Ministry for Primary Industries
Manatū Ahu Matua

Import risk analysis: Fresh salacca (*Salacca zalacca*) fruit from Indonesia

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Growing and Protecting New Zealand

Ministry for Primary Industries
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Version 1.1

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Approved for general release

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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 pathogens on the fresh salacca fruit from Indonesia pathway. It assesses the likelihood of entry, exposure, establishment and spread of the associated pathogens and pests in relation to imported fresh salacca fruit from Indonesia and assesses the potential impacts of those organisms should they enter and establish in New Zealand. The document has been internally peer reviewed and 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.

Contributors to this risk analysis

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

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Executive summary

Indonesia has requested permission to import fresh salacca (*Salacca zalacca*) fruit in to New Zealand. A risk analysis has already been completed by the Australian Department of Agriculture and this was used as a starting point to assess the biosecurity risks of unwanted pests and pathogens entering New Zealand with fresh salacca fruit. The current document is intended to be read alongside the Australian risk analysis (DoA 2014).

The hazard identification in DoA (2014) was assessed and other sources were used to determine whether there were any gaps in regard to New Zealand potential importation of salacca fruit. A hazard identification for New Zealand is provided in an appendix. The hazard list for New Zealand was determined to be largely the same as the DoA (2014) hazard list, which had just three mealybug genera (*Dysmicoccus, Planococcus,* and *Pseudococcus*), and the oil palm bunch rot fungus *Marasmius palmivorus.* Additionally, the fungus *Thielaviopsis paradoxa* was determined to be a hazard; there were no reliable records found for the fungus *T. paradoxa* in New Zealand as previous records were determined to be a different species. Therefore a risk analysis was completed for *T. paradoxa.*

For the mealybugs (*Dysmicoccus, Planococcus,* and *Pseudococcus*), the likelihood of entry into New Zealand with fresh salacca fruit is low, likelihood of exposure is moderate, and the likelihood of establishment is moderate (particularly in northern New Zealand and protected areas such as glasshouses). There is a low likelihood of economic impacts, very low likelihood of environmental impacts (both with some uncertainty) and negligible likelihoods of sociocultural or human health impacts. Therefore these three genera of mealybugs are considered to be non-negligible risks on imported fresh salacca fruit from Indonesia. The risk is worth considering and further analysis may be undertaken to decide if additional measures are warranted. The DoA combine their probabilities using a risk matrix, and they combined their likelihood and consequences probabilities for the mealybugs to get an overall probability of very low, which is below their acceptable level of protection, and they concluded that no specific risk management measures were required for these pests. New Zealand does not have a formal method for combining probabilities in this way.

DoA (2014) concluded that no specific risk management measures were required for *M. palmivorus* as the unrestricted risk estimate was negligible, which achieves Australia's ALOP. There is a low likelihood of *M. palmivorus* entering New Zealand. The likelihood of exposure is moderate to high. The likelihood of establishment is moderate. The economic and environmental consequences of establishment are very low; and sociocultural and human health impacts of establishment are negligible. In consideration of these assessments, *Marasmius palmivorus* is considered to be a non-negligible risk on imported fresh salacca fruit from Indonesia. The risk is worth considering and further analysis may be undertaken to decide if additional measures are warranted.

DoA (2014) did not regard *T. paradoxa* as a hazard so did not do a risk assessment for this species. For importation into New Zealand, the likelihood of entry and likelihood of exposure are considered to be low. The likelihood of establishment is considered to be high, and the likelihood of spread is considered to be moderate. The economic and environmental consequences of establishment of *T. paradoxa* in New Zealand are considered to be low, and sociocultural consequences are likely to be very low. The human health consequences of establishment are likely to be negligible. In consideration of these assessments, *Thielaviopsis paradoxa* is considered to be a non-negligible risk on imported fresh salacca fruit from Indonesia. The risk is worth considering and further analysis may be undertaken to decide if additional measures are warranted.

Introduction

Indonesia has requested permission to export fresh salacca (*Salacca zalacca*) fruit into New Zealand. The Australian Government Department of Agriculture (DoA) has recently completed a risk analysis on salacca fruit from Indonesia to Australia (DoA 2014). Because this is the same commodity from the same country, and the DoA's biosecurity risk analysis process is similar to New Zealand's (see MAF BNZ 2006), we have used the Australian risk analysis as a base for this New Zealand risk analysis. This New Zealand risk analysis examines if the conclusions in DoA (2014) also apply to importations of salacca from Indonesia to New Zealand, and, where there are differences, examines the risk to New Zealand. It is intended that this document is read alongside the Australian Department of Agriculture's salacca from Indonesia risk analysis document (DoA 2014). For further information about MPI risk analysis processes please see (MAF BNZ 2006) and the first few chapters in the "Import Risk Analysis: Tomato and *Capsicum* seed for sowing from all countries" on the MPI website.

Commodity assumptions

- Salacca fruit will be commercially produced (and grown in monoculture), in registered orchards.
- Fruit will have no soil, stalks or leaf material associated with it, and will have skin on.
- Fruit will be brushed with mechanical brushes and any visibly damaged or diseased fruit will be removed during harvesting, processing, or pre-border inspection.
- Good agricultural practices (GAP) will be followed as described in the *Marasmius palmivorus* risk assessment in DoA (2014).
- These and all other conditions described in DoA (2014) will be followed.

Hazard identification

Sources
Two primary sources were used as the basis for the list of pests to consider for hazard identification: Australian Department of Agriculture (2014) *Final import risk analysis report for fresh Salacca fruit from Indonesia* (referred to as DoA 2014); and, Indonesia agricultural quarantine agency (2013) *Technical information of salacca fruit* (referred to as Indonesia 2013). Other sources were used to determine if there were any additional pests[1], and to determine New Zealand status of the organisms[2].

1.2 Method

The hazard identification section from the Australian risk analysis (DoA 2014), and the Indonesian pest list (Indonesia 2013) were examined for completeness. A review of the literature did not reveal any additional hazards.

The main differences between an Australian and New Zealand hazard ID for the same commodity and country result from differences in the species excluded from the hazard list because they are already established in Australia or New Zealand. For all potential hazard organisms listed in the Australian RA, their presence in New Zealand was assessed. There were several organisms that were not regarded as hazards to Australia because they were already present in Australia, but which needed further consideration for New Zealand.

The rationale for inclusion or exclusion of pests in the hazard list for the DoA (2014) was reviewed to see whether it was consistent with New Zealand hazard identification methodology. This determined whether Australian hazards would also be considered hazards on the New Zealand pathway.

1.3 Results

The hazard identification table for New Zealand is provided in the appendix. It provides a simplified version of the Australian hazard ID table and the New Zealand conclusions. There were five genera or species where further explanation is required as to the hazard status in New Zealand; that explanation is provided below.

***Thielaviopsis paradoxa* (fungus)**
T. paradoxa is considered a hazard on the salacca from Indonesia to New Zealand pathway. DoA (2014) determined that *T. paradoxa* was not a hazard to Australia because it was present in Australia. For this reason they did not examine whether it had the potential to be on the pathway, establish and spread, or have economic consequences in Australia.
T. paradoxa is not thought to be present in New Zealand. It was previously recorded in New Zealand (as *Ceratocystis paradoxa*) (Landcare Research 2016a) however the taxonomy of this species has changed. The fungi found and recorded as *C. paradoxa* in New Zealand are now classified as *Thielaviopsis musarum* (isolated from roots and crown of banana from Great Barrier Island, NZ, 2003) and *Thielaviopsis ethacetica* (isolated from wheat leaf spots, from Oamaru, NZ, 1996) (Landcare Research 2016b).

1 Sources such as CAB abstracts, google scholar, and other databases were used
2 See appendix 1

T. paradoxa has the potential to be present on the salacca fruit from Indonesia to New Zealand pathway. It has not been reported from salacca fruit in Indonesia. However, it is found in Indonesia on other hosts (African oil palm and pineapple: Farr and Rossman 2016) and is present on salacca fruit in Thailand (Soytong and Jitkasemsuk 2001, on fruit of *Salacca edulis* which is a synonym of *Salacca zalacca*). Since it occurs in Indonesia and occurs on salacca in other countries with similar climates, there is no reason that it would not occur on salacca in Indonesia. Although there could possibly be taxonomic differences, meaning that there is some uncertainty in the association, it is still worth considering this pathogen further. Some reported hosts (Farr and Rossman 2016) of *T. paradoxa* are common in New Zealand such as *Eucalyptus*, kumara, potato, lettuce, and pumpkin. It is also found on numerous palm species, therefore nikau palms and ornamental palms in New Zealand may be suitable as hosts. While the New Zealand climate is not ideal, the climate in warmer areas of New Zealand should be sufficiently warm to allow *T. paradoxa* to establish and spread. It can be very damaging on some hosts and may have some economic consequences here; these are worth examining more fully in a risk assessment.

***Tolumnia* sp. (Hemiptera: Pentatomidae)**

Tolumnia sp. is not considered to be a hazard on the salacca fruit from Indonesia to New Zealand pathway.

DoA (2014) stated that this species was not a hazard because there was no potential for it to be on the pathway. They state: "…reported to feed on *Salacca* palm but not to cause significant damage to the plant (Schuiling and Mogea 1991). *Tolumnia* spp. would not remain on the fruit during harvesting operations due to its size and flight behaviour."
However, while adults may not remain associated with fruit, it is considered that immatures (eggs and/or nymphs) may be able to stay on the fruit, may be too small to be visible on inspection, and would not fly off fruit, so were not covered by the DoA (2014) reasoning. This was further investigated and is summarised below:

Only three papers were found providing information on biology of the *Tolumnia* genus. None of them mentioned *Salacca* species, or *Tolumnia* sp. immatures (eggs or nymphs); therefore, information was taken from the wider literature. In the wider Pentatomidae family, most papers report that eggs are laid in clusters on the underside of leaves, or more rarely the top of leaves, or stems. The only reference found which mentioned Pentatomidae eggs on fruit was Basnet et al. (2015). They say that in a vineyard *Halyomorpha halys* egg masses "*were usually found on the lower surface of grape leaves, although they were occasionally on the upper leaf surface, on the berry, or on the rachis*." As this is the only reference found to eggs being laid on fruit, it is assumed that Pentatomidae lay eggs on fruit only very rarely. If there were large numbers of eggs laid on fruit there may be some likelihood of some eggs surviving the brushing process; however as there are only likely to be a few eggs it is very unlikely that many eggs laid on salacca fruit would remain after fruit brushing, partly because of the smoothness of the salacca fruit. Eggs are therefore not considered a hazard on this pathway.

Nymphs could be associated with the fruit and may be too small to see but are likely to be removed during harvesting, inspection, and processing including brushing, similar to the adults. Nymphs are therefore not considered a hazard on this pathway.

***Pseudococcus longispinus* (Hemiptera: Pseudococcidae) (Long tailed mealybug)**

P. longispinus is not considered to be a hazard on the salacca from Indonesia to New Zealand pathway.
DoA (2014) determined that this species was not a hazard because it was present in all states and territories of Australia. It is also present in New Zealand, however it is a potential vector of plant

pathogens that may not be present in New Zealand. After assessment it was determined that it is very unlikely to vector viruses when found on salacca fruit from Indonesia for the following reasons:

- It is not known to vector any viruses in salacca, only other viruses such as grapevine viruses.
- Grapevines are assumed to be relatively rare in Indonesia.
- Salacca is grown in a monoculture so it is very unlikely that an individual of *P. longispinus* found on a salacca fruit would have had the opportunity to have been on a grapevine previously and pick up grapevine viruses.
- There is very little information available about viruses in salacca, and there has been no evidence found that *P. longispinus* transmits viruses from salacca to other plants.

***Mycena* sp. (fungus) and *Nodocnemus* sp. (Coleoptera: Curculionidae)**

Neither *Mycena* sp. nor *Nodocnemus* sp. are considered to be hazards on the salacca from Indonesia to New Zealand pathway.

Mycena sp. are found on woody substrates. *Nodocnemus* sp. bores into the stalk. It was determined that these species would only be a hazard if woody material, such as stalks, were imported with the fruit. DoA (2014) states that stalks are not usually included with the fruit, it appears that the fruit is cut off the stalk when it is removed from the bunch during harvesting. To ensure that there is no stalk, the commodity is described as fruit free from stalks and leaves.

Hazard identification conclusion

In conclusion, the hazard list for New Zealand was determined to be largely the same as the DoA (2014) hazard list, which had just three mealybug genera (*Dysmicoccus*, *Planococcus*, and *Pseudococcus*), and the oil palm bunch rot fungus *Marasmius palmivorus.* Additionally, *T. paradoxa* was determined to be a hazard; there were no reliable records found for the fungus *T. paradoxa* in New Zealand as previous records were determined to be a different species. Therefore, a risk analysis was done for *T. paradoxa*.

Risk assessment

Mealybugs (*Dysmicocccus* sp., *Planococcus* sp., *Pseudococcus* sp.) risk assessment

Summary
Overall, the risk assessment for mealybugs in DoA (2014) largely applies to New Zealand. The conditions under which the salacca is being grown and will be processed and transported are the same for exports destined for Australia and New Zealand. The risk analysis procedures for New Zealand and Australia are broadly similar, however there are process differences which are discussed below. Both New Zealand and Australia use similar sources, and both follow the IPPC framework.

Entry assessment
The Australian procedure separates the "probability of entry" into the "probability of importation" and the "probability of distribution". The New Zealand "probability of entry" loosely corresponds to the DoA "probability of importation". The DoA categorise the probability of importation of these pseudococcids as "moderate". Their reasoning is that they are associated with salacca fruit and can survive the conditions of harvest and transit; but are likely to be visible and likely to be removed on pack house processing (or by manual or mechanical brushing) and inspection. These factors are not likely to differ for fruit entering New Zealand, however New Zealand risk assessments would generally conclude a low likelihood of entry for the circumstances described.

Exposure assessment
Likelihood of exposure is the likelihood that organisms which have arrived in New Zealand come into contact with a suitable host plant. This classification is not used in the DoA procedure, however when discussing their "probability of distribution" they assess some factors which we would consider as part of the probability of exposure. They say that the pseudococcid genera are able to survive post border storage and transport temperatures and may be discarded near suitable hosts, but that pseudococcids will have to actively disperse to a suitable host plant part. The adults and crawlers only disperse over short distances, and slowly, and they only survive a short time without feeding. Part of their reasoning is that there are likely to be suitable host plants in Australia. There are also likely to be suitable host plants in New Zealand. The DoA probability of distribution of the species in the three pseudococcid genera into Australia is "moderate".

Other information has been taken into consideration from a New Zealand Ministry for Primary Industries (MPI) document, the Pest Risk assessment on armoured scale insects on the fresh produce pathway (MPI 2014). Armoured scale insects (family Diaspididae, or diaspidids) are closely related to pseudococcids (Pseudococcidae; both families are in the superfamily Coccoidea) and many aspects of their biology are shared.

The likelihood of exposure for diaspidids on commercial fresh produce is considered to be one of the critical steps limiting their ability to establish in New Zealand (MPI 2014). This is due to the specialised biology of diaspidids; most life stages are sessile, are attached to the host commodity and will die as the host decomposes. Only crawlers and adult males are mobile, but these are unlikely to survive production and transit due to their small size and fragile nature. However, crawlers may emerge from eggs laid by mature females once they have crossed the border. Crawlers must then escape the host commodity and survive to locate and successfully settle on a suitable host plant. Mortality is very high in the crawler stage, from not finding a suitable host to feed on, and from desiccation and predation. The proportion of imported hosts that are both infested with mature reproducing females and are disposed of in a manner that allows this to occur is likely to be very low.

Pseudococcids differ from diaspidids in that they are not covered by a hard scale or test, and all lifestages are able to move, albeit to a limited extent. Their increased mobility is likely to result in a slightly increased likelihood of exposure for pseudococcids compared to that of diaspidids. However, some evidence suggests that pseudococcids are very similar to diaspidids in terms of likelihood of exposure via the fresh produce pathway; that is, successful dispersal from the point of entry is most likely to take place at the crawler stage (MPI 2014).

In light of the arguments from these two sources (DoA 2014, MPI 2014), the likelihood of exposure of the pseudococcid species on salacca from Indonesia to a suitable host plant in New Zealand is considered to be “low”.

Establishment assessment
The likelihood of establishment is assessed assuming that successful exposure has taken place. The Australian Department of Agriculture estimate that the probability of establishment and probability of spread are both high. The probability of establishment is partly determined by the climate and hosts available in the country that the salacca is being imported into. The New Zealand climate and hosts available are different to those in Australia.

The pseudococcids have not been identified to species level, therefore it is not possible to predict their climatic tolerances and host preferences with any accuracy, but:

- Since each species is known to be present in Indonesia it is assumed that each may be able to establish at least in the warmer parts of New Zealand or in protected environments such as glasshouses.
- Since at least one known host for each species is salacca, a member of the palm family (Arecaceae), it is assumed that each species may attack other palms, including nikaus and other ornamentals, but it is not known how wide their host range is likely to be. Some coccoids are specialists, but many have very wide host ranges (e.g. *Maconellicoccus hirsutus* (OEPP/EPPO 2005)).
- It is not clear whether the species found on salacca are parthenogenetic or sexually reproducing. If they are sexually reproducing, adults will have to find a mate to produce a population which would lower the likelihood of establishment.

The likelihood of establishment of pseudococcids on salacca from Indonesia is considered to be moderate particularly in the northern parts of New Zealand or in glasshouses. There is some uncertainty in this conclusion because the exact species involved are not known.

Consequence assessment
Economic impact
The most likely potential hosts of these pseudococcids in New Zealand are nikau palms and ornamental palms in the family Arecaceae, although as some coccids have wide host ranges, they could have potentially more hosts than this. Association with ornamental palms could cause some unwanted impacts in both production and trade if these species establish. Commercial nurseries would be likely to have existing controls for insects such as armoured scales, soft scales and/or mealybugs, and these species could be expected to be controlled to some extent by

such activities. However these activities cannot be assumed to be carried out in all circumstances. Honeydew production and associated sooty mould may be a problem in nurseries. Ornamental palms are sold by garden centres to the public and for public display in warmer northern areas (e.g. in parks, roadside plantings etc). There is also a trade in hiring out office plants which is likely to include palms. These plants moving around in protected environments may be good hosts and vectors for these pseudococcids. It is not clear what impact there would be by these pseudococcid species on these plants, but it is unlikely to be very high. Even if these pseudococcids did damage the plants quite substantially, there would not be a very high economic impact.

DoA (2014) assessed economic impact of the pseudococcids from salacca from these three genera as “low”, based on previous DoA assessments on these genera.

Mealybugs are known to vector plant viruses, such as grapevine leafroll-associated viruses (MPI 2014). There is a low likelihood that these pseudococcids could introduce a virus or multiple viruses to New Zealand. This low likelihood is because mealybugs are much less mobile on the plant than other groups of vectors such as aphids and leafhoppers, which makes them relatively inefficient as virus vectors (Hull 2002). It is difficult to determine which virus(es) as the species of pseudococcids are not known. No records were found of viruses on *Salacca* species, but as there is relatively little literature available about this crop there could potentially be some viruses associated with the *Salacca* fruit which have not yet been reported.

It is not clear how widely the pseudococcids found on salacca from the three genera (*Dysmicoccus*, *Planococcus,* and *Pseudococcus*) will be able to establish in New Zealand. It is highly likely that there are some natural enemies of these species present in New Zealand which would decrease any impacts these species had if they established. These natural enemies could include the predatory ladybird *Cryptolaemus montrouzieri* and the microwasp *Anagyrus fusciventris* (discussed in relation to the pseudococcid *Maconellicoccus hirsutus* in MPI (2014)).

Previous New Zealand risk analyses on pseudococcids (e.g. on table grapes or *Pyrus* from China; *Citrus* from Samoa or stonefruit from USA) have assessed economic impacts from low to high, but mostly moderate.
The economic impacts in New Zealand are likely to be low (with some uncertainty).

Environmental impact
As these pseudococcids are found on salacca, other Arecaceae such as the New Zealand native nikau palms may be hosts. It is unknown what impact these pseudococcids are likely to have on these nikau palms. They may also have impacts on other native species, it is difficult to determine as the species of the pseudococcids are unknown. Pseudococcids secrete honeydew and if these species are able to build up to high populations in native bush there could be knock on effects, such as increases in wasp numbers as they feed on the honeydew, or black sooty mould fungus growing on the honeydew. It is unlikely that the pseudococcids will build up to these numbers though as there are not many Arecaceae hosts in native forests and these pseudococcids may be restricted to areas of New Zealand with warmer climates.

Previous New Zealand risk analyses on pseudococcids (e.g. on table grapes or *Pyrus* from China; *Citrus* from Samoa or stonefruit from USA) have assessed environmental impacts from very low to moderate, but mostly moderate.

The environmental impacts are likely to be very low (with some uncertainty), as the pseudococcids are likely to be restricted to only areas of New Zealand with relatively warmer climates.

Sociocultural impact

DoA did not mention sociocultural consequences of establishment, however this is a standard part of all MPI assessments (MAF BNZ 2006). MPI (2014) said that the establishment of *M. hirsutus* could result in some impacts in home gardeners from weakened plants, the establishment of viruses, the secretion of honeydew which may attract ants. However these impacts were not expected to be significant and they were likely to be limited because *M. hirsutus* could not establish widely in New Zealand and it would be likely that natural enemies would limit the numbers of *M. hirsutus.*

Similarly, the pseudococcids found on salacca fruit could impact home gardeners with palms or other hosts in their garden by weakening the plants, introducing viruses into the gardens and possibly secreting honeydew and attracting ants. It is not clear how widely the pseudococcids found on salacca from the three genera (*Dysmicoccus, Planococcus,* and *Pseudococcus*) will be able to establish in New Zealand and it is likely that they will be impacted by natural enemies already present in New Zealand.
The sociocultural impacts are likely to be negligible.

Human health impact

There are no known human health impacts associated with pseudococcids so human health impacts are likely to be negligible.

Overall conclusions

The DoA combine their probabilities using a risk matrix. They have combined the likelihood and consequences probabilities for the mealybug analysis to get an overall probability of very low, which is below their acceptable level of protection. They concluded therefore that no specific risk management measures were required for these pests.

New Zealand does not have a formal method for combining probabilities.
The likelihood of entry is low, the likelihood of exposure is moderate, and the likelihood of establishment is moderate (particularly in northern New Zealand and protected areas such as glasshouses). There is a low likelihood of economic impacts, very low likelihood of environmental impact (both with some uncertainty) and negligible likelihoods of sociocultural or human health impacts. Table 1 below summarises these estimates.

Risk estimation Table 1: Mealybugs (*Dysmicoccus* sp., *Planococcus* sp., *Pseudococcus* sp., on imported fresh salacca fruit from Indonesia

	Considered to be:			
Likelihood of:	**Negligible**	**Low**	**Moderate**	**High**
Entry		X		
Exposure			X	
Establishment			X	
Spread				
Consequences of establishment				
Economic		X		
Environmental	X	X		
Socio-cultural	X			
Human Health	X			

In consideration of these assessments, *Dysmicoccus* sp., *Planococcus* sp., and *Pseudococcus* sp. are considered to be non-negligible risks on imported fresh salacca fruit from Indonesia. The risk is worth considering and further analysis may be undertaken to decide if additional measures are warranted.

Oil palm bunch rot (*Marasmius palmivorus*) risk assessment

Entry assessment
The probability of entry of *M. palmivorus* on salacca from Indonesia to New Zealand is considered to be low.

DoA (2014) assessed the probability of entry as very low. MPI would also conclude that it is low but not very low for the following reasons:

DoA (2014) states that symptoms of *M. palmivorus* on salacca fruit would be obvious as early infection is characterised by the appearance of white or pink mycelium growing over the surface of developing fruit bunches. But possible infections at a low level, before the mycelium had developed over the surface, would be not visible on inspection but develop further once the fruit entered New Zealand. Spores or mycelia may not be cleaned off by brushes particularly if they were inside the fruit.

DoA (2014) also state that the likelihood of entry of *M. palmivorus* is low because infected salacca fruit has not been reported from Indonesia. The fungus has been reported from Indonesia but not on salacca (Farr & Rossman 2016), and on fruit of salacca (*Salacca wallichiana*, which is a different species to *Salacca zalacca*) in Thailand (Pinitpaitoon 2003 in DoA 2014). Therefore it may not be present on fruit in Indonesia. However, because salacca in Indonesia is a relatively new export crop which has not been well studied (compared to, for example, oranges from the USA), so it is highly likely that it is present on the fruit in Indonesia as well but has not as yet been recorded. Furthermore, the climate in Thailand where it is found on salacca fruit is similar to the climate in Indonesia so there is no reason to believe that *M. palmivorus* would not be present on salacca fruit in Indonesia.

DoA (2014) note that following the 'Good Agricultural Practices' (GAP) farm certification scheme is important, and we would emphasise this. This likelihood of entry is completed assuming that this program has been followed. DoA state "*This program ensures export fruit are produced following the guidelines developed for farm management (i.e. cultivation, orchard hygiene, and harvesting practices), and pest monitoring and surveillance. The prevalence of the fungus will be limited in salacca orchards operating under GAP. Fruit, foliage and inflorescences colonised by the fungus would be removed during pest monitoring and inspection. Additionally, potential infection foci such as dead material and fruit bunches that have aborted development or are poorly pollinated would be removed during orchard sanitation*." Additionally, "*high density planting and high humidity from a dense canopy cover increases the presence of* M. palmivorus *(Turner 1981)"* so orchard management is very important. It is important that healthy looking fruit is picked.

Exposure assessment
DoA (2014) has a section on the Probability of distribution, which concludes it to be low. There is not have an exposure section but the way in which the Probability of distribution is estimated is most similar to the New Zealand exposure assessment.

It is likely that exposure of *M. palmivorus* on salacca from Indonesia to New Zealand is moderate to high. This species is primarily saprophytic so any rotting plant material would be a suitable host. Disposal of fruit into rotting compost, for example, would lead to exposure to sufficient rotting material.

Establishment assessment
The likelihood of establishment of *M. palmivorus* in New Zealand is likely to be moderate. Hosts of this species are tropical (such as banana, rubber, pineapple, coconut and oil palms). Nikau and ornamental palms are likely hosts. The climate is likely to be suitable in northern New Zealand over summer and allow survival over winter in microclimates. *M. palmivorus* is primarily saprophytic so it can survive on rotting host material. As it is only found on tropical host plants, in tropical countries (Anon 2010), *M. palmivorus* is unlikely to have much disease potential as it is likely that it is not sufficiently warm or humid in New Zealand for severe disease.

Consequence assessment
Economic consequences
DoA (2014) conclude that the overall consequence of establishment of *M. palmivorus* in Australia is very low.

The consequences of establishment in New Zealand are also very low. The only likely hosts of economic importance grown in New Zealand are ornamental palms. It is likely that *M. palmivorus* would not have much impact on ornamental palms even if they were infected, because the climate is probably not ideal for *M. palmivorus.* Furthermore, *M. palmivorus* does not appear to have much impact unless there are poor horticultural practices that induce moist conditions. No edible fruit is grown from palms in New Zealand.

Environmental consequences
The only palm species (Arecaceae) native to New Zealand is the nikau palm. Even if this was infected, like ornamental palms it is unlikely that it would be impacted much by infection, as climate conditions are not suitable for this fungus to thrive in most of New Zealand. Other host families are Bromeliaceae (*Ananas comosus,* pineapple); Euphorbiae (*Hevea brasiliensis,* rubber); and Musaceae (*Musa x paradisiaca,* banana). There are no New Zealand native species in any of these families (PCN 2016). The likelihood of environmental consequences of establishment of *M. palmivorus* in New Zealand are likely to be very low.

Sociocultural and human health consequences
Amenity palms may be infected but the climate conditions are not suitable for this fungus to thrive in most of New Zealand. The sociocultural and human health consequences are likely to be negligible.

Conclusion
There is a low likelihood of *M. palmivorus* entering New Zealand. The likelihood of exposure is moderate to high. The likelihood of establishment is moderate. The economic and environmental consequences of establishment are very low; and sociocultural and human health impacts of establishment are negligible.

Risk estimation table 2: *Marasmius palmivorus* on imported fresh salacca fruit from Indonesia

	Considered to be:			
Likelihood of:	**Negligible**	**Low**	**Moderate**	**High**
Entry		■		
Exposure			■	■
Establishment			■	
Spread				
Consequences of establishment				

Economic				
Environmental				
Socio-cultural				
Human Health				

In consideration of these assessments, *Marasmius palmivorus* is considered to be a non-negligible risk on imported fresh salacca fruit from Indonesia. The risk is worth considering and further analysis may be undertaken to decide if additional measures are warranted.

Thielaviopsis paradoxa risk assessment

Taxonomy

Thielaviopsis paradoxa is part of a complex that various authors consider to comprise substantially greater species diversity than previously recognised (e.g. Mbenoun et al. 2014). Consequently there is a lot of uncertainty around species boundaries and identification, as well as recent changes at the generic level (de Beer et al. 2014).

A fungus formerly identified as *Ceratocystis paradoxa* (a synonym of *T. paradoxa*) has been recorded twice in New Zealand (Landcare Research 2016b). However there was doubt that these records of presence were valid, as recent taxonomic changes have been made to the genus. Landcare Research re-examined the two cultures that were collected and held in New Zealand under the name of *Ceratocystis paradoxa.* Their assessment was that the cultures were not *C. paradoxa.* They determined that one was *Thielaviopsis musarum,* and the other *Thielaviopsis ethacetica* (Landcare Research 2016b).

These taxonomic revisions also mean that there is uncertainty about other records of *T. paradoxa,* including the records from salacca in Thailand and other hosts in Indonesia. One scenario is that the fungi in question would now be regarded as *T. ethacetica,* therefore not considered a quarantine pest for New Zealand because the species is already present here.

From Landcare Research 2016b:

> "Mbenoun et al. (2014) noted that *T. paradoxa* (as *C. paradoxa*) has in the past often been confused with *T. ethacetica* (as *C. ethacetica*). They considered *T. paradoxa* to have a more restricted distribution than previously accepted, and that the commonly reported, cosmopolitan *Thielaviopsis* species with a broad host range is probably *T. ethacetica."*

Since there is no practical way for us to determine the validity of the literature references to *T. paradoxa,* we are following the names recorded in the literature. This means that the records on salacca in Thailand, and recorded on other hosts in Indonesia, is still regarded as *T. paradoxa.* Therefore a risk analysis is required because *T. paradoxa* is not known to be present in New Zealand and may pose a biosecurity risk. This risk analysis is subject to uncertainty around the taxonomy of *T. paradoxa.*

Biology

The following is taken from Elliot (2015), talking about *T. paradoxa* on palms:

- *T. paradoxa* produces two different types of asexual spores, endoconidia and chlamydospores. Chlamydospores will survive for long periods in the soil. For palms, they are only able to infect a palm when a fresh wound is present. Diseases caused by the fungus may progress more rapidly when the palm is stressed. Most infections occur in non-lignified or lightly lignified tissue. The fungus often produces volatile substances which give the diseased tissue a fermented fruit odour.
- While the fungus is found throughout the world, its host range is primarily restricted to monocot plants grown in warm climates. The fungus causes diseases of palms, banana, pineapple and sugarcane. While the fungus has not been reported on every palm species, all are considered potential hosts for this fungus.

- For palms, there is often no visible indication of infection until either the trunk collapses on itself or the canopy suddenly falls off the trunk. The canopy often appears normal and healthy.
- The fungal pathogen can spread from palm to palm as follows. First, if spores are produced on diseased palm tissue, these spores can be moved by wind or water to fresh wounds. The spores may also be moved about by insects and rodents. Second, the chlamydospores are spores that can survive in the environment, especially soil, for long periods. Fresh wounds could become infected via contaminated soil.

On pineapple (Jackson 2015) *T. paradoxa* is a wound fungus causing leaf spots, fruit and basal rots of pineapple. It causes severe loss of planting materials, and is the major postharvest disease of fruit for the fresh-fruit market. The rots occur during transport and storage when refrigeration is not available. Fruits are infected though bruises, growth cracks or wounds made when they are detached. On the fruits, soft watery rots occur, at first with a brittle outer shell. Later, the skin, flesh and core break down and the fruit leaks through the shell. Sometimes, only the fruit shell remains with a few black fibres inside, and collapses under slight pressure.

Entry assessment

Later stages of infection in salacca fruit by *T. paradoxa* are likely to be obvious, and fruit will be discarded during harvesting, processing or pre-export inspection. Soytong and Jitkasemsuk (2001) reported *T. paradoxa* on salacca (*Salacca edulis*, a synonym of *Salacca zalacca*) fruit in Thailand. The "infected fruit discoloured brown to black and appeared rotted with white mycelia on the lesions. Fruit eventually abscised."

However earlier stages of infection on the fruit may not be visible, particularly if infection is inside the fruit. *T. paradoxa* invades fruit hosts through wounds (Hubert et al. 2014, Kile 1993), so infected fruit may be discarded because of visible wounds, but some wounds may be small and not detected, or remain internal until well developed. If fruit is only taken from orchards which have no signs of infection, it is unlikely that fruit to be exported will be infected with *T. paradoxa*. Postharvest disease resulting from infections by pathogens in the field may result in symptoms which are too inconspicuous to be noticed at harvest, and the infections in fleshy fruits and vegetables continue to develop after harvest (Agrios 2005 p554).

It is unlikely that brushing will remove the fungus except for some of the larger mycelia on the surface.

The likelihood of entry is considered to be low, particularly if fruit is only taken from orchards without visible infection.

Exposure assessment

The likelihood of exposure is estimated assuming that entry of *T. paradoxa* into New Zealand has occurred.

Some fruit which has early or mild infections with *T. paradoxa* will be consumed. Some will be discarded in landfill. For both of these, exposure to a new host will not occur. However some fruit could be discarded in compost near potential host plants. Some fruit may have been imported with early stage non-visible infection, and as the infection develops over time after the fruit has been imported and sold, the fruit may show visible signs of infection. This fruit is likely to be disposed of, either in landfill or compost. There is a low likelihood that *T. paradoxa* on infected fruit discarded in compost could move to suitable hosts. *T. paradoxa* can be saprophytic, so there is a low likelihood that it develops further first in rotted potential hosts such as other vegetative matter in the compost. There would then be more inoculum so it is more likely to be able to reach a living host, and be a source of new infections. It can also have spores living in the soil (Elliott 2015).

Furthermore there have not been any reported association of *T. paradoxa* with salacca in Indonesia. It is highly likely that it does affect salacca in Indonesia (as it has been reported from salacca in Thailand and on other hosts in Indonesia), but as it has not been reported directly on salacca in Indonesia it is unlikely to be a large problem and therefore the rate of infection can reasonably be assumed to be low.

The likelihood of exposure is considered to be low.

Establishment and spread assessment

The climate in much of New Zealand is likely to be too cold for *T. paradoxa* to thrive, as most of the hosts of this species are tropical hosts, so it is likely that this species prefers warm climates. However as it is a cosmopolitan species it is likely that it will be able to establish in much of New Zealand, but without becoming a major pest. It is polyphagous so is likely to find suitable hosts here to survive on, although the hosts to which it does the most damage (e.g. pineapple, sugarcane, bananas) are not grown commonly here. It is also sometimes saprophytic which increases the chance that it will find suitable substrates to develop on (i.e. any rotting vegetation).

Ceratocystis species are spread by insects (Witthuhn et al. 1999), and *T. paradoxa* (as *C. paradoxa*) has been recorded being vectored by picnic beetles (Coleoptera: Nitidulidae) (Chang & Jensen 1974).

T. paradoxa (as *C. paradoxa*) disperses by soil, possibly by wind and water, insects and pruning tools (Kile 1993).

In palms, *T. paradoxa* spreads as follows. Firstly, if spores are produced on diseased palm tissue, they can be moved by wind or water to fresh wounds, or the spores may be moved by insects or rodents. Secondly the chlamydospores are spores that can survive in the environment, especially soil, for long periods. Fresh wounds can become infected via contaminated soil (Elliott 2015).

The likelihood of establishment is considered to be high, and the likelihood of spread is considered to be moderate.

Consequence assessment

Economic impact

Kile (1993) states that *T. paradoxa* "is generally considered a weak pathogen." Where it is pathogenic, its main hosts are tropical species, particularly pineapple (*Ananas* spp.), sugarcane (*Saccharum officinarum*) (Chang & Jensen 1974) and banana and plantain (*Musa* spp.). For example, *C. paradoxa* has been described as "a major disease of sugarcane in cane growing areas around the world, and causes economic losses through failure of germination of infected seed pieces and through rotting and souring of mature cane stalks" (Chang & Jensen 1974). It causes black rot post harvest disease in pineapple (Hubert et al. 2014). Other tropical hosts include palms (Arecaeae), papaya (*Carica papaya*), coconut (*Cocos* spp.), coffee (*Coffea* spp.), taro (*Colcasia* spp.), mango (*Mangifera indica*), and tropical grass/sedge species (e.g. *Brachiaria dictyoneura, Eleocharis* sp.) (Farr & Rossman 2016).

T. paradoxa has also been reported overseas on the following hosts which are common in New Zealand: *Eucalyptus*, kumara (*Ipomoea batatas*), potato (*Solanum tuberosum*), lettuce (*Lactuca sativa*), pumpkin (*Cucurbita moschata*), and macrocarpa trees (*Cupressus macrocarpa*) (Farr & Rossman 2016). Kumara, potato, lettuce, pumpkin and macrocarpa trees are all important to New Zealand but are not thought to be major hosts of *T. paradoxa.* Very few articles were found in CAB abstracts on *T. paradoxa* (and its synonyms) on these hosts, suggesting that it is not often reported to be a problem on these hosts.

Eucalyptus trees are grown as a forestry crop but it is assumed that the impacts of this fungus on eucalyptus trees would be minor as they are grown outside, and the climate in much of New Zealand is likely to not be warm and humid enough for the fungus to thrive.
As the main hosts are tropical species such as pineapple and sugarcane it is unlikely that *T. paradoxa* would have much impact in New Zealand. It is too cold here to grow crops like pineapple or sugarcane commercially. There is a low likelihood that it could be a problem on suitable hosts in glasshouses.

The economic impact of establishment of *T. paradoxa* in New Zealand is considered to be low.

Environmental impact
The families of host species of *T. paradoxa* were determined. The Plant Conservation Network (PCN 2016) was checked to see which native New Zealand species were found in these 19 families, and their threatened status. There were many native species in host families. None of these native species have been recorded as hosts, so it is not clear whether these plants will be hosts.
However there is a low likelihood that they will be infected by *P. paradoxa* if it established in New Zealand because other plants in the same family are hosts. Some of the families of host species, and the native New Zealand plants in those families are Arecaceae (nikau palm); Rubiaceae (e.g. many native *Coprosma* species, some at risk and threatened – nationally critical); Cyperaceae (many native species including some at risk); Poaceae (many native species including some at risk); and Meliaceae – with only one native species, *Dysoxylum spectabile* (kohekohe), but this species is ecologically important because it is very common.

It is assumed unlikely that native species would be impacted significantly by this fungus given that the climate will not be suitable for the fungus to thrive in most areas of New Zealand.
The environmental impact of establishment of *T. paradoxa* in New Zealand is considered to be low.

Sociocultural and human health impact
There is a low likelihood that home gardeners would be affected if plants became infected. Potatoes, kumara, lettuce, and pumpkin are grown by home gardeners. Kumara is also of importance to Maori. Eucalyptus trees are grown in home gardens. Ornamental palms could also potentially be hosts.

For all of these plants, it is assumed that they are only minor hosts and not infected frequently. It is unlikely that infected plants would be impacted given that the climate is not suitable for the fungus to thrive in most of New Zealand. There is some potential for vegetables to be damaged in glasshouses.

Sociocultural impacts are likely to be very low.

There are no known human health impacts from *Thielaviopsis paradoxa* so the human health consequences of establishment in New Zealand are considered to be negligible.

Conclusion
The likelihood of entry and likelihood of exposure are considered to be low. The likelihood of establishment is considered to be high, and the likelihood of spread is considered to be moderate. The economic and environmental consequences of establishment of *T. paradoxa* in New Zealand are considered to be low, and sociocultural consequences are likely to be very low. The human health consequences of establishment are likely to be negligible.

Risk estimation table 3: *Thielaviopsis paradoxa* on imported fresh salacca fruit from Indonesia

	Considered to be:			
Likelihood of:	**Negligible**	**Low**	**Moderate**	**High**
Entry		■		
Exposure		■		
Establishment				■
Spread			■	
Consequences of establishment				
Economic		■		
Environmental		■		
Socio-cultural	■	■		
Human Health	■			

In consideration of these assessments, *Thielaviopsis paradoxa* is considered to be a non-negligible risk on imported fresh salacca fruit from Indonesia. The risk is worth considering and further analysis may be undertaken to decide if additional measures are warranted.

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Appendix: Hazard identification table for salacca fruit from Indonesia to New Zealand

Organism	Follow pathway (DoA 2014)	Hazard in DoA 2014?	DoA Hazard conclusion accepted?	Present in NZ?	Reference for presence in NZ	Subspecific taxa (Mycobank 2016)	Hazard in NZ?
Insecta: Coleoptera							
Adoretus sinicus Burmeister, 1855 (Scarabaeidae) Chinese rose beetle	No	No	Yes	No	not in NZOR 2016 or PPIN 2016	n/a	N
Callispa elegans Baly, 1876 (Chrysomelidae) Leaf beetle	No	No	Yes	No	not in NZOR 2016 or PPIN 2016	n/a	N
Callispa pusilla Gestro, 1896 (Chrysomelidae) Leaf beetle	No	No	Yes	No	not in NZOR 2016 or PPIN 2016	n/a	N
Carpophilus sp. (Nitidulae) Dried-fruit beetle	No	No	Yes	Some spp.	NZOR 2016	n/a	N
Holotrichia javana Brenske, 1892 (Scarabaeidae) White grub	No	No	Yes	No	not in NZOR 2016 or PPIN 2016	n/a	N
Lepidiota stigma (Fabricius, 1798) (Scarabaeidae) Sugarcane white grub	No	No	Yes	No	not in NZOR 2016 or PPIN 2016	n/a	N
Nodocnemus sp. (Curculionidae)	No	No	Yes	No	not in NZOR 2016 or PPIN 2016	n/a	N*
Omotemnus miniatocrinitus Chevrolat, 1882 (Curculionidae)	No	No	Yes	No	not in NZOR 2016 or PPIN 2016	n/a	N

Organism	Follow pathway (DoA 2014)	Hazard in DoA 2014?	DoA Hazard conclusion accepted?	Present in NZ?	Reference for presence in NZ	Subspecific taxa (Mycobank 2016)	Hazard in NZ?
Omotemnus serrirostris Boheman, 1845 (Curculionidae)	No	No	Yes	No	not in NZOR 2016 or PPIN 2016	n/a	N
Pistosia inornata (Gestro, 1892) (Chrysomelidae)	No	No	Yes	No	not in NZOR 2016 or PPIN 2016	n/a	N
Rhynchophorus ferrugineus (Olivier, 1790) (Curculionidae) Red palm weevil	No	No	Yes	No	not in NZOR 2016 or PPIN 2016	n/a	N
Rhynchophorus palmarum (Linnaeus, 1758) (Curculionidae) South American palm weevil	No	No	Yes	No	not in NZOR 2016; recorded as absent in PPIN 2016	n/a	N
Insecta: Hemiptera							
Astegopteryx nipae (van der Goot, 1917) (Aphididae) Pemphigid aphid	No	No	Yes	No	not in NZOR 2016 or PPIN 2016	n/a	N
Astegopteryx rappardi Hille Ris Lambers, 1953 (Aphididae) Pemphigid aphid	No	No	Yes	No	not in NZOR 2016 or PPIN 2016	n/a	N
Cerataphis lataniae (Boisduval, 1867) (Aphididae) Palm aphid	No	No	Yes	No	not in NZOR 2016 or PPIN 2016	n/a	N
Dysmicoccus sp. (Pseudococcidae)	Yes	Yes	Yes	Some spp.	NZOR 2016	n/a	**Y**

Organism	Follow pathway (DoA 2014)	Hazard in DoA 2014?	DoA Hazard conclusion accepted?	Present in NZ?	Reference for presence in NZ	Subspecific taxa (Mycobank 2016)	Hazard in NZ?
Ischnaspis longirostris (Signoret, 1882) (Diaspididae) Black thread scale	No	No	Yes	No	not in NZOR 2016; recorded as absent PPIN 2016	n/a	N
Planococcus sp. (Pseudococcidae)	Yes	Yes	Yes	Some spp.	NZOR 2016	n/a	**Y**
Pseudococcus sp. (Pseudococcidae)	Yes	Yes	Yes	Some spp.	NZOR 2016	n/a	**Y**
Pseudococcus longispinus (Targiono Tozzetti, 1867) (Pseudococcidae) Long tailed mealybug	Yes	No	No**	Yes	NZOR 2016	n/a	N*
Tolumnia sp. (Pentatomidae)	No	No	No	No	not in NZOR 2016 or PPIN 2016	n/a	N*
Insecta: Hymenoptera							
Trigona sp. (Apidae) Sugarbag bee, stingless bee	No	No	Yes	No	not in NZOR 2016	n/a	N
Insecta: Lepidoptera							
Amathusia ochraceofusca ochraceofusca Honrath, 1888 (Nymphalidae)	No	No	Yes	No	not in NZOR 2016 or PPIN 2016	n/a	N
Artona catoxantha (Hampson, 1892) (Zygaenidae) Coconut leaf moth	No	No	Yes	No	not in NZOR 2016 or PPIN 2016	n/a	N

Organism	Follow pathway (DoA 2014)	Hazard in DoA 2014?	DoA Hazard conclusion accepted?	Present in NZ?	Reference for presence in NZ	Subspecific taxa (Mycobank 2016)	Hazard in NZ?
Darna sp. (Limacodidae)	No	No	Yes	No	not in NZOR 2016 or PPIN 2016	n/a	N
Hidari irava (Moore, 1858) (Hesperiidae) Coconut skipper	No	No	Yes	No	not in NZOR 2016 or PPIN 2016	n/a	N
Lotongus avesta (Hewitson, 1868) (Hesperiidae)	No	No	Yes	No	not in NZOR 2016 or PPIN 2016	n/a	N
Parasa lepida (Cramer, 1799) (Limacodidae)	No	No	Yes	No	not in NZOR 2016 or PPIN 2016	n/a	N
Ploneta diducta (Snellen, 1900) (Limacodidae)	No	No	Yes	No	not in NZOR 2016 or PPIN 2016	n/a	N
Setora sp. (Walker, 1855) (Limacodidae)	No	No	Yes	No	not in NZOR 2016 or PPIN 2016	n/a	N
Insecta: Orthoptera							
Sexava coriacea (Linnaeus, 1758) (Tettigoniidae) Long-horned grasshopper	No	No	Yes	No	not in NZOR 2016 or PPIN 2016	n/a	N
Sexava karnyi Leefmans, 1927 (Tettigoniidae)	No	No	Yes	No	not in NZOR 2016 or PPIN 2016	n/a	N

Organism	Follow pathway (DoA 2014)	Hazard in DoA 2014?	DoA Hazard conclusion accepted?	Present in NZ?	Reference for presence in NZ	Subspecific taxa (Mycobank 2016)	Hazard in NZ?
Sexava nubila (Stal, 1874) (Tettigoniidae)	No	No	Yes	No	not in NZOR 2016 or PPIN 2016	n/a	N
			Bacteria				
Pectobacterium carotovorum subsp. *carotovorum* (Jones 1901) Hauben et al. 1999 (Enterobacteriales: Enterobacteriaceae) Bacterial soft rot	n/a	No	No**	Yes	Landcare Research 2016a & B. Weir pers. comm. 2016	N***	N
			Fungi				
Aspergillus sp. (Eurotiales: Trichocomaceae)	Yes	No	Yes	Some spp.	Landcare Research 2016a	n/a	N
Cercospora sp. (Capnodiales : Mycosphaerellaceae)	No	No	Yes	Some spp.	Landcare Research 2016a	n/a	N
Fusarium sp. (Hypocreales: Nectriaceae)	Yes	No	Yes	Some spp.	Landcare Research 2016a	n/a	N
Lasiodiplodia theobromae (Pat.) Griffon & Maubl. (Botryosphaeriales: Botrytosphaeriaceae) Stem end rot	n/a	No	No**	Yes	Landcare Research 2016a	N	N
Lembosia zalaccae Hansf. (Capnodiales : Asterinaceae)	No	No	Yes	No	not in Landcare Research 2016a or PPIN 2016	n/a	N
Marasmiellus javanicus Retnowati (Agaricales: Marasmiaceae)	No	No	Yes	No	not in Landcare Research 2016a or PPIN 2016	n/a	N

Organism	Follow pathway (DoA 2014)	Hazard in DoA 2014?	DoA Hazard conclusion accepted?	Present in NZ?	Reference for presence in NZ	Subspecific taxa (Mycobank 2016)	Hazard in NZ?
Marasmius palmivorus Sharples (Agaricales: Marasmiaceae) Oil palm bunch rot	Yes	Yes	Yes	No	not in Landcare Research 2016a	n/a	**Y**
Mycena sp. (Agaricales: Mycenaceae)	Yes	No	No	Some spp.	Landcare Research 2016a	n/a	N*
Pestalotia sp. (Xylariales: Amphisphaeriaceae) Leaf spot	No	No	Yes	Some spp.	Landcare Research 2016a	n/a	N
Pestalotiopsis palmarum (Cooke) Steyaert (Xylariales: Amphisphaeriaceae) Pestalotiopsis leaf spot	n/a	No	No**	Yes	Landcare Research 2016a	N	N
Erythricium salmonicolor (Berk. & Broome) Burds. (1985) (synonym *Phanerochaete salmonicolor*) (Polyporales: Phanerochaetacerae) Pink disease	No	No	Yes	Yes	Landcare Research 2016a	N	N
Thielaviopsis paradoxa (De Seynes) Hohn. 1904 (Microascales: Ceratocystudaceae)	n/a	No	No**	No	Landcare Research 2016a, 2016b	N	**? ***
Plantae							
Cephaleuros virescens Kunze (Trentepohliales: Trentepohliaceae) Algal leaf spot	n/a	No	No**	Yes	Landcare Research 2016a	N	N

All organisms listed were recorded in Indonesia. For citations see Australia (2014).
*see notes in hazard identification section of main document
** not a hazard to Australia because it is present across Australia. This conclusion doesn't apply to NZ
***no evidence of haplotypes etc of *P. carotovorum* subsp. *carotovorum*
"Follow pathway" is from the hazard identification table in the Australian risk analysis. This is not a term we use in New Zealand. It essentially means it is associated with the fruit and stays with the fruit during picking and processing.

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