</i> has the capacity to survive fruit storage	Yes. <i>Panonychus citri</i> has a wide host range of about 90	Yes. <i>Panonychus citri</i> is an economically	Yes (DGP, WA)

Department of Agriculture, Fisheries and Forestry

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
Synonym(s): <i>Tetranychus citri</i> McGregor, 1916 [Tetranychidae] Citrus red mite	Phạm 2013a; Whittle 1992)	(Government of Western Australia 2023). NSW (APPD 2023).	species prefers to feed on fully expanded young leaves but has also been reported to infest citrus fruit (UC IPM 2022). <i>Panonychus citri</i> may remain undetected due to their small size, and packing house practices may not remove all mites.	and transport conditions. <i>Panonychus citri</i> has a wide host range, with many hosts widely grown in Australia. <i>Panonychus citri</i> present on pomelo fruit could potentially disperse and transfer to a new host within close proximity.	different species across 30 plant families, including citrus, apple, pear, peach, plum, grape, strawberry and several broad-leaved evergreen ornamentals (Alford 2007; Bolland, Gutierrez & Flechtmann 1998; NSW DPI 2017c; PIRSA 2020; Shinkaji 1979). This mite is established across the Central Coast region of NSW (NSW DPI 2017b), and similar climates are found in some parts of Australia. <i>Panonychus citri</i> can actively disperse for short distances within and between plants (NSW DPI 2017c). Movement of infested host plant material or contaminated equipment could also spread <i>P. citri</i>	important and widespread pest of commercial horticultural crops although damage is mostly limited to citrus (EFSA Panel on Plant Health 2008a). Severe infestations may weaken the host plant causing defoliation, fruit drop and dieback of young shoots or twigs (Alford 2007; NSW DPI 2017c; Vacante 2010).	

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
					across longer distances.		
<i>Phyllocoptruta oleivora</i> (Ashmead, 1879) [Eriophyidae] Citrus rust mite	Yes (Phạm 2013a; Whittle 1992)	Yes. NSW, NT, Qld, WA (APPD 2023; CABI 2023b)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Polyphagotarsonemus latus</i> (Banks, 1904) [Tarsonemidae] Broad mite	Yes (Phạm 2013a; Whittle 1992)	Yes. NSW, NT, Qld, SA, Vic., WA (APPD 2023)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Tetranychus kanzawai</i> Kishida, 1927 Synonym(s): <i>Tetranychus hydrangeae</i> Pritchard & Baker, 1855 [Tetranychidae] Kanzawa spider mite	Yes (PPD 2016)	Yes. Under official control (Regional) for WA (Government of Western Australia 2023). NSW, Qld (APPD 2023)	Yes. <i>Tetranychus kanzawai</i> infests the leaves, stems and fruit of host plants, including pomelo and other <i>Citrus</i> species (Vacante 2015, 2016). While principally found on the leaves of host plants, spider mites may spread to other plant parts including fruit, particularly if population densities are high (Jeppson, Keifer & Baker 1975), and could potentially be present on pomelo fruit. <i>Tetranychus kanzawai</i> may remain undetected due to their small size, and packing house practices may not remove all mites.	Yes. <i>Tetranychus kanzawai</i> has the capacity to survive fruit storage and transport conditions. <i>Tetranychus kanzawai</i> has a host range of around 190 wild and cultivated plant species (Migeon & Dorkeld 2023; Yano, Kanaya & Takafuji 2003), such as pear, tea, pawpaw, strawberry, apple, grapes and melon (CABI 2023b). Many of these hosts are available in	Yes. Hosts of <i>T. kanzawai</i> are widely available in WA. <i>Tetranychus kanzawai</i> has been recorded from at least 25 countries (Migeon & Dorkeld 2023). It has successfully established in Qld and NSW (Gutierrez & Schicha 1983). Similar climates exist in various parts of WA, suggesting that <i>T. kanzawai</i> has the potential to establish and spread in WA.	Yes. <i>Tetranychus kanzawai</i> is a significant polyphagous pest subject to quarantine measures in many parts of the world (Navajas et al. 2001). It is considered a pest of economic concern in Japan, Korea, Taiwan, and China, where it has caused serious damage to greenhouse grapevines, tea, and other	Yes (DGP, WA)

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
				Australia. <i>Tetranychus kanzawai</i> generally disperse by crawling, but some may be dispersed in wind (Kennedy & Smitley 1985; Yano, Kanaya & Takafuji 2003). Spider mites present on pomelo fruit could potentially transfer to a new host within close proximity.		horticultural crops and deciduous fruit trees (Kondo 2004; Takafuji et al. 2000). Feeding activity when pest mite population levels are high causes wilting, defoliation, and reduced growth (Cheng 2007; Ho 2000).	
BACTERIA							
' <i>Candidatus</i> Liberibacter asiaticus' corrig. Jagoueix <i>et al.</i> , 1994 Synonym(s): <i>Liberobacter asiaticum</i> Monique Garnier, 1994 [Rhizobiales: Phyllobacteriaceae] Huanglongbing (HLB), citrus greening disease	Yes (Bové et al. 1996; Tomimura et al. 2009; Truc & Hong 2001; Trung 1991; Whittle 1992)	No records found	Yes. ' <i>Candidatus</i> Liberibacter asiaticus' (CLas) infects pomelo (Bové et al. 1996; Truc & Hong 2001). This pathogen infects hosts systemically by moving through the phloem (Tyler et al. 2009), thus, fruit may be infected with CLas (Ding et al. 2015; Fang et al. 2021: DAFF 2011). Symptoms on fruit include greening at the styler end, misshapeness, and early drop (Gottwald, da Graca & Bassanezi 2007). Fruit showing symptoms are likely to be detected and removed during harvest and packing house practices. However, fruit with early stages of infection	No. ' <i>Candidatus</i> Liberibacter asiaticus' is highly unlikely to be able to transfer from infected imported pomelo fruit to suitable hosts in Australia (DAFF 2011). ' <i>Candidatus</i> Liberibacter asiaticus' is vectored by the psyllids <i>Diaphorina citri</i> , <i>Trioza erytreae</i> , <i>Cacopsylla</i> and (<i>Psylla</i>) <i>citrisuga</i> ,	Assessment not required	Assessment not required	No

Appendix B: Initiation and categorisation for pests of pomelo fruit 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 showing no symptoms may not be detected and excluded from export.	and reported to be weakly vectored by <i>D. communis</i> (Donovan et al. 2012; Om et al. 2021). These vectors are not known to be present in Australia. Studies on seed transmission of CLas have given inconsistent results, and, where transmission has occurred, CLas remains at a very low titre in the resulting seedlings (Albrecht & Bowman 2009; Benyon et al. 2009; Graham et al. 2008; Hartung, Halbert & Shatters 2008). Further, the pathogen is only transiently present in the resulting seedlings (Albrecht & Bowman 2009) (Bagio, Canteri & Leite Júnior 2020). Thus, seed transmission is an epidemiologically			

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
				insignificant pathway for spread of this pathogen.			
' <i>Candidatus</i> Phytoplasma asteris' [16SrI-B subgroup] (HLB symptom associated phytoplasma) [Acholeplasmatales: Acholeplasmataceae]	Yes (Alvarez et al. 2013; Hoat et al. 2015)	No records found	Yes. ' <i>Candidatus</i> Phytoplasma asteris' (16SrI-B) is known to affect citrus, including pomelo, with symptoms of leaf yellowing and/or mottling (Chen et al. 2009). There are no reports of its association with the fruit. However, phytoplasmas inhabit the phloem sieve-tube and can establish systemic infections (Christensen et al. 2005). Asymptomatic pomelo fruit sourced from ' <i>Ca. P. asteris</i> ' (16SrI-B)-infected plants may carry the phytoplasma into Australia.	No. The movement of phytoplasmas from imported fruit to a suitable host would require a vector (Weintraub & Beanland 2006), such as phloem-sucking leaf hoppers, plant hoppers or psyllids (Bosco et al. 2007; Marcone 2014). Potential insect vectors present in Australia would preferentially feed on new flushes of growth (Halbert & Manjunath 2004) rather than on harvested or discarded (rotting or desiccating) fruit. Additionally, there is no evidence that phytoplasmas can be seed transmitted in citrus (Faghihi et al. 2011; Jeger et al. 2017).	Assessment not required	Assessment not required	No

Appendix B: Initiation and categorisation for pests of pomelo fruit 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' Zreik et al. 1995 [16SrII]	Yes (Hoat et al. 2015)	No. Previously recorded as present as ' <i>Candidatus</i> Phytoplasma aurantifolia' (Lee, Wylie & Jones 2010; Saqib et al. 2005; Streten & Gibb 2006; Tairo, Jones & Valkonen 2006). However, these were considered misidentifications of ' <i>Candidatus</i> Phytoplasma australasia' (Bertaccini et al. 2022; Jardim et al. 2023).	Yes. ' <i>Candidatus</i> Phytoplasma aurantifolia' is known to infect citrus (Noorizadeh et al. 2022), causing, for example, witches broom symptoms in lime. Phytoplasmas inhabit the phloem sieve-tube and can establish systemic infections (Christensen et al. 2005). Asymptomatic pomelo fruit sourced from ' <i>Candidatus</i> Phytoplasma aurantifolia' infected plants could potentially carry this phytoplasma into Australia.	No. The transfer of phytoplasmas from imported fruit to a suitable host would require vectors (Weintraub & Beanland 2006), such as phloem-feeding leaf hoppers, plant hoppers or psyllids (Bosco et al. 2007; Marcone 2014). Potential insect vectors present in Australia would preferentially feed on new flushes of growth (Halbert & Manjunath 2004). Additionally, there is no evidence that phytoplasmas can be seed transmitted in citrus (Faghihi et al. 2011; Jeger et al. 2017).	Assessment not required	Assessment not required	No
<i>Pseudomonas syringae</i> pv. <i>syringae</i> van Hall, 1902 [Pseudomonadales: Pseudomonadaceae] Bacterial canker	Yes (CABI 2023a; MARD 2010; Nguyen et al. 2017)	Yes. NSW, NT, Qld, SA, Tas., Vic., WA (APPD 2023; Government of Western Australia 2023; Peters et al. 2004)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No

Department of Agriculture, Fisheries and Forestry

Appendix B: Initiation and categorisation for pests of pomelo fruit 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>Xanthomonas citri</i> subsp. <i>citri</i> (Gabriel et al., 1989 ex Hasse 1915) Schaad et al., 2007</p> <p>Synonym(s): <i>Xanthomonas axonopodis</i> pv. <i>citri</i> (Hasse) Vauterin et al., 1995; <i>Xanthomonas citri</i> (ex Hasse, 1915) Gabriel et al., 1989; <i>Xanthomonas campestris</i> pv. <i>citri</i> (Hasse) Dye, 1978 [Xanthomonadales: Xanthomonadaceae] Citrus canker ('XCC'), Asiatic canker, citrus canker A</p>	<p>Yes (Ngoc et al. 2009; Trung 1991; Whittle 1992)</p>	<p>No, eradicated. Citrus canker was detected in Darwin, NT, in April 2018, and in northern WA in May 2018. Following extensive surveillance and tracing activities, Western Australia and Northern Territory were officially declared free of citrus canker in 2019 (DPIRD 2019) and 2021 (Northern Territory Government 2021), respectively.</p>	<p>Yes. <i>Xanthomonas citri</i> subsp. <i>citri</i> infects pomelo (Broadbent et al. 1992; Vernière et al. 2014). Symptoms on fruit include callus-like necrotic lesions with a water-soaked margin, which appear around 7 days after inoculation under ideal conditions. Symptoms can take up to 60 days to appear under unfavourable conditions (Gottwald, Graham & Schubert 2002). Fruit showing symptoms at an advanced stage of infection may be readily detected and removed during harvest and packing house practices. However, fruit with early stages of infection may not show obvious symptoms (Department of Agriculture 2016; Gottwald & Graham 2000) and therefore may not be excluded from export.</p>	<p>Yes. <i>Xanthomonas citri</i> subsp. <i>citri</i> bacteria in fruit lesions remain viable for several months (Golmohammadi et al. 2007; Gottwald et al. 2009; Shiotani et al. 2009). The bacterium can survive fruit storage and transport conditions (Golmohammadi et al. 2007; Goto 1962; Luo et al. 2020; Peltier 1920). Host plants are readily available throughout Australia. The bacterium can be dispersed over short distances through rain splash and irrigation. In addition, it can be distributed through machinery and people. Transfer of <i>X. citri</i> subsp. <i>citri</i> from fruit discarded in close proximity to susceptible hosts</p>	<p>Yes. <i>Xanthomonas citri</i> subsp. <i>citri</i> infects a wide range of <i>Citrus</i> species (Peltier & Frederich 1920, 1924). Citrus is a significant commercial crop in Australia (Hogan et al. 2022) and is also grown in many home gardens across Australia (Citrus Australia 2021; Hardy et al. 2010; Plant Health Australia 2015). Citrus production regions with a tropical or subtropical climate would be most likely to support the establishment and spread of <i>X. citri</i> subsp. <i>citri</i> (Bureau of Meteorology 2023; Gottwald & Graham 2000; Stall & Seymour 1983), and citrus canker outbreaks have occurred in regions</p>	<p>Yes. <i>Xanthomonas citri</i> subsp. <i>citri</i> is one of the most economically damaging diseases of citrus worldwide (Plant Health Australia 2004) and most <i>Citrus</i> species are susceptible. In addition to direct crop losses, the introduction of this pathogen would impact on interstate trade and access to overseas markets. The cost of eradication alone for the Emerald, Qld incursion in 2004 was estimated to be \$17.6 million (Gambley et al. 2009).</p>	<p>Yes (EP)</p>

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
				has been demonstrated under artificial conditions (Gottwald et al. 2009).	with these climates in the past. The bacterium naturally disperses via water-splash; and can be spread by human activities (Department of Agriculture 2016).		
CHROMALVEOLATA							
<i>Phytophthora citrophthora</i> (R.E. Sm. & E.H. Sm.) Leonian Synonym(s): <i>Pythiacystis citrophthora</i> R.E. Sm. & E.H. Sm. [Peronosporales: Peronosporaceae] Brown rot of citrus fruit	Yes (Drenth & Guest 2004; Whittle 1992)	Yes. NSW, Qld, SA, Vic., WA (APPD 2023; Burgess et al. 2021)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Phytophthora insolita</i> Ann & W.H. Ko [Peronosporales: Peronosporaceae] Downy mildew	Yes (De Patrizio et al. 2013)	Yes. WA (APPD 2023; Burgess et al. 2021)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Phytophthora mekongensis</i> Cacciola & N.V. Hoa	Yes (Puglisi et al. 2017)	No records found	Yes. <i>Phytophthora mekongensis</i> has been reported to infect pomelo (Puglisi et al. 2017). Symptoms on fruit include a light brown, leathery	Yes. <i>Phytophthora mekongensis</i> is likely to survive fruit storage and	Yes. This pathogen has the ability to affect a number of other <i>Citrus</i> species	Yes. <i>Phytophthora mekongensis</i> infects grapefruit, sweet orange,	Yes

Department of Agriculture, Fisheries and Forestry

Appendix B: Initiation and categorisation for pests of pomelo fruit 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: Peronosporaceae] Brown rot			rind decay, with white mycelium forming under humid conditions (Puglisi et al. 2017). Fruit showing symptoms at an advanced stage of infection may be readily detected and removed during harvest and packing house practices. However, fruit with early stages of infection may not show obvious symptoms, and therefore may not be excluded from export.	transportation conditions (Puglisi et al. 2017). Sporangia produced by <i>P. mekongensis</i> can be easily dispersed by wind and rain splash (Cacciola et al. 2017; Puglisi et al. 2017). The pathogen also produces motile zoospores, which can aid transfer from infected fruit to new host plants (Cacciola et al. 2017; Erwin & Ribeiro 1996; Puglisi et al. 2017).	in addition to pomelo, including grapefruit, sweet orange and bergamot (Puglisi et al. 2017). Citrus is a significant commercial crop in Australia (Hogan et al. 2022) and is also grown in many home gardens across Australia (Citrus Australia 2021; Hardy et al. 2010; Plant Health Australia 2015). This pathogen is reported from areas with high temperatures and rainfall (Cacciola et al. 2017; Puglisi et al. 2017). These climatic conditions are available in parts of Australia, which will favour the establishment and spread of <i>P. mekongensis</i> .	bergamot and pomelo. Puglisi et al. (2017) reported a 10% reduction in fruit production in pomelo orchards affected by <i>P. mekongensis</i> in Vietnam. In addition to direct crop losses, the introduction of this pathogen could impact on interstate trade and access to overseas markets.	
<i>Phytophthora nicotianae</i> Breda de Haan	Yes (Chau & Hong 2007;	Yes. NSW, NT, Qld, SA, Vic., WA (APPD 2023; Government	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No

Appendix B: Initiation and categorisation for pests of pomelo fruit 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
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Synonym(s): <i>Phytophthora allii</i> Sawada; <i>Phytophthora parasitica</i> Dastur [Peronosporales: Peronosporaceae] Black shank, citrus gummosis	Drenth & Sendall 2004)	of Western Australia 2023)					
<i>Phytophthora palmivora</i> (E.J. Butler) E.J. Butler Synonym(s): <i>Phytophthora faberi</i> Maubl. [Peronosporales: Peronosporaceae] Bud rot	Yes (Dau et al. 2008; Drenth & Sendall 2004)	Yes. NSW, NT, Qld, Vic., WA (APPD 2023; Barber et al. 2013; Vawdrey 2001)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Phytophthora prodigiosa</i> Cacciola & M.V. Tri [Peronosporales: Peronosporaceae]	Yes (Puglisi et al. 2017)	No records found	No. This pathogen is reported primarily as a soil inhabitant colonising fallen fruit as a secondary opportunistic pathogen (Puglisi et al. 2017). There are no reports available to indicate an association of <i>P. prodigiosa</i> with commercially produced, export quality pomelo fruit.	Assessment not required	Assessment not required	Assessment not required	No
FUNGI							

Appendix B: Initiation and categorisation for pests of pomelo fruit 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>Alternaria alternata</i> (Fr.) Keissl. Synonym(s): <i>Alternaria fasciculata</i> (Cooke & Ellis) L.R. Jones & Grout; <i>Alternaria tenuis</i> Nees [Pleosporales: Pleosporaceae] Alternaria leaf spot	Yes (Le et al. 2000; PPD 2009)	Yes. NSW, NT, Qld, SA, Tas., Vic., WA (APPD 2023; Le & Gregson 2019)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Alternaria citri</i> Ellis & N. Pierce [Pleosporales: Pleosporaceae] Stalk end rot	Yes (Whittle 1992)	Yes. NSW, Qld, SA, Vic., WA (APPD 2023)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Colletotrichum gloeosporioides</i> (Penz.) Penz. & Sacc. Synonym(s): <i>Glomerella cingulata</i> (Stoneman) Spauld. [Glomerellales: Glomerellaceae] Anthracnose	Yes (Chau & Hong 2007; Trung 1991; Whittle 1992)	Yes. NSW, NT, Qld, SA, Tas., Vic., WA (APPD 2023; Giblin, Coates & Irwin 2010; Government of Western Australia 2023; Shivas et al. 2016)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Colletotrichum siamense</i> Prihast., L. Cai & K.D. Hyde Synonym(s): <i>Colletotrichum hymenocallidis</i> Y.L.	Yes (Grousset et al. 2016)	Yes. NSW, NT, Qld (ALA 2023; APPD 2023; Shivas et al. 2016)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No

Department of Agriculture, Fisheries and Forestry

Appendix B: Initiation and categorisation for pests of pomelo fruit 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
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Yang, Zuo Y. Liu, K.D. Hyde & L. Cai [Glomerellales: Glomerellaceae]							
<i>Corynespora cassiicola</i> (Berk. & M. A. Curtis) Synonym(s): <i>Cercospora melonis</i> (Cooke) [Pleosporales: Corynesporascaceae]	Yes (CABI 2023a; Farr & Rossman 2022; Madriz-Ordeñana et al. 2019)	Yes. NSW, NT, Qld, Vic., WA (APPD 2023; Farr & Rossman 2022)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Curvularia lunata</i> (Wakker) Boedijn Synonym(s): <i>Cochliobolus lunatus</i> R.R. Nelson & Haasis [Pleosporales: Pleosporaceae] Head mould of grasses, rice and sorghum	Yes (MARD 2010)	Yes. NSW, NT, Qld, Vic., WA (APPD 2023; Government of Western Australia 2023; Pak et al. 2017)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Diaporthe citri</i> F. A. Wolf Synonym(s): <i>Phomopsis citri</i> H.S Fawcett [Diaporthales: Diaporthaceae]	Yes (TARI 1996; Trung 1991)	Yes. NSW, NT, Qld, SA, Vic., WA (APPD 2023; EPPO 2023; Farr & Rossman 2022; Government of Western Australia 2023)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
Melanose, stem end fruit rot							
<i>Elsinoë fawcettii</i> Bitanc. & Jenkins (pathotypes absent from Australia) Synonym(s): <i>Sphaceloma fawcettii</i> Jenkins [Myriangiales: Elsinoaceae] Citrus scab	Yes (Chau & Hong 2007; Trung 1991; Whittle 1992)	Yes. However, there are exotic pathotypes not known to be present in Australia (Hyun et al. 2009), therefore, the potential for <i>E. fawcettii</i> to enter on the pathway needs to be assessed. Two pathotypes have been reported in Australia (Tryon's and lemon) which are present in NSW, NT and Qld (APPD 2023; Timmer et al. 1996).	Yes. <i>Elsinoë fawcettii</i> is known to infect pomelo (Gopal et al. 2014; Thuan 2017) and causes warty scabs to develop on fruit. Severely infected fruit are scarred and distorted, making them unmarketable (Gopal et al. 2014). Fruit showing symptoms at an advanced stage of infection may be readily detected and removed during harvest and packing house practices. However, fruit with early stages of infection may not show obvious symptoms, and therefore may not be excluded from export.	Yes. The fungus can survive in scab pustules on the fruit (Chung 2011b; Timmer, Garnsey & Graham 2000) and is likely to survive fruit storage and transport conditions (Sivanesan & Critchett 1974). Scab pustules produce spores, which can disperse to new host plants through wind and water splash, and to some extent by insects (CABI 2023a).	Yes. Establishment of exotic pathotypes may only be possible in wet subtropical or cooler tropical parts of Australia, as citrus scab usually does not establish in areas of low rainfall and long, hot summers (Gopal et al. 2014). Some pathotypes of the species have already established in coastal NSW, Qld and NT (Timmer et al. 1996), indicating that other pathotypes could also establish in these areas. Species in the Rutaceae family (mostly <i>Citrus</i> spp.) are the only known hosts (Gopal et al. 2014). The fungus can spread short distances by water splash during rain, overhead irrigation or	Yes. Citrus scab affects all <i>Citrus</i> spp. causing significant economic losses (Gopal et al. 2014). Market value of fruit can be reduced by up to 50% due to blemishes, scars and distortions (Chung 2011b; Hyun et al. 2009). Losses are largely dependent on local and seasonal variations in the weather and the pathotype involved (Gopal et al. 2014). The disease can affect susceptible rootstocks in the nursery, making seedlings stunted, or bushy and difficult to bud (Gopal et al. 2014).	Yes (EP)

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
					spraying operations (Gopal et al. 2014; Timmer, Garnsey & Graham 2000). It can spread long distance via the movement of infected host plants for planting and infected fresh fruit (Gopal et al. 2014; Timmer, Garnsey & Graham 2000).		
<i>Erysiphe quercicola</i> 'citrus strain' S. Takam. & U. Braun Synonym(s): <i>Oidium citri</i> (J.M. Yen) U. Braun; <i>Pseudoidium anacardii</i> (F. Noack) U. Braun & R.T.A Cook [Helotiales: Erysiphaceae] Citrus powdery mildew	Yes (Tam 2016 EN44456)	No records found	No. <i>Erysiphe quercicola</i> is known to infect citrus (Baiswar et al. 2015; Tam, Dung & Liem 2016). It affects young leaves and fruit, causing defoliation and premature fruit drop (Tam, Dung & Liem 2016). In the unlikely event that the powdery mildew fungus that may be present on the fruit surface will be highly visible and are likely to be removed during harvest and packing house practices. Therefore, this pathogen is unlikely to be present on commercially produced, export quality fruit.	Assessment not required	Assessment not required	Assessment not required	No
<i>Fibroidium tingitaninum</i> (J.C. Carter) U. Braun & R.T.A. Cook	Yes (Trung 1991; Whittle 1992)	No records found	No. <i>Fibroidium tingitaninum</i> is known to infect citrus (Baiswar et al. 2015; Roy & Ghosh 1991; Zheng et al. 2022). <i>Fibroidium tingitaninum</i> mainly affects the	Assessment not required	Assessment not required	Assessment not required	No

Department of Agriculture, Fisheries and Forestry

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
Synonym(s): <i>Oidium tingitaninum</i> J.C. Carter; <i>Acrosporium tingitaninum</i> (J.C. Carter) Subram [Helotiales: Erysiphaceae] Citrus powdery mildew			leaves and twigs, and symptoms include a pale whitish growth (Roy & Ghosh 1991). Infected fruit are reported to drop prematurely rather than develop to maturity (Business Queensland 2019a; Chung 2011a). Therefore, this pathogen is unlikely to be present on commercially produced, export quality fruit.				
<i>Geotrichum candidum</i> Link Synonym(s): <i>Galactomyces candidum</i> de Hoog & M.T. Sm. [Saccharomycetales: Dipodascaceae] Sour rot	Yes (Hong-Thao et al. 2016)	Yes. NSW, NT, Qld, Tas., Vic., WA (APPD 2023; Government of Western Australia 2023; Shivas 1989)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Lasiodiplodia theobromae</i> (Pat.) Griffon & Maubl. Synonym(s): <i>Botryosphaeria rhodiana</i> (Cooke) Arx; <i>Botryodiplodia theobromae</i> Pat; <i>Diplodia theobromae</i> (Pat) [Botryosphaerales: Botryosphaeriaceae]	Yes (Nguyen et al. 2006)	Yes. NSW, NT, Qld, SA, WA (APPD 2023; CABI 2023a; Government of Western Australia 2023; Peterson et al. 1991)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
Diplodia rot of cocoa							
<i>Meliola citricola</i> Syd. & P. Syd. [Meliolales: Meliolaceae] Black mildew	Yes (Trung 1991; Whittle 1992)	No records found	No. <i>Meliola citricola</i> is known to infect citrus (Minter 2006). Symptoms include black growth on leaves, and occasionally on mature fruit (Minter 2006; Whittle 1992). Although the fungus can colonise fruit, the infection is highly visible; therefore, any infected fruit are likely to be removed during harvest and packing house practices.	Assessment not required	Assessment not required	Assessment not required	No
<i>Necator salmonicolor</i> (Berk. & Broome) K.H. Larss., Redhead & T.W. May Synonym(s): <i>Erythricium salmonicolor</i> (Berk. & Broome) Burds.; <i>Corticium salmonicolor</i> Berk & Broome; <i>Phanerochaete salmonicolor</i> (Berkeley & Broome) Jülich [Corticiales: Corticiaceae] Pink disease	Yes (CABI 2023a; USDA 2020a)	Yes. Qld, NT (APPD 2023)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No

Appendix B: Initiation and categorisation for pests of pomelo fruit 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>Neocosmospora lichenicola</i> (C. Massal) Sand.-Den. & Crous Synonym(s): <i>Bactridium lichenicola</i> (C. Massal.) Wollenw.; <i>Cylindrocarpon lichenicola</i> (C. Massal.) D. Hawksw.; <i>Fusarium lichenicola</i> C. Massal.; <i>Cylindrocarpon tonkinense</i> Bugnic. [Hypocreales: Nectriaceae]	Yes (Amby et al. 2015; Farr & Rossman 2022)	Yes. Qld (APPD 2023; Brayford 1987)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Neocosmospora solani</i> (Martius) L. Lombard & Crous Synonym(s): <i>Fusarium solani</i> (Mart.) Sacc. [Hypocreales: Nectriaceae]	Yes (Farr & Rossman 2022; Thu et al. 2021)	Yes. NSW, NT, Qld, SA, Tas., Vic., WA (Elmer et al. 1997; Government of Western Australia 2023; Liew et al. 2016; Sangalang et al. 1995)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Penicillium digitatum</i> (Pers.) Sacc. Synonym(s): <i>Aspergillus digitatus</i> Pers.	Yes (Whittle 1992)	Yes. NSW, Qld, SA, Vic., WA (APPD 2023; Cook & Dubé 1989; Government of	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
[Eurotiales: Aspergillaceae] Green mould		Western Australia 2023)					
<i>Penicillium italicum</i> Wehmer Synonym(s): <i>Penicillium ventuosum</i> Westling [Eurotiales: Trichocomaceae] Blue mould	Yes (Whittle 1992)	Yes. NSW, Qld, SA, Vic., WA (APPD 2023)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Phyllosticta citriasiana</i> Wulandari, Crous & Gruyter [Botryosphaeriales: Phyllostictaceae] Citrus tan spot	Yes (Farr & Rossman 2022; Wulandari et al. 2009)	No records found	Yes. <i>Phyllosticta citriasiana</i> affects pomelo (Farr & Rossman 2022; Wulandari et al. 2009). Symptoms on fruit are limited to the fruit rind, appear after the fruit start ripening (Wang et al. 2011), and consist of small shallow lesions with a central tan crater surrounded by a darker rim (Wulandari et al. 2009). Fruit showing symptoms at an advanced stage of infection may be readily detected and removed during harvest and packing house practices. However, fruit with early stages of infection may not show obvious symptoms, and therefore may not be excluded from export.	No. The only known host of this pathogen is pomelo (Wang et al. 2011), which has a limited distribution in Australia. Although pycnidia in lesions may survive fruit storage and transport conditions (Wulandari et al. 2009), typical postharvest practices such as chlorine washing, application of fungicides and waxing are reported to significantly reduce lesion	Assessment not required	Assessment not required	No

Department of Agriculture, Fisheries and Forestry

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
				formation and the number of pycnidia forming in those lesions in the closely related species <i>Phyllosticta citricarpa</i> (Moyo et al. 2020). Pycnidiospores of <i>Phyllosticta</i> species can only travel short distances through water-splash (Guarnaccia et al. 2019; Kotze 1981), and a minimum of 12 hours of leaf/fruit wetness is required at optimum temperatures in order for spores to germinate and initiate infection in a new host (Guarnaccia et al. 2019). It is unlikely that <i>P. citriasiana</i> will transfer from infected fruit to a susceptible host.			
<i>Phyllosticta citricarpa</i> (McAlpine) Aa.	Yes (Chau & Hong 2007;	Yes. NSW, NT, Qld, Vic. (ALA 2023; APPD 2023:	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
Synonym(s): <i>Guignardia citricarpa</i> Kiely; <i>Phoma citricarpa</i> McAlpine; <i>Phyllostictina citricarpa</i> (McAlpine) Petr. [Botryosphaerales: Phyllostictaceae] Citrus black spot (CBS)	EFSA PLH Panel 2014a)	Glienke et al. 2011)					
<i>Sclerotinia sclerotiorum</i> (Lib.) de Bary Synonym(s): <i>Hymenoscyphus sclerotiorum</i> (Lib.) W. Phillips [Helotiales: Sclerotiniaceae] Cottony soft rot	Yes (Farr & Rossman 2022)	Yes. NSW, Qld, SA, Tas., Vic., WA (APPD 2023; Cook & Dubé 1989; Government of Western Australia 2023)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Zasmidium citri-griseum</i> (F.E. Fisher) U. Braun & P.W. Crous Synonym(s): <i>Zasmidium citri</i> Whiteside; <i>Mycosphaerella citri</i> Whiteside;	Yes (Chau & Hong 2007; Farr & Rossman 2022; Trung 1991)	Yes. Qld (APPD 2023)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No

Appendix B: Initiation and categorisation for pests of pomelo fruit 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>Cercospora citri-grisea</i> F.E. Fisher [Mycosphaerellales: Mycosphaerellaceae] Citrus greasy spot							
VIROIDS							
<i>Citrus exocortis viroid</i> (CEVd) Synonym(s): <i>Citrus viroid IIa</i> (CVd-IIa) [Pospiviroidae: Pospiviroid] Exocortis	Yes (Bové et al. 1996; Trung, Hong & Vien 2005; Whittle 1992)	Yes. NSW, Qld, SA, Vic., WA (Broadbent et al. 1988; Gillings, Broadbent & Gollnow 1991; Hardy, Donovan & Barkley 2008; van Brunschot et al. 2014; Visvader et al. 1982; Washington & Nancarrow 1983; Chambers et al. 2023)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
<i>Hop stunt viroid</i> (HSVd) [Pospiviroidae: Hostuviroid]	Yes (TARI 1996)	Yes (Donovan 2022; Fraser & Broadbent 1979; Gillings, Broadbent & Gollnow 1991; Koltunow, Krake & Rezaian 1988)	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No
VIRUSES							

Appendix B: Initiation and categorisation for pests of pomelo fruit 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>Citrus tristeza virus</i> (CTV) (Strains absent from Australia/under official control) [Closteroviridae: Closterovirus] Tristeza of citrus	Yes, strains unknown (Chau & Hong 2007; Thu Hong et al. 1996; Trung, Hong & Vien 2005; Whittle 1992)	Yes. However, the mandarin stem-pitting strains are absent from Australia and are considered a quarantine pest. Further, the sweet orange stem-pitting strain is found only in Queensland (Donovan, Holford & Chambers 2020). Therefore, the potential for <i>Citrus tristeza virus</i> to enter on the pathway needs to be assessed. The grapefruit stem-pitting strain is widely distributed in Australia (Broadbent, Brlansky & Indsto 1996).	Yes. Pomelo is reported to be a host of CTV (Ayazpour et al. 2011; Ghosh et al. 2014; Hong 1998). Infected trees produce small citrus fruits of poor quality (OEPP EPPO 1995). The virus is phloem limited and can be detected in fruit (Yokomi 2009b); therefore, pomelo fruit sourced from infected plants may carry the virus into Australia.	No. Although the virus can be found in fruit, CTV is not seedborne (Dawson et al. 2015; Yokomi 2009b). Natural spread is through infected propagative material, and transmission by aphids (Yokomi 2009b). There are no records for transmission of this virus from an infected fruit to a susceptible host. Potential vector insects present in Australia would preferentially feed on new flushes of growth (Michaud 1998) rather than discarded (decaying) fruit. Therefore, this virus is unlikely to transfer to a suitable host in Australia through the fruit pathway.	Assessment not required	Assessment not required	No
<i>Coguvirus citri</i> (CCGAV)	Yes (Chau & Hong 2007;	Yes (Donovan 2022; Teakle	Assessment not required	Assessment not required	Assessment not required	Assessment not required	No

Department of Agriculture, Fisheries and Forestry

Appendix B: Initiation and categorisation for pests of pomelo fruit 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			
Synonym(s): <i>Citrus concave gum-associated virus</i> [Phenuiviridae: Coguvirus]	Thu Hong et al. 1996)	1997; Wright et al. 2018)					
<i>Ophiovirus citri</i> (CPsV) Synonym(s): <i>Citrus psorosis virus</i> ; <i>Ophiovirus citrus ringspot virus (CRSV)</i> ; <i>Ophiovirus citri</i> [Aspiviridae: Ophiovirus]	Yes (Chau & Hong 2007; Thu Hong et al. 1996; Whittle 1992)	Yes. NSW, Qld, SA, Vic., WA (Cook & Dubé 1989; Harvey 1961; Letham 1995; Simmonds 1966; Washington & Nancarrow 1983)	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 2023a).
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 2023a).
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 2023a).
Arthropod	The largest phylum of animals, including the insects, arachnids and crustaceans.
Asexual reproduction	The development of a new individual from a single cell or group of cells in the absence of meiosis.
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 database bicon.agriculture.gov.au/BiconWeb4.0
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 2023a).
Control (of a pest)	Suppression, containment, or eradication of a pest population (FAO 2023a).

Pomelo fruit from Vietnam: biosecurity import requirements draft report

Glossary, acronyms and abbreviations

Term or abbreviation	Definition
Crawler	Intermediate mobile nymph stage of certain arthropods.
DGP	Draft Group policy. This refers to the <i>Draft report for a review of pest risk assessments for spider mites (Acari: Trombidiformes: Tetranychidae)</i> (draft spider mite review) (DAFF 2023a).
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 2023a).
Endemic	Belonging to, native to, or prevalent in a particular geography, area, or environment.
Endocarp	Innermost layer of the pericarp, which directly surrounds the pulp segments containing the seeds.
Entomophagous	Feeding on insects.
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 2023a).
EP	Existing policy. This denotes that a pest species has previously been assessed in another policy published by the department.
Establishment (of a pest)	Perpetuation, for the foreseeable future, of a pest within an area after entry (FAO 2023a).
Exocarp	Forms the outer skin of citrus fruit, often referred to as flavedo.
FAO	Food and Agriculture Organization of the United Nations
Fresh	Living; not dried, deep-frozen or otherwise conserved (FAO 2023a).
FSANZ	Food Standards Australia New Zealand (foodstandards.gov.au/Pages/default.aspx) and the Australia New Zealand Food Standards Code (foodstandards.gov.au/code/Pages/default.aspx)
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 2021a).
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 2023a).
Import permit	Official document authorising importation of a commodity in accordance with specified phytosanitary import requirements (FAO 2023a).
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.

Pomelo fruit from Vietnam: biosecurity import requirements draft report

Glossary, acronyms and abbreviations

Term or abbreviation	Definition
Infestation (of a commodity)	Presence in a commodity of a living pest of the plant or plant product concerned. Infestation includes infection (FAO 2023a).
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 2023a).
Intended use	Declared purpose for which plants, plant products or other articles are imported, produced or used (FAO 2023a).
Interception (of a pest)	The detection of a pest during inspection or testing of an imported consignment (FAO 2023a).
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 2023a).
Introduction (of a pest)	The entry of a pest resulting in its establishment (FAO 2023a).
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 2023a). 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 white spongy tissue 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 2023a).
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 2023a).
Pathogen	A biological agent that can cause disease to its host.
Pathway	Any means that allows the entry or spread of a pest (FAO 2023a).
PPD	Plant Protection Department
Petal fall	The flower is past the pollination stage, and petals wilt and fall. The ovule at the base of the flower has developed into a small fruit at this stage.

Pomelo fruit from Vietnam: biosecurity import requirements draft report

Glossary, acronyms and abbreviations

Term or abbreviation	Definition
Pericarp	Composed of three layers in citrus fruit; exocarp/flavedo (outermost layer), mesocarp/albedo (middle layer) and endocarp (innermost layer) and is often referred to as the peel or the rind.
Pest	Any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products (FAO 2023a).
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 2023a).
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 2023a).
Pest free place of production (PFPF)	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 2023a).
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 2023a).
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 2023a).
Pest risk assessment (for quarantine pests)	Evaluation of the probability of the introduction and spread of a pest and the magnitude of the associated potential economic consequences (FAO 2023a).
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 2023a).
Pest risk management (for quarantine pests)	Evaluation and selection of options to reduce the risk of introduction and spread of a pest (FAO 2023a).
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 2023a).
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 2023a).
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 2023a).
Phytosanitary certification	Use of phytosanitary procedures leading to the issue of a phytosanitary certificate (FAO 2023a).
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 2023a). 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 2023a).
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 2023a).
Polyphagous	Feeding on a relatively large number of hosts from different plant family and/or genera.

Pomelo fruit from Vietnam: biosecurity import requirements draft report

Glossary, acronyms and abbreviations

Term or abbreviation	Definition
PRA area	Area in relation to which a pest risk analysis is conducted (FAO 2023a).
Production site	In this report, a production site is a continuous planting of pomelo 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 2023a).
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 2023a).
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 2023a).
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 2023a).
Regulated pest	A quarantine pest or a regulated non-quarantine pest (FAO 2023a).
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 2023a).
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 2023a).
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

Term or abbreviation	Definition
Treatment (as a phytosanitary measure)	Official procedure for killing, inactivating, removing, rendering infertile or devitalising regulated pests (FAO 2023a).
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

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