Importation of Rambutan Fruit (*Nephelium lappaceum* L.) from Central America and Mexico into the Continental United States

A Pathway-Initiated Risk Assessment

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CONTENTS

A. Executive Summary

This risk assessment (RA) document examines the risks associated with the importation of the fruit of rambutan (*Nephelium lappaceum* L.) into the United States from Central America and Mexico. Information on pests affecting rambutan production in the Americas is limited, so in this risk assessment, the pests that affect rambutan throughout the world are listed if, and only if, populations of that pest also are reported in the countries of Central America and Mexico. The table listing the pests should not be interpreted to infer that a direct association of a given pest on rambutan within these countries was reported in the scientific literature or that all pests known to affect rambutan in the world are listed.

In this risk assessment, pest interception data demonstrated that six quarantine pests of rambutan are present in Central America and Mexico and that these pests can follow the pathway on rambutan fruit. These six pests include two scale insects (*Coccus moestus* and *C. viridis*) and four mealybugs (*Dysmicoccus neobrevipes* (Beardsley), *Planococcus lilacinus* (Cockerell), *P. minor* (Maskell) and *Pseudococcus landoi* (Balachowsky)).

These quarantine pests that are likely to follow the pathway are qualitatively analyzed using the methodology described in the USDA-APHIS Guidelines 5.02, which examines pest biology in the context of the Consequences of Introduction and the Likelihood of Introduction and estimates the baseline pest risk potential. The baseline pest risk potential for all these pests was rated High. Port-of-entry inspections appear insufficient to safeguard U.S. agriculture, and phytosanitary measures should be developed to reduce the risk.

Fruit fly forced feeding studies on rambutan submitted by the Honduran government were reviewed as part of this assessment, and the data support the conclusion that the native fruit flies of quarantine concern—*Anastrepha ludens*, *A. obliqua*, and *Ceratitis capitata*—are unlikely to be transported on undamaged fruit.

B. Introduction

This risk assessment was prepared by the Animal and Plant Health Inspection Service (APHIS) of the U.S. Department of Agriculture (USDA) to examine the pest risks associated with the importation from Central America and Mexico into the United States of fresh rambutan fruit (*Nephelium lappaceum* L.). This risk assessment is qualitative, and risk is expressed in terms such as high and low rather than as probabilities or frequencies. The details of the methodology and rating criteria can be found in *Pathway-Initiated Pest Risk Assessments: Guidelines for Qualitative Assessments, Version 5.0* (USDA, 2000).

Regional and international plant protection organizations—e.g., the North American Plant Protection Organization (NAPPO) and the International Plant Protection Convention (IPPC) administered by the Food and Agriculture Organization (FAO) of the United Nations—provide guidance for conducting pest risk analyses. The methods used to initiate, conduct, and report this RA are consistent with guidelines provided by NAPPO and FAO. Our use of biological and phytosanitary terms conforms to "Definitions and Abbreviations" (Introduction Section) of *International Standards for Phytosanitary Measures, Section 1—Import Regulations: Guidelines for Pest Risk Analysis* (FAO, 1996).

The FAO guidelines describe three stages of pest risk analysis: Stage 1 (initiation), Stage 2 (risk assessment), and Stage 3 (risk management). This document satisfies the requirements of FAO Stages 1 and 2.

C. Risk Assessment

1. Initiating Event: Proposed Action

This commodity-based, pathway-initiated risk assessment is in response to a request for USDA authorization to allow importation into the United States of fresh rambutan fruit (*Nephelium lappaceum* L.) grown in Central America and Mexico, which is a potential pathway for the introduction of plant pests. The regulatory authority for importation of fruits and vegetables from foreign sources into the United States is codified in Title 7 of the Code of Federal Regulations 319, Part 56 (7 CFR §319.56).

2. Assessment of Weediness Potential

If the species considered for import poses a risk as a weed pest, then a "pest-initiated" risk assessment is conducted. The results of the weediness screening for rambutan do not prompt a pest-initiated risk assessment because there are no reports of rambutan growing as a weed in the consulted literature (Table 1).

Table 1. Assessment of the Weediness Potential of Rambutan

Commodity: *Nephelium lappaceum* L. (rambutan) (Sapindaceae)

Phase 1: Rambutan grows in limited production in Florida, Hawaii, and Puerto Rico.

Phase 2: Is the species listed in:

- No — Geographical Atlas of World Weeds (Holm *et al.*, 1979)
- No — World's Worst Weeds (Holm *et al.*, 1977) or World Weeds: Natural Histories and Distribution (Holm *et al.*, 1997)
- No — Report of the Technical Committee to Evaluate Noxious Weeds; Exotic Weeds for Federal Noxious Weed Act (Gunn and Ritchie, 1982)
- No — *Economically Important Foreign Weeds* (Reed, 1977)
- No — Weed Science Society of America list (WSSA, 1989)
- No — Is there any literature reference indicating weediness, *e.g.*, AGRICOLA, CAB, Biological Abstracts, AGRIS; search on "species name" combined with "weed".

Phase 3: Rambutan is not widely prevalent in the United States, it is grown in limited production, and is not listed as a weed in any of the above references. There is no evidence to support that rambutan poses a risk as a weed.

3. Current Status, Previous Risk Assessments and Pest Interceptions

Currently, rambutan fruit enters the continental United States from Hawaii with irradiation as a treatment for *Bactrocera dorsalis* and *Ceratitis capitata*. Fruit also may enter from Grenada where economically important fruit flies are not known to occur.

Most prior importation requests for entry of rambutan were denied because of the potential for infestation by fruit flies that are quarantine pests. In 1987, entry of fruit from Belize was denied because the host status for *Ceratitis capitata* and *Anastrepha* was unknown, and there were no acceptable treatments for these fruit flies. In 1983 and 1990, two separate decisions denied entry of rambutan fruit from Costa Rica based on the lack of acceptable treatments for fruit flies including *Ceratitis capitata*. A 1992 decision denied entry of fruit from Guatemala based on the lack of acceptable treatments for *Ceratitis capitata* and *Anastrepha*. In 1987 and 1993, two separate decisions denied entry of the fruit from Honduras based on similar findings. In 1992, fruit from Mexico was denied entry because the host status for *Anastrepha* was unknown and acceptable treatments for this pest did not exist. Pathology reports generally were not part of the earlier decisions, and later decisions did not identify any pathogens of quarantine significance. In 1988, entry of fruit from Grenada was permitted because quarantine-significant fruit flies were not known to occur in this country.

The decision history for importation of rambutan from other regions of the world reflects similar fruit fly concerns. In 1978, entry of fruit from Sri Lanka was denied because there was no approved treatment for either *Dacus* spp. or *Cryptophlebia ombrodelta*, but the pathology recommendation was to permit entry subject to inspection and freedom from plant debris. Entry of fruit from Thailand was denied in 1983 because of the lack of acceptable treatment for the complex of fruit flies of the genus

Dacus. Entry of fruit from Malaysia was denied in 1986 because there was no approved treatment for *Dacus dorsalis*. In 1997, fruit from Hawaii was permitted into the continental United States into non-fruit-fly supporting areas with irradiation as a treatment for *Bactrocera dorsalis* and *Ceratitis capitata*.

A query of the database of United States pest interceptions from 1985–2001 reported interceptions of pests on rambutan from the countries in this risk assessment (PIN 309, 2001). In 1995, *Nephelium lappaceum* fruit from Belize was intercepted with an infestation of a species of Pseudococcidae. Interceptions from Costa Rica were: *Coccus moestus* (2000), *Coccus viridis* (1998), *Hemiberlesia* sp. (1995), *Orthezia* sp. (1998), *Pseudococcus landoi* (1996), *Pseudococcus* sp. (1994), and Pseudococcidae sp. (1997, 1999). Interceptions from El Salvador were: a species of Heteroptera (2001), *Planococcus* sp. (1999), Pseudococcidae sp. (1992), and Pyraustinae sp. (1992). A species of Pseudococcidae was intercepted on *Nephelium* sp. fruit from Guatemala in 1988. Interceptions from Honduras were: *Aleuroplatus cococolus* (1987), *Pseudococcus* sp. (1997), Riodinidae sp. (1998), Tortricidae sp. (1987) and Tropiduchidae sp. (1987). There were two separate interceptions of *Planococcus minor* on the fruit of *Nephelium* sp. from Mexico in 1988 and 1996. Pests were not intercepted on rambutan fruit from Nicaragua from 1985–2001. In 2000, there was one interception of a species of Pseudococcidae from Panama. All the interceptions were from fruit in passenger baggage except for the pests on leaves in three shipments of propagative materials imported from Honduras in 1987 (PIN 309, 2001).

4. Pest Categorization

Rambutan is native to Malaysia and Indonesia and is cultivated in many of the low-lying regions of tropical Asia, especially Thailand. Until the 1950s, its distribution was limited, but rambutan cultivation now includes production in the tropical regions of the Americas (Morton, 1987; Tindall, 1994). For these reasons, information on the pests of this crop in the new production regions is limited, and the extent that rambutan is affected by endemic populations of pests may not be fully realized. In this risk assessment, Table 2 reports the pests that infect or infest rambutan throughout the world if, and only if, populations of that pest also are reported in the countries of Central America and Mexico. The table should not be interpreted to infer that a direct association of a given pest on rambutan within these countries was reported in the scientific literature, or that all pests known to affect rambutan in the world are listed. This table only presents information about a pest's prevalence relative to the risks associated with the importation of rambutan, along with the host associations and regulatory data used to select the quarantine pests given detailed biological analysis.

Pests of rambutan reported only at the genus or higher taxonomic levels are included in Table 2 but are not further analyzed in this risk assessment. This applies to the following fungi: *Botrytis* sp. (Tindall, 1994), *Cercospora* sp. (Tindall, 1994; Kunishi and Kitagawa, 1996), *Cladosporium* sp. (Tindall, 1994; Kunishi and Kitagawa, 1996), *Coniothyrium* sp. (Kunishi and Kitagawa, 1996), *Gloeosporium* sp. (Tindall, 1994; Kunishi and Kitagawa, 1996), *Ophioceras* sp. (Tindall, 1994) and *Trichoderma* sp. (Kunishi and Kitagawa, 1996). This also applies to the following intercepted pests: *Hemiberlesia* sp., Heteroptera sp., *Orthezia* sp., *Planococcus* sp., Pseudococcidae spp., *Pseudococcus* sp., Pyraustinae sp., Riodinidae sp., Tortricidae sp. and Tropiduchidae sp.

There are a number of genera listed in Table 2 designated with a quarantine status of "cannot be determined." For the purposes of a risk assessment, the quarantine status of an organism cannot be determined solely from identification to the genus level because individual species within those genera are potential pests that may or may not occur within the United States. In contrast, identification only to the genus level may be all that is practical to evaluate if a shipment requires treatment during a port-of-entry inspection. The IPPC guidelines do not require assessment of pests identified only by genus name (FAO, 1996).

The group of organisms identified in Table 2 as "Yeasts (Levadura)" exemplifies the difficulties of assessing risks in these types of situations. Generally, yeasts are unicellular fungi that reproduce by fission and are associated with food production and spoilage (Alexopoulos and Mims, 1979). The report from Costa Rica identified yeast pests only by the name "Levadura" (Mora Umaña, 2000).

There is one report of a yeast species, *Pichia sporocuriosa*, isolated from rambutan from Malaysia (Peter *et al*., 2000). Other reports of yeasts infecting rambutan were not found, but the yeast *Pichia guilliermondii* experimentally protected apples from the postharvest fruit rotting fungi *Botrytis cinerea* and *Penicillium expansum* (Kohmoto *et al*., 1995). Based on these findings, it cannot be determined if the yeasts in Costa Rica are pathogenic or potential biological control agents.

Other organisms may be detrimental to the agricultural production systems of the United States but they are not reasonably expected to follow the pathway of the commodity. Some are associated mainly with plant parts other than the commodity, such as the root weevil *Cleistolophus viridimargo* (McCoy and Duncan, 2001; Woodruff, 1985). Some organisms are not reasonably expected to remain with the commodity during processing, some are likely to die during shipment, and some are infrequently intercepted as biological contaminants.

The discussion that follows Table 2 explains aspects affecting the analysis of individual organisms.

Table 2: Pests Associated with Nephelium lappacearum in Central America and Mexico and Presence in the United States on Any Host

Scientific Name	Distribution[1]	Plant Part	Quarantine Pest	Follow Pathway	References
ARTHROPODS					
Aleuroplatus cococolus Quaintance and Baker (Homoptera: Aleyrodidae)	HN, PA	Leaf	Yes	No	Mound and Halsey, 1978; PPQ Interception
Amorbia emigratella Busck (Lepidoptera: Tortricidae)	MX, US	Fruit	No	Yes	Kunishi and Kitagawa, 1996; McQuate *et al*., 2000; Zhang, 1994
Anastrepha spp. (Diptera: Tephritidae)	CAm, FL, MX	Fruit	Yes	No[3]	CABI, 2000; Vasquez, 2000; White and Elson-Harris, 1992
Carpophilus dimidiatus (Fabricius) (Coleoptera: Nitidulidae)	NI, MX, US	Fruit, Seed	No	Yes	CABI, 2000; Tindall, 1994; Zee *et al*., 1993
Ceratitis capitata (Wiedemann) (Diptera: Tephritidae)	CR, GT, HW, HN, NI, PA, SV	Fruit	Yes	No[3]	CABI, 2000: McQuate *et al*., 2000; Vasquez, 2000; White and Elson-Harris, 1992
Ceroplastes ceriferus (Fabricius) (Homoptera: Coccidae)	PA, US	Leaf, Stem	No	No	Ben-Dov, 1993; CABI, 2000
Ceroplastes floridensis (Comstock) (Homoptera: Coccidae)	CR, GT, HN, NI, PA, MX, US	Fruit, Leaf, Stem	No	Yes	Ben-Dov, 1993; CABI, 2000; McGuire and Crandall, 1967; Mora Umaña, 2000
Cleistolophus viridimargo Champion (Coleoptera: Curculionidae)	BZ, HN	Root	Yes	No	Caniz, 2000; McCoy and Duncan, 2001; Woodruff, 1985
Coccus hesperidum (Linnaeus) (Homoptera: Coccidae)	CAm, MX, US	Leaf, Stem	No	No	CABI, 2000

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Coccus moestus De Lotto (Homoptera: Coccidae)	CR	Fruit	Yes	Yes	PPQ Interception
Coccus viridis (Green) (Homoptera: Coccidae)	CR, FL, GT, HN, HW, MX, NI, PA, SV	Fruit, Leaf, Stem	Yes	Yes	CABI, 2000; Hamon and Williams, 1984; Kunishi and Kitagawa, 1996; McGuire and Crandall, 1967; PPQ Interception
Dysmicoccus brevipes (Cockerell) (Homoptera: Pseudococcidae)	CA, CAm, FL, HW, LA, MX	Fruit, Inflorescence, Leaf, Root, Stem	No	Yes	CABI, 2000; Kunishi and Kitagawa, 1996; McGuire and Crandall, 1967
Dysmicoccus neobrevipes (Beardsley) (Homoptera: Pseudococcidae)	HW, CR, GT, HN, MX, PA, SV	Fruit, Inflorescence, Leaf, Root, Stem	Yes	Yes	CABI, 2000; PPQ Interception; Williams and Granara de Willink, 1992
Hemiberlesia lataniae (Signoret) (Homoptera: Diaspididae)	CR, GT, HN, MX, NI, PA, US	Fruit, Leaf, Stem	No	Yes	CABI, 2000; Kunishi and Kitagawa, 1996
Hemiberlesia rapax (Comstock) (Homoptera: Diaspididae)	CR, GT, HN, MX, US	Fruit, Leaf, stem	No	Yes	CABI, 2000; Kunishi and Kitagawa, 1996; McGuire and Crandall, 1967
Hemiberlesia sp. (Homoptera: Diaspididae)	CR	Fruit, Leaf, Stem	Yes	Yes	PPQ Interception
Howardia biclavis (Comstock) (Homoptera: Diaspididae)	FL, CAm?, MX	Fruit	No	Yes	Hawaii, 1996; Nakahara, 1982
Nipaecoccus nipae (Maskell) (Homoptera: Pseudococcidae)	BZ, CA, CR, FL, GT, HW, LA, MX, NI, PA, SV	Fruit, Leaf, Stem	No	Yes	CABI, 2000; Kunishi and Kitagawa, 1996
Orthezia sp. (Homoptera: Ortheziidae)	CR	Inflorescence, Leaf, Stem	Yes	No	PPQ Interception

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Planococcus citri (Risso) (Homoptera: Pseudococcidae)	CR, GT, HN, MX, PA, SV, US	Fruit, Inflorescence, Stem	No	Yes	CABI, 2000; Kunishi and Kitagawa, 1996; McGuire and Crandall, 1967; Tindall, 1994
Planococcus lilacinus (Cockerell) (Homoptera: Pseudococcidae)	SV	Fruit, Inflorescence, Leaf, Stem	Yes	Yes	CABI, 2000; Morton, 2000; PPQ Interception; Tindall, 1994; Williams and Granara de Willink, 1992
Planococcus minor (Maskell) (Homoptera: Pseudococcidae)	CR, GT, HN, MX	Fruit	Yes	Yes	Cox, 1989; PPQ Interception; Williams and Granara de Willink, 1992
Planococcus sp. (Homoptera: Pseudococcidae)	SV	Fruit, Inflorescence, Leaf, Stem	Yes	Yes	PPQ Interception
Pseudaulacaspis pentagona (Targioni and Tozzetti) Macgillivray (Homoptera: Diaspididae)	CR, HN, PA, US	Leaf, Root, Stem	No	No	CABI, 2000; Kozar, 1990
Pseudococcidae sp. (Homoptera: Pseudococcidae)	BZ, CR, GT, SV	Fruit	Yes	Yes	PPQ Interception
Pseudococcus affinis (Maskell) (Homoptera: Pseudococcidae)	CA, GT	Fruit	No	Yes	CABI, 2000; Kunishi and Kitagawa, 1996; Williams and Granara de Willink, 1992
Pseudococcus jackbeardsleyi (Gimpel and Miller) (Homoptera: Pseudococcidae)	CAm, FL, HW, MX TX	Fruit, Leaf, Stem	No	Yes	CABI 2000; Gimpel and Miller, 1996; Mora Umaña, 2000; Williams and Granara de Willink, 1992

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Pseudococcus landoi (Balachowsky) (Homoptera: Pseudococcidae)	CR, GT, HN, MX, NI, PA	Fruit	Yes	Yes	Gimpel and Miller, 1996; PPQ Interception; Williams and Granara de Willink, 1992
Pseudococcus longispinus (Targioni and Tozzetti) (Homoptera: Pseudococcidae)	CR, GT, HN, MX, PA, US	Fruit, Inflorescence, Leaf, Stem	No	Yes	CABI 2000; Kunishi and Kitagawa, 1996; McGuire and Crandall, 1967
Pseudococcus sp. (Homoptera: Pseudococcidae)	CR, HN	Fruit	Yes	Yes	PPQ Interception
Pulvinaria psidii (Maskell) (Diptera: Chloropidae)	CR, MX, US	Fruit, Inflorescence, Leaf, Stem	No	Yes	CABI, 2000; Kunishi and Kitagawa, 1996
Pyraustinae sp. (Lepidoptera: Pyralidae)	SV	Fruit	Yes	Yes	PPQ Interception
Riodinidae sp. (Lepidoptera: Riodinidae)	HN	Fruit	Yes	Yes	PPQ Interception
Selenaspidus articulatas (Morgan) (Homoptera: Diaspididae)	BZ, CR, FL, HN, MX, PA	Fruit, Leaf, Stem	No	Yes	CABI, 2000; McGuire and Crandall, 1967; Nakahara, 1982
Tetranychus cinnabarinus (Boisduval) (Acari: Tetranychidae)	CR, MX, US	Inflorescence, Leaf	No	No	CABI, 2000; Tindall, 1994
Tortricidae sp. (Lepidoptera: Tortricidae)	HN	Leaf	Yes	No	PPQ Interception
Tropiduchidae sp. (Homoptera: Tropiduchidae)	HN	Leaf	Yes	No	PPQ Interception
ALGAE					
Cephaleuros sp.	CR	Leaf	CBD[4]	No	Mora Umaña, 2000
Cephaleuros virescens Kunze	CAm, FL	Leaf	No	No	CABI, 2000; Tindall, 1994

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BACTERIA					
Pseudomonas sp.	CR	Leaf	CBD[4]	No	Mora Umaña, 2000
Xanthomonas nepheliae Barr. (Pordesimo and Baredo)	HN	Leaf	Yes	No	Bradbury, 1986; Caniz, 2000; Cook, 1975; Tindall, 1994
FUNGI					
Aspergillus sp. (Fungi Imperfecti: Hyphomycetales)	HN	Fruit	CBD[4]	Yes	Caniz, 2000; Tindall, 1994
Capnodium sp. (Ascomycota: Dothideales)	HN	Fruit	CBD[4]	Yes	Caniz, 2000
Colletotrichum sp. (Fungi Imperfecti: Coelomycetales)	HN	Fruit, Leaf	CBD[4]	Yes	Caniz, 2000; Kunishi and Kitagawa, 1996; Tindall, 1994; Visaranthanonth and Ilag, 1987; Zee, 1998
Corticium salmonicolor (Berke and Broome) (Basidiomycota: Cortinariales)	CAm, FL, LA, MS, MX	Leaf, Stem	No	No	CABI, 2000; Caniz, 2000; McGuire and Crandall, 1967; Tindall, 1994
Dothiorella sp. (Ascomycota: Coelomycetales)	HN	Fruit	CBD[4]	Yes	Caniz, 2000
Dolabra nepheliae (Booth and Ting) (Ascomycota: Dothideales)	HN	Leaf, Stem	Yes	No	CABI, 2000; Caniz, 2000; Tindall, 1994; Zalasky *et al.*, 1971
Fusarium spp. *(Nectria* sp.) (Fungi Imperfecti: Hyphomycetales)	CR	Stem	CBD[4]	No	Mora Umaña, 2000

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Fusarium spp. (Fungi Imperfecti: Hyphomycetales)	CR	Fruit	CBD[4]	Yes	Kunishi and Kitagawa, 1996; Mora Umaña, 2000; Tindall, 1994; Visaranthanonth and Ilag, 1987
Gliocephalotrichum spp. (Fungi Imperfecti: Hyphomycetales)	CR	Fruit	CBD[4]	Yes	Mora Umaña, 2000
Glomerella cingulata (Stoneman) Spauld. and H. Schrenk (Ascomycota: Phyllacorales) Anamorph *Colletotrichum gloeosporioides* (Penz.) Penz. and Sacc. in Penz.	CAm, MX, US	Fruit, Inflorescence, Leaf, Stem	No	Yes	CABI, 2000; Farungsang *et al.*, 1994; Raabe *et al.*, 1989; Farr *et al.*, 1989; CMI 315, 1971; McGuire and Crandall, 1967; Tindall, 1994
Lasiodiplodia theobromae (Pat.) Griffon and Maubl. (Fungi Imperfecti: Coelomycetales) (Anamorph *Botryodiplodia theobromae* Pat.)	CR, GT, HN, MX, NI, PA, SV, US	Fruit, Inflorescence, Leaf Root, Seed, Stem	No	Yes	CABI, 2000; Caniz, 2000; CMI 519, 1976; Farr *et al.*, 1989; Farungsang *et al.*, 1994; Mora Umaña, 2000; Tindall, 1994; Visarathanonth and Ilag, 1987; Zee *et al.*, 1998
Macrophomina spp. (Fungi Imperfecti: Coelomycetales)	CR	Fruit	CBD[4]	Yes	Mora Umaña, 2000
Oidium sp. (Fungi Imperfecti: Hyphomycetales)	HN	Fruit	CBD[4]	Yes	Caniz, 2000; Morton, 2000
Penicillium sp. (Fungi Imperfecti: Hyphomycetales)	HN	Fruit	CBD[4]	Yes	Caniz, 2000
Pestalotia spp. (Fungi Imperfecti: Hyphomycetales)	CR	Fruit	CBD[4]	Yes	Mora Umaña, 2000; Kunishi and Kitagawa, 1996; Tindall, 1994; Visaranonth and Ilag, 1987

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Phoma spp. (Fungi Imperfecti: Coelomycetales)	CR	Fruit	CBD[4]	Yes	Kunishi and Kitagawa, 1996; Mora Umaña, 2000
Phomopsis spp. (Fungi Imperfecti: Coelomycetales)	CR	Fruit	CBD[4]	Yes	Farungsang *et al.*, 1994; Kunishi and Kitagawa, 1996; Mora Umaña, 2000; Tindall, 1994; Visaranonth and Ilag, 1987
Phytophthora nicotianae Breda de Haan var. *parasitica* (Dastur) G.M. Waterhouse (Oomycota: Peronosporales)	CAm, MX, US	Fruit, Leaf, Root, Stem	No	Yes	CABI, 2000; CMI 35, 1964; Farr *et al.*, 1989; Raabe *et al.*, 1981; Tindall, 1994
Rigidoporus microporus (Fr.) Overeem (Basidiomycota: Poriales) (*Rigidoporus lignosus* (Klotzsch) Imazcki)	AL, CR, FL, LA, MS, MX, PH	Inflorescence, Leaf, Root, Stem	No	No	CABI, 2000; Morton, 2000; Tindall, 1994
Rhizopus stolonifer (Ehrenb.:Fr.) Vuill. (Zygomycota: Mucorales)	CAm?, MX, US	Fruit	No	Yes	CMI 110, 1966; Raabe *et al.*, 1981; Tindall, 1994; Visaranthanonth and Ilag, 1987
Yeast (Levadura)	CR, MY	Fruit	CBD[4]	Yes	Mora Umaña, 2000; Peter *et al.*, 2000
NEMATODA					
Radopholus similis (Cobb) Thorne (Tylenchida: Pratylenchidae)	CAm, FL, HW, LA, MX, TX	Leaf, Root	Yes	No	CABI, 2000; Latha *et al.*, 1997
Rotylenchulus reniformis (Linford and Oliveira) (Tylenchida: Rotylenchulidae)	BZ, HN, MX, PA, US	Root	No	No	CABI, 2000; Latha *et al.*, 1997

[1] AL = Alabama; BZ = Belize; CA = California; CAm = all countries in Central America; CR = Costa Rica; FL = Florida; GA = Georgia; GT = Guatemala; HN = Honduras; HW = Hawaii; LA = Louisiana; MS = Mississippi; MX = Mexico; NI = Nicaragua; PA = Panama; PH = Philippines; SV = El Salvador; TX = Texas; US = widely distributed in the United States.

[3]*See the discussion on Ceratitis capitata and Anastrepha spp. infra.*
[4]*Members of this genus are reported in the United States, but because the organism was not identified to the species level, the status as a quarantine pest cannot be determined (CBD). Port of entry interceptions of organisms identified only to the genus level are assumed to be interceptions of quarantine pests when quarantine pests exist within that genus.*

Recent studies suggest that fruit flies present in Central America and Mexico are not likely to infest rambutan fruit, and they are not reported as pests of rambutan in these regions. McQuate *et al.*, 2000, reported moderately high levels of survival of *Ceratitis capitata* on artificially infested rambutan fruit in the laboratory, but *C. capitata* was not recovered from the field on any of 47,188 fruits from ten varieties collected over two field seasons. In the same study, there was a very low field infestation rate (>.021%) for *Bactrocera dorsalis*. Yet in Hawaii, *B. dorsalis* displaced *C. capitata* over much of its range, so field exposure of rambutan to *C. capitata* is limited (Bess, 1953; Vargas *et al.*, 1995). Vasquez (2000) exposed damaged and undamaged rambutan fruits to high-density populations of *C. capitata*, *Anastrepha ludens*, and *A. obliqua* in cages. On peel-damaged (pulp exposed) fruit *C. capitata* was able to oviposit, but this was followed by a very low pupation rate (Vasquez, 2000). The peel of the rambutan fruit may deter fruit flies, but the mechanism is unknown, and rigorous culling of damaged fruit at the packinghouse could eliminate the need for quarantine treatments (Witherell, 2000). Based on these recent reports, this risk assessment finds that fruit flies are not likely to follow the pathway on *undamaged* rambutan fruit.

Fruit flies in the genus *Anastrepha* and *Ceratitis capitata* are not present in Asia, so the interceptions reported as *C. capitata* on rambutan in baggage from Thailand and *Anastrepha* on rambutan in baggage from Vietnam (PIN 309, 2000) apparently are errors either in the identification of the baggage origin or of the pest. In contrast, the fruit flies in the genus *Bactrocera* are found in Asia and are routinely intercepted on imports of rambutan, but these flies are not found in Central America or Mexico. Prior decisions on rambutan from Central America and Mexico denied entry or permitted entry of rambutan only with treatment because rambutan was believed to be a host for all these fruit flies.

All the remaining quarantine pests listed in Table 2 require phytosanitary actions to be taken upon detection in shipments of fresh rambutan fruit from Central America or Mexico. This identified level of risk for a quarantine pest applies only to this risk assessment because pests pose different levels of risk from a different commodity from the same host plant species.

The quarantine pests that reasonably can be expected to follow the pathway are analyzed further within this document and are listed in Table 3.

Table 3. Quarantine pests on rambutan selected for further analysis

Pest	Occurrence
Coccus moestus	Costa Rica
Coccus viridis	Central America, Mexico
Dysmicoccus neobrevipes	Central America, Mexico
Planococcus lilacinus	Central America
Planococcus minor	Central America, Mexico
Pseudococcus landoi	Central America, Mexico

5. Consequences of Introduction

The conceptual model for this analysis is APHIS Guidelines v. 5.02 (APHIS, 2000). In this risk assessment, the first five risk elements combine to form an assessment of the risk associated with the consequences of introduction. The value for the consequences of introduction is interpreted by using those guidelines. The remaining risk element ratings are evaluated and combined as described in those guidelines to give a value for the risk associated with the likelihood of introduction. Together, the consequences of introduction and the likelihood of introduction values form an evaluation of the pest risk potential. These science-based evaluations of the risks associated with this importation are designed to inform decisionmakers.

The major sources of uncertainty present in this risk assessment are similar to those in other risk assessments. They include the use of a developing process (APHIS, 2000; Orr, *et al.*, 1993), the approach used to combine risk elements (Bier, 1999; Morgan and Henrion, 1990), and the evaluation of risk by comparisons to lists of factors within the guidelines (Kaplan, 1992; Orr *et al.*, 1993). To address this last source of uncertainty, the lists of factors were interpreted as illustrative and not exhaustive. Other traditionally recognized sources of uncertainty are the quality of the biological information (Gallegos and Bonano, 1993), which includes uncertainty whenever biological information is lacking on the regional flora and fauna. Inherent biological variation within a population of organisms also introduces uncertainty (Morgan and Henrion, 1990).

The qualitative pest risk analysis of the quarantine pests listed in Table 3 begins with a compilation and analysis of basic biological information about each pest. Each risk element is examined individually, and the risk ratings are summarized in Table 4.

Coccus viridis and C. moestus. Climatic conditions favorable for *Coccus viridis* exist in both natural and greenhouse situations within the United States (USDA, 1990), but short-lived greenhouse infestations in Florida demonstrate this insect's tropical nature and limited adaptability. A variety of host plants are present in many U.S. areas that are suitable for this insect. *The risk rating for climate-host interaction is medium* (2).

This insect has a wide host range consisting of vegetable, fruit, and ornamental crops such as asters, chrysanthemum, species of citrus, and coffee. A partial listing of the plant families with genera that can act as a host for this insect is Apocynaceae, Araceae, Asteraceae, Euphorbiaceae, Lauraceae, Rubiaceae, Rutaceae, Verbenaceae and Zingiberaceae (Ben-Dov, 1993). *The risk rating for host-range is high* (3).

Coccus viridis has an inherent slow dispersal behavior (Tandon *et al*., 1988), and there is no evidence of unassisted long range dispersal by this species. This insect was intercepted over 2000 times from over 50 countries since 1985 (many interceptions were from Hawaii and Puerto Rico). This pest is different from other soft scales because it is reported to produce multiple generations per year (Hamon and Williams, 1984; Kosztarab, 1997). *The risk rating for dispersal potential is high* (3).

Populations of *C. viridis* insect are established in Florida, Hawaii, Guam, Puerto Rico, and the U.S. Virgin Islands (Gill, *et al*., 1977), so additional establishment appears unlikely to seriously impact foreign or domestic markets. Feeding by an individual scale is small, but large populations cause yellowing, defoliation, reduction in fruit set, and loss of plant vigor (Gill, *et al*., 1977). These scales often feed along the main vein of the leaf, near the green shoots, on stems, green twigs, and on fruit (Gill, *et al*., 1977). Damage by this pest to young trees in the first 2 years after transplanting can be substantial. Additionally, excretions of "honeydew" often are a food source for sooty mold fungi. Sooty molds blacken leaves and decrease photosynthesis, decreasing plant vigor and growth (Gill, *et al*., 1977), which reduces fruit marketability (CABI, 2000). *The risk rating for economic impact is medium* (2).

The host range of *Coccus viridis* includes Asteraceae, Euphorbiaceae, and Verbenaceae, and each of these families has a member on the U.S. list of threatened and endangered species in the continental United States (USFWS, 2001) that is in the same genus as a known host for this pest. For the estimate of environmental impact, this risk assessment assumes *C. viridis* will extend its host range to all family members within its known host range if populations enter and establish within the continental United States. If this occurs, then the potentially impacted threatened species are California populations of *Senecio layneae* Greene (Asteraceae) and *Verbena californica* Moldenke (Verbenaceae) (ARS, 2001; USFWS, 2001). If this occurs, then the potentially impacted endangered species is the Texas population of *Manihot walkerae* Croizat (Euphorbiaceae) (ARS, 2001; USFWS, 2001). The lack of extensive spread from established populations of *C. viridis* in Florida, along with its dispersal biology, suggests that the tropical or neotropical environmental requirements of this pest will continue to restrict its environmental impact. The risk rating for environmental impact is *medium* (2). *The cumulative rating for the consequences of introduction for Coccus viridis is medium* (12).

The September 13, 2000, interception of *Coccus moestus* on *Nephelium lappaceum* at San Francisco is the first report of this insect on this host. Prior to this interception, the economically important host range for this insect included mango (*Mangifera indica*), breadfruit (*Artocarpus altilis*), cashew (*Anacardium occidentale*), and avocado (*Persea americana*) (Ben-Dov, 1993). *Coccus moestus* often is reported on mango and other tropical fruit hosts from the Caribbean and Pacific Islands, China, and Japan (PIN 309, 2001; Doug Odermatt, personal communication, November 5, 2001). Collections were reported from Costa Rica, Guyana, Jamaica, Guam, Palau Islands, Truk Islands, Barbados, Guadeloupe, and Kenya (Gill *et al*., 1977; Doug Miller, personal communication, November 2, 2001). Generally, this risk assessment assumes the biology of *C. moestus* is similar to *C. viridis* because of the lack of information to the contrary. Although the reported host range of *C. moestrus* is more restricted than *C. viridis*, this risk assessment assumes that the same range of threatened and endangered species are at risk for both of these soft scale insects. *The cumulative rating for the consequences of introduction is medium* (12).

Dysmicoccus neobrevipes. Based on the reported climates that the gray pineapple mealybug inhabits, the corresponding U.S. plant hardiness zones that appear suitable for population establishment by *Dysmiococcus neobrevipes* range from Zones 8 to 10 (USDA, 1990). Hosts for this pest include a wide variety of species from at least 33 plant families (Ben-Dov, 1994). Populations are present in Hawaii (Rohrback *et al.,* 1986; Rohrback *et al*., 1988). The widely distributed pineapple mealybug, *D. brevipes*, has a similar geographic distribution except for additional populations in California, Florida, and Louisiana (CABI, 2000; Ben-Dov, 1994). *The risk rating for climate-host interaction is medium* (2).

This polyphagous insect's primary hosts are pineapple and apple, and it has a wide host range including members of the following plant families: Agavaceae, Cactaceae, Cucurbitaceae, Fabaceae, Malvaceae, Rosaceae, and Sapindaceae (Ben-Dov, 1994; Williams and Granara de Willink, 1992; CABI, 2000; PIN 309, 2000). Many host plants of commercial or environmental interest grow in Florida, Texas, Arizona, and California. *The risk rating for host range is high* (3).

Dispersal potential is related to both the number and motility of the offspring. Beardsley (1959) reported that gray mealybug strains from Oahu used for life-history studies conducted by Ito in the 1930s were *D. neobrevipes*. Those earlier studies showed the average number of first instars produced per female was 346.65, and several generations occur each year. Yet *Dysmicoccus* species appear to be slowly dispersed by this life stage, which actively crawls short distances on the same plant or to neighboring plants within one day (CABI, 2000). Within-field dispersal of *D. neobrevipes* when assisted by big-headed ants in pineapple fields was measured at 27.5 m in 3 months (Beardsley *et al.*, 1982). Long-distance dispersal of all life stages occurs on consignments of plant material and fruit as demonstrated by over 1,300 interceptions from over 40 countries (PIN 309, 2000). *Dysmicoccus* species also is dispersed by wind and animals (CABI, 2000). *The risk rating for dispersal potential is high* (3).

This mealybug is a serious economic pest of tropical or subtropical crops. Colonization and feeding on pineapple occur on the basal parts of leaves and fruit, and "honeydew" excretions are a food source for black sooty molds that reduce the market value of fruit (CABI, 2000). This insect is associated with "pineapple mealybug wilt disease" as a vector of the closterovirus that causes yield reductions (CABI, 2000). Biological and chemical control measures frequently are needed to control mealybugs, attending ants, and sooty molds (CABI, 2000; Beardsley *et al.*, 1982) because this complex of pests lowers crop yield and reduces the crop's market value. *The risk rating for economic impact is high* (3).

The host range of *D. neobrevipes* includes Agavaceae, Cactaceae and Cucurbitaceae, and each of these families has a member on the U.S. list of threatened and endangered species in the continental United States (USFWS, 2001) that is in the same genus as a known host for this pest. For the estimate of environmental impact, this risk assessment assumes *D. neobrevipes* will extend its host range to all family members within its known host range if populations enter and establish within the continental United States. If this occurs, then the potentially impacted endangered species are Arizona populations of *Agave arizonica* Gentry and Weber (Agavaceae), California populations of *Opuntia basilaris* Engelm. and Bigelow var. *treleasei* Coult. ex Tourney (Cactaceae) and Florida populations of *Cucurbita okeechobeensis* (Small) Bailey subsp. *okeechobeensis* (Cucurbitaceae) (ARS, 2001; USFWS, 2001). The host range of this pest does not extend to families with members that are listed as threatened species (USFWS, 2001). The impact of the pineapple mealybug on Hawaiian plants listed as threatened or endangered species (USFWS, 2001) suggests that additional infestations by another mealybug does pose additional risk to at-risk plant populations. *The risk rating for environmental impact is high (3), and the cumulative rating for the consequences of introduction is high (14/15).*

Planococcus lilacinus. This is the dominant mealybug on cocoa (*Theobroma cacao*) in Java and Sri Lanka, and is known as the coffee mealybug throughout southern Asia. This pest occurs mainly in the Palaearctic, Malaysian, Oriental, Australian, and Neotropical regions, and probably was introduced into the South Pacific from Southern Asia. Since the 1970s, it has been reported in Comoros, Kenya, and Madagascar (CABI, 2000). The climatic conditions and the presence of host plants make U.S. tropical areas suitable for survival and establishment of this insect. *The risk rating for climate-host interaction is medium* (2).

The host range of *P. lilacinus* is extremely wide. Cox (1989) listed 45 host plant species within 23 families, including Anacardiaceae, Annonaceae, Asteraceae, Bombacaceae, Dioscoreaceae, Dipterocarpaceae, Euphorbiaceae, and Fabaceae. This polyphagous pest infests a wide range of hosts, including economically important plants such as coffee, tamarinds, mandarins, custard apples, coconuts, *Citrus*, grapes, guavas, and mangoes. *The risk rating for host range is high* (3).

The dispersal potential considers both the number of offspring and the motility of the pest. For *P. lilacinus*, the average fecundity recently was reported as 252 nymphs/female, and females completed their lifecycle and oviposition in an average of 47 days in a relatively warm and humid climate (Mukhopadhyay and Ghose, 1999). Although the local dispersion of adults and nymphs by locomotion is of relatively short duration, *P. lilacinus* was intercepted 776 times from 32 countries since 1985 (PIN 309, 2001), and long distance dispersal in trade is common. *The risk rating for dispersal potential is high* (3).

P. lilacinus causes severe damage to young trees by killing the tips of branches and roots on a wide range of economically important species. In several parts of India, chemical and biological control agents are used to control this pest (CABI 2000). This suggests that additional controls will be needed if *P. lilacinus* enters and establishes populations within the United States. This insect is reported to vector a virus of the cocoa plant (Roivainen, 1980). *The risk rating for the economic impact is high* (3).

The host range of *Planococcus lilacinus* includes Ericaceae, Euphorbiaceae, and Rhamnaceae, and each of these families has a member on the U.S. list of threatened and endangered species in the continental United States (USFWS, 2001) that is in the same genus as a known host for this pest. For the estimate of environmental impact, this risk assessment assumes *P. lilacinus* will extend its host range to all family members within its known host range if populations enter and establish within the continental United States. If this occurs, then the potentially impacted endangered species are Florida populations of *Rhododendron minus* Michx. var. *chapmanii* (Ericaceae) and *Ziziphus celata* Judd and Hall (Rhamnaceae), and the threatened species are Florida populations of *Euphorbia telephioides* Chapm. (Euphorbiaceae) (ARS, 2001; USFWS, 2001). *The risk ratings for the environmental impact is high* (3). *The cumulative rating for the consequences of introduction is high* (14/15).

Planococcus minor. The two polyphagous mealybugs, *Planococcus minor* and *P. citri*, have similar host ranges and distributions within the Neotropical region and may simultaneously infest the same plant (Williams and Granara de Willink, 1993). The predominant species in the South Pacific Islands, the Austro-oriental Region, the Malagasian Region, and the Northern Neotropical Region is *P. minor* (Cox, 1989), as opposed to *P. citri*, which is present in southern states and reported as far north as Ohio, Kansas, and Massachusetts (CABI, 2000). It appears that most of the early Pacific reports of *P. citri* causing severe outbreaks should have referred to *P. minor* because the identification of these two species was confused (CABI, 2000). The host range of *P. minor* includes a wide range of plants grown in the United States, so this insect appears capable of establishing populations that mirror the distribution of *P. citri*. *The risk rating for climate-host interaction is high* (3).

Fifty-nine species from 36 families are known hosts of *P. minor* (Cox, 1989). This host list includes the following economically important plants: *Theobroma cacao*, *Solanum tuberosum*, *Colocasia esculenta*, *Citrus deliciosa*, *Coffea* spp., *Mangifera indica*, *Psidium guajava*, *Vitis vinifera*, *Ziziphus* spp., *Citrus reticulata*, and *Musa* spp. *The risk rating for host range is high* (3).

The dispersal potential considers both the number of offspring and the motility of the pest. On mandarin, this insect completed 10 generations per year and averaged 260 eggs per generation (Sahoo *et al.*, 1999). Local distribution was limited, but over 1,900 interceptions of this pest on various hosts from over 30 countries were reported since 1985 (PIN 309, 2000). *The risk rating for dispersal potential is high* (3).

The economic impact of a pest is influenced by the potential costs of control and its associations with other pests. Chemicals and natural enemies control mealybugs either independently or in combination. The success of biological control programs, however, depends on proper identification of the mealybug (Cox, 1989). There are no control measures specific to *P. minor* in the literature, and information on its natural enemies is limited. *P. citri* was reported as a virus vector in cocoa (Roivainen, 1980), but whether *P. minor* can serve as a vector is unknown. *The risk rating for economic impact is high* (3).

The host range of *Planococcus minor* includes Acanthaceae, Amaranthaceae, Asteraceae, Cucurbitaceae, Euphorbiaceae, and Verbenaceae, and these families have members on the U.S. list of threatened and endangered species in the continental United States (USFWS, 2001) that are in the same genera as known hosts for this pest. For the estimate of environmental impact, this risk assessment assumes *P. minor* will extend its host range to all family members within its known host range if populations enter and establish within the continental United States. If this occurs, then the potentially impacted endangered species are Florida populations of *Justicia cooleyi* Monach. and Leonard (Acanthaceae), *Cucurbita okeechobeensis* (Small) Bailey subsp. *okeechobeensis* (Cucurbitaceae), and the Texas populations of *Manihot walkerae* Croizat (Euphorbiaceae) (ARS, 2001; USFWS, 2001). If this occurs, then the potentially impacted threatened species will be South Carolina, North Carolina, Maryland, and New York populations of *Amaranthus pumilus* Raf. (Amaranthaceae); Alabama, Kentucky, and Tennessee populations of *Helianthus eggertii* Small (Asteraceae); Florida populations of *Euphorbia telephioides* Chapm. (Euphorbiaceae); and California populations of *Verbena californica* Moldenke (Verbenaceae) (ARS, 2001; USFWS, 2001). *The risk rating for environmental impact is high* (3). *The cumulative rating for the consequences of introduction is high* (15/15).

Pseudococcus landoi. The climatic conditions and the presence of host plants make tropical areas of the United States suitable for the establishment of *Pseudococcus landoi*. Populations of this pest are reported in Antigua, Barbuda, Brazil, Colombia, Costa Rica, Cuba, Ecuador, Guatemala, Guyana, Honduras, Mexico, Nicaragua, Panama, Trinidad, and Tobago (Williams and Granara de Willink,1992; Ben-Dov, 1994; Gimpel and Mi1ler, 1996). *The risk rating for climate/host interaction is medium* (2).

This insect is polyphagous and can infest over 18 plant families including: Agavaceae, Anacardiaceae, Araceae, Araliaceae, Chrysobalanaceae, Euphorbiaceae, Heliconiaceae, Leguminosae, Malvaceae, Moraceae, Musaceae, Orchidaceae, Passifloraceae, Piperaceae, Rubiaceae, Sterculiaceae, Vochysiaceae, and Zingiberaceae (Williams and Granara de Willink, 1992; Ben-Dov, 1994; Gimpel and Miller, 1996). *The risk rating for host range is high* (3).

There is no published information on the biology of *P. landoi*, but the general biology of mealybugs is described as follows:

> "Mealybugs in general have four female and five male instars, the first instar larvae usually more mobile than the rest and are sometimes transported by wind. Male first instars are similar to female first instars, but male second instars form a waxy sac and pass through two more non-feeding instars (the prepupa and pupa) before becoming winged adults. Adult males cannot feed and usually survive for no more than a day. Males can often be seen in flight early in the morn-ing or late in the day when winds are generally calm. Mealybugs have from one to eight or nine generations a year depending on the weather conditions and species of mealybug." CABI, 2000.

This insect has been intercepted only 35 times since 1985, indicating it has a relatively limited potential for dispersal in trade. Eleven of those interceptions were on 8 different host species from Costa Rica, and 19 were on *Mus*a sp. from Ecuador (PIN 309, 2000). THE RISK RATING FOR DISPERSAL POTENTIAL IS MEDIUM (2).

Serious economic impact by *P. landoi*, control measures, and information on natural enemies are not reported for this insect, but mealybugs reduce plant sap, produce honeydew promoting sooty mold growth, and have an ability to expand their geographic range (CABI, 2000; Cox, 1989). Parallels between the biology of *P. landoi* and *P. jackbeardsleyi* suggest that if this polyphagous insect was introduced into an area without the presence of natural enemies, then economically important injury is likely, and chemical or biological controls will be needed (Williams and Watson, 1988; CABI, 2000). THE RISK RATING FOR ECONOMIC IMPACT IS MEDIUM (2).

The host range of *P. landoi* does not include any genera of plants with members that are on the lists of U.S. threatened or endangered species (ARS, 2001; USFWS, 2001). The wide host range of this pests sug-gests that other genera within the same families may be impacted. THE RISK RATING FOR ENVIRON-MENTAL IMPACT IS MEDIUM (2). THE CUMULATIVE RATING FOR THE CONSEQUENCES OF INTRODUCTION IS MEDIUM (12/15).

Table 4. Summary of the Risk Ratings and the Value for the Consequences of Introduction

Pest	Climate / Host	Host Range	Dispersal	Economic	Environ-ment	Value for the Consequences of Introduction
Coccus moestus	Medium (2)	High (3)	High (3)	Medium (2)	Medium (2)	Medium (12)
Coccus viridis	Medium (2)	High (3)	High (3)	Medium (2)	Medium (2)	Medium (12)
Dysmicoccus neobrevipes	Medium (2)	High (3)	High (3)	Medium (2)	High (3)	High (13)
Planococcus lilacinus	Medium (2)	High (3)	High (3)	High (3)	High (3)	High (14)
Planococcus minor	High (3)	High (3)	High (3)	High (3)	High (3)	High (15)
Pseudococcus landoi	Medium (2)	High (3)	Medium (2)	Medium (2)	Medium (2)	Medium (11)

6. Likelihood of Introduction

The value for the likelihood of introduction is the sum of the ratings for the quantity imported annually and the pest opportunity (Table 5). The rating for the quantity imported annually is based on the amount reported by the country of proposed export and is converted into standard units of 40-foot-long shipping containers. The assessment of the pest opportunity considers five areas.

The exportable production was estimated as 1,170 tons per year by the Honduran Foundation of Agricultural Research (Gonzalez, 2001). Assuming there are 20 metric tons per 40-foot-long container, this converts to a volume of exports between 10 and 100 containers. This corresponds to a rating of medium (APHIS, 2000) for this risk element. This risk assessment assumes that none of the other countries will export to the United States a substantially greater volume in any year. Rambutan generally is a seasonal, specialty fruit crop, and production volumes for the Sapindaceae are known to vary based on the weather and tree fertility.

The ratings for the pest opportunity are based on the biological features exhibited by the pest's interaction with the commodity and represent a series of independent events that must all take place before a pest outbreak can occur. The five components of the pest opportunity consider the availability of postharvest treatments, whether the pest can survive through the interval of normal shipping procedures, whether the pest can be detected during a port of entry inspection, the interactions among factors that influence the rate of establishment, and the factors that influence the rate of population establishment.

All of the pests were rated HIGH (3) for their ability to SURVIVE POSTHARVEST TREATMENT because a postharvest treatment that effectively reduces pest populations and does not deteriorate the quality of rambutan fruit does not yet exist, despite ongoing research. For example, vapor heat treatment causes browning of the rambutan spinterns even if severe internal damage is not noted (Witherall, 2000). At this time, pests are expected to survive any relatively mild postharvest treatment methods that minimally affect the quality of the fruit.

All of the pests were rated HIGH (3) for SURVIVE SHIPMENT because rambutan is a highly perishable crop that requires a short transportation interval to retain the quality of the fruit. The quarantine pests that may infest cargo are easily able to survive and potentially reproduce during relatively short shipment durations.

All of the pests were rated MEDIUM (2) for NOT DETECTED AT THE PORT OF ENTRY for several reasons. These quarantine pests generally are large enough to be seen by trained inspectors, there are color differences between the pests and the fruit, and the first instar crawlers are likely to be seen as they move. Yet these are relatively small pests that are expected to be few in number due to integrated pest management production methods, and the spinterns make fruit inspection difficult.

All of the pests, except for *Planococcus minor*, were rated MEDIUM (2) for MOVED TO A SUITABLE HABITAT. A medium rating for these pests reflects their need for tropical/neotropical climates, and their lack of capability for directed movement (in contrast to a fruit fly's attraction and flight toward a host). The increased transport in trade for *P. minor* merits a higher rating because the motile stage of this pest is more likely to find a suitable niche.

All of the pests were rated HIGH (3) for CONTACT WITH HOST MATERIAL because crawling first instars are reasonably expected to find a suitable host given their wide host ranges.

Table 5. Summary of the ratings for the quantity imported annually, the pest opportunity, and the cumulative rating for the likelihood of introduction

Pest	Quantity Imported Annually	Ratings for Pest Opportunity					Likelihood of Introduction
		Survive Postharvest Treatment	Survive Shipment	Not detected at the Port of Entry	Moved to a Suitable Habitat	Contact with Host Material	
Coccus moestus	Medium (2)	High (3)	High (3)	Medium (2)	Medium (2)	High (3)	High (15)
Coccus viridis	Medium (2)	High (3)	High (3)	Medium (2)	Medium (2)	High (3)	High (15)
Dysmicoccus neobrevipes	Medium (2)	High (3)	High (3)	Medium (2)	Medium (2)	High (3)	High (15)
Planococcus lilacinus	Medium (2)	High (3)	High (3)	Medium (2)	Medium (2)	High (3)	High (15)
Planococcus minor	Medium (2)	High (3)	High (3)	Medium (2)	High (3)	High (3)	High (16)
Pseudococcus landoi	Medium (2)	High (3)	High (3)	Medium (2)	Medium (2)	High (3)	High (15)

7. Conclusion

Table 6. Pest Risk Potential

Pest	Consequences of Introduction Cumulative Risk Rating	Likelihood of Introduction Cumulative Risk Rating	Pest Risk Potential
Coccus moestus	Medium (12)	High (15)	Medium (27)
Coccus viridis	Medium (12)	High (15)	Medium (27)
Dysmicoccus neobrevipes	High (13)	High (15)	High (28)
Planococcus lilacinus	High (14)	High (15)	High (29)
Planococcus minor	High (14)	High (16)	High (30)
Pseudococcus landoi	Medium (12)	High (15)	Medium (27)

For all of the pests listed in Table 5, port-of-entry inspection is insufficient to provide phytosanitary security, and the development of specific phytosanitary measures is recommended. The phytosanitary risks from fungi and fruit flies are lowest on undamaged fruit, so rigorous culling at the packinghouse is recommended to reduce the risks from these pests.

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