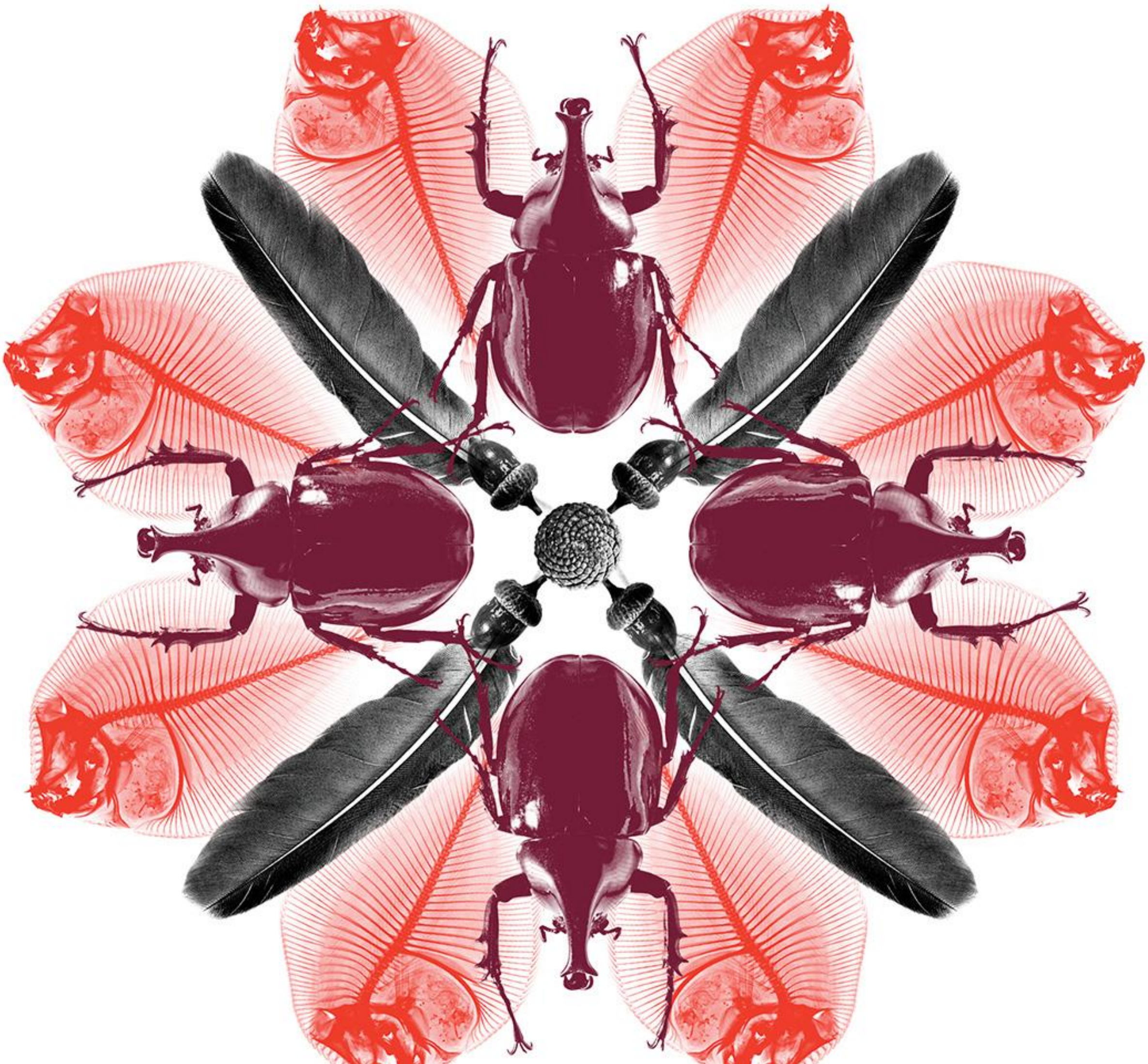
Australian Government
Department of Agriculture

Final report for the review of biosecurity import requirements for fresh decrowned pineapples from Taiwan

August 2019



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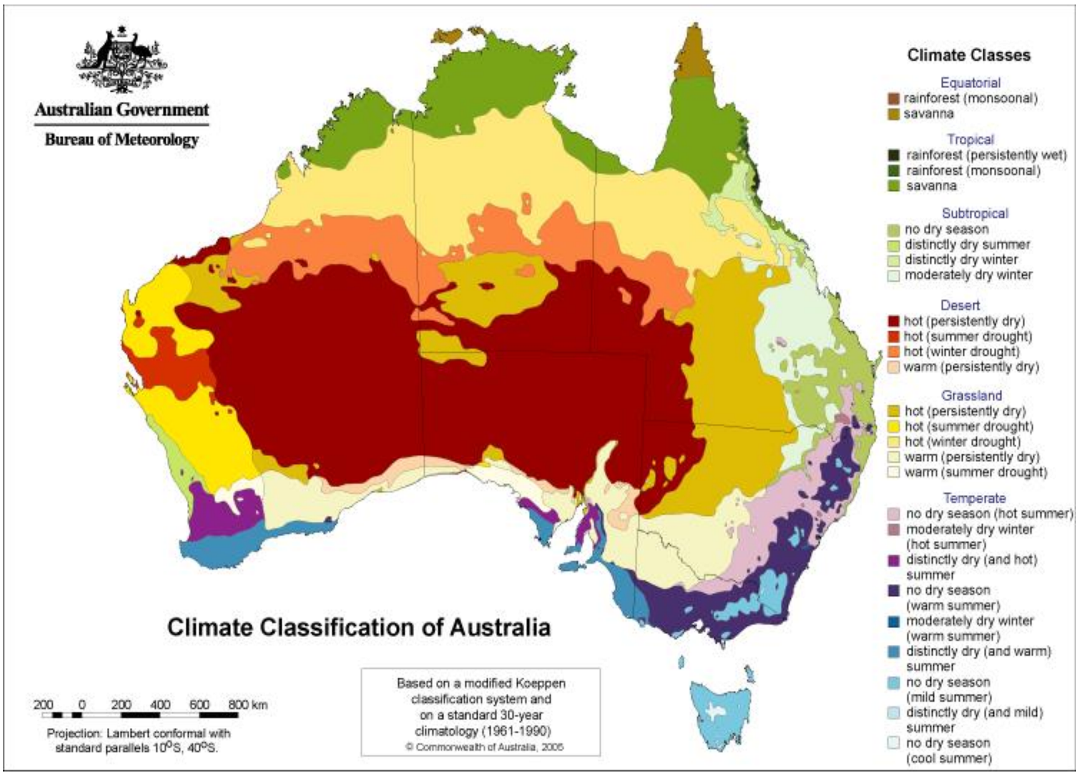


Acronyms and abbreviations

Term or abbreviation	Definition
ACT	Australian Capital Territory
AFA	Agriculture and Food Agency (Taiwan)
ALOP	Appropriate level of protection
BA	Biosecurity Advice
BAPHIQ	Bureau of Animal and Plant Health Inspection and Quarantine (Taiwan)
BICON	Australia's Biosecurity Import Conditions System
BIRA	Biosecurity Import Risk Analysis
CSIRO	Commonwealth Scientific and Industrial Research Organisation
EP	Existing policy
FAO	Food and Agriculture Organization of the United Nations
FSANZ	Food Standards Australia New Zealand
IPPC	International Plant Protection Convention
ISPM	International Standard for Phytosanitary Measures
NSW	New South Wales
NT	Northern Territory
PC	Phytosanitary Certificate
PRA	Pest risk analysis
Qld	Queensland
SA	South Australia
SPS Agreement	WTO agreement on the Application of Sanitary and Phytosanitary Measures
TARI	Taiwan Agricultural Research Institute
Tas.	Tasmania
the department	The Department of Agriculture
Vic.	Victoria
WA	Western Australia
WTO	World Trade Organization

Summary

This risk analysis report considers the biosecurity risks for Australia associated with the importation of commercially produced fresh decrowned pineapples for human consumption from Taiwan.

Currently, the importation of fresh pineapple fruit for human consumption is permitted into Australia only from Malaysia, the Philippines, Thailand, Sri Lanka and the Solomon Islands, provided it meets Australian biosecurity import conditions.

This final report recommends that the importation of fresh decrowned pineapple fruit to Australia from all commercial production areas in Taiwan be permitted, subject to it meeting a range of biosecurity requirements as summarised in this report.

This final report contains details of all known pests with the potential to be associated with the importation of fresh decrowned pineapple fruit from Taiwan that may be of biosecurity concern to Australia. It also provides risk assessments for identified quarantine pests, and recommends risk management measures to reduce the biosecurity risk to an acceptable level.

Five quarantine pests have been identified in this risk analysis as requiring risk management measures. Those pests are:

- Mealybugs: grey pineapple mealybug (*Dysmicoccus neobrevipes*), papaya mealybug (*Paracoccus marginatus*), Madeira mealybug (*Phenacoccus madeirensis*), Pacific mealybug (*Planococcus minor*), and Jack Beardsley mealybug (*Pseudococcus jackbeardsleyi*).

Two thrips species, cotton thrips (*Frankliniella schultzei*) and onion thrips (*Thrips tabaci*) were assessed as regulated articles as they are capable of harbouring and spreading emerging orthotospoviruses that are quarantine pests for Australia, and therefore require risk management measures.

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

Recommended risk management measures take account of regional differences within Australia. One pest, Pacific mealybug (*Planococcus minor*), has been identified as a regional quarantine pest for Western Australia, because interstate quarantine regulations and enforcement are in place for this species.

This final report recommends a risk management measure, combined with an operational system, to reduce the risks posed by the seven identified species (five quarantine pests and two regulated articles), so as to achieve the appropriate level of protection for Australia. This measure is:

- Pre-export methyl bromide fumigation.

Taiwan must provide a submission to the Department of Agriculture that demonstrates it has processes and procedures for the registration, approval and audit of treatment facilities. The Department of Agriculture may request on-site verification of the treatment facilities.

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

- amendments to the text of Chapter 3: ‘Taiwan’s commercial production practices for pineapples’, to provide further clarity on the processes for removing the basal leaves, crown and stem material on pineapples;
- amendments to the text of Chapter 5: ‘Pest risk management’, to clarify that the risk mitigation measure of methyl bromide fumigation is to be conducted in Taiwan prior to export;
- addition of Appendix B: ‘Issues raised in stakeholder comments’ which summarises key technical comments from stakeholders, and how technical issues were considered by the department in this final report, for example, evidence supporting the assessment that methyl bromide fumigation is an effective treatment to manage mealybugs present in the blossom cups of pineapples;
- minor corrections, rewording and editorial changes for consistency, clarity and web-accessibility.

The department finalised a risk analysis to assess the biosecurity risk associated with the importation of decrowned pineapples from Malaysia in 2012. Some of the major differences between the pests assessed in the previous risk analysis for decrowned pineapples from Malaysia and the final risk analysis of decrowned pineapples from Taiwan are:

- Bacterial fruit collapse and heart rot of pineapples caused by *Dickeya* sp. (pineapple strain – formerly known as *Erwinia chrysanthemi*), a bacterial pathogen present in Malaysia and associated with pineapples in Malaysia, is not present in Taiwan, and thus was not assessed in this risk analysis.
- *Phytophthora meadii* (rubber leaf drop), a fungal pathogen, was assessed in the Malaysian decrowned pineapple risk analysis as being on the pathway and achieving the appropriate level of protection for Australia. A further review of the literature for this pathogen did not uncover modern/reliable records to indicate that pineapple is a host for *P. meadii.* Therefore, it is considered in this risk analysis that this pest is not associated with the pathway.

Fusariosis is a high priority disease of pineapples for Australia. A comprehensive review of the literature found no records of fusariosis or fusariosis-like disease in Taiwan.

1 Introduction

1.1 Australia's biosecurity policy framework

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

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

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

Australia's risk analyses are undertaken by the Department of Agriculture 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 reviews of existing policy and import conditions, pest-specific assessments, weed risk assessments, biological control agent assessments or scientific advice).

Further information about Australia's biosecurity framework is provided in the *Biosecurity Import Risk Analysis Guidelines 2016* located on the Department of Agriculture's website at http://www.agriculture.gov.au/biosecurity/risk-analysis/guidelines.

1.2 This risk analysis

1.2.1 Background

The Taiwanese Bureau of Animal and Plant Health Inspection and Quarantine (BAPHIQ) formally requested market access to Australia for fresh decrowned pineapples for human consumption in a submission received in April 2015. This submission contained information on the pests associated with pineapples in Taiwan, including the plant parts affected, and the standard commercial production practices for pineapple fruit in Taiwan.

On 23 August 2017, the department publicly announced the commencement of this risk analysis, advising that it would be progressed as a review of biosecurity import requirements. This analysis is conducted in accordance with Section 174 of the *Biosecurity Act 2015*.

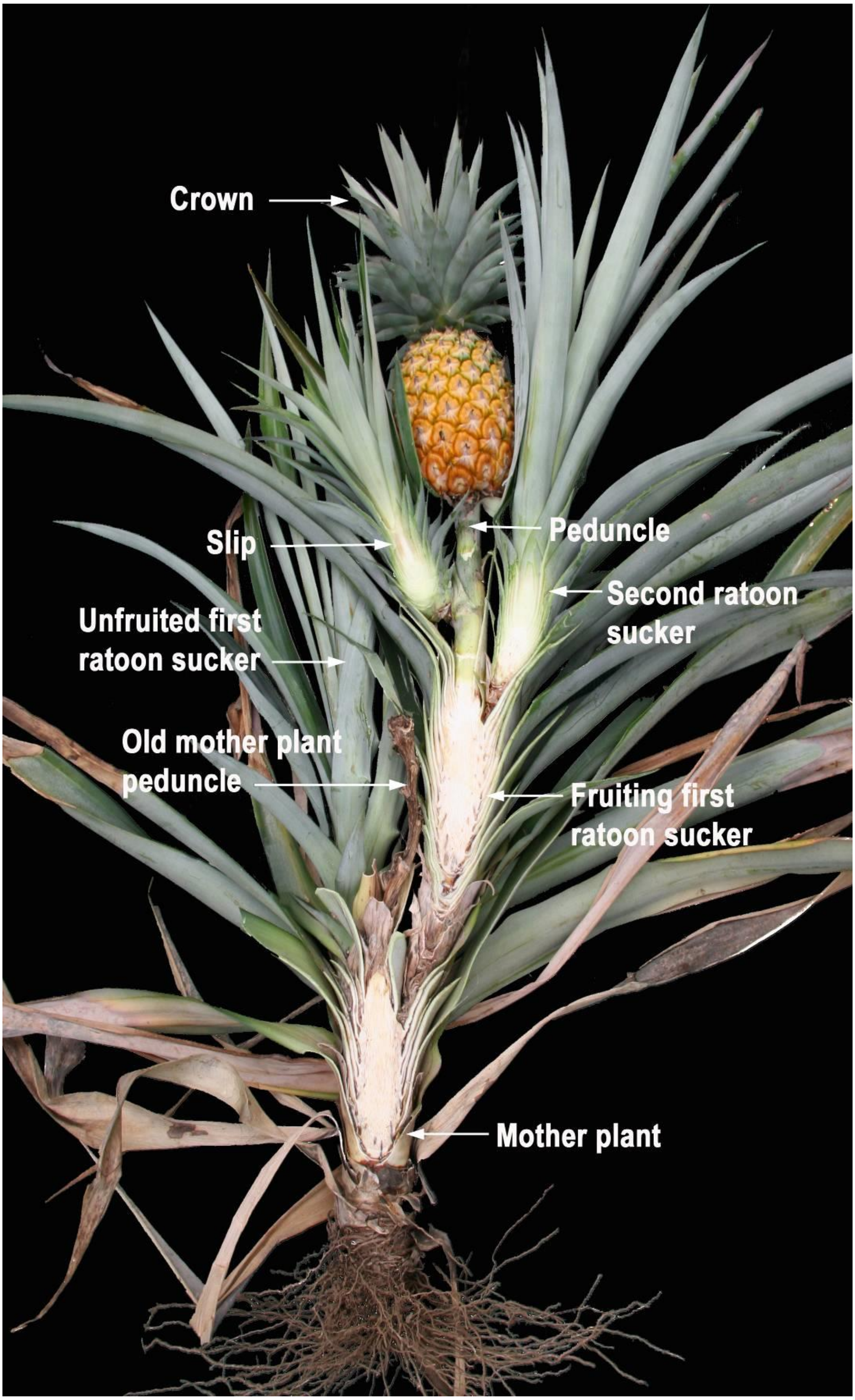
In August 2017, the department visited pineapple production areas in Taiwan. The objective of the visit was to observe commercial production, pest management and other export practices.

1.2.2 Scope

The scope of this risk analysis is to consider the biosecurity risk that may be associated with the pathway of fresh decrowned pineapple fruit (*Ananas comosus*) (henceforth decrowned pineapple), grown in Taiwan using typical commercial production and packing procedures for import into Australia for human consumption.

The major parts of a pineapple plant are shown in Figure 1. For the purposes of this risk analysis, fresh decrowned pineapples are defined as the fruit with the crown and basal leaves removed. This risk analysis includes the import of all cultivars of commercially-produced decrowned pineapples from all production regions in Taiwan.

Figure 1: Photograph showing major parts of the pineapple plant



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1.2.3 Existing policy

International policy

Import policy exists for decrowned pineapple fruit from Malaysia (DAFF 2012a) as well as for pineapple fruit from the Philippines, Thailand, Sri Lanka and the Solomon Islands (AFFA 2002). For Taiwan, import policy exists for lychee (DAFF 2013) and mango (Biosecurity Australia 2006) fruit. The potential pests of biosecurity concern identified for decrowned pineapple fruit from Taiwan are the same as, or of the same pest groups as those previously identified for pineapple, as well as for other horticultural commodities for which import conditions exist.

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

The department has considered all the pests previously identified in existing policies and, where relevant, the information in those assessments has been taken into account in this risk analysis. The department has also reviewed the latest literature to ensure that information in previous assessments is still valid. The biosecurity risk posed by thrips, and the orthotospoviruses they transmit, from all countries was previously assessed in the *Final group pest risk analysis for thrips and orthotospoviruses on fresh fruit, vegetable, cut-flower and foliage imports* (Australian Government Department of Agriculture and Water Resources 2017) (thrips group PRA), which is applicable to decrowned pineapples from Taiwan. The department has determined that the information in those assessments can be adopted for the species under consideration in this risk analysis.

Domestic arrangements

The Australian Government is responsible for regulating the movement of goods such as plants and plant products into and out of Australia. However, the state and territory governments are responsible for plant health controls within their individual jurisdictions. 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. Once 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 decrowned pineapple from Taiwan that are assessed in this risk analysis, there are other organisms that may arrive with the imported commodity. These organisms could include pests of other crops or predators and parasitoids of other arthropods. The department considers these organisms to be contaminating pests that could pose sanitary risks (to human or animal life or health) or phytosanitary risks (to plant life or health). These risks are identified and addressed using existing operational procedures that require a 600 unit on-arrival inspection of all consignments, or equivalent procedures. The department will investigate whether any pest identified through these processes may be of biosecurity concern to Australia, and may thus require remedial action.

1.2.5 Consultation

On 23 August 2017, the department notified stakeholders, in Biosecurity Advice 2017/17, of the commencement of a review of biosecurity import requirements for fresh decrowned pineapples from Taiwan.

Prior to and after the announcement of this risk analysis, the department engaged with the Australian pineapple industry regarding the process and technical aspects of this risk analysis, including through direct meetings (face-to-face and teleconferences).

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

The draft report was released on 29 August 2018 (Biosecurity Advice 2018/22) for comment by stakeholders, for a period of 60 days that concluded on 29 October 2018.

The department received three written submissions on the draft report. All submissions received, and issues raised by domestic stakeholders during the consultation period, were carefully considered, and, where relevant, changes were made in this final report. A summary of key technical stakeholder comments and how there were considered is provided in Appendix B.

1.2.6 Next Steps

The final report will be published on the department's website, along with a notice advising stakeholders of its release. The department will also notify BAPHIQ, the registered stakeholders and the WTO Secretariat about the release of the final report. Publication of the final report represents the end of the risk analysis process. Before any trade in decrowned pineapples from Taiwan commences, the department will verify that Taiwan can implement the required pest risk management measures, and the system of operational procedures necessary to maintain and verify the phytosanitary status of pineapples for export to Australia from Taiwan (as specified in Chapter 5: Pest risk management of this report). On verification of these requirements, the import conditions for decrowned pineapples from Taiwan will be published in the department's Biosecurity Import Conditions (BICON) system. Applications of import permits can then be made online through BICON.

2 Method for pest risk analysis

This chapter sets out the method used for the pest risk analysis (PRA) in this report. The Department of Agriculture has conducted this PRA in accordance 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 2019c) that have been developed under the SPS Agreement (WTO 1995).

A PRA is 'the process of evaluating biological or other scientific and economic evidence to determine whether an organism is a pest, whether it should be regulated, and the strength of any phytosanitary measures to be taken against it' (FAO 2019b). A pest is 'any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products' (FAO 2019b). This definition is also applied in the *Biosecurity Act 2015*.

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

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

Restricted risk is estimated with phytosanitary measure(s) applied. A phytosanitary measure is 'any legislation, regulation or official procedure having the purpose to prevent the introduction and/or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests' (FAO 2019b).

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

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

2.1 Stage 1 Initiation

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

Appendix A of this risk analysis report lists the pests with the potential to be associated with the exported commodity produced using commercial production and packing procedures. Appendix A does not present a comprehensive list of all the pests associated with the entire plant, but concentrates on the pests that could be on the assessed commodity. Contaminating pests that have no specific relation to the commodity or the export pathway have not been listed and would be addressed by Australia's current approach to contaminating pests.

The identity of the pests is given in Appendix A. The species name is used in most instances but a lower taxonomic level is used where appropriate. Synonyms are provided where the current scientific name differs from that provided by BAPHIQ or where the cited literature used a different scientific name.

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

For pests that had been considered by the department in other risk assessments and for which import conditions already exist, this risk analysis considered the likelihood of entry of pests on the commodity and whether existing policy is adequate to manage the risks associated with its import. Where appropriate, the previous risk assessment was taken into consideration in this risk analysis.

A Group Pest Risk Analysis (Group PRA) has been applied in this risk analysis, as explained in Section 2.2.7.

2.2 Stage 2 Pest risk assessment

A pest risk assessment (for quarantine pests) is the 'evaluation of the probability of the introduction and spread of a pest and of the magnitude of the associated potential economic consequences' (FAO 2019b).

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

2.2.1 Pest categorisation

Pest categorisation identifies which of the pests with the potential to be on the commodity are quarantine pests for Australia and require pest risk assessment. A 'quarantine pest' is a pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled (FAO 2019b).

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

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

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

2.2.2 Assessment of the probability of entry, establishment and spread

Details of how to assess the 'probability of entry', 'probability of establishment' and 'probability of spread' of a pest are given in ISPM 11 (FAO 2019c). The SPS Agreement (WTO 1995) uses the term 'likelihood' rather than 'probability' for these estimates. In qualitative PRAs, the department uses the term 'likelihood' for the descriptors it uses for its estimates of likelihood of entry, establishment and spread. The use of the term 'probability' is limited to the direct quotation of ISPM definitions.

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

Likelihood of entry

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

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

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

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

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

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

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

- commercial procedures (for example, refrigeration) applied to consignments during distribution in Australia
- dispersal mechanisms of the pest, including vectors, to allow movement from the pathway to a host

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

Likelihood of establishment

Establishment is defined as the 'perpetuation for the foreseeable future, of a pest within an area after entry' (FAO 2019b). In order to estimate the likelihood of establishment of a pest, reliable biological information (for example, lifecycle, host range, epidemiology, survival) is obtained from the areas where the pest currently occurs. The situation in the PRA area can then be compared with that in the areas where it currently occurs and expert judgement used to assess the likelihood of establishment.

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

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

Likelihood of spread

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

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

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

Assigning likelihoods for entry, establishment and spread

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

Table 2.1: Nomenclature of likelihoods

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

Combining likelihoods

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

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

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

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

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

Table 2.2: Matrix of rules for combining likelihoods

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

Time and volume of trade

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

The department normally considers the likelihood of entry on the basis of the estimated volume of 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 considered that a low to moderate volume of trade will occur.

2.2.3 Assessment of potential consequences

The objective of the consequence assessment is to provide a structured and transparent analysis of the potential consequences if the pests or disease agents were to enter, establish and spread in Australia. The assessment considers direct and indirect pest effects and their economic and environmental consequences. The requirements for assessing potential consequences are given in Article 5.3 of the SPS Agreement (WTO 1995), ISPM 5 (FAO 2019b) and ISPM 11 (FAO 2019c).

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

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

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

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

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

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

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

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

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

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

Indiscernible—pest impact unlikely to be noticeable.

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

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

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

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

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

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

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

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

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

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

2.2.4 Estimation of the unrestricted risk

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

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

Table 2.5: Risk estimation matrix

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

2.2.5 The appropriate level of protection (ALOP) for Australia

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

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

2.2.6 Adoption of outcomes from previous assessments

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

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

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

2.2.7 Application of the Group PRA to this risk analysis

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

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

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

The *Final group pest risk analysis for mealybugs and the viruses they transmit on fresh fruit, vegetable, cut flower and foliage imports* was finalised in January 2019 and is not applied in this risk analysis. However, its assessments and recommended risk management measures are consistent with the present analysis.

The Group PRA that was applied to this risk analysis is:

- The *Final group pest risk analysis for thrips and orthotospoviruses on fresh fruit, vegetable, cut-flower and foliage imports* (Australian Government Department of Agriculture and Water Resources 2017), which is referred to as the 'thrips group PRA'.

2.3 Stage 3 Pest risk management

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

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

ISPM 11 (FAO 2019c) provides details on the identification and selection of appropriate risk management options and notes that the choice of measures should be based on their effectiveness in reducing the likelihood of entry of the pest.

Examples given of measures commonly applied to traded commodities include:

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

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

3 Taiwan's commercial production practices for pineapples

This chapter provides information on pre-harvest, harvest and post-harvest practices, considered to be standard practices in Taiwan for the production and packing of fresh decrowned pineapples for export. The export capability of Taiwan is also outlined.

3.1 Considerations used in estimating unrestricted risk

Taiwan provided Australia with information on the standard commercial practices used in the production of commercial pineapple cultivars in different regions in Taiwan. This information has been complemented with data from other sources such as published literature, and was taken into consideration when estimating the unrestricted risks of pests that may be associated with the import of this commodity.

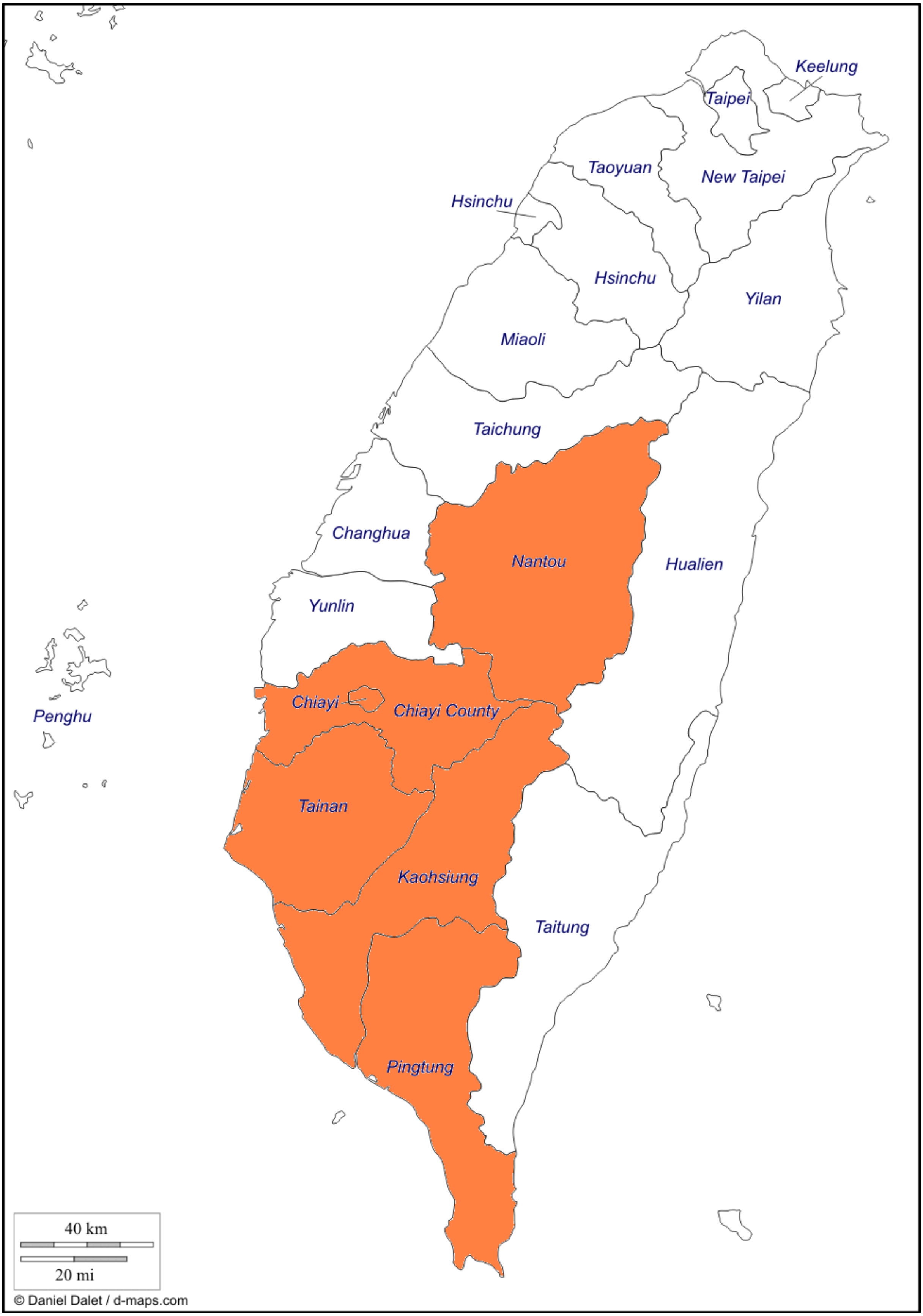
The Department of Agriculture visited pineapple production areas in Changhua, Chiayi and Pingtung counties in August 2017. The objective of the visit was to observe the harvesting, processing and packing, pest management procedures, and other export practices for decrowned pineapple production. The observations and additional information provided during the visit confirmed the production and processing procedures described in this chapter are standard commercial production practices for decrowned pineapples for export.

In estimating the likelihood of pest introduction it has been assumed that the pre-harvest, harvest and post-harvest production practices for decrowned pineapples described in this chapter are implemented in all regions, and for all cultivars of decrowned pineapples within the scope of this analysis. Where a specific practice described in this chapter has not been used to estimate the unrestricted risk, it is clearly identified and explained in Chapter 4.

3.2 Pineapple production areas

Pineapples have been grown in Taiwan for over 100 years. The major pineapple growing regions in Taiwan are Pingtung (accounting for 130,419 tonnes of production in 2014), Nantou (71,770 tonnes), Kaohsiung (47,284 tonnes), Chiayi (46,294 tonnes) and Tainan (44,061 tonnes). Approximately 11,000 hectares of land in Taiwan is used for growing pineapples. Major pineapple production areas in Taiwan are shown in Map 3.

Map 3: Major pineapple production areas in Taiwan

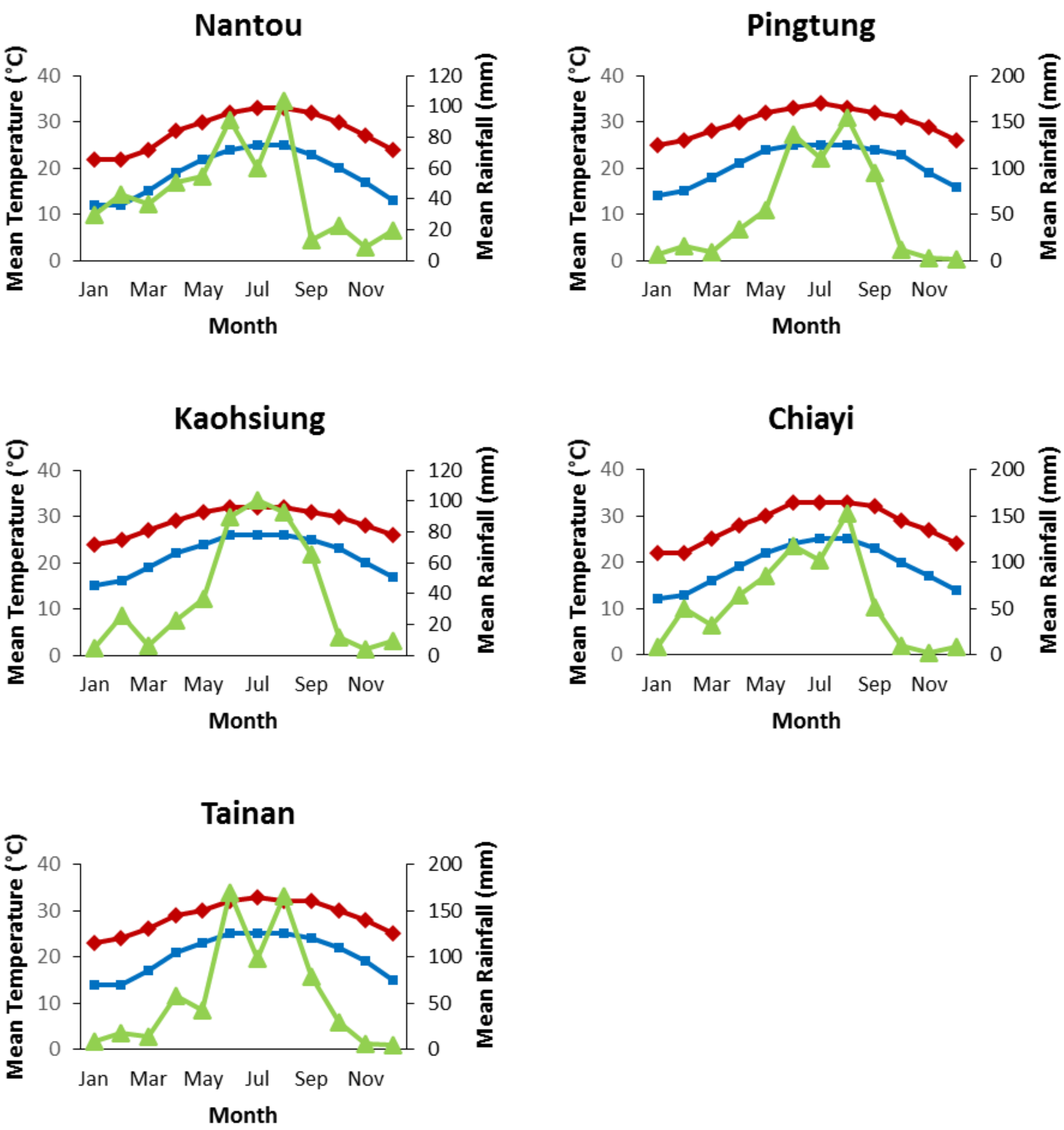


(Oriental Travel 2012) (edited – pineapple growing areas shown in orange)

3.3 Climate in production areas

Taiwan is situated on the Tropic of Cancer and, as such, has a tropical to subtropical climate. Winters are warm and comparatively dry, while summers are hot and very wet, with thunderstorms and occasional typhoons. The weather is more variable in spring and autumn than in summer and winter (CWB 2017). The mean monthly maximum and minimum temperatures of major pineapple growing regions in Taiwan, as well as their mean monthly rainfalls, are shown in Figure 2.

Figure 2: Mean monthly maximum and minimum temperatures and mean monthly rainfall in major pineapple production areas of Taiwan



Monthly mean maximum (—♦—) and minimum (—■—) temperatures (°C) and mean monthly rainfall (millimetres) (—▲—) from climatic data collected between 2000 and 2012 (World Weather Online 2017) in Taiwan's major pineapple production areas of Nantou, Pingtung, Kaohsiung, Chiayi and Tainan.

3.4 Pre-harvest

3.4.1 Cultivars

Taiwan's main pineapple cultivar, Tai-nung No. 17 (Figure 3), accounts for 85 per cent of pineapple production in Taiwan. However, Taiwan also cultivates many other pineapple cultivars, which provide fruit with a range of characteristics (Table 3.1). Most farmers grow a single cultivar.

Figure 3: Tai-nung No. 17 cultivar

Table 3.1: Pineapple cultivars grown in Taiwan and the respective characteristics of their fruit

Cultivar	Harvest time	Flesh texture	Average weight (kilograms)	Average total soluble solids	Average acidity
Tai-nung No. 4	March–May	Fine	1.2	19.5 °Brix	0.43%
Tai-nung No. 6	April–May	Fine	1.2	15.1 °Brix	0.34%
Tai-nung No. 11	May–June	Fine	1.0	14.8 °Brix	0.57%
Tai-nung No. 13	September–February	Rough	1.2	15.7 °Brix	0.27%
Tai-nung No. 16	April–July	Fine	1.3	18.0 °Brix	0.47%
Tai-nung No. 17	March–May	Fine	1.4	14.1 °Brix	0.28%
Tai-nung No. 18	April–July	Fine	1.5	14.1 °Brix	0.39%
Tai-nung No. 19	May–October	Fine	1.6	16.7 °Brix	0.46%
Tai-nung No. 20	May–October	Fine	1.3	16.9 °Brix	0.49%
Tai-nung No. 21	April–October	Fine	1.4	18.4 °Brix	0.63%
Tai-nung No. 22	May–October	Fine	1.7	17.6 °Brix	0.43%
Smooth Cayenne	May–July	Rough	1.6	16.0 °Brix	0.35%

3.4.2 Cultivation practices

Pineapples in Taiwan are planted from September to November every year, and each plant is harvested twice over a three-year period. Planting stock is sourced from the Taiwan Agricultural Research Institute (TARI). Approximately 35,000 to 40,000 pineapple plants are planted per hectare, in rows spaced approximately 140 centimetres apart (Figure 4). Natural rainfall is sufficient for most pineapple farms, but flood irrigation is employed where necessary. Farms tend to be comparatively small, ranging from less than one hectare to several hectares in size. The small size of these farms encourages the formation of pineapple farmer cooperatives, which are common in Taiwan. Taiwan's Agriculture and Food Agency (AFA) is responsible for coordinating and regulating production, as well as registering and auditing farms, sorting houses and packhouses.

Pineapples in Taiwan are produced via forced culture using either a calcium carbide (CaC_2) solution or Ethrel (active ingredient Ethephon) to induce flowering. The fruits mature approximately six months after treatment. The maturity of the fruit is judged according to its external colour, using a grading scale.

Figure 4: Pineapple field in Pingtung County

3.4.3 Pest management

Pineapple farms in Taiwan must be registered with AFA via their farm certification scheme for Good Agricultural Practice (GAP) in order to be eligible for export.

Spraying for pests and diseases occurs early in the season and sprays are generally not applied between flowering and harvest to prevent pesticide residue remaining on fruit. Growers are required to maintain records of spray applications.

3.5 Harvesting and handling procedures

Mature pineapple fruit are harvested by cutting the fruit peduncle using knives. The harvested fruits are packed into plastic crates and emptied into large bins for transport to sorting houses with traceability information, including the producer, field and date of harvest.

Figure 5: Plastic crate of pineapples with traceability information on label

3.6 Post-harvest

BAPHIQ is responsible for carrying out export inspection, registering treatment facilities, certifying phytosanitary treatments and issuing phytosanitary certificates.

3.6.1 Sorting house

Sorting houses in the post-harvest chain for the export of pineapples must be registered with AFA on an annual basis.

Freshly harvested pineapples are sent to a sorting house where deformed and damaged fruit are removed. The basal leaves and crown are removed from pineapples that are destined for export markets where this is a requirement. The basal leaves and crown are manually removed using a sharp knife or blade to ensure that no leaves remain. Stem material is trimmed at this stage in accordance with the requirements of the destination market. For example, for pineapples destined for Australia, all stem material is to be removed. The decrowned pineapples are then graded by weight (Figure 6) before being packed into labelled crates (Figure 5) and sent to a packhouse. Fresh pineapples for the domestic market are not decrowned but are simply graded by weight and packed into crates or cartons for direct supply to the domestic market.

Figure 6: Grading area in a sorting house in Pingtung County

3.6.2 Packhouse

Decrowned pineapples are transported to the packhouse in refrigerated trucks. Pineapples are checked to ensure that the requirements of the export market are met. For pineapples destined for Australia, this means the crown, stem material and basal leaves have been removed.

Air blowers are used to clean the decrowned pineapples to remove any contaminants of debris. Fruits are then graded by weight, fitted into individual protective foam sleeves, and packed into cardboard cartons (Figure 7), which are then loaded onto pallets. Pallets of fruit are cooled to a temperature of approximately 10 °C before they are ready for inspection and loading into shipping containers. As with sorting houses, packhouses must be registered annually with the AFA.

Figure 7: 10 kg packed box of pineapples

Export procedures

Decrowned pineapples destined for Australia will be fumigated or treated with an equivalent treatment in a treatment facility prior to inspection and export. Pre-export phytosanitary inspection is carried out by BAPHIQ inspectors who undertake annual training by specialist entomologists and plant pathologists from universities and/or research institutions. Packhouses have a dedicated inspection area comprising a bench area including a light with an inbuilt magnifying lens, and reference wall charts of important pineapple pests (Figure 8). Following pest-free certification, the decrowned pineapples are then loaded into shipping containers for export.

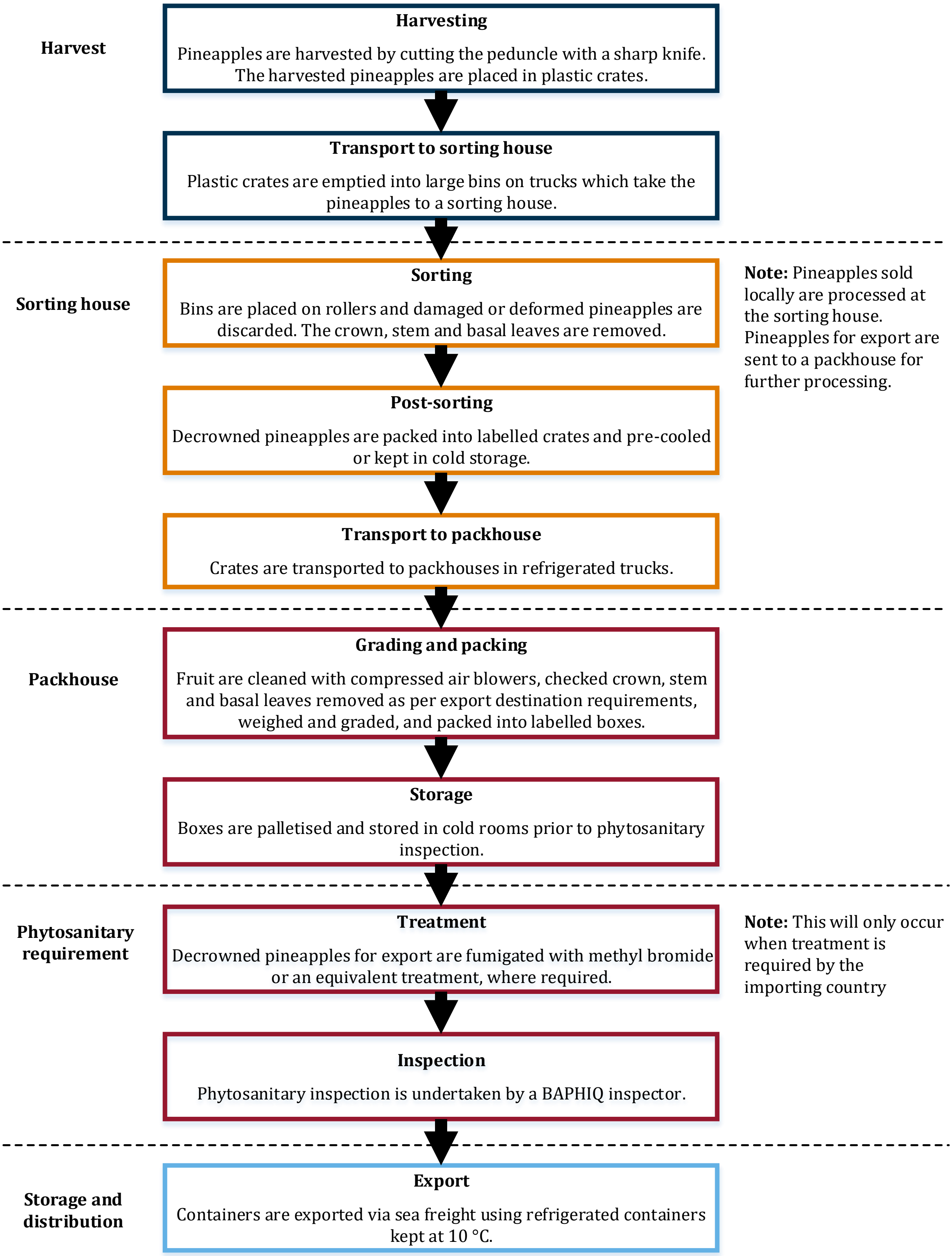
Figure 8: Inspection area bench in a packhouse in Changhua County

3.6.3 Transport

Most exports of decrowned pineapples from Taiwan to Australia will be transported by sea, with an approximate shipping time to Australia of 18–20 days. The temperature of shipping containers is expected to be maintained at approximately 10 °C to prevent spoilage.

Error! Reference source not found. summarises the operational steps from harvesting to xport of decrowned pineapples in Taiwan.

Figure 9: Summary of farm and post-harvest steps for pineapples grown in Taiwan for export



3.7 Export capability

3.7.1 Production statistics

The total planted area and total production of pineapples in Taiwan have remained relatively stable from 2007 to 2016 (Table 3.2).

Table 3.2: Pineapple production by year in Taiwan

Year	Total planted area (hectares)	Total production (tonnes)
2007	12,376	476,811
2008	11,510	452,060
2009	11,236	434,769
2010	9,972	420,172
2011	9,030	401,367
2012	9,335	392,211
2013	9,797	413,465
2014	10,154	456,243
2015	10,516	493,998
2016	10,974	527,161

Data obtained from BAPHIQ, September 2017.

3.7.2 Export statistics

The volume of fresh pineapple exports from Taiwan has increased from 2,955 tonnes in 2011 to 29,146 tonnes in 2016, a nearly ten-fold increase in five years. Taiwan exports pineapples to a range of countries, with China and Japan being the main export destinations (Table 3.3).

Table 3.3: Taiwan pineapple export volumes by country and year

Export market	Volume in tonnes per year		
	2015	**2016**	**2017[a]**
China	21,440	27,891	25,081
Japan	1,261	1,130	657
Canada	16	6	5
Hong Kong	31	16	17
The Republic of Korea	16	78	-
Singapore	2	1	2
Guam	7	5	-
Malaysia	0.281	0.094	0.12
United Arab Emirates	1	0.036	-
Palau	0.037	-	-
Macau	0.1	-	0.011
Indonesia	0.04	-	-
Bahrain	-	0.15	-
Other markets	-	19	-
Total	**22,774**	**29,146**	**25,762**

a Data incomplete. Table shows trade up to 31 July 2017.
Data obtained from BAPHIQ August 2017

3.7.3 Export season

Pineapples can be produced in Taiwan all year round. However, peak production and export occurs from February to September.

4 Pest risk assessments

A total of seven quarantine pests (Table 4.1) and two regulated thrips species (Table 4.2) ('regulated articles', see Section 4.3) associated with export-quality decrowned pineapples produced in Taiwan were identified in the pest categorisation process (Appendix A). This chapter assesses the likelihood of the entry (importation and distribution), establishment and spread of these pests, and the economic, including environmental, consequences these pests may cause if they were to enter, establish and spread in Australia.

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

Assessments of risks associated with these pests are presented in this chapter unless otherwise indicated.

Most of the identified quarantine pests and all pest groups considered here have been assessed previously by the department. Therefore, the outcomes of the previous assessments have been extended to include these pests, 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 adoption of outcomes from previous assessments and the application of the thrips group PRA to this risk analysis are outlined in Sections 2.2.6 and 2.2.7.

The biosecurity risk posed by thrips and the orthotospoviruses they transmit, from all countries on fresh fruit, vegetable, cut-flower and foliage imports was previously assessed in the *Final group pest risk analysis for thrips and orthotospoviruses on fresh fruit, vegetable, cut-flower and foliage imports* (Australian Government Department of Agriculture and Water Resources 2017), which is applicable to decrowned pineapples from Taiwan. A summary of pest information from the thrips group PRA is presented in this chapter for convenience.

Table 4.1: Quarantine pests associated with fresh decrowned pineapples from Taiwan

Pest	Common name
Mealybugs [Hemiptera: Pseudococcidae]	
Dysmicoccus neobrevipes (EP)	Grey pineapple mealybug
Paracoccus marginatus (EP)	Papaya mealybug
Phenacoccus madeirensis	Madeira mealybug
Planococcus minor (EP, WA)	Pacific mealybug
Pseudococcus jackbeardsleyi (EP)	Jack Beardsley mealybug
Armoured scales [Hemiptera: Diaspididae]	
Diaspis boisduvalii (EP, WA)	Boisduval scale
Diaspis bromeliae (WA)	Pineapple scale

EP: Species has been assessed previously and import policy already exists. **WA:** Pest of quarantine concern for Western Australia.

Table 4.2: Regulated thrips associated with fresh decrowned pineapples from Taiwan

Thrips [Thysanoptera: Thripidae] species	Common name
Frankliniella schultzei	Cotton thrips
Thrips tabaci	Onion thrips

4.1 Mealybugs

***Dysmicoccus neobrevipes* (EP), *Paracoccus marginatus* (EP), *Phenacoccus madeirensis*, *Planococcus minor* (EP, WA), *Pseudococcus jackbeardsleyi* (EP)**

Dysmicoccus neobrevipes, *Paracoccus marginatus*, *Phenacoccus madeirensis*, *Planococcus minor* and *Pseudococcus jackbeardsleyi* belong to the Pseudococcidae or 'mealybug' family. They have been grouped together because of their related biology and taxonomy, and are predicted to pose similar risks and require similar risk mitigation measures. In this assessment, the term 'mealybug' is used to refer to these five species. The scientific name is used when the information refers to a specific species.

Planococcus minor is not present in Western Australia (WA) and is a pest of regional quarantine concern for that state (Government of Western Australia 2018).

Various mealybug species, including four of the species assessed here, were assessed previously in existing risk analyses—decrowned pineapples from Malaysia (DAFF 2012a), decrowned pineapples from the Philippines, Thailand, Sri Lanka and the Solomon Islands (Biosecurity Australia 2002), mangoes from Indonesia, Thailand and Vietnam (Department of Agriculture and Water Resources 2015), lychees from Taiwan and Vietnam (DAFF 2013), mangoes from Taiwan (Biosecurity Australia 2006) and mangosteens from Thailand (DAFF 2004).

In those existing risk analyses, the unrestricted risk estimates for mealybugs were uniformly assessed as not achieving the ALOP for Australia. Therefore, specific risk management measures are required for these pests on these pathways, and in this report are extended to imported decrowned pineapples from Taiwan.

As described in detail in Section 4.1.1, the department has assessed the factors affecting the likelihood of importation of mealybugs on decrowned pineapples from Taiwan as being comparable to those resulting in the previous assessment of High for mealybugs in the risk analysis for decrowned pineapples from Malaysia. In the current analysis mealybugs are also considered to be associated with pineapples in Taiwan, able to survive the fruit processing procedures and processes of transport from Taiwan to Australia.

Mealybugs have a wide host range, and host material is likely to be available all year in Australia. The likelihoods of distribution of mealybugs from decrowned pineapples from Taiwan are considered comparable to those of mealybugs from decrowned pineapples from Malaysia, since pineapples are grown year-round in both regions and are likely to be similarly distributed in Australia. In both instances, the likelihood of distribution is assessed as Moderate.

The likelihoods of establishment and spread of mealybugs in Australia from decrowned pineapples from Taiwan are considered comparable to those for mealybugs from decrowned pineapples from Malaysia, and to other previous assessments. These likelihoods relate specifically to events that occur in Australia, and are principally independent of the importation pathway. The likelihoods of establishment and of spread of mealybugs from decrowned pineapples from Taiwan are both assessed as High. The consequences of the entry, establishment and spread of mealybugs in Australia are also independent of the importation pathway and were assessed as Low.

In addition, the department has reviewed the latest relevant literature—for example, Mani and Shivaraju (2016), Santa-Cecilia et al (2016), Hu et al (2017) and Jithu et al (2016). No new information was found to significantly change the assessments of risk ratings for importation, distribution, establishment, spread or consequences as set out for mealybugs in existing policies.

4.1.1 Likelihood of entry

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

Likelihood of importation

It is considered that the likelihoods of importation of *Dysmicoccus neobrevipes*, *Planococcus minor* and *Pseudococcus jackbeardsleyi* on decrowned pineapples from Taiwan are directly comparable to the assessments made for decrowned pineapples from Malaysia, where the likelihoods were rated as High.

The rating of High is extended in this analysis to *Phenacoccus madeirensis* and *Paracoccus marginatus* for the following reasons:

- Both *Phenacoccus madeirensis* and *Paracoccus marginatus* have a life history typical of mealybugs, including those of the other three species identified in this pest risk assessment (Amarasekare et al. 2008; Chong, Oetting & van Iersel 2003).
- Both *Phenacoccus madeirensis* and *Paracoccus marginatus* are known to be pests of pineapples (Culik, Ventura & dos S. Martins 2009; Saengyot & Burikam 2011), and are present in Taiwan (García Morales et al. 2019).
- *Phenacoccus madeirensis* and *Paracoccus marginatus* are of comparable size to other mealybugs identified in this pest risk assessment (García Morales et al. 2019; Kaydan, Erklic & Ulgenturk 2012), and can be expected to be similarly capable of hiding within the textured surfaces of decrowned pineapples, thus potentially being able to survive fruit processing procedures in Taiwan.
- The effect of temperature on *Phenacoccus madeirensis* (Chong, Oetting & van Iersel 2003) and *Paracoccus marginatus* (Amarasekare et al. 2008) life cycles is essentially identical to that for *Planococcus minor* (Francis, Kairo & Roda 2012a) and other mealybugs, with very similar maximum temperature tolerances and instar progression times. Both species are considered to be potentially capable of surviving the transport processes from Taiwan to Australia.

For the reasons outlined, *Phenacoccus madeirensis* and *Paracoccus marginatus* are considered comparable to previously assessed mealybugs. The likelihoods of importation of *Phenacoccus madeirensis* and *Paracoccus marginatus,* and of *Dysmicoccus neobrevipes*, *Planococcus minor* and *Pseudococcus jackbeardsleyi*, on decrowned pineapples from Taiwan are assessed as High.

Likelihood of distribution

Decrowned pineapples from Malaysia and from Taiwan are expected to be exported to Australia at similar times of the year. All nymphal stages and adult female mealybugs of the species assessed here are mobile; the most active stage is the ‘crawler’ (first instar) stage (Franco, Zada & Mendel 2009), which is considered to be the most likely stage to reach a host plant through its own activity. A large number of mealybug hosts are herbaceous (García Morales et al. 2019); many are close to or at ground level, and potentially in close proximity to disposed waste in backyards, roadsides and parks. However, as disposed waste would deteriorate quickly, mealybugs would need to find a suitable host in a limited timeframe.

The previous assessment for mealybugs on decrowned pineapples from Malaysia rated the likelihood of distribution as Moderate (DAFF 2012a). The comparable export season for decrowned pineapples from Malaysia and from Taiwan, together with the similarities in biologies of the previously assessed mealybugs and the mealybugs in this pest risk assessment, support extension of the previously assessed likelihoods of distribution for mealybugs to this pest risk assessment. Therefore, the likelihoods of distribution of mealybugs on decrowned pineapples from Taiwan are assessed as Moderate.

Overall likelihood of entry

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

The likelihood that mealybugs will enter Australia as a result of trade in decrowned pineapples from Taiwan and be distributed in a viable state to a susceptible host is assessed as Moderate.

4.1.2 Likelihoods of establishment and spread

The likelihoods of establishment and of spread for mealybugs are independent of the import pathway, and are comparable to those provided in all previous pest risk assessments for mealybugs, including the pest risk assessment for mealybugs in the risk analysis for decrowned pineapples from Malaysia (DAFF 2012a). The ratings from previous assessments are:

Likelihood of establishment: High

Likelihood of spread: High

4.1.3 Overall likelihood of entry, establishment and spread

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

The likelihood that one or more of the identified species of mealybugs will enter Australia as a result of trade in decrowned pineapples from Taiwan, be distributed in a viable state to a susceptible host, establish in Australia, and subsequently spread within Australia is assessed as Moderate.

4.1.4 Consequences

It is considered that the consequences of entry, establishment and spread of mealybugs in Australia are independent of the import pathway, and are comparable across pest risk assessments, including the risk analysis for decrowned pineapples from Malaysia (DAFF 2012a). The rating for overall consequences for mealybugs in previous risk analyses was Low. Therefore, the overall consequences for mealybugs from decrowned pineapples from Taiwan is also assessed as Low.

4.1.5 Unrestricted risk estimate

The unrestricted risk estimates for all mealybugs from decrowned pineapples from Taiwan are assessed as Low, which is comparable to the estimates in previous assessments, and which does not achieve the ALOP for Australia. Therefore, specific risk management measures are required for these pests.

4.2 Armoured scales

Diaspis boisduvalii (EP, WA) and *D. bromeliae* (WA)

Diaspis boisduvalii and *D. bromeliae* belong to the Diaspididae or 'armoured scale' family. They have been grouped together because of their related biology and taxonomy, and are predicted to pose similar risks and require similar risk mitigation measures. In this assessment, the term 'armoured scale' is used to refer to these two species. The scientific name is used when the information refers to a specific species.

Diaspis boisduvalii and *D. bromeliae* are not present in Western Australia, and are pests of regional concern for that state (Government of Western Australia 2018).

Diaspis boisduvalii was assessed in the risk analysis for mangosteens from Indonesia (DAFF 2012b), and two other armoured scales, *Melanaspis bromiliae* and *Unaspis citri* were assessed in the risk analysis for decrowned pineapples from Malaysia (DAFF 2012a). Several other armoured scale species have been assessed previously in a number of risk analyses—mangoes from Indonesia, Thailand and Vietnam (Department of Agriculture and Water Resources 2015) and lychees from Taiwan and Vietnam (DAFF 2013).

In those risk analyses, minor differences in individual risk ratings for armoured scales are present, but the final unrestricted risk estimates have all been assessed as achieving the ALOP for Australia. Therefore, specific risk management measures are not required for these pests on these pathways.

As described in Section 4.2.1, the department has assessed the factors affecting the likelihood of importation of armoured scales on decrowned pineapples from Taiwan as being comparable to those resulting in the previous assessment of High for armoured scales in the risk analysis for decrowned pineapples from Malaysia. In the current analysis armoured scales are considered to be associated with pineapples in Taiwan, able to survive the fruit processing procedures and processes of transport from Taiwan to Australia.

The abilities of all species of armoured scales to disperse are effectively identical. The likelihoods of distribution of armoured scales from decrowned pineapples from Taiwan are considered comparable to those of armoured scales from decrowned pineapples from Malaysia, since pineapples are grown year-round in both regions and are likely to be similarly distributed in Australia. In both instances the likelihood of distribution is assessed as Low.

The likelihoods of establishment and spread of armoured scales in Australia from decrowned pineapples from Taiwan are considered comparable to those for armoured scales from decrowned pineapples from Malaysia, and to other previous assessments. These likelihoods relate specifically to events that occur in Australia, and are principally independent of the importation pathway. The likelihoods of establishment and of spread for armoured scales from decrowned pineapples from Taiwan are assessed as High and Moderate respectively. The consequences of the entry, establishment and spread of armoured scales in Australia are also independent of the importation pathway and have been assessed as Low.

In addition, the department has reviewed the latest relevant literature on armoured scales —for example, Huang and Wang (2016), Suh (2016), and Chen et al (2016). No new information was found to significantly change the assessments of risk ratings for importation, distribution, establishment, spread or consequences, as set out for armoured scales in existing policies.

4.2.1 Likelihood of entry

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

Likelihood of importation

It is considered that the likelihoods of importation of *Diaspis boisduvalii* and *D. bromeliae* on decrowned pineapples from Taiwan are directly comparable to the assessments made for *Melanaspis bromiliae* and *Unaspis citri* in the risk analysis for decrowned pineapples from Malaysia (DAFF 2012a), where the likelihoods were rated as High.

The rating of High is extended in this analysis to *Diaspis boisduvalii* and *D. bromeliae* for the following reasons:

- Both *Diaspis boisduvalii* and *D. bromeliae* have a life history typical of armoured scales (Beardsley & Gonzalez 1975; Espinosa et al. 2009; Watson 2016) including of *Unaspis citri* (Buckley & Hodges 2013), which was assessed in the risk analysis for decrowned pineapples from Malaysia.
- Both *Diaspis boisduvalii* and *D. bromeliae* are known to be pests of pineapples and are present in Taiwan (García Morales et al. 2019).
- All adult female armoured scales are sessile (Beardsley & Gonzalez 1975). Therefore, adult females of *Diaspis boisduvalii* and *D. bromeliae* can potentially be expected to attach to the surfaces of decrowned pineapples in a similar manner to *Melanaspis bromiliae* and *Unaspis citri* on decrowned pineapples from Malaysia, and thus to be capable of remaining on pineapples exported from Taiwan.
- All feeding stages of armoured scales, as well as the adult stage of female armoured scales, produce a hard 'scale' covering (Beardsley & Gonzalez 1975) which can protect them from fruit cleaning processes. Therefore it could be expected that, as for assessments of *Melanaspis bromiliae* and *Unaspis citri* on decrowned pineapples from Malaysia, *Diaspis boisduvalii* and *D. bromeliae* could survive on decrowned pineapples from Taiwan through post-harvest processing and cleaning procedures.

For the reasons outlined, *Diaspis boisduvalii* and *D. bromeliae* are thus considered comparable to previously assessed armoured scales. The likelihood of importation of *D. boisduvalii* and *D. bromeliae* on decrowned pineapples from Taiwan is assessed as High.

Likelihood of distribution

Both decrowned pineapples from Malaysia and from Taiwan are expected to be exported to Australia at a similar time of year. The only means of dispersal for armoured scales is the crawler stage—other nymphal stages and adult females of armoured scales are sessile, and adult males are weak and short-lived (Beardsley & Gonzalez 1975). Crawlers may be able to reach a nearby host from infested pineapple waste, however, it is considered that hosts of *Diaspis boisduvalii* and *D. bromeliae* (García Morales et al. 2019) are unlikely to be found near a commercial waste disposal site.

The previous assessment for armoured scales on decrowned pineapples from Malaysia rated the likelihood of distribution as Low (DAFF 2012a). The comparable export season for decrowned pineapples from Malaysia and from Taiwan, together with the similarities in biologies of the previously assessed armoured scales and the armoured scales in this pest risk assessment, support the extension of the previously assessed likelihoods of distribution for armoured scales to this pest risk assessment. Therefore, the likelihoods of distribution of armoured scales on decrowned pineapples from Taiwan are assessed as Low.

Overall likelihood of entry

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

The likelihood that armoured scales will enter Australia as a result of trade in decrowned pineapples from Taiwan, and be distributed in a viable state to a susceptible host, is assessed as Low.

4.2.2 Likelihoods of establishment and spread

The likelihoods of establishment and of spread for armoured scales are independent of the import pathway, and are comparable to those provided in all previous pest risk assessments for armoured scales, including the pest risk assessment for armoured scales in the risk analysis for decrowned pineapples from Malaysia (DAFF 2012a). The ratings from previous assessments are:

Likelihood of establishment: High

Likelihood of spread: Moderate

4.2.3 Overall likelihood of entry, establishment and spread

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

The likelihood that armoured scales will enter Australia as a result of trade in decrowned pineapples from Taiwan, be distributed in a viable state to a susceptible host, establish in Australia, and subsequently spread within Australia is assessed as Low.

4.2.4 Consequences

It is considered that the consequences of entry, establishment and spread of armoured scales in Australia are independent of the import pathway, and are comparable across pest risk assessments, including the risk analysis for decrowned pineapples from Malaysia (DAFF 2012a). The rating for overall consequences for armoured scales in previous risk analyses was Low. Therefore, the overall consequences for armoured scales from decrowned pineapples from Taiwan is also assessed as Low.

4.2.5 Unrestricted risk estimate

The unrestricted risk estimates for armoured scales from decrowned pineapples from Taiwan are assessed as Very Low, which is comparable to the estimates in previous assessments, and which achieves the ALOP for Australia. Therefore, no specific risk management measures are required for these pests.

4.3 Regulated thrips as vectors of emerging quarantine orthotospoviruses

Frankliniella schultzei* and *Thrips tabaci

No thrips species that are quarantine pests for Australia were identified on the decrowned pineapples from Taiwan pathway. However, *Frankliniella schultzei* and *Thrips tabaci* are identified as regulated articles because they are capable of harbouring and spreading (vectoring) emerging orthotospoviruses that are quarantine pests for Australia, as detailed in the thrips group PRA (Australian Government Department of Agriculture and Water Resources 2017).

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 2019b). For readability and simplicity, *Frankliniella schultzei* and *Thrips tabaci* are referred to as 'regulated thrips' in this document.

The indicative likelihood of entry for all thrips is assessed in the thrips group PRA as Moderate. This indicative likelihood is also relevant to regulated thrips that transmit quarantine orthotospoviruses. After assessment of relevant pathway-specific factors (see Section 2.2.7) for decrowned pineapples from Taiwan, likelihoods of entry of Moderate were verified as appropriate for these regulated thrips (Table 4.3).

Table 4.3: Regulated thrips species for decrowned pineapples from Taiwan

Pest	In thrips group PRA	Regulated thrips	On decrowned pineapple pathway	Moderate likelihood of entry for thrips verified
Frankliniella schultzei	Yes	Yes	Yes	Yes
Thrips tabaci	Yes	Yes	Yes	Yes

A summary of the risk assessment for quarantine orthotospoviruses transmitted by thrips is presented in Table 4.4 for convenience.

Table 4.4: Risk estimates for emerging quarantine orthotospoviruses vectored by regulated thrips

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

(a) The identified regulated thrips vector emerging quarantine orthotospoviruses, and this table presents the risk estimates for these viruses from the thrips group PRA.

The indicative unrestricted risk estimate for emerging quarantine orthotospoviruses transmitted by regulated thrips is Low, which does not achieve the ALOP for Australia, as assessed in the thrips group PRA (Table 4.4).

This indicative unrestricted risk estimate is considered to be applicable for the emerging orthotospoviruses known to be vectored by the thrips species present on the pathway for decrowned pineapples from Taiwan. Therefore, specific risk management measures are required for regulated thrips to mitigate the risk posed by emerging quarantine orthotospoviruses, in order to achieve the ALOP for Australia.

The conclusion of this risk assessment, which is based on the thrips group PRA, applies to all phytophagous quarantine thrips and regulated thrips on the pathway for decrowned pineapples from Taiwan, irrespective of their specific identification in this document.

4.4 Pest risk assessment conclusions

Table 4.5: Summary of unrestricted risk estimates for quarantine pests associated with decrowned pineapples from Taiwan

Pest name	Likelihood of						Consequences	URE
	Entry			Establishment	Spread	EES		
	Importation	Distribution	**Overall**					
Mealybugs [Hemiptera: Pseudococcidae]								
Dysmicoccus neobrevipes (EP)	High	Moderate	**Moderate**	High	High	Moderate	Low	**Low**
Phenacoccus madeirensis	High	Moderate	**Moderate**	High	High	Moderate	Low	**Low**
Paracoccus marginatus (EP)	High	Moderate	**Moderate**	High	High	Moderate	Low	**Low**
Planococcus minor (EP, WA)	High	Moderate	**Moderate**	High	High	Moderate	Low	**Low**
Pseudococcus jackbeardsleyi (EP)	High	Moderate	**Moderate**	High	High	Moderate	Low	**Low**
Armoured scales [Hemiptera: Diaspididae]								
Diaspis boisduvalii (EP, WA)	High	Low	**Low**	High	Moderate	Low	Low	**Very Low**
Diaspis bromeliae (WA)	High	Low	**Low**	High	Moderate	Low	Low	**Very Low**
Orthotospoviruses [Bunyavirales: Tospoviridae] vectored by regulated thrips (*Frankliniella schultzei* and *Thrips tabaci*) (a)								
Listed in the thrips group PRA	Moderate	Moderate	**Low**	Moderate	High	Low	Moderate	**Low**

EP: Species has been assessed previously and import policy already exists. **WA**: Pest of quarantine concern for Western Australia. **EES**: Overall likelihood of entry, establishment and spread.
URE: Unrestricted risk estimate. This is expressed in an ascending scale from negligible to extreme.
(a) The identified regulated thrips vector emerging quarantine orthotospoviruses, and this table presents the risk estimates for these viruses from the thrips group PRA (Australian Government Department of Agriculture and Water Resources 2017).

4.5 Summary of assessment of quarantine pests of concern

This section provides a summary of the assessment of quarantine pests of concern (shown in Figure 10).

The pest categorisation process (Appendix A) identified 104 pests. Of these 104 pests:

- 70 pests are already present in Australia, and not under official control, and therefore were not further considered;
- 26 pests were assessed as not having potential to be on the pathway of fresh decrowned pineapples, and therefore were not further considered;
- one pest was assessed as not being of potential economic consequence, and therefore was not further considered.

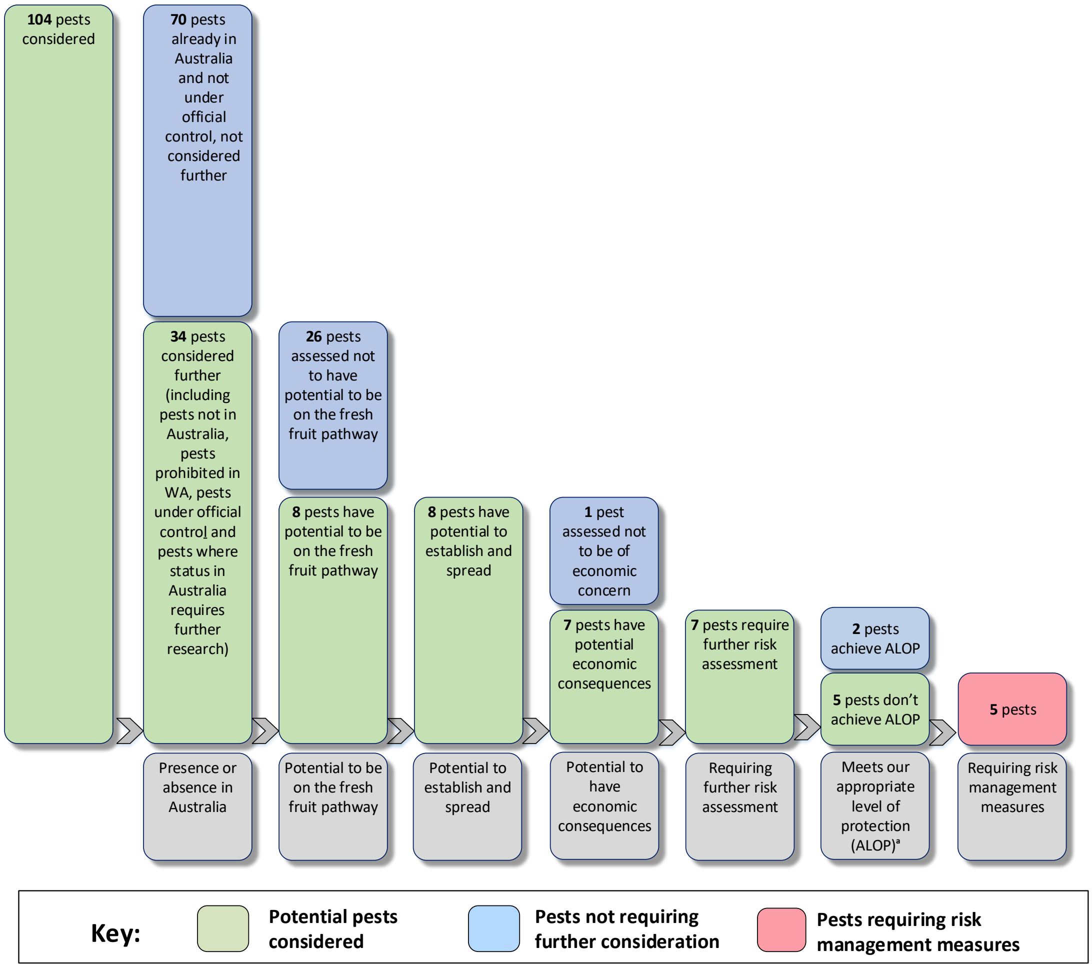
The outcome of the above process left seven pests that required further consideration, which is pest risk assessment. Pest risk assessments for these seven pests were completed:

- the estimated risk for the two armoured scales was assessed as achieving the ALOP for Australia so that no specific risk management measures are required. These pests are:
  - *Diaspis boisduvalii*
  - *Diaspis bromeliae*
- The estimated risk for five pests were assessed as not achieving the ALOP for Australia, and therefore these five pests require specific risk management measures. These pests are:
  - *Dysmicoccus neobrevipes*
  - *Phenacoccus madeirensis*
  - *Paracoccus marginatus*
  - *Planococcus minor*
  - *Pseudococcus jackbeardsleyi*

Two thrips species present in Taiwan, *Frankliniella schultzei* and *Thrips tabaci*, were identified in the thrips group PRA as regulated thrips due to their ability to vector emerging quarantine orthotospoviruses. Their potential to introduce emerging quarantine orthotospoviruses into Australia via the decrowned pineapple pathway was confirmed (Table 4.3 and Table 4.4) and the thrips group PRA was applied for these two thrips species. These two regulated thrips require specific risk management measures to mitigate the risk from emerging quarantine orthotospoviruses.

The two regulated thrips species have not been included in Figure 10: Summary of assessment of quarantine pests of concern.

Figure 10: Summary of assessment of quarantine pests of concern



Note that Figure 10 does not include the two regulated thrips species and the emerging quarantine orthotospoviruses they vector, as identified in this chapter and summarised in Section 4.5.

5 Pest risk management

This chapter provides information on the management of quarantine pests and regulated thrips identified as having an unrestricted risk that does not achieve the appropriate level of protection (ALOP) for Australia. The recommended risk management measure for these pests are described in this chapter. This chapter also describes the operational system that is required for the maintenance and verification of the phytosanitary status of decrowned pineapples from Taiwan for export to Australia.

5.1 Pest risk management measures and phytosanitary procedures

Pest risk management evaluates and selects options for measures to reduce the risk of entry, establishment or spread of quarantine pests and regulated thrips for Australia, where they have been assessed to have an unrestricted risk level that does not achieve the ALOP for Australia. In calculating the unrestricted risk estimate, existing commercial production practices in Taiwan have been considered, as have post-harvest procedures and the packing of fruit.

In addition to Taiwan's existing commercial production systems and packhouse operations for decrowned pineapples, specific pest risk management measures are recommended in order to achieve the ALOP for Australia.

In this chapter, the Department of Agriculture has recommended risk management measures that may be applied to consignments of decrowned pineapples sourced from Taiwan. Finalisation of the import conditions may be undertaken with input from the Australian states and territories as appropriate.

5.1.1 Pest risk management for quarantine pests

Pest risk assessments identified the quarantine pests listed in Table 5.1 as having unrestricted risks that do not achieve the ALOP for Australia. Therefore, risk management measures are required to manage the risks posed by these pests. The recommended measure is listed in Table 5.1.

Table 5.1: Risk management measure recommended for quarantine pests of decrowned pineapples from Taiwan

Pest	Common name	Measure
Dysmicoccus neobrevipes (EP)	Grey pineapple mealybug	Pre-export methyl bromide fumigation or an alternative post-harvest phytosanitary treatment approved by the Department of Agriculture
Pseudococcus jackbeardsleyi (EP)	Jack Beardsley mealybug	
Paracoccus marginatus (EP)	Papaya mealybug	
Phenacoccus madeirensis	Madeira mealybug	
Planococcus minor (EP, WA)	Pacific mealybug	

EP: Species has been assessed previously and import policy already exists. **WA:** Pest of quarantine concern for Western Australia.

5.1.2 Pest risk management for regulated thrips

The thrips group PRA has identified thrips and emerging orthotospoviruses of biosecurity importance to Australia (Australian Government Department of Agriculture and Water Resources 2017). *Frankliniella schultzei* and *Thrips tabaci* are associated with decrowned pineapples from Taiwan. Measures are required to reduce the risk posed by the emerging quarantine orthotospoviruses they vector, to achieve the ALOP for Australia (Table 5.2).

Table 5.2: Risk management measure recommended for regulated thrips associated with decrowned pineapples from Taiwan

Regulated thrips	Common name	Measure
Frankliniella schultzei	Cotton thrips	Pre-export methyl bromide fumigation or an alternative post-harvest phytosanitary treatment approved by the Department of Agriculture
Thrips tabaci	Onion thrips	

Management for mealybugs and thrips

The risk management measure recommended for quarantine mealybugs (Table 5.1) is based on existing policy for the import of decrowned pineapples from Malaysia (DAFF 2012a). This risk analysis considers that when the following risk management measure is applied, the restricted risk for the identified quarantine mealybugs will achieve the appropriate level of protection (ALOP) for Australia. The risk management measure for mealybugs is:

- Pre-export methyl bromide fumigation, or an alternative post-harvest phytosanitary treatment approved by the Department of Agriculture.

It should be noted that the risk management measure recommended by the Department of Agriculture to manage mealybugs in most fresh fruits is visual inspection and, if required by observed presence, remedial action (Australian Government Department of Agriculture and Water Resources 2016; Department of Agriculture and Water Resources 2016b, 2017).

However, because the surface of decrowned pineapples contains many crevices and spines, which can harbour mealybugs, visual inspection alone is not considered to be a technically feasible measure to assess the potential presence of these pests. Therefore, the Department of Agriculture recommends pre-export methyl bromide fumigation as a measure to reduce the risks associated with these quarantine mealybugs (*Dysmicoccus neobrevipes*, *Paracoccus marginatus*, *Phenacoccus madeirensis*, *Planococcus minor* and *Pseudococcus jackbeardsleyi*).

For the same reason this measure is also considered appropriate for the regulated thrips (*Frankliniella schultzei*, *Thrips tabaci*) (Table 5.2) and is consistent with the options provided in the thrips group PRA (Australian Government Department of Agriculture and Water Resources 2017).

The Department of Agriculture recommends that decrowned pineapples be fumigated prior to export for two hours as specified below:

- 32 grams methyl bromide per cubic metre at a pulp temperature of 21 °C or greater; or
- 40 grams methyl bromide per cubic metre at a pulp temperature of 16–20 °C; or
- 48 grams methyl bromide per cubic metre at a pulp temperature of 11–15 °C; or
- 64 grams methyl bromide per cubic metre at a pulp temperature of 10 °C.

Taiwan must provide a submission to the Department of Agriculture that demonstrates it has processes and procedures for the registration, approval and audit of treatment facilities. The Department of Agriculture may request on-site verification of the treatment facilities.

5.1.3 Consideration of alternative measures

Consistent with the principle of equivalence detailed in ISPM 11: *Pest risk analysis for quarantine pests* (FAO 2019c), the Department of Agriculture will consider any alternative measure proposed by BAPHIQ, providing that it demonstrably manages the target pests to achieve the ALOP for Australia. Evaluation of any such measure will require a technical submission from BAPHIQ that details the proposed measure and includes suitable information to support the claimed efficacy for consideration by the Department of Agriculture.

5.2 Operational system for the maintenance and verification of phytosanitary status

A system of operational procedures is necessary to maintain and verify the phytosanitary status of decrowned pineapples from Taiwan. This is to ensure that the recommended risk management measures have been met and appropriate capabilities are maintained.

5.2.1 A system of traceability to source farms

The objectives of the recommended procedure are to ensure that:

- decrowned pineapples are sourced only from farms located in Taiwan producing commercial export-quality fruit, and
- farms from which decrowned pineapples are sourced can be identified, so investigation and corrective action can be targeted rather than applied to all contributing export farms, in the event that live/viable pests are intercepted.

Taiwan's Agriculture and Food Agency (AFA) must ensure that decrowned pineapples for export to Australia can be traced back to a registered commercial export farm in Taiwan. AFA and BAPHIQ would be responsible for ensuring that export pineapple growers are aware of pests of biosecurity concern to Australia and of the required risk management measures.

5.2.2 Registration of packhouses and treatment providers and auditing of procedures

The objectives of this recommended procedure are to ensure that:

- commercial quality decrowned pineapples are sourced only from packhouses and treatment providers that are approved by AFA
- treatment providers are approved by BAPHIQ and are capable of applying a treatment that suitably manages the target pests. Application of methyl bromide fumigation treatment must be consistent with Australia's standards for the application of methyl bromide fumigation treatment, described in *Methyl bromide fumigation methodology* and *Guide to performing (Quarantine and pre-shipment) QPS fumigation with methyl bromide* on the department's website at www.agriculture.gov.au/import/arrival/treatments/treatments-fumigants#methyl-bromide-fumigation.

Export packhouses are registered with AFA before the commencement of harvest each season. AFA must maintain a list of registered packhouses. AFA is required to ensure that the registered packhouses are suitably equipped and have a system in place to carry out the specified

phytosanitary activities. Records of AFA audits must be made available to the Department of Agriculture upon request.

Decrowned pineapples are to undergo methyl bromide fumigation in Taiwan prior to export, by treatment providers that have been registered with and audited by BAPHIQ for that purpose. Records of BAPHIQ registration requirements and audits are to be made available to the Department of Agriculture upon request.

Approval for treatment providers by BAPHIQ must include verification that suitable systems are in place to ensure compliance with the treatment requirements. This may include:

- documented procedures to ensure decrowned pineapples are appropriately treated, in line with Australia's standards for the application of methyl bromide fumigation treatment, and safeguarded post-treatment
- staff training to ensure compliance with procedures
- record-keeping procedures
- suitability of facilities and equipment
- compliance with BAPHIQ's system of oversight of treatment application.

5.2.3 Packaging, labelling and containers

The objectives of this recommended procedure are to ensure that:

- decrowned pineapples 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 2019b))
- unprocessed packaging material, for example unprocessed plant material—which is not permitted entry, or may vector pests identified as not being on the pathway or pests not known to be associated with decrowned pineapples—is not imported with decrowned pineapples
- all wood material, containers and transport methods (non-commodity) used in packaging and transport of decrowned pineapples complies with the Non-commodity information requirements policy (Department of Agriculture and Water Resources 2016c)
- secure packaging is used during storage and transport to Australia to prevent re-infestation during storage and transport and to prevent escape of pests during clearance procedures on arrival in Australia. Packaging must meet Australia's secure packaging options published on the department's BICON system at https://bicon.agriculture.gov.au/BiconWeb4.0/ViewElement/Element/Index?elementPk=914691&caseElementPk=992680
- the packaged decrowned pineapples are labelled with sufficient identification information for the purposes of traceability. This may include:
  - the treatment facility name/number and treatment identification reference/number
  - packhouse registration reference/number

Export packhouses and treatment providers (where applicable) must ensure clean, new packaging and labelling are appropriate to maintain phytosanitary status of the export consignments.

5.2.4 Specific conditions for storage and movement

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

Treated and/or inspected decrowned pineapples for export to Australia must be kept secure and segregated at all times from any fruit for domestic or other markets, and from untreated/non pre-inspected product, to prevent mixing or cross-contamination.

5.2.5 Freedom from trash

The objective of this recommended procedure is to ensure that decrowned pineapples 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.

5.2.6 Pre-export phytosanitary inspection and certification by BAPHIQ

The objectives of this recommended procedure are to ensure that Australia's import conditions have been met.

All consignments must be inspected in accordance with official procedures for all visually-detectable quarantine pests and other regulated articles (including soil, animal and plant debris) using random samples of 600 units per phytosanitary certificate, or equivalent, as per ISPM 31: *Methodologies for sampling consignments* (FAO 2016). One unit is considered to be a single decrowned pineapple.

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

Each PC must include:

- a description of the consignment (including traceability information),
- details of disinfestation treatments (for example, methyl bromide fumigation) which includes date, concentration, temperature, duration, and/or attach fumigation certificate (as appropriate),
- any other statements that may be required.

5.2.7 Phytosanitary inspection by the Department of Agriculture

The objectives of this recommended procedure are to ensure that:

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

On arrival in Australia, the Department of Agriculture 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 decrowned pineapples from Taiwan meet Australia's import conditions. When inspecting consignments, the department will use, random samples of 600 units per phytosanitary certificate and inspection methods suitable for the commodity.

5.2.8 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 conditions will be subject to a suitable remedial treatment where an effective treatment is available and biosecurity risks associated with applying the treatment can be effectively managed, or the imported consignment will be re-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 any pest intercepted.

In the event that decrowned pineapple consignments are repeatedly non-compliant, the Department of Agriculture reserves the right to suspend imports (either all imports or imports from specific pathways) and conduct an audit of the risk management systems. Imports will recommence only when the Department of Agriculture is satisfied that appropriate corrective action has been undertaken.

5.3 Uncategorised pests

If an organism that has not been categorised in this review, including contaminant pests, is detected on decrowned pineapples on arrival in Australia, it will require assessment by the Department of Agriculture to determine its quarantine status and whether phytosanitary action is required.

Assessment will also be required if the detected species was categorised as not likely to be on the import pathway. If the detected species was categorised as being on the pathway, but assessed as having an unrestricted risk that achieves the ALOP for Australia, then it may require reassessment. The detection of any pests of biosecurity concern not already identified in this 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 appropriate level of protection for Australia.

5.4 Review of processes

5.4.1 Verification of protocol

Prior to or during the first season of trade, the Department of Agriculture will verify the implementation of the required import conditions and phytosanitary measures, including of registration, operational procedures and treatment providers, where applicable. This may involve representatives from the Department of Agriculture visiting areas in Taiwan that produce decrowned pineapples for export to Australia.

5.4.2 Review of policy

The Department of Agriculture will review the import policy after a suitable volume of trade has been achieved. In addition, the department reserves the right to review the import policy as deemed necessary, including if there is reason to believe that any pest or phytosanitary status in Taiwan has changed.

BAPHIQ must inform the Department of Agriculture immediately on detection of any new pest of pineapple that might be of potential biosecurity concern to Australia.

5.5 Meeting Australia's food laws

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

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

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

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

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

6 Conclusion

The findings of this final risk analysis for fresh decrowned pineapples from Taiwan are based on a comprehensive scientific analysis of relevant literature.

The Department of Agriculture considers that the risk management measures recommended in this report will provide an appropriate level of protection against the quarantine pests and regulated thrips identified as associated with the trade of fresh decrowned pineapples from Taiwan.

Appendix A: Initiation and categorisation for pests of fresh decrowned pineapples from Taiwan

The table identifies pests that have the potential to be present on fresh decrowned pineapples grown in Taiwan using typical commercial production and packing procedures, and to be imported into Australia.

The *Final group pest risk analysis for thrips and orthotospoviruses on fresh fruit, vegetable, cut-flower and foliage imports* (Australian Government Department of Agriculture and Water Resources 2017) has been applied in this risk analysis.

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

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

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

This is not a comprehensive list of all pests associated with pineapple plants, and it does not include soil-borne pests and pathogens, or wood-borers and root pests, as these are not directly related to the export pathway of fresh decrowned pineapples. Other pests that may occasionally be detected in trade, but which are not specifically associated with decrowned pineapples, are not categorised here. Any such contaminant pests detected at the border are managed under existing standard operational procedures. It is important to note that any quarantine pests detected on arrival by quarantine inspection will be actioned as appropriate, even if they have not been assessed in this report.

The department is aware of the recent changes in fungal nomenclature concerning the separate naming of 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. As official lists of accepted and rejected fungal names become available, these accepted names will be adopted.

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
ARTHROPODS						
Coleoptera						
Adoretus sinicus Burmeister, 1855 [Scarabaeidae] Chinese rose beetle	Yes (CABI 2019)	No records found	No. *Adoretus sinicus* has been recorded feeding on pineapple roots (Joy, Anjana & Soumya 2016). No records of association with pineapple fruit have been found.	Assessment not required	Assessment not required	No
Anomala expansa (Bates, 1866) [Scarabaeidae] Taiwanese bronze scarab	Yes (GBIF Secretariat 2015)	No records found	No. *Anomala expansa* was mentioned as a pest that attacked only the roots of pineapple in Taiwan (Jiang et al. 2011). No other records of an association with pineapple fruit have been found.	Assessment not required	Assessment not required	No
Araecerus fasciculatus (De Geer, 1775) [Anthribidae] Cocoa weevil	Yes (CABI 2019)	Yes. NSW, Vic., WA (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No
Epuraea luteola Erichson, 1843 Synonyms: *Epuraea (Haptoncus) luteolus* Erichson, 1843; *Haptoncus luteolus* Erichson, 1843 [Nitidulidae] Yellowbrown sap beetle	Yes (Kirejtshuk 2005)	Uncertain; two records in northern NSW from 1955 and five records in Christmas Island from 1989 (Plant Health Australia 2019).	No. There is little specific information on *E. luteola,* however, it is known to be a pest of dried and decaying fruit (Ewing & Cline 2004; Mifsud & Audisio 2008; Myers 2011) and is not known to be associated with fresh fruit.	Assessment not required	Assessment not required	No
Epuraea (Haptoncus) ocularis Fairmaire, 1849 Synonyms: *Epuraea ocularis* (Fairmaire, 1849); *Haptoncus ocularis* Fairmaire [Nitidulidae] Pineapple sap beetle	Yes (Kirejtshuk 2005)	Yes. NSW, NT, Qld (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Phenolia (Lasiodites) picta (MacLeay, 1825) Synonym: *Lasiodactylus pictus* MacLeay, 1825 [Nitidulidae]	Yes (Kirejtshuk 2005)	No records found	No. There is little specific information on *L. pictus*. This species has been found in rotting mango fruits (Abdullahh & Shamsulaman 2008). Not known to attack fresh fruit. No records of association with pineapple fruit have been found.	Assessment not required	Assessment not required	No
Oryctes rhinoceros Linnaeus, 1758 [Scarabaeidae] Coconut rhinoceros beetle	Yes (CABI 2019)	No records found	No. *Oryctes rhinoceros* has been recorded as a minor pest of pineapple (CABI 2019; Dornberg 2015). However, eggs are laid in rotting plant material, which is unlikely to be exported, and larvae feed on the material around the site of oviposition. Adults grow up to 50 millimetres long (CABI 2019) and are likely to be noticed and removed during harvest and packaging.	Assessment not required	Assessment not required	No
Tribolium castaneum (Herbst, 1797) [Tenebrionidae] Red flour beetle	Yes (CABI 2019)	Yes. ACT, NSW, NT, Qld, SA, Tas., Vic., WA (Plant Health Australia 2019). Regulated as a Declared Organism (Prohibited (s22(2))) of WA Biosecurity and Agriculture Management Act (2007) (Government of Western Australia 2018).	No. *Tribolium castaneum* has been previously recorded as a pest of pineapple (Yunus & Ho 1980). However, this species is mostly associated with grain and stored commodities (Baldwin & Fasulo 2014), and attacked fruit tends to be stored and/or dried fruit, not freshly harvested fruit (CABI 2019). Therefore, this species is not likely to be found on fresh pineapples from Taiwan.	Assessment not required	Assessment not required	No
Diptera						
Atherigona orientalis Schiner, 1868 [Muscidae] Pepper fruit fly	Yes (CABI 2019)	Yes. NT (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Hemiptera						
Aonidiella aurantii (Maskell, 1879) [Diaspididae] California red scale	Yes (CABI 2019)	Yes. NSW, NT, Qld, SA, Tas., Vic., WA (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No
Aspidiotus destructor Signoret, 1869 [Diaspididae] Coconut scale	Yes (CABI 2019)	Yes. NSW, NT, Qld, Vic., WA (CABI 2019; Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No
Aspidiotus nerii Bouché, 1833 [Diaspididae] Ivy scale, oleander scale	Yes (BAPHIQ 2015)	Yes. NSW, NT, Qld, SA, Tas., Vic., WA (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No
Ceroplastes floridensis Comstock, 1881 [Coccidae] Florida wax scale	Yes (CABI 2019)	Yes. Qld, NSW (Plantwise 2019). Regulated as a Declared Organism (Prohibited (s12)) of WA Biosecurity and Agriculture Management Act (2007) (Government of Western Australia 2018).	No. Although *C. floridensis* has been found on pineapple, it is not associated with fruit as damage is concentrated around leaves and stems (Jiang et al. 2011; Sharma & Buss 2011).	Assessment not required	Assessment not required	No
Coccus formicarii (Green, 1896) Synonym: *Taiwansaissetia formicarii* (Green, 1896) [Coccidae]	Yes (Jiang et al. 2011)	No records found	No. *Coccus formicarii* was listed only as a pest of pineapple leaves (Jiang et al. 2011). No records of association with pineapple fruit have been found.	Assessment not required	Assessment not required	No

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Coccus hesperidum Linnaeus, 1758 [Coccidae] Brown soft scale	Yes (CABI 2019)	Yes. ACT, NSW, NT, Qld, SA, Vic., WA (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No
Diaspis boisduvalii Signoret, 1869 [Diaspididae] Boisduval scale	Yes (CABI 2019; Chen, Wong & Ku 2016)	Yes. Qld, SA, Tas. (ABRS 2019; García Morales et al. 2019). Regulated as a Declared Organism (Prohibited (s12)) of WA Biosecurity and Agriculture Management Act (2007) (Government of Western Australia 2018).	Yes. Pineapple is a known host for *D. boisduvalii*, and this species can be found on all areas of its host plant including fruit during high levels of infestation (Espinosa et al. 2009; García Morales et al. 2019). They are extremely small and may go unnoticed during harvest and packing.	Yes. *Diaspis boisduvalii* is polyphagous and found in greenhouses around the world, and is already present in Queensland, South Australia and Tasmania (ABRS 2019; García Morales et al. 2019). This species may be wind dispersed (Tenbrink & Hara 1992), which would allow it to spread to Western Australia.	Yes. *Diaspis boisduvalii* is recorded as a pest of banana, pineapple and other crops grown in Australia, and is also recorded as a significant pest of greenhouse orchids (Espinosa et al. 2009).	Yes (EP, WA)

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Diaspis bromeliae (Kerner, 1778) [Diaspididae] Pineapple scale	Yes (Chen, Wong & Ku 2016)	Yes. Qld (García Morales et al. 2019). Regulated as a Declared Organism (Prohibited (s12)) of WA Biosecurity and Agriculture Management Act (2007) (Government of Western Australia 2018).	Yes. Although *D. bromeliae* is known to prefer feeding on leaves of pineapple, it is also known to infest the fruit during heavy infestations (García Morales et al. 2019; Joy, Anjana & Soumya 2016; Newett & Rigden 2015). They are extremely small and may go unnoticed during harvest and packing.	Yes. Bromeliads, orchids and other epiphytes that are both popular as houseplants and present as native plants in Australia are listed as hosts for *D. bromeliae* (García Morales et al. 2019; Watson 2002). This species may be wind dispersed (Watson 2002), which would allow this species to find suitable hosts and spread to Western Australia.	Yes. Economic damage by *D. bromeliae* tends to be limited to pineapple plantations. The majority of pineapple production in Australia occurs in Queensland, where *D. bromeliae* is already present. However, it is also known to be found on orchids, which suggests it could be a threat to Australia's native biodiversity.	Yes (WA)
Dysmicoccus brevipes (Cockerell, 1893) [Pseudococcidae] Pineapple mealybug	Yes (BAPHIQ 2015)	Yes. NSW, NT, Qld, SA, Tas., WA (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Dysmicoccus neobrevipes Beardsley, 1959 [Pseudococcidae] Grey pineapple mealybug	Yes (Martin Kessing & Mau 2007b)	No records found	Yes. *Dysmicoccus neobrevipes* feeds on the sap of plant tissue, including pineapple, mostly at the top of the plant around the leaves. However, it may also be found on fruit (Newett & Rigden 2015; Plantwise 2019). *Dysmicoccus neobrevipes* is extremely small and could go unnoticed during harvest and packing.	Yes. This species is polyphagous and found in many areas of the tropics. It is therefore likely that, upon introduction, *D. neobrevipes* would be capable of finding conditions and host plants suitable for establishment and spread.	Yes. This species is known to spread pineapple wilt disease, which causes significant losses to pineapple growers (CABI 2019; Plantwise 2019). In addition, it is known to attack mango, citrus, banana and other crops grown in Australia (García Morales et al. 2019).	Yes (EP)
Ferrisia virgata (Cockerell, 1893) [Pseudococcidae] Grey mealybug	Yes (BAPHIQ 2015)	Yes. NSW, NT, Qld, WA (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No
Geisha distinctissima (Walker, 1858) [Flatidae] Green broad winged planthopper	Yes (Bourgoin 2014; Jiang et al. 2011)	No records found	No. There is little specific information on this species. However, Jiang et al. (2011) listed *G. distinctissima* as being present only on leaves and stems of pineapple, and no other records of association with pineapple have been found.	Assessment not required	Assessment not required	No
Icerya aegyptiaca Douglas, 1890 [Monophlebidae] Breadfruit mealybug	Yes (Plantwise 2019)	Yes. NSW, NT, Qld, WA (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Icerya seychellarum (Westwood, 1855) [Monophlebidae] Seychelles scale	Yes (CABI 2019)	Yes. NSW, NT, Qld, WA (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No
Kilifia acuminata Signoret, 1873 [Coccidae] Acuminate scale	Yes (García Morales et al. 2019)	No records found	No. This species feeds on leaves (Williams & Watson 1990) and no records of association with pineapple fruit have been found.	Assessment not required	Assessment not required	No
Lawana imitata (Melichar, 1902) [Flatidae] Flatid planthopper	Yes (Jiang et al. 2011)	No records found	No. *Lawana imitata* was listed as only a pest of pineapple shoots and stems (Jiang et al. 2011), and no other records of association with pineapple have been found.	Assessment not required	Assessment not required	No
Lepidosaphes gloverii (Packard, 1869) Synonym: *Aspidiotus gloverii* Packard, 1869 [Diaspididae] Glover scale, citrus long scale	Yes (BAPHIQ 2015)	Yes. NSW, NT, Qld, Vic. (ABRS 2019; CABI 2019; Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No
Lepidosaphes laterochitinosa Green, 1925 [Diaspididae]	Yes (García Morales et al. 2019; Suh & Bombay 2015)	No records found	No. There is little specific information on this species. Jiang et al. (2011) listed *L. laterochitinosa* as a pest of pineapples, present on both leaves and fruit. However, the status of this species as a pest of pineapples has since been rejected (Huang & Wang 2016) and no primary records of presence on pineapple fruits have been found.	Assessment not required	Assessment not required	No
Leptocorisa acuta (Thunberg, 1783) [Coreidae] Rice seed bug, paddy bug	Yes (CABI 2019)	Yes. NSW, NT, Qld, Tas., WA (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Melanaspis smilacis (Comstock, 1883) [Diaspididae]	Yes (BAPHIQ 2015)	No records found	No. This species occurs on stems and leaves, sucking sap from plant tissue (BAPHIQ 2016; García Morales et al. 2019). No records of association with pineapple fruit have been found.	Assessment not required	Assessment not required	No
Paracoccus marginatus Williams and Granara de Willink, 1992 [Pseudococcidae] Papaya mealybug	Yes (CABI 2019)	No records found	Yes. This species has been recorded as a pest of pineapple and is a major pest of many fruit crops, to the point of covering the surface of some fruits at high infestation levels (CABI 2019).	Yes. *Paracoccus marginatus* is polyphagous and known to feed on over 55 species of plants (University of Florida 2014).	Yes. *Paracoccus marginatus* is known to damage avocado, citrus, tomato, cotton, sweet potato and other crops grown in Australia, leading to stunted growth and cosmetic damage (University of Florida 2014).	Yes (EP)
Parasaissetia nigra (Nietner, 1861) [Coccidae] Nigra scale	Yes (García Morales et al. 2019)	Yes. NSW, NT, Qld, SA, Vic., WA (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Phenacoccus madeirensis Green, 1923 [Pseudococcidae] Madeira mealybug	Yes (CABI 2019)	No records found	Yes. This species is found on pineapple plants (Culik, Ventura & dos S. Martins 2009) and has been recorded feeding on fruits of other species (CABI 2019).	Yes. This species has a wide host range including citrus, cotton, pineapple, and other crops grown in Australia (García Morales et al. 2019). It also has a range of ornamental host plants (Pellizzari & Germain 2010), which occur throughout Australia.	Yes. This species is known to attack citrus, cotton, pineapple and other crops grown in Australia, although it usually causes little damage (García Morales et al. 2019). It is also known to attack *Acacia* (Plantwise 2019) and may therefore pose a threat to Australia's natural ecosystems.	Yes
Pinnaspis buxi (Bouché, 1851) [Diaspididae] Bamboo mussel-scale	Yes (García Morales et al. 2019)	Yes. NSW, NT, Qld, WA (ABRS 2019; Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No
Pinnaspis strachani (Cooley, 1899) [Diaspididae] Cotton white scale	Yes (García Morales et al. 2019)	Yes. NSW, NT, Qld, SA, WA (ABRS 2019; García Morales et al. 2019; Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No
Planococcus citri (Risso, 1813) [Pseudococcidae] Citrus mealybug	Yes (BAPHIQ 2015)	Yes. ACT, NSW, NT, Qld, SA, Tas., Vic., WA (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Planococcus lilacinus (Cockerell, 1905) [Pseudococcidae] Cacao mealybug	Yes (Plantwise 2019)	Yes. Torres strait, under official control (QDAF 2018a).	No. *Planococcus lilacinus* has been listed as a pest of pineapple (Jiang et al. 2011), but no other reports of an association with pineapple have been found.	Assessment not required	Assessment not required	No
Planococcus minor (Maskell, 1897) [Pseudococcidae] Pacific mealybug	Yes (García Morales et al. 2019)	Yes. ACT, NSW, NT, Qld, SA, Vic. (Plant Health Australia 2019). Regulated as a Declared Organism (Prohibited (s12)) of WA Biosecurity and Agriculture Management Act (2007) (Government of Western Australia 2018).	Yes. *Planococcus minor* is known to have spread via trade of fresh fruit (Francis et al. 2012) and is a known pest of pineapple, where it is found on all parts of the plant (García Morales et al. 2019; Jiang et al. 2011).	Yes. *Planococcus minor* is capable of normal reproduction at temperatures of 20–29 °C (Francis, Kairo & Roda 2012a), indicating the climatic suitability of many parts of Australia. In addition, *P. minor* is polyphagous (Francis et al. 2012) and can be dispersed by wind (Roda et al. 2013), suggesting a significant potential to establish and spread in Western Australia.	Yes. *Planococcus minor* is a known pest of banana, soybean, mango and other fruit crops (Roda et al. 2013). Feeding by *P. minor* causes stunted growth and encourages growth of sooty mould through the excretion of honeydew (Francis, Kairo & Roda 2012b), reducing the value of commodities infested by this pest.	Yes (EP, WA)

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Podoparalecanium machili (Takahashi, 1933) [Coccidae]	Yes (Huang & Lin 2014)	No records found	Uncertain. There is little specific information on this species. However, it has been previously found in pineapple fields in Taiwan (Huang & Lin 2014).	Uncertain. There is little specific information on this species. There are reports of its presence on *Machilus* and *Cinnamomum* species (García Morales et al. 2019), some of which are present in Australia (ALA 2019). Suitable climatic conditions are present in parts of Australia, indicating that it may be able to establish and spread here.	No. This species may cause damage to *Cinnamomum* species which are considered a weed in Australia (NSW DPI 2016). The department is not aware of any reports of damage to pineapple or any other horticultural crop and the paucity of literature concerning this pest suggests that it is not of significant economic or environmental concern.	No
Prococcus acutissimus (Green, 1896) Synonym: *Coccus acutissimus* Green, 1896 [Coccidae] Banana-shaped scale	Yes (García Morales et al. 2019)	No records found	No. This species has been listed as only a pest of pineapple leaves (Jiang et al. 2011) and no other records of an association with pineapple have been found. It is found on leaves of other hosts (García Morales et al. 2019).	Assessment not required	Assessment not required	No

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Pseudococcus jackbeardsleyi Gimpel and Miller, 1996 [Pseudococcidae] Jack Beardsley mealybug	Yes (García Morales et al. 2019)	Yes. Torres Strait and Cape York Peninsula, under official control (QDAF 2018b).	Yes. This species is found on all parts of host plants, including pineapples, and prefers sheltered areas (Plantwise 2019), which can be provided by the rough surface of pineapple fruits.	Yes. This species is highly polyphagous (Plantwise 2019) and likely to come into contact with a suitable host plant on which it can grow and reproduce. The distribution of this species is expanding and it is expected to become established in Africa (CABI 2019), indicating a wide range of suitable climates.	Yes. This species has been found on mango, cotton, citrus, grapes and other crops, which are grown in Australia (CABI 2019). Although there have been no major recorded outbreaks of this species (Plantwise 2019), its polyphagous nature suggests it could be capable of economic and environmental damage.	Yes (EP)
Pseudococcus longispinus (Targioni Tozzetti, 1867) [Pseudococcidae] Long tailed mealybug	Yes (BAPHIQ 2015)	Yes. ACT, NSW, Qld, SA, Tas., Vic., WA (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No
Pulvinaria psidii Maskell, 1893 Synonym: *Chloropulvinaria psidii* Maskell, 1893 [Coccidae] Green shield scale	Yes (García Morales et al. 2019)	Yes. ACT, NSW, NT, Qld, SA, WA (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Rhopalosiphum rufiabdominale (Sasaki, 1899) Synonym: *Rhopalosiphum rufiabdominalis* Sasaki, 1899 [Aphididae] Rice root aphid	Yes (Plantwise 2019)	Yes. NT, NSW, Qld, SA, Tas., Vic., WA (Plantwise 2019).	Assessment not required	Assessment not required	Assessment not required	No
Saccharicoccus sacchari (Cockerell, 1895) [Pseudococcidae] Pink sugarcane mealybug	Yes (García Morales et al. 2019)	Yes. Qld, WA (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No
Lepidoptera						
Agrotis ipsilon (Hufnagel, 1766) [Noctuidae] Black cutworm	Yes (BAPHIQ 2015)	Yes. ACT, NSW, Qld, SA, Tas., WA, NT (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No
Eudocima fullonia (Clerck, 1764) [Noctuidae] Fruit-piercing moth	Yes (CABI 2019)	Yes. NSW, NT, Qld, WA (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No
Euproctis taiwana Sliv., 1913 [Lymantriidae] Tussock moth	Yes (BAPHIQ 2015)	No records found	No. There is little information on this species. However, the larval stage is known to feed on flowers and leaves of *Gladiolus* species (Wang 1982) and flowers of pineapple in Taiwan (BAPHIQ 2015; Huang & Lin 2014). No records of association with pineapple fruit have been found.	Assessment not required	Assessment not required	No

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Spodoptera exigua (Hübner, 1808) [Noctuidae] Lesser armyworm, beet armyworm	Yes (CABI 2019)	Yes. ACT, NSW, NT, Qld, SA, Tas., Vic., WA (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No
Spodoptera litura (Fabricius, 1775) [Noctuidae] Armyworm	Yes (BAPHIQ 2015)	Yes. ACT, NSW, NT, Qld, Tas., Vic., WA (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No
Orthoptera						
Atractomorpha sinensis Bolívar, 1905 [Pyrgomorphidae]	Yes (BAPHIQ 2015)	No records found	No. Adults feed on foliage, buds and stems if they are tender, and eggs are laid in soil (Martin Kessing & Mau 2007a). Not known to attack fruit and, in any case, adults and nymphs are likely to be disturbed and not remain on fruit during harvest.	Assessment not required	Assessment not required	No
Oxya chinensis (Thunberg, 1815) Synonym: *Gryllus chinensis* Thunberg, 1815 [Acrididae] Rice grasshopper	Yes (Jiang et al. 2011)	No records found	No. *Oxya chinensis* is known to feed on the leaves of rice (Plantwise 2019) and has been recorded as a minor pest of pineapple (Illingworth 1928; Jiang et al. 2011). However, there are no records of this species being present on pineapple fruit. Both adults and nymphs are likely to disturbed and not remain on fruit during harvest. Eggs are laid in soil (Plantwise 2019).	Assessment not required	Assessment not required	No
Oxya velox (Fabricius, 1787) [Acrididae] Paddy field grasshopper	Yes (BAPHIQ 2015)	No records found	No. There is little specific information on this species. However, Huang et al (2016) listed them as only a pest of pineapple leaves. No records of association with pineapple fruit have been found and, in any case, adults and nymphs are likely to be disturbed and not remain on fruit during harvest.	Assessment not required	Assessment not required	No

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Thysanoptera						
Frankliniella schultzei (Tryborn, 1910) [Thripidae] Cotton thrips	Yes (Wang et al. 2010)	Yes. Widespread (Australian Government Department of Agriculture and Water Resources 2017). However, assessed as vector vector of emerging quarantine orthotospoviruses (Australian Government Department of Agriculture and Water Resources 2017).	Yes. Pineapple is a host (CABI 2019) and this species is known to attack fruit (Plantwise 2019). The rough surface of pineapples may provide shelter for individuals of this species.	Not applicable to vector. However, the emerging quarantine orthotospoviruses vectored by this thrips have potential for establishment and spread (Australian Government Department of Agriculture and Water Resources 2017).	Not applicable to vector. However, the emerging quarantine orthotospoviruses vectored by this thrips have potential for consequences (Australian Government Department of Agriculture and Water Resources 2017).	Thrips group PRA applied (Australian Government Department of Agriculture and Water Resources 2017).
Thrips hawaiiensis (Morgan, 1913) [Thripidae]	Yes (CABI 2019)	Yes. NT, Qld, NSW (Australian Government Department of Agriculture and Water Resources 2017).	Assessment not required	Assessment not required	Assessment not required	No

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Thrips tabaci Lindemann, 1889 [Thripidae] Onion thrips	Yes (CABI 2019)	Yes. Widespread (Australian Government Department of Agriculture and Water Resources 2017). However, assessed as vector vector of emerging quarantine orthotospoviruses (Australian Government Department of Agriculture and Water Resources 2017).	Likely. This species is known to be associated with pineapple (Lewis et al. 1997; Sakimura 1937) but its association with fruit remains unclear. Eggs are laid on leaves, flowers, stems or bulb tissue (Mau & Martin Kessing 1991); not known to lay on fruit. The rough surface of pineapples may provide shelter for individuals of this species.	Not applicable to vector. However, the emerging quarantine orthotospoviruses vectored by this thrips have potential for establishment and spread (Australian Government Department of Agriculture and Water Resources 2017).	Not applicable to vector. However, the emerging quarantine orthotospoviruses vectored by this thrips have potential for consequences (Australian Government Department of Agriculture and Water Resources 2017).	Thrips group PRA applied (Australian Government Department of Agriculture and Water Resources 2017).
Trombidiformes						
Dolichotetranychus floridanus (Banks, 1900) [Tenuipalpidae] Pineapple flat mite, false spider mite	Yes (BAPHIQ 2015)	Yes. Qld (CABI 2019).	Assessment not required	Assessment not required	Assessment not required	No
Eutetranychus orientalis (Klein, 1936) [Tetranychidae] Citrus brown mite	Yes (CABI 2019)	Yes. NT, Qld, WA (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No
Oligonychus litchii Lo and Ho, 1989 [Tetranychidae] Litchi spider mite	Yes (Chen, Li & Chang 2016)	No records found	No. *Oligonychus litchii* feeds on sap by sucking near veins on a leaf, before spreading to the entire leaf as population density increases (Chen, Li & Chang 2016). No records of association with pineapple fruit have been found.	Assessment not required	Assessment not required	No

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Panonychus citri (McGregor, 1916) [Tetranychidae] Citrus red mite	Yes (CABI 2019)	Yes. NSW, Qld (CABI 2019). Regulated as a Declared Organism (Prohibited (s12)) of WA Biosecurity and Agriculture Management Act (2007) (Government of Western Australia 2018). Domestic restrictions for the movement of host material of this pest into Vic. And SA from other Australian states/territories where this pest is present only include planting material, not fruit (DEDJTR 2016; PIRSA 2017).	No. Adults and nymphs feed on both leaves and fruits (Plantwise 2019). *Panonychus citri* has been listed as a pest of pineapple (Jiang et al. 2011). However, it has since been assessed as not a pest of pineapples (Huang & Wang 2016) and no other sources linking this species to pineapple have been found.	Assessment not required	Assessment not required	No
Tyrophagus putrescentiae (Schrank, 1781) [Acaridae] Cereal mite	Yes (CABI 2019)	Yes. NSW, NT, SA, WA (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
BACTERIA						
Acetobacter aceti (Pasteur 1864) Beijerinck 1898 [Rhodospirillales: Acetobacteraceae] Pink disease (Note: Several distinct bacteria have been implicated as the causal agent(s) of pink disease.)	Yes (BAPHIQ 2015)	Yes. NSW (Drysdale & Fleet 1989), Australia (Bradbury 1986).	Assessment not required	Assessment not required	Assessment not required	No
Gluconobacter oxydans (Henneberg 1897) De Ley 1961 [Rhodospirillales: Acetobacteraceae] Pink disease (Note: Several distinct bacteria have been implicated as the causal agent(s) of pink disease.)	Yes (BAPHIQ 2015)	Yes. NSW (Drysdale & Fleet 1989), SA (Mateo et al. 2014).	Assessment not required	Assessment not required	Assessment not required	No

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Pantoea agglomerans (Ewing and Fife 1972) Gavini et al. 1989 Synonyms: *Enterobacter agglomerans* Ewing and Fife 1972; *Erwinia herbicola* (Löhnis 1911) Dye 1964 [Enterobacteriales: Enterobacteriaceae] Pink disease (Note: Several distinct bacteria have been implicated as the causal agent(s) of pink disease.)	Yes (BAPHIQ 2015)	Yes. NSW, Qld, Vic., WA (Government of Western Australia 2018; Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Pantoea ananatis (Serrano 1928) Mergaert et al. 1993 Synonym: *Erwinia ananas* Serrano 1928 [Enterobacteriales: Enterobacteriaceae] Bacterial fruitlet brown rot	Yes (BAPHIQ 2015)	Yes. NSW, NT, Qld (Pegg & Anderson 2009; Plant Health Australia 2019). Listed as a Declared Pest (Prohibited (s12)) under WA's *Biosecurity and Agriculture Management Act* 2007 (Government of Western Australia 2018). However, routine visual inspection is not an adequate measure to detect this pest in host material and specific measures are not required for this pest for the movement of fruit or planting material of numerous hosts into WA from other Australian states/territories where this pest is present.	Assessment not required	Assessment not required	Assessment not required	No

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
CHROMALVEOLATA						
Globisporangium splendens (Hans Braun) Uzuhashi, Tojo & Kakish Synonym: *Pythium splendens* Hans Braun [Peronosporales: Pythiaceae] Root rot	Yes (Jiang et al. 2011)	Yes. NSW, Qld, SA, WA (Plant Health Australia 2019), Tas. (Sampson & Walker 1982).	Assessment not required	Assessment not required	Assessment not required	No
Phytophthora cinnamomi Rands [Peronosporales: Peronosporaceae] Green fruit rot, fungal heart rot, root rot	Yes (Ann & Ko 1985; BAPHIQ 2015; Ho 1990)	Yes. ACT, NSW, NT, Qld, SA, Tas., Vic., WA (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Phytophthora meadii McRae [Peronosporales: Peronosporaceae] Rubber leaf drop, top rot, heart rot/stem rot, fruit rot	Yes (Abad et al. 2008; Ann et al. 2003). Pineapple is a host (Sideris 1929; Sideris & Paxton 1930).	No. Declared absent (Australian Government Department of Agriculture 2014).	No. Rubber is the main host of *P. meadii* (Stamps 1985) and it has a limited natural host range (Erwin & Ribeiro 1996). Association of *P. meadii* with stem and fruit rot of pineapples in Hawaii was first reported by Sideris (1929). A review by Erwin and Ribeiro (1996), lists top rot caused by *P. meadii* as a disease of the pineapple fruit in Hawaii however the only known reference for *P. meadii* causing fruit rot in pineapples is the first report by Sidieris (1929). Stamps (1985) recognises pineapple as a host of *P. meadii*, however this assertion was not supported by any cited literature. *Phytophthora meadii* was considered as a pest of pineapples in Malaysia in the IRA for decrowned pineapples finalised in 2012. As determined by the pest risk assessment in the IRA, the fungus had an unrestricted risk estimate of 'Negligible', which meets Australia's appropriate level of protection (ALOP) (DAFF 2012a). We have been unable to identify recent host records for the fungus on pineapple. Presently, *P. meadii* is not reported as a pest of pineapples in Hawaii (DeFrank et al. 1999; Green & Nelson 2015). *Phytophthora meadii* has been recorded as a pest of West Indian holly (*Leea coccinea*) in Hawaii (Aragaki & Uchida 1994). On the basis that there are no modern records to indicate that pineapple is a host of *P. meadii*, it is considered that this pest is not associated with the pathway.	Assessment not required	Assessment not required	No

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Phytophthora nicotianae Breda de Haan Synonym: *Phytophthora nicotianae var. parasitica* (Dastur) G.M. Waterh [Peronosporales: Peronosporaceae] Heart rot	Yes (BAPHIQ 2015; Ho 1990)	Yes. NSW, NT, Qld, SA, Tas., Vic., WA (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No
Phytophthora palmivora (E.J. Butler) E.J. Butler [Peronosporales: Peronosporaceae] Heart rot	Yes (BAPHIQ 2015; Ho 1990)	Yes. NSW, NT, Qld, Vic., (Plant Health Australia 2019) WA (Stukely 2012).	Assessment not required	Assessment not required	Assessment not required	No
Phytopythium vexans (de Bary) Abad, de Cock, Bala, Robideau, Lodhi & Lévesque Synonym: *Pythium vexans* de Bary [Peronosporales: Pythiaceae]	Yes (Ho 2009; Ho 2004)	Yes. NSW, Qld (Plant Health Australia 2019) WA (Government of Western Australia 2018; Shivas 1989).	Assessment not required	Assessment not required	Assessment not required	No
Pythium aphanidermatum (Edson) Fitzp [Peronosporales: Pythiaceae] Heart rot	Yes (Ho 2009; Ho 2004)	Yes. NSW, NT, Qld, WA (Government of Western Australia 2018; Plant Health Australia 2019), SA (Bumbieris 1972).	Assessment not required	Assessment not required	Assessment not required	No
Pythium arrhenomanes Drechsler [Peronosporales: Pythiaceae]	Yes (Ho 2009; Ho 2004)	Yes. Qld, NSW (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Pythium myriotylum Drechsler [Peronosporales: Pythiaceae] Soft rot	Yes (Ho 2009; Ho 2004)	Yes. NSW, NT, Qld, Vic, WA (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No
FUNGI						
Asterinella stuhlmannii (Henn.) Theiss [Microthyriales: Microthyriaceae] Leaf spot	Yes (Plant Protection Society 1979)	No records found	No. *Asterinella stuhlmannii* infects leaves causing leaf spot (Singh 1980; Stevenson 1975). No records of association with pineapple fruit have been found. Pineapples from Taiwan will be decrowned.	Assessment not required	Assessment not required	No
Athelia rolfsii (Curzi) C. C. Tu & Kimbr. Synonym: *Sclerotium rolfsii* Sacc. [Polyporales: Atheliaceae] Rolf's disease	Yes (Fu, Huang & Lin 2012a, b)	Yes. ACT, NSW, NT, Qld, SA, Tas., Vic., WA (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No
Ceratocystis paradoxa (Dade) C. Moreau Synonym: *Thielaviopsis paradoxa* (De Seynes) Höhn [Microascales: Ceratocystidaceae] Base rot	Yes (BAPHIQ 2015; Jiang et al. 2011)	Yes. NSW, NT, Qld, Vic., WA (Government of Western Australia 2018; Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Corynespora cassiicola (Berk. & M.A. Curtis) C.T. Wei [Pleosporales: Corynesporascaceae] Leaf spot	Yes (Chen & Tzean 2009; Tsai et al. 2015)	Yes. NSW, NT, Qld, Vic. (Plant Health Australia 2019). Regulated as a Declared Organism (Prohibited (s12)) of WA Biosecurity and Agriculture Management Act (2007) (Government of Western Australia 2018). However, routine visual inspection is not an adequate measure to detect this pest in host material and specific measures are not required for this pest for the movement of fruit or planting material of numerous hosts into WA from other Australian states/territories where this pest is present.	Assessment not required	Assessment not required	Assessment not required	No

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Curvularia eragrostidis (Henn.) J.A. Mey Synonym: *Pseudocochliobolus eragrostidis* Tsuda & Ueyama [Pleosporales: Pleosporaceae] Leaf rot	Yes (Shao, Lee & Wei 2011)	Yes. NSW, NT, Qld, WA (Government of Western Australia 2018; Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No
Cyclodomus comosi Sawada [Phyllachorales: Unassigned] Leaf spot	Yes (Plant Protection Society 1979)	No records found	No. *Cyclodomus comosi* forms lesions on pineapple leaves (Commonwealth Mycological Institute 1961; Plant Protection Society 1979; Sawada 1959). No records of association with pineapple fruit have been found.	Assessment not required	Assessment not required	No
Fusarium chlamydosporum Wollenw. & Reinking Synonym: *Pseudofusarium purpureum* Matsush. [Hypocreales: Nectriaceae]	Yes (GBIF Secretariat 2017) *F. chlamydosporum* has recently been reported to cause fusariosis in pineapple in Malaysia (Ibrahim et al. 2016b). However, there is no evidence of *F. chlamydosporum* causing fusariosis on pineapples in Taiwan.	Yes NSW, Qld, SA, Qld, Vic., Tas., WA (Government of Western Australia 2018; Plant Health Australia 2019). Although *F. chlamydosporum* is present in Australia, there is no evidence of *F. chlamydosporum* causing fusariosis on pineapples in Australia.	Assessment not required	Assessment not required	Assessment not required	No

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Fusarium fujikuroi Nirenberg *F. fujikuroi* is part of the *Gibberella fujikuroi* (Sawada) Wollenw. species complex. It is distinct from the species known to cause fruitlet core rot [Hypocreales: Nectriaceae] Fusariosis	Yes. (Chen et al. 2016) *F. fujikuroi* has recently been reported to cause fusariosis in pineapple in Malaysia (Ibrahim et al. 2016a). However, there is no evidence of *F. fujikuroi* causing fusariosis on pineapples in Taiwan.	Yes. NSW, Qld (Liew et al. 2016; Plant Health Australia 2019). Although *F. fujikuroi* is present in Australia, there is no evidence of *F. fujikuroi* causing fusariosis on pineapples in Australia.	Assessment not required	Assessment not required	Assessment not required	No
Fusarium incarnatum (Desm.) Sacc. Synonym: *Fusarium semitectum* Berk. & Ravenel [Hypocreales: Nectriaceae]	Yes (Hsu et al. 2012) *F. incarnatum* has recently been reported to cause fusariosis in pineapple in Malaysia (Ibrahim et al. 2016b). However, there is no evidence of *F. incarnatum* causing fusariosis on pineapples in Taiwan.	Yes. WA (Government of Western Australia 2018). Although *F. incarnatum* is present in Australia, there is no evidence of *F. incarnatum* causing fusariosis on pineapples in Australia.	Assessment not required	Assessment not required	Assessment not required	No
Fusarium oxysporum Schltdl. 1824 [Hypocreales: Nectriaceae] Fruit rot	Yes (Su et al. 2015; Lin et al. 2010)	Yes. ACT, NSW, NT, Qld, SA, Tas., Vic., WA (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Fusarium proliferatum (Matsush.) Nirenberg ex Gerlach & Nirenberg 1982 [Hypocreales: Nectriaceae] Pineapple fruit rot, leaf spot	Yes (Su et al 2015)	Yes. NSW, Qld, NT, SA, Tas., Vic., WA (Elmer et al. 1997; Liew et al. 2016; Plant Health Australia 2019; Summerell et al. 2011).	Assessment not required	Assessment not required	Assessment not required	No
Fusarium solani (Mart.) Sacc. 1881 [Hypocreales: Nectriaceae] Fruit rot	Yes (Su et al 2015)	Yes. NT, NSW, Qld, SA, Tas., Vic., WA (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No
Fusarium verticillioides (Sacc.) Nirenberg 1976 Synonym: *Fusarium moniliforme* J. Sheld. This pathogen is part of the *Gibberella fujikuroi* (Sawada) Wollenw. species complex. It is distinct from the species known to cause fusariosis [Hypocreales: Nectriaceae] Fruitlet core rot	Yes (BAPHIQ 2015)	Yes. NSW, Qld, SA, Vic., WA (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Golovinomyces cichoracearum (DC.) V.P. Heluta Synonym*: Erysiphe cichoracearum* DC [Erysiphales: Erysiphaceae] Powdery mildew	Yes (Jiang et al. 2011)	Yes. NSW, Qld, SA, Tas., Vic., WA (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No
Lasiodiplodia theobromae (Pat.) Griffon & Maubl. [Botryosphaeriales: Botryosphaeriaceae] Botryodiplodia rot	Yes (Fan, Yeh & Hong 2013; Ko, Wang & Ann 2004; Ni et al. 2012)	Yes. NT, Qld, WA (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No
Macrophomina phaseolina (Tassi) Goid. [Botryosphaeriales: Botryosphaeriaceae] Charcoal root rot	Yes (Plant Protection Society 1979)	Yes. ACT, NSW, NT, Qld, SA, Vic., WA (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No
Marasmius crinis-equi F. Muell. ex Kalchbr. [Agaricales: Marasmiaceae] Horse hair blight	Yes (Plant Protection Society 1979)	Yes. Qld, Vic. (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No
Myrothecium roridum Tode : Fr. [Hypocreales: Stachybotryaceae]	Yes (Hong et al. 2013; Tsay, Yeuh & Tung 1996)	Yes. NSW, NT, Qld, SA, Vic. (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Neoscytalidium dimidiatum (Penz.) Crous & Slippers [Botryosphaeriales: Botryosphaeriaceae] Hendersonula fruit rot	Yes (Chuang et al. 2012; Lan et al. 2012)	Yes. NT, Qld, WA (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No
Nigrospora oryzae (Berk. & Broome) Petch Synonym: *Khuskia oryzae* H.J. Huds. [Trichosphaeriales: Unassigned] Storage fruit rot	Yes (Plant Protection Society 1979)	Yes. ACT, NSW, NT, Qld, SA, Vic., WA (Government of Western Australia 2018; Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No
Passalora fulva (Cooke) U. Braun & Crous Synonym: *Cladosporium fulvum* Cooke, *Fulvia fulva* (Cooke) Cif. [Capnodiales: Mycosphaerellaceae]	Yes (Plant Protection Society 1979)	Yes. NSW, NT, Qld, SA, Tas., Vic. (Plant Health Australia 2019) WA (Shivas 1989).	Assessment not required	Assessment not required	Assessment not required	No
Penicillium funiculosum Thom [Eurotiales: Trichocomaceae] Black spot of pineapple	Yes (BAPHIQ 2015)	Yes. NSW, Qld, Vic. (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No
Periconia byssoides Pers. Synonym: *Periconia pycnospora* Fresen. [Pleosporales: Unassignied]	Yes (Plant Protection Society 1979)	Yes. NSW, NT, Qld (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Pestalotia ananas Sawada [Xylariales: Amphisphaeriaceae] Leaf spot	Yes (Plant Protection Society 1979)	No records found	No. *Pestalotia ananas* forms lesions on pineapple leaves (Plant Protection Society 1979; Sawada 1959). No records of association with pineapple fruit have been found. Pineapples from Taiwan will be decrowned.	Assessment not required	Assessment not required	No
Pestalotiopsis theae (Sawada) Steyaert Synonym: *Pestalotia theae* Sawada [Apmhisphaeriales: Pestalotiopsidaceae]	Yes (Plant Protection Society 1979)	Yes. Qld, NT (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No
Phyllosticta ananassae Sawada [Botryosphaeriales: Botryosphaeriaceae] Leaf spot	Yes (Plant Protection Society 1979)	No records found	No. *Phyllosticta ananassae* forms lesions on pineapple leaves (Plant Protection Society 1979; Sawada 1959). No records of association with pineapple fruit have been found.	Assessment not required	Assessment not required	No
Rhizopus stolonifer (Ehrenb. Fr.) Vuill. [Mucorales: Mucoraceae]	Yes (Plant Protection Society 1979; Shao, Lee & Wei 2011)	Yes. NSW, NT, Qld, Vic., WA (Government of Western Australia 2018; Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No
Saccharomyces spp. [Saccharomycetales: Saccharomycetaceae] Yeast rot	Yes (BAPHIQ 2015)	Yes. *Saccharomyces* spp. unidentified to species level are recorded in SA and WA (Plant Health Australia 2019). Further, yeast rot of pineapples due to *Saccharomyces* spp. is widespread in Australia (Pegg & Anderson 2009).	Assessment not required	Assessment not required	Assessment not required	No

Pest	Present in Taiwan	Present within Australia	Potential to be on pathway	Potential for establishment and spread	Potential for economic consequences	Pest risk assessment required
Spegazzinia tessarthra (Berk. & M.A. Curtis) Sacc. [Xylariales: Apiosporaceae]	Yes (Chen & Zeng 2000)	Yes. NSW, Qld, SA, WA (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No
Stachylidium bicolor Link [Unassigned: Unassigned]	Yes (Farr & Rossman 2016)	Yes. SA (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No
Thanatephorus cucumeris (A.B. Frank) Donk Synonym: *Rhizoctonia solani* J.G. Kühn [Cantharellales: Ceratobasidiaceae]	Yes (Hsiao et al. 2008; Tschen et al. 1989; Tu & Chang 1978) Pineapple is a host (Hernández Mansilla et al. 2005; Watanabe & Tsudome 1970).	Yes. NSW, NT, Qld, SA, Tas., Vic. (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No
VIRUSES						
Pineapple mealybug wilt-associated virus (PMWaV-1, PMWaV-2, PMWaV-3) [Closteroviridae: Ampelovirus]	Yes (BAPHIQ 2015; Shen et al. 2009)	Yes. Widespread in eastern Australia (Pegg 1993). PMWaV-1, PMWaV-2, PMWaV-3 have been reported in Qld (Gambley et al. 2008; Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No
Tomato spotted wilt orthotospovirus[1] [Tospoviridae: Orthotospovirus] Pineapple yellow spot virus	Yes (Zheng et al. 2010)	Yes. NSW, Qld, SA, Vic. (Plant Health Australia 2019).	Assessment not required	Assessment not required	Assessment not required	No

[1]The former genus Tospovirus has been renamed *Orthotospovirus* and has been assigned to the family *Tospoviridae* within the order *Bunyavirales*.

Appendix B: Issues raised in stakeholder comments

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

Issue 1: Methyl bromide fumigation is not effective against mealybugs present in the blossom cups of pineapples

Response: Methyl bromide has been used widely for quarantine fumigation of fresh horticulture products for many years, and is globally recognised as an effective method to control insects and other organisms.

- The insecticidal value of methyl bromide was first recognised in the 1930's when it was widely adopted for plant quarantine purposes (Bond 1989). More recently, it has been used extensively as a fumigant to control pests in other goods such as stored products and timber.
- Methyl bromide is an effective and versatile fumigant due to its ability to penetrate quickly and deeply into sorptive materials (such as fruit flesh) at normal atmospheric pressures (Bond 1989).
- Methyl bromide fumigation has been successfully used as a phytosanitary measure internationally to manage the biosecurity risk associated with internal and external pests on a wide range of commodities, including important internal feeding pests (e.g. fruit flies).

Australia permits the importation of pineapples treated by methyl bromide fumigation to manage the biosecurity risk of mealybugs from a number of countries. The treatment protocol recommended for pineapples from Taiwan, as specified in Chapter 5 of the report, is:

- 32 grams methyl bromide per cubic metre at a pulp temperature of 21 °C or greater; or
- 40 grams methyl bromide per cubic metre at a pulp temperature of 16–20 °C; or
- 48 grams methyl bromide per cubic metre at a pulp temperature of 11–15 °C; or
- 64 grams methyl bromide per cubic metre at a pulp temperature of 10 °C

This schedule is the same treatment schedule required for all countries permitted to export pineapples to Australia. This treatment schedule has been applied to pineapples imported into Australia for over a decade, and has been observed to be an effective treatment for managing the biosecurity risk of mealybugs to achieve Australia's appropriate level of protection (ALOP).

Blossom cups are an integral part of the anatomy of the pineapple fruit (see figure 11 in (Okimoto 1948)), and are present in all pineapple fruit. It has been stated that mealybugs could seek shelter and hide in the blossom cups of pineapples. The department has considered this possibility in its determination of the appropriate management measure to reduce the biosecurity risk of mealybugs to achieve ALOP. All pineapple consignments imported into Australia are inspected on arrival to ensure that methyl bromide fumigation has been effective, and that the consignment complies with Australian import requirements. Pineapples are inspected according to departmental procedures, using an inspection method specifically designed to detect pests that may be present on the pineapple fruit.

All available evidence indicates that methyl bromide fumigation is an effective treatment against mealybugs, including against mealybugs that may be present in the blossom cups of pineapples.

Given its demonstrated efficacy and international acceptance for managing pests of horticultural commodities, including pineapples, methyl bromide fumigation is considered an appropriate treatment to mitigate the biosecurity risks associated with mealybugs on pineapples to an acceptable level.

Issue 2: Pineapples imported from Taiwan into Australia may not have been grown and sourced from commercial production farms located in Taiwan

Response: It is a requirement that on arrival in Australia, a consignment can be verified as being produced and packed in Taiwan. The import conditions require pineapples be grown and sourced from registered commercial export farms in Taiwan, and that a traceability system be in place to ensure that pineapples exported to Australia can be traced back to the farm of origin. It is also a requirement that packed pineapples be labelled with appropriate traceability information, and for the details to be included on the phytosanitary certificate.

Taiwan has a robust traceability system in place for the production of fresh pineapples. Taiwan's Agriculture and Food Agency (AFA) is responsible for coordinating and regulating production, which includes registering and auditing all commercial export farms, sorting houses and packhouses. BAPHIQ is responsible for carrying out export inspection, registering treatment facilities, certifying phytosanitary treatments and issuing phytosanitary certificates. Taiwan's traceability system ensures individual pineapples packed for export can be traced through each stage of the export production chain, from harvest to packing.

Before trade can commence, the department will verify that Taiwan can implement the required risk management measures, and the system of operational procedures necessary to maintain and verify the phytosanitary status of imported pineapples. This will include satisfactory demonstration that an appropriate traceability system is in place. The department also reserves the right to audit the system at any time. It is considered that these requirements will ensure pineapples imported into Australia from Taiwan are produced and sourced only from registered commercial export farms located in Taiwan.

Other issues

The department has made a number of changes to the risk analysis following consideration of stakeholder comments on the draft report, and from its continual review of the literature. These include:

- amendments to the text in the production practices section of the report (Chapter 3) to provide further clarity on the processes for removing the basal leaves, crown and stem material of pineapples;
- amendments to the text in the pest risk management section of the report (Chapter 5) to clarify that the proposed risk mitigation measure of methyl bromide fumigation is to be conducted in Taiwan, prior to export to Australia (i.e. pre-export fumigation);
- amendments to the pest risk management section (Chapter 5) to include requirements for containers and to include a hyperlink to information on packaging requirements;
- updates to the glossary to include additional terms used in the report, and

- minor corrections, rewording and editorial changes for consistency, clarity and web-accessibility.

Glossary

Term or abbreviation	Definition
Additional declaration	A statement that is required by an importing country to be entered on a phytosanitary certificate and which provides specific additional information on a consignment in relation to regulated pests (FAO 2019b).
AFA	Agriculture and Food Agency. Taiwan's agency responsible for registration of export farms and packhouses as well as coordination of domestic production.
Agvet chemical	Agricultural and veterinary chemical.
Appropriate level of protection (ALOP)	The level of protection deemed appropriate by the Member establishing a sanitary or phytosanitary measure to protect human, animal or plant life or health within its territory (WTO 1995).
Appropriate level of protection (ALOP) for Australia	The *Biosecurity Act 2015* defines the appropriate level of protection (or ALOP) for Australia as a high level of sanitary and phytosanitary protection aimed at reducing biosecurity risks to very low, but not to zero.
Area	An officially defined country, part of a country or all or parts of several countries (FAO 2019b).
Arthropod	The largest phylum of animals, including the insects, arachnids and crustaceans.
Asexual reproduction	The development of new individual from a single cell or group of cells in the absence of meiosis.
Australian territory	Australian territory as referenced in the *Biosecurity Act 2015* refers to Australia, Christmas Island and Cocos (Keeling) Islands.
BAPHIQ	Bureau of Animal and Plant Health Inspection and Quarantine. Taiwan's agency responsible for registration of treatment facilities and all issues pertaining to biosecurity.
Basal leaves	Leaves associated with the peduncle, located directly beneath the fruit.
Biosecurity	The prevention of the entry, establishment or spread of unwanted pests and infectious disease agents to protect human, animal or plant health or life, and the environment.
Biosecurity measures	The *Biosecurity Act 2015* defines biosecurity measures as measures to manage any of the following: biosecurity risk, the risk of contagion of a listed human disease, the risk of listed human diseases entering, emerging, establishing themselves or spreading in Australian territory, and biosecurity emergencies and human biosecurity emergencies.
Biosecurity import risk analysis (BIRA)	The *Biosecurity Act 2015* defines a BIRA as an evaluation of the level of biosecurity risk associated with particular goods, or a particular class of goods, that may be imported, or proposed to be imported, into Australian territory, including, if necessary, the identification of conditions that must be met to manage the level of biosecurity risk associated with the goods, or the class of goods, to a level that achieves the ALOP for Australia. The risk analysis process is regulated under legislation.
Biosecurity risk	The *Biosecurity Act 2015* refers to biosecurity risk as the likelihood of a disease or pest entering, establishing or spreading in Australian territory, and the potential for the disease or pest causing harm to human, animal or plant health, the environment, economic or community activities.
Consignment	A quantity of plants, plant products or other articles being moved from one area to another and covered, when required, by a single phytosanitary certificate (a consignment may be composed of one or more commodities or lots) (FAO 2019b).
Contaminating pest	A pest that is carried by a commodity and, in the case of plants and plant products, does not infest those plants or plant products (FAO 2019b).
Control (of a pest)	Suppression, containment or eradication of a pest population (FAO 2019b).
Crawler	Intermediate mobile nymph stage of certain Arthropods.

Term or abbreviation	Definition
Crown	All vegetative plant material located above the pineapple fruit.
Cultivar	A cultivated variety; an assemblage of cultivated individuals distinguished by any characters significant for the purposes of agriculture, forestry or horticulture, and which, when reproduced, retains its distinguishing features (Western Australian Herbarium 2018).
Diapause	Period of suspended development/growth occurring in some insects, in which metabolism is decreased.
The department	The Department of Agriculture.
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 2019b).
Endemic	Belonging to, native to, or prevalent in a particular geography, area or environment.
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 2019b).
Establishment (of a pest)	Perpetuation, for the foreseeable future, of a pest within an area after entry (FAO 2019b).
Farm	A contiguous area of pineapple plants operated as a single entity. Within this report, a single farm is covered under one registration and is issued a unique identifying number.
Fresh	Living; not dried, deep-frozen or otherwise conserved (FAO 2019b).
Fumigation	A method of pest control that completely fills an area with gaseous pesticides to suffocate or poison the pests within.
Genus	A taxonomic category ranking below a family and above a species and generally consisting of a group of species exhibiting similar characteristics. In taxonomic nomenclature the genus name is used, either alone or followed by a Latin adjective or epithet, to form the name of a species.
Goods	The *Biosecurity Act 2015* defines goods as an animal, a plant (whether moveable or not), a sample or specimen of a disease agent, a pest, mail or any other article, substance or thing (including, but not limited to, any kind of moveable property).
Host	An organism that harbours a parasite, mutual partner, or commensal partner, typically providing nourishment and shelter.
Host range	Species capable, under natural conditions, of sustaining a specific pest or other organism (FAO 2019b).
Import permit	Official document authorising importation of a commodity in accordance with specified phytosanitary import requirements (FAO 2019b).
Infection	The internal 'endophytic' colonisation of a plant, or plant organ, and is generally associated with the development of disease symptoms as the integrity of cells and/or biological processes are disrupted.
Infestation (of a commodity)	Presence in a commodity of a living pest of the plant or plant product concerned. Infestation includes infection (FAO 2019b).
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 2019b).
Intended use	Declared purpose for which plants, plant products, or other regulated articles are imported, produced or used (FAO 2019b).
Interception (of a pest)	The detection of a pest during inspection or testing of an imported consignment (FAO 2019b).
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

Term or abbreviation	Definition
	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 2019b).
Introduction (of a pest)	The entry of a pest resulting in its establishment (FAO 2019b).
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 2019b). 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.
Mature fruit	Commercial maturity is the start of the ripening process. The ripening process will then continue and provide a product that is consumer-acceptable. Maturity assessments include colour, starch, index, soluble solids content, flesh firmness, acidity, and ethylene production rate.
Non-regulated risk analysis	Refers to the process for conducting a risk analysis that is not regulated under legislation (Department of Agriculture and Water Resources 2016a).
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 2019b).
Pathogen	A biological agent that can cause disease to its host.
Pathway	Any means that allows the entry or spread of a pest (FAO 2019b).
Pest	Any species, strain or biotype of plant, animal, or pathogenic agent injurious to plants or plant products (FAO 2019b).
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 2019b).
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 2019b).
Pest risk assessment (for quarantine pests)	Evaluation of the probability of the introduction and spread of a pest and of the magnitude of the associated potential economic consequences (FAO 2019b).
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 2019b).
Pest risk management (for quarantine pests)	Evaluation and selection of options to reduce the risk of introduction and spread of a pest (FAO 2019b).
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 2019b).
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 2019b).

Term or abbreviation	Definition
Phytosanitary certificate	An official paper document or its official electronic equivalent, consistent with the model of certificates of the IPPC, attesting that a consignment meets phytosanitary import requirements (FAO 2019b).
Phytosanitary certification	Use of phytosanitary procedures leading to the issue of a phytosanitary certificate (FAO 2019b).
Phytosanitary measure	Phytosanitary relates to the health of plants. Any legislation, regulation or official procedure having the purpose to prevent the introduction and/or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests (FAO 2019b). 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 2019b).
Phytosanitary regulation	Official rule to prevent the introduction and/or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests, including establishment of procedures for phytosanitary certification (FAO 2019b).
Polyphagous	Feeding on a relatively large number of hosts from different plant family and/or genera.
PRA area	Area in relation to which a pest risk analysis is conducted (FAO 2019b).
Practically free	Of a consignment, field or place of production, without pests (or a specific pests) in numbers or quantities in excess of those that can be expected to result from, and be consistent with good cultural and handling practices employed in the production and marketing of the commodity (FAO 2019b).
Production site	In this report, a production site is a continuous planting of pineapple plants treated as a single unit for pest management purposes. If a farm is subdivided into one or more units for pest management purposes, then each unit is a production site. If the farm is not subdivided, then it is also the production site.
Pupa	An inactive life stage that only occurs in insects that undergo complete metamorphosis, for example butterflies and moths (Lepidoptera), beetles (Coleoptera) and bees, wasps and ants (Hymenoptera).
Quarantine	Official confinement of regulated articles for observation and research or for further inspection, testing or treatment (FAO 2019b).
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 2019b).
Regulated article	Any plant, plant product, storage place, packaging, conveyance, container, soil and any other organism, object or material capable of harbouring or spreading pests, deemed to require phytosanitary measures, particularly where international transportation is involved (FAO 2019b).
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 2019b).
Regulated pest	A quarantine pest or a regulated non-quarantine pest (FAO 2019b).
Restricted risk	Restricted risk is the risk estimate when risk management measures are applied.
Risk analysis	Refers to the technical or scientific process for assessing the level of biosecurity risk associated with the goods, or the class of goods, and if necessary, the identification of conditions that must be met to manage the level of biosecurity risk associated with the goods, or class of goods to a level that achieves the ALOP for Australia.
Risk management measure	Are conditions that must be met to manage the level of biosecurity risk associated with the goods or the class of goods, to a level that achieves the

Term or abbreviation	Definition
	ALOP for Australia. In this risk analysis, the term 'risk management measure' and 'phytosanitary measure' may be used interchangeably.
Spread (of a pest)	Expansion of the geographical distribution of a pest within an area (FAO 2019b).
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 occurrence or absence by surveying, monitoring or other procedures (FAO 2019b).
Systems approach(es)	The integration of different risk management measures, at least two of which act independently, and which cumulatively achieve the appropriate level of protection against regulated pests.
Trash	Soil, splinters, twigs, leaves and other plant material, other than fruit as defined in the scope of this risk analysis. For example, stem and leaf material, seeds, soil, animal matter/parts or other extraneous material
Treatment	Official procedure for the killing, inactivation or removal of pests, or for rendering pests infertile or for devitalisation (FAO 2019b).
Unrestricted risk	Unrestricted risk estimates apply in the absence of risk management measures.
Vector	An organism that does not cause disease itself, but which causes infection by conveying pathogens from one host to another.
Viable	Alive, able to germinate or capable of growth.

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