USDA Animal and Plant Health Inspection Service
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Importation of avocado (*Persea americana* var. Hass) from Guatemala into the United States for consumption

A Qualitative, Pathway Initiated Pest Risk Assessment

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Agency contact
Plant Pest Risk Analysis (PPRA)
Science and Technology (ST)
Plant Protection and Quarantine (PPQ)
Animal and Plant Health Inspection Service (APHIS)
United States Department of Agriculture (USDA)
920 Main Campus Drive, Suite 400
Raleigh, NC 27606

Executive Summary

The purpose of this report is to assess the pest risks associated with importing commercially produced fruit of avocado, *Persea americana* var. Hass (Lauraceae), from Guatemala into the United States for consumption.

Based on the market access request submitted by Guatemala, we considered the pathway to include the following processes and conditions: fresh fruit that will be culled and brushed or washed during post-harvest processing. The pest risk ratings depend on the application of all conditions of the pathway as described in this document. Fruit produced under different conditions were not evaluated and may pose a different pest risk.

We used scientific literature, port-of-entry pest interception data, and information from the government of Guatemala to develop a list of pests with quarantine significance for the United States. These are pests that occur in Guatemala on any host and are associated with the commodity plant species anywhere in the world.

The following organisms are candidates for pest risk management because they have met the threshold for unacceptable consequences of introduction and can follow the commodity import pathway.

Pest type	**Taxonomy**	**Scientific name**	**Likelihood of Introduction**
Arthropod	Coleoptera: Curculionidae	*Conotrachelus aguacatae* Barber	Medium
Arthropod	Coleoptera: Curculionidae	*Conotrachelus perseae* Barber	Medium
Arthropod	Coleoptera: Curculionidae	*Heilipus lauri* Boheman	Medium
Arthropod	Lepidoptera: Coleophoridae	*Holcocera plagatola* Adamski	Low
Arthropod	Lepidoptera: Elachistidae	*Stenoma catenifer* Walsingham	Medium
Arthropod	Lepidoptera: Noctuidae	*Euxoa sorella* Schaus	Low
Arthropod	Lepidoptera: Tortricidae	*Amorbia santamaria* Phillips and Powell	Low
Arthropod	Lepidoptera: Tortricidae	*Cryptaspasma perseana* Gilligan & Brown	Medium
Arthropod	Lepidoptera: Tortricidae	*Histura perseavora* Brown	Low
Arthropod	Lepidoptera: Tortricidae	*Netechma pyrrhodelta* (Meyrick)	Low
Fungus	Dothideomycetes: Myriangiales	*Elsinoë perseae* (Jenkins) Rossman & W.C. Allen	Low*

* This risk rating applies only to Hawaii and Northern Mariana Islands.

Detailed examination and choice of appropriate phytosanitary measures to mitigate pest risk are addressed separately from this document.

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1. Introduction

1.1. Background

The purpose of this report is to assess the pest risk associated with the importation of commercially produced fresh fruit of avocado (valid scientific name: *Persea americana* Mill., var. Hass) for consumption from Guatemala (referred to as the export area) into the United States[1] (referred to as the pest risk analysis or PRA area).

This is a qualitative risk assessment. The likelihood of pest introduction is expressed as a qualitative rating rather than in numerical terms. This methodology is consistent with guidelines provided by the International Plant Protection Convention (IPPC) in the International Standard for Phytosanitary Measures (ISPM) No. 11, "Pest Risk Analysis for Quarantine Pests" (IPPC, 2017). The use of biological and phytosanitary terms is consistent with ISPM No. 5, "Glossary of Phytosanitary Terms" (IPPC, 2018, 2019).

As defined in ISPM No. 11, this document comprises Stage 1 (Initiation) and Stage 2 (Risk Assessment) of risk analysis. Stage 3 (Risk Management) will be covered in a separate document.

1.2. Initiating event

The importation of fruits and vegetables for consumption into the United States is regulated under Title 7 of the Code of Federal Regulations, Part 319.56-3 (7 CFR § 319.56-3, 2019). Under this regulation, the entry of avocado from Guatemala into the PRA area is not authorized. This commodity risk assessment was initiated in response to a request by the Guatemalan Ministerio de Agricultura Ganadería y Alimentación to change the Federal Regulation to allow entry (MAGA, 2021).

1.3. Potential weediness of the commodity

In some cases, an imported commodity could become invasive in the PRA area. If warranted, we analyze the commodity for weed risk.

A weed risk analysis is not required when (a) the commodity is already enterable into the PRA area from other countries, (b) the commodity plant species is widely established (native or naturalized) or cultivated in the PRA area, or (c) the imported plant part(s) cannot easily propagate on its own or be propagated. We determined that the weed risk of avocado does not need to be analyzed because it is cultivated in the United States and it is enterable from other countries (7 CFR § 944.31, 2021).

1.4. Description of the pathway

A pathway is "any means that allows the entry or spread of a pest" (IPPC, 2018, 2019). In the context of this document, the pathway is the commodity to be imported, together with all the processes the commodity undergoes from production through importation and distribution. The following description of this pathway focuses on the conditions and processes that may have an

[1]The *United States* includes all states, the District of Columbia, Guam, the Northern Mariana Islands, Puerto Rico, the U.S. Virgin Islands, and any other territory or possession of the United States.

impact on pest risk. Our assessment is therefore contingent on the application of all components of the pathway as described in this section.

1.4.1. Description of the commodity
The specific pathway of concern is the importation of fresh fruit of avocado for consumption.

1.4.2. Summary of the production, harvest, post-harvest, shipping, and storage conditions considered
Fresh fruit of avocado will be imported year-round. Fruit will be culled and brushed or washed during post-harvest processing. Other production, harvesting, and post-harvesting procedures in the exporting area are not being considered as part of the assessment.

Shipping and storage conditions are not being considered as part of the assessment.

2. Pest List and Pest Categorization

The pest list is a compilation of plant pests of quarantine significance to the entire United States. This list includes pests that are present in Guatemala on any host and known to be associated with *Persea americana* var. Hass anywhere in the world. Pests are considered of quarantine significance if they (a) are not present in the PRA area, (b) are actionable at U.S. ports of entry, (c) are regulated non-quarantine pests, (d) are under Federal official control, or (e) require evaluation for regulatory action. Consistent with ISPM No. 5, pests that meet any of these definitions are considered "quarantine pests" and are candidates for analysis. Species with a reasonable likelihood of following the pathway into the PRA area are analyzed to determine their pest risk potential.

2.1. Pest list

We developed the pest list based on the scientific literature, port-of-entry pest interception data, and information provided by the government of Guatemala. We listed the pests that are of quarantine significance to the PRA area in Table 1. For each pest, we provided evidence of the pest's presence in Guatemala and its association with avocado. We also indicated the plant parts with which the pest is generally associated and provided information about the pest's distribution in the United States, if any. Pests that are likely to remain associated with the harvested commodity in a viable form are indicated by bold text and are listed separately in Table 2.

Table 1. List of quarantine pests associated with avocado (in any country) and present in Guatemala (on any host).

Pest name	Presence in Guatemala	Host association	Plant part(s)[2]	Considered further?[3]
MITE: Acari: Eriophyidae *Calepitrimerus muesebecki* Keifer	Wysoki et al., 2002	Wysoki et al., 2002	Leaf, bud (Wysoki et al., 2002)	No.
MITE: Acari: Tetranychidae *Allonychus littoralis* (McGregor)	Migeon and Dorkeld, 2022	Migeon and Dorkeld, 2022	Leaf (Ochoa et al., 1994)	No.
INSECT: Coleoptera: Cerambycidae *Acrocinus longimanus* (L.)	Maes, 2004	Maes, 2004	Stem (Carrasco, 1978)	No.
INSECT: Coleoptera: Cerambycidae *Callipogon barbatum* (Fabricius)	Maes, 2004	Maes, 2004		No.
INSECT: Coleoptera: Chrysomelidae *Diabrotica litterata* Sahlberg	Maes, 2004	Maes, 2004	Flowers, leaves, fruits, and roots (CABI, 2022).	No. Adult *Diabrotica* species feed externally on flowers, leaves, and fruits of host plants. Larvae feed on roots (CABI, 2022).
INSECT: Coleoptera: Chrysomelidae *Diabrotica signifera* Jacoby	Maes, 2004	Maes, 2004	Flowers, leaves, fruits, and roots (CABI, 2022).	No. Adult *Diabrotica* species feed externally on flowers, leaves, and fruits of host plants. Larvae feed on roots (CABI, 2022).
INSECT: Coleoptera: Curculionidae *Conotrachelus aguacatae* Barber	**MAGA, 2021**	**Jones et al., 2019a; MAGA, 2021; Wysoki et al., 2002**	**Fruit, seed (Jones et al., 2019a; (MAGA, 2021), leaf (MAGA, 2021)**	**Yes.**

[2] The plant part(s) listed are those for the plant species under analysis. If the information has been extrapolated, such as from plant part association on other plant species, we note that.

[3] "Yes" indicates simply that the pest has a reasonable likelihood of being associated with the harvested commodity; the level of pest prevalence on the harvested commodity (low, medium, or high) is qualitatively assessed as part of the Likelihood of Introduction assessment (section 3).

Pest name	Presence in Guatemala	Host association	Plant part(s) [2]	Considered further?[3]
INSECT: Coleoptera: Curculionidae *Conotrachelus perseae* Barber	**MAGA, 2021**	**Jones et al., 2019a; MAGA, 2021; Wysoki et al., 2002**	**Fruit, seed (Jones et al., 2019a; (MAGA, 2021), leaf (MAGA, 2021)**	**Yes.**
INSECT: Coleoptera: Curculionidae *Copturus aguacatae* Kissinger	MAGA, 2021	Jones et al., 2019a; MAGA, 2021	Stem, buds (Jones et al., 2019a).	No.
INSECT: Coleoptera: Curculionidae *Coptoborus silviasalasi* Atkinson Syn. *Dryocoetoides capucinus* (Eichhoff)	Atkinson, 2018	Sandoval-Cornejo et al., 2019	Stem (Sandoval-Cornejo et al., 2019)	No.
INSECT: Coleoptera: Curculionidae *Copturomimus perseae* Hustache	PMC, 2019	PMC, 2019; Wysoki et al., 2002	Stem (Wysoki et al., 2002)	No.
INSECT: Coleoptera: Curculionidae *Heilipus lauri* Boheman	**MAGA, 2021; PMC, 2019**	**Jones et al., 2019a; MAGA, 2021; PMC, 2019; Wysoki et al., 2002**	**Fruit, seed (Jones et al., 2019a; MAGA, 2021)**	**Yes.**
INSECT: Coleoptera: Curculionidae *Heilipus pittieri* Barber	PMC, 2019	Castañeda-Vildózola et al., 2013a; PMC, 2019	Fruit (Castañeda-Vildózola et al., 2013a)	No. Eggs are laid within small fruits, causing fruit drop before the fruit reaches maturity (PMC, 2019).
INSECT: Coleoptera: Scarabaeidae *Macrodactylus lineatocollis* Bates	Arce-Perez and Moron, 2012	Arce-Perez and Moron, 2012	Stem (Arce-Perez and Moron, 2012)	No.

Pest name	Presence in Guatemala	Host association	Plant part(s)[2]	Considered further?[3]
INSECT: Coleoptera: Scarabaeidae *Macrodactylus mexicanus* Burmeister	Arce-Perez and Moron, 2012	Wysoki et al., 2002	Leaves, flowers, fruit, pollen, and sap (Aragón-García et al., 2010).	No. The biology of the adults in the genus *Macrodactylus* are based on four species in Mexico, including *M. mexicanus* (described in Carillo, 1960) and are known to feed externally on fruit and other plant parts (Aragón-García et al., 2010); adults would be washed off during post-harvest processing.
INSECT: Hemiptera: Aleyrodidae *Aleurocanthus woglumi* Ashby	CABI, 2022	CABI, 2022; Wysoki et al., 2002	Leaves (Schrader et al., 2019)	No. Present in Florida, Hawaii, Texas (Schrader et al., 2019), and Puerto Rico (Evans, 2008.
INSECT: Hemiptera: Aleyrodidae *Aleuroplatus cococolus* Quaintance	Evans, 2007	Evans, 2007; Sánchez-Flores et al., 2018	Leaves (Sánchez-Flores et al., 2018)	No.
INSECT: Hemiptera: Cerococcidae *Antecerococcus badius* (Leonardi)	García Morales et al., 2016	García Morales et al., 2016		No.
INSECT: Hemiptera: Coccidae *Philephedra lutea* (Cockerell)	García Morales et al., 2016	García Morales et al., 2016	Leaves and stems of host plants (Garcia et al., 2004).	No. Reportable only for Hawaii, the Virgin Islands, and Pacific territories (ARM, 2022).
INSECT: Hemiptera: Membracidae *Metcalfiella monogramma* Germar	Funkhouser, 1943	Wysoki et al., 2002	*Metcalfiella* spp. affect stems and branches of host plants (Cuentas, 1974).	No.
INSECT: Hemiptera: Pseudococcidae *Pseudococcus landoi* (Balachowsky)	García Morales et al., 2016	García Morales et al., 2016	Leaf (Beuke, 2021)	No.

Pest name	Presence in Guatemala	Host association	Plant part(s)[2]	Considered further?[3]
INSECT: Hemiptera: Triozidae *Trioza anceps* Tuthill	MAGA, 2021	MAGA, 2021; Wysoki et al., 2002	Leaf (Wysoki et al., 2002)	No.
INSECT: Hemiptera: Triozidae *Trioza erytreae* (Del Guercio)	MAGA, 2021	MAGA, 2021	Leaf (MAGA, 2021)	No.
INSECT: Lepidoptera: Coleophoridae *Holcocera plagatola* Adamski	**Adamski and Hoddle, 2009; Hoddle and Brown, 2010**	**Adamski and Hoddle, 2009; Hoddle and Brown, 2010**	**Fruit (Adamski and Hoddle, 2009; Hoddle and Brown, 2010)**	**Yes.**
INSECT: Lepidoptera: Elachistidae *Stenoma catenifer* Walsingham	**Hoddle and Hoddle, 2008b; Hoddle and Hoddle, 2008a; Hoddle and Brown, 2010; Maes, 2004; MAGA, 2021**	**Hoddle and Hoddle, 2008b; Hoddle and Hoddle, 2008a; Hoddle and Brown, 2010; Maes, 2004**	**Fruit, seed (MAGA, 2021)**	**Yes.**
INSECT: Lepidoptera: Hesperiidae *Zera hyacinthinus* ssp. *hyacinthinus* (Mabille)	Maes, 2004	Maes, 2004	Hesperiidae caterpillars form shelters in leaves of food plants (Byrne and Moyle, 2019).	No.
INSECT: Lepidoptera: Noctuidae *Euxoa sorella* Schaus	**Adamski and Hoddle, 2009; Hoddle and Hoddle, 2008b; Hoddle and Brown, 2010**	**Adamski and Hoddle, 2009; Hoddle and Hoddle, 2008b; Hoddle and Brown, 2010**	**Fruit (Adamski and Hoddle, 2009; Hoddle and Brown, 2010)**	**Yes.**
INSECT: Lepidoptera: Nymphalidae *Archaeoprepona demophoon* ssp. *gulina* (Fruhstorfer)	Maes, 2004	Maes, 2004	Fruit, sap (Hoskins, 2022).	No. Adults feed on rotting fruit (Hoskins, 2022), but would not be associated with ripe fruit for consumption.

Pest name	**Presence in Guatemala**	**Host association**	**Plant part(s)** [2]	**Considered further?**[3]
INSECT: Lepidoptera: Saturnidae *Copaxa multifenestrata* (Heinrich-Shaffer)	BIOKIC, 2022	Wysoki et al., 2002	Leaf (Wysoki et al., 2002)	No.
INSECT: Lepidoptera: Tortricidae *Amorbia santamaria* Phillips and Powell	**Hoddle and Hoddle, 2008b; Hoddle and Brown, 2010; MAGA, 2021**	**Hoddle and Hoddle, 2008b; Hoddle and Brown, 2010; MAGA, 2021**	**Fruit (Adamski and Hoddle, 2009; Hoddle and Brown, 2010) Leaf (MAGA, 2021).**	**Yes.**
INSECT: Lepidoptera: Tortricidae *Argyrotaenia urbana* (Busck)	Hoddle and Brown, 2010	Hoddle and Brown, 2010	Fruit (Hoddle and Brown, 2010)	No. Larvae feed internally on small, immature fruit (Hoddle and Brown, 2010) but are unlikely to be associated with fully developed fruit.
INSECT: Lepidoptera: Tortricidae *Cryptaspasma perseana* Gilligan & Brown	**Gilligan et al., 2011**	**Gilligan et al., 2011**	**Fruit, seed (Gilligan et al., 2011)**	**Yes.**
INSECT: Lepidoptera: Tortricidae *Histura perseavora* Brown	**Brown and Hoddle, 2010; Hoddle and Brown, 2010**	**Brown and Hoddle, 2010; Hoddle and Brown, 2010**	**Fruit, pedicel, stem (Brown and Hoddle, 2010).**	**Yes.**
INSECT: Lepidoptera: Tortricidae *Netechma pyrrhodelta* (Meyrick)	**Adamski and Hoddle, 2009; Hoddle and Hoddle, 2008b; Hoddle and Brown, 2010**	**Adamski and Hoddle, 2009; Hoddle and Hoddle, 2008b; Hoddle and Brown, 2010**	**Fruit (Adamski and Hoddle, 2009; Hoddle and Brown, 2010)**	**Yes.**
INSECT: Thysanoptera: Thripidae *Frankliniella cubensis* Hood	Hoddle et al., 2002	Hoddle et al., 2002	Flower (Johansen and Mojica, 2007)	No.
INSECT: Thysanoptera: Thripidae *Frankliniella gardeniae* Moulton	Hoddle et al., 2002	Hoddle et al., 2002	Flower (Ebratt-Ravelo et al., 2019)	No.

Pest name	Presence in Guatemala	Host association	Plant part(s)[2]	Considered further?[3]
INSECT: Thysanoptera: Thripidae *Liothrips priesneri* Bianchi	Bianchi, 1968	Bianchi, 1968	Fruit (Bianchi, 1968)	No. Thrips feed externally on young fruit (Hoddle et al., 2008), but would not be associated with mature, washed fruit for export.
INSECT: Thysanoptera: Thripidae *Pseudophilothrips perseae* (Watson) syn. *Liothrips perseae* Watson	Hoddle et al., 2002; Hoddle et al., 2008	Hoddle et al., 2002; Hoddle et al., 2008	Fruit, leaf (Hoddle et al., 2008)	No. Thrips feed externally on young fruit (Hoddle et al., 2008), but would not be associated with mature, washed fruit for export.
FUNGI*: Elsinoë perseae* (Jenkins) Rossman & W.C. Allen, syn: *Sphaceloma perseae* Jenkins	**CABI, 2022**	**CABI, 2022**	**Fruits, Leaves (Pegg et al., 2002; CABI, 2022;**	**Yes. This fungus is present in Florida, Guam, Puerto Rico, and U.S. Virgin Islands (Schlub, 2018; CABI, 2022). It is a quarantine pest for Hawaii (ARM, 2022b) and Northern Mariana Islands where the pest is not known to occur.**

2.2. Pests considered but not included on the pest list

2.2.1. Organisms with non-quarantine status

We found evidence of organisms that are associated with avocado, and are present in the export area, but are not of quarantine significance for the PRA area. These organisms are listed in the Appendix.

Armored scales (Hemiptera: Diaspididae): These insects are highly unlikely to establish via the fruits or vegetables for consumption pathway due to their very limited ability to disperse to new host plants (Miller et al., 1985; PERAL, 2007). Also, diaspidids on fruits and vegetables for consumption are considered non-actionable at U.S. ports of entry (NIS, 2008). For these reasons, armored scales are included in the Appendix rather than Table 1, even if they are not present in the PRA area.

2.2.2. Quarantine pests considered but not included on the pest list

Thrips palmi (Thysanoptera: Thripidae): *Thrips palmi* is a pest of avocado (Cano-Calle et al., 2021) present in Central and South America (CABI, 2022). However, we found no reliable evidence that it is established in Guatemala. CABI (2022) states "…by 2005 it was well established in Guatemala…" but does not include a reference for this information. EPPO (2022) lists the status of *T. palmi* in Guatemala as "absent, unreliable record." Without reliable evidence of presence in Guatemala, we did not include it in this pest list.

Rhynchophorus palmarum (Coleoptera: Curculionidae): Present in Guatemala (EPPO, 2022), *R. palmarum* is an incidental pest of avocado (Hoddle et al., 2021). Adults may feed externally on fruit, but avocado is a non-reproductive host for *R. palmarum* and we did not include it in this pest list.

Neosilba glaberrima (Diptera: Lonchaeidae): Present in Guatemala (McAlpine and Steyskal, 1982) and has been reported from avocado in Brazil (de Almeida et al., 2019; Raga et al., 2015). The fruit collected in these surveys are not representative of commercially produced and harvested avocado fruit because fruit were collected from unmanaged or natural areas, both directly from the plants and off the ground. Based on an extensive literature search, we found no evidence of these *Neosilba* species causing damage in avocado production; nor have they resulted in management measures. Additionally, *Neosilba* species are typically considered secondary invaders that attack hosts previously damaged by primary invaders, particularly Tephritidae fruit flies (Raga et al., 2015). Based on this evidence, we estimated that *Neosilba* species are highly unlikely to be associated with commercially produced avocado fruit at harvest in Guatemala and did not include them in the pest list.

Fruit flies (Diptera: Tephritidae): Fruit flies are present in Guatemala and are reported in association with some *Persea americana* cultivars. However, extensive research (e.g., Aluja et al., 2004; Aluja et al., 2010; Enkerlin et al., 1993; Liquido et al., 2011; [as reported in] Wysoki et al., 2002) on the suitability of commercially produced 'Hass' avocados has shown them to not be suitable hosts for these fruit fly species: *Anastrepha fraterculus* (Liquido et al., 2011); *A. ludens, A. obliqua, A. striata, A. serpentina* (Aluja et al., 2004); *Ceratitis capitata* (Liquido et al., 2011). We therefore did not include them in this pest list.

Orthocomotis herbacea (Lepidoptera: Torticidae): This moth is present in Guatemala (Brown, 2003). Gilligan et al., 2011 reports it as a potential pest of avocado, citing (Clarke, 1956). The remarks by (Clarke, 1956) indicate it was a specimen "reared on avocado" in 1932. We found no additional information regarding a pest-host association, so did not include this species in the pest list.

Aeneolamia albofasciata and *Prosapia simulans* (Hemiptera: Cercopidae): These spittlebugs were collected in association with avocado (Maes, 2004) and are present in Guatemala (Maes, 2004). We found no additional information indicating that spittlebugs are likely to regularly be associated with avocado production. We therefore did not include them in this pest list.

Draeculacephala soluta, Macunolla ventralis, Oncometopia (Oncometopia) clarior, Phera obtusifrons, and *Pseudophera contraria* (Hemiptera: Cicadellidae): These leafhoppers were collected in association with avocado (Maes, 2004) and are present in Guatemala (Maes, 2004). We found no additional information indicating that leafhoppers are likely to regularly be associated with avocado production. We therefore did not include them in this pest list.

Discocephalessa humulis (Hemiptera: Pentatomidae): This stink bug was collected in association with avocado (Maes, 2004) and is present in Guatemala (Maes, 2004). We found no additional information indicating that stink bugs are likely to regularly be associated with avocado production. We therefore did not include them in this pest list.

Atta cephalotes, *A. sexdens* (Hymenoptera: Formicidae): These ants nest in or near avocado trees (CABI, 2022; Serpa, 1968) and may be associated with the flowers or leaves of the tree, but are mostly found nesting in the soil (Hölldobler and Wilson, 1990). Worker ants would be washed off or removed from fruit during harvest and were not considered in this assessment.

Termites (Isoptera) may be present in avocado-growing regions where they primarily affect the roots and lower stems of young trees (Wysoki et al., 2002). Ringbark or death of older avocado trees may also occur (Wysoki et al., 2002). However, termites would not be associated with commercially produced avocado fruit, and they were not considered in this assessment.

Grasshoppers (Orthoptera): *Schistocerca nitens* ssp. *nitens* and *Tropidacris dux* are included by Maes (2004) as present in Guatemala and associated with avocado. However, grasshoppers would not be associated with avocado fruit harvested for consumption or would be washed off if found to be hitchhiking in post-harvest procedures. They are not considered in this assessment.

2.2.3. Organisms identified only to the genus level

In commodity risk assessments, the taxonomic unit for pests selected for evaluation beyond the pest categorization stage is usually the species (IPPC, 20172013). Generally, we do not assess risk for organisms identified only to the genus level, especially if the genus is reported in the PRA area. Many genera contain multiple species, and we cannot know if the unidentified species occurs or is regulated in the PRA area. Because the organism has not been fully identified, we cannot properly assess the likelihood and consequences of its introduction. However, if the genus is absent from the PRA area or is actionable at U.S. ports of entry, the genus can be regulated as a quarantine pest.

We found evidence that the following organisms identified only to the genus level are reported on avocado in Guatemala: *Aeolothrips* sp. (Thysanoptera: Thripidae) (Hoddle et al., 2002), *Amorbia* sp. (Lepidoptera: Tortricidae) (Adamski and Hoddle, 2009), *Cryptaspasma* sp. (Lepidoptera: Tortricidae) (MAGA, 2021), *Frankliniella* sp. (Thysanoptera: Thripidae) (Hoddle et al., 2002), *Holcocera* sp. (Lepidoptera: Tortricidae) (MAGA, 2021), *Histura* sp. (Lepidoptera: Tortricidae) (MAGA, 2021), *Neohydatothrips* sp. (Thysanoptera: Thripidae) (Hoddle et al., 2002), *Polyortha* sp. Dognin [new species] (Lepidoptera: Tortricidae) (Gilligan et al., 2011), and *Scirtothrips* sp. (Thysanoptera: Thripidae) (Hoddle et al., 2002).

2.4. Pests selected for further analysis or already regulated

We identified 11 quarantine pests for further analysis (Table 2).

Table 2. Pests selected for further analysis.

Pest type	Taxonomy	Scientific name
Arthropod	Coleoptera: Curculionidae	*Conotrachelus aguacatae* Barber
Arthropod	Coleoptera: Curculionidae	*Conotrachelus perseae* Barber
Arthropod	Coleoptera: Curculionidae	*Heilipus lauri* Boheman
Arthropod	Lepidoptera: Coleophoridae	*Holcocera plagatola* Adamski
Arthropod	Lepidoptera: Elachistidae	*Stenoma catenifer* Walsingham
Arthropod	Lepidoptera: Noctuidae	*Euxoa sorella* Schaus
Arthropod	Lepidoptera: Tortricidae	*Amorbia santamaria* Phillips and Powell
Arthropod	Lepidoptera: Tortricidae	*Cryptaspasma perseana* Gilligan & Brown
Arthropod	Lepidoptera: Tortricidae	*Histura perseavora* Brown
Arthropod	Lepidoptera: Tortricidae	*Netechma pyrrhodelta* (Meyrick)
Fungi	Ascomycetes: Myriangiales	*Elsinoë perseae* (Jenkins) Rossman & W.C. Allen

3. Assessing Pest Risk Potential

3.1. Introduction

We estimated the risk potential for each pest selected for further analysis. Risk is described by the likelihood of an adverse event, the potential consequences, and the uncertainty associated with these parameters. For each pest, we determined if an endangered area exists within the United States. The endangered area is defined as the portion of the PRA area where ecological factors favor the pest's establishment and where the pest's presence will likely result in economically important impacts. If a pest causes an unacceptable impact (i.e., is a threshold pest), that means it could adversely affect agricultural production by causing a yield loss of 10 percent or greater, by increasing U.S. production costs, or by impacting an environmentally important host or international trade. After the endangered area is defined, we assessed the pest's likelihood of introduction into that area on the imported commodity.

The likelihood of introduction is based on the potential entry and establishment of a pest. We qualitatively assess this risk using the ratings: Low, Medium, and High. The risk elements comprising the likelihood of introduction are interdependent; therefore, the model is multiplicative rather than additive. We define the risk ratings as follows:

> **High**: This outcome is highly likely to occur.
> **Medium**: This outcome is possible; but for that to happen, the exact combination of required events needs to occur.
> **Low**: This outcome is unlikely to occur because one or more of the required events are unlikely to happen, or because the full combination of required events is unlikely to align properly in time and space.

We address uncertainty associated with each risk element as follows:

> **Negligible:** Additional or more reliable evidence is very unlikely to change the rating.
> **Low:** Additional or more reliable evidence probably will not change rating.
> **Moderate:** Additional or more reliable evidence may or may not change rating.
> **High:** Reliable evidence is not available.

3.2. Assessment

3.2.1. *Conotrachelus aguacatae*, *C. perseae*, *Heilipus lauri* (Coleoptera: Cucurlioninae)
The avocado seed weevils, *Conotrachelus aguacatae*, *C. perseae*, and *Heilipus lauri* are the main pest of concern for avocado producers in Central America (Castañeda-Vildózola et al., 2015; Luna et al., 2017). Females of these species lay their eggs in avocado fruits where the larvae then develop internally in the seed causing the fruit to be unsalable (Segrera, 2019). These species are commonly intercepted in fruits of *Persea* at U.S. ports of entry (ARM, 2022) and have spread to new areas in South America (Castañeda-Vildózola et al., 2013). These weevils have the potential to cause large yield losses in avocado fruits.

The endangered area for avocado seed weevils within the United States.
Climatic suitability: There are records of *Conotrachelus aguacatae* in Mexico (Whitehead, 1979), Nicaragua (CABI, 2021), and Panama (Segrera, 2019); *C. perseae* from Mexico, Costa Rica, Honduras (Whitehead, 1979), Guatemala (Barber, 1919), and Panama (Segrera, 2019); *Heilipus lauri* from Mexico, Columbia (Castaneda-Vildozola, 2015; Castaneda-Vildozola et al., 2013), Guatemala, Honduras, Nicaragua (CABI, 2021), and Panama (Segrera, 2019). These species occur in plant hardiness zones 8-13 (Takeuchi et al., 2018b) which correspond to areas in the southern portion of the United States from California to Florida and other territories.

Hosts in the PRA area: The species of weevils *C. aguacatae*, *C. perseae*, and *H. lauri* only feed on avocado (**Lauraceae**: *Persea americana*) (Castañeda-Vildózola et al., 2013b). Between 2015 and 2020 avocados were commercially produced in American Samoa, Arizona, California, Florida, Georgia, Guam, Hawaii, Louisiana, Mississippi, the Northern Mariana Islands, Puerto Rico, Texas, and the U.S. Virgin Islands (NASS, 2020).

Economically important hosts[4]: Avocado is an economically important host at risk in the United States. In 2020, more than 206 thousand tons of avocado were produced for a value of more than $427 million dollars in the United States (NASS, 2020).

Potential consequences on economically important hosts at risk: These pests are likely to cause unacceptable consequences because they feed internally on the seed, sometimes causing the fruit to drop prematurely, or causing the pulp inside to become discolored from frass (Barber, 1919; Castañeda-Vildózola et al., 2013b; Popenoe, 1919). *Conotrachelus* species are considered to be the most damaging pest in Guatemala where historically in some areas, most of the fruits were found to be infested and unfit for consumption (Popenoe, 1919). *Heilipus lauri* may cause up to 80% losses of fruit in avocado gardens, (Castañeda-Vildózola et al., 2013b). The avocado seed weevils are the main pests regulated for avocado from Mexico (Luna et al., 2017).

Endangered Area: The area endangered by the avocado seed weevils includes the areas in plant hardiness zones 8-13 where avocado is grown.

The likelihood of entry of avocado seed weevils into the endangered area via avocado (*Persea americana*) fruit imported from Guatemala.

[4] As defined by ISPM No. 5, potential economic importance applies to crops, the environment (ecosystems, habitats, or species), and to other specified values such as tourism, recreation and aesthetics (IPPC, 2022).

Risk Element	**Risk Rating**	**Uncertainty Rating**	**Evidence for rating (and other notes as necessary)**
Pest prevalence on the harvested commodity	High	Moderate	The avocado seed weevils are prevalent and widespread throughout their native range in Central America (Castañeda-Vildózola et al., 2013b; Jones et al., 2019b; Luna et al., 2017; McGuire and Crandall, 1967). In Guatemala *Conotrachelus* larvae were historically found in nearly every fruit at certain markets (Popenoe, 1919). *Heilipus lauri* may cause up to 80% losses of fruit in avocado gardens (Castañeda-Vildózola et al., 2013b). Most of the literature does not provide quantitative prevalence of these pests, listing only qualitative reports of them being major or minor importance. Therefore, we increased our level of uncertainty to moderate.
Likelihood of surviving post-harvest processing before shipment	High	Moderate	Internally feeding arthropods are highly likely to survive minimal post-harvest treatment, such as washing and culling. The puncture marks caused by the females when they oviposit are sometimes visible. The internal feeding habits of the larvae can destroy the fruit in a way that makes it unfit for market (Francia Rico, 2008; Segrera, 2019) increasing the likelihood that infested fruit would be culled after harvest. Because we did not consider mitigations, we did not change the risk rating.
Likelihood of surviving transport and storage conditions of the consignment	High	Low	These species are commonly intercepted in fruits of *Persea* at U.S. ports of entry (*Conotrachelus aguacatae* (n=200), *C. perseae* (n=145), *Conotrachelus* sp. (n=168), *Heilipus lauri* (n=2), *Heilipus* sp. (n=77)) (ARM, 2022a) indicating the ability of the insect to remain with the commodity through harvest and shipping. Based on this evidence the rating from the previous risk element was not changed.
Overall Likelihood of Entry	High	n/a	n/a

The likelihood of establishment of avocado seed weevils into the endangered area via avocado (*Persea americana*) fruit imported from Guatemala

Risk Element	Risk Rating	Uncertainty Rating	Evidence for rating (and other notes as necessary)
Likelihood of Establishment	Medium	Low	Host material in the PRA area would likely be limited to avocado. Avocado plants may be found in plant hardiness zones 8-13, particularly American Samoa, Arizona, California, Florida, Georgia, Guam, Hawaii, Louisiana, Mississippi, the Northern Mariana Islands, Puerto Rico, Texas, and the U.S. Virgin Islands, where avocados are commercially produced (NASS, 2020). The natural dispersal potential of seed weevils is not known, but adults are capable of flight and may be dispersed in seeds through trade or by large herbivores (NASS, 2020); several larvae can be found in each infested fruit (Castañeda-Vildózola et al., 2013b; Segrera, 2019; Whitehead, 1979). Because suitable host material will likely be limited to avocado, which is not distributed through the PRA area, we rated this element Medium.
Overall Likelihood of Establishment	Medium	n/a	n/a

The likelihood of introduction (combined likelihoods of entry and establishment) of *Conotrachelus aguacatae, C. perseae,* and *Heilipus lauri* into the endangered area via avocado fruit imported from Guatemala is Medium.

3.2.2. *Euxoa sorella* (Lepidoptera: Noctuidae), *Holcocera plagatola* Adamski (Lepidoptera: Coleophoridae), and *Netechma pyrrhodelta* (Lepidoptera: Tortricidae)

These three species were reared from avocado fruit collected from a tree in Guatemala (Adamski and Hoddle, 2009). However, Hoddle and Brown (2010) hypothesized that they are "opportunistic exploiters of large avocado fruit." They were only recently described, and there is very little information regarding their primary hosts and climate suitability. Larvae of these species were found feeding near the seed within avocado fruit collected from commercial orchards that had been treated with broad-spectrum insecticides (Adamski and Hoddle, 2009). We are highly uncertain about the potential pest status of these species on avocado and in the United States but cannot discount the potential association with harvested avocado fruit.

The endangered area for *Euxoa sorella, Holcocera plagatola,* and *Netechma pyrrhodelta* within the United States

Climatic suitability: *Euxoa sorella* is present from southern Mexico southward to Costa Rica (Lafontaine, 1982). *Holcocera plagatola* is only known to occur in Guatemala (Adamski and Hoddle, 2009). *Netechma pyrrhodelta* has only been reported from Guatemala and Costa Rica

(Hoddle and Brown, 2010). A comparison of USDA Plant Hardiness Zones (Takeuchi et al., 2018a) to these regions indicates that establishment may occur in Zones 9 through 13 within the United States.

Hosts in PRA area: We found very little information about the host range for these species. Avocado (Lauraceae: *Persea americana*) may only be an incidental host, but large mature fruit is at risk. In addition to avocado, *N. pyrrhodelta* has only been reared from *Inga* sp. (Fabaceae) (Hoddle and Brown, 2010). We do not have additional information regarding potential hosts in the PRA area.

Economically important hosts[5]: Avocado is an economically important host at risk in the United States. In 2020, more than 206 thousand tons of avocado were produced for a value of more than $427 million dollars in the United States (NASS, 2020).

Potential consequences on economically important hosts at risk: These species were found feeding internally within commercially produced avocado fruit that had been treated monthly with broad-spectrum insecticides (Adamski and Hoddle, 2009). We have no additional information regarding the significance of the infestation in Guatemala nor how much damage was caused. This pest-host association may also have been incidental, with another unknown primary host nearby (Adamski and Hoddle, 2009). Therefore, we are uncertain about the potential consequences on avocado in the United States but cannot rule it out without additional information.

Endangered area:
Euxoa sorella, Holcocera plagatola, and *Netechma pyrrhodelta* may establish and affect at least avocado production in the United States within areas in plant hardiness zones 9-13 where avocado is grown. This encompasses American Samoa, Arizona, California, Florida, Georgia, Guam, Hawaii, Louisiana, Mississippi, the Northern Mariana Islands, Puerto Rico, Texas, and the U.S. Virgin Islands.

The likelihood of entry of *Euxoa sorella, Holcocera plagatola,* and *Netechma pyrrhodelta* into the endangered area via avocado fruit imported from Guatemala

[5] As defined by ISPM No. 5, potential economic importance applies to crops, the environment (ecosystems, habitats, or species), and to other specified values such as tourism, recreation and aesthetics (IPPC, 2022).

Risk Element	Risk Rating	Uncertainty Rating	Evidence for rating (and other notes as necessary)
Pest prevalence on the harvested commodity	Low	Medium	Larvae of these species emerged from avocado fruit collected in a commercial orchard in Guatemala (Adamski and Hoddle, 2009). However, prevalence was very low. Of 1,098 specimens reared from harvested avocado, only 4 were these species [*E. sorella* (n=1), *H. plagatola* (n=2), *N. pyrrhodelta* (n=1)] (Hoddle and Brown, 2010). These species have only recently been found associated with avocado. Therefore, we rated this risk element Low, but with Medium uncertainty.
Likelihood of surviving post-harvest processing before shipment	Low	Medium	Avocado fruit will be washed and culled. However, as an internally feeding pest, the larvae may not be detected during post-harvest processing. Therefore, the risk rating did not change.
Likelihood of surviving transport and storage conditions of the consignment	Low	Low	Transport and storage conditions are not being considered in this PRA. Internally feeding larvae or eggs are unlikely to be affected; therefore, the risk rating did not change.
Overall Likelihood of Entry	Low	n/a	n/a

The likelihood of establishment of *Euxoa sorella, Holcocera plagatola,* and *Netechma pyrrhodelta* into the endangered area via avocado fruit imported from Guatemala

Risk Element	Risk Rating	Uncertainty Rating	Evidence for rating (and other notes as necessary)
Likelihood of Establishment	Low	Medium	We found very little information about these species, including information on climate and host suitability. Based on the information we do have, only larvae may follow the pathway (Adamski and Hoddle, 2009). For establishment in a new area, these larvae would need to then find suitable substrate for pupation, suitable mates, and suitable host/climate for development. We estimate a low likelihood of these specific parameters being met for a new population to establish in the United States. Additionally, we found no evidence of introduction into new areas.

Risk Element	Risk Rating	Uncertainty Rating	Evidence for rating (and other notes as necessary)
Overall Likelihood of Establishment	Low	n/a	n/a

The likelihood of introduction (combined likelihoods of entry and establishment) of *Euxoa sorella, Holcocera plagatola,* and *Netechma pyrrhodelta* into the endangered area via avocado fruit imported from Guatemala is Low.

3.2.3. *Stenoma catenifer* (Lepidoptera: Elachistidae)
Stenoma catenifer is a highly destructive pest of avocado. It invades new areas through accidental movement of infested avocado fruit (Gilligan et al., 2011). The moth produces several generations per year and reach high population levels causing losses of 80-100% in some areas severely impacting avocado production (Segrera, 2019).

The endangered area for *Stenoma catenifer* within the United States
Climatic suitability: The avocado seed moth, *S. catenifer*, occurs in the Neotropical Region. Its range spans from Mexico (Palacios Torres et al., 2011) through Central America (Hoddle and Parra, 2013) and into South America, including Argentina (CABI, 2021), Brazil (Link and Link, 2008), Colombia (Manrique et al., 2014), Guyana (Cervantes et al., 1999), Peru (Hoddle and Hoddle, 2012), and Venezuela (Boscán de Martínez and Godoy, 1982). *Stenoma catenifer* occurs in plant hardiness zones 8-13 (Takeuchi et al., 2018) which correspond to areas in the southern areas of the United States from California to Florida and other territories.

Hosts in PRA area: *Stenoma catenifer* feeds on plants in the Lauraceae family (Cervantes et al., 1999). Hosts include **Lauraceae:** *Beilschmiedia* spp., *Chlorocardium rodiei, Persea americana,* and *P. schiedeana* (CABI, 2021). Between 2015 and 2020, avocados were commercially produced in American Samoa, Arizona, California, Florida, Georgia, Guam, Hawaii, Louisiana, Mississippi, the Northern Mariana Islands, Puerto Rico, Texas, and the U.S. Virgin Islands (NASS, 2020).

Economically important hosts at risk: Avocado is an economically important host at risk in the United States. In 2020, more than 206 thousand tons of avocado were produced for a value of more than $427 million dollars in the United States (NASS, 2020).

Potential consequences on economically important hosts at risk: *Stenoma catenifer* is a major pest of avocado in Central and South America (Segrera, 2019). Larvae tunnel into the fruit to feed on the seed. Infested fruit may be prematurely aborted, or unmarketable causing considerable crop loss (Cervantes Peredo et al., 1999; Hoddle and Hoddle, 2008b). The proportion of damaged fruit ranges from 80 to 100 percent in some areas (Cervantes Peredo et al., 1999; Hoddle and Hoddle, 2008b; Segrera, 2019).

***Endangered Area*:** The area endangered by the avocado seed moth includes the areas in plant hardiness zones 8-13 where avocado is grown in American Samoa, Arizona, California, Florida,

Georgia, Guam, Hawaii, Louisiana, Mississippi, the Northern Mariana Islands, Puerto Rico, Texas, and the U.S. Virgin Islands.

The likelihood of entry of *Stenoma catenifer* into the endangered area via avocado imported from Guatemala

Risk Element	Risk Rating	Uncertainty Rating	Evidence for rating (and other notes as necessary)
Pest prevalence on the harvested commodity	High	Low	*Stenoma catenifer* is one of the most destructive pests of avocado (Ebeling, 1959). It undergoes several generations a year and can reach high population levels throughout the growing season, including during harvest. Females can lay up to 164 eggs during her lifetime (Segrera, 2019). Eggs are typically laid on rough surfaces on the fruit or along crevices such as the area around the fruit pedicel (Cervantes Peredo et al., 1999; Hoddle and Hoddle, 2008b). Multiple larvae feed inside the fruit (Ebeling, 1959). Because the insect can reach high populations levels and it has two life stages associated with the fruit, we rated this risk rating as high with low uncertainty.
Likelihood of surviving post-harvest processing before shipment	High	Low	As internal feeders, the larvae are not likely to be affected by post-harvest surface cleansing and culling, especially if the damage is not obvious. However, the presence of later instars on fruit would probably be detected due to the presence of frass and visible feeding damage (Cervantes Peredo et al., 1999; Hoddle and Hoddle, 2008b). Since post-harvest practices would not reduce all life stages of this pest, we did not change the previous rating.
Likelihood of surviving transport and storage conditions of the consignment	High	Low	*Stenoma* sp. have been intercepted at U.S. ports of entry in *Persea americana* (n=515). (ARM, 2022a), indicating that this moth can survive standard shipping conditions. For this reason, we did not change the risk rating.
Overall Likelihood of Entry	High	n/a	n/a

The likelihood of establishment of *Stenoma catenifer* into the endangered area via avocado imported from Guatemala

Risk Element	Risk Rating	Uncertainty Rating	Evidence for rating (and other notes as necessary)
Likelihood of Establishment	Medium	Moderate	Host material in the PRA area would likely be limited to avocado. Avocado plants may be found in Plant hardiness zones 8-13, particularly American Samoa, Arizona, California, Florida, Georgia, Guam, Hawaii, Louisiana, Mississippi, the Northern Mariana Islands, Puerto Rico, Texas, and the U.S. Virgin Islands, where avocados are commercially produced (NASS, 2020). The natural dispersal potential of *S. catenifer* is not known (male adults were recorded flying ca. 67m, though this may be an underestimate) (Hoddle et al., 2011), but several larvae can be found in each infested fruit (Hoddle and Parra, 2013). Because suitable host material will likely be limited to avocado, which is not distributed through the PRA area, we rated this element Medium.
Overall Likelihood of Establishment	Medium	n/a	n/a

The likelihood of introduction (combined likelihoods of entry and establishment) of *Stenoma catenifer* into the endangered area via avocado fruit imported from Guatemala is Medium.

3.2.4. *Amorbia santamaria* (Lepidoptera: Tortricidae)

This moth primarily feeds on leaves of avocado (MAGA, 2021), but occasionally may feed internally in large, mature fruit (Hoddle and Brown, 2010). First described in 2007, we have very little information regarding its pest status and climatic suitability. We are highly uncertain about the potential pest status of these species on avocado and in the United States but cannot discount the potential association with harvested avocado fruit.

The endangered area for *Amorbia santamaria* within the United States

Climatic suitability: *Amorbia santamaria* is only known to occur in Guatemala (Hoddle and Hoddle, 2008b; Hoddle and Brown, 2010; MAGA, 2021), but was also collected in Costa Rica more than a century ago (Phillips-Rodriguez and Powell, 2007). First described in 2007 (Phillips-Rodriguez and Powell, 2007), we found no indication that the species had been introduced elsewhere. A comparison of USDA Plant Hardiness Zones (Takeuchi et al., 2018a) to these regions indicates that establishment may occur in Zones 10 through 13 within the United States, limiting potential establishment to southern Florida, Hawaii, and the territories.

Hosts in PRA area: *Amorbia santamaria* is not well studied, so the full host range for this species is unknown. The only reported host of *A. santamaria* is avocado (Lauraceae: *Persea americana*) (Hoddle and Hoddle, 2008b; Hoddle and Brown, 2010; MAGA, 2021; Phillips-Rodriguez and Powell, 2007)). Between 2015 and 2020, avocados were commercially produced in American Samoa, Arizona, California, Florida, Georgia, Guam, Hawaii, Louisiana, Mississippi, the Northern Mariana Islands, Puerto Rico, Texas, and the U.S. Virgin Islands (NASS, 2020).

Economically important hosts[6]*:* Avocado is an economically important host at risk in the United States. In 2020, more than 206 thousand tons of avocado were produced for a value of more than $427 million dollars in the United States (NASS, 2020).

Potential consequences on economically important hosts at risk: This species has been found feeding internally within commercially produced avocado fruit (Hoddle and Brown, 2010). We have no additional information regarding the significance of the infestation in Guatemala nor how much damage was caused. Therefore, we are uncertain about the potential consequences on avocado in the United States but cannot rule it out without additional information.

Endangered area: *Amorbia santamaria* may establish and affect at least avocado production in the United States within areas in plant hardiness zones 9-13 where avocado is grown.

The likelihood of entry of *Amorbia santamaria* into the endangered area via avocado fruit imported from Guatemala

Risk Element	Risk Rating	Uncertainty Rating	Evidence for rating (and other notes as necessary)
Pest prevalence on the harvested commodity	Low	Low	*Amorbia santamaria* is present in avocado producing regions of Guatemala, but primarily feeds on leaves (MAGA, 2021). However, larvae have been collected from large, mature fruit at a very low incidence (n=5 of 1,098 specimens identified) (Hoddle and Brown, 2010). Based on the occasional association as an internal pest in mature fruit, we rated this element Low.
Likelihood of surviving post-harvest processing before shipment	Low	Low	*Amorbia santamaria* is most likely to be associated with harvested avocados as internally feeding larvae. They would therefore be unlikely to be affected by post-harvest processing. Based on this, we did not change the risk rating.

[6] As defined by ISPM No. 5, potential economic importance applies to crops, the environment (ecosystems, habitats, or species), and to other specified values such as tourism, recreation and aesthetics (IPPC, 2022).

Risk Element	Risk Rating	Uncertainty Rating	Evidence for rating (and other notes as necessary)
Likelihood of surviving transport and storage conditions of the consignment	Low	Low	Transport and storage conditions are not being considered in this PRA. Internally feeding larvae or eggs are unlikely to be affected; therefore, the risk rating did not change.
Overall Likelihood of Entry	Low	n/a	n/a

The likelihood of establishment of *Amorbia santamaria* into the endangered area via avocado fruit imported from Guatemala

Risk Element	Risk Rating	Uncertainty Rating	Evidence for rating (and other notes as necessary)
Likelihood of Establishment	Low	Medium	We found very little information about this recently described pest, including information on climate and host suitability. Based on the information we do have, only larvae may follow the pathway (Hoddle and Brown, 2010). In order for establishment in a new area, these larvae would need to then find suitable substrate for pupation, suitable mates, and suitable host/climate for development. Without additional information about this species, we estimate a Low likelihood of these specific parameters being met for a new population to establish in the United States. Additionally, we found no evidence of introduction into any new areas outside of Guatemala, so reduced our uncertainty from High to Medium.
Overall Likelihood of Establishment	Low	n/a	n/a

The likelihood of introduction (combined likelihoods of entry and establishment) of *Amorbia santamaria* into the endangered area via avocado fruit imported from Guatemala is Low.

3.2.5. *Cryptaspasma perseana* (Lepidoptera: Tortricidae)

Cryptaspasma perseana is an avocado seed borer described from avocado fruit in 2011 (Gilligan et al., 2011). It is present in Guatemala and Mexico (Gilligan et al., 2011; Mancilla-Brindis et al., 2019; Ortega-Licona et al., 2016). There is not enough information available to estimate the potential for spreading beyond its native range, or whether the endangered area may encompass additional climates or hosts. While it has not yet been found in standard commercial production of Hass avocados, new research on this species is ongoing and it cannot be ruled out (Mancilla-

Brindis et al., 2019; Mancilla-Brindis et al., 2021). We are highly uncertain about the potential pest status of this species in the United States.

The endangered area for *Cryptaspasma perseana* within the United States

Climatic suitability: *Cryptaspasma perseana* is distributed in Mexico and central Guatemala (Gilligan et al., 2011; Mancilla-Brindis et al., 2019; Ortega-Licona et al., 2016). However, it was recently described, and we do not have enough information to determine whether climate suitability may be further expanded than the Plant Hardiness Zones of Guatemala and central Mexico. It is likely to be able to establish in at least Plant Hardiness Zones corresponding to this region, including Zones 9-13 (Takeuchi et al., 2018a).

Hosts in PRA area: *Cryptaspasma perseana* is not well studied, so the full host range for this species is unknown. Known hosts include avocado (Lauraceae: *Persea americana*) and *Prioria copaifera* (Fabaceae) (Brown et al., 2020; Gilligan et al., 2011). Between 2015 and 2020, avocados were commercially produced in American Samoa, Arizona, California, Florida, Georgia, Guam, Hawaii, Louisiana, Mississippi, the Northern Mariana Islands, Puerto Rico, Texas, and the U.S. Virgin Islands (NASS, 2020).

Economically important hosts[7]*:* Avocado is an economically important host at risk in the United States. In 2020, more than 206 thousand tons of avocado were produced for a value of more than $427 million dollars in the United States (NASS, 2020).

Potential consequences on economically important hosts at risk: This pest has infested backyard avocados (Ortega-Licona et al., 2016), and been reared from avocados in laboratory settings (Gilligan et al., 2011). We have no additional information regarding the significance of this pest in avocados nor how much damage has been caused. Therefore, we are uncertain about the potential consequences on avocado in the United States but cannot rule it out without additional information.

Endangered area: *Cryptaspasma perseana* may establish and affect at least avocado production in the United States within areas in plant hardiness zones 9-13 where avocado is grown.

The likelihood of entry of *Cryptaspasma perseana* into the endangered area via avocado fruit imported from Guatemala

[7] As defined by ISPM No. 5, potential economic importance applies to crops, the environment (ecosystems, habitats, or species), and to other specified values such as tourism, recreation and aesthetics (IPPC, 2022).

Risk Element	Risk Rating	Uncertainty Rating	Evidence for rating (and other notes as necessary)
Pest prevalence on the harvested commodity	Low	Medium	We found very little information regarding the potential infestation of *C. perseana* in Hass avocado in Guatemala. Gilligan et al. (2011) reared this species from avocado in laboratory settings. It has also been collected from backyard orchards in Mexico (Mancilla-Brindis et al., 2019; Ortega-Licona et al., 2016). Hass variety avocados do not appear to be a preferred host as it is mostly found in creole avocados (Mancilla-Brindis, et al., 2021), but it can infest Hass varieties (Hoddle and Hoddle, 2008b). It has not become a problem in commercial orchards of Hass because of standard management practices that reduce tortricids (Mancilla-Brindis et al., 2021). Additionally, it may be more likely to colonize dropped fruit, but more research is needed to confirm this (Macilla-brindis et al., 2021). We found no additional information regarding the potential prevalence in commercial orchards, so rated this risk element Low, but with medium uncertainty.
Likelihood of surviving post-harvest processing before shipment	Low	Low	*Cryptaspasma perseana* is most likely to be associated with harvested avocados as internally feeding larvae. They would therefore be unlikely to be affected by post-harvest processing. Based on this, we did not change the risk rating.
Likelihood of surviving transport and storage conditions of the consignment	Low	Low	Transport and storage conditions are not being considered in this PRA. Internally feeding larvae or eggs are unlikely to be affected; therefore, the risk rating did not change.
Overall Likelihood of Entry	Low	n/a	n/a

The likelihood of establishment of *Cryptaspasma perseana* into the endangered area via avocado fruit imported from Guatemala

Risk Element	Risk Rating	Uncertainty Rating	Evidence for rating (and other notes as necessary)
Likelihood of Establishment	Medium	High	*Cryptaspasma perseana* is not well studied, so the full host range for this species is unknown. It infests avocado and *Prioria copaifera* (Brown et al., 2020; Gilligan et al., 2011). The *Cryptaspasma* genus is generally associated with large stone type seeds such as Lauraceae (Laurales) and Myrtaceae (Myrtales) (Brown et al., 2019), so may infest a wider range of species that are present in the United States. Many individuals may infest a single fruit (Mancilla-Brindis et al., 2021), increasing the possibility of finding suitable mates for establishment. For this reason, we estimate the likelihood of establishment to be Medium, but with High uncertainty. It is unclear whether infestation levels of Hass avocados would be as high as other varieties.
Overall Likelihood of Establishment	Medium	n/a	n/a

The likelihood of introduction (combined likelihoods of entry and establishment) of *Cryptaspasma perseana* into the endangered area via avocado fruit imported from Guatemala is Medium.

3.2.6. *Histura perseavora* (Lepidoptera: Tortricidae)

Histura perseavora larvae feed in avocado fruit pulp around the seed (Brown and Hoddle, 2010). It was described about 10 years ago from Guatemala (Brown and Hoddle, 2010). We have very little additional information about this species, including the significance of damage caused. However, it has been collected from large, mature Hass and non-Hass avocado fruit in both managed and non-managed orchards (Hoddle and Brown, 2010). We are uncertain about the potential consequences on avocado in the United States but cannot rule it out without additional information.

The endangered area for *Histura perseavora* within the United States

Climatic suitability: *Histura perseavora* is only known to occur in Guatemala (Brown and Hoddle, 2010). It was described for the first time in 2010 with no additional information on its distribution since then. We do not have enough information to determine whether climate suitability may be further expanded than the Plant Hardiness Zones of Guatemala.

Hosts in PRA area: *Histura perseavora* larvae were collected from commercially produced avocado (Lauraceae: *Persea americana*) (Brown and Hoddle, 2010). We do not have additional information regarding potential hosts in the PRA area.

Economically important hosts[8]*:* Avocado is an economically important host at risk in the United States. In 2020, more than 206 thousand tons of avocado were produced for a value of more than $427 million dollars in the United States (NASS, 2020).

Potential consequences on economically important hosts at risk: This pest was found feeding internally within commercially produced avocado fruit in both managed and non-managed avocado orchards (Brown and Hoddle, 2010). We have no additional information regarding the significance of the infestation in Guatemala nor how much damage was caused. Therefore, we are uncertain about the potential consequences on avocado in the United States but cannot rule it out without additional information.

Endangered area: *Histura perseavora* may establish and affect at least avocado production in the United States within areas in at least plant hardiness zones 10-13 where avocado is grown.

The likelihood of entry of *Histura perseavora* into the endangered area via avocado fruit imported from Guatemala

Risk Element	Risk Rating	Uncertainty Rating	Evidence for rating (and other notes as necessary)
Pest prevalence on the harvested commodity	Medium	High	*Histura perseavora* has recently been described as pest of avocado, reared from mature Hass fruit in both managed and non-managed orchards (Brown and Hoddle, 2010). It is frequently associated with avocado orchards in Guatemala but is typically found on fruit that has fallen to the ground (Arévalo and Bonilla, 2019). We found no evidence that this is a significant pest of concern to growers, and therefore rated this risk element Medium.
Likelihood of surviving post-harvest processing before shipment	Medium	Low	*Histura perseavora* is most likely to be associated with harvested avocados as internally feeding larvae. They would therefore be unlikely to be affected by post-harvest processing. Based on this, we did not change the risk rating.
Likelihood of surviving transport and storage conditions of the consignment	Medium	Low	Transport and storage conditions are not being considered in this PRA. Internally feeding larvae or eggs are unlikely to be affected; therefore, the risk rating did not change.

[8] As defined by ISPM No. 5, potential economic importance applies to crops, the environment (ecosystems, habitats, or species), and to other specified values such as tourism, recreation and aesthetics (IPPC, 2022).

Risk Element	Risk Rating	Uncertainty Rating	Evidence for rating (and other notes as necessary)
Overall Likelihood of Entry	Medium	n/a	n/a

The likelihood of establishment of *Histura perseavora* into the endangered area via avocado fruit imported from Guatemala

Risk Element	Risk Rating	Uncertainty Rating	Evidence for rating (and other notes as necessary)
Likelihood of Establishment	Low	Medium	We found very little information about this recently described pest, including information on climate and host suitability. Based on the information we do have, only larvae may follow the pathway (Brown and Hoddle, 2010). For establishment in a new area, these larvae would need to then find suitable substrate for pupation, suitable mates, and suitable host/climate for development. Without additional information about this species, we estimate a Low likelihood of these specific parameters being met for a new population to establish in the United States. Additionally, we found no evidence of introduction into any new areas outside of Guatemala.
Overall Likelihood of Establishment	Low	n/a	n/a

The likelihood of introduction (combined likelihoods of entry and establishment) of *Histura perseavora* into the endangered area via avocado fruit imported from Guatemala is Low.

3.2.7. *Elsinoë perseae* (Jenkins) Rossman & W.C. Allen, syn: *Sphaceloma perseae* Jenkins (Dothideomycetes: Myriangiales)

The avocado scab fungus, *Elsinoë perseae* (previously known as *Sphaceloma perseae*) is considered to be host specific (Everett and Siebert, 2018) but closely related *Elsinoë* spp. cause similar scab diseases of other economically important crops, such as *E. fawcettii* and *E. australis* on citrus (Fan et al., 2017). The disease is most prominent and most easily diagnosed on the fruit of very susceptible varieties. Spots are first oval, slightly raised, and brown to purplish brown. As the fruit mature, spots coalesce, and the centers of these spots become sunken, and a large portion of the fruit may become rough in appearance (Palmateer et al., 2006; Everett et al., 2011).

Avocado scab results in premature fruit drop and reduced fruit quality, which heavily impacts marketability (Everett and Siebert, 2018; Fan et al., 2017). An indirect but nevertheless major impact of this disease is that it restricts market access to pest-free countries (Everett and Siebert,

2018). This is a quarantine pest for Hawaii (ARM, 2022b) and Northern Mariana Islands where the pathogen is not known to occur.

The endangered area for *Elsinoë perseae* within the Hawaii and Northern Mariana Islands
Climatic suitability: *Elsinoë perseae* is present in **Africa** (Guinea, Morocco, South Africa, Zambia, Zimbabwe; **Asia** (Philippines, Taiwan); **North America (**Costa Rica, Cuba, Dominican Republic, Guadeloupe, Guatemala, Haiti, Honduras, Jamaica, Nicaragua, Panama, El Salvador, Mexico, United States (Florida, Texas), Puerto Rico and U.S. Virgin Islands; **South America** (Argentina, Brazil, Guyana, Peru, Venezuela (CABI, 2022, ARM, 2022; Everett et al., 2011). Comparing the plant hardiness zones with known geographic distribution, we predict that the pest could establish in areas corresponding to Plant Hardiness Zones 8 to 13 (Takeuchi and Fowler, 2018).

Hosts in PRA area: The only host of *E. perseae* is *Persea americana* [Lauraceae: *Persea americana* (CABI, 2022), which is grown in Hawaii and Northern Mariana Islands (Kartesz, 2022; NRCS, 2022). These areas are suitable for the pathogen.

Economically important hosts at risk: The only economically important host present is *P. americana* (NASS, 2022; USDA, 2020).

Potential consequences on economically important hosts at risk: *Elsinoë perseae* is a severe problem in humid tropical regions where it causes losses due to fruit drop and lower market value of avocado fruit (Menge and Ploetz, 2003). This pest is likely to cause unacceptable consequences because it is one of the most serious phytosanitary issues in avocado-producing countries such as Mexico (Ávila-Quezada et al., 2002; Téliz-Ortiz et al., 2003). Young avocado leaves and fruit (from fruit set to the time the fruit reaches one third to one half of the mature size) are the most susceptible plant tissues to the pathogen (Ávila-Quezada et al., 2002). Scab symptoms begin with scattered corky, raised brown to purplish-brown lesions or ‘scabs’ which merge as the disease progresses causing deep brown fissures covering the fruit surface (Burnett, 1974). Avocado scab results in premature fruit drop and reduced fruit quality, which heavily impacts marketability (Everett and Siebert, 2018; Fan et al., 2017). The disease incidence can be as high as 98% (Ávila-Quezada et al., 2002). Crop losses of up to 53% have been reported (Quezada et al., 2003) and price reductions ranging from 27-53% (Morales-Garcia, 2017). Avocado scab lesions may provide a gateway for the entry of other pathogens (Menge and Ploetz, 2003a). In addition to direct marketable fruit losses, the occurrence of this disease could restrict market access to pest-free countries (Parkinson and Geering, 2019).

***Endangered Area*:** *Elsinoë perseae* has the potential to occur in plant hardiness zones 8-13 (Takeuchi et al., 2018) which correspond to areas in Hawaii and Northern Mariana Islands.

The likelihood of introduction of *Elsinoë perseae* into the endangered area via *Persea americana* imported from Guatemala

Risk Element	Risk Rating	Uncertainty Rating	Evidence for rating (and other notes as necessary)
Pest prevalence on the harvested commodity	High	Low	Avocado scab results in premature fruit drop and reduced fruit quality, which heavily impacts marketability (Everett & Siebert, 2018; Fan et al., 2017). *Elsinoë perseae* is one of the main phytosanitary concerns in avocado-producing countries (Ávila-Quezada et al., 2002; Everett and Siebert, 2018; Fan et al., 2017). Crop losses of up to 53% have been reported (Vidales, 1996). The disease incidence can be as high as 98% (Ávila-Quezada et al., 2002), therefore we rated the pest prevalence on the harvested commodity high.
Likelihood of surviving post-harvest processing before shipment	Medium	Low	We found no evidence that this pathogen could produce latent infections on avocado fruit or that the pathogen is seed transmitted. Symptoms of avocado scab our noticeable in severe cases with dark sunken spots and fruit becoming rough in appearance (Palmateer et al., 2006; Everett et al., 2011). Because a portion of infected fruit would likely be culled, we reduced the rating for this element to Medium.
Likelihood of surviving transport and storage conditions of the consignment	Medium	Low	In the last five years there has been one interception of *E. perseae* in avocado fruit from Mexico in permit cargo and twenty-six in fruit found in baggage from all over the world (ARM, 2022b). This indicates that the pathogen can remain in the commodity through storage and transport. Therefore, the rating for this element remains medium.
Overall Likelihood of Entry	Medium	Low	n/a

The likelihood of establishment of *Elsinoë perseae* into the endangered area via *Persea americana* imported from Guatemala

Risk Element	Risk Rating	Uncertainty Rating	Evidence for rating (and other notes as necessary)
Likelihood of Establishment	Low	Low	Avocado is the only known host of *E. perseae* (Jenkins, 1934) so establishment in Hawaii and Northern Mariana Islands would be limited. Avocado scab is not known to be seed transmitted (Everett and Siebert, 2018). Further, most of the infection occurs up to 2–3 months after fruit set suggesting that sporulation occurs during this period as well (Quezada et al., 2003) which would happen prior to harvest. Additionally, it would be highly unlikely for discarded fruit to come in contact with susceptible host material, due to the epidemiology of the disease and the restricted distribution of avocado in Hawaii and Northern Mariana Islands.
Overall Likelihood of Establishment	Low	n/a	n/a

The likelihood of introduction (combined likelihoods of entry and establishment) of *Elsinoë perseae* into the endangered area via avocado fruit imported from Guatemala is Low.

4. Summary

Of the organisms associated with avocado worldwide and present in the export area, we identified 12 organisms that are quarantine pests for the United States. These pests are likely to meet the threshold for unacceptable consequences in the PRA area and have a reasonable likelihood of following the commodity pathway (Table 3). Thus, these pests are candidates for risk management. These results represent a baseline estimate of the risks associated with the import commodity pathway as described in section 1.4.

Table 3. Summary of pests that met the threshold for unacceptable consequences of introduction, have a reasonable likelihood of following the commodity pathway, and thus are candidates for risk management.

Pest type	Scientific name	Likelihood of Introduction	Uncertainty statement (optional)[a]
Arthropod	*Conotrachelus aguacatae* Barber	Medium	N/A
Arthropod	*Conotrachelus perseae* Barber	Medium	N/A
Arthropod	*Heilipus lauri* Boheman	Medium	N/A
Arthropod	*Holcocera plagatola* Adamski	Low	Association of this species with avocado may be incidental (Hoddle and Brown, 2010).

Pest type	Scientific name	Likelihood of Introduction	Uncertainty statement (optional)[a]
Arthropod	*Stenoma catenifer* Walsingham	Medium	N/A
Arthropod	*Euxoa sorella* Schaus	Low	Association of this species with avocado may be incidental (Hoddle and Brown, 2010).
Arthropod	*Amorbia santamaria* Phillips and Powell	Low	N/A
Arthropod	*Cryptaspasma perseana* Gilligan & Brown	Medium	Species was recently described (Gilligan et al., 2011), and we are uncertain about the extent of potential impacts.
Arthropod	*Histura perseavora* Brown	Low	Species was recently described (Brown and Hoddle, 2010), and we are uncertain about the extent of potential impacts.
Arthropod	*Netechma pyrrhodelta* (Meyrick)	Low	Association of this species with avocado may be incidental (Hoddle and Brown, 2010).
Fungus	*Elsinoë perseae* (Jenkins) Rossman & W.C. Allen	Low	This risk rating applies only to Hawaii and Northern Mariana Islands.

[a]The uncertainty statement, if included, identifies the most important source(s) of uncertainty.

Our assessment of risk is contingent on the application of all components of the pathway as described in section 1.4. Appropriate phytosanitary measures to mitigate pest risk are addressed separately from this document.

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6. Appendix: Pests with non-quarantine status

We found evidence that the organisms listed below are associated with avocado and present in Guatemala. Because these organisms are not of quarantine significance for the United States (ARM, 2021 as defined by ISPM 5, IPPC, 20182019), we did not list them in Table 1 nor did we intensively evaluate their association with avocado and their presence in Guatemala. Therefore, the organisms are considered to have only "potential" association with the commodity and presence in Guatemala.

We listed these organisms along with the references supporting their potential presence in Guatemala, their presence in the United States (if applicable), and their potential association with avocado. If any of the organisms are not present in the United States, we also provided justification for their non-quarantine status. Unless otherwise noted, these organisms are non-actionable at U.S. ports of entry.

Organism	**In Guatemala**	**In U.S.**	**Host Association**	**Notes**
MITE: Acari: Tarsonemidae *Polyphagotarsonemus latus* (Banks)	Maes, 2004	Maes, 2004	Maes, 2004; Wysoki et al., 2002	
MITE: Acari: Tenuipalpidae *Brevipalpus phoenicis* (Geijskes)	CABI, 2022	CABI, 2022	Peña, 2003	
MITE: Acari: Tetranychidae *Oligonychus perseae* Tuttle, Baker & Abbatiello	MAGA, 2021	Migeon and Dorkeld, 2022	MAGA, 2021; Wysoki et al., 2002	
MITE: Acari: Tetranychidae *Oligonychus peruvianus* (McGregor)	Migeon and Dorkeld, 2022	Migeon and Dorkeld, 2022	Migeon and Dorkeld, 2022	
MITE: Acari: Tetranychidae *Oligonychus punicae* (Hirst)	Maes, 2004; MAGA, 2021	Maes, 2004	Maes, 2004; MAGA, 2021; Wysoki et al., 2002	
MITE: Acari: Tetranychidae *Tetranychus urticae* Koch	Maes, 2004	Migeon and Dorkeld, 2022	Maes, 2004	
INSECT: Coleoptera: Chrysomelidae *Cerotoma atrofasciata* Jacoby	Maes, 2004	Clark et al., 2004	Maes, 2004	
INSECT: Coleoptera: Chrysomelidae *Charidotella (Charidotella) sexpunctata* (Fabricius)	Maes, 2004	Maes, 2004	Maes, 2004	

Organism	**In Guatemala**	**In U.S.**	**Host Association**	**Notes**
INSECT: Coleoptera: Chrysomelidae *Diabrotica balteata* Leconte	Maes, 2004	Maes, 2004	Maes, 2004	
INSECT: Coleoptera: Chrysomelidae *Neolema sexpunctata* (Olivier)	Maes, 2004	Maes, 2004	Maes, 2004	
INSECT: Coleoptera: Curculionidae *Cryptocarenus diadematus* Eggers	Atkinson, 2022	Atkinson, 2022	Atkinson, 2022	
INSECT: Coleoptera: Curculionidae *Caulophilus latinasus* (Say)	CABI, 2022	CABI, 2022	CABI, 2022	
INSECT: Coleoptera: Curculionidae *Caulophilus oryzae* (Gyllenhal)	CABI, 2022	CABI, 2022	CABI, 2022	
INSECT: Coleoptera: Curculionidae *Euplatypus parallelus* (Fabricius)	EPPO, 2021	EPPO, 2021	EPPO, 2021	
INSECT: Coleoptera: Scarabaeidae *Cotinis mutabilis* (Gory & Percheron)	Maes, 2004	Maes, 2004	Maes, 2004	
INSECT: Coleoptera: Scarabaeidae *Strategus aloeus* (Linnaeus)	Maes, 2004	Maes, 2004	Maes, 2004	
INSECT: Coleoptera: Scolytidae *Xyleborus affinis* Eichhoff	Maes, 2004	Maes, 2004	Maes, 2004	
INSECT: Coleoptera: Scolytidae *Xyleborus ferrugineus* (Fabricius)	CABI, 2022	CABI, 2022	CABI, 2022	
INSECT: Coleoptera: Scolytidae *Xyleborus volvulus* (Fabricius)	CABI, 2022	CABI, 2022	CABI, 2022	
INSECT: Coleoptera: Scolytidae *Xylosandrus crassiusculus* (Motschulsky)	CABI, 2022	CABI, 2022	CABI, 2022	

Organism	**In Guatemala**	**In U.S.**	**Host Association**	**Notes**
INSECT: Diptera: Cecidomyiidae *Asphondylia websteri* Felt	Hoddle, 2008	Hoddle, 2008	Hoddle, 2008	
INSECT: Hemiptera: Aleyrodidae *Aleurodicus cocois* Curtis	Evans, 2007	Evans, 2007	Evans, 2007	
INSECT: Hemiptera: Aleyrodidae *Aleurodicus dispersus* Russell	CABI, 2022	CABI, 2022	CABI, 2022	
INSECT: Hemiptera: Aleyrodidae *Aleurodicus dugesii* Cockerell	CABI, 2022	CABI, 2022; Wysoki et al., 2002	CABI, 2022; Wysoki et al., 2002	
INSECT: Hemiptera: Aleyrodidae *Aleurodicus rugioperculatus* Martin	CABI, 2022; Kumar et al., 2020	CABI, 2022; Kumar et al., 2020	Kumar et al., 2020	
INSECT: Hemiptera: Aleyrodidae *Aleuroglandulus subtilis* Bondar	Evans, 2007	Evans, 2007	Evans, 2007	
INSECT: Hemiptera: Aleyrodidae *Aleurothrixus trachoides* (Back)	EPPO, 2022	EPPO, 2022	EPPO, 2022	
INSECT: Hemiptera: Aleyrodidae *Bemisia tabaci* (Gennadius)	Maes, 2004	Maes, 2004	Maes, 2004	Considered Quarantine organism, but no action required, except when on tomato from the Dominican Republic (ARM, 2022).
INSECT: Hemiptera: Aleyrodidae *Paraleyrodes minei* Iaccarino	Evans, 2007	Wysoki et al., 2002	Evans, 2007; Wysoki et al., 2002	
INSECT: Hemiptera: Aleyrodidae *Tetraleurodes mori* (Quaintance)	Arreaga and Rodriguez, 2007	Dooley et al., 2010; Wysoki et al., 2002	Arreaga and Rodriguez, 2007; Wysoki et al., 2002	
INSECT: Hemiptera: Aleyrodidae *Tetraleurodes perseae* Nakahara	MAGA, 2021	Wysoki et al., 2002	MAGA, 2021; Wysoki et al., 2002	

Organism	In Guatemala	In U.S.	Host Association	Notes
INSECT: Hemiptera: Aleyrodidae *Trialeurodes floridensis (Quaintance)*	Evans, 2007	Evans, 2007	Evans, 2007	
INSECT: Hemiptera: Aleyrodidae *Trialeurodes vaporariorum* Westwood	CABI, 2022	CABI, 2022	CABI, 2022; Wysoki et al., 2002	
INSECT: Hemiptera: Aphididae *Aphis gossypii* Glover	Maes, 2004	Maes, 2004	Maes, 2004; Wysoki et al., 2002	
INSECT: Hemiptera: Aphididae *Aphis spiraecola* Patch	Yahia, 2011	CABI, 2022	CABI, 2022	
INSECT: Hemiptera: Aphididae *Myzus persicae* Sulzer	MAGA, 2021	CABI, 2022	MAGA, 2021; Wysoki et al., 2002	
INSECT: Hemiptera: Asterolecaniidae *Bambusaspis bambusae* (Boisduval)	García Morales et al., 2016	García Morales et al., 2016	García Morales et al., 2016	
INSECT: Hemiptera: Cicadellidae *Tylozygus fasciatus* (Walker)	Maes, 2004	Maes, 2004	Maes, 2004	
INSECT: Hemiptera: Coccidae *Ceroplastes floridensis* Comstock	García Morales et al., 2016; Maes, 2004	García Morales et al., 2016; Maes, 2004	García Morales et al., 2016; Maes, 2004	
INSECT: Hemiptera: Coccidae *Ceroplastes stellifer* (Westwood). Syn: *Vinsonia stellifera* (Westwood)	García Morales et al., 2016	García Morales et al., 2016	García Morales et al., 2016	
INSECT: Hemiptera: Coccidae *Coccus hesperidum hesperidum* (Linnaeus)	García Morales et al., 2016; Maes, 2004	García Morales et al., 2016; Maes, 2004	García Morales et al., 2016; Maes, 2004; Wysoki et al., 2002	
INSECT: Hemiptera: Coccidae *Coccus longulus* (Douglas)	García Morales et al., 2016	García Morales et al., 2016	García Morales et al., 2016	
INSECT: Hemiptera: Coccidae *Coccus viridis* (Green)	García Morales et al., 2016; Maes, 2004	García Morales et al., 2016; Maes, 2004	García Morales et al., 2016; Maes, 2004	

Organism	In Guatemala	In U.S.	Host Association	Notes
INSECT: Hemiptera: Coccidae *Eucalymnatus tessellatus* (Signoret)	García Morales et al., 2016	Dekle, 1999	Dekle, 1999	
INSECT: Hemiptera: Coccidae *Kilifia acuminata* (Signoret)	García Morales et al., 2016	García Morales et al., 2016	García Morales et al., 2016	
INSECT: Hemiptera: Coccidae *Milviscutulus mangiferae* (Green)	García Morales et al., 2016	García Morales et al., 2016	García Morales et al., 2016	
INSECT: Hemiptera: Coccidae *Parasaissetia nigra* (Nietner)	García Morales et al., 2016; Maes, 2004	García Morales et al., 2016; Maes, 2004	García Morales et al., 2016; Maes, 2004	
INSECT: Hemiptera: Coccidae *Phalacrococcus howertoni* Hodges & Hodgson	García Morales et al., 2016	García Morales et al., 2016	García Morales et al., 2016	
INSECT: Hemiptera: Coccidae *Philephedra tuberculosa* Nakahara & Gill	García Morales et al., 2016	García Morales et al., 2016	García Morales et al., 2016	
INSECT: Hemiptera: Coccidae *Protopulvinaria pyriformis* (Cockerell)	García Morales et al., 2016	García Morales et al., 2016	García Morales et al., 2016; Wysoki et al., 2002	
INSECT: Hemiptera: Coccidae *Pseudokermes vitreus* (Cockerell)	García Morales et al., 2016	García Morales et al., 2016	García Morales et al., 2016	
INSECT: Hemiptera: Coccidae *Pulvinaria psidii* Maskell	García Morales et al., 2016	CABI, 2022	CABI, 2022	
INSECT: Hemiptera: Coccidae *Saissetia coffeae* (Walker)	García Morales et al., 2016; Maes, 2004	García Morales et al., 2016; Maes, 2004	García Morales et al., 2016; Maes, 2004	
INSECT: Hemiptera: Coccidae *Saissetia neglecta* De Lotto	García Morales et al., 2016	García Morales et al., 2016	García Morales et al., 2016	
INSECT: Hemiptera: Coccidae *Saissetia oleae oleae* (Olivier)	García Morales et al., 2016	García Morales et al., 2016	García Morales et al., 2016	

Organism	In Guatemala	In U.S.	Host Association	Notes
INSECT: Hemiptera: Diaspididae[9] *Acutaspis albopicta* (Cockerell)	García Morales et al., 2016	García Morales et al., 2016; Morse et al., 2009; Wysoki et al., 2002		Action required only when destined to Hawaii (ARM, 2021).
INSECT: Hemiptera: Diaspididae *Acutaspis aliena* (Newstead) Syn. *Melanaspis aleina* (Newstead)	García Morales et al., 2016	Wysoki et al., 2002	García Morales et al., 2016	
INSECT: Hemiptera: Diaspididae *Acutaspis scutiformis* (Cockerell)	García Morales et al., 2016	García Morales et al., 2016	García Morales et al., 2016	
INSECT: Hemiptera: Diaspididae *Aspidiotus destructor* Signoret	Maes, 2004	Maes, 2004	Maes, 2004	
INSECT: Hemiptera: Diaspididae *Chrysomphalus aonidium* (Linnaeus)	Maes, 2004	Maes, 2004; Wysoki et al., 2002	Maes, 2004	
INSECT: Hemiptera: Diaspididae *Chrysomphalus dictyospermi* (Morgan)	CABI, 2022	García Morales et al., 2016	Moznette, 1919	
INSECT: Hemiptera: Diaspididae *Diaspis boisduvalii* Signoret	García Morales et al., 2016	García Morales et al., 2016	García Morales et al., 2016	
INSECT: Hemiptera: Diaspididae *Hemiberlesia diffinis* Newstead	García Morales et al., 2016	Wysoki et al., 2002	García Morales et al., 2016	
INSECT: Hemiptera: Diaspididae *Hemiberlesia lataniae* (Signoret)	CABI, 2022	García Morales et al., 2016	Rugman-Jones et al., 2009	

[9] All armored scales (Diaspididae) are non-actionable at U.S. ports of entry on fruits and vegetables for consumption (NIS, 2008). Therefore, we did not need to determine whether they occur in the United States.

Organism	In Guatemala	In U.S.	Host Association	Notes
INSECT: Hemiptera: Diaspididae *Hemiberlesia rapax* (Comstock)	García Morales et al., 2016; Maes, 2004	García Morales et al., 2016; Maes, 2004; Wysoki et al., 2002	García Morales et al., 2016; Maes, 2004	
INSECT: Hemiptera: Diaspididae *Ischnaspis longirostris* (Signoret)	García Morales et al., 2016	García Morales et al., 2016	García Morales et al., 2016	
INSECT: Hemiptera: Diaspididae *Lepidosaphes beckii* (Newman)	Maes, 2004	Maes, 2004	Maes, 2004	
INSECT: Hemiptera: Diaspididae *Lepidosaphes gloverii* (Packard)	Maes, 2004	Maes, 2004	Maes, 2004	
INSECT: Hemiptera: Diaspididae *Melanaspis nigropunctata (Cockerell)*	García Morales et al., 2016	García Morales et al., 2016	García Morales et al., 2016	
INSECT: Hemiptera: Diaspididae *Melanaspis squamea* Ferris	García Morales et al., 2016	García Morales et al., 2016		
INSECT: Hemiptera: Diaspididae *Morganella longispina* (Morgan)	García Morales et al., 2016	García Morales et al., 2016	García Morales et al., 2016	
INSECT: Hemiptera: Diaspididae *Parlatoria pergandii* Comstock	Maes, 2004	Maes, 2004	Maes, 2004	
INSECT: Hemiptera: Diaspididae *Parlatoria proteus* (Curtis)	García Morales et al., 2016	García Morales et al., 2016	García Morales et al., 2016	
INSECT: Hemiptera: Diaspididae *Pseudaonidia trilobitiformis* (Green)	García Morales et al., 2016	García Morales et al., 2016	García Morales et al., 2016	
INSECT: Hemiptera: Diaspididae *Pseudaulacaspis cockerelli* (Cooley)	CABI, 2022	CABI, 2022	García Morales et al., 2016	
INSECT: Hemiptera: Diaspididae *Pseudischnaspis acephala* Ferris	García Morales et al., 2016	García Morales et al., 2016		

Organism	In Guatemala	In U.S.	Host Association	Notes
INSECT: Hemiptera: Diaspididae *Pseudischnaspis bowreyi* (Cockerell)	García Morales et al., 2016; Maes, 2004	García Morales et al., 2016; Maes, 2004	García Morales et al., 2016; Maes, 2004	
INSECT: Hemiptera: Diaspididae *Pseudoparlatoria parlatorioides* (Comstock)	García Morales et al., 2016	García Morales et al., 2016	García Morales et al., 2016	
INSECT: Hemiptera: Diaspididae *Selenaspidus articulatus* (Morgan)	Maes, 2004	Maes, 2004; Wysoki et al., 2002	Maes, 2004	
INSECT: Hemiptera: Diaspididae *Unaspis citri* (Comstock)	García Morales et al., 2016	García Morales et al., 2016	García Morales et al., 2016	
INSECT: Hemiptera: Membracidae *Umbonia crassicornis* (Amyot & Serville)	Maes, 2004	Maes, 2004	Maes, 2004	
INSECT: Hemiptera: Monophlebidae *Icerya purchasi* Maskell	CABI, 2022	García Morales et al., 2016	Wysoki and Izhar, 1978	
INSECT: Hemiptera: Pentatomidae *Nezara viridula* (Linnaeus)	CABI, 2022	Wysoki et al., 2002	CABI, 2022	
INSECT: Hemiptera: Pseudococcidae *Dysmicoccus brevipes* (Cockerell)	García Morales et al., 2016	García Morales et al., 2016; Wysoki et al., 2002	García Morales et al., 2016	
INSECT: Hemiptera: Pseudococcidae *Dysmicoccus neobrevipes* Beardsley	García Morales et al., 2016	García Morales et al., 2016	Chia and Evans, 1997	
INSECT: Hemiptera: Pseudococcidae *Ferrisia virgata* (Cockerell)	García Morales et al., 2016	García Morales et al., 2016; Wysoki et al., 2002	García Morales et al., 2016	
INSECT: Hemiptera: Pseudococcidae *Nipaecoccus nipae* (Maskell)	García Morales et al., 2016	García Morales et al., 2016; Wysoki et al., 2002	García Morales et al., 2016	

Organism	In Guatemala	In U.S.	Host Association	Notes
INSECT: Hemiptera: Pseudococcidae *Paracoccus marginatus* Williams & Granara de Willink	García Morales et al., 2016	García Morales et al., 2016	García Morales et al., 2016	
INSECT: Hemiptera: Pseudococcidae *Phenacoccus madeirensis* Green	García Morales et al., 2016	Katbeh-Bader et al., 2019	García Morales et al., 2016	
INSECT: Hemiptera: Pseudococcidae *Phenacoccus solenopsis* Tinsley	García Morales et al., 2016	Abdel-Razzik et al., 2015	García Morales et al., 2016	
INSECT: Hemiptera: Pseudococcidae *Planococcus citri* (Risso)	García Morales et al., 2016; Maes, 2004	García Morales et al., 2016; Maes, 2004; Wysoki et al., 2002	García Morales et al., 2016; Maes, 2004	
INSECT: Hemiptera: Pseudococcidae *Planococcus minor* (Maskell)	García Morales et al., 2016	García Morales et al., 2016	García Morales et al., 2016	
INSECT: Hemiptera: Pseudococcidae *Pseudococcus jackbeardsleyi* Gimpel & Miller	García Morales et al., 2016	García Morales et al., 2016	García Morales et al., 2016	
INSECT: Hemiptera: Pseudococcidae *Pseudococcus longispinus* (Targioni Tozzetti)	García Morales et al., 2016	García Morales et al., 2016	García Morales et al., 2016; Wysoki et al., 2002	
INSECT: Hemiptera: Pseudococcidae *Pseudococcus viburni* (Signoret)	García Morales et al., 2016	García Morales et al., 2016	García Morales et al., 2016	
INSECT: Hemiptera: Tingidae *Pseudacysta perseae* (Heidemann)	Rugman-Jones et al., 2012	Peña, 2003; Rugman-Jones et al., 2012; Wysoki et al., 2002	Peña, 2003; Rugman-Jones et al., 2012	
INSECT: Heteroptera: Alydidae *Hyalymenus tarsatus* (Fabricius)	Maes, 2004	Maes, 2004	Maes, 2004	

Organism	In Guatemala	In U.S.	Host Association	Notes
INSECT: Heteroptera: Coreidae *Leptoglossus zonatus* (Dallas)	Maes, 2004	Maes, 2004	Maes, 2004	
INSECT: Heteroptera: Lygaeidae *Oncopeltus (Erythrischius) cingulifer* Stal	Maes, 2004	Maes, 2004	Maes, 2004	
INSECT: Heteroptera: Thyreocoridae *Galgupha guttiger* (Stal)	Maes, 2004		Maes, 2004	Non-quarantine (ARM, 2022).
INSECT: Hymenoptera: Formicidae *Solenopsis geminata* (Fabricius)	CABI, 2022	CABI, 2022	CABI, 2022	
INSECT: Lepidoptera: Noctuidae *Peridroma saucia* (Hübner)	CABI, 2022	CABI, 2022	CABI, 2022	
INSECT: Lepidoptera: Tortricidae *Argyrotaenia montezumae* (Walsingham)	Obraztsov, 1961	Obraztsov, 1961	Gilligan et al., 2011; Obraztsov, 1961	
INSECT: Lepidoptera: Tortricidae *Micrathetis triplex* Walker	Hoddle and Hoddle, 2008b; Hoddle and Brown, 2010	Poole, 2022	Hoddle and Hoddle, 2008b; Hoddle and Brown, 2010	
INSECT: Lepidoptera: Tortricidae *Platynota rostrana* (Walker)	Maes, 2004	Maes, 2004	Maes, 2004	
INSECT: Thysanoptera: Thripidae *Frankliniella gossypiana* Hood	Hoddle et al., 2002	CABI, 2022	Hoddle et al., 2002	
INSECT: Thysanoptera: Thripidae *Frankliniella occidentalis* (Pergande)	CABI, 2022	Wysoki et al., 2002	CABI, 2022	
INSECT: Thysanoptera: Thripidae *Frankliniella williamsi* Hood	Hoddle et al., 2002	CABI, 2022	Hoddle et al., 2002	
INSECT: Thysanoptera: Thripidae *Heliothrips haemorrhoidalis* (Bouche)	PMC, 2019	CABI, 2022	PMC, 2019	

Organism	**In Guatemala**	**In U.S.**	**Host Association**	**Notes**
INSECT: Thysanoptera: Thripidae *Karnyothrips merrilli* Watson	Hoddle et al., 2002	CABI, 2022	Hoddle et al., 2002	
INSECT: Thysanoptera: Thripidae *Neohydatothrips burungae* (Hood)	Mound et al., 2019	Mound et al., 2019; Rugman-Jones et al., 2006	Mound et al., 2019	
INSECT: Thysanoptera: Thripidae *Scirtothrips aceri* Moulton	Hoddle et al., 2002	Hoddle et al., 2008	Hoddle et al., 2002	
INSECT: Thysanoptera: Thripidae *Scirtothrips perseae* Nakahara	Hoddle et al., 2002	Hoddle et al., 2002	Hoddle et al., 2002; Wysoki et al., 2002	
FUNGI *: Aithaloderma citri* (Briosi & Pass.) Woron., syn: *Capnodium citri* Penz.	Farr and Rossman, 2022	Farr and Rossman, 2022	Farr and Rossman, 2022	
FUNGI*: Albonectria rigidiuscula* (Berk. & Broome) Rossman & Samuels (= *Calonectria rigidiuscula* (Berk. & Broome) Sacc; *Nectria rigidiuscula* Berk. & Broome) Anamorph: *Fusarium decemcellulare* C. Brick	CABI, 2022; Farr and Rossman, 2022	CABI, 2022; Farr and Rossman, 2022	CABI, 2022 Farr and Rossman, 2022	
FUNGI*: Alternaria alternata* (Fr.: Fr) Keissl., syn: *Alternaria citri* Ellis and N. Pierce	Farr and Rossman, 2022	Farr and Rossman, 2022; CABI, 2022	Farr and Rossman, 2022; CABI, 2022	
FUNGI*: Athelia rolfsii* (Curzi) Tu & Kimbr. (= *Sclerotium* ***rolfsii*** Sacc.) Anamorph: *Corticium rolfsii* Curzi	CABI, 2022	CABI, 2022; Farr and Rossman, 2022	Menge and Ploetz, 2003;	
FUNGI*: Botryosphaeria dothidea* (Moug.) Ces. & de Not	CABI, 2022	CABI, 2022; Farr and Rossman, 2022	CABI, 2022: Everett et al., 2011; Farr and Rossman, 2022	

Organism	In Guatemala	In U.S.	Host Association	Notes
FUNGI*: Ceratocystis fimbriata* Ellis & Halst.	Farr and Rossman, 2022; CABI, 2022	Farr and Rossman, 2022; CABI, 2022	Farr and Rossman, 2022	
FUNGI*: Colletotrichum gloeosporioides* (Penz.) Penz. & Sacc, syn: *Glomerella cingulata* (Stoneman) Spauld. & H. Schrenk	CABI, 2022; Farr and Rossman, 2022	CABI, 2022;Farr and Rossman, 2022	CABI, 2022; Ploetz et al., 1994; Farr and Rossman, 2022	
FUNGI*: Corynespora cassiicola* (Berk. & M.A. Curtis) C.T. Wei	Farr and Rossman, 2022; CABI, 2022	Farr and Rossman, 2022; CABI, 2022	Farr and Rossman, 2022	
FUNGI*: Curvularia lunata* (Wakker) Boedijn, syn: *Acrothecium lunatum* Wakker	Farr and Rossman, 2022; CABI, 2022	Farr and Rossman, 2022; CABI, 2022	Farr and Rossman, 2022	
FUNGI*: Fusarium graminearum* Schwabe, syn: *Gibberella zeae* (Schwein. : Fr.) Petch	Farr and Rossman, 2022	Farr and Rossman, 2022; CABI, 2022	Farr and Rossman, 2022	
FUNGI*: Lasiodiplodia theobromae,* (Pat.) Griffon & Maubl., syn: *Botryosphaeria rhodina* (Berk. & M.A. Curtis) Arx	Farr and Rossman, 2022; CABI, 2022	Farr and Rossman, 2022; CABI, 2022	Farr and Rossman, 2022; CABI, 2022	
FUNGI*: Nigrospora oryzae* (Berk. and Curt.) Petch., syn: *Khuskia oryzae* H.J. Huds	Farr and Rossman, 2022	Farr and Rossman, 2022; CABI, 2022	CABI, 2022; Farr and Rossman, 2022	
FUNGI*: Phytophthora cinnamomi* Rands	CABI, 2022	CABI, 2022 Farr and Rossman, 2022	Ploetz et al., 1994; CABI, 2022; Farr and Rossman, 2022	
FUNGI*: Phytophthora citrophthora* (R.E. Sm. & E.H. Sm.) Leonian	Farr and Rossman, 2022; CABI, 2022	Farr and Rossman, 2022; CABI, 2022	Farr and Rossman, 2022; CABI, 2022	
FUNGI*: Phytophthora heveae* A. Thomps.	CABI, 2022	CABI, 2022	CABI, 2022	
FUNGI*: Phytophthora nicotianae* Breda de Haan (= *P. parasitica* Dastur)	CABI, 2022	CABI, 2022	CABI, 2022	

Organism	**In Guatemala**	**In U.S.**	**Host Association**	**Notes**
FUNGI*: Phytophthora palmivora* (E.J. Butler) E. J. Butler	CABI, 2022	CABI, 2022	CABI, 2022	
FUNGI*: Phytopythium vexans* (de Bary) Abad, de Cock, Bala, Robideau, Lodhi & Lévesque, syn: *Pythium vexans* de Bary	CABI, 2022	CABI, 2022	Ramírez-Gil and Morales, 2019	
FUNGI*: Rhizoctonia noxia* (Donk) Oberw., R. Bauer, Garnica & R. Kirschner, syn: *Corticium koleroga* (Cooke) Höhn., *Pellicularia koleroga* Cooke	Farr and Rossman, 2022; CABI, 2022	Farr and Rossman, 2022; CABI, 2022	Farr and Rossman, 2022	
FUNGI*: Rhizoctonia solani* J.G. Kühn, syn: *Thanatephorus cucumeris* (A. B. Frank) Donk	Farr and Rossman, 2022	Farr and Rossman, 2022	Mircetich and Zentmyer, 1960	
FUNGI*: Rhizopus stolonifer* (Ehrenb.: Fr.) Vuill., syn: *Rhizopus nigricans* Ehrenb.	Farr and Rossman, 2022	Farr and Rossman, 2022	Farr and Rossman, 2022	
FUNGI*: Rosellinia bunodes* (Berk. & Br.) Sacc. Black	CABI, 2022	CABI, 2022	Farr and Rossman, 2022; CABI, 2022	
FUNGI*: Sclerotinia sclerotiorum* (Lib.) de Bary	CABI, 2022	CABI, 2022	CABI, 2022	
FUNGI*: Verticillium albo-atrum* Reinke & Bert.	CABI, 2022	CABI, 2022	USDA, 1999	
VIROID: Avsunviroidae *Avsunviroid Avocado sunblotch viroid*	Everett and Siebert, 2018	CABI, 2022	CABI, 2022; Ploetz et al., 1994; Everett and Siebert, 2018	Present in Florida and California (CABI, 2022); not under official control.