Ministry for Primary Industries
Manatū Ahu Matua

# *Import risk analysis:* Fresh Rambutan from Vietnam

Version 1.0
30 September 2016

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New Zealand Government

Growing and Protecting New Zealand

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Import Risk Analysis: fresh rambutan from Vietnam

Version 1.0

30 September 2016

Approved for general release

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## Version information

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New Zealand is a member of the World Trade Organisation and a signatory to the Agreement on the Application of Sanitary and Phytosanitary Measures ("The Agreement"). Under the Agreement, countries must base their measures on an International Standard or an assessment of the biological risks to plant, animal or human health.

This document provides a scientific analysis of the risks associated with pests and diseases on fresh rambutan from Vietnam. It assesses the likelihood of entry, exposure, establishment and spread of pests and diseases in relation to imported rambutan from Vietnam and assesses the potential impacts of those organisms should they enter and establish in New Zealand. The document has been internally peer reviewed and has been prepared using material from a USDA risk assessment, and existing, internally & externally peer-reviewed MPI risk assessments. It is now released publicly. Any significant new science information received that may alter the level of assessed risk will be included in a review, and an updated version released.

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The following people provided significant input into the development of this risk analysis:

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# Contents Page

## Tables                                                                                                    Page



## Figures                                                                                                    Page

# Executive summary

**Purpose**
The purpose of this Import Risk Analysis (IRA) is to identify the biosecurity risks associated with the importation into New Zealand of fresh rambutan fruit from Vietnam

**Background**
This IRA was initiated by a new market access request for the importation of fresh rambutan (*Nephelium lappaceum*, Sapindaceae) fruit for consumption to New Zealand from Vietnam.

The commodity is defined as: "commercially produced, harvested *Nephelium lappaceum* fruit with skin. The commodity may include a short stem but excludes flowers and leaves. The rambutan (fruit) is single-seeded round to oval fruit between 3-6 cm long with reddish leathery peel covered with fleshy spines and firm whitish flesh".

Rambutan is produced in export- and GAP-registered orchards in the tropical southern provinces of Vietnam, utilising integrated pest management and integrated cultural management of some specific pests. There is some variation in practices between orchards. These practices are expected to reduce the level of pests in orchards, but not completely eliminate their association with commercially produced fruit.

The risks associated with rambutan from Vietnam have previously been assessed for the PRA area of USA. This IRA documents the adaptation of the USA risk analysis for the PRA area of New Zealand. Specifically, the USA hazard table was adapted, and additional pest risk assessments were done. This IRA does not propose risk management options nor include an analysis of efficacy of potential risk management options.

**Results of the hazard identification process**
The hazard identification process identified 34 organisms considered to be hazard organisms, i.e. associated with rambutan fruit, known from Vietnam, absent from New Zealand (or known from New Zealand but the organism can vector exotic plant pathogens). The 34 hazard organisms included:

- One mite (*Eutetranychus orientalis*)
- One fruit fly (*Bactrocera dorsalis*)
- 25 Hempitera [2 hard scales (*Aulacaspis tubercularis, Unaspis citri*), 5 soft-scales, 16 mealy bugs, 2 stinkbugs (*Tessaratoma javanica, Tessaratoma papillosa*)]
- Two thrips (*Thrips hawaiiensis, Scirtothrips dorsalis*)
- Two ants (*Oecophylla smaragdina, Technomyrmex albipes*)

**The risk assessment process and considerations**
The risk has been assessed on the basis that the baseline risk management of rambutan from Vietnam includes commercial practices for removal of pests detected during the harvesting, handling, cleaning and packaging of fruit for export. The risk has been assessed on the basis that the baseline risk management excludes exposure of fruit to irradiation, fumigation or temperature treatments.

MPI has previously done pest risk assessments of the 34 identified hazard organisms (or closely related organisms) for other importation pathways. As those assessments are for different commodity pathways the risk conclusions are not directly applicable to rambutan from Vietnam. However, they contained applicable biological data and the assessments of risk provided a basis to enable rapid pest risk assessment for this new importation pathway. The risk assessments in this document avoid duplicating sections of hazard identification and biological data that are recorded elsewhere. Rather, they focus on analysis analysis of the key steps in the risk pathway factors: likelihood of entry, exposure and establishment (i.e. introduction) and likely consequences of establishment; specifically for rambutan from Vietnam.

**Risk assessment**

The findings of the pest risk assessments are summarised in Table 1 below. Key points are:

- Seven of the 34 hazard organisms are considered to be negligible risks on rambutan from Vietnam.
- The other 27 organisms are considered to be non-negligible risks and include: mealybugs and soft-scales as risk groups, the stink bug *Tessaratoma papillosa*, the mite *Eutetranychus orientalis*, and the thrips *Scirtothrips dorsalis,* the fruit fly *Bactrocera dorsalis,* and the moths *Conogethes punctiferalis* and *Cryptophlebia ombrodelta*.
- The pests considered to present the highest risk are the fruit fly *Bactrocera dorsalis*, and the moths *Conogethes punctiferalis* and *Cryptophlebia ombrodelta*. Each of these pests have potential to cause moderate or high economic consequences; and they can each have life-stages occuring inside rambutan fruit, which makes them difficult to detect during the harvesting, handling, cleaning and packaging of fruit for export, leading to a high likelihood of entering New Zealand on this pathway.

## Table 1 Summary of risk assessment outputs

| Pest type | Organism assessed | Risk estimation | Entry | Exposure | Establishment | Spread | Economic | Environmental | Sociocultural | Human health |
|---|---|---|---|---|---|---|---|---|---|---|
| | | ISPM 11 Terminology: | Probability of Introduction ("Introduction" encompasses entry, exposure and establishment) | | | Probability of spread | Economic consequences (economic, environmental and social effects) | | | Not applicable |
| Fruit flly | *Bactrocera dorsalis* | Non-negligible | High | Low | Mod-High (seasonal populations) | ND | High | ND | ND | ND |
| Internal feeding moths | *Conogethes punctiferalis* | Non-negligible | High | Low | Moderate | ND | Moderate | ND | ND | ND |
| | *Cryptophlebia ombrodelta* | Non-negligible | High | Low | Low- | ND | Low - Moderate | ND | ND | ND |
| | *Conopomorpha cramerella* | Negligible | High | Negligible | - | - | - | - | - | - |
| Thrips | *Thrips hawaiiensis* | Negligible | Negligible | - | - | - | - | - | - | - |
| | *Scirtothrips dorsalis* | Non-negligible | Moderate | Low | Low (outdoors) Moderate (indoors) | ND | Low | Low | Low | Low |
| Mites | *Eutetranychus orientalis* | Non-negligible | Low- mod | Low | low | - | Low | - | - | - |
| Stinkbugs | *Tessaratoma javanica* | Negligible | Low | Negligible | - | - | - | - | - | - |
| | *Tessaratoma papillosa* | Non-negligible | Low | Low | Low | ND | Low | ND | ND | ND |
| Mealybugs, armoured-scale & soft-scale insects | Aulacaspis tubercularis (hard-scale) | Negligible | Low | Negligible | - | - | - | - | - | - |
| | Unaspis citri | Negligible | Moderate | Negligible | - | - | - | - | - | - |
| | Mealybugs (16 species) [1] | Non-negligible | Low-Moderate | Negligible - Low | Low-Moderate | ND | Low - Moderate | ND | ND | ND |
| | Soft-scales (5 species) [2] | Non-negligible | Low-Moderate | Negligible - Low | Low-Moderate | ND | Low - Moderate | ND | ND | ND |
| Hitchhikers (Ants) | *Oecophylla smaragdina* | Negligible | Low | Moderate | Very low | - | - | - | - | - |
| | *Technomyrmex albipes* | Negligible | Very low | Moderate | Very low | - | - | - | - | - |

Pests highlighted with pink shading are considered to be non-negligible risks on rambutan from Vietnam.

ND = not determined; [-] = assessment stopped

1 Mealybug species included in the assessment are: *Dysmicoccus brevipes, D. neobrevipes, Exallomochlus hispidus, Ferrisia virgata, Maconellicoccus hirsutus, Nipaecoccis viridis, Paracoccus interceptus, Phenacoccus madeirensis, Planococcus lilacinus, P. litchi, P. minor, Pseudococcus aurantiacus, P. comstocki, P. cryptus, P. jackbeardsleyi, Rastrococcus tropicasiaticus*

2 Soft-scale species included in the assessment are: *Ceroplastes floridensis, Ceroplastes rubens, Ceroplastes rusci, Coccus viridis, Drepanococcus chiton*

# 1 Risk analysis background and process

## 1.1 Background

This risk analysis has been developed in response to a market access request from the government of Vietnam for fresh rambutan fruit (*Nephelium lappaceum*, Sapindaceae).

The risks associated with fresh rambutan fruit from Vietnam have been assessed previously, albeit for a different Pest Risk Analysis (PRA) area, the continental United States of America (USDA-PERAL 2011). That risk analysis was the starting point for MPI's risk analysis of the pathway:

- Firstly, the American analysis was reviewed and assessed to determine a) its applicability to the New Zealand situation, and b) whether there were any gaps in the risk analysis.
- In that initial review and assessment it was established that the American analysis included a hazard identification which was sufficiently comprehensive that it could be readily adapted to the New Zealand situation. However, the pest risk assessment component was not directly applicable because it was based on rambutan fruit that had undergone a generic irradiation treatment (at 400 Gy). This is in contrast to the MPI risk analysis process that is usually based on fruit having had no specific treatment. Consequently the American risk assessment did not adequately address the risks relevant to New Zealand.
- Having identified that the American analysis lacked pest risk assessments relevant to the the specific pathway of rambutan from Vietnam to New Zealand, additional risk assessment was done by MPI (this document). Most of the pests that required pest risk assessment have been previously assessed by MPI on other commodities and pathways. Consequently, relevant data and conclusions from those other works have been used in this risk assessment. A fit-for-purpose philosophy has been adopted in assessing and communicating each pest risk. This has resulted in the presentation of the pest risk assessments being modified for this risk assessment.

## 1.2 Scope of this risk analysis

This risk analysis covers the importation of fresh rambutan fruit cultivated in Vietnam.

The risk analysis is qualitative. The scope of this analysis:

- Includes identification of hazard organisms associated with fresh rambutan fruit
- Includes assessment of the risks: this includes likelihoods of entry, exposure, and establishment of hazard organisms (i.e. each of the steps that are required to lead to introduction of an organism); and the likely consequences of the hazard organisms establishing a population in New Zealand.
- Does not include identification of risk management options
- Does not include assessment of efficacy of risk management options

## 1.3 Overview of the risk analysis process

The MPI framework for undertaking a risk analysis builds on the existing international framework of the International Plant Protection Convention (IPPC), and extends the scope under the SPS Agreement[3] to include all of the values required by the Biosecurity Act (1993). The following briefly describes the New Zealand Ministry for Primary Industries process and methodology for undertaking import risk analyses. For a more detailed description of the process and methodology please refer to the Biosecurity New Zealand Risk Analysis Procedures (Version 1 12 April 2006) which is available on the Ministry for Primary Industries web site (MAF, 2006).

The risk analysis process leading to the final risk analysis document is summarised in Figure 1.

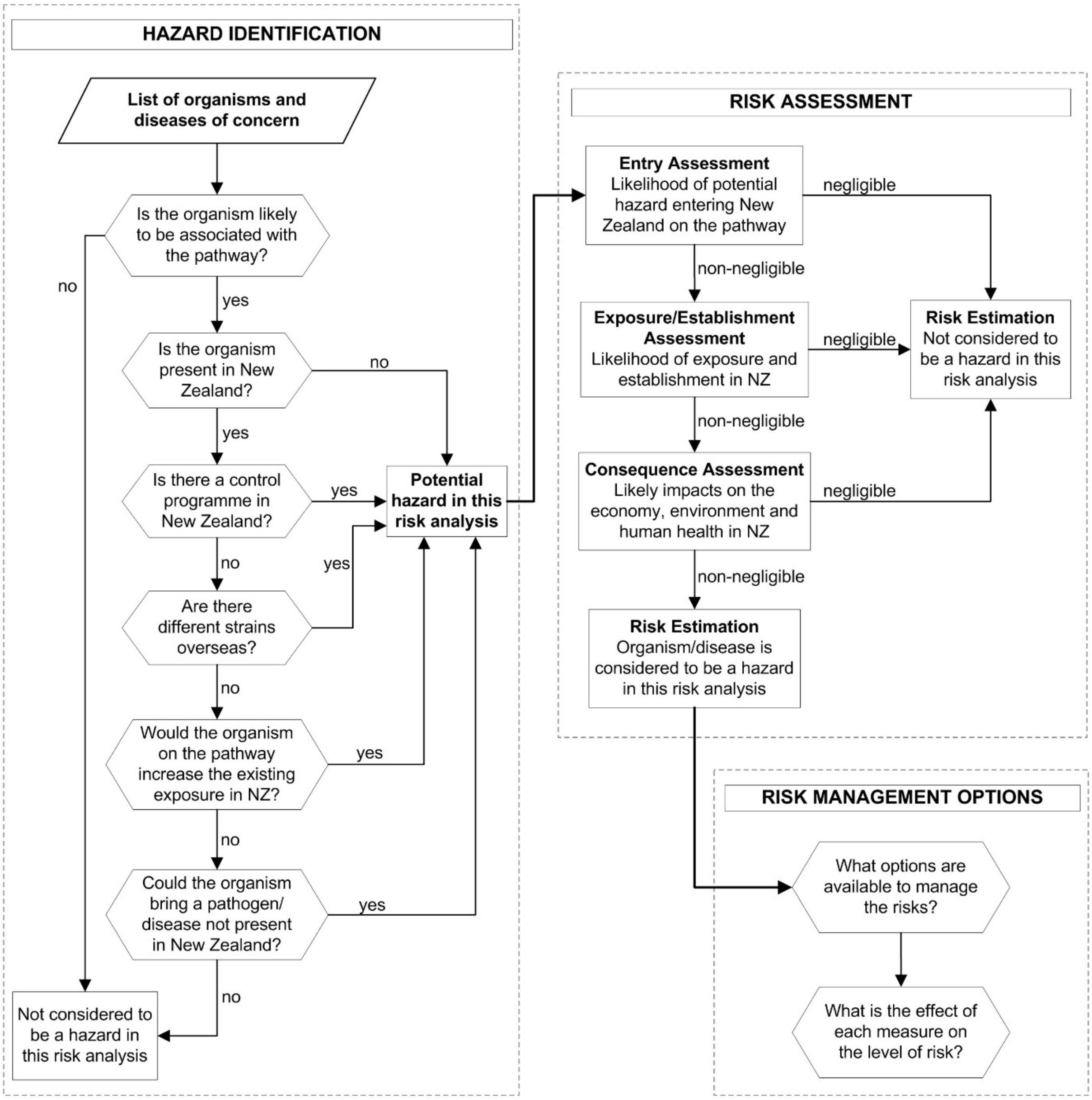


Figure 1 Diagrammatic representation of the risk analysis process

The process outlined in Figure 1 is further supported by additional information in Appendix 4.

This analysis has been subject to internal peer review. Additional external peer review of this document has not been undertaken because the MPI source documents have previously been externally peer reviewed.

3 SPS Agreement means the World Trade Organisation Agreement on the Application of Sanitary and Phytosanitary Measures

# References for Chapter 1

MAF (2006) Biosecurity New Zealand risk analysis procedures. Ministry of Agriculture and Forestry, New Zealand, 201 pp. Available online at http://www.biosecurity.govt.nz/files/pests-diseases/surveillance-review/risk-analysis-procedures.pdf

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# 2 Commodity and pathway description

## 2.1 Commodity description

For the purposes of this risk assessment "fresh rambutan for consumption" is defined as **commercially-produced, harvested *Nephelium lappaceum* fruit with skin. The commodity may include a short stem but excludes flowers and leaves. The rambutan (fruit) is single-seeded round to oval fruit between 3-6 cm long with reddish leathery peel covered with fleshy spines and firm whitish flesh".** Fruit arrive in New Zealand as individual pieces of fruit rather than attached to others (via the stems) within a bunch. Several individual pieces of fruit would be packaged together prior to export from Vietnam.

**Taxonomy**

| | |
|---|---|
| Scientific name: | *Nephelium lappaceum* L. |
| Other relevant scientific names: | *Nephelium glabrum* Noronh, *N. chryseum* Blume, *N. sufferrugineum* Radlk |
| Family: | Sapindaceae |
| Common names: | Rambutan, Chom Chom |

## 2.2 Rambutan biology relevant to this risk assessment

- In some areas, rambutan trees bear fruit twice annually. In southern Asia, fruits are harvested during July and September, the main fruiting season. Fruits are also harvested from December to February if the trees have fruit twice in the one year (Fruitipedia 2015).
- Flowering may occur over a period of 23-38 days depending on the cultivar. Fruits may be produced in large bunches, with 40-60 fruits per panicle, but most often only 12-13 fruits per panicle are retained to maturity. The time required from fruit set to harvest is about 105-115 days (Orwa et al 2009).
- Based on this information it is concluded that flowers do not occur when fruit is ready for harvest.
- Rambutan ripens only on the tree. The fresh fruit is fragile and easily bruised, and so has a limited shelf life. Ordinarily, the fruits must be delivered to markets within three days of harvesting before shrivelling and decay begins. Fungicidal applications and packing in perforated polyethylene bags have extended fresh life somewhat, and storage at 10°C and 95% humidity has preserved the fruits in fresh conditions for 12 days. Some cultivars keep better than others (Morton 1987).

## 2.3 Pathway description

In broad terms, the importation pathway involves commercial production of rambutan in Vietnam, post-harvest handling, packaging, application of any phytosanitary measures required by New Zealand (these are not yet determined; they will be determined in the IHS development process, and are not taken into consideration for the risk assessment) and official phytosanitary inspection in Vietnam (requirements of which are not yet determined and are not taken into consideration for the risk assessment), followed by transportation to New Zealand in insect-proof packaging. Upon arrival at a New Zealand port of entry, MPI quarantine inspectors provide border-clearance if the consignment meets the requirements set out in the import health standard (details of which are not yet determined). The fruit will then be transported throughout New Zealand to fruit retailers, purchased by consumers who will then consume the fleshy part of the fruit, and dispose of the fruit-peel and seed (and a small proportion of fleshy parts and whole fruits) into landfill, compost or into the environment. As the fruit peel and seed are not consumed, there is unavoidable waste from this commodity that will enter waste disposal pathways in New Zealand.

**Seasons of arrival into New Zealand:**

- winter and early spring (July – September), and
- summer (December – February).

It is assumed that the majority of fresh rambutan fruit from Vietnam would be arriving during the New Zealand winter through to early spring (July – September), because these are the months which comprise the main fruiting season in South East Asia (Fruitipedia 2015). However, as some rambutan trees have a second fruiting from December to February (Fruitipedia 2015), it is assumed that fresh rambutan fruit from Vietnam will also arrive during the New Zealand summer.

### 2.3.1 Baseline risk management on fresh rambutan fruit from Vietnam

For the purposes of the risk assessment, the risk to New Zealand of pests associated with rambutan from Vietnam is assessed on the basis that a certain baseline of risk management exists for all fresh rambutan fruit exported from Vietnam to New Zealand. A key point to note is that whilst MPI does not include specific treatments (e.g. irradiation, heat treatment or fumigation) when defining the baseline risk management of rambutan from Vietnam, the USDA risk analysis does include generic irradiation at 400 Gy. The implications for the relevance of the USDA risk assessment are mentioned in Section 2.3.2.

**Included** in MPI's baseline risk management of fresh rambutan fruit from Vietnam (for the purpose of risk assessment) is:

- Commercial production and post-harvest activities; integrated pest management, and integrated commodity management. This involves practices observed by MPI (MPI 2014) and/or described by the Vietnamese Ministry of Agriculture and Rural Development, Plant Protection Department (MARD PPD, 2014) as follows:
    - Rambutan is produced in export- and GAP[4]-registered orchards in Vietnam. Specific pests are managed chemically and/or culturally (which may include fruit-bagging three weeks prior to harvest) during production, but there is variation between orchards. *These practices are expected to reduce the level of pests in orchards, but not completely eliminate their association with commercially produced fruit.*
    - Fruit is harvested and transported to pack houses in polystyrene bins to prevent re-infestation.
    - Fruit undergoes an initial sorting process before manual cleaning. Most fruit would have had the stem removed before manual cleaning.

[4] GAP = Good Agricultural Practices. Note that this generally has no specific impact on pest management occurring in orchards. The focus of GAP programmes is generally on food safety elements. See https://www.ams.usda.gov/services/auditing/gap-ghp.

- Each individual fruit is cleaned after it has been separated from the bunch it was attached to. Fruit is manually cleaned, quality checked and weighed. This process is expected to result in visible pests being identified and removed (or infested fruit being discarded). The complex architecture of rambutan fruit created by the spines present on the skin/peel is likely to make overall efficacy of pest identification lower than the efficacy that might be achieved with simple-structured fruit. In particular, insects or insect life-stages that are very small or are reddish in colour are likely to be very difficult to detect during cleaning and checking of fruit.
- The pack-house has insect zappers and plastic curtain sheeting which separates different operational activity areas.
- Fruit is packed in pest-proof boxes, and loaded in a secure area.

**Excluded** from MPI's baseline risk management of fresh rambutan fruit from Vietnam, (for the purpose of risk assessment), is:

- Irradiation, or heat treatment, or fumigation of fruit, i.e. pest risk is assessed on the basis that neither irradiation, nor heat treatment nor fumigation of fruit has occurred.
- Phytosanitary inspection of the commodity by the Vietnamese NPPO.
- Phytosanitary inspection of the commodity in New Zealand upon arrival at ports of entry.

### 2.3.2 Implications of MPI and USDA baselines of risk management

MPI and USDA use different baselines of risk management when undertaking risk assessment of rambutan from Vietnam. Specifially, USDA includes irradiation at 400 Gy, whereas New Zealand does not include any irradiation. When the USDA took into account the irradiation of rambutan, they concluded that the only remaining unmanaged risk on rambutan from ASEAN countries was the fungus *Oidium nephelii*. Consequently, this is the only rambutan pest that they did a pest risk assessment for, and not relevant to the New Zealand PRA area. Additional pest risk assessment was required by MPI (this document).

## 2.4 Climate in the rambutan production areas of Vietnam

Rambutan production occurs in South Vietnam, mainly in the following provinces: Dong Nai, Binh Duong, Baria Vungtau, Tien Giang, Ben Tre, Vinh Long, Tra Vinh and Can Tho (Ho Dinh Hai 2016). South Vietnam has a tropical climate all year round, with hot, humid conditions. The wet season is from May to November with June to August registering the highest rainfall figures. Temperatures average around 25-30°C all year round with the hottest and most humid period being from the end of February to May (Vietnam Travel Guide 2016).

## 2.5 There is no rambutan industry in New Zealand

The climate in New Zealand is considered unsuitable for growing rambutan, which is strictly a tropical fruit requiring a moist warm climate with a well distributed annual rainfall of at least 200cm (Fruitipedia 2015; Dixon 2015). There is no rambutan production in New Zealand.

## 2.6 New Zealand climate

**General**
New Zealand is situated in the South Pacific and ranges from 34˚ 00’ S and 166˚ 00’ E to 48˚ 00’ S and 179˚ 00’E. It has a maritime climate which varies from warm subtropical in the far north to cool temperate in the far south, with severe alpine conditions in the mountainous areas. Mountain chains extending the length of New Zealand’s South Island provide a barrier for the prevailing westerly winds, dividing the country into two separate climatic regions. The West Coast of the South Island is the wettest and the area to the east of the mountains, just over 100 km away, is the driest (NIWA 2007).

Annual rainfall in most parts of the country is between 600 and 1600 mm, with a dry period during the summer. At four locations on the west coast of the South Island (Westport, Hokitika, Mt Cook and Milford Sound) mean annual rainfall was between 2200 mm and 6800 mm for the period 1971-2000 (NIWA 2007). Rainfall is higher in winter than summer in the northern and central areas of New Zealand, whereas for much of southern New Zealand rainfall is lowest in winter. Mean annual temperatures range from 10°C in the south to 16°C in the north. The coldest month is usually July, and the warmest month usually January or February. Inland and to the east of the ranges the variation between summer and winter temperatures is up to 14°C. Temperatures also drop about 0.7°C for every 100 m of altitude (NIWA 2007).

Sunshine hours are relatively high in places sheltered from the west and most of New Zealand would have at least 2000 hours annually. Most snow falls in the mountain areas. Snow rarely falls at the coast of the North Island and west of the South Island, although the east and south coasts of the South Island may experience some snow in winter. Frosts can occur anywhere, and usually form on cold nights with clear skies and little wind (NIWA 2007).

**The northern North Island**
The northern part of New Zealand is the most climatically suitable for the establishment of new pests and pathogens coming from a tropical climate such as Vietnam’s rambutan growing regions. However, organisms vary in their climatic tolerances and ability to adapt, so other areas of New Zealand cannot be completely excluded as having potentially suitable climates for pests of tropical origin.

The northern North Island includes Kaitaia, Kerikeri, Whangarei, Auckland (New Zealand’s largest city), and Tauranga (see figure 5 for map of regions). The latter two cities both contain large active sea ports. Kerikeri is a well known orcharding town with many varieties of *Citrus* fruit grown there. Avocado, kumara, olives, macadamia and tamarillos are the other main crops grown there (HortNZ and Plant & Food Research 2012). This is a sub-tropical zone, with warm humid summers and mild winters. Typical summer daytime maximum air temperatures range from 22˚C to 26˚C, but seldom exceed 30˚C. Winter daytime maximum air temperatures range from 12˚C to 17˚C (NIWA 2007).

The Auckland region produces a variety of crops including *Citrus* species such as mandarins and lemons, strawberries, herbs, brassicas, carrots, chestnuts, greenhouse crops, lettuce, macadamias, olives, onions, pumpkin and wine grapes (HortNZ and Plant & Food Research 2012). Auckland has the highest rate of naturalised plants of any city in New Zealand. The prime reasons for the high numbers of plant species are considered to be the moderate climate favouring species from many climatic zones, and availability of habitats (Esler 1988).

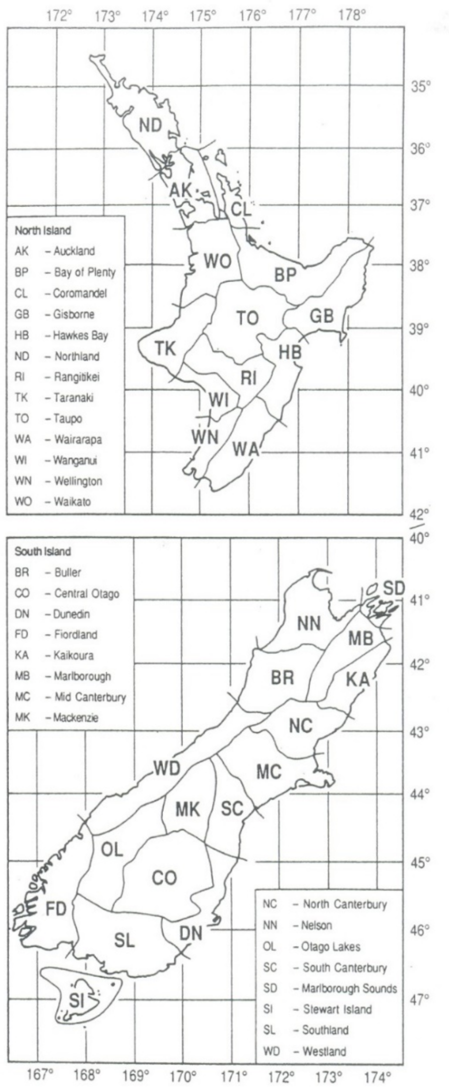
Auckland also has the largest population in the country, with the greatest influx of incoming goods and people and contains the largest sea and air ports. Therefore it is likely to be one of the first places risk organisms could establish.

The Bay of Plenty, Gisborne and Hawkes Bay regions may also have suitable climates for some pests of Vietnamese origin. Considered together, these regions produce asparagus, avocados, citrus (lemons, mandarins, oranges, tangelos), feijoas, kiwifruit, melon, olives, peas, persimmons, pip fruit (apples, pears), pumpkin, stone fruit (apricots, plums, nectarines, peaches), squash, sweet corn (maize), tomatoes, and wine grapes (HortNZ and Plant & Food Research 2012).

### 2.6.1 Map of New Zealand

The following map (Figure 2) is used here to give the reader an idea of the location of some of the regions and their corresponding latitudes and longitudes mentioned in this document. The Crosby Codes were not used in this risk analysis as full names are considered easier to read.

Figure 2 Map of New Zealand portraying Crosby Codes for New Zealand and presenting latitudes/longitudes (from Fauna of NZ Series)



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# 3 Hazard identification for fresh rambutan fruit from Vietnam

Appendix 1 summarises some key evidence of the hazard analysis and the hazard-status conclusions. The organisms in the shaded rows are considered by MPI to be hazards[5] on fresh rambutan fruit imported from Vietnam into New Zealand, and have been collated into the table in Section 3.2. Organisms were considered to be a hazard if they met all of the following criteria:

- absent from New Zealand OR present in New Zealand but are vectors of micro-organisms (e.g. virus, fungi, bacteria); AND
- recorded from Vietnam; AND
- recorded to have an association with the rambutan plant; AND
- recorded to be associated with fruit; AND
- have potential to establish in New Zealand and cause unwanted impacts.

## 3.1 Adaptation of a USA hazard analysis for the New Zealand situation

The main source of data underpinning the analysis of organism hazard-status was the United States Department of Agriculture risk assessment, entitled "Importation of Fresh Fruit of Litchi (*Litchi chinensis*), Longan (*Dimocarpus longan*), and Rambutan (*Nephelium lappaceum*) into the Continental United States from ASEAN Countries" (PERAL-USDA 2011).

PERAL-USDA (2011) recorded the hazard-status of each organism for the PRA area of the USA, rather than for New Zealand; and in relation to the USA's regulatory status of the organisms rather than New Zealand's regulatory status. This meant that the hazard analysis had to be adapted for New Zealand. Specifically, a) the list of organisms assessed for hazard status in New Zealand was derived from Table 5 in PERAL-USDA (2011); and b) some further analysis and data collection was required to determine whether the organisms were hazards for New Zealand.

The USDA risk assessment was fully referenced, and the sources of information used were the same or similar to the sources MPI would routinely use. As such, in general the data included in the PERAL-USDA (2011) hazard identification was considered to be accurate. Consequently, it is the document cited as the source of evidence for the majority of organisms assessed by MPI, for the following categories:

- organism presence in Vietnam,
- organism association with the rambutan plant (*Nephelium lappaceum*), and
- organism association with rambutan fruit.

Where gaps in the American analysis were identified other data sources were used, as explained below.

The process of adapting the American analysis for the PRA area of New Zealand involved the following steps:

5 The term 'hazard' used here has a specific meaning within the framework of pest risk analysis at MPI. In accordance with the MPI risk analysis procedures the term 'hazard' is equivalent to the ISPM11 definition: "has potential to be a quarantine pest", where 'quarantine pest' is defined by the IPPC as 'a pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled'.

1. Organisms that were reported in PERAL-USDA (2011) to be present in Vietnam AND associated with the rambutan plant were added to a draft list of organisms to be assessed for hazard status in New Zealand;
2. Organisms were considered to be non-hazards by MPI if they had no association with rambutan fruit. The PERAL-USDA (2011) conclusion about association of the organism with rambutan fruit was taken at face value.
3. The USDA policy about armoured scale insects (Diaspididae) is that they do not consider Diaspididae to be hazards requiring further risk analysis[6]. This is not consistent with MPI's usual approach. In this MPI hazard analysis, MPI concluded that Diaspididae are hazards and require further analysis.
4. Any organism which still had potential to be a hazard was assessed for presence/absence from New Zealand by looking at data in the standard authoritative sources e.g. MPI's PPIN database, Gordon (2010), the New Zealand Organisms Register (NZOR 2015) and Fungi NZ (2015). It was not necessary to analyse presence/absence in New Zealand if the organism had already been assessed as a non-hazard on the basis of other criteria.
5. Additional information was sought for some organisms that had incomplete datasets, e.g. organisms known to occur in the USA, but not known from New Zealand. If an organism was known to occur in the USA, PERAL-USDA (2011) considered it to be a non-hazard and their analysis often stopped, leaving an incomplete data set for 'presence in Vietnam' and/or 'association with rambutan fruit' for some organisms. If the organism was not known from New Zealand, one or both of the incomplete datasets had to be completed by MPI in order to reach a hazard-status conclusion for the PRA area of New Zealand.
6. A process was undertaken to verify (at random) the accuracy of some of the information in the USDA risk assessment and the validity of the USDA hazard conclusion. This included doing independent searches of published literature and information available via the search engines Google and Google Scholar; and on websites such as ScaleNet (Garcia et al 2015), CPC, and others. For instance, the pests of Rambutan mentioned by Janick (1994) were added to the list of potential hazard organisms, and cross-checked against the USDA list. Janick 1994 contained a list of Rambutan pests across a wide range of taxonomic groups, making it a good resource to use for cross-checking and comparison. This resulted in some additional pests being identified, added to the draft hazard list and assessed for hazard status.
7. The hazard identification analysis was peer-reviewed within MPI.

6 USDA consider that Diaspididae may enter on commercial fruit for consumption, but they are highly unlikely to become established via this pathway. Therefore they do not analyse Diaspididae further.

## 3.2 Hazard organisms requiring further assessment

These organisms are included for further assessment as they are considered to be hazards on fresh rambutan fruit from Vietnam for the PRA area of New Zealand. Refer to Appendix 1 for further details of the justification.

These organisms are considered to be ‘hazards’ because they have potential to be ‘quarantine pests’[7] as outlined in ISMP11: they are recorded as present in Vietnam, not known from New Zealand (or are regulated in New Zealand), recorded from rambutan plants, associated with fruit, and have potential to establish and have impact in New Zealand.

| | |
|---|---|
| Acari (Mites) | *Eutetranychus orientalis* |
| Diptera (Flies) | *Bactrocera dorsalis* |
| Hemiptera (aphids aphididea; bugs - pentatomidae, Lygaeidae, Miridae; mealybugs pseudococcidae; scales coccoidae & diaspididae; whiteflies Aleyrodidae; ) | *Aulacaspis tubercularis*<br>*Ceroplastes floridensis*<br>*Ceroplastes rubens*<br>*Ceroplastes rusci*<br>*Coccus viridis*<br>*Drepanococcus chiton*<br>*Dysmicoccus brevipes*<br>*Dysmicoccus neobrevipes*<br>*Exallomochlus hispidus*<br>*Ferrisia virgata*<br>*Maconellicoccus hirsutus*<br>*Nipaecoccus viridis*<br>*Paracoccus interceptus*<br>*Phenacoccus madeirensis*<br>*Planococcus lilacinus*<br>*Planococcus litchi*<br>*Planococcus minor*<br>*Pseudococcus aurantiacus*<br>*Pseudococcus comstocki*<br>*Pseudococcus cryptus*<br>*Pseudococcus jackbeardsleyi*<br>*Rastrococcus tropicasiaticus*<br>*Tessaratoma javanica*<br>*Tessaratoma papillosa*<br>*Unaspis citri* |
| Hymenoptera (sawflies, wasps, bees, ants) | *Oecophylla smaragdina*<br>*Technomyrmex albipes* |
| Lepidoptera (moths, butterflies) | *Conogethes punctiferalis*<br>*Conopomorpha cramerella*<br>*Cryptophlebia ombrodelta* |
| Thysanoptera (thrips) | *Thrips hawaiiensis*<br>*Scirtothrips dorsalis* |

7 ‘Quarantine pest’ is defined by the IPPC as ‘a pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled’.

## References for Chapter 3

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PERAL-USDA (2011) *Importation of fresh fruit of litchi (litchi chinensis), longan (dimocarpus longan), and rambutan (nephelium lappaceum) into the continential united states from ASEAN countries: A qualitative, pathway-initiated pest risk assessment*. Raleigh, NC 27606: Plant Epidemiology and Risk Analysis Laboratory, Center for Plant Health Science and Technology, United States Department of Agriculture.

# 4 Risk analysis of hazard organisms associated with fresh rambutan fruit from Vietnam

## 4.1 A note about modified presentation of pest risk assessments

MPI has previously done pest risk assessments of the hazard organisms listed in Chapter 3, or closely related organisms, for different commodity pathways. Although the risk conclusions are not directly applicable to rambutam from Vietnam, key aspects of those risk assessments are directly relevant to the pathway assessed in this document. To avoid duplication of effort, a fit-for-purpose philosophy has been adopted in assessing and communicating the pest risks in this document to avoid duplication of effort. As a result, the presentation of the pest risk assessments is different to previous MPI pest risk assessments; principally the presentation is customised for the needs of this risk assessment as follows:

- The focus is on communication of the analysis of key risk factors, rather than duplication of hazard data and biological data that has been recorded elsewhere. Consequently:
  - The hazard identification data is held in the hazard identification table in Appendix 1; it is not repeated or expanded here within each pest risk assessment.
  - The information about geographic range, host range and pest biology that is held in other MPI risk assessments has not been repeated here. It can be found in the documents cited.
- The risk estimation is communicated early in each pest risk assessment, rather than at the end.

## 4.2 Fruit fly: *Bactrocera dorsalis*

### 4.2.1 Summary of risk of *Bactrocera dorsalis* on rambutan from Vietnam

**Scientific name:** *Bactrocera dorsalis* (Hendel, 1912) (Diptera: Tephritidae)
**Other relevant scientific names:** *B. philippinensis, B. invadens, B. papayae*
**Common name [/s]:** oriental fruit fly, mango fruit fly

**Brief description of pest:** *B. dorsalis* is a polyphagous fruit fly that lays eggs in the skin of ripening host-fruit; the larvae bore into the host-fruit and feed on the fruit flesh (MAF 2009a).

**Source Risk Assessments:** This summary of risk is underpinned by the information documented in previous peer-reviewed MPI pest risk assessments of *B. dorsalis* in other fresh fruits (MPI 2009a, 2009b, 2007), information about pests of rambutan in Vietnam (Waterhouse 1993; Hoa et al 2010), and other recent sources.

**Risk Estimation:** *Bactrocera dorsalis* is considered to be a risk on fresh rambutan from Vietnam because: a) the likelihood of seasonal introduction into New Zealand via this pathway is considered to be non-negligible; and b) the potential economic impact within New Zealand is considered to be high due to the likely impact on the fruit industry. The following arguments support this assessment:

**a) It is considered that *B. dorsalis* is likely to be seasonally-introduced into New Zealand via fresh rambutan from Vietnam**

- It is considered that there is a high likelihood that small numbers of *B. dorsalis* will enter New Zealand in consignments of rambutan from Vietnam on a regular basis. *B. dorsalis* is a very widespread and important pest in Vietnam and known to be a pest of rambutan (Waterhouse 1993). Even though the infestation rate of rambutan fruit in Southeast Asia is reported to be low (similar to the low infestation rate in Hawaii of 0.021%) (McQuate et al 2000), and the likely number of larvae per infested rambutan fruit (~3-4 larvae per fruit) (McQuate et al 2000), is lower than recorded for other *B. dorsalis* host fruits[8], it remains likely that a small proportion of the rambutan fruit entering New Zealand will contain several eggs and/or larvae of *B. dorsalis* inside individual fruits (Hoa et al 2010; Waterhouse 1993; MAF 2009a,b; McQuate et al 2000). This is because they are internal pests and can therefore avoid detection during the harvesting, handling, cleaning and packaging steps of the pathway. MPI interception data showing *B. dorsalis* in Longan fruit (a related tropical fruit) exported from South East Asia demonstrates that *B. dorsalis* can avoid detection during the harvesting, handling, cleaning and packaging steps of commercially produced fruit (MPI 2015a).

- The likelihood of exposure, i.e. *B. dorsalis* finding a suitable host in New Zealand, is considered to be low because the majority (~80%) of infested fruit is expected to be either discarded in land fill or via in-sink disposal (Hogg et al 2010; Viggers 1993); or consumed; and none of those end-points will expose *B. dorsalis* to an environment conducive to their survival. Furthermore, any *B. dorsalis* in fruit discarded into environments that can be conducive to insect survival e.g. composting, random dumping in gardens, or distribution on farm land for animal feed (Hogg et al 2010; Viggers 1993), must still successfully complete larval development within the fruit, then pupate in the soil or compost, and eventually emerge as adults, before they can fly to suitable hosts (of which there are a range occurring in New Zealand commercial and home gardens situations e.g. apple, apricot, avocado, capsicum, citrus, passionfuit, peach, pear, plum, and tomato) (MAF 2009a,b). Whilst some disposal sites might enable larval development into adulthood, the presence of suitable environmental conditions at the disposal site and the absence of predators is not a certainty.
- This section assumes there is no surveillance or response activities taking place. If only climatic factors are considered, *B. dorsalis* is considered to have a low likelihood of establishing permanent populations in New Zealand. This is because the New Zealand climate is too cool: mean annual temperatures <17°C are unsuitable for persistent populations (Stringer et al 2013). Even in a warmer than usual year (2011), the highest mean annual temperature in New Zealand was <17°C (it was 16.7°C) (NIWA 2016)[9]. However, it is considered that there is a high likelihood that seasonal populations (>1 generation) can be maintained in restricted distributions (Northland, Waikato, Bay of Plenty) during the warmer months (Stringer et al 2013). The projected warming by 2030 would likely allow a second generation of *B. dorsalis* in additional areas of the North Island (Stringer 2013). Taking account of the need for a mating pair to find each other, the likelihood of a seasonal population establishing specifically from the rambutan from Vietnam pathway is considered to be moderate to high, slightly lower than if just climatic factors are considered. Given that a single rambutan fruit has the potential to yield 3-4 adults it is not unreasonable to expect that a mating pair can find each other; yet, it is also conceivable that only one adult might reach maturity; this scenario reduces the likelihood of mating occurring because of the reliance on additional exposure events occurring in the proximity.

**b) It is considered that *B. dorsalis* is likely to have high economic consequences in New Zealand**

8 The spinterns (spines) on rambutan fruit are thought to interfere with *B. dorsalis* oviposition (McQuate et al 2000)
9 Other highest mean annual temperatures are 15.7°C (2015), 15.2°C (2014), 16.5°C (2013), 15.8°C (2012) (NIWA 2016)

*B. dorsalis* is a highly polyphagous pest (Plantwise 2016). Many of New Zealand's important crop species are recorded as 'main' hosts of *B. dorsalis*, including (but not limited to) apple, apricot, avocado, citrus, sweet cherry, tomato (MPI 2015c). The combined export & domestic sales value of these crops is approximately $0.9 billion[10]. The host status of buttercup squash (*Cucurbita maxima*) needs to be confirmed, and MPI does not consider that kiwifruit is a host of *B. dorsalis* as no association with *Actinidia deliciosa* has been found to date (MPI 2015c).

Given the combined value of some main-host species grown in New Zealand, the likely economic consequence of a seasonal population of *B. dorsalis* in New Zealand in the fruit growing regions of Northland, Waikato or Bay of Plenty is considered to be high, due to the combined impacts of i) *B. dorsalis* reducing the quality and yield of fruit, e.g. and ii) restricted access to the international export markets that import our fruit.

The environmental consequences are considered to be low (MAF 2009b), the human health consequences are considered to be negligible (MAF 2009b). The socio-cultural consequences are likely to be low because any populations in NZ will likely not be permanent, and will likely occur in restricted distributions (Northland, Waikato, Bay of Plenty).

## References for Chapter 4.2


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MAF (2009b) Import Risk Analysis: Table grapes (Vitis vinifera) from China. Published by MAF Biosecurity New Zealand. http://www.biosecurity.govt.nz/files/regs/imports/risk/table-grapes-china-ra.pdf

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MPI (2015a) Pest interception data for Litchi and Longan imported to New Zealand

MPI (2015b) Cost data for response to Queensland fruit fly population in Auckland

MPI 2015c Internal report; a compilation of published host lists.


10 apple ($536 m export), apricot ($16 m domestic + export), avocado ($127m domestic + export), citrus ($56 m domestic + export), sweet cherry ($42 m domestic + export), tomato ($109 m domestic + export) (Freshfacts 2014)

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## 4.3 Internal-feeding moths: *Conogethes punctiferalis, Cryptophlebia ombrodelta, Conopomorpha cramerella*

### 4.3.1 Summary of risk of *Conogethes punctiferalis* on rambutan from Vietnam

**Scientific name:** *Conogethes punctiferalis* (Guenée, 1854) (Lepidoptera: Crambidae)

**Other relevant scientific names:** *Dichocrocis punctiferalis, Astura guttalis, Astura punctiferalis, Deiopeia detracta, Botys nicippealis*

**Common name/s**: yellow peach moth, castor seed caterpillar, castor borer, cone moth, durian fruit borer, maize moth, peach pyralid moth, Queensland bollworm, smaller maize borer

**Brief description of pest:** *C. punctiferalis* is a highly polyphagous moth, whose larvae feed on and inside fruit.

**Source Risk Assessments**: This summary of risk is underpinned by the information documented in previous peer-reviewed MPI pest risk assessments of *C. punctiferalis* in grapes and pears from China, and stonefruit from Australia (MAF 2009a, MAF 2009b, MPI 2012); the USDA risk assessment for rambutan from Vietnam (USDA 2011), and information about pests of rambutan in Vietnam (Waterhouse 1993; Hoa et al 2010).

**Risk Estimation:** *Conogethes punctiferalis* is considered to be a risk on fresh rambutan from Vietnam because it is likely to: a) be introduced into New Zealand via this pathway; and b) have a moderate economic impact to New Zealand's fruit industry. The following arguments support this assessment:

**a) It is considered that *C. punctiferalis* is likely to be introduced into New Zealand via fresh rambutan from Vietnam**

- It is considered that there is a high likelihood that small numbers of *C. punctiferalis* will enter New Zealand in consignments of rambutan from Vietnam on a regular basis. This is because *C. punctiferalis* larvae (up to 25 mm long) occur inside rambutan fruit (Waterhouse 1993; Astridge 1998, 2006, MAF 2009b), and therefore they can avoid detection during the harvesting, handling, cleaning and packaging steps of the pathway; particularly if the larvae is an early (therefore smaller) instar because the entry hole will be small. Pupae are considered unlikely to be associated with packaged fruit because the damage done during the course of larval development to the stage of pupation would likely cause the rambutan fruit to be brown and/or dead (see next paragraph); and, as this would be noticeable, the fruit would not be harvested and/or packaged (USDA 2011).

  *C. punctiferalis* is a very widespread pest in Vietnam and a pest of rambutan in Vietnam (Waterhouse 1993). But much of the rambutan infested with *C. punctiferalis* is not expected to be harvested or packaged because it causes "Rambutan fruit in all species to die and turn brown in infected clusters" (Astridge, 2006). Fruit presenting with those signs will be easily recognised. However, it is assumed here that some infested, harvest-ready rambutan fruit can be alive and normal-coloured, on the basis that a harvest-ready fruit recently infested with an early instar larvae would not yet have caused fruit to be dead/ brown. Furthermore, European interception data from November 2015 showing *C. punctiferalis* (as *Dichocrocis punctiferalis*) on rambutan from Vietnam going into Switzerland demonstrates that *C. punctiferalis* can avoid detection during the harvesting, handling, cleaning and packaging steps of the pathway (Europhyt 2015).

- *C. punctiferalis* has a low likelihood of being exposed to a host plant in New Zealand via this pathway. This is because the majority of rambutan will be either consumed or discarded in land fill (Hogg et al 2010; Viggers 1993), so only a small proportion of imported rambutan will be discarded in an environment that would enable the larvae of *C. punctiferalis* to develop into adults and fly to a host plant. Suitable hosts occurring in New Zealand commercial and home garden situations include apples, apricots, cherries, grapes, maize/sweetcorn, peaches, pears, sunflower (MAF 2009b).
- Taking account of factors specific to the pathway of rambutan from vietnam, *C. punctiferalis* has only a moderate[11] likelihood (rather than high) of establishing in New Zealand. Factors in favour of establishment are: a) the warmer northern regions of New Zealand that would likely provide a climate suitable for *C. punctiferalis* (i.e. Northland, Auckland, Waikato, Hawkes Bay) also have suitable hosts (apples, apricots, cherries, grapes, maize/sweetcorn, peaches, pears, sunflower) (MAF 2009b); b) mature larva can overwinter, meaning that it has ability to hibernate when conditions become unfavourable. But given that rambutan fruit may contain just one larva[12] it is expected that multiple infested fruit would need to be disposed of in fairly close proximity in order for a mating pair to find each other. This factor reduces the likelihood of establishment somewhat.

**b) It is considered that *C. punctiferalis* is likely to have moderate economic consequences in New Zealand**

In New Zealand the economic value of some of the crops that *C. punctiferalis* feeds on are considerable (Freshfacts 2014; NZIER 2016):

- apples - $536m (the 2014 export and domestic sales)
- peaches, apricots and cherries - $71m (the 2014 export and domestic sales)
- maize/sweetcorn - ~ $800m (GDP contribution 2012),
- grapes - $1.3 billion (GDP contribution 2012),

Two thirds of New Zealand's apple and maize/sweetcorn production, and a portion of stone-fruit and grape production (Brooker 2009; Teara 2016) occurs in the regions where the moth is likely to establish. Economic losses would likely arise from some direct fruit damage caused by the moth (yield and quantity impacts), additional costs to control the pest, and the potential for adverse impact on market access if these industries have to change from their current low chemical-use regime (MAF 2009b; MAF 2012). Taking these into account, the economic consequence of *C. punctiferalis* to New Zealand are considered to be moderate.

The environmental consequences are considered to be low, and the socio-cultural and human health consequences are considered to be negligle MPI (2012).

### *4.3.2* Summary of risk of *Cryptophlebia ombrodelta* on rambutan from Vietnam

**Scientific name:** *Cryptophlebia ombrodelta* (Lower, 1898) (Lepidoptera: Tortricidae)

11 In MPI's import risk analysis for Stonefruit from Australia (MPI, 2012), the likelihood of *C. punctiferalis* establishing in New Zealand via that pathway was considered to be low. A key factor influencing that rating was the influence of low prevalence of *C. punctiferalis* in Australian stonefruit orchards on establishment, and is in contrast to a likely higher prevalence in Vietnamese Rambutan orchards. It is this difference in prevalence of the pest at the beginning of the pathway which primarily accounts for the different likelihoods of establishment.

12 *C. punctiferalis* eggs are laid singly on fruit (MAF 2009b) meaning that rambutan fruit may contain only one larva, not multiple larva.

**Other relevant scientific names:** *Arctiophora ombrodelta, Argyroploce carpophaga, Arotrophora ombrodelta, Cryptophlebia carpophaga*
**Common name/s**: Macadamia nut borer

**Brief description of pest:** *C. ombrodelta* is a polyphagous moth with hosts mainly in the Fabaceae family. The larvae feed on and inside fruit.

**Source Risk Assessments**: This summary of risk is underpinned by the information documented in the USDA risk assessment for rambutan from Vietnam (USDA-PERAL 2011), and in previous peer-reviewed MPI pest risk assessments of *C. ombrodelta* in fresh litchi fruit (MAF 2008, MAF 2007).

**Risk estimation:** *C. ombrodelta* is considered to be a risk on fresh rambutan from Vietnam because it is likely to a) be introduced into New Zealand via this pathway; and b) have a moderate economic impact to New Zealand's fruit industry. The following arguments support this assessment:

**a) It is considered that *C. ombrodelta* is likely to be introduced into New Zealand via fresh rambutan from Vietnam (Note: there is some uncertainty with the rating for likelihood of entry)**

- Although *C. ombrodelta* is known from Vietnam and is known to affect rambutan, the prevalence of the pest in Vietnamese rambutan orchards is not known. This entry assessment assumes that *C. ombrodelta* is a reasonably prevalent pest in rambutan orchards in Vietnam. Therefore, given that an assumption has been used, there is some uncertainty with this assessment. There is considered to be a high likelihood that small numbers of *C. ombrodelta* will enter New Zealand in consignments of rambutan from Vietnam on a regular basis. The main reason for this is that the larvae of *C. ombrodelta* feed inside the fruit (MAF 2008; USDA-PERAL 2011; McQuate et al 2000) and being internal, *C. ombrodelta* larvae can avoid detection during the harvesting, handling, cleaning and packaging steps of the pathway; particularly if the larvae is an early (therefore smaller) instar because the entry hole will be small. MPI has intercepted larvae of *C. ombrodelta* infesting Litchi (a Sapindaceae fruit similar to rambutan) from Australia. This demonstrates that *C. ombrodelta* can avoid detection during harvesting, handling, cleaning and packaging steps of a Sapindaceae fruit pathway. Other life-stages are unlikely to be associated with rambutan fruit. USDA-PERAL (2011) concluded in their risk assessment that pupae and adults of the genus *Cryptophlebia* are unlikely to be associated with packaged fruit because they would likely be detected prior to export: firstly the damage done to the fruit during the course of larval development to the stage of pupation would cause noticeable damage to the fruit; and secondly, pupation occurs outside the fruit (USDA-PERAL 2011).
- *C. ombrodelta* is considered to have a low likelihood of being exposed to a host plant in New Zealand via this pathway. This is because the majority of rambutan will be either consumed or discarded in land fill (Hogg et al 2010; Viggers 1993), so only a small proportion of imported rambutan will be discarded in an environment that would enable the larvae of *C. ombrodelta* to develop into adults and fly to a host plant. Suitable hosts occurring in New Zealand commercial and backyard situations include avocado, common bean (*Phaseolus vulgaris*), macadamia, orange, and wattles (*Acacia* spp.) (MAF 2008; AEI 2016).
- *C. ombrodelta* is considered to have a low likelihood of establishing in New Zealand via Rambutan from Vietnam. Although the climate in Northland is likely to be sufficiently warm for *C. ombodelta*, and suitable hosts (beans, macadamia, avocado and orange)

(MAF 2008; AEI 2016) will be available in Northland, the likelihood of a male and female finding each other and mating is greatly reduced, and therefore the overall likelihood of establishment is considered to be low. Mating likelihood is reduced because several infested rambutan fruits discarded in close proximity will be required to yield a mating pair. This is due to the fact that eggs are laid singly and typically only one larva is found feeding in a single fruit (McQuate et al 2000). Note that other regions in New Zealand where hosts of *C. ombodelta* grow are likely to be too cold (MAF 2008). No information was found in the existing risk assessments about overwintering ability of mature larva, but it is assumed here that they can overwinter (like larvae of *C. punctiferalis*).

**b) *C. ombrodelta* is likely to have low to moderate economic consequences in New Zealand**

If *C. ombrodelta* established in New Zealand, it is considered that the economic consequence of *C. ombrodelta* is likely to range from low to moderate, caused by impacts to commercial production of avocado and citrus[13]. Only about one third of the national avocado crop, which had export and domestic sales of $126 million in 2014 (Freshfacts 2014), is at risk from *C. ombrodelta* because only about one third is grown in Northland (MPI 2016) where *C. ombrodelta* may establish permanent populations (MAF 2008). Likewise, only a portion of the national citrus crop, which had export and domestic sales of $14.6 million in 2014 (Freshfacts 2014), is at risk because only a portion of the national crop is grown in Northland (Teara 2016). Impacts would likely include direct damage to fruit, and there is potential for damage to market access (which accounts for the ‘moderate’ impact rating). Although *C. ombrodelta* may also occur seasonally in neighbouring districts due to seasonal migration (e.g. Bay of Plenty), and could therefore potentially occur in all major avocado and orange growing regions, the likely overall impact is not considered to be high because it is assumed that existing pest management in orchards would minimise damage to only a small portion of each crop.

The environmental consequences are considered to be low, and this is uncertain. The likely geographic range of populations of *C. ombrodelta* (Northland) limits potential for impact on native species; some potential native host candidates might include the four native genera in the Fabaceae in New Zealand, and two in the Proteaceae (MAF 2008). No evidence was found about human health impacts.

### *4.3.3* Summary of risk of *Conopomorpha cramerella* on rambutan from Vietnam

**Scientific name:** *Conopomorpha cramerella* (Bradley, 1986) (Lepidoptera: Gracillariidae)

**Other relevant scientific names:** *Acrocercops cramerella, Gracillaria cramerella, Zarathra cramerella*

**Common name/s**: Cocoa pod borer

**Brief description of pest:** *C. cramerella* is a moth whose larvae bore into fruit. Although polyphagous, the recorded host range is narrow, consisting of nine plant species (Lim 1992).

**Source Risk Assessments:** This summary of risk is underpinned by the information documented in the USDA risk assessment for rambutan from Vietnam (PERAL-

13 Economic impact due to infestation of macadamia would be minor because it is a very small industry in New Zealand (NZIER 2016). Economic impact due to infestation of beans would be minor because the most important growing area is Canterbury (NZIER 2016) and *C. ombrodelta* is unlikely to establish there.

USDA 2011), and in a previous peer-reviewed MPI pest risk assessment of *C. cramerella* in fresh litchi fruit (MAF 2007).

**Risk estimation:** *C. cramerella* is not considered to be a risk on fresh rambutan from Vietnam because it is unlikely to be introduced into New Zealand via this pathway, on account of an absence of suitable hosts. The following arguments support this assessment:

***C. cramerella* is not likely to be introduced into New Zealand via fresh rambutan from Vietnam**

- Although *C. cramerella* is known from Vietnam (PERAL-USDA 2011) and is known to affect rambutan (Waterhouse 1993), the prevalence of the pest in Vietnamese rambutan orchards is not known. This entry assessment assumes that *C. cramerella* is a reasonably prevalent pest in rambutan orchards in Vietnam. Therefore, given that an assumption has been used, there is some uncertainty with this assessment. There is considered to be a high likelihood that small numbers of *C. cramerella* will enter New Zealand in consignments of rambutan from Vietnam on a regular basis. The main reason for this is that the larvae of *C. cramerella* feed inside the fruit (USDA-PERAL 2011) and being internal, *C. ombrodelta* larvae can avoid detection during the harvesting, handling, cleaning and packaging steps of the pathway; particularly if the larvae is an early (therefore smaller) instar because the entry hole will be small. Larvae of an unidentified Gracillariidae moth infesting Litchi (a fruit similar to rambutan) from Thailand, Vietnam, Taiwan and India have been detected at the New Zealand border (MPI Interception database), demonstrating that moths of this type can indeed avoid detection during the harvesting, handling, cleaning and packaging steps of commercial sapindaceous fruit pathways.

  Life-stages other than larvae are unlikely to be associated with rambutan fruit. USDA-PERAL (2011) concluded in their risk assessment that pupae and adults of the genus *Conopomorpha* are unlikely to be associated with packaged fruit because they would likely be detected prior to export: firstly the damage done to the fruit during the course of larval development to the stage of pupation would cause noticeable damage to the fruit, and secondly pupation occurs outside the fruit (USDA-PERAL 2011).

- *C. cramerella* is considered to have a negligible likelihood of exposure due to a lack of known hosts in New Zealand. The known host range of *C. cramerella* consists of nine species across four plant families: Malvaceae (sensu lato), Sapindaceae, Fabaceae, and Meliaceae[14], (Lim 1992; PERAL-USDA 2011). Only three of the known hosts are permitted in New Zealand (*Nephelium lappaceum, Theobroma cacao* and *Lansium domesticum*) (PBI 2016), but these are tropical plants considered to be extremely uncommon, if cultivated at all in New Zealand (Google 2016; NZ Flora 2016). It is not known whether *C. cramerella* would be able to expand the known host range to include other members of the Malvaceae (sensu lato), Sapindaceae, Fabaceae, and Meliaceae plant families, particularly those that do occur in New Zealand. It is assumed here that there is a negligible likelihood of host expansion in New Zealand, given that *C. cramerella* already occurs across a wide distribution in Asia and Oceania (CPC 2016) where these plant families are common, yet the known host range remains at nine species. Due to the assumption, there is some uncertainty associated with this exposure assessment.

14 *Nephelium* species: *N. lappaceum* (rambutan), *N. mutabile, N. malaiense*; .*Pometia pinnata* (Fijian longan), *Cola* species: *C. acuminata* (cola*), C. nitida; Theobroma cacao* (cocoa), *Cynometra cauliflora*, and *Lansium domesticum* (CPC 2016; Lim 1992). Note that reports of *C. cramerella* attacking litchi and longan are not accurate (PERAL-USDA 2011; Lim 1992).

Consequently, despite the likelihood of *C. cramerella* entering New Zealand in rambutan from Vietnam, the likelihood of *C. cramerella* being introduced via this pathway is negligible, because exposure to a host plant is a critical step to introduction and that step is considered to have negligible likelihood of occurring. Therefore, there is no need to assess the other component of risk, i.e. the consequences of introduction.

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## 4.4 Thrips: *Thrips hawaiiensis* and *Scirtothrips dorsalis*

### 4.4.1 Summary of risk of *Thrips hawaiiensis* on rambutan from Vietnam

**Scientific name:** *Thrips hawaiiensis* (Morgan, 1913) (Thysanoptera: Thripidae)
**Other relevant scientific names:** *Euthrips hawaiiensis* Morgan, 1913; *Taeniothrips hawaiiensis* (Morgan); *Physothrips hawaiiensis* (Morgan); *Taeniothrips eriobotryae* Moulton, 1928; *Taeniothrips pallipes* var. *florinatus* Priesner, 1935; *Thrips*

*albipes* Bagnall, 1914; *Thrips hawaiiensis* form *imitator* Priesner, 1934; *Thrips nigriflava* Schmutz, 1913; *Thrips pallipes* Bagnall, 1926; *Thrips sulphurea* Schmutz, 1913; *Thrips versicolor* Bagnall, 1926

**Common names:** Hawaiian flower thrips, banana flower thrips, flower thrips

**Brief description:** *Thrips hawaiiensis* is a small sap-sucking flower thrips. It is polyphagous, feeding on the flowers of many species across many plant families (MAF 2010).

**Source Risk Assessments:** This summary of risk is underpinned by the information documented in previous peer-reviewed MPI pest risk assessments of *Thrips hawaiiensis* in litchi, pears and *Phalaenopsis* (MAF 2008, 2009a, 2010 respectively).

**Risk estimation:** *T. hawaiiensis* is not considered to be a risk on Rambutan from Vietnam because it is not likely be introduced into New Zealand via this pathway. The following argument supports this assessment:

**It is considered that *T. hawaiiensis* is not likely to be introduced in New Zealand via Rambutan from Vietnam**

- *T. hawaiiensis* is considered to have a negligible likelihood of entering New Zealand on this pathway because *T. hawaiiensis* has a negligible likelihood of being associated with harvest-ready rambutan fruit. The plant part that *T. hawaiiensis* associates with is flowers, not harvest-ready fruit (MAF 2009a); and on Rambutan trees, the flowers and harvest-ready fruit do not appear to occur at the same time (Orwa et al 2009), therefore eliminating potential for *T. hawaiiensis* to be associated with harvest-ready fruit in a hitch-hiker capacity.

### 4.4.2 Summary of risk of *Scirtothrips dorsalis* on rambutan from Vietnam

**Scientific name:** *Scirtothrips dorsalis* Hood (Thysanoptera:Thripidae)

**Other scientific names:** *Neophysopus fragariae* Girault; *Heliothrips minutissimus* Bagnall; *Anaphothrips andreae* Karny; *Anaphothrips fragariae* Girault; *Scirtothrips dorsalis* var. *padmae* Ramakrishna; *Scirtothrips fragariae* Girault; *Scirtothrips minutissimus* (Bagnall); *Scirtothrips padmae* Ramakrishna; *Scirtothrips andreae* (Karny)

**Common names:** chilli thrips; yellow tea thrips; strawberry thrips; Assam thrips

**Brief description:** *Scirtothrips dorsalis* is a small polyphagous thrips - size descriptions range from 0.7mm long to 1.2 mm (MPI 2013; UF-IFAS 2016) - that causes economic damage to many crops by feeding on plants and vectoring viruses.

**Source Risk Assessments:** This summary of risk is underpinned by the information documented in the previous peer-reviewed MPI pest risk assessment of *Scirtothrips dorsalis* on cut flowers (MPI 2013).

**Risk estimation:** *S. dorsalis* is considered to be a risk on fresh rambutan from Vietnam because it is considered that there is a non-negligible (but uncertain) likelihood that it will be introduced into New Zealand via this pathway, and there are likely to be low economic, environmental and sociocultural impacts. The following argument supports this assessment:

**a) It is considered that *S. dorsalis* is likely to be introduced into New Zealand via fresh rambutan from Vietnam (but note that most components of the Introduction pathway have a low likelihood, and there is uncertainty due to assumptions made about association with the spines on rambutan)**

- It is considered that there is a moderate likelihood that small numbers of *S. dorsalis* will enter New Zealand in consignments of rambutan from Vietnam on a regular basis. As *S. dorsalis* is reported as a major pest of rambutan in Thailand (Salakpetch 2000), it is reasonable to assume that it is a pest of rambutan orchards in Vietnam. Although it is noted as a particular pest during flowering, it can sometimes destroy fruits (Salakpetch 2000), indicating it is associated with fruit. As *S. dorsalis* adults and larvae feed on any soft part of the plant (MPI 2013) and as the spines on mature rambutan fruit are soft and tender (Sharma et al 2009), it is considered here that there is a moderate likelihood that adults and larvae do feed on <u>mature</u> harvest-ready rambutan fruit. It is assumed that there is a moderate likelihood that eggs and pupae will also be associated with rambutan fruit, given that these lifestages are recorded from oranges and fruit of *Momordica charantia* respectively (MPI 2013). As all lifestages of *S. dorsalis* are very small (<1mm) they are difficult to see and can avoid detection during the harvesting, handling, cleaning and packaging steps of the pathway, as demonstrated by the interceptions of *S. dorsalis* on other commercial plant material pathways (MPI 2013).
- It is considered that *S. dorsalis* has a low likelihood of being exposed to a host plant in New Zealand via this pathway. This is because only a small proportion of the rambutan peel (the fruit-part that would have *S. dorsalis* associated with it) will be discarded in an environment that would enable the *S. dorsalis* to find a host plant (e.g. compost, or random disposal near plants) (Hogg et al 2010; Viggers 1993). The likelihood is not negligible because adults are mobile and can actively fly short distances; immatures are wingless but have some mobility; mature larvae and pupae could pass through to adult emergence; and as *S. dorsalis* is polyphagous there will be plenty of suitable hosts occurring in New Zealand commercial and home garden situations including asparagus, onion, kiwifruit, pumpkin, cucumber, bean, tomato, capsicum, citrus, pear, strawberry, common fig, kumara, cherry, eggplant, grape (MPI 2013).
- *S. dorsalis* currently has a tropical/subtropical distribution (MPI 2013). It is considered that there is only a low likelihood (with moderate uncertainty) that *S. dorsalis* can establish <u>permanent</u> outdoor populations in New Zealand, primarily due to climatic factors (MPI 2013). Any establishment event would likely be limited to the north of the North Island (down to Tauranga) which is a sub-tropical zone with warm humid summers and mild winters (MPI 2013). Furthermore, outdoor establishment would be unlikely to start from winter arrivals (MPI 2013) and most rambutan from Vietnam would arrive in New Zealand from winter through to early spring (July – September)[15]. Note that *S. dorsalis* is considered to have a moderate likelihood of establishing in protected environments (e.g. glasshouses) because this has occurred in other countries with temperate climates (MPI 2013).

**b) It is considered that *S. dorsalis* is likely to have low economic, environmental and socio-cultural consequences in New Zealand**

*S. dorsalis* reduces yield and quality of fruit and vegetables by causing feeding damage, and by vectoring plant viruses which can cause disease in the host plant (MPI 2013). If *S. dorsalis* established in New Zealand, the consequences to individual growers are likely to be significant (costly disruption to integrated pest management), but <u>at the national level the economic</u>

15 July to September are the months in which most fruit mature and are exported from Southern Asia (Fruitipedia 2015). Fruit would be sent directly to market because it has a very limited shelf-life (~12 days; see section 2.2).

consequences are considered to be low (MPI 2013). As *S. dorsalis* is highly polyphagous a number of economically important plants might be affected (e.g. strawberries, grapes, citrus, tomato, capsicum, beans, ornamentals, cut-flowers, eggplant, kiwifruit, cucumber, melon and asparagus). However, the direct damage is not expected to be as great as reported from other countries (Florida, Japan and India) because: a) the impact is likely to be limited only to the north of the North Island, and b) rapid population growth of *S. dorsalis* in the outdoors is unlikely in New Zealand due to the climatic conditions here (MPI 2013). The environmental and socio-cultural consequences of *S. dorsalis* are considered to be low (MPI 2013).

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## 4.5 Mites: *Eutetranychus orientalis*

### 4.5.1 Summary of risk of *Eutranychus orientalis* on rambutan from Vietnam

**Scientific name:** *Eutetranychus orientalis* (Klein, 1936) (Acarina: Tetranychidae)

**Other scientific names:** *Anychus orientalis* Klein 1936; *Eutetranychus anneckei* Meyer, 1974

**Common names:** citrus brown mite; oriental (red) mite

**Brief description:** *E. orientalis* is a phytophagous mite belonging to the spider mite family. It causes damage to plants by feeing on the contents of plant cells in leaves, which eventually causes the leaves to become chlorotic and discoloured (MAF 2011).

**Source Risk Assessments:** This summary of risk is underpinned by the information documented in a previous peer-reviewed MPI pest risk assessment of *Eutetranychus orientalis* on fresh cut roses from South Africa (MAF 2011) and the EFSA (2013) risk assessment of this organism.

**Risk Estimation:** *E. orientalis* is considered to be a risk on fresh rambutan from Vietnam because it is considered that there is a non-negligible likelihood (albeit uncertain) that it will be introduced into New Zealand via this pathway, and there are low economic, environmental and socioeconomic impacts. The following argument supports this assessment:

***a) E. orientalis* is considered likely to be introduced into New Zealand via fresh rambutan from Vietnam (but note that most components of the Introduction pathway have a low likelihood, and there is uncertainty due to assumptions made about mites feeding on the spines of rambutan)**

- The rambutan plant is a main host of *E. orientalis* (CPC 2016). It is considered that there is a low-moderate likelihood (with moderate uncertainty) that small numbers of *E. orientalis* will enter New Zealand on this pathway. The opinion of EFSA (2013) that the mite can be found on “green parts attached to fruit and that it can feed on all chlorophyll containing parts of its host” would suggest that it can be associated with the green tips of the spines of the rambutan fruit (assuming that the harvest-ready fruit still have green parts to the spines). As the spines are numerous and the tips have a tendancy to curl slightly, it is reasonable to assume that the adults and immature stages will find hiding places amongst the spines that enable them to readily avoid detection. In addition, even though *E. orientalis* is primarily associated with leaves (which it feeds on) (MAF 2011), and the rambutan commodity imported into New Zealand does not contain leaves, rambutan fruit may become contaminated with small numbers of mites via inadvertent transfer from leaves onto fruit during harvest. As all life stages (egg, larvae, nymph and adult) are very small (<0.5mm) (CPC 2016) their presence as contaminants on fruit would be very difficult to detect during harvesting, handling, cleaning and packaging steps of the pathway.

- *E. orientalis* is considered to have a low likelihood of being exposed to a host plant in New Zealand via this pathway. This is because only a small proportion of the rambutan peel (the fruit-part that would have *E. orientalis* associated with it) will be discarded in an environment that would enable the mite to find a host plant (e.g. compost, or random disposal near plants) (Hogg et al 2010; Viggers 1993). Host availability will not be a barrier to exposure because *E. orientalis* is polyphagous and there are likely to be many suitable hosts occurring in New Zealand commercial and home garden situations (e.g. capsicum, chrysanthemum, pumpkin, dahlia, kumera, walnut, passionfruit, avocado, broad bean, poplar, plum, almond, peach, pear, rose, willow, aubergine, nightshade, grape, maize; MAF 2011). *E. orientalis* has mobility via crawling and can be dispersed by wind currents (MAF 2011).

- In a risk assessment of fresh cut roses, MAF has previously considered that *E. orientalis* has a moderate likelihood of establishing in New Zealand. However, the distribution would likely be limited to regions of New Zealand that are both warm enough, and have a relative humidity low enough to enable *E. orientalis* to establish; there are few regions in New Zealand that fit those criteria, but Napier and Gisborne are potentially suitable (MAF 2011)[16]. However, on the rambutan from Vietnam pathway, it is considered that the likelihood of establishing in New Zealand is low because: a) the mite is considered likely to enter on rambutan in small numbers (rather than in groups) - this reduces the likelihood of a mating pair finding each other, and consequently there is a low likelihood of sexual reproduction occurring[17]; and b) establishment would be unlikely to start from winter arrivals (too wet and cold) and most rambutan from Vietnam would arrive in New Zealand from winter through to early spring (July – September)[18].

***b) E. orientalis* is considered likely to have low economic, environmental and socio-cultural consequences in New Zealand**

- The potential economic impact of *E. orientalis* is considered to be low. Although *E.* orientalis is polyphagous the main economic impacts are on citrus crops (EFSA 2013). *E. orientalis* is a notable pest of citrus (MAF 2011). If *E. orientalis* established in New Zealand, there is potential for impacts on the citrus industry as a result of increased phytosanitary requirements for the export trade. Occasional outbreaks requiring control might occur in New Zealand on citrus crops in Napier/Gisborne areas during periods of summer drought. However, as the export value of the citrus crop is small (~$7 million in 2014; Freshfacts 2014), the potential economic impact is considered to be low. It is expected that in New Zealand, crops other than citrus (e.g. French bean – *Phaseolus vulgaris*) could have outbreaks of *E. orientalis*, but this is likely to occur only during periods of summer drought. The environmental and socio-cultural consequences of *E. orientalis* are considered to be low, and the human health consequences are considered to be negligible (MAF 2011).

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16 The current distribution of *E. orientalis* is in the equatorial, tropical and subtropical areas of Africa, Asia and Europe, and high temperature conditions (18–30 °C; optimum: 21–27 °C) are favourable to *E. orientalis* within a wide range of relative humidities (35–72 %; optimum RH 59–70 %) (EFSA 2013).

17 Although females can reproduce parthenogenically to produce male offspring, this is unlikely to be an establishment advantage because the male offspring will need a female to mate with to produce the next generation, and the parent females are likely to die before the male offspring develop to adulthood (MAF 2011).

18 July to September are the months in which most fruit mature and are exported from Southern Asia (Fruitipedia 2015). Fruit would be sent directly to market because it has a very limited shelf-life (~12 days; see section 2.2).

Fruitipedia (2015) Rambutan. http://www.fruitipedia.com/Rambutan.htm Accessed December 2015.

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## 4.6 Stinkbugs: *Tessaratoma javanica* and *Tessaratoma papillosa*

### *4.6.1* Summary of risk of *Tessaratoma javanica* and *Tessaratoma papillosa* on rambutan from Vietnam

| | |
|---|---|
| **Scientific name:** | *Tessaratoma javanica* (Thunberg) (Hemiptera: Tessaratomidae |
| **Common name/s**: | stink bug |
| | |
| **Scientific name:** | *Tessaratoma papillosa* (Drury) (Hemiptera: Tessaratomidae) |
| **Common name/s**: | litchi stink bug |

**Brief description:** *T. javanica* and *T. papillosa* are large mobile stink bugs (2.5 to 3 cm long, ~1.5 cm wide). Nymphs and adults suck the sap of flowering and fruiting shoots, causing flowers and fruits to fall (CPC 2016b; Shama et al 2015).
**Source Risk Assessments**: This summary of risk for both *Tessaratoma* species is underpinned by the information documented in the USDA risk assessment for rambutan from Vietnam (PERAL-USDA 2011), a recent article about the biology and morphology of *Tessaratoma javanica* (Shama et al 2015), and other sources of publicly available literature.

**Risk Estimation:** *Tessaratoma papillosa* is considered to be a risk on fresh rambutan from Vietnam because it is likely to establish in New Zealand via this pathway, and cause low economic impacts (with uncertainty). However, *Tessaratoma javanica* is not considered to be a risk on rambutan from Vietnam because it is considered not likely be introduced into New Zealand via this pathway. The following arguments support this assessment:

***a) Tessaratoma papillosa* is considered likely to be introduced into New Zealand via fresh rambutan from Vietnam, but *Tessaratoma javanica* is not:**

- Although *T. javanica* and *T. papillosa* are reported from rambutan trees (PERAL-USDA 2011) and are known from Vietnam (PERAL-USDA 2011), it is considered that there is only a low likelihood that *Tessaratoma* eggs (in small groups e.g. 1-2) will occasionally enter New Zealand on this pathway. Eggs are preferably laid on the underside of leaves, but are also observed on fruits (Shama et al 2015). But eggs are relatively large (~2.5 mm diameter) and they are usually laid in clusters, making them even more obvious (Shama et al 2015). Consequently, it is considered highly likely that clustered eggs on fruit would be detected during the harvesting, handling, cleaning and packaging steps of the pathway; but eggs not present in a cluster might occasionally be undetected. The likelihood that individual nymphs or adults will be associated with rambutan is considered to be negligible. Nymphs and adults are mobile (MPI 2012) and are likely to move off fruit during fruit-handling (CPC 2016b); nymphs instinctively fall to the ground when disturbed (CPC 2016b). Furthermore, individual nymphs (from ~3 x 6 mm) and adults (~3 x 1.5 cm) are of a size (Shama et al 2015) that is visible and so any *Tessaratoma* bugs remaining on the fruit after harvest are considered highly likely to be seen and removed during handling, cleaning and packaging of the fruit.

- Exposure would require eggs to mature to the point that nymphs hatch and can go in search of a host plant. Summer arrivals of either *T. javanica* or *T. papillosa* eggs would likely have some potential to yield first instar nymphs, due to the mean air temperatures in New Zealand being ~16-20°C [19] (NIWA 2016). But the likelihood of exposure is subtantially reduced, to low, because only a small proportion of the rambutan peel (the fruit-part that would have *Tessaratoma* eggs associated with it) will be discarded in an environment that would enable a newly hatched first instar nymph to find a host plant (e.g. compost, or random disposal near plants) (Hogg et al 2010; Viggers 1993). And then if host availability is taken into account:
    - The likelihood of ***T. papillosa*** being exposed to a host plant in New Zealand via this pathway is unchanged (i.e. not less than low) because the known host plants occurring in New Zealand are common in home gardens, particularly the citrus and rose: citrus, pear, plum, peach (CPC 2016), pomegranate, eucalyptus, rose (Menzel & Waite 2005).
    - However, in contrast, ***T. javanica*** is considered to have a negligible likelihood of being exposed to a host plant in New Zealand because the reported host range is small and these hosts are scarce in New Zealand. CPC (2016a) lists only longan (*Dimocarpus longan*) as a host of *T. javanica*, but six other additional host interactions are recorded by Shama et al (2015), Rao (1992) and Sen (1966) collectively[20]. Only two of these recorded hosts (*Litchi chinensis; Ziziphus jujuba*) are known from New Zealand (NZ Flora 2016; NZPCN 2016). *Litchi chinensis* is present in very small numbers: in 2007 there were 15 trees on one property in Kaitaia in Northland, and one tree in Kaipara, near Auckland (MAF 2007). These numbers are unlikely to have increased substantially since then, as it has a restricted ability to set seed and grow in New Zealand (MAF 2007). NZ Flora (2016) records *Ziziphus jujuba* as "present in captivity/cultivation/culture" in New Zealand. Two speciality nurseries are known to have sold, or are currently selling *Ziziphus jujuba* seeds or plants[21]. But given that additional evidence about *Z. jujuba* in New Zealand is difficult to find, it is assumed here that *Z. jujuba* plants are not commonly grown in New Zealand.
- If only climatic factors are considered, *T. papillosa* is considered to have a moderate likelihood of establishing in New Zealand, but probably in restricted geographic regions where temperatures are warmer e.g. Northland. Although *T. papillosa* is pest of tropical

19 Based on data showing that first instars of *T. javanica* emerge from eggs after about 13 days at 25°C (Shama et al 2015); and *T. papillosa* instars emerge after 7-12 days at 22°C; or 20-25 days at 18°C (CPC 2016b)
20 *Sapindus* sp. (*S. laurifolius; S. emarginatus*) (Rao 1992); *Ziziphus jujuba* (Sen 1966); *Litchi chinensis*; kusum (*Schleichera oleosa*); and *Michelia champaca* (syn. of *Magnolia champaca*) (Shama et al 2015).
21 Nestlebrae nursery (http://nestlebraeexotics.co.nz ); and Shaman's Garden (http://www.shaman.co.nz/Medicinal-Plants-and-Seeds.html)

origin and has relatively high temperature requirements for growth and development of over 15°C (MAF 2007), there are examples of other pests with similar or higher developmental thresholds establishing in many areas in New Zealand (MPI 2012)[22]; or which are considered likely to establish in New Zealand [e.g. *Halyomorpha halys* (the brown marmorated stink bug) (MPI 2012). However, taking account of the factors specific to the pathway of rambutan from Vietnam, the likelihood of establishment is considered to be low. Only small numbers of one or two individual eggs of *T. papillosa* are likely to enter occasionally on the rambutan pathway; and this is a significant barrier to sexual reproduction because the likelihood of a male and female finding each other is considered low in that scenario (MPI 2012).

**b) *Tessaratoma papillosa* is considered likely to have low economic consequences in New Zealand (this rating is made with uncertainty due to assumptions made)**

If *T. papillosa* established in New Zealand, the likely economic consequence of *T. papillosa* is considered to be low. *T. papillosa* causes damage to litchi and longan fruit (discoloration, premature drop) (CPC 2016) and so is assumed here to be likely to cause the same type of damage to other recorded hosts including citrus, plum, pear and peach. However, as these are not main hosts of *T. papillosa* (CPC 2016), and the climate in New Zealand is not likely to be optimal, it is considered here that the population density of *T. papillosa* is not likely to become high enough to cause serious damage to those fruits. *T. papillosa* is reported as a vector of longan witches' broom disease virus (Chen et al 2001). The potential for *T. papillosa* to transmit other viruses is not known. Due to the assumptions made in this assessment, the impact conclusion is uncertain.

The environmental consequences are uncertain but considered to be low because the climate is not likely to be optimal and populations will likely be restricted to Northland; and the host range appears to be reasonably narrow. The bugs might be a nuisance on the minor hosts in home gardens (citrus, plum, pear) so the socio-cultural impact is considered to be low. No evidence was found of human health consequences.

## References for Chapter 4.6


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# 4.7 Mealybugs (Pseudococcidae), armoured-scale insects (Diaspididae) and soft scale insects (Coccidae):

## 4.7.1 Summary of risk of the armoured scale insect *Aulacaspis tubercularis*

**Scientific name:** *Aulacaspis tubercularis* Newstead (Hemiptera: Diaspididae)
**Common name/s**: mango scale
**Brief description:** *A. tubercularis* is a small armoured scale insect (adult female ~ 1.5-2 mm wide) which occurs on leaves, young stems and fruits (AEI 2016).
**Source Risk Assessments:** This summary of risk for *A. tubercularis* is underpinned by the information documented in the USDA risk assessment for rambutan from Vietnam (PERAL-USDA 2011), and a peer-reviewed MPI generic pest risk assessment of armoured scale insects on the fresh produce pathway (MPI 2014).

**Risk Estimation:** *A. tubercularis* is not considered to be a risk on fresh rambutan from Vietnam because it is considered unlikely to be introduced into New Zealand via this pathway, on account of the exposure to a host having a negligible likelihood. The following arguments support this conclusion:

***A. tubercularis* is considered not likely to be introduced into New Zealand via fresh rambutan from Vietnam**

- Although *A. tubercularis* is recorded from Vietnam (Garcia 2016), it is considered that there is a low likelihood that *A. tubercularis* will enter New Zealand on rambutan fruit from Vietnam. This is primarily because *A. tubercularis* is unlikely to be a major pest of rambutan given that no records of association with rambutan from any country could be found in publicly available scientific literature (PERAL-USDA 2011). The only recorded association of *A. tubercularis* with rambutan is from USDA interception data. USDA-PERAL (2011) states that the rambutan plant material was found in passenger baggage at USA ports, but it does not specify the plant part that was intercepted (i.e. fruit or stem or leaf). In the event of *A. tubercularis* being associated with rambutan fruit from Vietnam, this scale insect would likely occur as aggregations and mixed lifestages (particularly adult females and eggs), given that an aggregated distribution is typical of many diaspidid species (MPI 2014). Aggregated distribution can favour detection during the fruit handling and sorting phase, thereby reducing likelihood of entry. But equally the spines on rambutan create a complex architecture on the outside of the fruit, which can make it difficult to detect small pests, thereby increasing the likelihood of entry. On balance, these factors point to a low likelihood of entry for *A. tubercularis*, rather than a negligible likelihood of entry.

- It is considered that *A. tubercularis* has a negligible likelihood of exposure to a suitable host. The likelihood of exposure is considered to be negligible for two reasons. Firstly, the proportion of imported rambutan fruit that is both infested with the mobile crawler life-stage[23] and is disposed of in a manner that enables exposure is considered likely to be very low. This is on the basis that a) *A. tubercularis* is not considered to be a major pest of rambutan, hence the expected infestation rate and frequency of entry is very low, and b) fruit disposal practices in New Zealand result in ~80% of the discarded fruit and fruit peel going into land fill or in-sink disposal (Hogg et al 2010; Viggers 1993), which eliminates exposure for that portion of disposals. Secondly, the likelihood of exposure is diminished further (to negligible) because a) crawlers are fragile and mortality of this

23 Or with mature reproducing females that could yield crawlers post-border

life-stage is often extremely high, and b) despite crawlers having mobility they have limited ability to disperse (MPI 2014).

Consequently, despite the likelihood of *A. tubercularis* entering New Zealand on rambutan from Vietnam, the likelihood of *A. tubercularis* being introduced via this pathway is considered to be negligible, because exposure to a host plant is a critical step to introduction and that step is considered to have negligible likelihood of occurring. Therefore, there is no need to assess the other component of risk, i.e. the consequences of introduction.

### 4.7.2 Summary of risk of the armoured scale insect *Unaspis citri*

**Scientific name:** *Unaspis citri* Newstead (Hemiptera: Diaspididae)
**Common name/s**: citrus snow scale
**Brief description:** *U. citri* is a small armoured scale insect (adult female ~ 2.5 mm long) which occurs on the trunk and main limbs of host plants, but occasionally on leaves and fruits (AEI 2016)
**Source Risk Assessments:** This summary of risk is underpinned by the information a peer-reviewed MPI generic pest risk assessment of armoured scale insects on the fresh produce pathway (MPI 2014).

**Risk Estimation:** *U. citri* is not considered to be a risk on fresh rambutan from Vietnam because it is unlikely to be introduced into New Zealand via this pathway, on account of the exposure to a host having a negligible likelihood. The following arguments support this conclusion:

***U. citri* is considered not likely to be introduced into New Zealand via fresh rambutan from Vietnam**

- It is considered that there is a moderate likelihood that *U. citri* will enter New Zealand on rambutan fruit from Vietnam. This is primarily because it is assumed to occur in rambutan orchards in Vietnam, given that *U. citri* is known from Vietnam and does occur in rambutan orchards in another country (Costa Rica) (PFPAS 2007). In the event of *U. citri* being associated with rambutan fruit from Vietnam, this scale insect would likely occur as aggregations and mixed lifestages (particularly adult females, which are 1.5 – 2.25 mm long (Buckley & Hodges 2013) and eggs), given that an aggregated distribution is typical of many diaspidid species (MPI 2014). The infestation rate and frequency of entry of any life-stage of *U. citri* is expected to be very low on rambutan fruit, assuming *U. citri* feeding behaviour on rambutan trees is the same as in citrus trees, i.e. *U. citri* may be seen on fruit only if the population is large enough; it feeds primarily on the trunk and tree limbs (Buckley & Hodges 2013). Aggregated distribution can favour detection during the fruit handling and sorting phase, thereby reducing likelihood of entry. But equally, the spines on rambutan create a complex architecture on the outside of the fruit, which can make it difficult to detect small pests, thereby increasing the likelihood of entry. On balance, these factors point to a moderate likelihood of entry for *U. citri*. This rating (i.e. moderate likelihood) is made with high uncertainty because the occurrence of *U. citri* in Vietnamese rambutan orchards is an assumption rather than a certainty.

- As with the assessment of *A. tubercularis,* it is considered that *U. citri* has a negligible likelihood of exposure to a suitable host. The key factors in this consideration are the biology of hard-scales, fruit disposal practices in New Zealand, and the expected low infestation rate and frequency of entry of *U. citri*.

- Firstly, other than the adult winged-male, hard scales have only one life-stage that is mobile with ability to disperse to a host plant (the crawler stage). This is a major limitation to exposure (MPI 2014).
- Secondly, the proportion of imported rambutan fruit that is both infested with the mobile crawler life-stage[24] and is disposed of in a manner that enables exposure is likely to be very low. This is because the infestation rate and frequency of entry of any life-stage of *U. citri* is expected to be very low on rambutan fruit, assuming *U. citri* feeding behaviour on rambutan trees is the same as in citrus trees, i.e. *U. citri* may be seen on fruit only if the population is large enough; it feeds primarily on the trunk and tree limbs (Buckley & Hodges 2013). Furthermore, fruit disposal practices in New Zealand result in ~80% of the discarded fruit and fruit peel going into land fill or in-sink disposal (Hogg et al 2010; Viggers 1993), which eliminates exposure for that portion of disposals.
- Finally, the likelihood of exposure is diminished further (to negligible) because a) hardscale crawlers are fragile and mortality of this life-stage is often extremely high, and b) despite crawlers having mobility they have limited ability to disperse (MPI 2014).

Consequently, despite the moderate likelihood of *U. citri* entering New Zealand on rambutan from Vietnam, the likelihood of *U. citri* being introduced via this pathway is negligible, because exposure to a host plant is a critical step to introduction and that step is considered to have negligible likelihood of occurring. Therefore, there is no need to assess the other component of risk, i.e. the consequences of introduction.

### 4.7.3 Summary of risk of Mealybugs (Hemiptera: Pseudococcidae) and soft-scales (Hemiptera: Coccidae)

This summary of risk for all of the mealybugs and soft-scales listed below in Table 2 is underpinned by the information documented in the USDA risk assessment for rambutan from Vietnam (PERAL-USDA 2011), a peer-reviewed MPI generic pest risk assessment of armoured scale insects on the fresh produce pathway (which includes a risk analysis of a soft-scale insect, and a mealybug insect) (MPI 2014) and expanded hazard identification assessments in a peer-reviewed MPI import risk analysis for asparagus from Peru (MPI 2014b).

**Brief description of mealybugs and soft-scales:**
Soft scales are small wax-covered insects that attach themselves primarily to leaves, twigs or the trunk of the plant; they are phloem-feeders. Adult females typically range from 2-4 mm in length; immature crawlers are smaller. Wax colours vary and can include white, pink, grey, brown (Garcia et al 2016; CPC 2016).

Mealybugs are small insects covered in whitish powdery wax coating, often with wax threads/filaments. They are phloem-feeders and become immobile when they attach to the plant to feed, but (unlike scale insects) they can detach and move because they often retain legs. Adults females are from 2-5 mm in length (depending on species); crawlers are smaller (Garcia et al 2016; CPC 2016).

[24] Or with mature reproducing females that could yield crawlers post-border

## Table 2 Mealybugs and soft scales that were assessed for risk

| Scientific name | Other relevant scientific names | Common name/s |
|---|---|---|
| Mealybugs (Hemiptera: Pseudococcidae) | | |
| *Dysmicoccus brevipes* (Cockerell) | *Dactylopius* (*Pseudococcus*) *ananassae, Dactylopius brevipes, Dysmicoccus brevipes, Pseudococcus brevipes, Pseudococcus cannae, Pseudococcus defluiteri,Pseudococcus longirostralis, Pseudococcus missionum, Pseudococcus palauensis, Pseudococcus pseudobrevipes* (MAF 2008) | Pineapple mealybug |
| *Dysmicoccus neobrevipes* (Beardsley) | None (MAF 2008) | Grey pineapple mealybug |
| *Exallomochlus hispidus* (Morrison) | *Pseudococcus hispidus, Pseudococcus jacobsoni, Erium Hispidum, Cataenococcus hispidus, Paraputo hispidus* (Garcia et al 2016) | Cocoa mealybug |
| *Ferrisia virgata* Cockerell | *Dactylopius* spp., *Pseudococcus* spp. *Ferrisiana virgata, Heliococcus malvastrus* (MPI 2014) | Striped mealybug, grey mealybug, guava mealybug (MAF 2008) |
| *Maconellicoccus hirsutus* (Green, 1908) | *Phenacoccus hirsutus; Phenacoccus quaternus; Pseudococcus hibisci; Phenacoccus glomeratus; Pseudococcus crotolariae; Spilococcus perforatus; Paracoccus pasaniae; Maconellicoccus perforatus; Maconellicoccus pasaniae* | pink hibiscus mealybug, hibiscus mealybug, pink mealybug, hirsutus mealybug, grape mealybug, mulberry mealybug, cochenille de l'Hibiscus |
| *Nipaecoccis viridis* (Newstead) | *Dactylopius perniciosus*; *Dactylopius viridis*; *Nipaecoccus vastator*; *Pseudococcus perniciosus*; *Pseudococcus solitarius*; *Ripersia theae*; *Trionymus sericeus* (MAF 2009b) | spherical mealybug, hibiscus mealybug, karoo thorn mealybug |
| *Paracoccus interceptus* (Ezzat & McConnell) | *Allococcus morrisone, Planococcus morrisoni, Paracoccus morrisoni* (Garcia et al 2016) | Intercepted mealybug (ID tools 2016) |
| *Phenacoccus madeirensis* (Green) | *Phenacoccus grenadensis, Phenacoccus harbisoni, Phenacoccus gossypii* | Cassava mealybug |
| *Planococcus lilacinus* (Cockerell) | *Pseudococcus lilacinus, Pseudococcus tayabanus, Dactylopius crotonis, Dactylopius coffeae*; and more (Garcia et al 2016) | Cacao mealybug |
| *Planococcus litchi Cox* | None (Garcia et al 2016) | None given (Garcia et al 2016) |
| *Planococcus minor* (Maskell) | *Dactylopius calceolariae minor, Planococcus minor, Planococcus pacificus, Planococcus psidii, Pseudococcus calceolariae Minor* (MAF 2008) | Pacific mealybug, passionvine mealybug |
| *Pseudococcus aurantiacus* Williams | None (Garcia et al 2016) | Orange-coloured mealybug |
| *Pseudococcus comstocki* (Kuwana) | *Dactylopius comstocki* Kuwana, 1902 (MAF 2009a) | comstock mealybug, Japanese mealybug |
| *Pseudococcus cryptus* Hempel | *Pseudococcus citriculus*, *Pseudococcus mandarinus, Pseudococcus spathoglottidis* (MAF 2008) | Citriculus mealybug, cryptic mealybug |
| *Pseudococcus jackbeardsleyi* Gimpel & Miller | *Pseudococcus elisae* | Jack Beardsley mealybug |
| *Rastrococcus tropicasiaticus* Williams | None (Garcia et al 2016) | None given (Garcia et al 2016) |
| Soft-scale insects (Hemiptera: Coccidae) | | |
| *Ceroplastes floridensis* Comstock | *Cerostegia floridensis* (Garcia et al 2016) | Florida wax scale |
| *Ceroplastes rubens* Maskell | *Ceroplastes rubens minor* Maskell, 1897 | Red wax scale, pink wax scale |
| *Ceroplastes rusci* (Linnaeus) | *Coccus rusci, Coccus artemisiae, Coccus caricae, Calypticus radiates*, and more (Garcia et al 2016) | Fig wax scale |
| *Coccus viridis* (Green) | *Lecanium viride, Lecanium hesperidumafricanum, Lecanium viride, Coccus viridisbisexualis* and more (Garcia et al 2016) | Green scale, green coffee scale |
| *Drepanococcus chiton* (Green) | *Ceroplastodes chiton* | None given (Garcia et al 2016) |

**Risk Estimation:** Mealybugs (Pseudococcidae) and soft scales (Coccidae) are pest groups that are considered to be a risk on fresh rambutan from Vietnam because it is likely that at least one of the species listed above can establish in New Zealand via rambutan from Vietnam, and cause low to moderate economic impacts. The following arguments support this assessment:

**a) The likelihood of mealybugs and soft scales being introduced into New Zealand via rambutan from Vietnam is considered to be non-negligible.**

- The likelihood of entry of low level infestations of mealybugs or soft scale insects is considered to range from low to moderate, and the position of any given mealybug or soft scale species within this range is dependent on the prevalence of that species in commercial rambutan orchards, and on whether the species preferentially infests fruit rather than leaves, twigs etc. An assumption is made here that given the number of mealybug and soft-scales associated with rambutan [listed above] that there will be at least one species at each end of the range (low to moderate) for likelihood of entry. The likelihood of entry is not high because they can be detected during harvesting, handling, cleaning and packaging steps of the pathway. However, the cleaning of fruit is not considered sufficient to diminish the likelihood of entry to negligible because low level infestations are likely to be difficult to detect in the complex spiny architecture of rambutan fruit (MPI 2014). MPI intercepts mealy bugs and soft-scales on fresh produce at the New Zealand border (MPI 2014), demonstrating that the likelihood of entry is not negligible.

- The likelihood of mealybugs and soft-scales being exposed to a suitable host in New Zealand via this pathway is considered to range from negligible to low. The likelihood of exposure is not moderate or high because although mealybugs and soft scales have mobile stages [crawlers & adult males for both soft scales and mealybugs; plus nymphs and female adults for mealybugs]: a) their mobility is very limited (MPI 2014); and b) the mobile crawler stage is delicate and susceptible to extremes of temperature, dessication, rain, and predation (MPI 2014), and these are barriers to the mobile stages surviving long enough to enable exposure to occur.

  The position of each species in the range from negligible to low has not been assessed for individual species, but would be influenced by:

  a) infestation rates in orchards in Vietnam, because this will affect the proportion of imported rambutan that is both infested [particularly with the mobile stage, crawlers] and disposed of in a manner that allows exposure to occur. Infestation rates in Vietnamese rambutan orchards were not known during this risk assessment.
  b) availability of hosts: hosts would likely be available for highly polyphagous species [e.g. mealybugs: *F. virgata* (MPI 2014b); *M. hirsutus* (MPI 2014); e.g. the soft scale *Ceroplastes rubens* (MPI 2014)].
  c) developmental thresholds: it is likely that temperature conditions in many parts of New Zealand and during winter especially, would be below the lower threshold for crawler development for some species [e.g. *Ceroplastes rubens* (MPI 2014)].
  d) in the case of mealybugs, mobility is not limited just to the crawler stage (unlike scale insects) - nymphs and adults are also capable of moving (MPI 2014) and so they would have the ability to move off discarded rambutan peel or fruit if it was no longer providing sufficient nutrition to the nymph/adult stage;

- The likelihood of establishment of soft-scales and mealybugs is considered to be low (for species that have a strictly sexual reproductive lifecycle) or moderate (for species that can reproduce parthenogenetically). A strictly sexual reproductive lifecycle limits the likelihood of establishment to low because a mature male and mature female need to find each other and successfully mate – and the likelihood of this is considered to be low because of the chain of events that would need to occur. Species that can reproduce parthenogenetically do not require a mating pair to find each other, and so the likelihood of establishment is elevated to moderate - but the likelihood is not considered to be high because the parthenogenetic insect must still survive to reproductive maturity and this is not guaranteed because there are a range of factors that can cause mortality (e.g. caused by predators, unsuitable environmental/climatic conditions). The suitability of climatic conditions has not been considered for all of the scale and mealybug species listed above. However, given that the climate is suitable for some mealybug species [albeit within restricted range e.g. the far North)] (MPI 2014; MPI 2014b), it is assumed that there will be suitable climatic conditions in at least some regions within New Zealand for the other species too.

**b) Soft scales and mealybugs are considered likely to have low to moderate economic consequences in New Zealand (depending on climatic suitability)**

Soft scales and mealybugs cause economic damage directly by feeding on sap, and indirectly by producing honeydew, which promotes growth of sooty mould. Heavy infestations reduce photosynthetic efficiency of hosts, curbing growth and disfiguring fruit (Ben-Dov & Hodgson 1997; CPC 2016). Depending on the species of soft scale and mealybug, the economic consequence of an establishment in New Zealand is likely to range from low to moderate. The position of any given soft-scale or mealybug species within the range of low to moderate economic impact is primarily dependent on the population densities that could occur in New Zealand and this is likely to be determined primarily by climate suitability; but it can also be dependent on the range of hosts it affects. The economic impacts are not considered to be negligible because many of the species listed are highly polyphagous [e.g. mealybugs *F. virgata, M. hirsutus;* and the soft-scale *C. rubens* (MPI 2014; MPI 2014b)] and so have potential to affect many commercial fruit and vegetable crops in New Zealand (including, for example, citrus, apple, stonefruit, kiwifruit, avocado, grapevine, cauliflower, tomato). For species that do not develop high population densities (due to sub-optimal climatic conditions) the likely economic impacts are considered to be low, irrespective of whether the species are polyphagous or not.

Based on previous MPI assessments of mealybugs and soft scales (MPI 2016) the environmental consequences of mealybugs and soft scales are considered to range from low to moderate. The nature of the impact will likely be that some native plant species will be suitable hosts; there may be sooty mould growth and/or ecosystem changes due to changes in population sizes of honeydew feeders in natural ecosystems and associated knock-on effects (MPI 2014). Socio-cultural impacts are likely to range from negligible to low (MPI 2016), and can include some damage to amenity plants and to home crops by the insects feeding on and weakening plants, transmitting viruses, secreting honeydew and attracting ants (MPI 2014). This might add to pest control costs for home gardeners. Human health consequences are considered to be neglible (MPI 2016).

## References for Chapter 4.7

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## 4.8 Hitchhikers - Ants: *Oecophylla smaragdina* and *Technomyrmex albipes*

### *4.8.1* Summary of risk of *Oecophylla smaragdina* on rambutan from Vietnam

**Scientific name:** *Oecophylla smaragdina* (Fabricius) (Hymenoptera: Formicidae)
**Common name/s**: green ant; Asian weaver ant; red tree ant
**Brief description:** *O. smaragdina* is a tree dwelling ant
**Source Risk Assessments:** This summary of risk is underpinned by the information documented in a peer-reviewed MPI pest risk assessment of another ant species (*Solenopsis geminata*) (MPI 2014) and other sources of publicly available literature.

**Risk Estimation:** *O. smaragdina* is not considered to be a risk on fresh rambutan from Vietnam because it is considered not likely be introduced into New Zealand via this pathway. The following arguments support this assessment:

***O. smaragdina* is considered not likely to be introduced into New Zealand via fresh rambutan from Vietnam**

- Although *O. smaragdina* (a tree ant) is a known inhabitant of rambutan trees (Tindall 1994; Astridge 2006; Tsuji et al 2004) and is known from Vietnam (PERAL-USDA 2011), it is considered that there is only a low likelihood that occasionally individual adult ants will enter New Zealand on this pathway. This is because the ants are 0.5-1.0 cm in length (OzAnimals 2016), thus big enough to be seen, and so the majority of ants on fruit are likely to be detected and removed during the preparation of fruit for export. The likelihood is not negligible because ants are known to be associated with imported fruit (including the related fruit litchi), indicating that despite their size, ants can sometimes avoid detection during the fruit handling and sorting phase (MPI interception data).

- *O. smaragdina* is considered to have a moderate likelihood of being exposed to food sources in New Zealand via this pathway. This is because ants are highly mobile and likely to move off rambutan fruit in search of food (MPI 2014). *O. smaragdina* is a polyphagous predator (Tindall 1994; Tsuji et al 2004) so suitable food is likely to be available near outdoor markets and rambutan disposal sites (MPI 2014).

- *O. smaragdina* is considered to have a very low likelihood of establishment in New Zealand via rambutan from Vietnam because this would require entry of either a nest of *O. smaragdina* ants (which has a negligible likelihood), or entry of a mated queen ant, followed by that queen successfully locating a suitable nesting site to start a new colony. Colony establishment by a queen ant would be severely restricted because *O. smaragdina* is an ant of tropical origins and distribution (current geographic distribution is India, South-east Asia, and northern Australia) and so the temperatures in New Zealand would likely restrict brood development and foraging activity (MPI 2014).

In consideration of *O. smaragdina* individuals having a low likelihood of entering, a moderate likelihood of exposure to a food source, and a very low likelihood of establishment via this pathway, it is considered that the overall likelihood of *O. smaragdina* being introduced to New Zealand via this pathway is negligible. Therefore, there is no need to assess the other component of risk, i.e. the consequences of introduction.

### *4.8.2* Summary of risk of *Technomyrmex albipes* on rambutan from Vietnam

**Scientific name:** *Technomyrmex albipes* (Smith 1861) (Hymenoptera: Formicidae) [25]

**Other relevant scientific names:** *Formica albipes, Tapinoma albipes* (Smith) and others

**Common name/s**: white footed ant

**Brief description:** *T. albipes* is a dark-coloured medium sized ant (~2-4 mm in length), that nests and forages both terrestrially and arboreally. They attend a wide range of sap-sucking hemipteran for honeydew (Bolton 2007).

**Source Risk Assessments:** This summary of risk is underpinned by the information documented in a peer-reviewed MPI import risk assessment of another ant species (*Solenopsis geminata*) (MPI 2014) and other sources of publicly available literature.

**Risk Estimation:** *T. albipes* is not considered to be a risk on fresh rambutan from Vietnam because it is not likely be introduced into New Zealand via this pathway. The following arguments support this assessment:

***T. albipes* is considered not likely to be introduced into New Zealand via rambutan from Vietnam**

- It is considered that there is only a very low likelihood that occasionally individual adult ants of *T. albipes* will enter New Zealand on this pathway. This is because the prevalence of *T. albipes* in rambutan orchards in Vietnam is assumed to be very low, given that no records were found in the usual information sources[26]. The likelihood of entry is not considered to be negligible because there is a known association between *T. albipes* and commercial rambutan, albeit in another country (USA), thus indicating the potential for the association to occur in Vietnam. *T. albipes* is recorded from Vietnam (Bolton 2007); and *T. albipes* has previously been intercepted on commercial rambutan from another country (USA - Hawaii) (CDFA 2008), where *T. albipes* does apparently occur in tropical fruit orchards (Souza et al 2008). Furthermore, these ants may avoid detection during the fruit handling and sorting phase of commercial production of rambutan because they are small (2-4 mm in length) and mobile (ISSG 2016).
- It is considered that *T. albipes* has a moderate likelihood of being exposed to food sources in New Zealand via this pathway. This is because ants are highly mobile and likely to move off rambutan fruit in search of food (MPI 2014). Although *T. albipes* primarily feeds on plant nectars and honeydew (ISSG 2016), assuming foraging and feeding behaviour is similar to other *Technomyrmex* species, it is likely to also feed on dead insects and other protein (UF-IFAS 2016). Consequently, suitable food is likely to be available near outdoor markets and rambutan disposal sites (MPI 2014).
- Just like *O. smaragdina*, *T. albipes* is considered to have a very low likelihood of establishment in New Zealand via rambutan from Vietnam because this would require entry of either a nest of *T. albipes* ants (which has a negligible likelihood), or entry of a mated queen ant, followed by that queen successfully locating a suitable nesting site to

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25 A recent revision of the genus by Bolton (2007) has shown that the ants formerly called *T. albipes* in NZ and Australia were not *T. albipes* but *T. jocosus* (i.e. it was a long standing mis-identification). *Technomyrmex albipes* remains a valid name and is distributed in Africa and tropical Asia. Full details of the key reference are: Bolton, B. (2007). Taxonomy of the Dolichoderinae ant genus *Technomyrmex* (Hymenoptera: Formicidae) based on the worker caste. Contributions of the American Entomological Institute. 35 (1): 150pp. (PPIN record for *T. jocosus*, 2016)

26 CAB Abstracts, google, google scholar, publications about rambutan cultivation.

start a new colony. Colony establishment would be restricted because the current geographical range of *T. albipes* indicates that warm tropical climates are optimal (AntWeb 2016) and so the temperatures in New Zealand would restrict brood development and foraging activity (MPI 2014).

In consideration of *T. albipes* individuals having a very low likelihood of entering, a moderate likelihood of exposure to a food source, and a very low likelihood of establishment via this pathway, it is considered that the overall likelihood of *T. albipes* being introduced to New Zealand via this pathway is negligible. Therefore, there is no need to assess the other component of risk, i.e. the consequences of introduction.

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# Appendix 1 Hazard identification of organisms that have been associated with *Nephelium lappaceum* and reported in Vietnam

Table 3 summarises the Hazard Identification data for the pathway of fresh rambutan from Vietnam to New Zealand. Note that the hazard conclusion for an organism in Table 3 is not necessarily applicable to the same organism on other pathways.

The pests in the shaded rows are considered to be **hazards** on Rambutan imported from Vietnam into New Zealand. The term 'hazard' used here has a specific meaning within the framework of pest risk analysis at MPI. In accordance with the MPI risk analysis procedures the term 'hazard' is equivalent to the ISPM11 definition: "has potential to be a quarantine pest", where 'quarantine pest' is defined by the IPPC as 'a pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled'.

Refer to Section 3.2 for a collated list of the organisms considered to be hazards on this pathway.

The main source of data underpinning the analysis of pest hazard status was the United States Department of Agriculture risk assessment (PERAL-USDA 2011), entitled "Importation of Fresh Fruit of Litchi (*Litchi chinensis*), Longan (*Dimocarpus longan*), and Rambutan (*Nephelium lappaceum*) into the Continental United States from ASEAN Countries". The hazard analysis by PERAL-USDA (2011) has been adapted for the New Zealand PRA area. Specifically, a) the list of organisms assessed for hazard status in New Zealand was derived from Table 5 in PERAL-USDA (2011); and b) some further analysis and data collection was required to determine whether the organisms were hazards (quarantine pests) for New Zealand. Refer to Section 3.1 for a description of the process used.

Table 3 Table summarising Hazard Identification data

[NR = not recorded; ND = Not determined]

| Organism | Present in New Zealand | Present in Vietnam | Continue | Association with Rambutan (*Nephelium lappaceum)* plant | Association with Rambutan fruit | Hazard conclusion | Implications for next step, i.e. risk assessment stage. |
|---|---|---|---|---|---|---|---|
| Arachnida (spiders) | | | | | | | |
| None identified | - | - | - | - | - | - | |
| Acari (mites) | | | | | | | |
| *Aceria litchi* [Eriophyidae] | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | No; PERAL-USDA 2011; No records found; Google, google scholar. | - | No | Exclude: insufficient evidence of association with commodity |
| *Brevipalpus lewisi* [Tenupalpidae] | Not recorded; PPIN 2015, Gordon 2010 | No record found; Google, google scholar, CPC | - | Yes, Astridge 2006 | - | No | Exclude: no record of presence in Vietnam |
| *Brevipalpus phoenicis* (Geijskes) [Tenupalpidae] | Yes; PPIN 2015; but regulated due to vector status | Yes, PERAL-USDA 2011 | Yes | Yes; PERAL-USDA 2011 | Yes; PERAL-USDA 2011 | No | Exclude: no evidence was found that the viruses vectored by this mite are known from Vietnam (Google; Google scholar, CAB abstracts, DVP web; Berry & Fan 2012). |
| *Eutetranychus orientalis* (Klein) [Tetranychidae] | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | As hitchhiker. Main association is with leaf. | Yes | Assess risk. |
| *Oulenziella* sp. [Winterschmidtiidae] | Not determined | No record found; Google, | - | Yes, Shimizu et al 2004 | - | No | Exclude: no record of presence in Vietnam |

| Organism | Present in New Zealand | Present in Vietnam | Continue | Association with Rambutan (*Nephelium lappaceum)* plant | Association with Rambutan fruit | Hazard conclusion | Implications for next step, i.e. risk assessment stage. |
|---|---|---|---|---|---|---|---|
| | | google scholar, CAB abstracts | | | | | |
| *Sellnickia caudata* [Oribatulidae] | Yes; PPIN 2015, | No, Ermilov 2015 | - | Yes, Astridge 2006 | - | No | Exclude: no record of presence in Vietnam |
| *Tetranychus urticae* Koch, 1836 [Tetranychidae] | Yes; PPIN 2015 | Yes, PERAL-USDA 2011 | No | - | - | No | Exclude: present in NZ and doesn't meet criteria for further work. |
| *Tetranychus cinnabarinus* [Tetranychidae] | Yes; Gordon 2010 | Yes, Janick 1994 | No | - | - | No | Exclude: present in NZ and doesn't meet criteria for further work. |
| Coleoptera (beetles) | | | | | | | |
| *Adoretus compressus* (Weber) [Scarabaeidae] | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011. Only adults (~1 cm) feed on fruit; All other life stages occur in soil (McQuate & Jameson 2011) | No | Exclude: adults unlikely to stay on commodity due to size and mobility. This agrees with USDA conclusion. |
| *Anomala antiqua* [Scarabaeidae] | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | No, PERAL-USDA 2011 | No | Exclude: insufficient evidence of association with commodity |
| *Anomala cupripes* Hope [Scarabaeidae] | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | No, PERAL-USDA 2011 | No | Exclude: insufficient evidence of association with commodity |
| *Hypomeces squamosus* (Fabricius) [Ciruculionidae] | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | No, PERAL-USDA 2011 | No | Exclude: insufficient evidence of association with commodity |
| *Xylopsocus capucinus* Fabricius | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | No, PERAL-USDA 2011 | No | Exclude: insufficient evidence of association with commodity |

| Organism | Present in New Zealand | Present in Vietnam | Continue | Association with Rambutan (*Nephelium lappaceum)* plant | Association with Rambutan fruit | Hazard conclusion | Implications for next step, i.e. risk assessment stage. |
|---|---|---|---|---|---|---|---|
| [Bostrichidae] | | | | | | | |
| Diptera (flies) | | | | | | | |
| *Bactrocera dorsalis* (Hendel) [Tephritidae] | Not recorded; PPIN 2015 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011 | Yes | Assess risk. |
| *Ceratitis capitata* (Wiedemann) [Tephritidae] | No (eradicated); PPIN 2015; Not recorded; Gordon 2010 | Not recorded; Google, Google scholar, CPC 2015 | No | - | - | No | Exclude: no records of presence in Vietnam |
| Gastropoda (snails) | | | | | | | |
| None identified | - | - | - | - | - | - | - |
| Hemiptera (aphids, bugs, mealybugs, scale insects, whiteflies) | | | | | | | |
| *Aleuroclava bifurcata* (Corbett) 1933 [Aleyrodidae] | Not determined | No record found; Google, Google scholar | - | Yes, Evans 2007 | - | No | Exclude: no records of presence in Vietnam |
| *Aleuroclava nephelii* (Corbett) 1935 [Aleyrodidae] | Not determined | No record found; Google, Google scholar | - | Yes, Evans 2007 | - | No | Exclude: no records of presence in Vietnam |
| *Aleuroplatus cococolus* Quaintance & Baker 1917 [Aleyrodidae] | Not determined | No record found; Google, Google scholar | - | Doubtful host association record. Evans (2007) records it on an unspecified species of the *Nephelium* genus. | - | No | Exclude: no records of presence in Vietnam, and doubtful host association |
| *Aleurotrachelus lumparensis* Corbett 1935 [Aleyrodidae] | Not determined | No record found; Google, Google scholar | - | Yes, Evans 2007 | - | No | Exclude: no records of presence in Vietnam |
| *Amblypelta lutescens* Dist. | Not determined | No record found; Google, | - | Yes; Janick 1994 | - | No | Exclude: no record of presence in Vietnam |

| Organism | Present in New Zealand | Present in Vietnam | Continue | Association with Rambutan (*Nephelium lappaceum)* plant | Association with Rambutan fruit | Hazard conclusion | Implications for next step, i.e. risk assessment stage. |
|---|---|---|---|---|---|---|---|
| [Pentatomidae] | | google scholar, CAB Abstracts | | | | | |
| *Aulacaspis tubercularis* Newstead [Diaspididae] | Not recorded; PPIN 2015 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011 Intercepted with rambutan (unspecified plant part) at US border. However, USDA concluded it was not a hazard because of lack of fruit association in literature | Yes | Assess risk. |
| *Bemisia tabaci* (Gennadius, 1889) [Aleyrodidae] | Yes; PPIN 2015. But regulated due to ability to vector viruses | Yes | Yes | Yes, EPPO 2007 | Yes, EPPO 2007. This one interception record was from a mixed consignment (*Nephelium lappaceum* and *Polygonum*) and is the only host association record found. No additional records of host association in CAB Abstracts, Google, Google scholar, CPC, EPPO Global database, PERAL-USDA 2011. | No | Exclude: insufficient evidence of association with commodity |
| *Ceroplastes ceriferus* (Fabricius) [Coccidae] | Yes; PPIN 2015 | Yes, PERAL-USDA 2011 | No | - | - | No | Exclude: present in NZ and doesn't meet criteria for further work. |
| *Ceroplastes floridensis* Comstock [Coccidae] | Not recorded; PPIN 2015, Gordon 2010 CPC (2015) says it is in NZ, but this is incorrect and not verified. | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Yes; association with fruit is assumed, based on other species of this genus being associated with fruit | Yes | Assess risk. |

| Organism | Present in New Zealand | Present in Vietnam | Continue | Association with Rambutan (*Nephelium lappaceum)* plant | Association with Rambutan fruit | Hazard conclusion | Implications for next step, i.e. risk assessment stage. |
|---|---|---|---|---|---|---|---|
| *Ceroplastes rubens* Maskell [Coccidae] | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011 | Yes | Assess risk. |
| *Ceroplastes rusci* (Linnaeus) [Coccidae] | Not recorded; PPIN 2015, Gordon 2010 | Yes; Vu et al 2006 | Yes | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011 | Yes | Assess risk. |
| *Cervaphis rappardi* Hille Ris Lambers [Aphididae] | Not determined | No record found; Google, google scholar, CAB Abstracts | - | http://www.aphidsonworldsplants.info/d_APHIDS_C.htm | - | No | Exclude: no record of presence in Vietnam |
| *Coccus hesperidum* Linnaeus [Coccidae] | Yes; PPIN 2015 | Yes, PERAL-USDA 2011 | No | - | - | No | Exclude: present in NZ and doesn't meet criteria for further work. |
| *Coccus viridis* (Green) [Coccidae] | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011 | Yes | Assess risk. |
| *Dialeurodes gemurohensis* Corbett 1935 [Aleyrodidae] | Not determined | No record round; google, google scholar | - | Yes, Evans 2007 | - | No | Exclude: no record of presence in Vietnam |
| *Drepanococcus chiton* (Green) [Coccidae] | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011 | Yes | Assess risk. |
| *Dysmicoccus brevipes* (Cockerell) [Pseudococcidae] | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Yes; association with fruit is assumed, based on other species of this genus being associated with fruit | Yes | Assess risk. |
| *Dysmicoccus lepelleyi* (Betrem) [Pseudococcidae | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | No, PERAL-USDA 2011 & Garcia et al 2015 | No | Exclude: insufficient evidence of association with commodity |

| Organism | Present in New Zealand | Present in Vietnam | Continue | Association with Rambutan (*Nephelium lappaceum)* plant | Association with Rambutan fruit | Hazard conclusion | Implications for next step, i.e. risk assessment stage. |
|---|---|---|---|---|---|---|---|
| *Dysmicoccus neobrevipes* Beardsley [Pseudococcidae] | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011 | Yes | Assess risk. |
| *Exallomochlus hispidus* (Morrison) [Pseudococcidae] | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011 | Yes | Assess risk. |
| *Ferrisia virgata* (Cockerell) [Pseudococcidae] | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011 | Yes | Assess risk. |
| *Hemiberlesia lataniae* (Signoret) [Diaspididae] | Yes, PPIN 2015 | Yes, PERAL-USDA 2011 | No | - | - | No | Exclude: present in NZ and doesn't meet criteria for further work. |
| *Hemiberlesia rapax* (Comstock) [Diaspididae] | Yes, PPIN 2015 | Yes, PERAL-USDA 2011 | No | - | - | No | Exclude: present in NZ and doesn't meet criteria for further work. |
| *Hordeolicoccus heterotrichus* Williams [Pseudococcidae] | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | No, PERAL-USDA 2011 | No | Exclude: insufficient evidence of association with commodity |
| *Hordeolicoccus nephelii* (Takahashi) [Pseudococcidae] | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | No, PERAL-USDA 2011 | No | Exclude: insufficient evidence of association with commodity |
| *Icerya purchasi* Maskell [Margarodidae] | Yes, PPIN 2015 | Yes, PERAL-USDA 2011 | No | - | - | No | Exclude: present in NZ and doesn't meet criteria for further work. |
| *Maconellicoccus hirsutus* (Green) [Pseudococcidae] | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011 | Yes | Assess risk. |
| *Nipaecoccus viridis* (Newstead) [Pseudococcidae] | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011 | Yes | Assess risk. |

| Organism | Present in New Zealand | Present in Vietnam | Continue | Association with Rambutan (*Nephelium lappaceum)* plant | Association with Rambutan fruit | Hazard conclusion | Implications for next step, i.e. risk assessment stage. |
|---|---|---|---|---|---|---|---|
| *Ozophora consanquinea* [Rhyparochromidae] | Not recorded; PPIN 2015, Gordon 2010 | No record found; Google, google scholar, CAB Abstracts | - | Yes, USCBP 2015 | - | No | Exclude: no record of presence in Vietnam |
| *Paracoccus interceptus* Lit [Pseudococcidae] | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011 | Yes | Assess risk. |
| *Phenacoccus madeirensis* Green [Pseudococcidae] | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011 Associated with fruit, trunk, leaves & fruit, but preferably infests lower surface of leaves. Longo et al 1995, cited in Kaydan et al 2012 | Yes | Assess risk. |
| *Phenacoccus solani* Ferris [Pseudococcidae] | No; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | No, Garcia et al 2015 | No | Exclude: insufficient evidence of association with commodity |
| *Planococcus citri* (Risso) [Pseudococcidae] | Yes, PPIN 2015. But regulated due to vector status | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011 | No | Exclude: no evidence was found that the viruses vectored by this mealybug are a hazard on this pathway (they are either in NZ, or not known from Vietnam or rambutan) |
| *Planococcus lilacinus* (Cockerell) [Pseudococcidae] | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011 | Yes | Assess risk. |
| *Planococcus litchi* Cox [Pseudococcidae] | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011 Plant part association is based on data for the genus. | Yes | Assess risk. |

| Organism | Present in New Zealand | Present in Vietnam | Continue | Association with Rambutan (*Nephelium lappaceum)* plant | Association with Rambutan fruit | Hazard conclusion | Implications for next step, i.e. risk assessment stage. |
|---|---|---|---|---|---|---|---|
| *Planococcus minor* (Maskell) [Pseudococcidae] | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011 | Yes | Assess risk. |
| *Prococcus acutissimus* (Green) [Coccidae] | No, PPIN 2015; Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | No, PERAL-USDA 2011, Garcia et al 2015 | No | Exclude: insufficient evidence of association with commodity |
| *Pseudaonidia trilobitiformis* (Green) [Diaspididae] | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | No, PERAL-USDA 2011 | No | Exclude: insufficient evidence of association with commodity |
| *Pseudaulacaspis pentagona* (Targioni) [Diaspididae] | No, PPIN 2015 | Yes, Garcia et al 2015 | Yes | No. Doubtful host association.<br>ScaleNet reports *Nephelium* but not the species (Garcia et al 2015) (there are 125 spp in *Nephelium*) (Plantwise 2015).<br><br>Other secondary sources (e.g. CPC and Plantwise) have “Nephelium (rambutan)” on host list but considered unreliable as no primary source is referenced. | Infests fruit of many plant species (MPI 2015) | No | Exclude: insufficient evidence of association with commodity |
| *Pseudococcus aurantiacus* Williams [Pseudococcidae] | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011 | Yes | Assess risk. |
| *Pseudococcus baliteus* Lit in Lit & Calilung | Not determined | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | No, PERAL-USDA 2011 | No | Exclude: insufficient evidence of association with commodity |

| Organism | Present in New Zealand | Present in Vietnam | Continue | Association with Rambutan (*Nephelium lappaceum)* plant | Association with Rambutan fruit | Hazard conclusion | Implications for next step, i.e. risk assessment stage. |
|---|---|---|---|---|---|---|---|
| [Pseudococcidae] | | | | | | | |
| *Pseudococcus comstocki* (Kuwana) [Pseudococcidae] | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011 | Yes | Assess risk. |
| *Pseudococcus cryptus* Hempel [Pseudococcidae] | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011 | Yes | Assess risk. |
| *Pseudococcus jackbeardsleyi* Gimpel & Miller [Pseudococcidae] | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011 | Yes | Assess risk. |
| *Pseudococcus longispinus* (Targioni Tozzetti) [Pseudococcidae] | Yes, Gordon 2010. But regulated due to vector status. | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011 | No | No evidence that the viruses this mealybug vectors are known from Vietnam |
| *Rastrococcus spinosus* (Robinson) [Pseudococcidae] | Not determined | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011 but reference is dubious | No | Evidence for association with fruit is weak; only one vague, non-specific reference & never intercepted |
| *Rastrococcus tropicasiaticus* Williams [Pseudococcidae] | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011 | Yes | Assess risk. |
| *Tessaratoma javanica* (Thunberg) [Pentatomidae] | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011 USDA concluded not a hazard due to size, biology & mobility | Yes | Assess risk. Nymph & adult feed on fruit. First instar nymphs are small (0.5 cm long), adults are big (2.5 cm) & mobile |
| *Tessaratoma longicorne* Dohrn. [Pentatomidae] | Not determined | No record found; Google, google scholar, CAB Abstracts | - | Yes, Janick 1994 | - | No | Exclude: no record for presence in Vietnam |

| Organism | Present in New Zealand | Present in Vietnam | Continue | Association with Rambutan (*Nephelium lappaceum)* plant | Association with Rambutan fruit | Hazard conclusion | Implications for next step, i.e. risk assessment stage. |
|---|---|---|---|---|---|---|---|
| *Tessaratoma papillosa* (Drury) [Pentatomidae] | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011 USDA concluded not a hazard due to size, biology & mobility | Yes | Assess risk. |
| *Toxoptera aurantii* (Boyer de Fonscolombe) [Aphididae] | Yes, PPIN 2015 | Yes, PERAL-USDA 2011 | No | - | - | No | Exclude: present in NZ and doesn't meet criteria for further work. |
| *Tuberaleyrodes rambutana* Takahashi 1955 [Aleyrodidae] | Not determined | No record found; Google, google scholar | - | Yes, Evans 2007 | - | No | Exclude: no record for presence in Vietnam |
| *Unaspis citri* [Diaspididae] | No, PPIN 2015 | Yes, Garcia 2015 | Yes | Yes, Garcia et al 2015 Mainly trunk, limbs, branches | Yes, Garcia et al 2015 Only occasional infestations of fruit and leaves (Citrus) | Yes | Assess risk. |
| Hymenoptera (sawflies, wasps, bees, ants) | | | | | | | |
| *Oecophylla smaragdina* (Fabricius) [Formicidae] | No, PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011; Janick 1994 | Yes | Yes, PERAL-USDA 2011 | Yes, based on general association of ants with honeydew of scale insects | Yes | Assess risk |
| *Technomyrmex albipes* (Smith, F. 1861) [Formicidae] | No, Landcare Research 2015; PPIN 2016 has old 'yes' records, based on a longstanding misidentification, explained by | Yes, http://www.antwiki.org/wiki/Vietnam | Yes | Yes, CDFA 2008 | Yes, CDFA 2008 Biological association with scale insects associated with Rambutan | Yes | Assess risk. |

| Organism | Present in New Zealand | Present in Vietnam | Continue | Association with Rambutan (*Nephelium lappaceum)* plant | Association with Rambutan fruit | Hazard conclusion | Implications for next step, i.e. risk assessment stage. |
|---|---|---|---|---|---|---|---|
| | Landcare 2015 & Bolton 2007 | | | | | | |
| Lepidoptera (butterflies, moths) | | | | | | | |
| *Achaea janata* (Linnaeus) [Noctuidae] | Not recorded PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011 | No | Exclude: only the adult feeds on fruit, so highly unlikely to stay on fruit during processing due to mobility |
| *Adoxophyes privatana* Walker [Tortricidae] | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | No, PERAL-USDA 2011 | No | Exclude: no evidence of association with commodity |
| *Archips micaceana* (Walker) [Tortricidae] | Not determined | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | No, PERAL-USDA 2011 | No | Exclude: no evidence of association with commodity |
| *Attacus atlas* (Linnaeus) [Saturniidae] | Not determined | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | No, PERAL-USDA 2011 | No | Exclude: no evidence of association with commodity |
| *Autoba* spp. [Erebidae] | Not determined | No, PERAL-USDA 2011 | - | Yes, Janick 1994 | No, PERAL-USDA 2011 | No | Exclude: no evidence of association with commodity |
| *Conogethes punctiferalis* (Guenée) [Pyralidae] | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011 Larvae bore into the fruit as the fruit matures (PERAL-USDA 2011) | Yes | Assess risk. Internal pest. |
| *Cryptoblabes gnidiella* Millière [Pyralidae] | Not determined | No record found; Google, google scholar, CAB Abstracts | - | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011 | No | Exclude: no record of presence in Vietnam |
| *Conopomorpha cramerella* Snellen [Gracillariidae] | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011 Internal pest (PERAL-USDA 2011; Janick 1994) | Yes | Assess risk. |

| Organism | Present in New Zealand | Present in Vietnam | Continue | Association with Rambutan (*Nephelium lappaceum)* plant | Association with Rambutan fruit | Hazard conclusion | Implications for next step, i.e. risk assessment stage. |
|---|---|---|---|---|---|---|---|
| *Cryptophlebia ombrodelta* [Tortricidae] | Not recorded; PPIN 2015, Gordon 2010 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011 Internal pest (McQuate et al 2000) | Yes | Assess risk. |
| *Cryptophlebia illepida* (Butler) [Tortricidae] | Not determined | No record found; Google, google scholar, CAB Abstracts | - | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011 Internal pest | No | Exclude: no record of presence in Vietnam |
| *Dudusa nobilis* [Notodontidae] | Not determined | Yes, BOLD Systems 2015 | - | Janick 1994 | No, PERAL-USDA 2011 | No | Exclude: no evidence of association with commodity |
| *Eublemma versicolor* Walker [Erebidae] | Not determined | No, PERAL-USDA 2011 | - | Janick 1994 | No, PERAL-USDA 2011 | No | Exclude: no evidence of association with commodity |
| *Eudocima fullonia* (Clerck) [Noctuidae] | Yes, as a vagrant, Gordon 2010 | Yes, PERAL-USDA 2011 | No | - | - | No | Exclude: only adult associated with fruit. So highly unlikely to stay on fruit during processing due to mobility |
| *Eudocima salaminia* (Cramer) [Noctuidae] | Not determined | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011 | No | Exclude: only adult associated with fruit. So highly unlikely to stay on fruit during processing due to mobility |
| *Euproctis scintillans* (Walker) [Lymantriidae] | Not determined | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | No, PERAL-USDA 2011 | No | Exclude: no evidence of association with commodity |
| *Homona coffearia* (Nietner) [Tortricidae] | Not determined | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | No, PERAL-USDA 2011 | No | Exclude: no evidence of association with commodity |

| Organism | Present in New Zealand | Present in Vietnam | Continue | Association with Rambutan (*Nephelium lappaceum)* plant | Association with Rambutan fruit | Hazard conclusion | Implications for next step, i.e. risk assessment stage. |
|---|---|---|---|---|---|---|---|
| *Melanitis leda ismene* Cramer [Nymphalidae] | Not determined | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | No, PERAL-USDA 2011 | No | Exclude: no evidence of association with commodity |
| *Neostauropus alternus* Walker [Notodontidae] | Not determined | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | No, PERAL-USDA 2011 | No | Exclude: no evidence of association with commodity |
| *Ophiusa coronata* (Fabricius) [Noctuidae] | Not determined | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011 | No | Eclude: Adult only associated with fruit, external feeder. So highly unlikely to stay on fruit during processing due to mobility |
| *Orgyia postica* (Walker) [Lymantriidae] | Not determined | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | No, PERAL-USDA 2011 | No | Exclude: no evidence of association with commodity |
| *Oxyodes scrobiculata* Fabricius [Noctuidae] | Not determined | No, PERAL-USDA 2011 | - | Yes, Janick 1994 | - | No | Exclude: no record of presence in Vietnam |
| *Parasa lepida* (Cramer) [Limacodidae] | Not determined | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | No, PERAL-USDA 2011 | No | Exclude: no evidence of association with commodity |
| *Scopelodes testacea* Butler [Limacodidae] | Not determined | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | No, PERAL-USDA 2011 | No | Exclude: no evidence of association with commodity |
| *Serrodes* spp. [Erebidae] | Not determined | No, PERAL-USDA 2011 | - | Yes, Janick 1994 | - | No | Exclude: no record of presence in Vietnam |

| Organism | Present in New Zealand | Present in Vietnam | Continue | Association with Rambutan (*Nephelium lappaceum)* plant | Association with Rambutan fruit | Hazard conclusion | Implications for next step, i.e. risk assessment stage. |
|---|---|---|---|---|---|---|---|
| *Setora nitens* Walker [Limacodidae] | Not determined | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | No, PERAL-USDA 2011 | No | Exclude: no evidence of association with commodity |
| *Statherotis discana* (Felder & Rogenhofer) [Tortricidae] | Not determined | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | No, PERAL-USDA 2011 | No | Exclude: no evidence of association with commodity |
| *Stauropus alternus* (Walker) [Notodontidae] | Not determined | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | No, PERAL-USDA 2011 | No | Exclude: no evidence of association with commodity |
| *Tirathaba mundella* Walker [Pyralidae] | Not determined | No record found; Google, google scholar, CAB Abstracts; No, PERAL-USDA 2011 | No | - | - | No | Exclude: no record of presence in Vietnam |
| Orthoptera (crickets, grasshoppers) | | | | | | | |
| *Chondracis rosea* (De Geer) [Acrididae] | Not recorded PPIN 2016 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | No, PERAL-USDA 2011 | No | Exclude: no evidence of association with commodity |
| Thysanoptera (thrips) | | | | | | | |
| *Thrips hawaiiensis* Morgan [Thripidae] | No; PPIN 2015 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Main association is with flowers, CPC 2015. Hitchhiker potential | Yes | Assess risk. |
| *Scirtothrips dorsalis* [Thripidae] | Not recorded; PPIN 2015, Gordon 2010 | Yes, CPC 2015 | Yes | Yes, CPC 2015 | Yes, CPC 2015. Feeds on young fruits; not reported feeding on mature | Yes | Assess risk. |

| Organism | Present in New Zealand | Present in Vietnam | Continue | Association with Rambutan (*Nephelium lappaceum)* plant | Association with Rambutan fruit | Hazard conclusion | Implications for next step, i.e. risk assessment stage. |
|---|---|---|---|---|---|---|---|
| | | | | | host tissues (CPC 2015). Hitchhiker potential | | |
| *Selenothrips rubrocinctus* [Thripidae] | Not determined | No record found; Google, google scholar, CAB Abstracts; No, PERAL-USDA 2011 | - | Yes, http://www.nt.gov.au/d/Content/File/p/Plant_Pest/719.pdf | - | No | Exclude: no record of presence in Vietnam |
| Viruses | | | | | | | |
| None identified | - | - | - | - | - | - | |
| Fungi | | | | | | | |
| *Botryodiplodia theobromae* Pat. | Yes, NZFungi 2015 | Not determined | - | Yes, Janick 1994 | - | No | Exclude: present in NZ and doesn't meet criteria for further work |
| *Botrytis* sp. | Not determined | Not determined | - | Yes, Janick 1994 | No, PERAL-USDA 2011 | No | Exclude: insufficient evidence of association with commodity |
| *Cladosporium* sp. | Not determined | Not determined | - | Yes, Janick 1994 | No, PERAL-USDA 2011 | No | Exclude: insufficient evidence of association with commodity |
| *Colletotrichum gloeosporioides* (Penz) Penz & Sacc (1884) [Glomerellaceae] | Yes, NZFungi 2015 | Yes, PERAL-USDA 2011 | No | - | - | No | Exclude: present in NZ and doesn't meet criteria for further work |
| *Dolabra* sp. *(D. nepheliae)* | Not determined | Not determined | - | Yes, Janick 1994 | No, PERAL-USDA 2011 | No | Exclude: insufficient evidence of association with commodity |
| *Erythricium salmonicolor* (Berk. & Broome) Burdsall [Corticiaceae] | Yes, NZFungi 2015 | Yes, PERAL-USDA 2011 | No | - | - | No | Exclude: present in NZ and doesn't meet criteria for further work |

| Organism | Present in New Zealand | Present in Vietnam | Continue | Association with Rambutan (*Nephelium lappaceum)* plant | Association with Rambutan fruit | Hazard conclusion | Implications for next step, i.e. risk assessment stage. |
|---|---|---|---|---|---|---|---|
| *Fusarium* sp. [Nectriaceae] | Yes, NZFungi 2015 | Yes, PERAL-USDA 2011 | No | - | - | No | Exclude: present in NZ and doesn't meet criteria for further work |
| *Fusarium decemcellulare* Brick (1909) [Nectriaceae] | Yes, NZFungi 2015 | CPC, 2015 | No | - | - | No | Exclude: present in NZ and doesn't meet criteria for further work |
| *Galactomyces geotrichum* (Butler & Peterson) Redhead & Malloch | Yes, NZFungi 2015 | Not determined | No | - | - | No | Exclude: present in NZ and doesn't meet criteria for further work |
| *Meliola* sp. [Maliolaceae] | Not determined | Not determined | - | Yes, Janick 1994 | | No | Record is at genus level; insufficient information about identify of pest. |
| *Meliola nephelii* [Maliolaceae] | Not determined | No record; google, google scholar 2015 | - | Yes, PERAL-USDA 2011; Janick 1994 | Yes, JPNPP 2015: | No | Exclude: insufficient evidence of association with commodity |
| *Nectria pseudotrichia* Berk. & M.A. Curtis [Nectriaceae] | Uncertain, NZFungi 2015 | Not determined | - | Yes, PERAL-USDA 2011 | No, PERAL-USDA 2011 | No | Exclude: no evidence of association with commodity |
| *Oidium nepheli* Hadwidjaja [Erysiphaceae] | Not determined | Yes, FAO 2015 (http://www.fao.org/docrep/008/ad523e/ad523e04.htm) | Yes | Yes, PERAL-USDA 2011 | Yes, PERAL-USDA 2011 | No | Exclude: unlikely to establish in New Zealand because rambutan is only known host (PERAL-USDA 2011), and NZ climate not suitable for growing rambutan (Dixon 2015) |
| *Phellinus noxius* (Corner) G. Cunn [Hymenochaetaceae] | No, NZFungi 2015 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | No, PERAL-USDA 2011 | No | Exclude: no evidence of association with commodity |
| *Phomopsis* sp. [Diaporthaceae] | Not determined | Not determined | - | Yes, Janick 1994; PERAL-USDA 2011 | No, PERAL-USDA 2011 | No | Exclude: no evidence of association with commodity |

| Organism | Present in New Zealand | Present in Vietnam | Continue | Association with Rambutan (*Nephelium lappaceum)* plant | Association with Rambutan fruit | Hazard conclusion | Implications for next step, i.e. risk assessment stage. |
|---|---|---|---|---|---|---|---|
| *Phytophthora botryosa* Chee [Peronosporaceae] | Not recorded, NZFungi 2015 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | Yes (young fruits), Janick 1994; No PERAL-USDA 2011 | No | Exclude: no evidence of association with commodity (mature export quality fruit) |
| *Phytophthora cinnamomi* Rands [Peronosporaceae] | Yes, PPIN 2015 | Yes, PERAL-USDA 2011 | No | - | - | No | Exclude: present in NZ and doesn't meet criteria for further work |
| *Phytophthora litchi* [Peronosporaceae] | Not determined | Not determined | - | No, PERAL-USDA 2011; no records found on google | - | No | Exclude: no evidence of association with commodity |
| *Phytophthora nicotianae* var. *parasitica* [Peronosporaceae] | Yes, NZFungi 2015 | Not determined | - | Yes, Janick 1994 | - | No | Exclude: present in NZ and doesn't meet criteria for further work |
| *Phytophthora* sp. [Peronosporaceae] | Yes, NZFungi 2015 | Yes, PERAL-USDA 2011 | No | - | Record is at genus level; insufficient information about identify of pest. | No | Exclude: insufficient evidence |
| *Pseudoperonospora nephelii* sp. nov. [Peronosporaceae] | Not determined | Not determined | - | No (for genus *Pseudoperonospora),* PERAL-USDA 2011 | - | No | Exclude: insufficient evidence of association with commodity |
| *Pseudocercospora nephelii* sp. nov. [Mycosphaerellaceae] | Not determined | Not determined | - | Yes, Janick 1994 | No records found; google, google scholar 2015 | No | Exclude: no evidence of association with commodity |
| *Rigidoporus microporus* (Fr.) Overeem [Meripilaceae] | Uncertain, NZFungi 2015 | Yes, PERAL-USDA 2011 | Yes | Yes, PERAL-USDA 2011 | No, PERAL-USDA 2011 | No | Exclude: no evidence of association with commodity |
| *Thyronectria* sp.(incl *Thyronectria pseudotrichia* Berk & M.A. Curtis (1853)) [Nectriaceae] | Not determined | Not determined | - | Yes, Janick 1994, PERAL-USDA 2011 | No, PERAL-USDA 2011 | No | Exclude: no evidence of association with commodity |

| Organism | Present in New Zealand | Present in Vietnam | Continue | Association with Rambutan (*Nephelium lappaceum)* plant | Association with Rambutan fruit | Hazard conclusion | Implications for next step, i.e. risk assessment stage. |
|---|---|---|---|---|---|---|---|
| Algae | | | | | | | |
| *Cephaleuros virescens* Kunz [Trentepohliaceae] | Yes, Scion 2010 | Not determined | - | Yes, Janick 1994 | - | No | Exclude: present in NZ and doesn't meet criteria for further work |
| Bacteria | | | | | | | |
| *Xanthomonas nepheliae* Barr. [Xanthomonadaceae] | Not determined | Not determined | - | Yes, Janick 1994 (Original reference is Pordesimao & Barredo 1970) | Dubious record of association with Rambutan, given that no other authors published original work since the one and only original record from 1970 | No | Exclude: insufficient evidence of association with commodity |
| *Pseudomonas syringae pv. syringae* | Yes, PPIN 2015 | Not determined | No | - | - | No | Exclude: present in NZ and doesn't meet criteria for further work |
| Nematodes | | | | | | | |
| *Rotylenchulus reniformis* Linford Olievera [Hoplolaimidae] | Not determined | Not determined | - | Yes, PERAL-USDA 2011 | No, PERAL-USDA 2011 | No | Exclude: no evidence of association with commodity |

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# Appendix 2 Excluded organisms (i.e. not hazards)

**Note:** If there is a change in circumstances for any of these organisms, e.g. if they are reported from the exporting country or further information becomes available regarding commodity association, then those organisms may require assessment.

Table 4 Excluded organisms

| These organisms are excluded from further assessment as no record was found of presence in Vietnam | These organisms are excluded from further assessment as they are either in NZ or there is insufficient evidence to suggest they are hazards on fresh rambutan |
|---|---|
| *Aleuroclava bifurcata* | *Aceria litchii* |
| *Aleuroclava nephelii* | *Achaea janata* |
| *Aleuroplatus cococolus* | *Adoretus compressus* |
| *Aleurotrachelus lumparensis* | *Adoxophyes privatana* |
| *Autoba spp.* | *Amblypelta lutescens* |
| *Brevipalpus lewisi* | *Anomala antiqua* |
| *Ceratitis capitata* | *Anomala cupripes* |
| *Cervaphis rappardi* | *Archips micaceana* |
| *Cryptoblabes gnidiella* | *Attacus atlas* |
| *Cryptophlebia illepida* | *Bemisia tabaci* |
| *Dialeurodes gemurohensis* | *Botryodiplodia theobromae* |
| *Eublemma versicolor* | *Botrytis sp.* |
| *Meliola nephelii* | *Brevipalpus phoenicis* |
| *Oulenziella sp.* | *Cephaleuros virescens* |
| *Oxyodes scrobiculata* | *Ceroplastes ceriferus* |
| *Ozophora consanquinea* | *Chondracis rosea* |
| *Selenothrips rubrocinctus* | *Cladosporium sp.* |
| *Sellnickia caudata* | *Coccus hesperidum* |
| *Serrodes spp.* | *Colletotrichum gloeosporioides* |
| *Tessaratoma longicorne* | *Dolabra sp. (D. nepheliae)* |
| *Tirathaba mundella* | *Dudusa nobilis* |
| *Tuberaleyrodes rambutana* | *Dysmicoccus lepelleyi* |
| | *Erythricium salmonicolor* |
| | *Eudocima fullonia* |
| | *Eudocima salaminia* |
| | *Euproctis scintillans* |
| | *Fusarium* sp. |
| | *Fusarium decemcellulare* |
| | *Galactomyces geotrichum* |
| | *Hemiberlesia lataniae* |
| | *Hemiberlesia rapax* |
| | *Homona coffearia* |
| | *Hordeolicoccus heterotrichus* |
| | *Hordeolicoccus nephelii* |
| | *Hypomeces squamosus* |
| | *Icerya purchasi* |
| | *Melanitis leda ismene* |
| | *Neostauropus alternus* |
| | *Oidium nepheli* |
| | *Ophiusa coronata* |
| | *Orgyia postica* |
| | *Parasa lepida* |

| | |
|---|---|
| | *Phellinus noxius*<br>*Phenacoccus solani*<br>*Phomopsis sp.*<br>*Phytophthora botryosa*<br>*Phytophthora cinnamomi*<br>*Phytophthora litchii*<br>*Phytophthora nicotianae var. parasitica*<br>*Phytophthora* sp.<br>*Planococcus citri*<br>*Prococcus acutissimus*<br>*Pseudaonidia trilobitiformis*<br>*Pseudaulacaspis pentagona*<br>*Pseudococcus baliteus*<br>*Pseudococcus longispinus*<br>*Pseudocercospora nephelii* sp. nov.<br>*Pseudomonas syringae pv. syringae*<br>*Pseudoperonospora nephelii sp. nov.*<br>*Rastrococcus spinosus*<br>*Rigidoporus microporus*<br>*Rotylenchulus reniformis*<br>*Scopelodes testacea*<br>*Setora nitens*<br>*Statherotis discana*<br>*Stauropus alternus*<br>*Tetranychus urticae* Koch (syn. *T. cinnabarinus*)<br>*Thyronectria sp.(Thyronectria pseudotrichia)*<br>*Toxoptera aurantii*<br>*Xanthomonas nepheliae*<br>*Xylopsocus capucinus* |

# Appendix 3 Supplementary information about the risk analysis process

## Commodity and pathway description

The first step in undertaking a risk analysis is to describe the commodity and entry pathway of the commodity. This includes relevant information on:

- the country of origin, including characteristics like climate, relevant agricultural practices, phytosanitary system;
- pre-export processing and transport systems;
- export and transit conditions, including packaging, mode and method of shipping;
- nature and method of transport and storage on arrival in New Zealand;
- characteristics of New Zealand's climate, and relevant agricultural practices.

This information provides context for the assessment of the potential hazard organisms.

## Hazard Identification

Hazard identification is conducted prior to the risk assessment stage. It is basically equivalent to "pest categorisation" in the system used under the International Plant Protection Convention (IPPC) system (FAO 2007), as described in ISPM 11. This process begins with the collation of a list of organisms and diseases that might be associated with the commodity in the country of origin and are potentially capable of causing harm (potential hazards = potential 'quarantine pests"). Potential hazards are then screened using the steps listed in the hazard identification section of Figure 1 and information on the biology and distribution of the organism or disease.

The hazard identification process identifies the organisms or diseases that are likely to be associated with the commodity from the exporting country, and which have the potential to cause harm to New Zealand (hazards).

Hitchhiker organisms, which have no biological host association with a commodity, are sometimes considered to be hazards where there are other sources of evidence for their likely association with a commodity, and where they meet the other criteria to be considered hazards.

During the hazard identification process, organisms and diseases are sometimes grouped on their biology and likely susceptibility to risk management measures. The groups are not absolute and some organisms fit into more than one group at different life stages.

Chapter 3 describes the hazard identification process undertaken for this IRA and lists the main information sources.

## Assessment of risks

Risk assessment is the evaluation of the likelihood of entry, exposure and establishment of a hazard organism, and the environmental, economic, human and/or animal health and socio-cultural consequences of the entry within New Zealand. The aim of risk assessment is to identify hazards which present a non-negligible risk, for which risk management measures may be considered. The risk assessment is qualitative, and descriptors (negligible, low, moderate, high) are used in assessing the likelihood of entry, exposure, establishment and spread, and the economic, environmental, socio-cultural and human health consequences. These descriptors are broadly defined in the Risk Analysis Procedure Manual (MAF 2006).

The descriptors used in this document for economic consequences are defined as follows:

Negligible <$100,000
Very low $100,000-$1,000,000
Low $1-10 million
Moderate $10-100 million
High $100 million – 1 billion
Very high >$1 billion

## Assessment of uncertainties

In this aspect of the risk analysis process the uncertainties and assumptions identified during the preceding hazard identification and risk assessment stages are stated within the text. An analysis of these uncertainties and assumptions can then be completed to identify which are critical to the outcomes of the risk analysis. Critical uncertainties or assumptions can then be considered for further research with the aim of reducing the uncertainty or removing the assumption.

Where the risk assessment has significant uncertainty, this is stated in the conclusion of the risk assessment. In these cases, the Risk Analysis Procedure Manual (MAF 2006) notes a precautionary approach to managing risk may be adopted. In these circumstances the measures should be reviewed as soon as additional information becomes available[27] and be consistent with other measures where equivalent uncertainties exist.

## Risk management options

The work on identification of risk management options and assessment of efficacy of risk management options is not included in this document as it is not within scope of this particular IRA. That part of MPIs risk analysis process will be documented elsewhere. The following is a description of what the risk management process typically involves.

For each organism classified as a hazard, a risk management step is carried out, which identifies the options available for managing the risk. In addition to the options presented, unrestricted entry or prohibition may also be considered for each hazard. Recommendations for the appropriate phytosanitary measures to achieve the effective management of risks are not made in this document. These will be determined when an Import Health Standard (IHS) is drafted.

As obliged under Article 3.1 of the WTO Agreement on the Application of Sanitary and Phytosanitary Measures (the SPS Agreement), the measures adopted in IHSs will be based on

[27] Article 5.7 of the SPS Agreement states that “a Member may provisionally adopt sanitary …. measures” and that “Members shall seek to obtain additional information …. within a reasonable period of time.” Since the plural noun “Members” is used in reference to seeking additional information a co-operative arrangement is implied between the importing and exporting country. That is the onus is not just on the importing country to seek additional information.

international standards, guidelines and recommendations where they exist, except as otherwise provided for under Article 3.3 (where measures providing a higher level of protection than international standards can be applied if there is scientific justification, or if there is a level of protection that the member country considers is more appropriate following a risk assessment).

## Review and consultation

Peer review is a fundamental component of an IRA to ensure the analysis is based on the most up to date and credible information available. Each analysis must be submitted to a peer review process involving recognised and relevant experts from New Zealand or overseas. The critique provided by the reviewers is reviewed and where appropriate, incorporated into the analysis. If suggestions arising from the critique are not adopted the rationale must be fully explained and documented.

The conclusions of the risk analysis will be summarised in a draft Risk Management Proposal (RMP) that accompanies the draft IHS for consultation. The risk analysis provides additional technical detail should submitters wish to see a more detailed scientific analysis of the biological risks.

Any submissions received from stakeholders during the consultation process will be analysed and compiled into a review of submissions. The Import Risk Analysis, Risk Management Proposal and draft Import Health Standards will be modified where appropriate depending on the outcome of consultation

## References

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